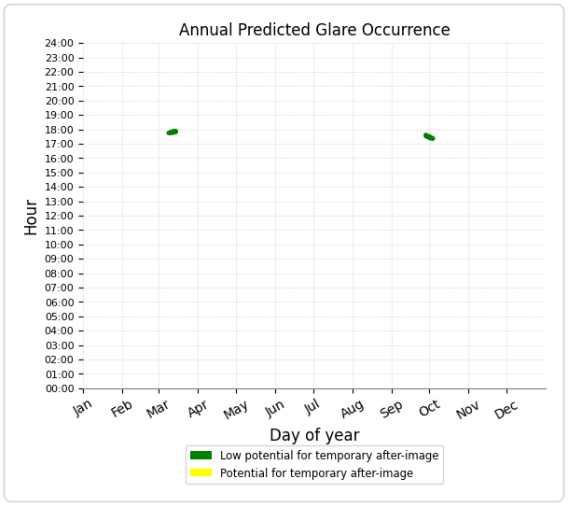
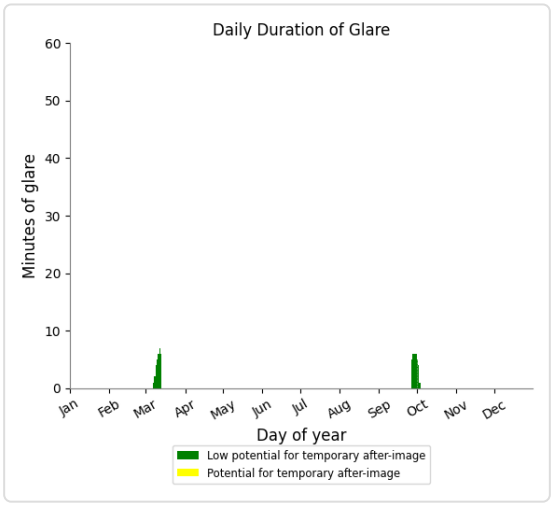
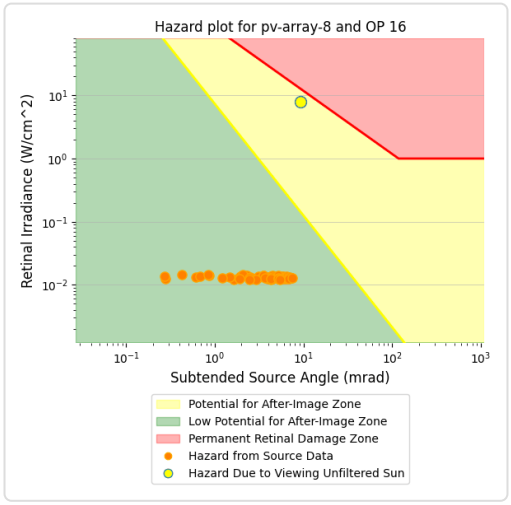
PV array 8 and OP 16

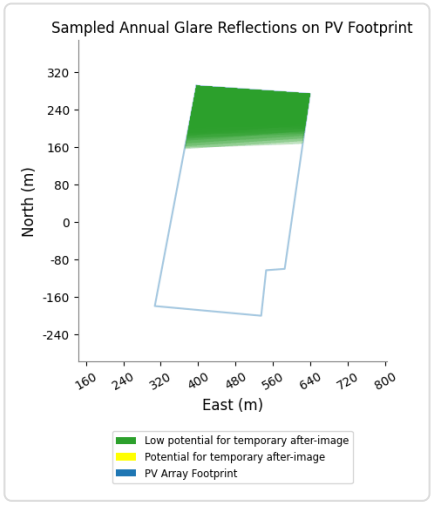
Yellow glare: none

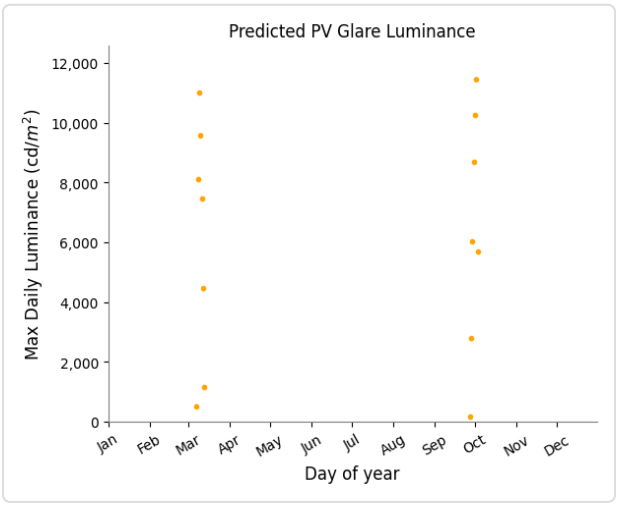
Green glare: 64 min.











PV array 8 and OP 1

No glare found

PV array 8 and OP 8

No glare found

PV array 8 and OP 9

No glare found

PV array 8 and OP 10

No glare found

PV array 8 and OP 11

No glare found

PV array 8 and OP 12

No glare found

PV array 8 and OP 17

No glare found

PV array 8 and OP 18

No glare found

PV array 8 and OP 19

No glare found

PV array 8 and OP 20

No glare found

PV array 8 and OP 21

No glare found

Assumptions

"Green" glare is glare with low potential to cause an after-image (flash blindness) when observed prior to a typical blink response time.
"Yellow" glare is glare with potential to cause an after-image (flash blindness) when observed prior to a typical blink response time.
Times associated with glare are denoted in Standard time. For Daylight Savings, add one hour.
The algorithm does not rigorously represent the detailed geometry of a system; detailed features such as gaps between modules, variable height of the PV array, and support structures may impact actual glare results. However, we have validated our models against several systems, including a PV array causing glare to the air-traffic control tower at Manchester-Boston Regional Airport and several sites in Albuquerque, and the tool accurately predicted the occurrence and intensity of glare at different times and days of the year.
Several V1 calculations utilize the PV array centroid, rather than the actual glare spot location, due to algorithm limitations. This may affect results for large PV footprints. Additional analyses of array sub-sections can provide additional information on expected glare. This primarily affects V1 analyses of path receptors.
Random number computations are utilized by various steps of the annual hazard analysis algorithm. Predicted minutes of glare can vary between runs as a result. This limitation primarily affects analyses of Observation Point receptors, including ATCTs. Note that the SGHAT/ ForgeSolar methodology has always relied on an analytical, qualitative approach to accurately determine the overall hazard (i.e. green vs. yellow) of expected glare on an annual basis.
The analysis does not automatically consider obstacles (either man-made or natural) between the observation points and the prescribed solar installation that may obstruct observed glare, such as trees, hills, buildings, etc.
The subtended source angle (glare spot size) is constrained by the PV array footprint size. Partitioning large arrays into smaller sections will reduce the maximum potential subtended angle, potentially impacting results if actual glare spots are larger than the sub-array size. Additional analyses of the combined area of adjacent sub-arrays can provide more information on potential glare hazards. (See previous point on related limitations.)
The variable direct normal irradiance (DNI) feature (if selected) scales the user-prescribed peak DNI using a typical clear-day irradiance profile. This profile has a lower DNI in the mornings and evenings and a maximum at solar noon. The scaling uses a clear-day irradiance profile based on a normalized time relative to sunrise, solar noon, and sunset, which are prescribed by a sun-position algorithm and the latitude and longitude obtained from Google maps. The actual DNI on any given day can be affected by cloud cover, atmospheric attenuation, and other environmental factors.
The ocular hazard predicted by the tool depends on a number of environmental, optical, and human factors, which can be uncertain. We provide input fields and typical ranges of values for these factors so that the user can vary these parameters to see if they have an impact on the results. The speed of SGHAT allows expedited sensitivity and parametric analyses.
The system output calculation is a DNI-based approximation that assumes clear, sunny skies year-round. It should not be used in place of more rigorous modeling methods.
Hazard zone boundaries shown in the Glare Hazard plot are an approximation and visual aid based on aggregated research data. Actual ocular impact outcomes encompass a continuous, not discrete, spectrum.
Glare locations displayed on receptor plots are approximate. Actual glare-spot locations may differ.
Refer to the Help page at **www.forgesolar.com/help/** for assumptions and limitations not listed here.

Default glare analysis parameters and observer eye characteristics (for reference only):

- Analysis time interval: 1 minute
- Ocular transmission coefficient: 0.5
- Pupil diameter: 0.002 meters
- Eye focal length: 0.017 meters
- Sun subtended angle: 9.3 milliradians

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FORGESOLAR GLARE ANALYSIS

Project: **BR10356 Normanton Larches Solar**
Site configuration: **Aviation 2000ft 180 and 205 OPs 1-20**

Created 08 Mar, 2024
Updated 21 Mar, 2024
Time-step 1 minute
Timezone offset UTC0
Minimum sun altitude 0.0 deg
DNI peaks at 1,000.0 W/m^2
Category 10 MW to 100 MW
Site ID 113984.19448

Ocular transmission coefficient 0.5
Pupil diameter 0.002 m
Eye focal length 0.017 m
Sun subtended angle 9.3 mrad
PV analysis methodology V2

Summary of Results

Glare with low potential for temporary after-image predicted

PV Array	Tilt	Orient	Annual Green Glare		Annual Yellow Glare		Energy	Peak Luminance
	°	°	min	hr	min	hr	kWh	cd/m^2
PV array 1	25.0	180.0	10,160	169.3	0	0.0	-	138,056
PV array 2	25.0	180.0	12,971	216.2	0	0.0	-	84,567
PV array 3	25.0	180.0	11,067	184.4	0	0.0	-	170,843
PV array 4	25.0	180.0	10,743	179.1	0	0.0	-	145,700
PV array 5	25.0	180.0	13,152	219.2	0	0.0	-	125,008
PV array 6	25.0	180.0	14,181	236.3	0	0.0	-	111,606
PV array 7	25.0	205.0	14,645	244.1	0	0.0	-	137,300
PV array 8	25.0	180.0	23,610	393.5	0	0.0	-	149,972

Total glare received by each receptor; may include duplicate times of glare from multiple reflective surfaces.

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
OP 1	2,245	37.4	0	0.0
OP 2	0	0.0	0	0.0
OP 3	0	0.0	0	0.0
OP 4	0	0.0	0	0.0
OP 5	0	0.0	0	0.0
OP 6	0	0.0	0	0.0
OP 7	7,205	120.1	0	0.0
OP 8	12,540	209.0	0	0.0

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
OP 9	0	0.0	0	0.0
OP 10	0	0.0	0	0.0
OP 11	0	0.0	0	0.0
OP 12	0	0.0	0	0.0
OP 13	0	0.0	0	0.0
OP 14	37,496	624.9	0	0.0
OP 15	24,099	401.6	0	0.0
OP 16	19,055	317.6	0	0.0
OP 17	6,289	104.8	0	0.0
OP 18	1,600	26.7	0	0.0
OP 19	0	0.0	0	0.0
OP 20	0	0.0	0	0.0

Component Data

PV Arrays

Name: PV array 1
Axis tracking: Fixed (no rotation)
Tilt: 25.0°
Orientation: 180.0°
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	53.270453	-1.023592	44.16	3.58	47.74
2	53.270382	-1.026510	38.69	3.58	42.27
3	53.270337	-1.028001	42.19	3.58	45.77
4	53.268374	-1.027819	47.55	3.58	51.13
5	53.267835	-1.027411	47.97	3.58	51.55
6	53.268194	-1.025823	42.76	3.58	46.34
7	53.268605	-1.023538	48.05	3.58	51.63

Name: PV array 2
Axis tracking: Fixed (no rotation)
Tilt: 25.0°
Orientation: 180.0°
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	53.272403	-1.022893	44.98	3.58	48.56
2	53.271659	-1.020468	49.10	3.58	52.68
3	53.271146	-1.020629	49.06	3.58	52.64
4	53.270568	-1.020768	49.76	3.58	53.34
5	53.269978	-1.022399	48.94	3.58	52.52
6	53.269490	-1.023494	46.53	3.58	50.11
7	53.270600	-1.023526	44.05	3.58	47.63
8	53.270658	-1.022721	44.52	3.58	48.10

Name: PV array 3
Axis tracking: Fixed (no rotation)
Tilt: 25.0°
Orientation: 180.0°
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	53.267270	-1.027453	49.52	3.58	53.10
2	53.267742	-1.026122	44.46	3.58	48.04
3	53.268066	-1.026004	43.25	3.58	46.83
4	53.268361	-1.024577	44.74	3.58	48.32
5	53.268515	-1.023451	48.43	3.58	52.01
6	53.263789	-1.021096	44.95	3.58	48.53
7	53.263606	-1.026144	50.81	3.58	54.39

Name: PV array 4
Axis tracking: Fixed (no rotation)
Tilt: 25.0°
Orientation: 180.0°
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	53.267296	-1.022818	47.72	3.58	51.30
2	53.267707	-1.018998	49.22	3.58	52.80
3	53.264120	-1.017373	43.17	3.58	46.75
4	53.264126	-1.017861	43.81	3.58	47.39
5	53.263885	-1.017893	45.60	3.58	49.18
6	53.263795	-1.021085	44.91	3.58	48.49

Name: PV array 5
Axis tracking: Fixed (no rotation)
Tilt: 25.0°
Orientation: 180.0°
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	53.268300	-1.019106	51.65	3.58	55.23
2	53.268197	-1.015587	47.94	3.58	51.52
3	53.267411	-1.014932	45.87	3.58	49.45
4	53.263776	-1.015093	42.99	3.58	46.57
5	53.263904	-1.017175	44.48	3.58	48.06
6	53.266359	-1.018355	43.98	3.58	47.56

Name: PV array 6
Axis tracking: Fixed (no rotation)
Tilt: 25.0°
Orientation: 180.0°
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	53.267286	-1.014793	45.26	3.58	48.84
2	53.263975	-1.015072	41.69	3.58	45.27
3	53.265181	-1.012926	37.52	3.58	41.10
4	53.265759	-1.012132	35.68	3.58	39.26
5	53.266067	-1.011724	35.43	3.58	39.01
6	53.266349	-1.011338	34.83	3.58	38.41
7	53.266619	-1.009836	34.68	3.58	38.26
8	53.267825	-1.010716	42.25	3.58	45.83

Name: PV array 7
Axis tracking: Fixed (no rotation)
Tilt: 25.0°
Orientation: 205.0°
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	53.272940	-1.014050	31.13	3.58	34.71
2	53.269536	-1.014748	43.02	3.58	46.60
3	53.269645	-1.012452	41.27	3.58	44.85
4	53.270081	-1.011636	34.85	3.58	38.43
5	53.270704	-1.010636	29.77	3.58	33.35
6	53.271050	-1.010400	28.91	3.58	32.49
7	53.271782	-1.010113	28.08	3.58	31.66
8	53.272411	-1.010113	28.03	3.58	31.61
9	53.273187	-1.010671	28.00	3.58	31.58
10	53.273251	-1.012685	29.03	3.58	32.61
11	53.272884	-1.012822	29.76	3.58	33.34

Name: PV array 8
Axis tracking: Fixed (no rotation)
Tilt: 25.0°
Orientation: 180.0°
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	53.273097	-1.017677	40.21	3.58	43.79
2	53.268846	-1.018975	51.56	3.58	55.14
3	53.268635	-1.015579	47.76	3.58	51.34
4	53.269518	-1.015402	43.76	3.58	47.34
4	53.269518	-1.015402	43.76	3.58	47.34
5	53.269537	-1.014758	43.02	3.58	46.60
5	53.269537	-1.014758	43.02	3.58	46.60
6	53.272940	-1.014050	31.13	3.58	34.71

Discrete Observation Point Receptors

Name	ID	Latitude (°)	Longitude (°)	Elevation (m)	Height (m)
OP 1	1	53.274658	-0.956085	26.85	609.60
OP 2	2	53.280560	-0.951536	27.44	609.60
OP 3	3	53.287000	-0.946429	23.00	609.60
OP 4	4	53.298511	-0.952811	33.00	609.60
OP 5	5	53.299640	-0.964398	28.38	609.60
OP 6	6	53.287225	-0.974011	23.92	609.60
OP 7	7	53.272753	-0.986371	37.57	609.60
OP 8	8	53.265874	-0.967488	33.88	609.60
OP 9	9	53.299127	-0.939421	18.00	609.60
OP 10	10	53.306154	-0.950150	29.17	609.60
OP 11	11	53.308462	-0.963540	37.62	609.60
OP 12	12	53.296511	-0.979762	23.67	609.60
OP 13	13	53.283581	-0.992722	40.63	609.60
OP 14	14	53.268595	-0.997529	38.41	609.60
OP 15	15	53.264437	-0.984998	29.15	609.60
OP 16	16	53.260330	-0.969119	37.98	609.60
OP 17	17	53.269570	-0.934272	22.21	609.60
OP 18	18	53.275422	-0.930581	24.95	609.60
OP 19	19	53.281734	-0.928263	23.00	609.60
OP 20	20	53.283581	-0.968861	22.00	609.60

Glare Analysis Results

Summary of Results

Glare with low potential for temporary after-image predicted

PV Array	Tilt	Orient	Annual Green Glare		Annual Yellow Glare		Energy	Peak Luminance
	°	°	min	hr	min	hr	kWh	cd/m^2
PV array 1	25.0	180.0	10,160	169.3	0	0.0	-	138,056
PV array 2	25.0	180.0	12,971	216.2	0	0.0	-	84,567
PV array 3	25.0	180.0	11,067	184.4	0	0.0	-	170,843
PV array 4	25.0	180.0	10,743	179.1	0	0.0	-	145,700
PV array 5	25.0	180.0	13,152	219.2	0	0.0	-	125,008
PV array 6	25.0	180.0	14,181	236.3	0	0.0	-	111,606
PV array 7	25.0	205.0	14,645	244.1	0	0.0	-	137,300
PV array 8	25.0	180.0	23,610	393.5	0	0.0	-	149,972

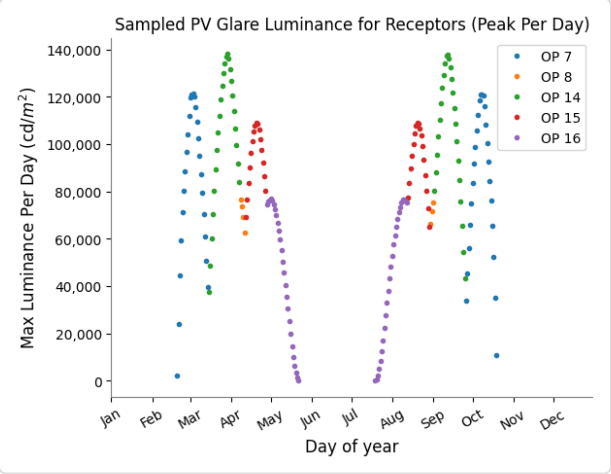
Total glare received by each receptor; may include duplicate times of glare from multiple reflective surfaces.

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
OP 1	2,245	37.4	0	0.0
OP 2	0	0.0	0	0.0
OP 3	0	0.0	0	0.0
OP 4	0	0.0	0	0.0
OP 5	0	0.0	0	0.0
OP 6	0	0.0	0	0.0
OP 7	7,205	120.1	0	0.0
OP 8	12,540	209.0	0	0.0
OP 9	0	0.0	0	0.0
OP 10	0	0.0	0	0.0
OP 11	0	0.0	0	0.0
OP 12	0	0.0	0	0.0
OP 13	0	0.0	0	0.0
OP 14	37,496	624.9	0	0.0
OP 15	24,099	401.6	0	0.0
OP 16	19,055	317.6	0	0.0
OP 17	6,289	104.8	0	0.0
OP 18	1,600	26.7	0	0.0
OP 19	0	0.0	0	0.0
OP 20	0	0.0	0	0.0

PV: PV array 1 low potential for temporary after-image

Receptor results ordered by category of glare

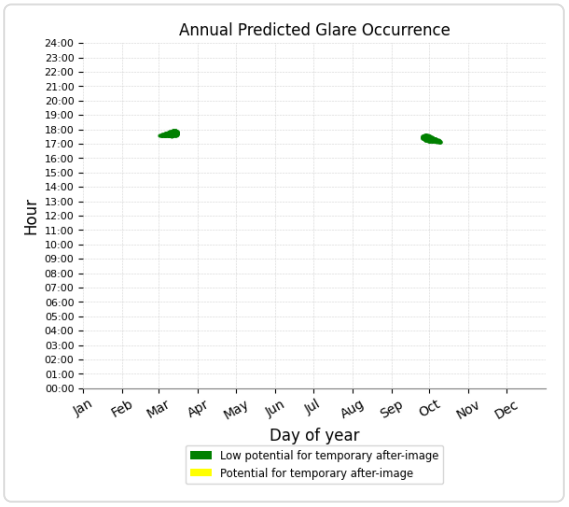
Receptor	Annual Green Glare		Annual Yellow Glare		Peak Luminance
	min	hr	min	hr	cd/m^2
OP 1	390	6.5	0	0.0	46,846
OP 7	1,176	19.6	0	0.0	121,209
OP 8	1,318	22.0	0	0.0	78,438
OP 14	2,302	38.4	0	0.0	138,056
OP 15	1,942	32.4	0	0.0	109,231
OP 16	1,842	30.7	0	0.0	76,957
OP 17	911	15.2	0	0.0	35,339
OP 18	279	4.7	0	0.0	25,935
OP 2	0	0.0	0	0.0	0
OP 3	0	0.0	0	0.0	0
OP 4	0	0.0	0	0.0	0
OP 5	0	0.0	0	0.0	0
OP 6	0	0.0	0	0.0	0
OP 9	0	0.0	0	0.0	0
OP 10	0	0.0	0	0.0	0
OP 11	0	0.0	0	0.0	0
OP 12	0	0.0	0	0.0	0
OP 13	0	0.0	0	0.0	0
OP 19	0	0.0	0	0.0	0
OP 20	0	0.0	0	0.0	0

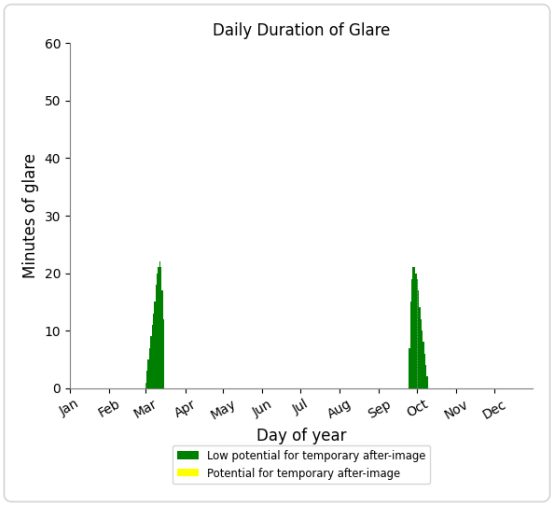


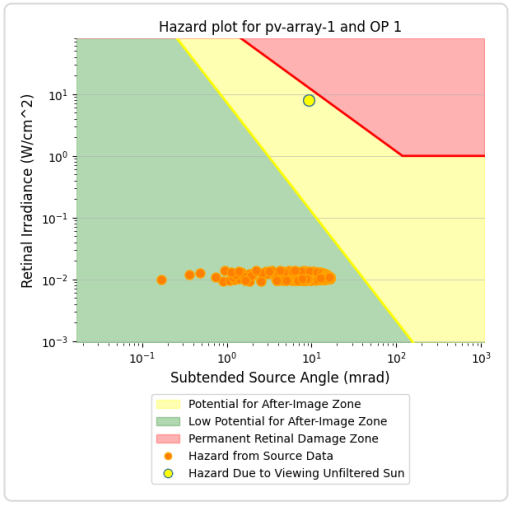
PV array 1 and OP 1

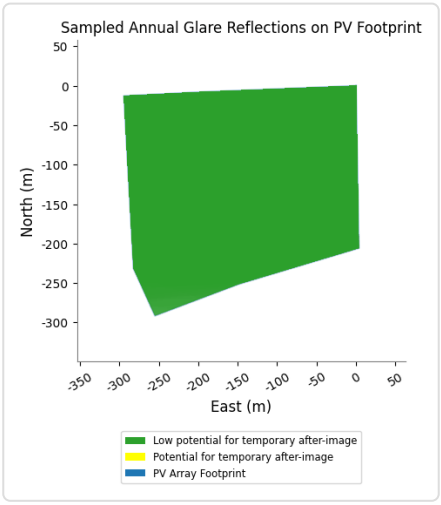
Yellow glare: none

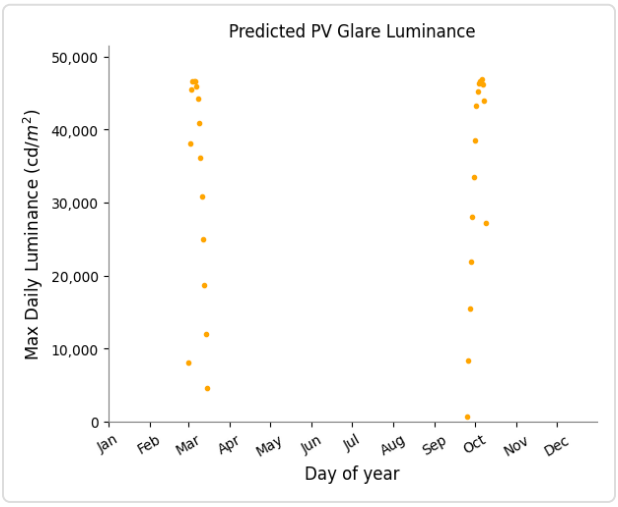
Green glare: 390 min.







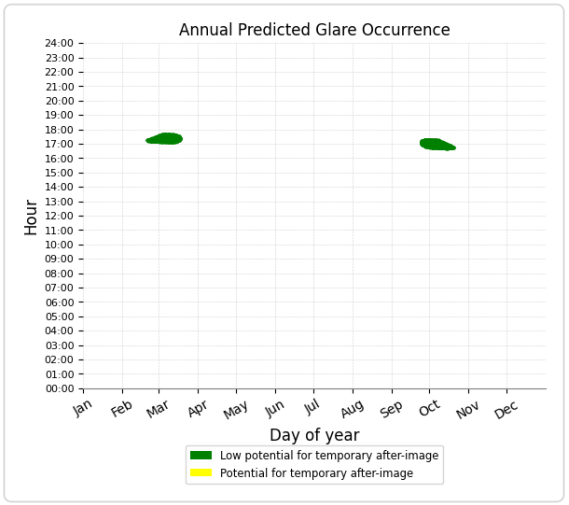


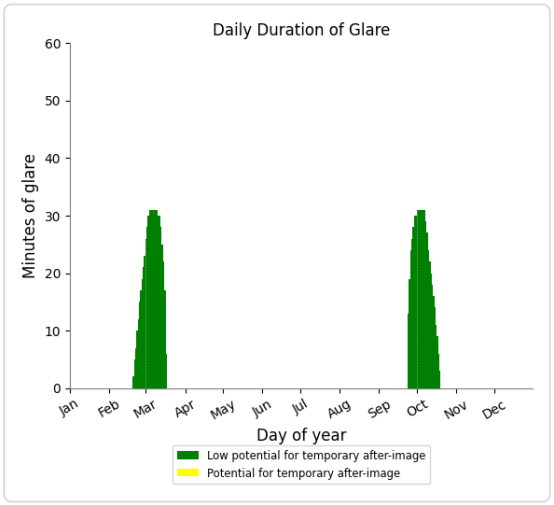


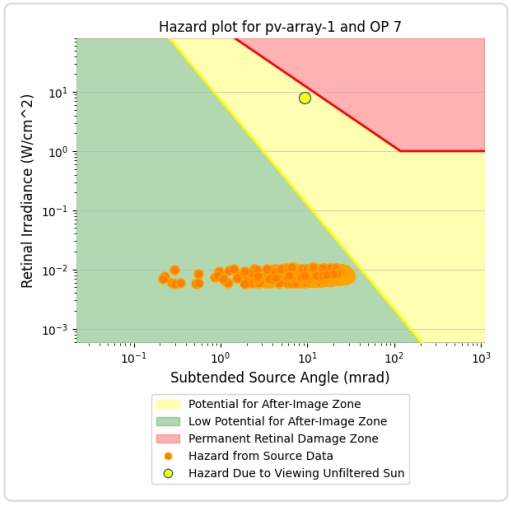
PV array 1 and OP 7

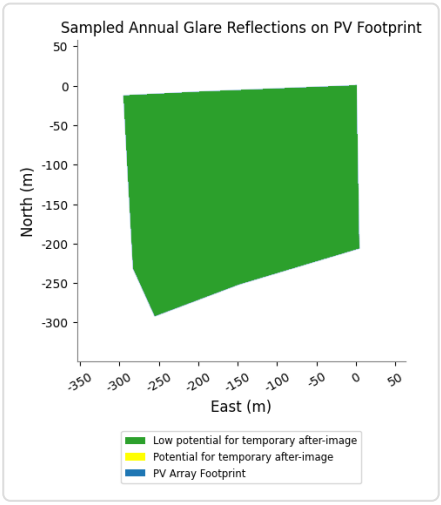
Yellow glare: none

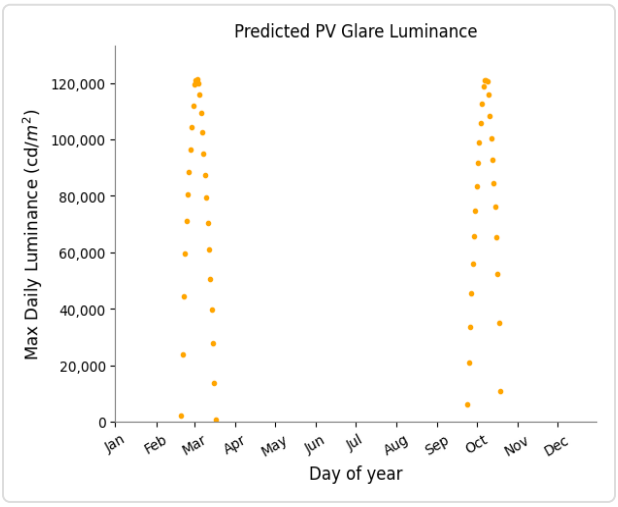
Green glare: 1,176 min.







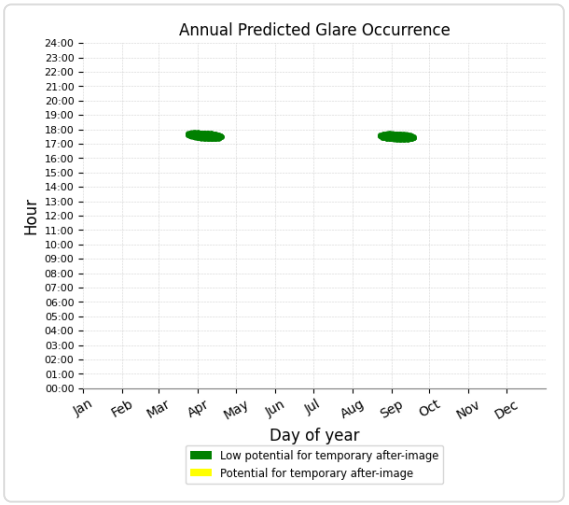


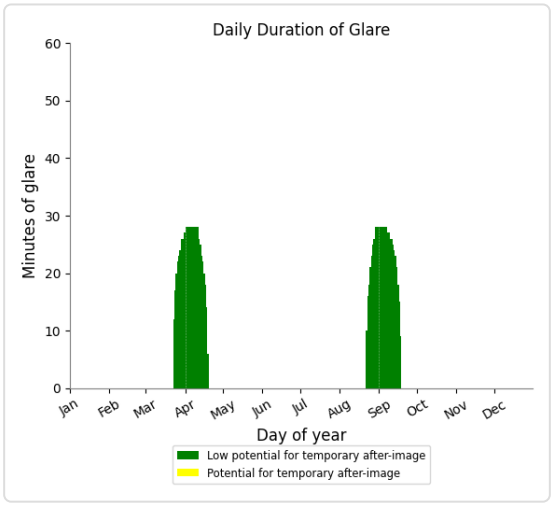


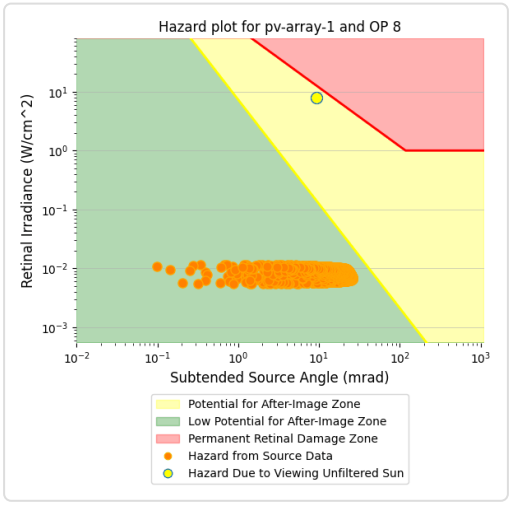
PV array 1 and OP 8

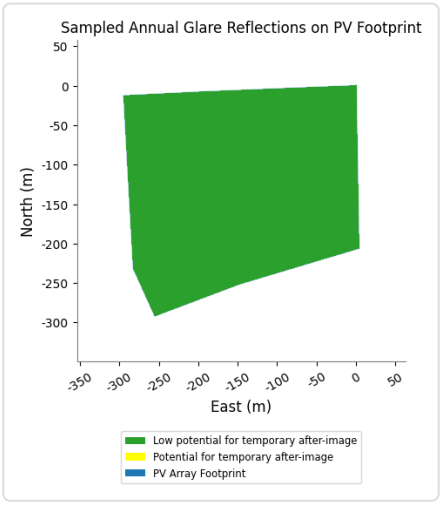
Yellow glare: none

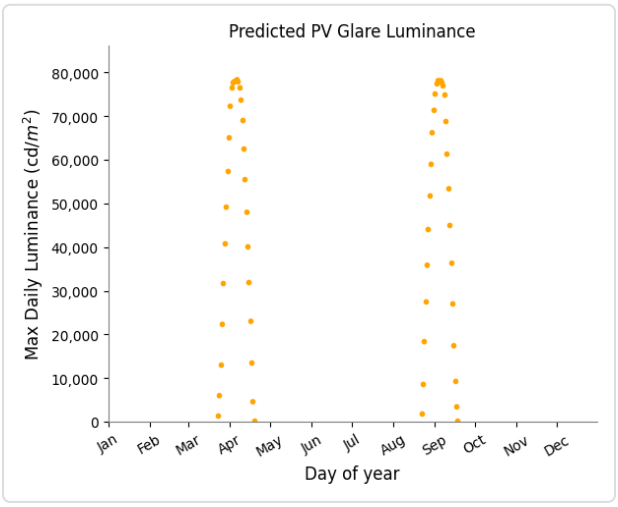
Green glare: 1,318 min.







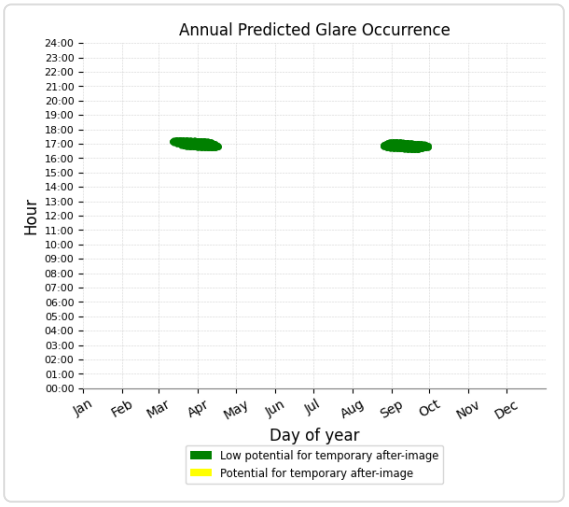


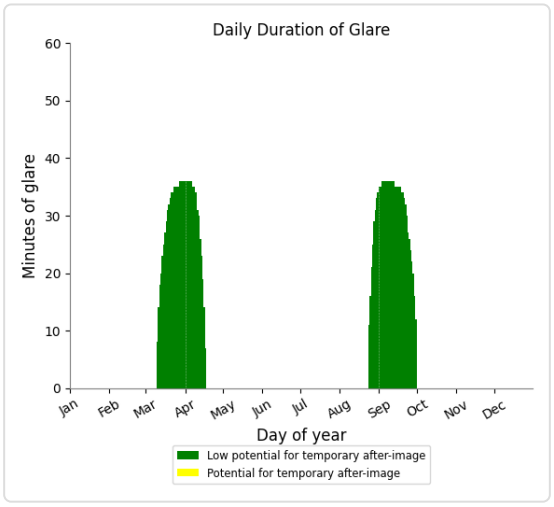


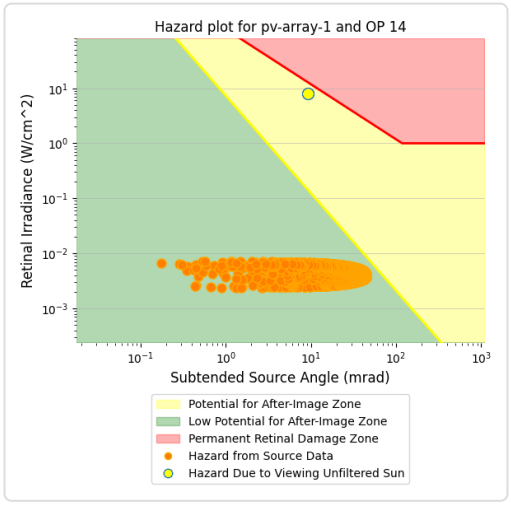
PV array 1 and OP 14

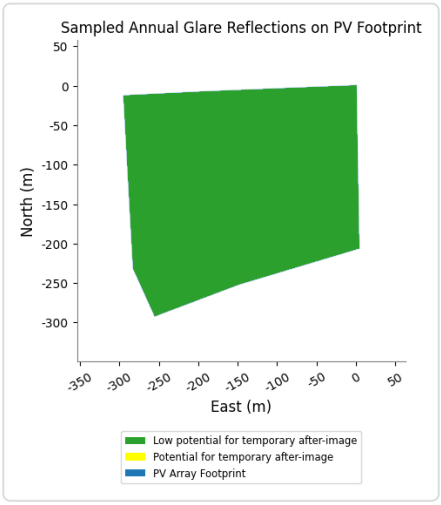
Yellow glare: none

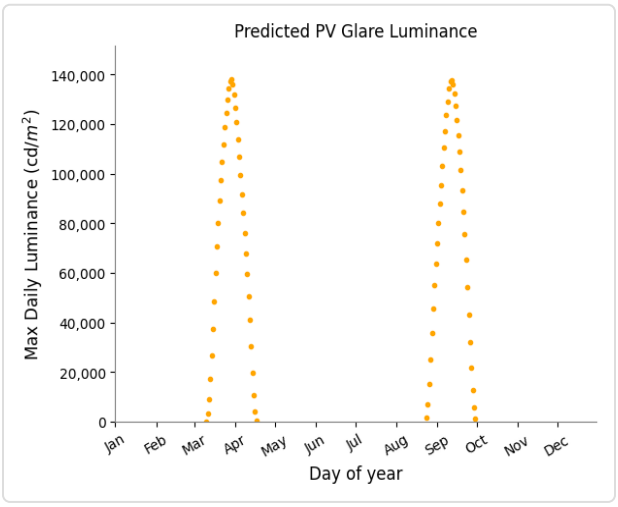
Green glare: 2,302 min.







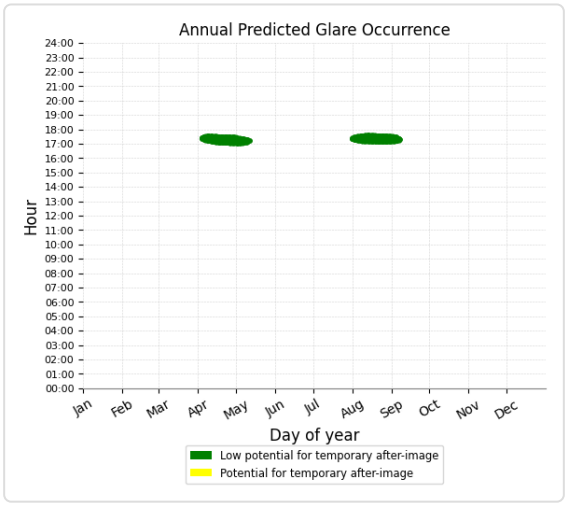


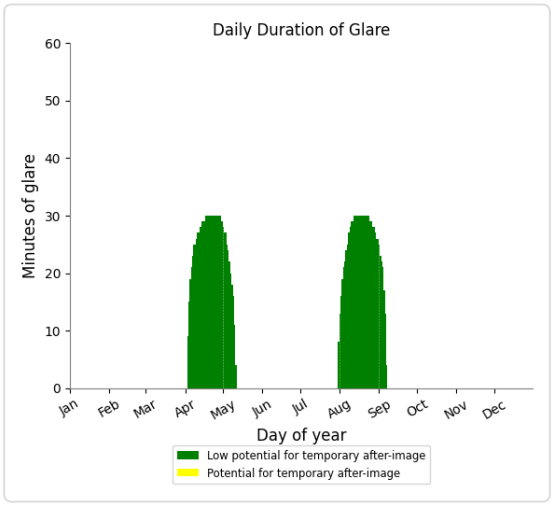


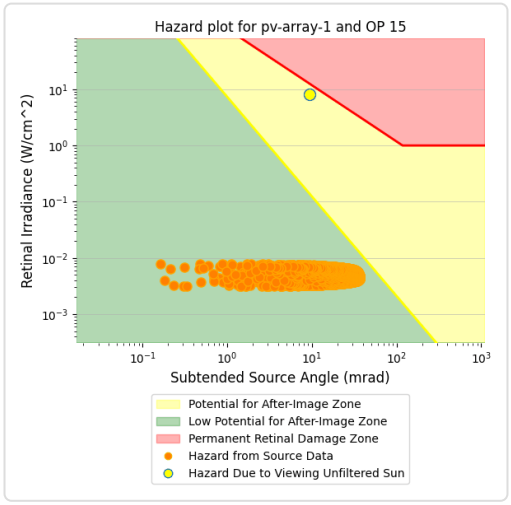
PV array 1 and OP 15

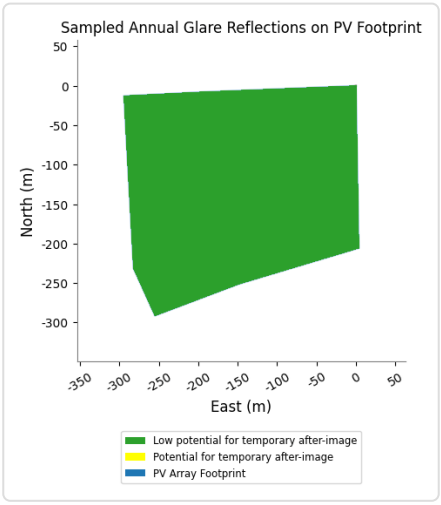
Yellow glare: none

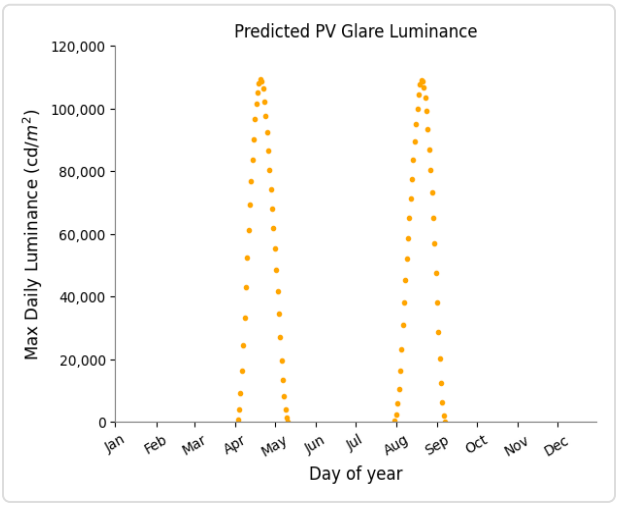
Green glare: 1,942 min.







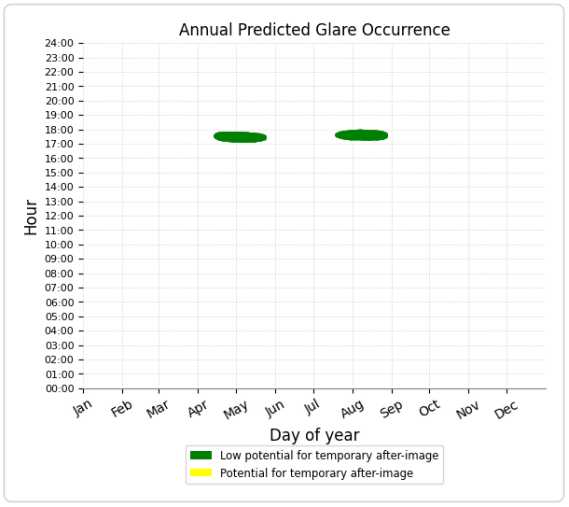


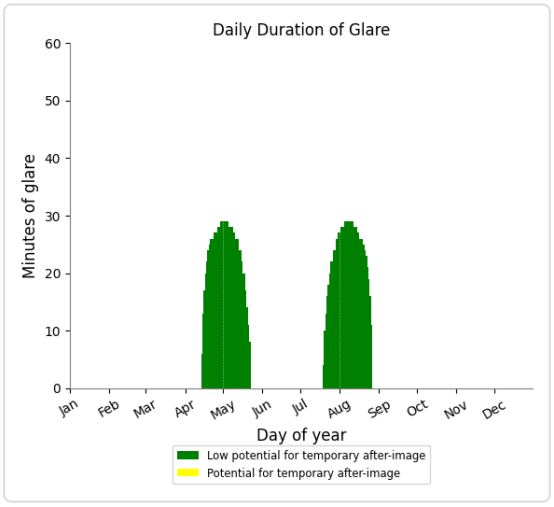


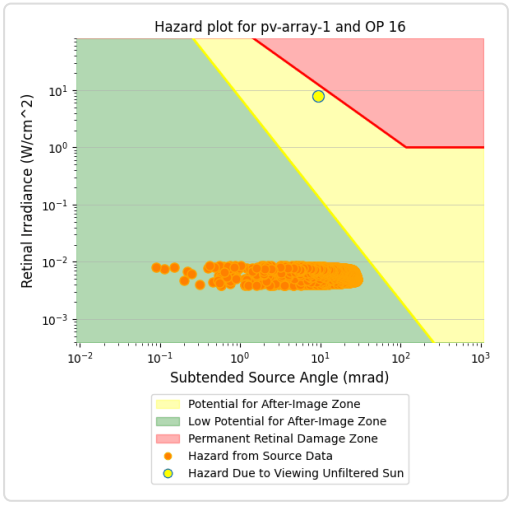
PV array 1 and OP 16

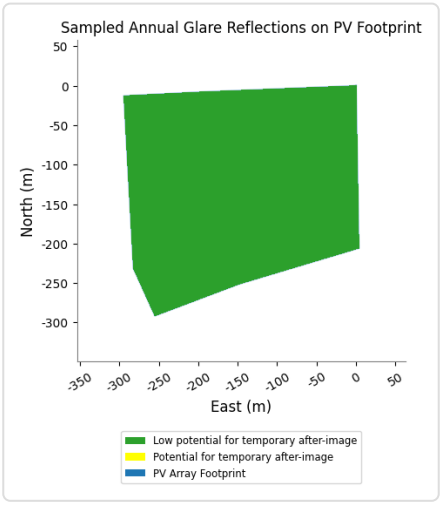
Yellow glare: none

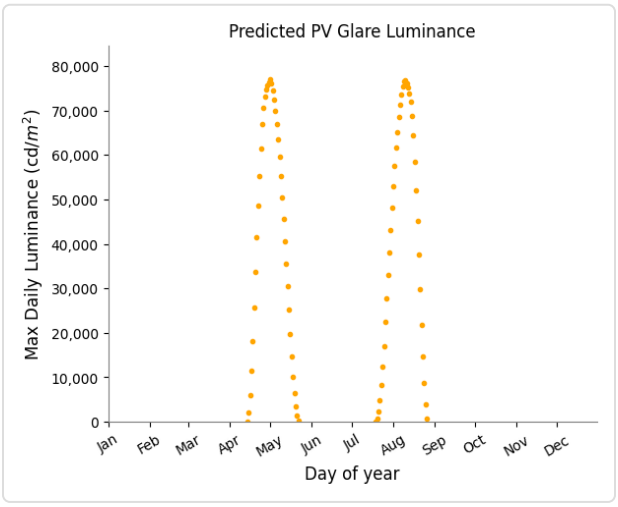
Green glare: 1,842 min.







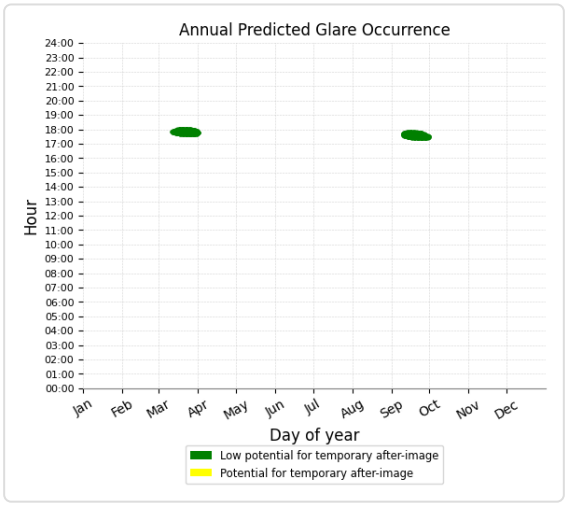


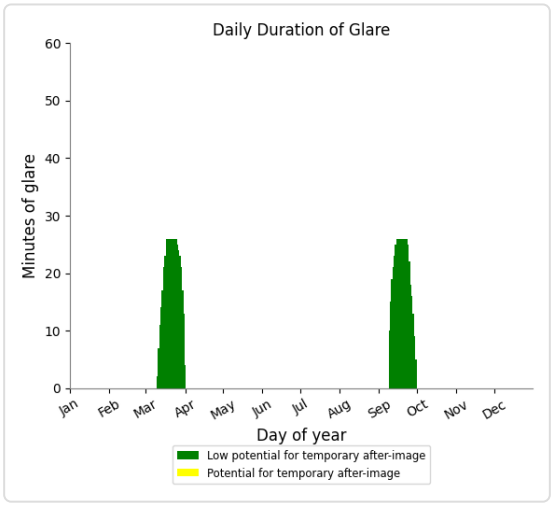


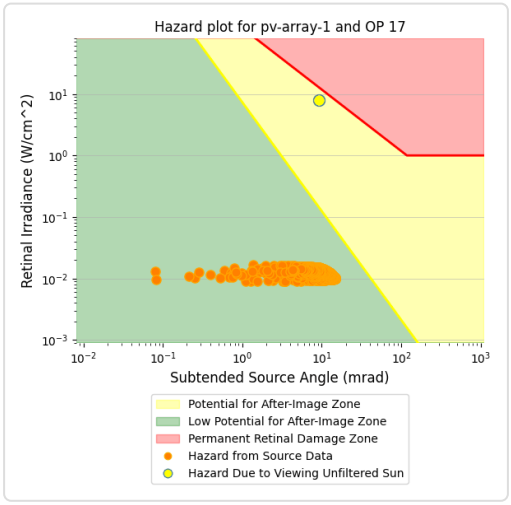
PV array 1 and OP 17

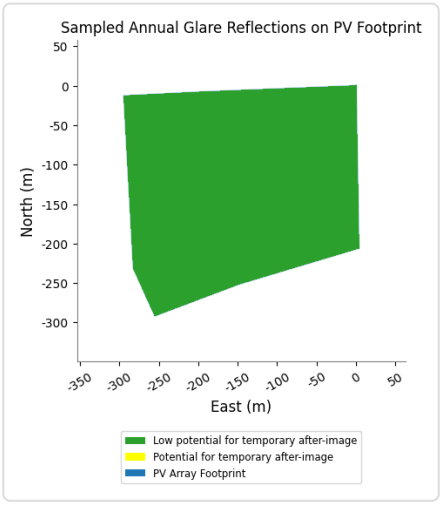
Yellow glare: none

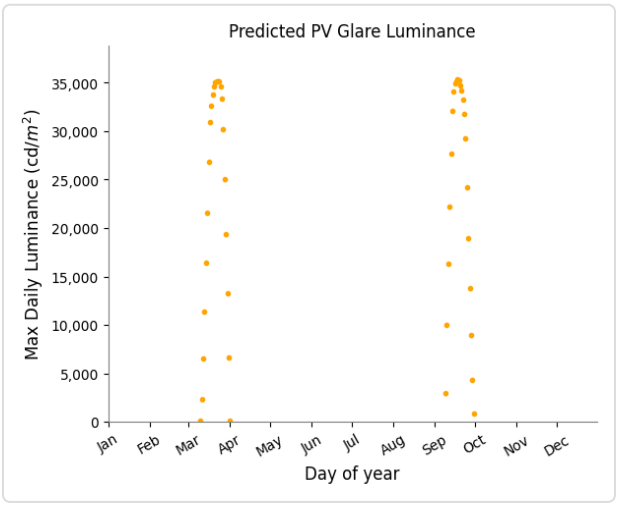
Green glare: 911 min.







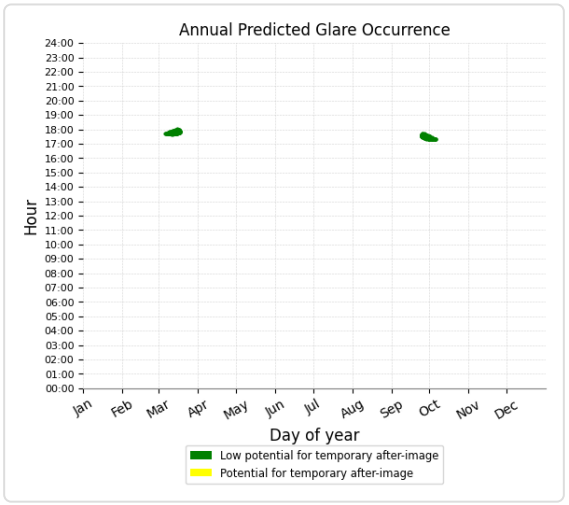


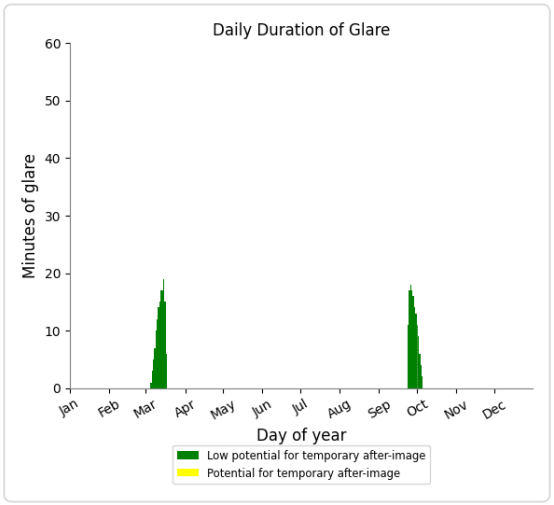


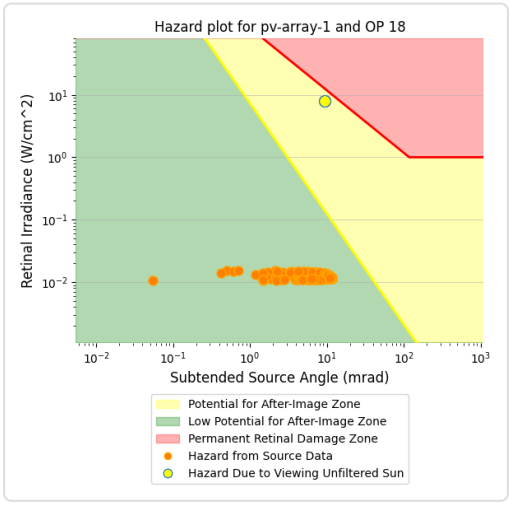
PV array 1 and OP 18

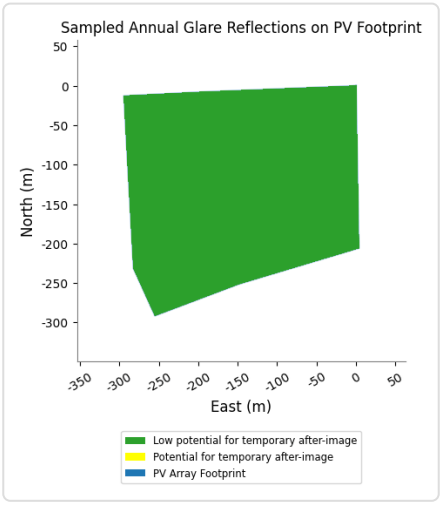
Yellow glare: none

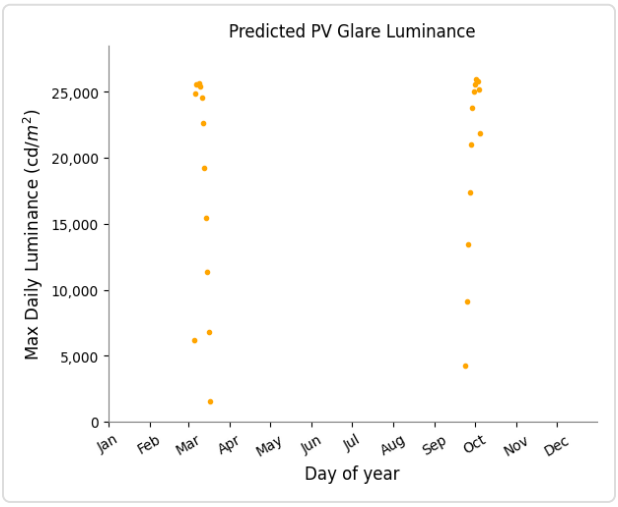
Green glare: 279 min.











PV array 1 and OP 2

No glare found

PV array 1 and OP 3

No glare found

PV array 1 and OP 4

No glare found

PV array 1 and OP 5

No glare found

PV array 1 and OP 6

No glare found

PV array 1 and OP 9

No glare found

PV array 1 and OP 10

No glare found

PV array 1 and OP 11

No glare found

PV array 1 and OP 12

No glare found

PV array 1 and OP 13

No glare found

PV array 1 and OP 19

No glare found

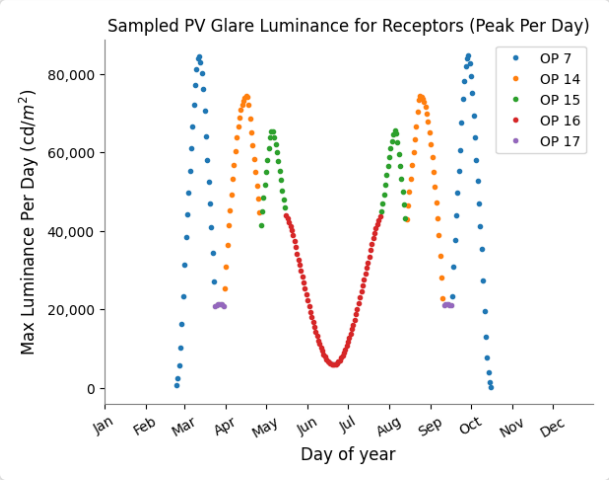
PV array 1 and OP 20

No glare found

PV: PV array 2 low potential for temporary after-image

Receptor results ordered by category of glare

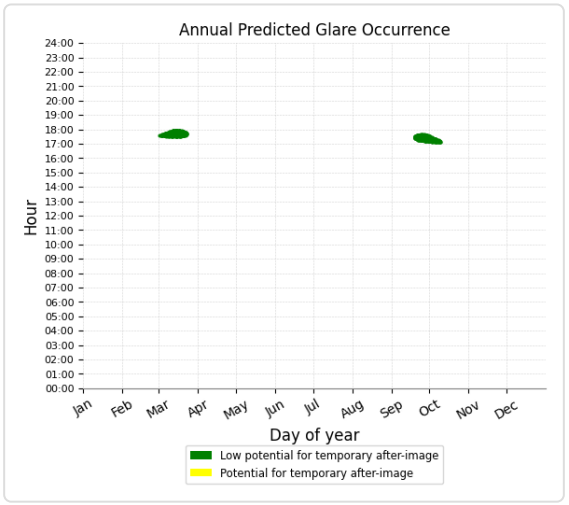
Receptor	Annual Green Glare		Annual Yellow Glare		Peak Luminance
	min	hr	min	hr	cd/m^2
OP 1	705	11.8	0	0.0	31,096
OP 7	1,614	26.9	0	0.0	84,567
OP 8	1,408	23.5	0	0.0	49,288
OP 14	2,500	41.7	0	0.0	74,269
OP 15	2,533	42.2	0	0.0	65,526
OP 16	2,690	44.8	0	0.0	45,963
OP 17	1,028	17.1	0	0.0	21,360
OP 18	493	8.2	0	0.0	16,318
OP 2	0	0.0	0	0.0	0
OP 3	0	0.0	0	0.0	0
OP 4	0	0.0	0	0.0	0
OP 5	0	0.0	0	0.0	0
OP 6	0	0.0	0	0.0	0
OP 9	0	0.0	0	0.0	0
OP 10	0	0.0	0	0.0	0
OP 11	0	0.0	0	0.0	0
OP 12	0	0.0	0	0.0	0
OP 13	0	0.0	0	0.0	0
OP 19	0	0.0	0	0.0	0
OP 20	0	0.0	0	0.0	0

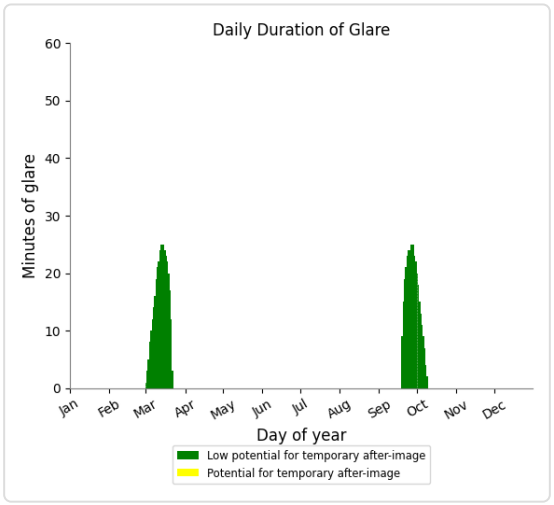


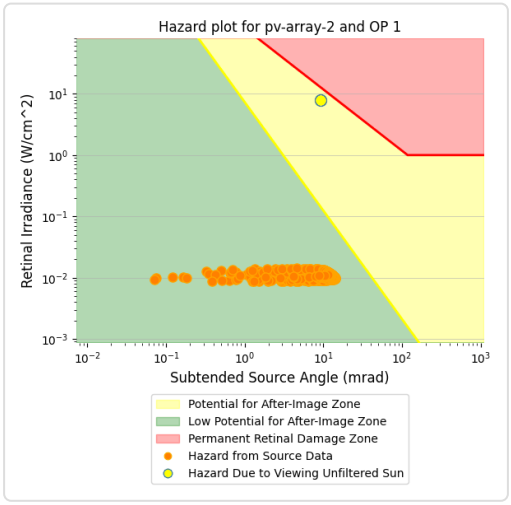
PV array 2 and OP 1

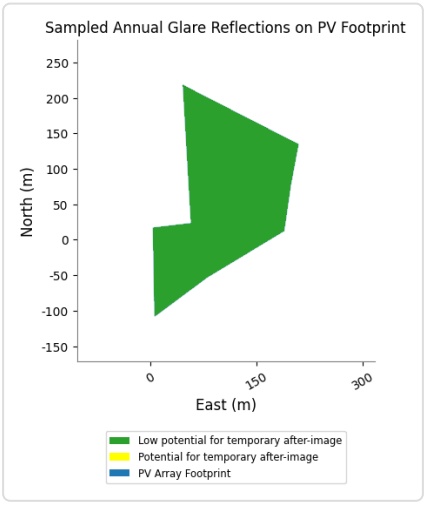
Yellow glare: none

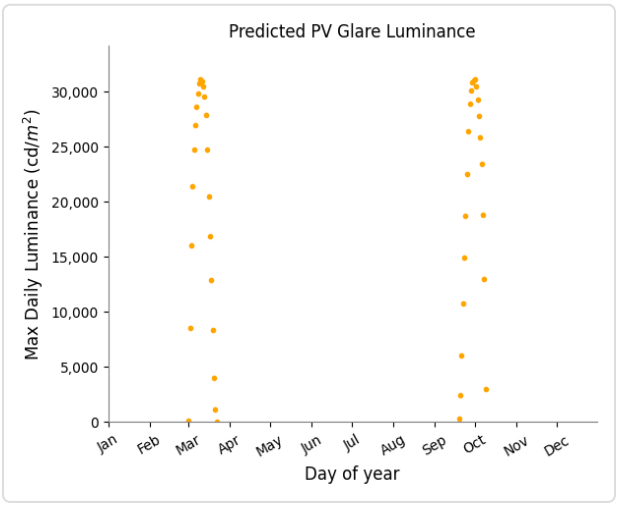
Green glare: 705 min.







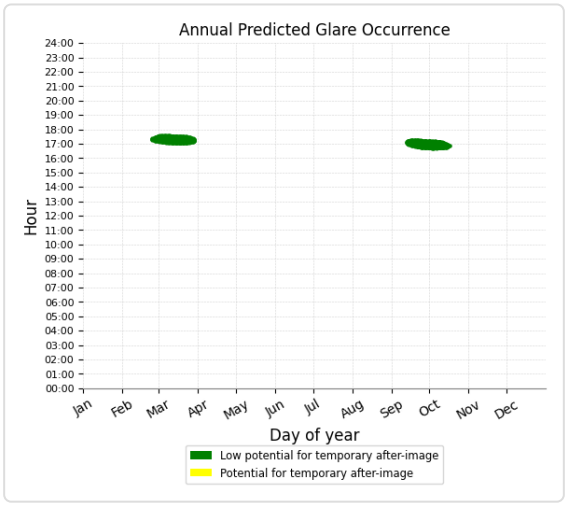


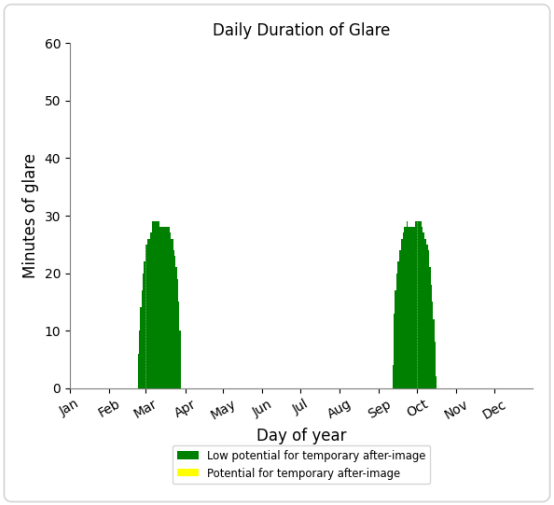


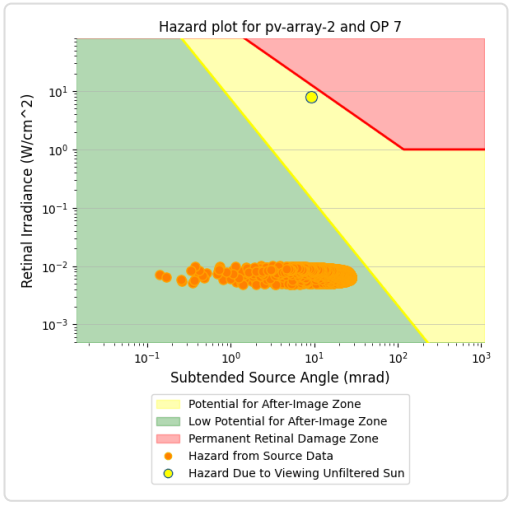
PV array 2 and OP 7

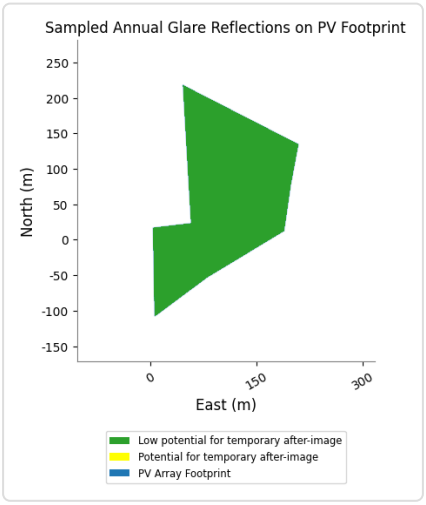
Yellow glare: none

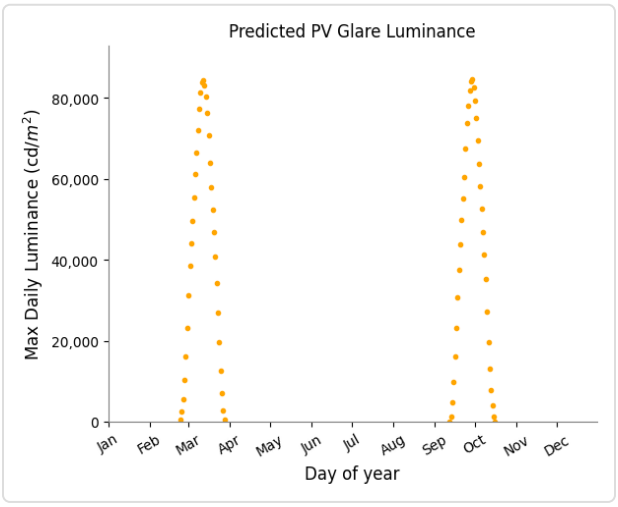
Green glare: 1,614 min.







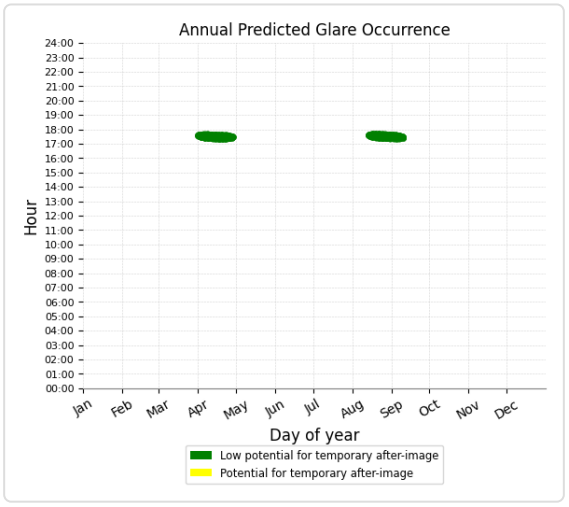


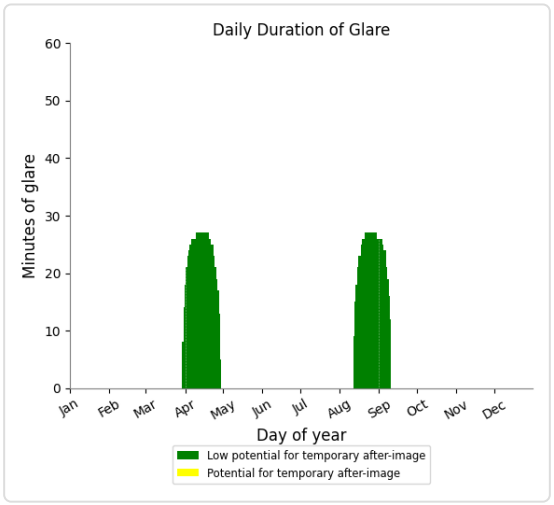


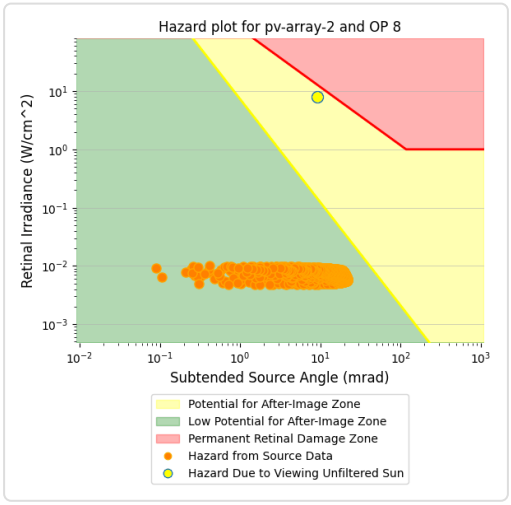
PV array 2 and OP 8

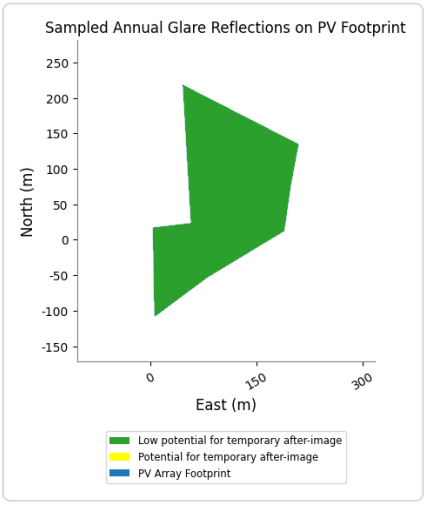
Yellow glare: none

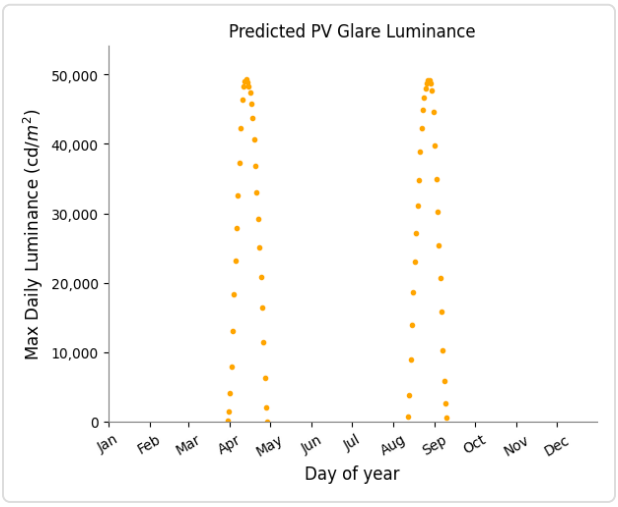
Green glare: 1,408 min.







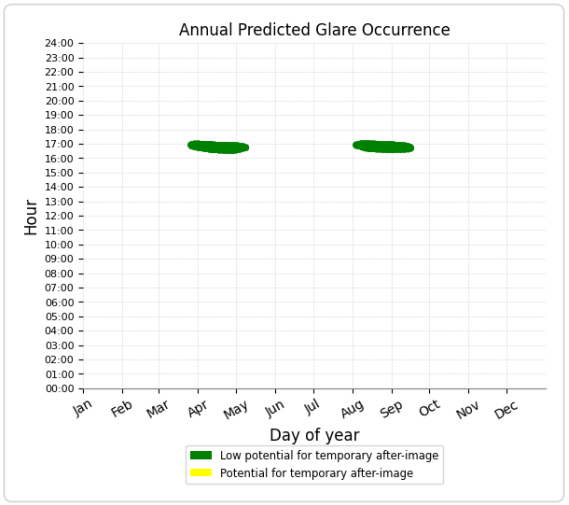


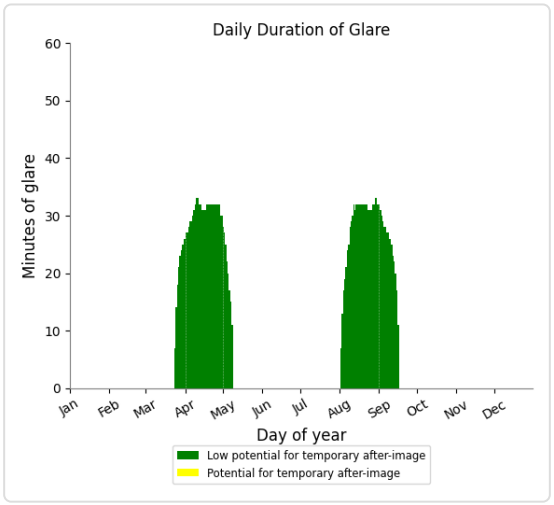


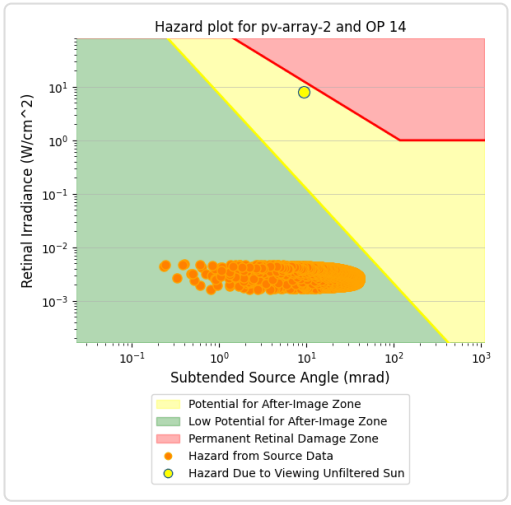
PV array 2 and OP 14

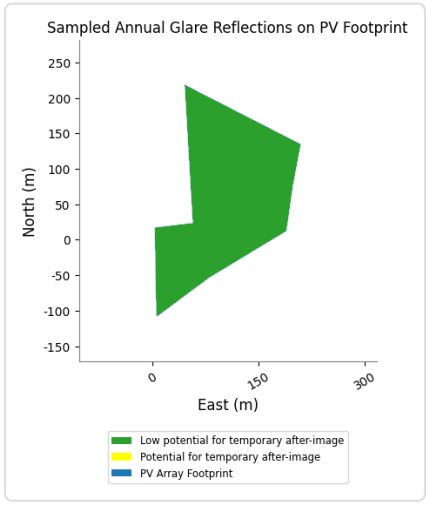
Yellow glare: none

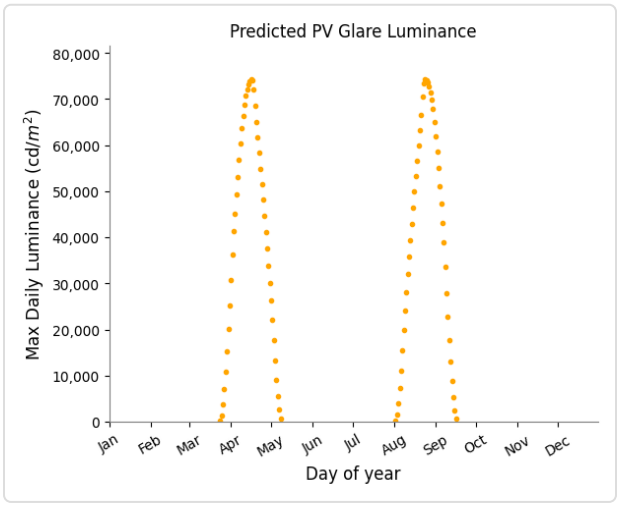
Green glare: 2,500 min.







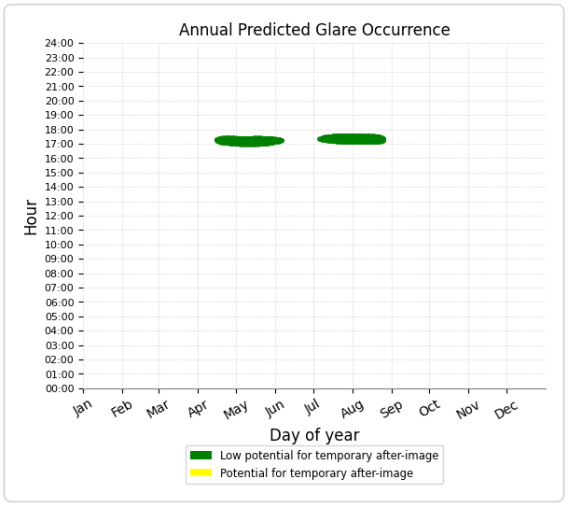


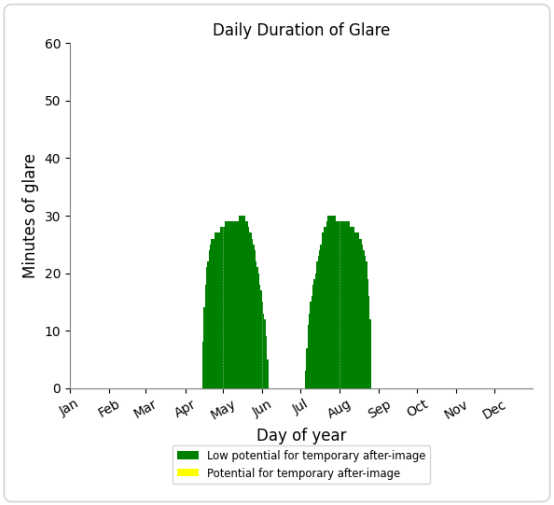


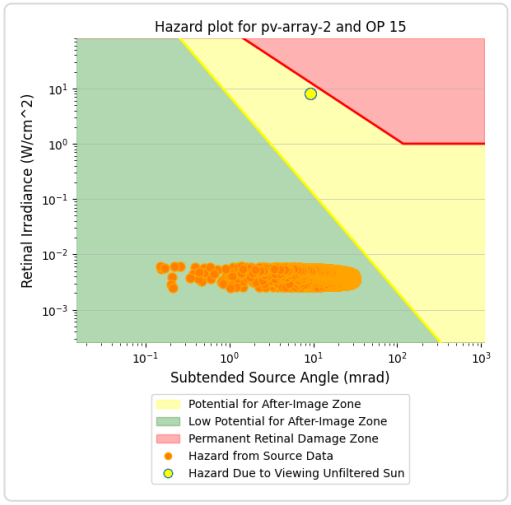
PV array 2 and OP 15

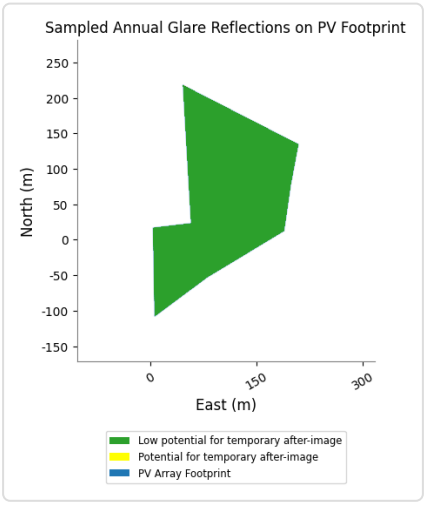
Yellow glare: none

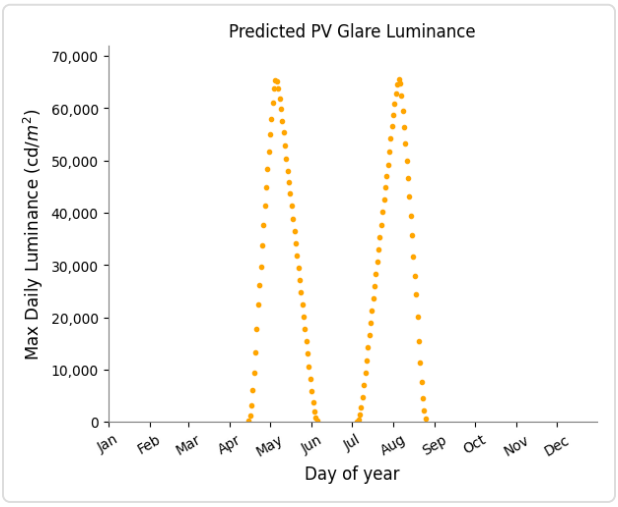
Green glare: 2,533 min.







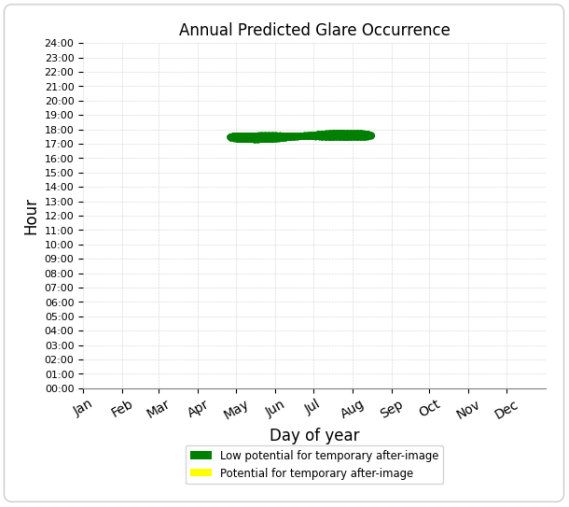


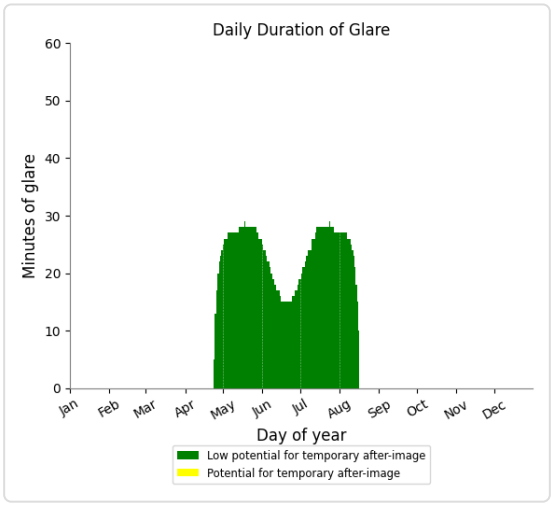


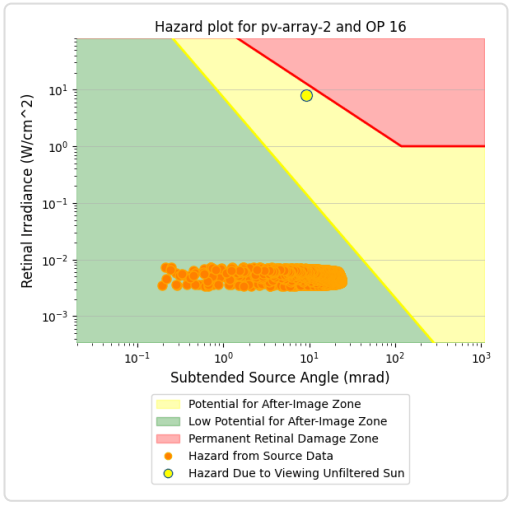
PV array 2 and OP 16

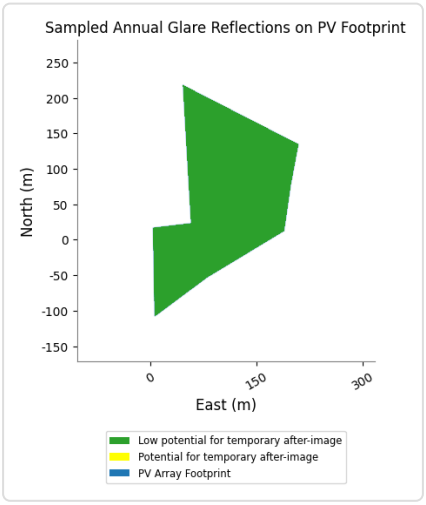
Yellow glare: none

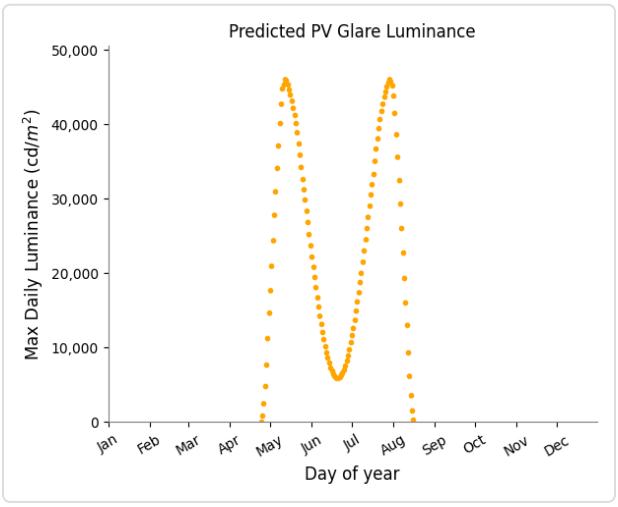
Green glare: 2,690 min.







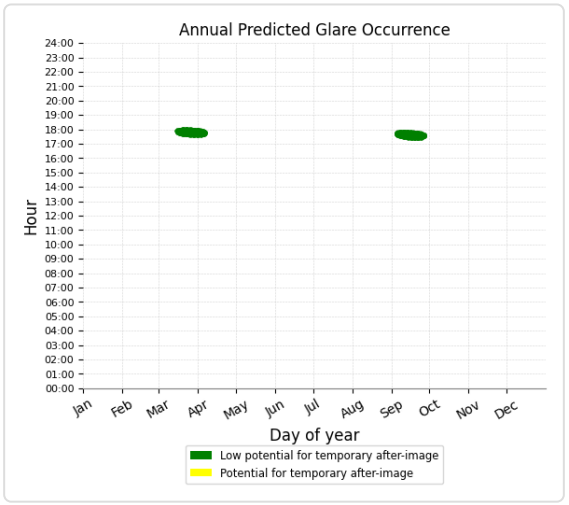


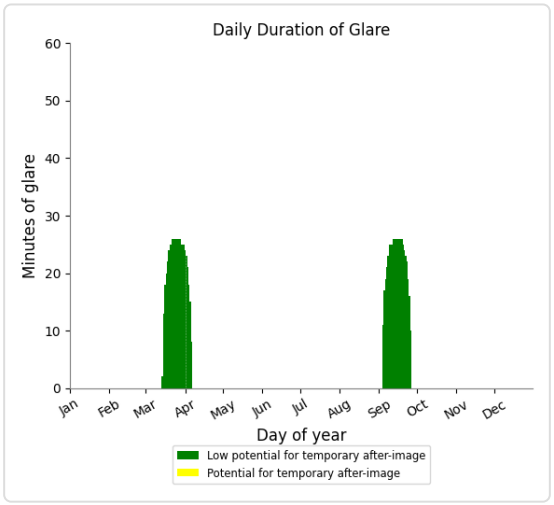


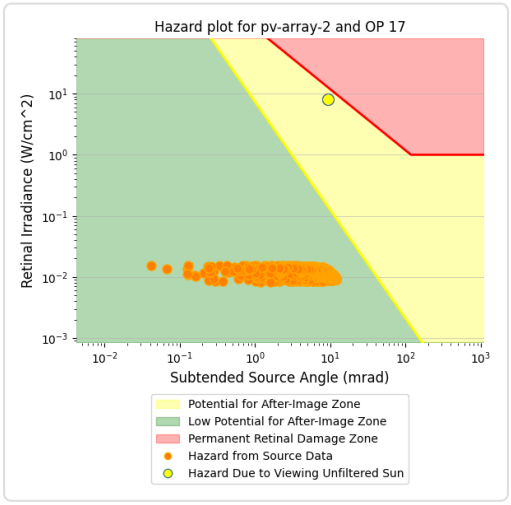
PV array 2 and OP 17

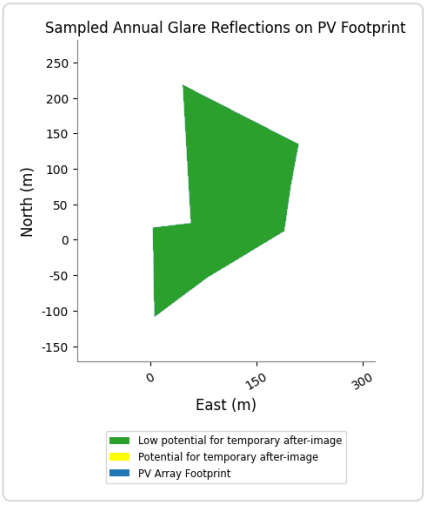
Yellow glare: none

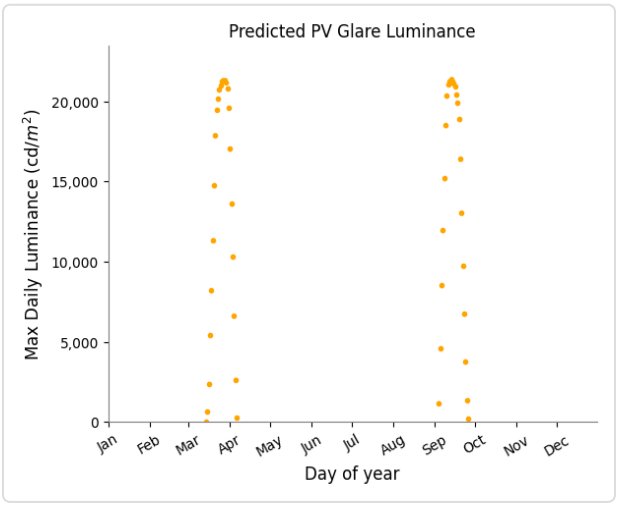
Green glare: 1,028 min.







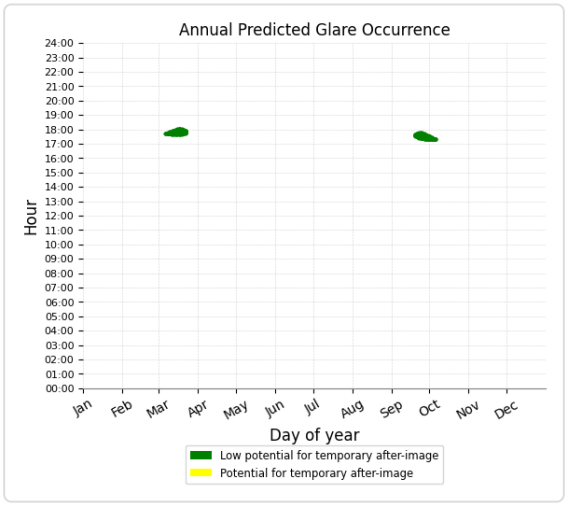


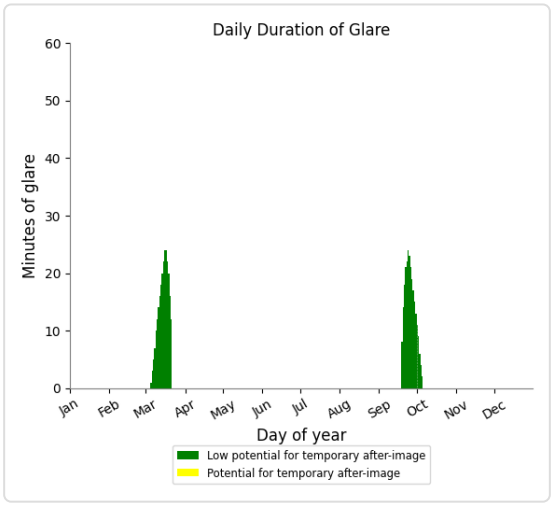


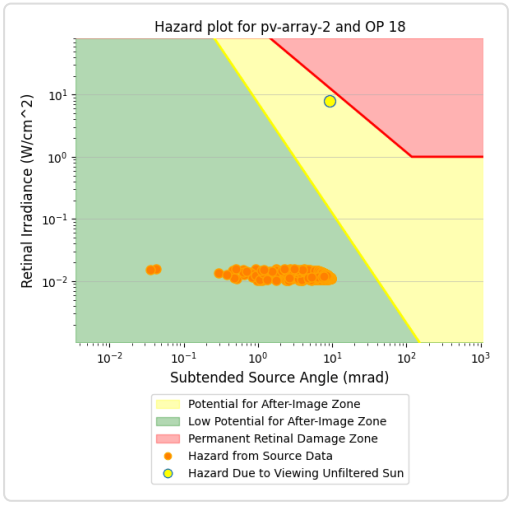
PV array 2 and OP 18

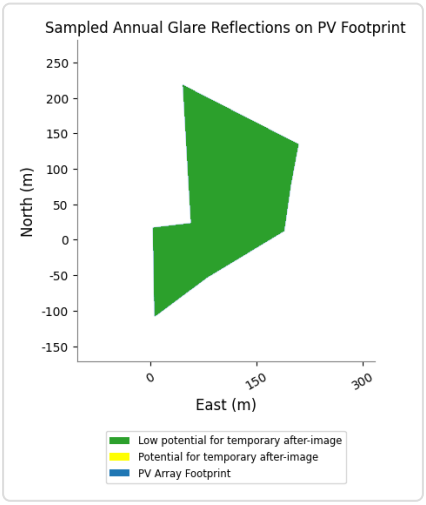
Yellow glare: none

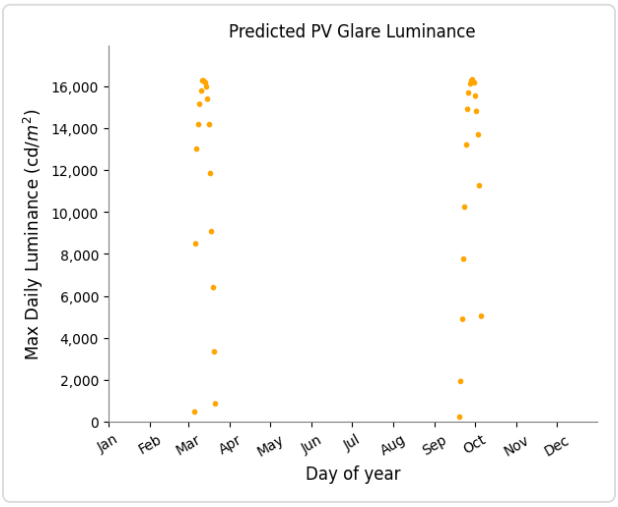
Green glare: 493 min.











PV array 2 and OP 2

No glare found

PV array 2 and OP 3

No glare found

PV array 2 and OP 4

No glare found

PV array 2 and OP 5

No glare found

PV array 2 and OP 6

No glare found

PV array 2 and OP 9

No glare found

PV array 2 and OP 10

No glare found

PV array 2 and OP 11

No glare found

PV array 2 and OP 12

No glare found

PV array 2 and OP 13

No glare found

PV array 2 and OP 19

No glare found

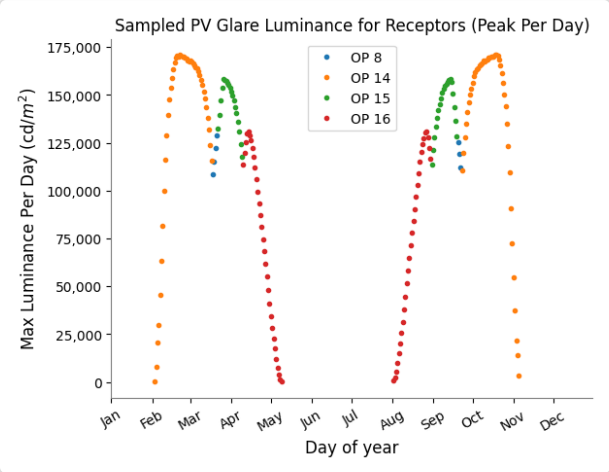
PV array 2 and OP 20

No glare found

PV: PV array 3 low potential for temporary after-image

Receptor results ordered by category of glare

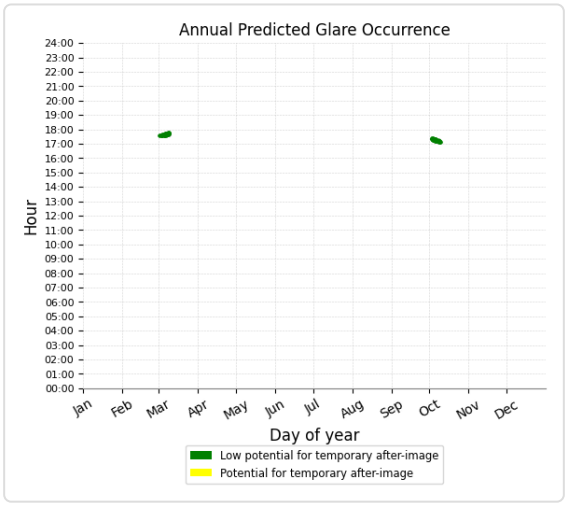
Receptor	Annual Green Glare		Annual Yellow Glare		Peak Luminance
	min	hr	min	hr	cd/m^2
OP 1	104	1.7	0	0.0	19,590
OP 7	447	7.5	0	0.0	88,736
OP 8	1,777	29.6	0	0.0	128,621
OP 14	3,167	52.8	0	0.0	170,843
OP 15	2,595	43.2	0	0.0	158,556
OP 16	2,120	35.3	0	0.0	131,006
OP 17	767	12.8	0	0.0	60,575
OP 18	90	1.5	0	0.0	12,611
OP 2	0	0.0	0	0.0	0
OP 3	0	0.0	0	0.0	0
OP 4	0	0.0	0	0.0	0
OP 5	0	0.0	0	0.0	0
OP 6	0	0.0	0	0.0	0
OP 9	0	0.0	0	0.0	0
OP 10	0	0.0	0	0.0	0
OP 11	0	0.0	0	0.0	0
OP 12	0	0.0	0	0.0	0
OP 13	0	0.0	0	0.0	0
OP 19	0	0.0	0	0.0	0
OP 20	0	0.0	0	0.0	0

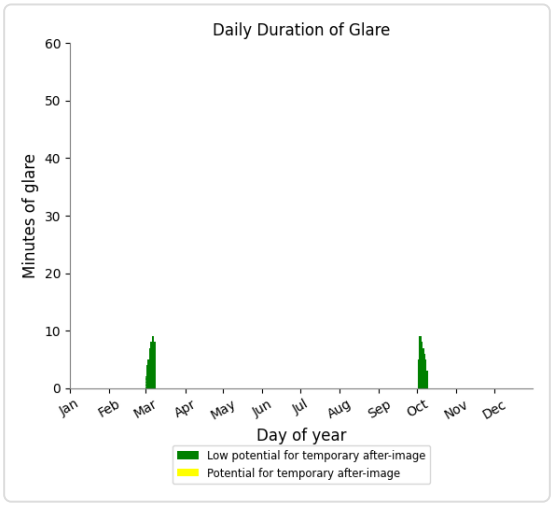


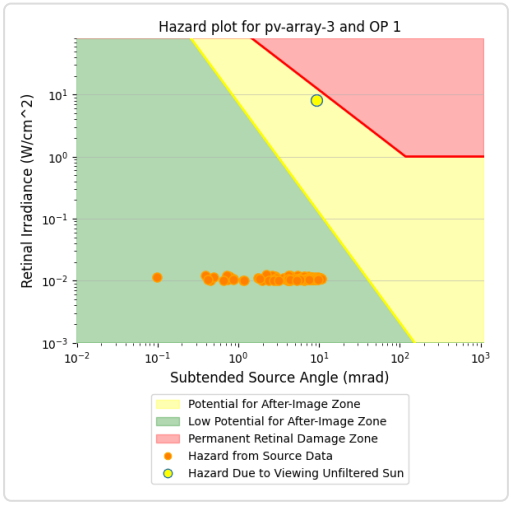
PV array 3 and OP 1

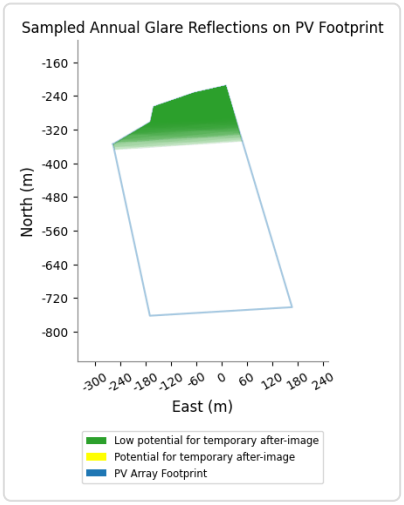
Yellow glare: none

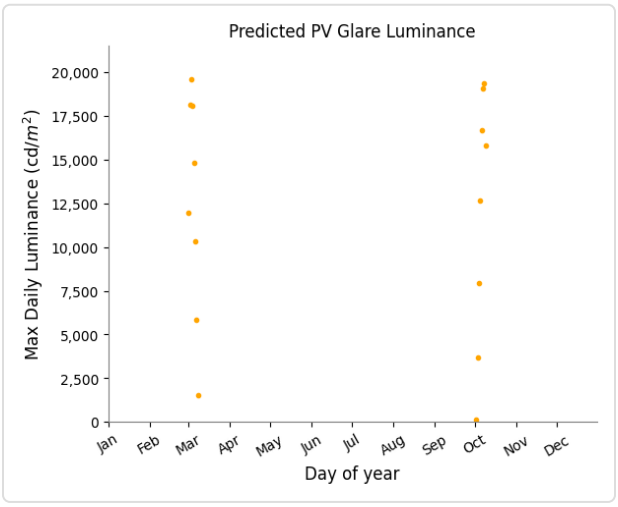
Green glare: 104 min.







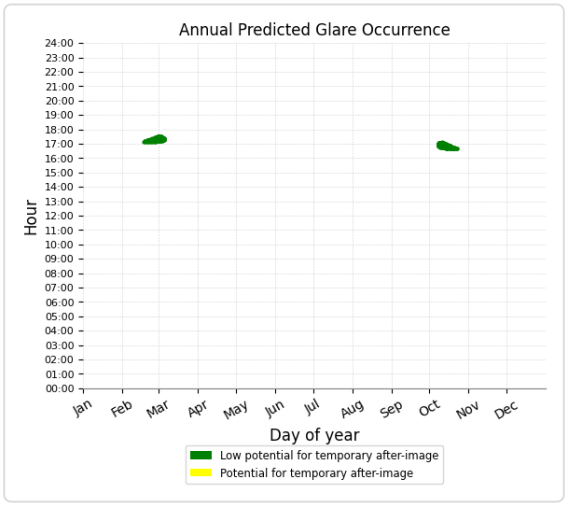


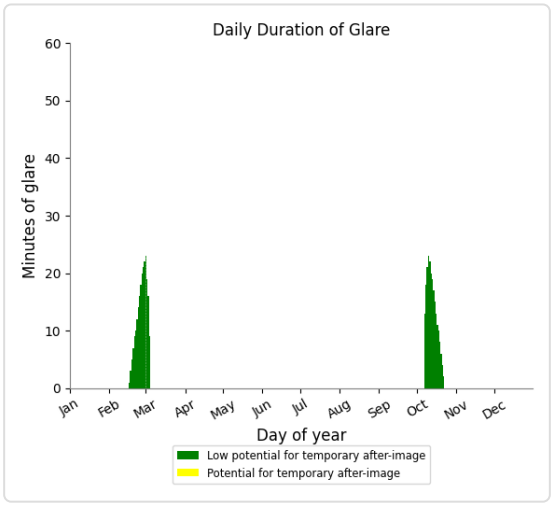


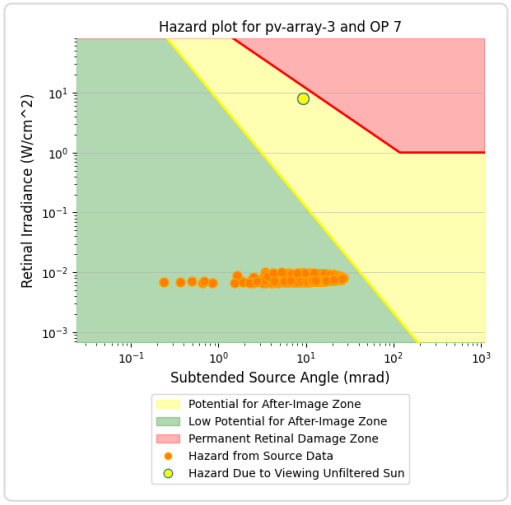
PV array 3 and OP 7

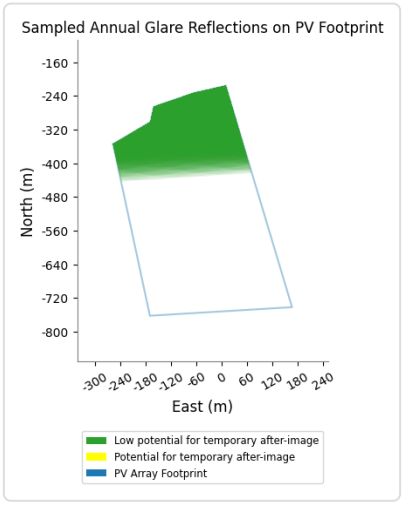
Yellow glare: none

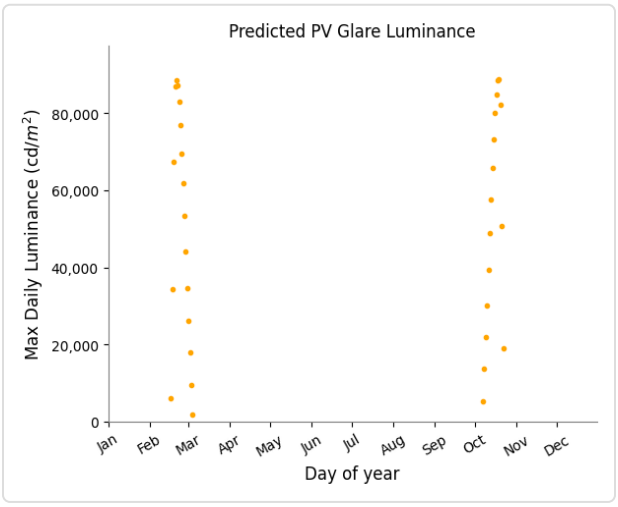
Green glare: 447 min.







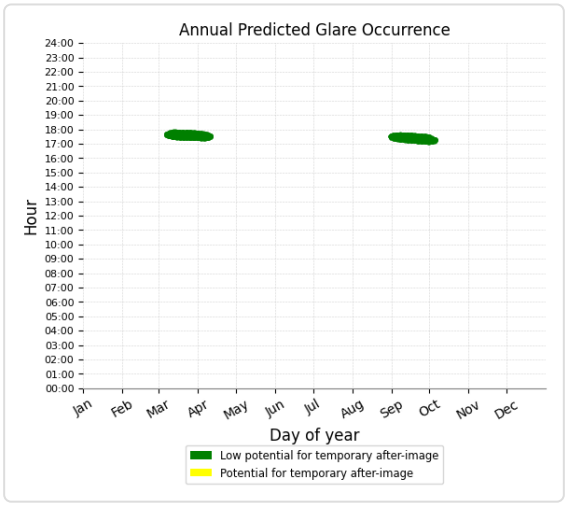


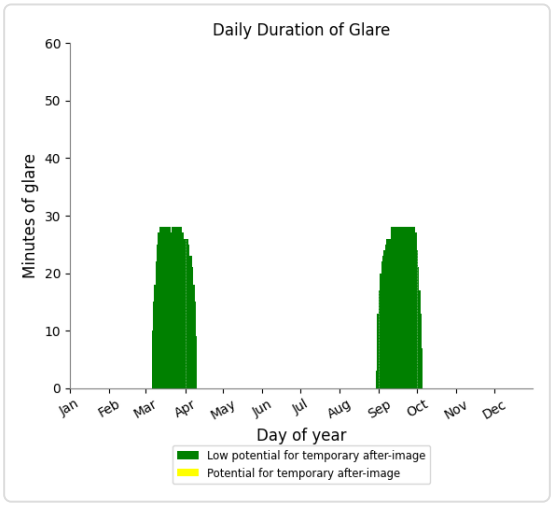


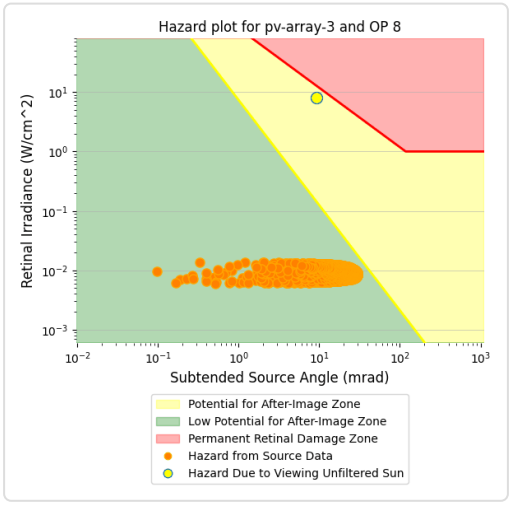
PV array 3 and OP 8

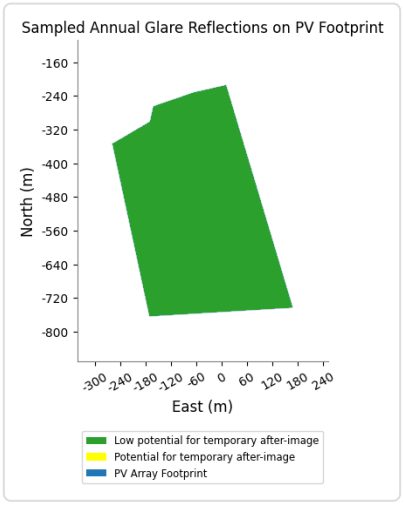
Yellow glare: none

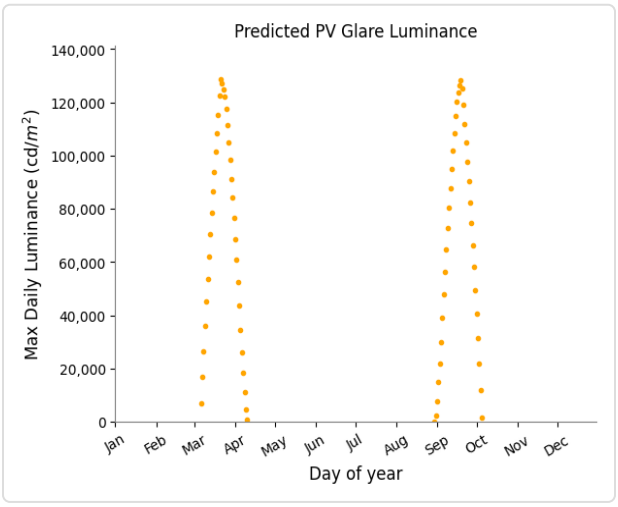
Green glare: 1,777 min.







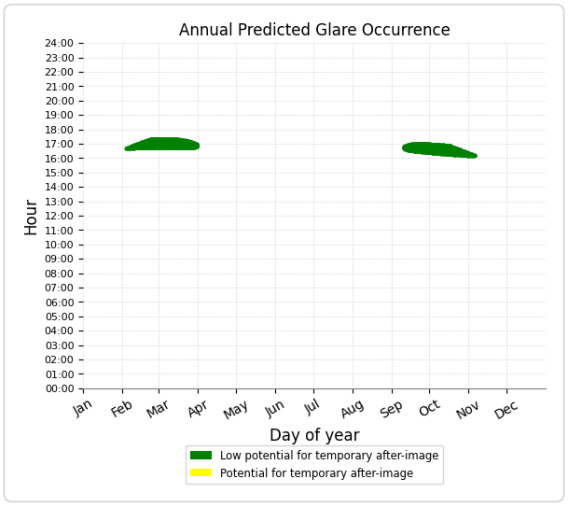


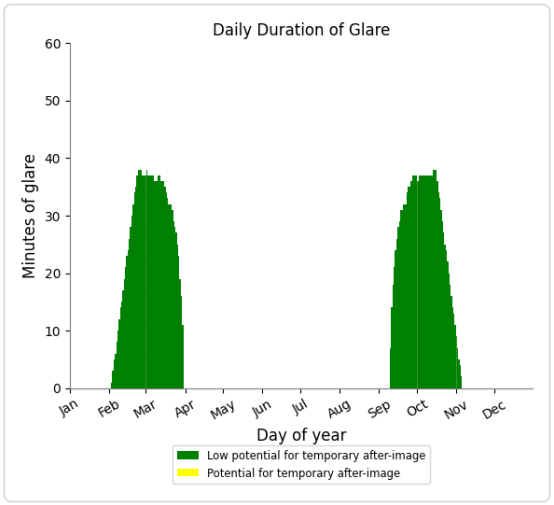


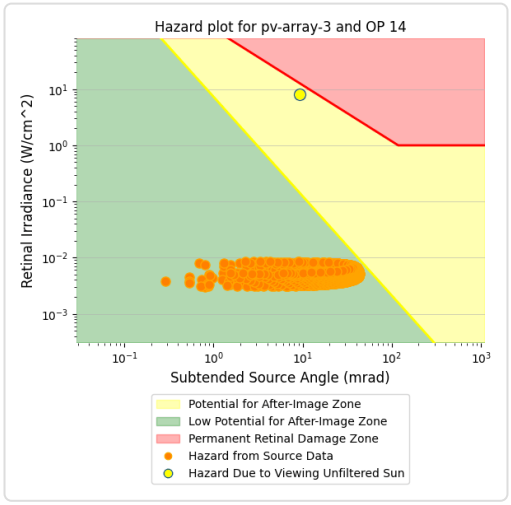
PV array 3 and OP 14

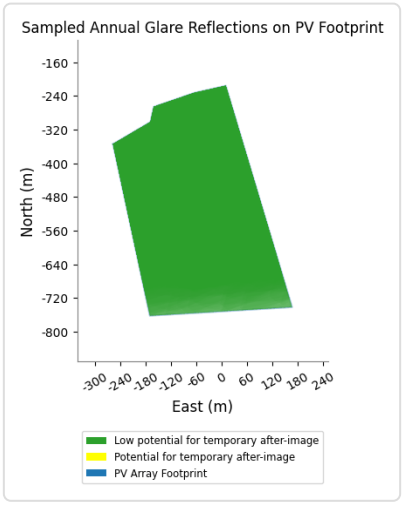
Yellow glare: none

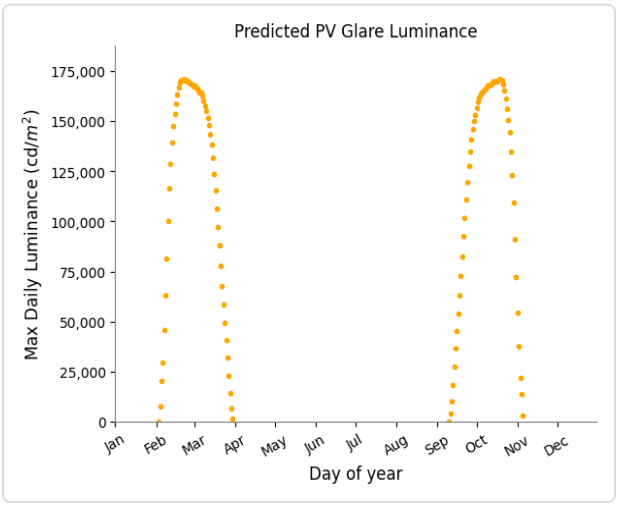
Green glare: 3,167 min.







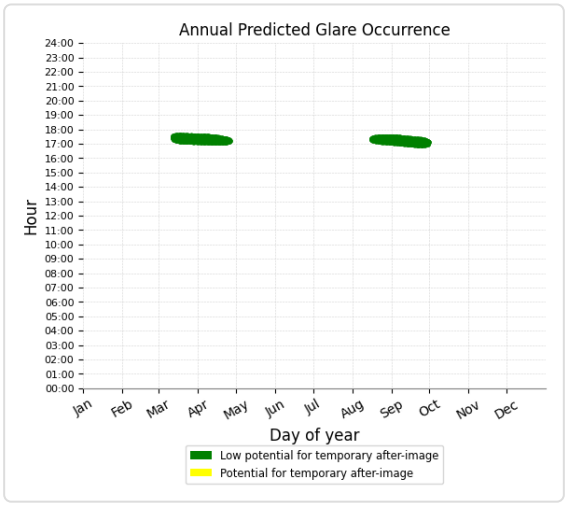


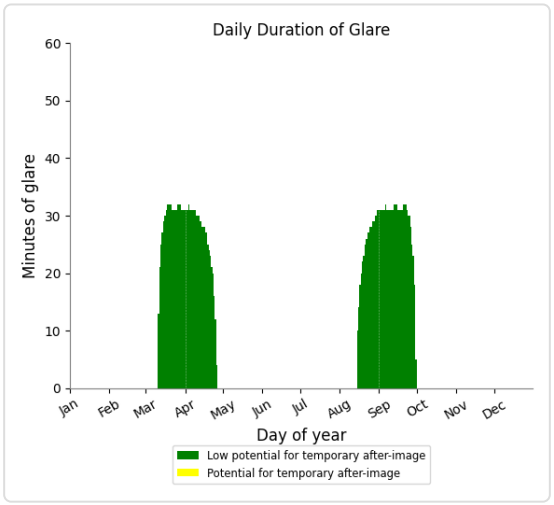


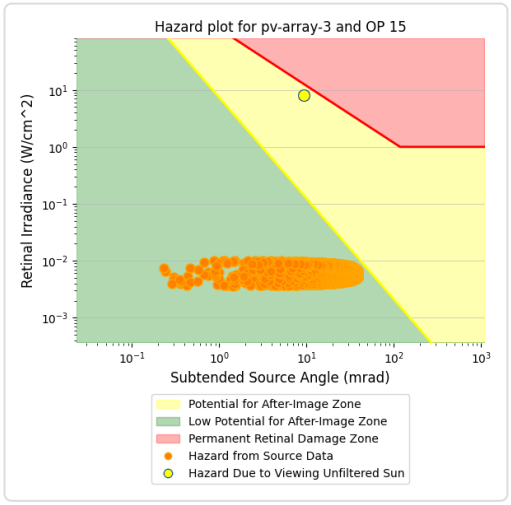
PV array 3 and OP 15

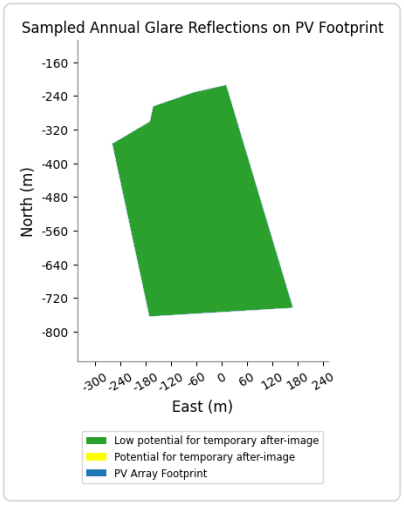
Yellow glare: none

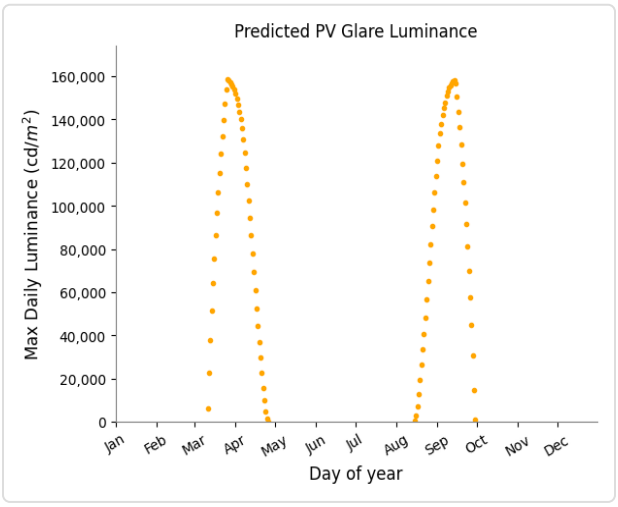
Green glare: 2,595 min.







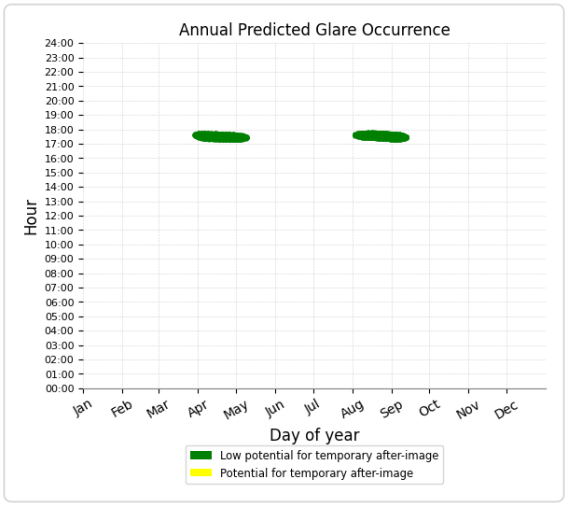


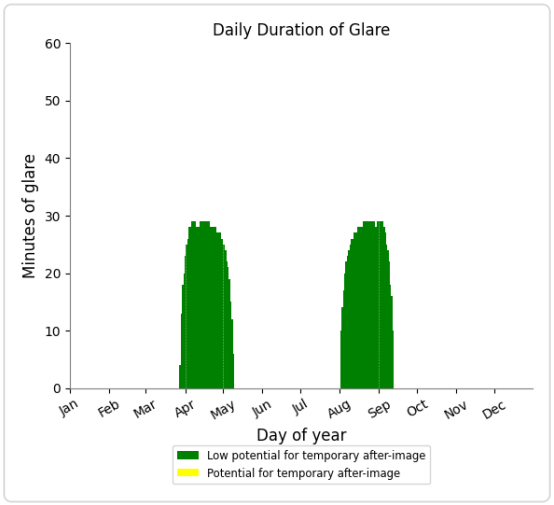


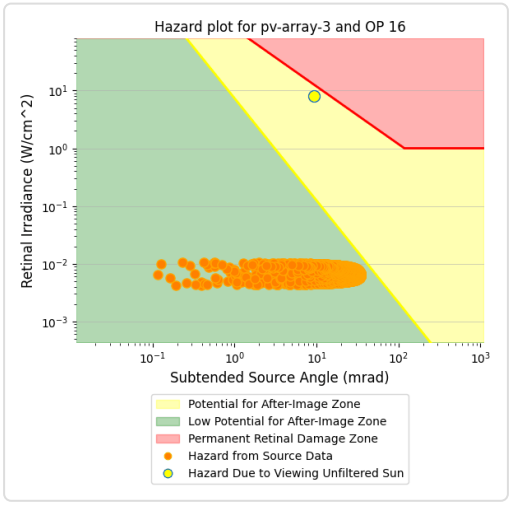
PV array 3 and OP 16

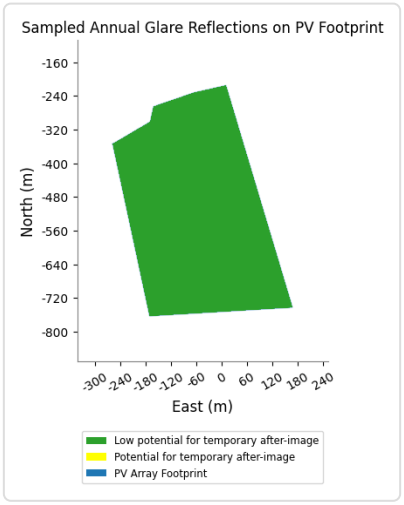
Yellow glare: none

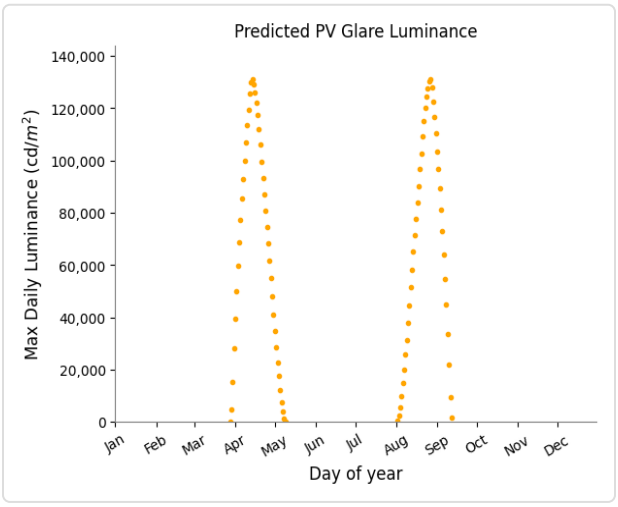
Green glare: 2,120 min.







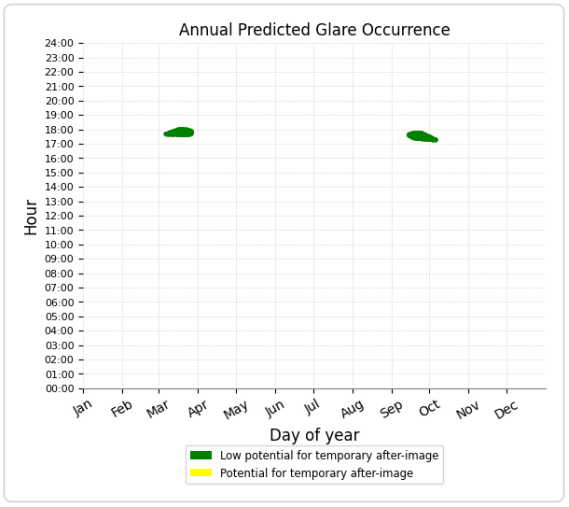


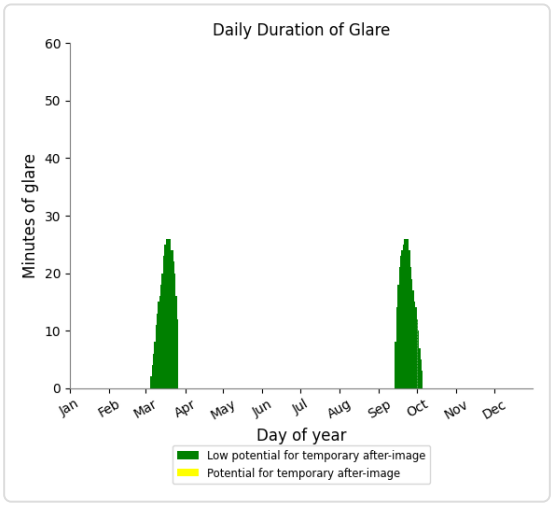


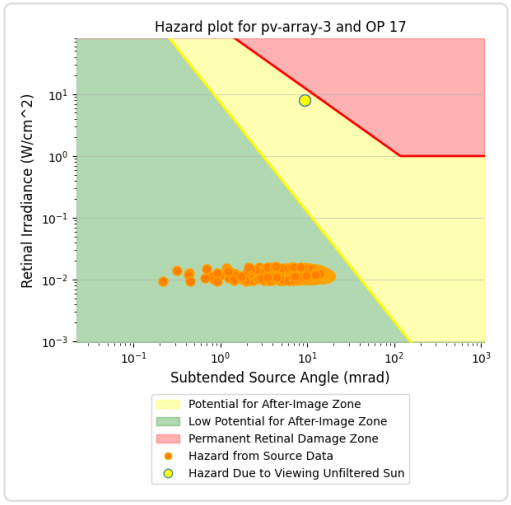
PV array 3 and OP 17

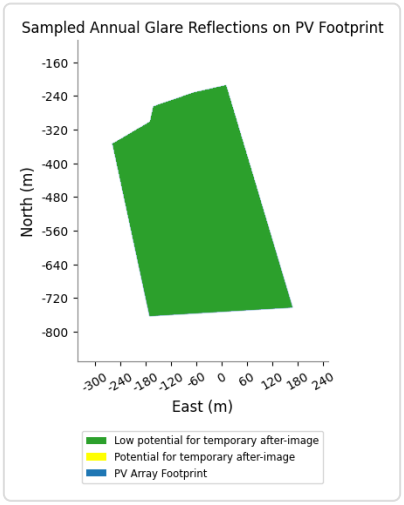
Yellow glare: none

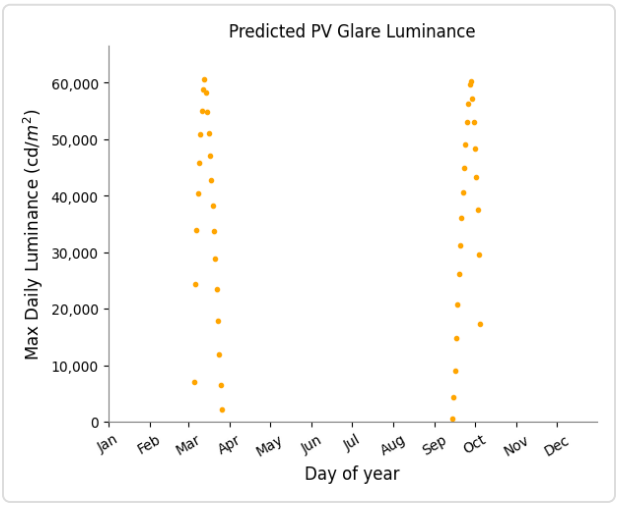
Green glare: 767 min.







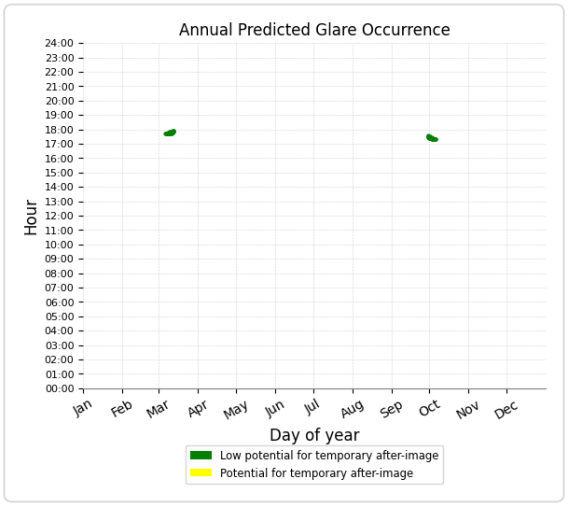


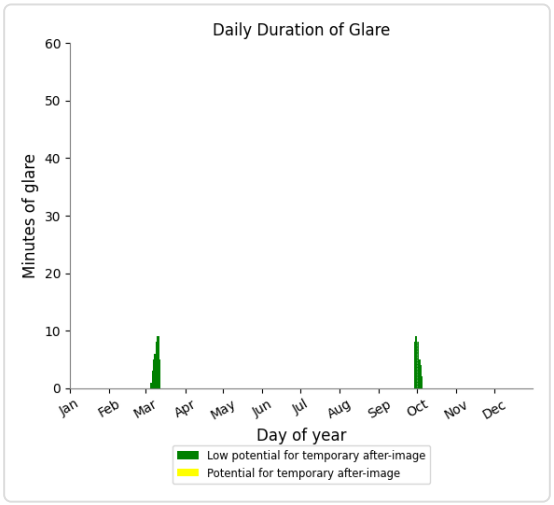


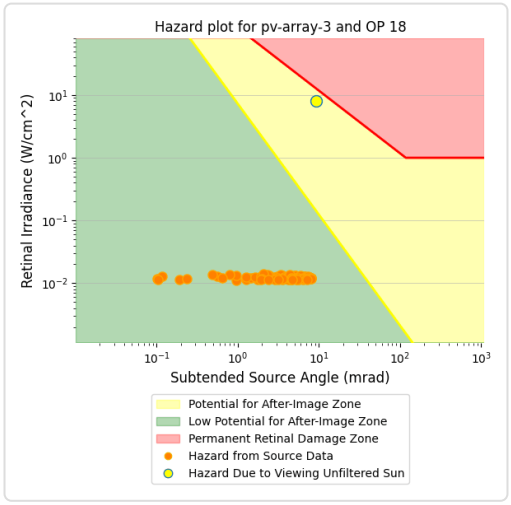
PV array 3 and OP 18

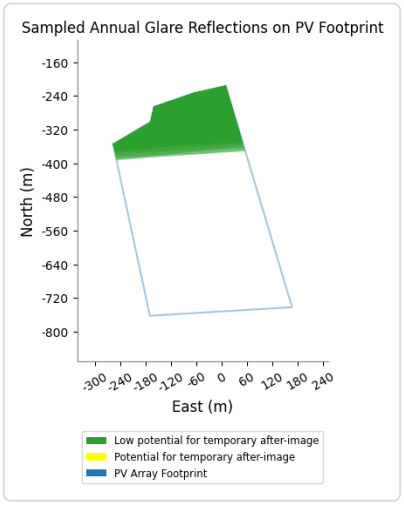
Yellow glare: none

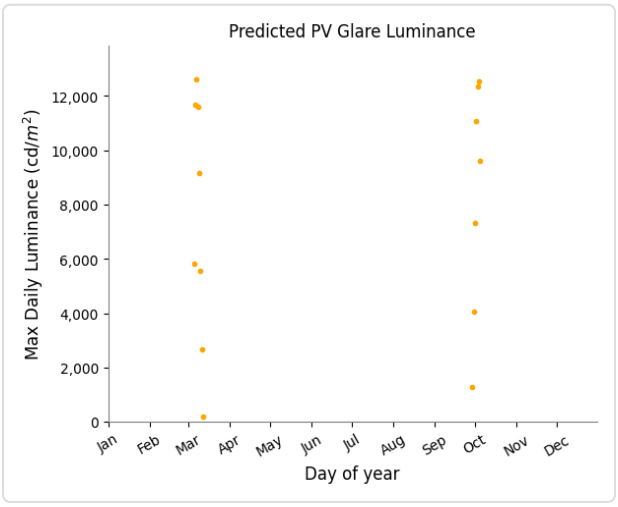
Green glare: 90 min.











PV array 3 and OP 2

No glare found

PV array 3 and OP 3

No glare found

PV array 3 and OP 4

No glare found

PV array 3 and OP 5

No glare found

PV array 3 and OP 6

No glare found

PV array 3 and OP 9

No glare found

PV array 3 and OP 10

No glare found

PV array 3 and OP 11

No glare found

PV array 3 and OP 12

No glare found

PV array 3 and OP 13

No glare found

PV array 3 and OP 19

No glare found

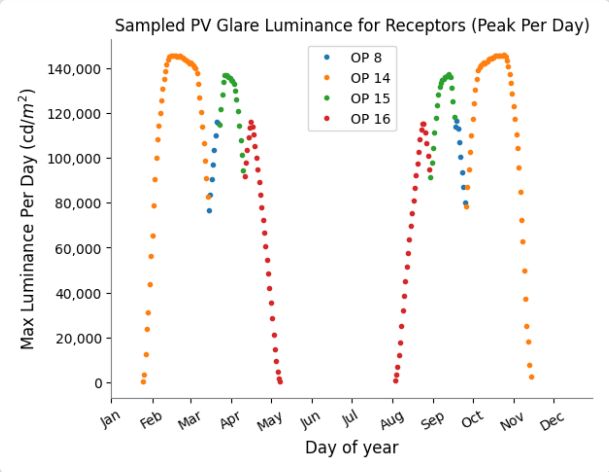
PV array 3 and OP 20

No glare found

PV: PV array 4 low potential for temporary after-image

Receptor results ordered by category of glare

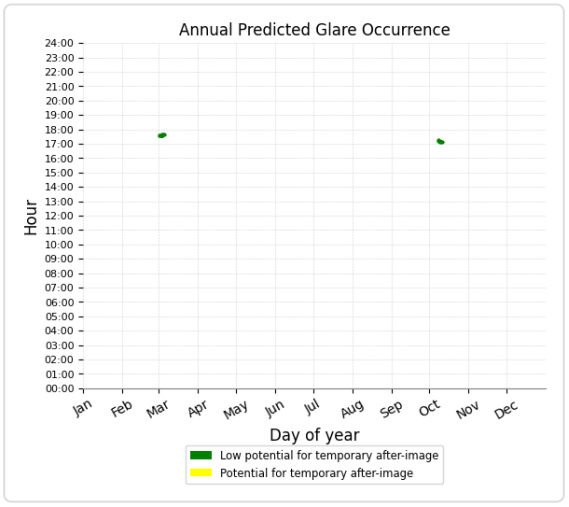
Receptor	Annual Green Glare		Annual Yellow Glare		Peak Luminance
	min	hr	min	hr	cd/m^2
OP 1	17	0.3	0	0.0	4,380
OP 7	246	4.1	0	0.0	58,794
OP 8	1,694	28.2	0	0.0	116,290
OP 14	3,610	60.2	0	0.0	145,700
OP 15	2,476	41.3	0	0.0	137,074
OP 16	1,975	32.9	0	0.0	115,771
OP 17	699	11.7	0	0.0	49,336
OP 18	26	0.4	0	0.0	4,951
OP 2	0	0.0	0	0.0	0
OP 3	0	0.0	0	0.0	0
OP 4	0	0.0	0	0.0	0
OP 5	0	0.0	0	0.0	0
OP 6	0	0.0	0	0.0	0
OP 9	0	0.0	0	0.0	0
OP 10	0	0.0	0	0.0	0
OP 11	0	0.0	0	0.0	0
OP 12	0	0.0	0	0.0	0
OP 13	0	0.0	0	0.0	0
OP 19	0	0.0	0	0.0	0
OP 20	0	0.0	0	0.0	0

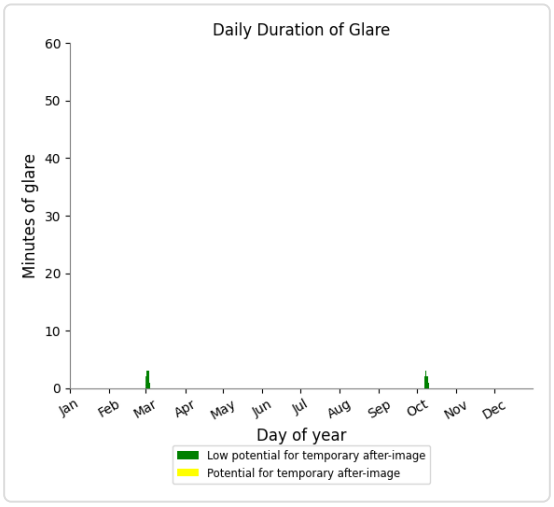


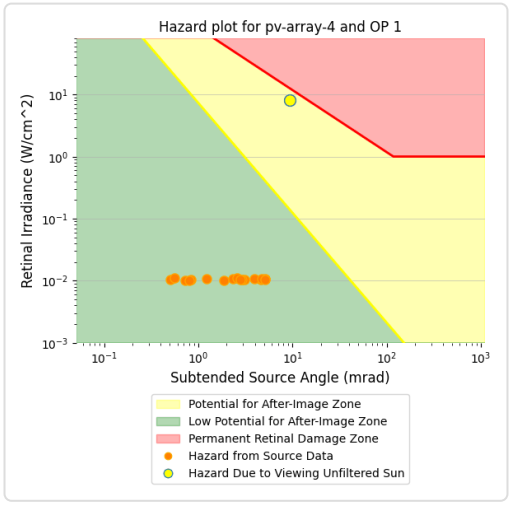
PV array 4 and OP 1

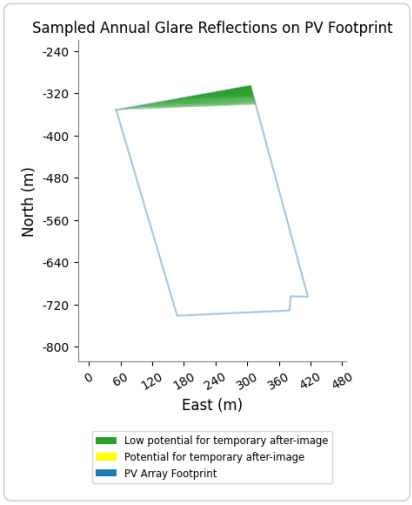
Yellow glare: none

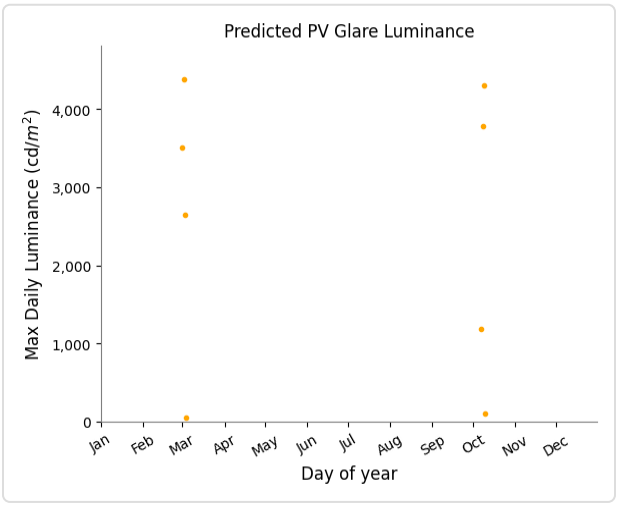
Green glare: 17 min.







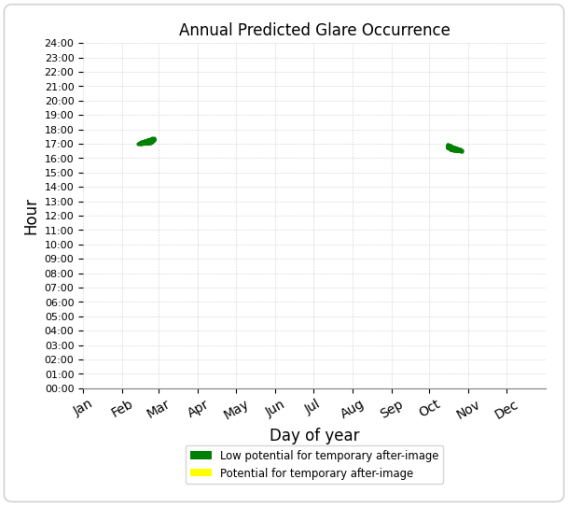


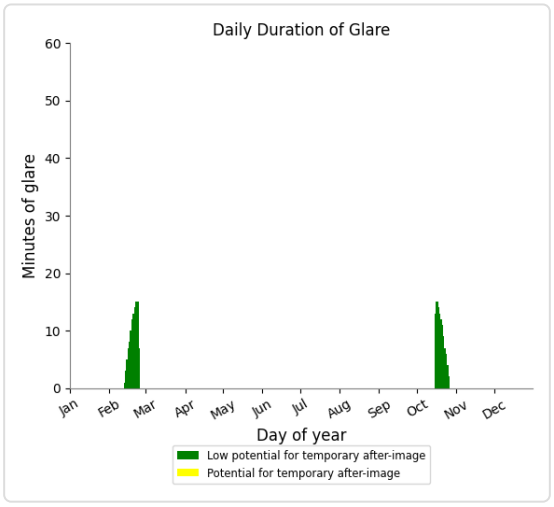


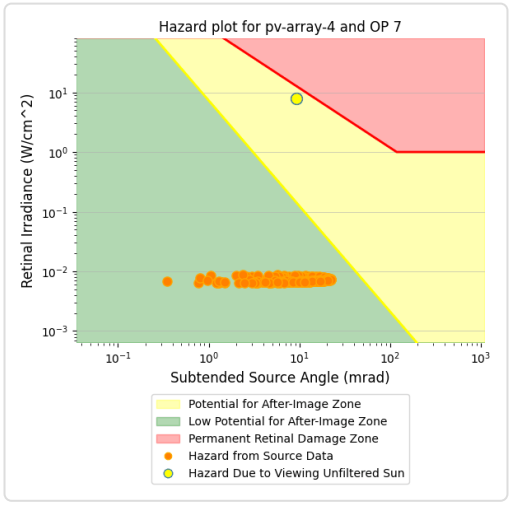
PV array 4 and OP 7

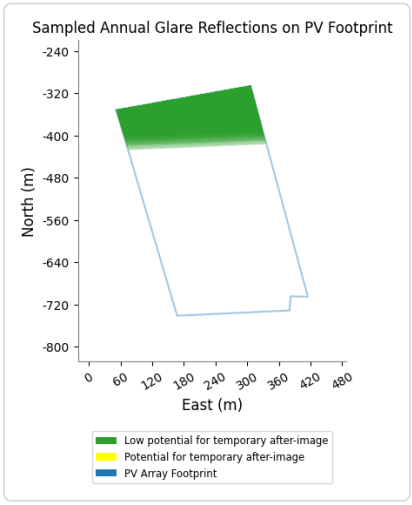
Yellow glare: none

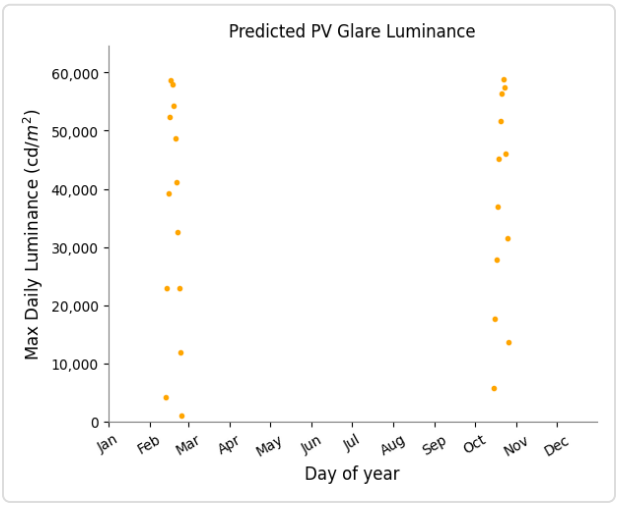
Green glare: 246 min.







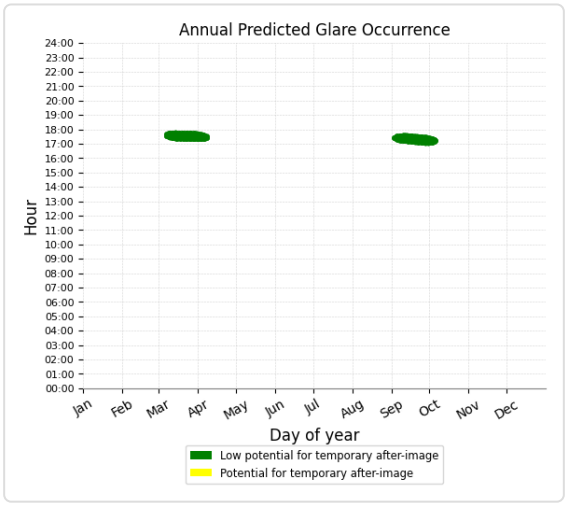


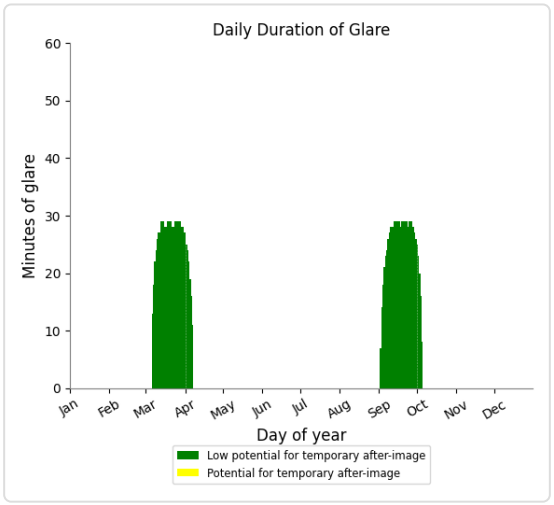


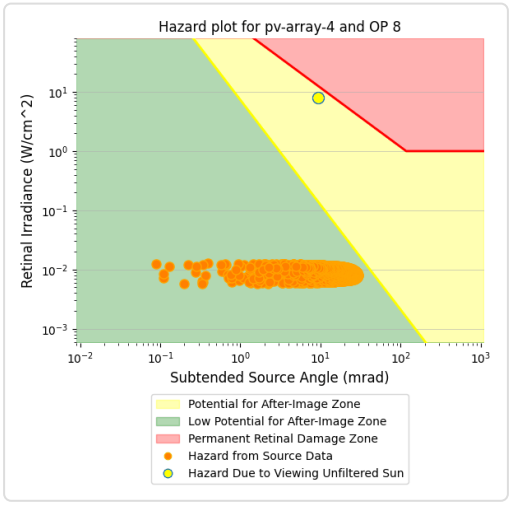
PV array 4 and OP 8

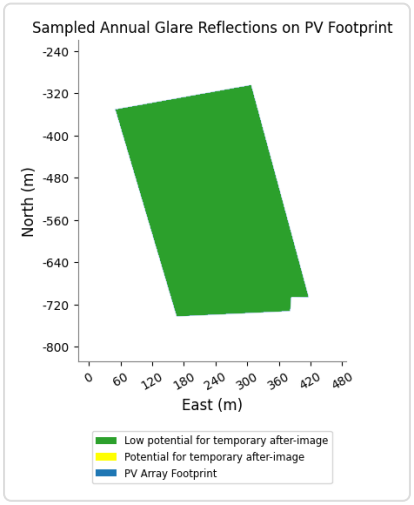
Yellow glare: none

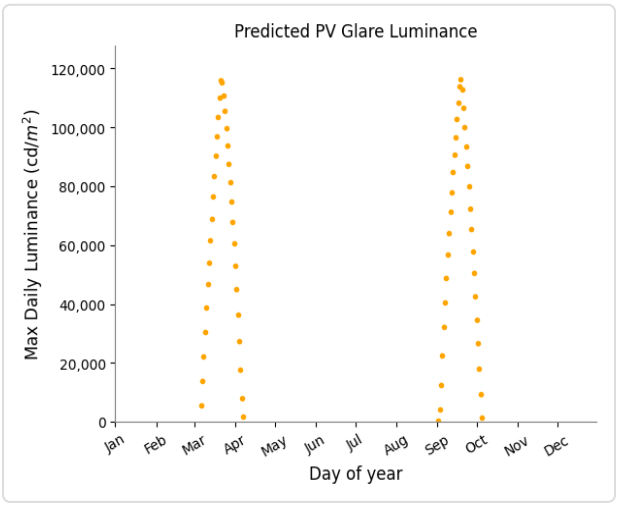
Green glare: 1,694 min.







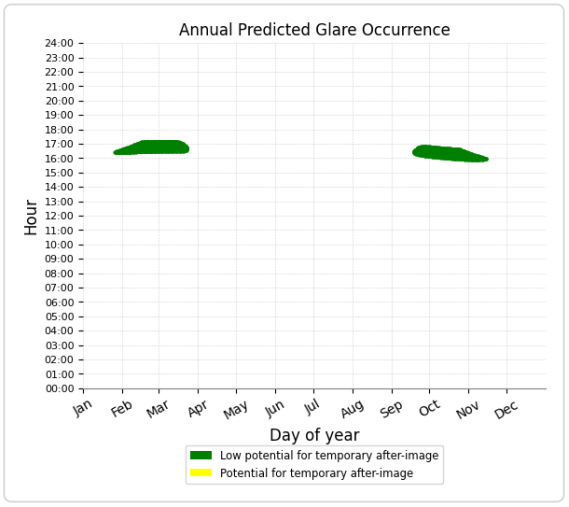


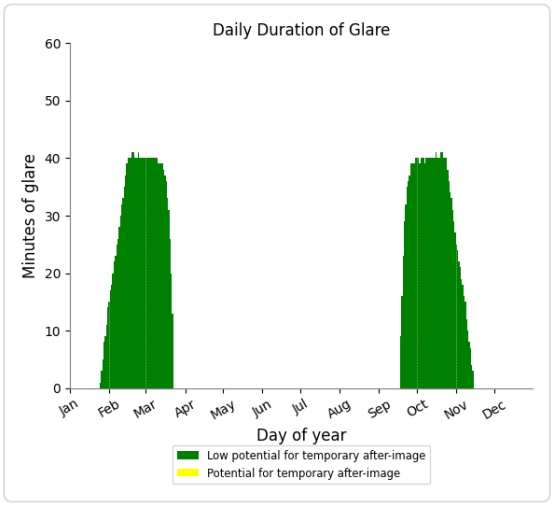


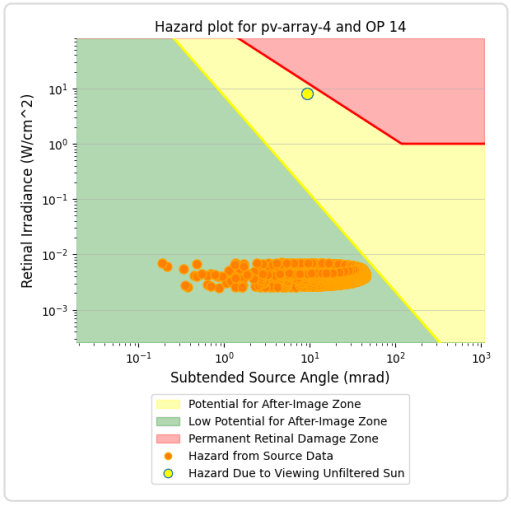
PV array 4 and OP 14

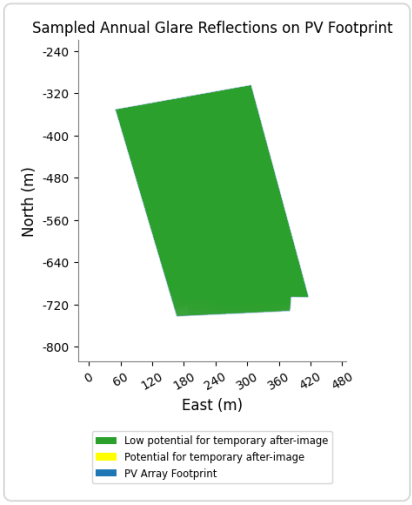
Yellow glare: none

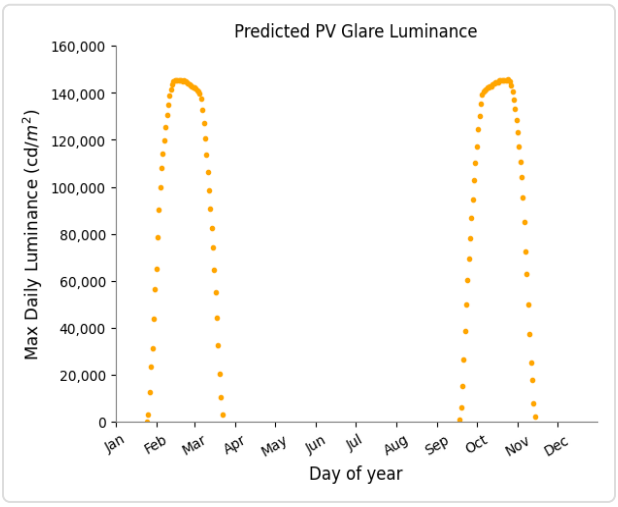
Green glare: 3,610 min.







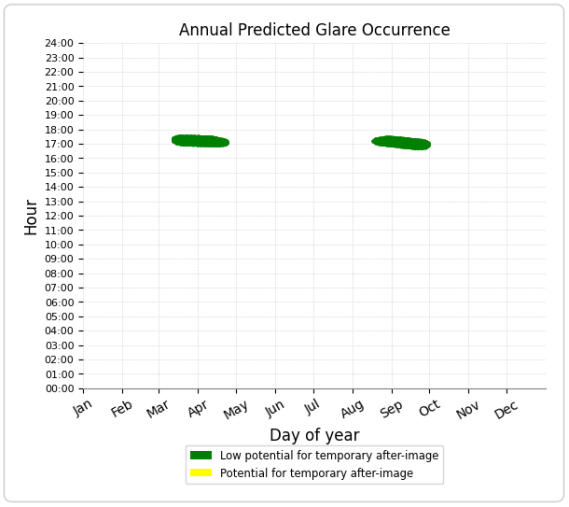


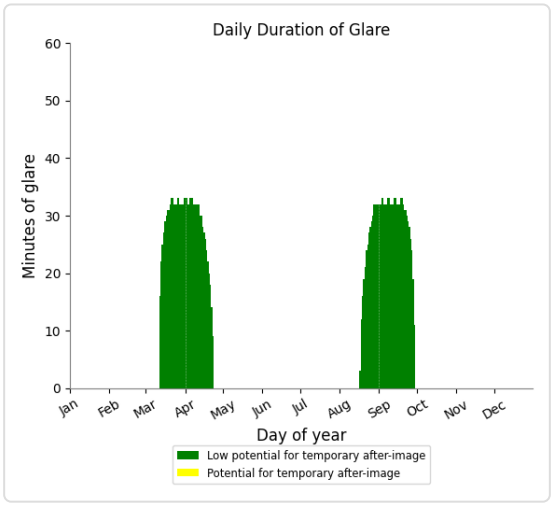


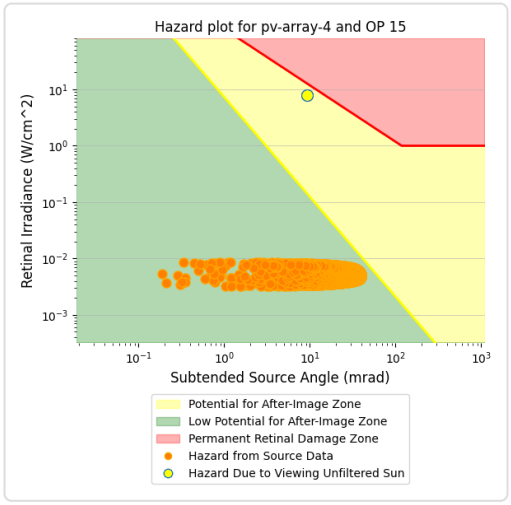
PV array 4 and OP 15

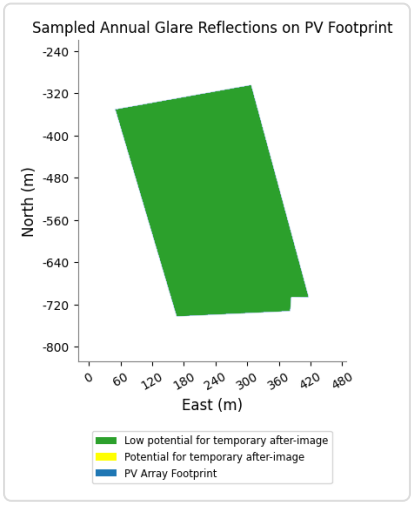
Yellow glare: none

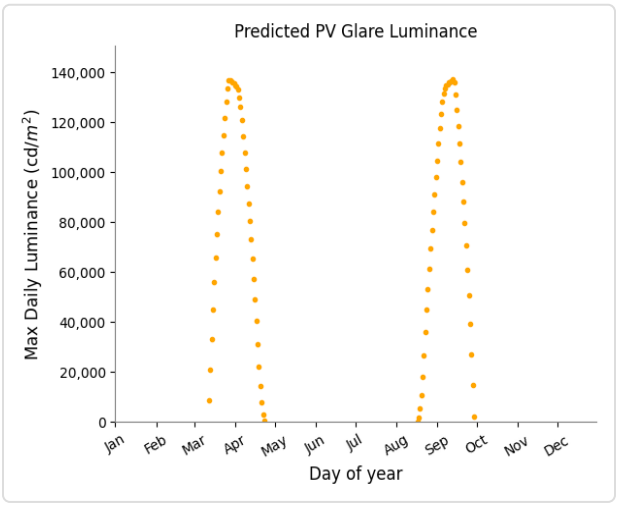
Green glare: 2,476 min.







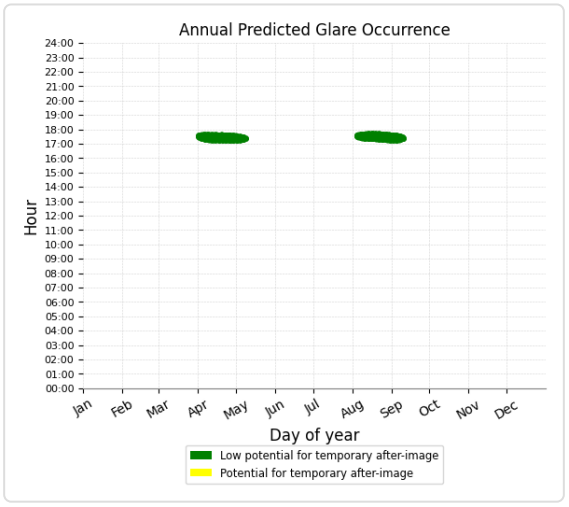


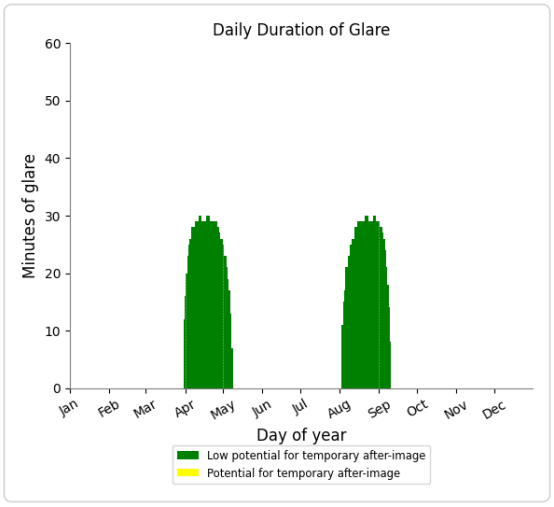


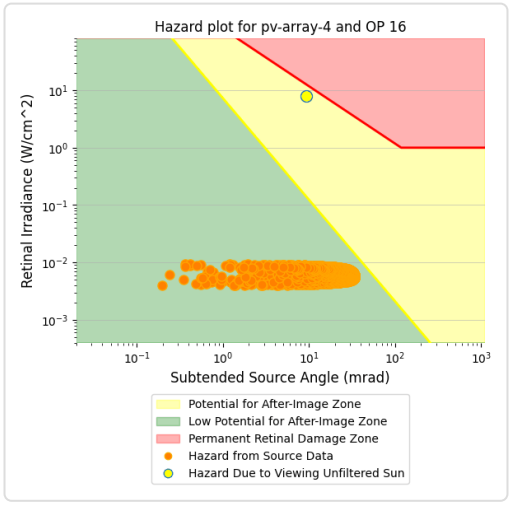
PV array 4 and OP 16

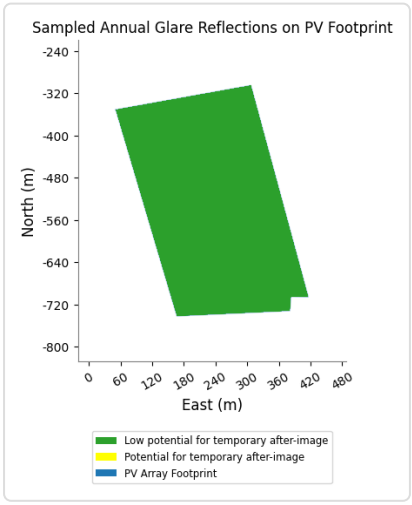
Yellow glare: none

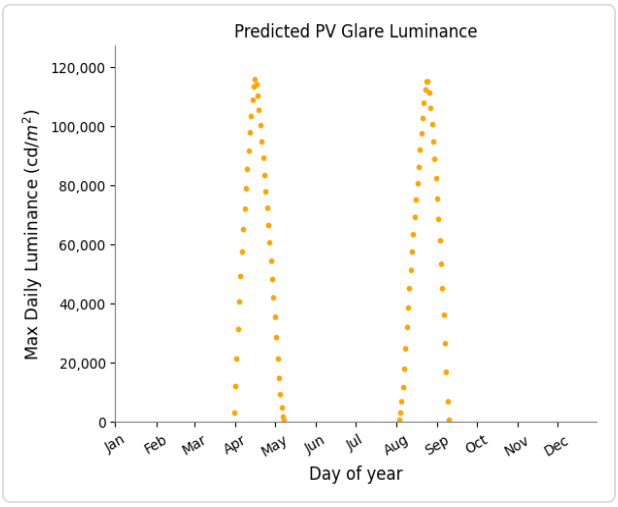
Green glare: 1,975 min.







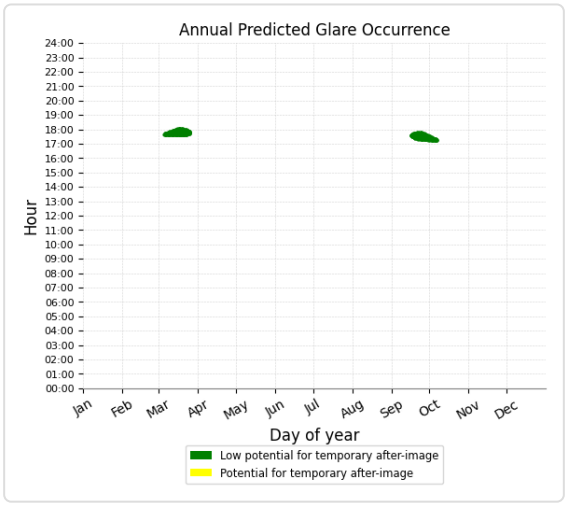


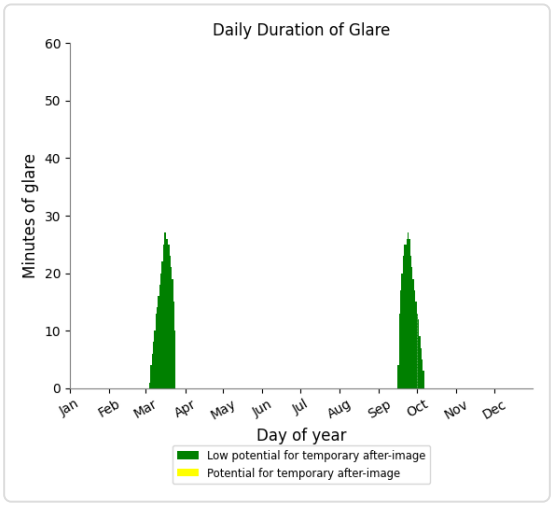


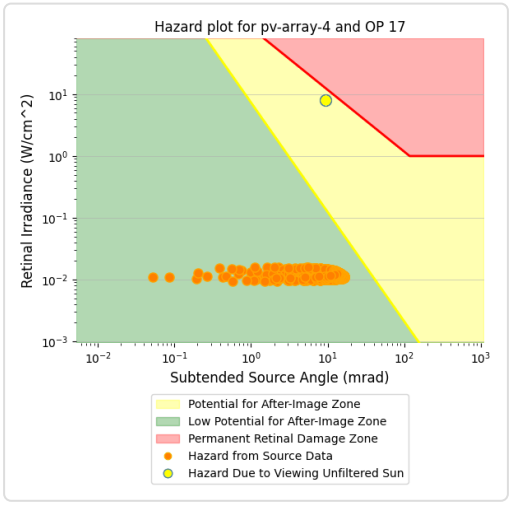
PV array 4 and OP 17

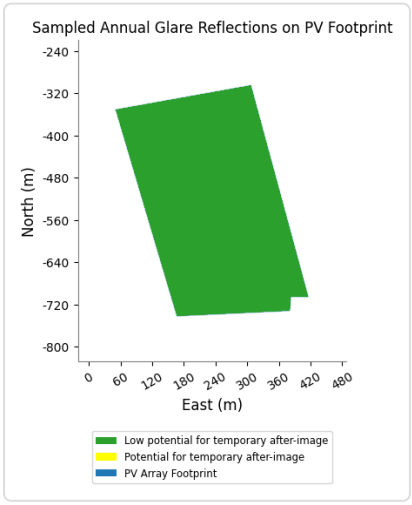
Yellow glare: none

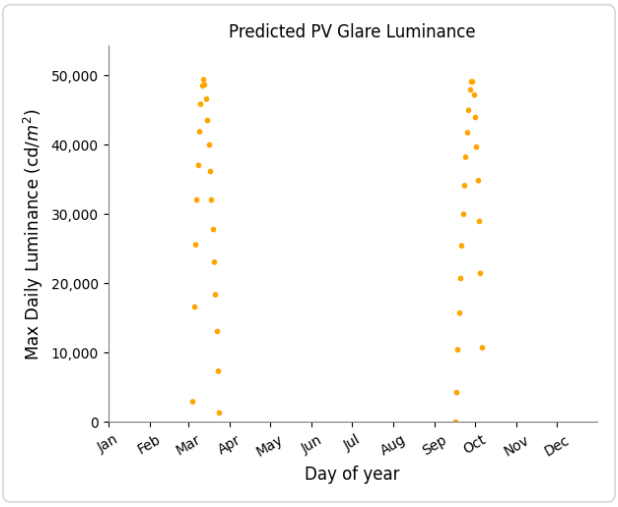
Green glare: 699 min.







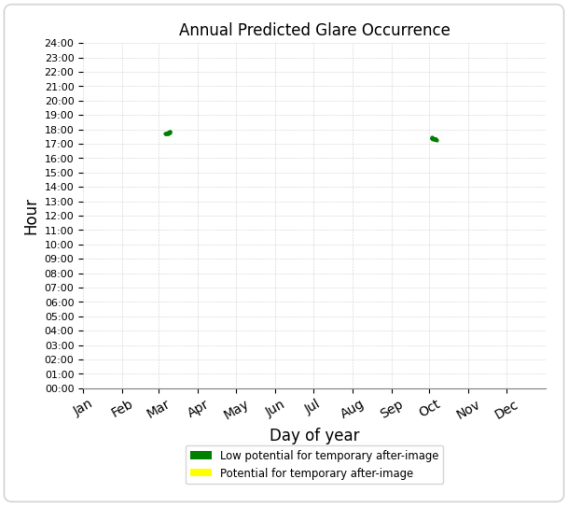


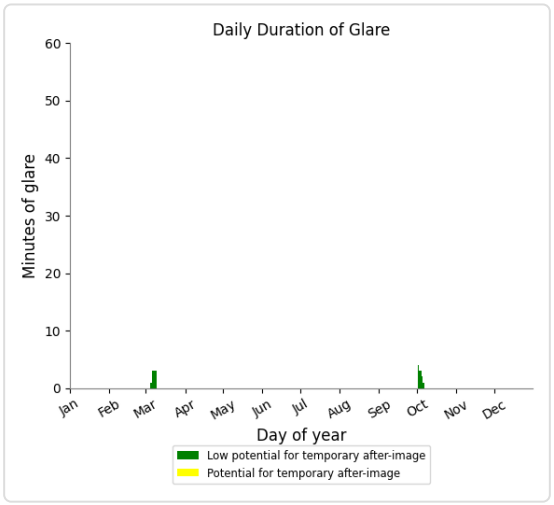


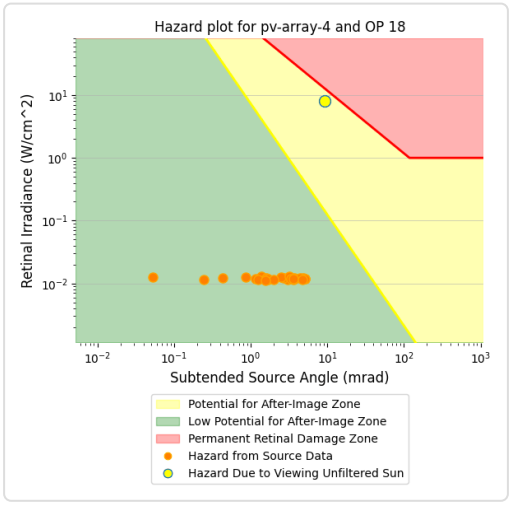
PV array 4 and OP 18

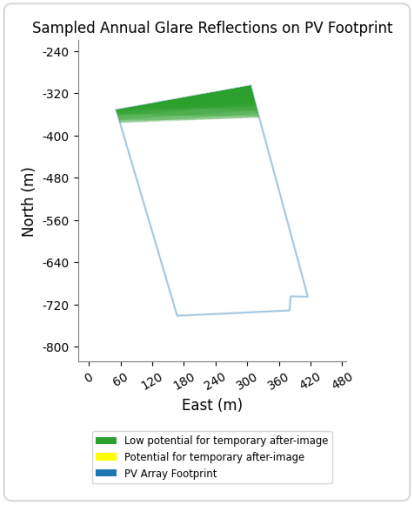
Yellow glare: none

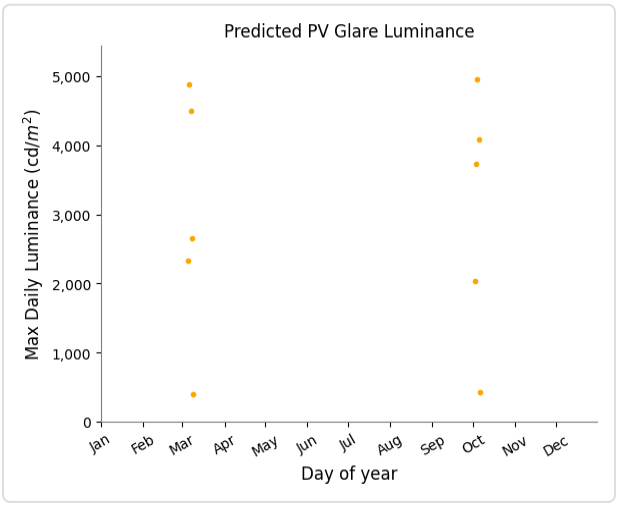
Green glare: 26 min.











PV array 4 and OP 2

No glare found

PV array 4 and OP 3

No glare found

PV array 4 and OP 4

No glare found

PV array 4 and OP 5

No glare found

PV array 4 and OP 6

No glare found

PV array 4 and OP 9

No glare found

PV array 4 and OP 10

No glare found

PV array 4 and OP 11

No glare found

PV array 4 and OP 12

No glare found

PV array 4 and OP 13

No glare found

PV array 4 and OP 19

No glare found

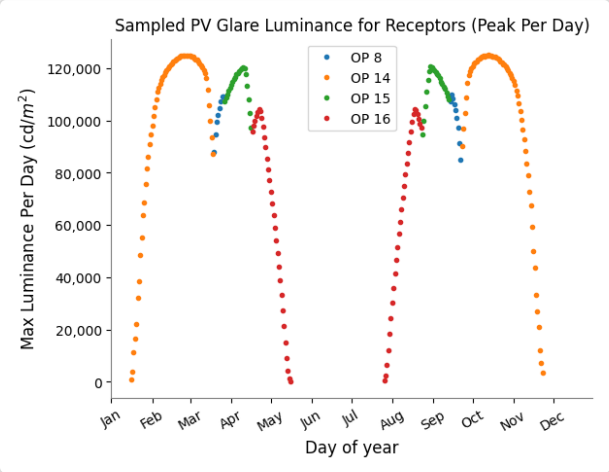
PV array 4 and OP 20

No glare found

PV: PV array 5 low potential for temporary after-image

Receptor results ordered by category of glare

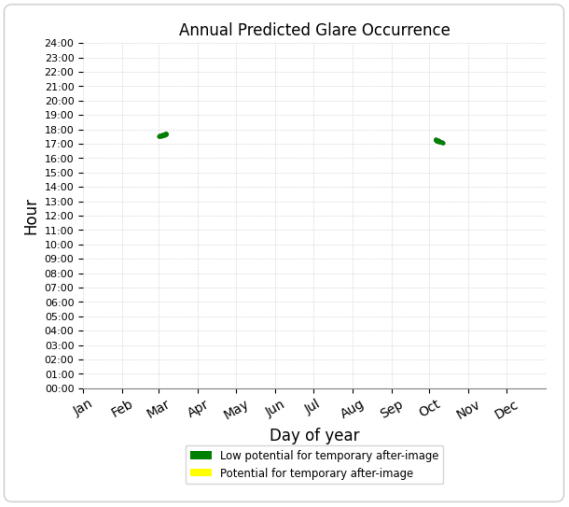
Receptor	Annual Green Glare		Annual Yellow Glare		Peak Luminance
	min	hr	min	hr	cd/m^2
OP 1	63	1.1	0	0.0	17,559
OP 7	522	8.7	0	0.0	93,327
OP 8	1,859	31.0	0	0.0	109,834
OP 14	4,698	78.3	0	0.0	125,008
OP 15	2,891	48.2	0	0.0	120,533
OP 16	2,267	37.8	0	0.0	104,330
OP 17	790	13.2	0	0.0	50,439
OP 18	62	1.0	0	0.0	11,301
OP 2	0	0.0	0	0.0	0
OP 3	0	0.0	0	0.0	0
OP 4	0	0.0	0	0.0	0
OP 5	0	0.0	0	0.0	0
OP 6	0	0.0	0	0.0	0
OP 9	0	0.0	0	0.0	0
OP 10	0	0.0	0	0.0	0
OP 11	0	0.0	0	0.0	0
OP 12	0	0.0	0	0.0	0
OP 13	0	0.0	0	0.0	0
OP 19	0	0.0	0	0.0	0
OP 20	0	0.0	0	0.0	0

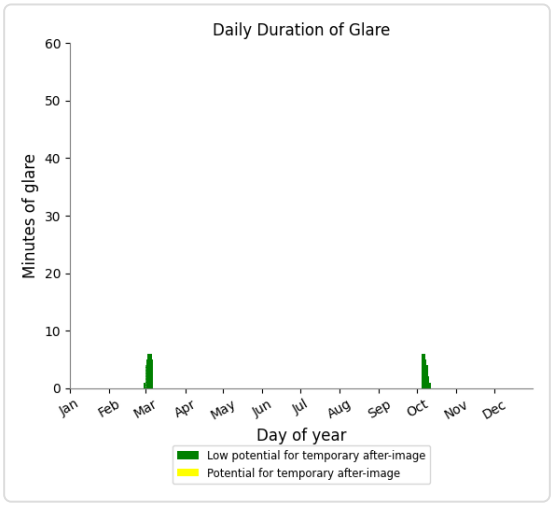


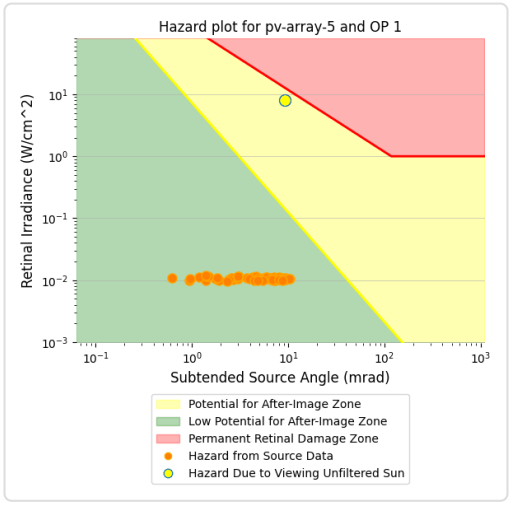
PV array 5 and OP 1

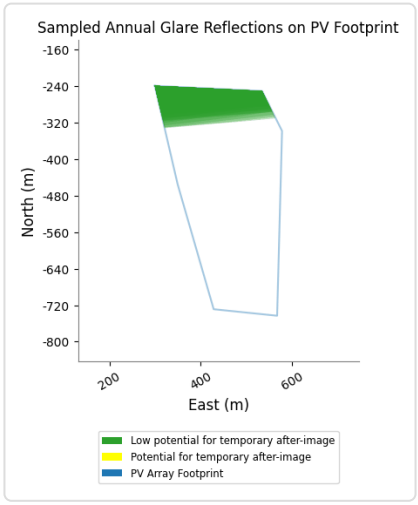
Yellow glare: none

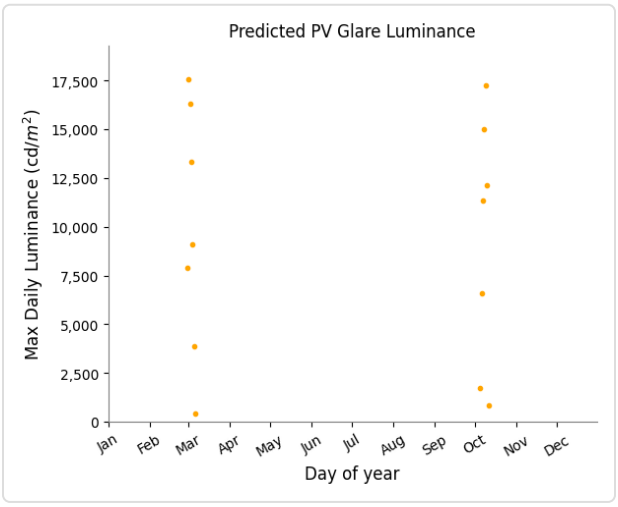
Green glare: 63 min.







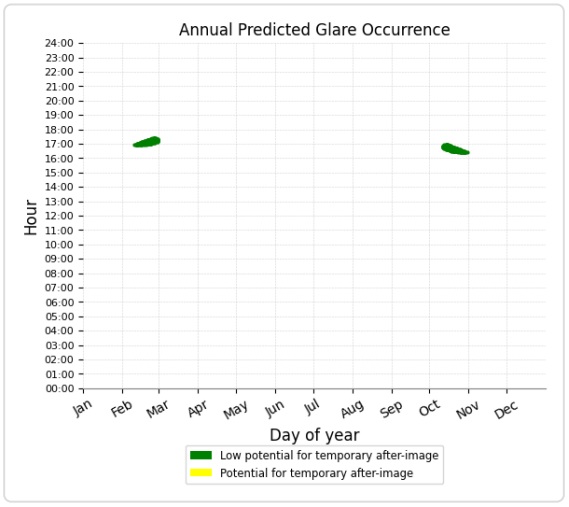


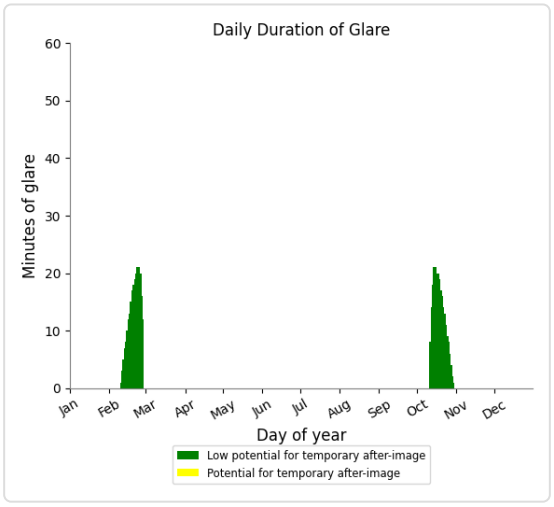


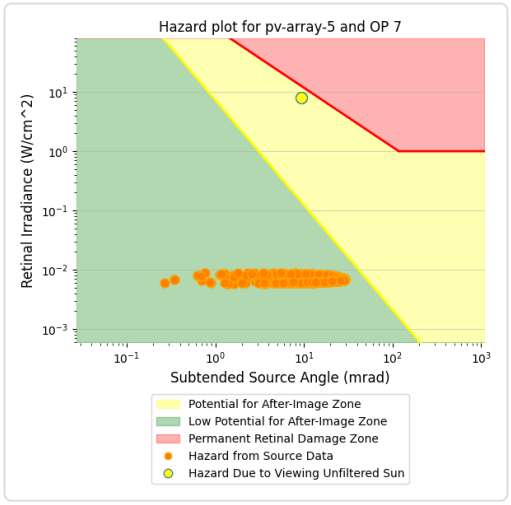
PV array 5 and OP 7

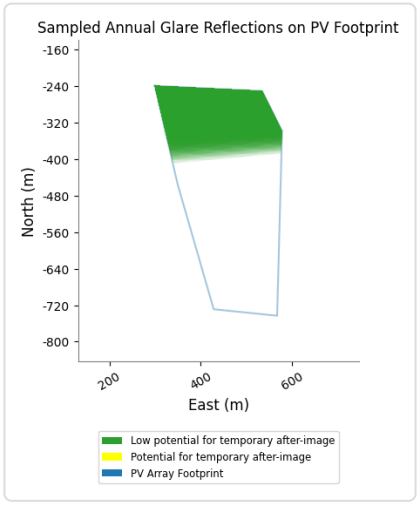
Yellow glare: none

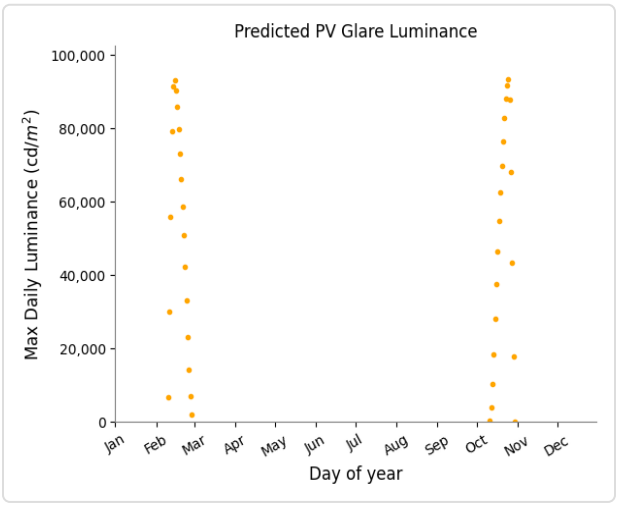
Green glare: 522 min.







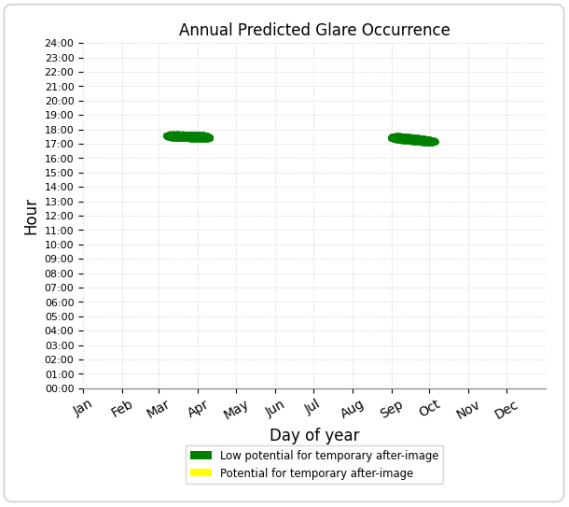


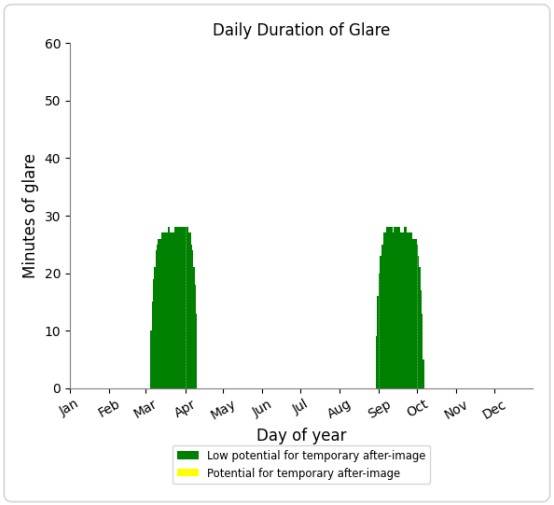


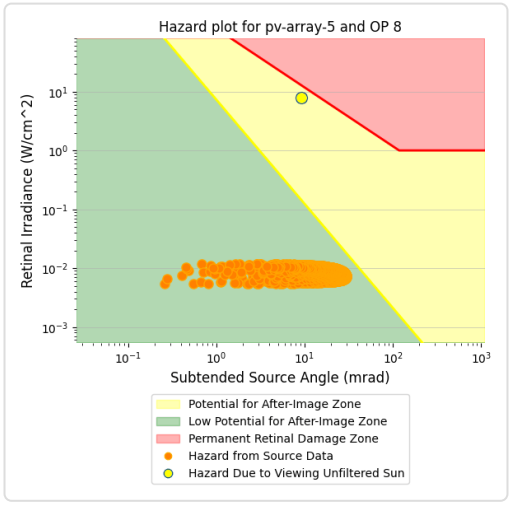
PV array 5 and OP 8

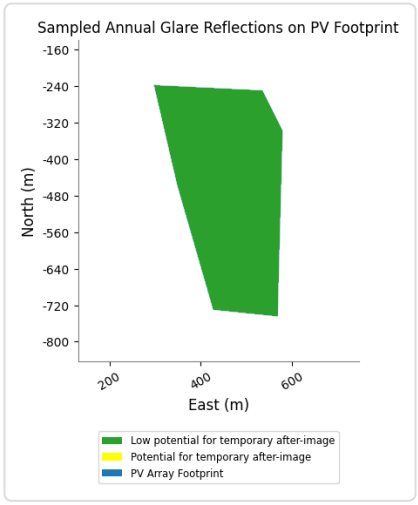
Yellow glare: none

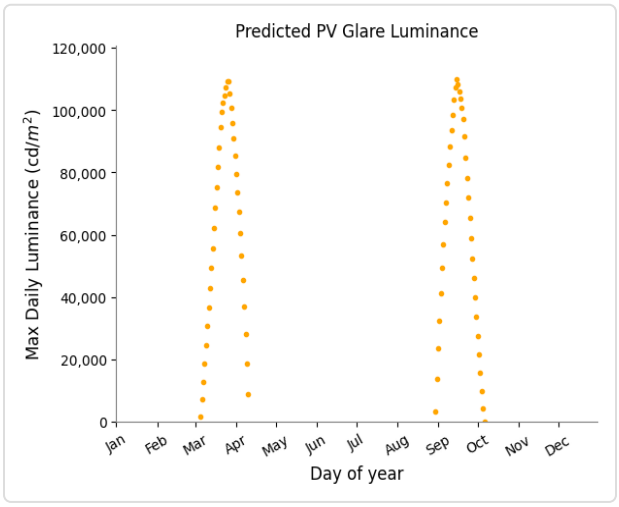
Green glare: 1,859 min.







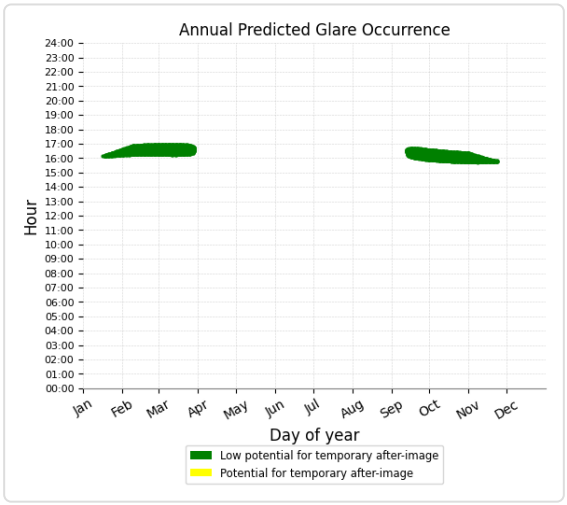


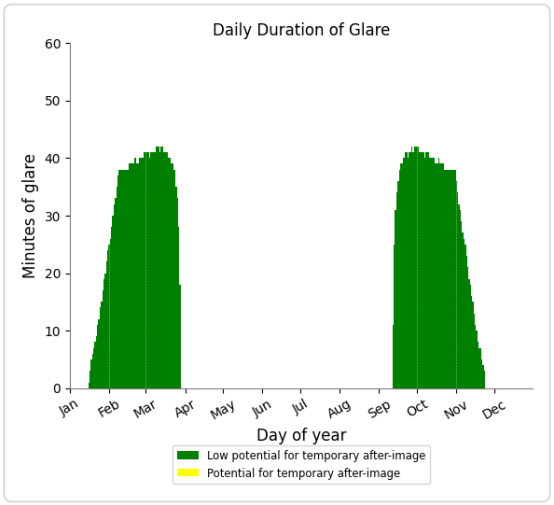


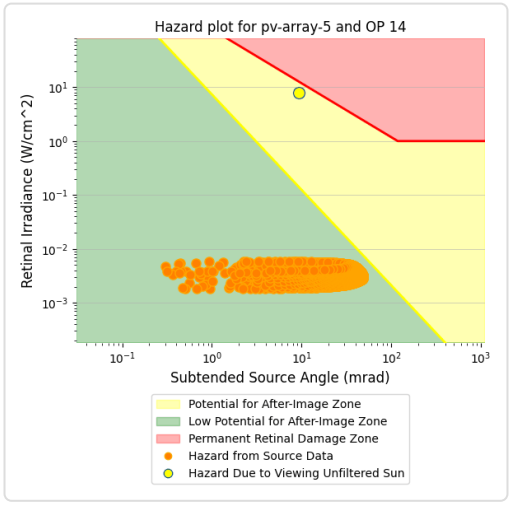
PV array 5 and OP 14

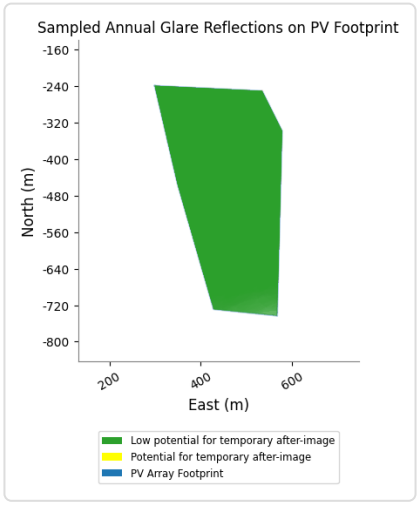
Yellow glare: none

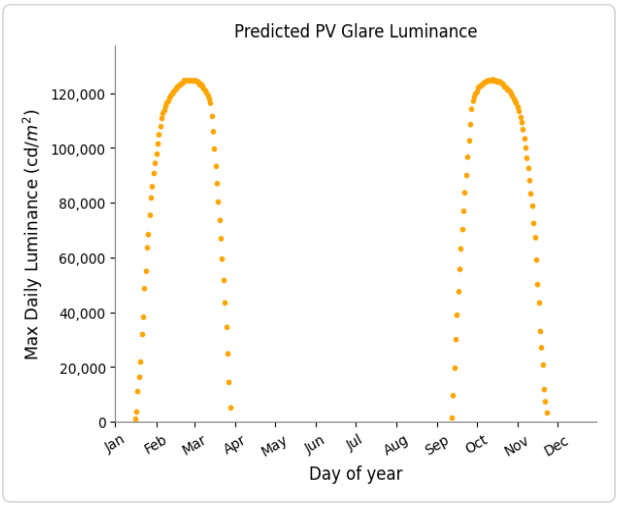
Green glare: 4,698 min.







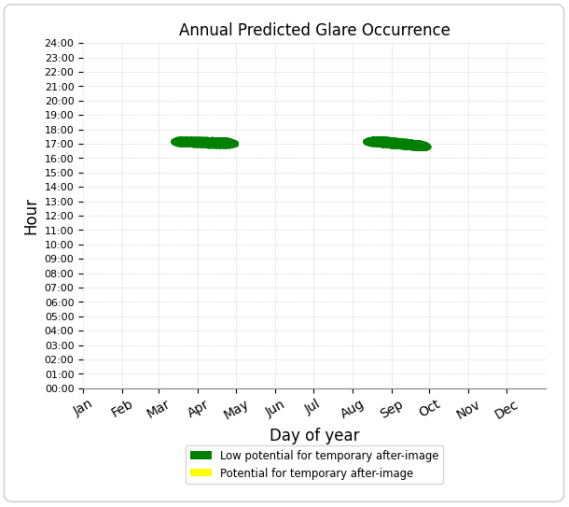


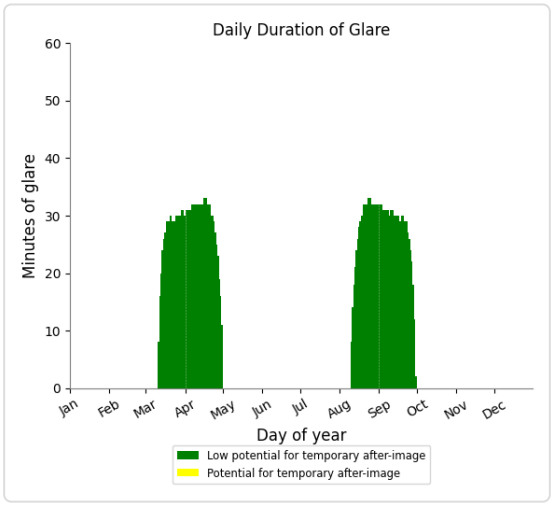


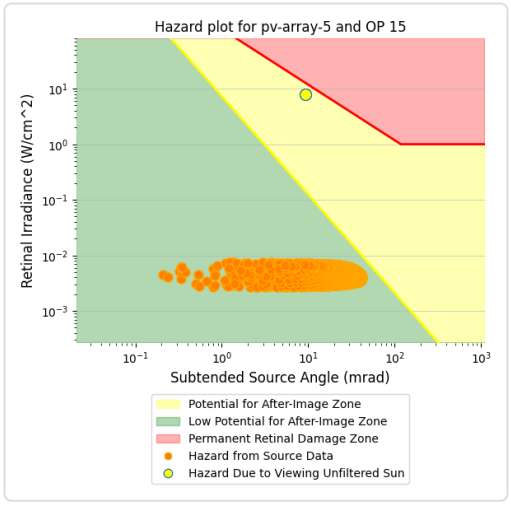
PV array 5 and OP 15

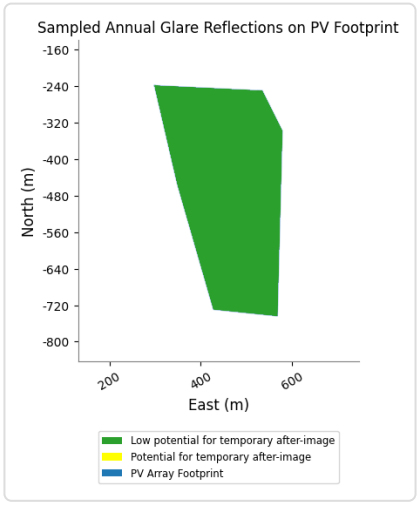
Yellow glare: none

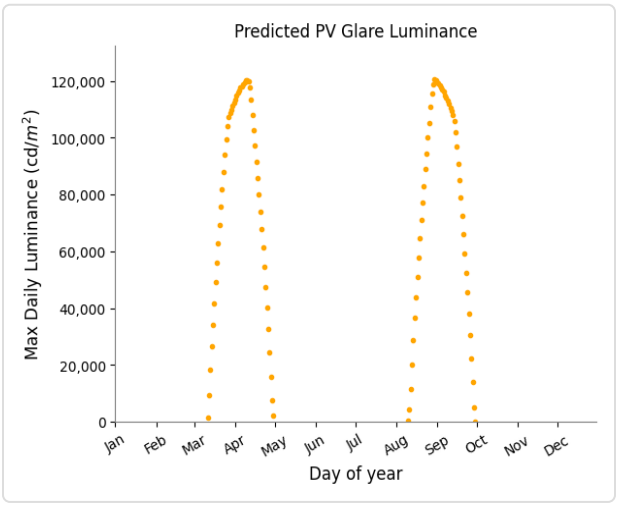
Green glare: 2,891 min.







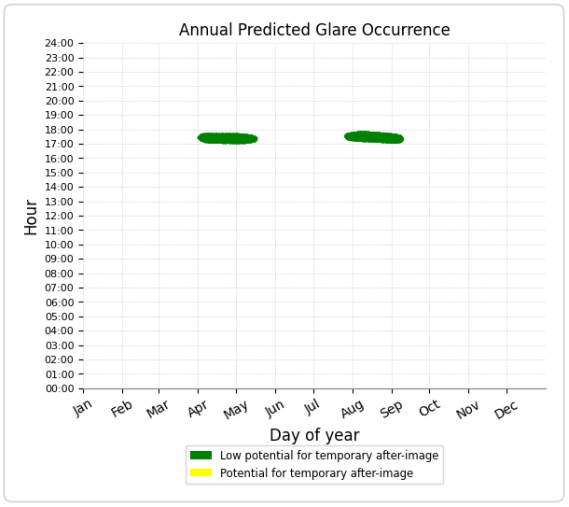


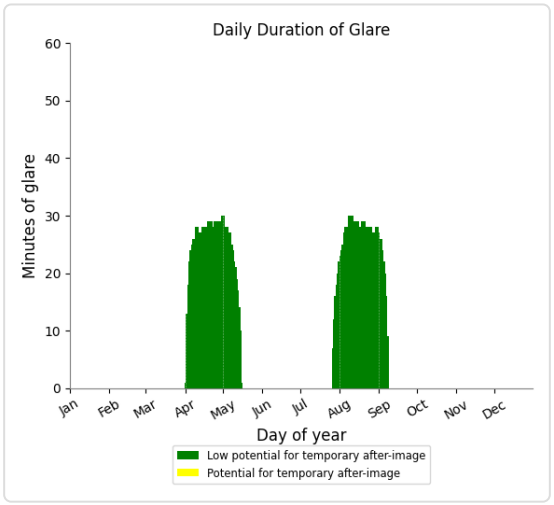


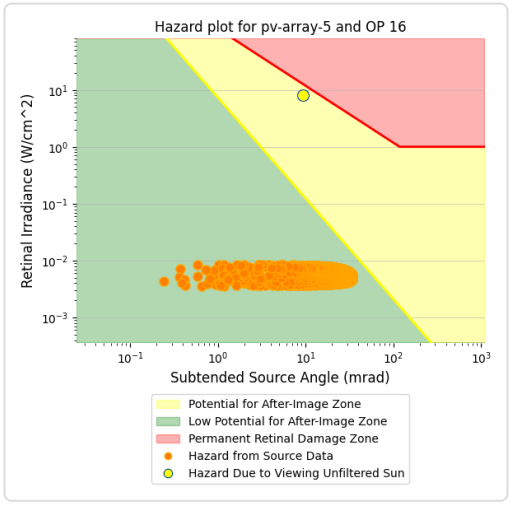
PV array 5 and OP 16

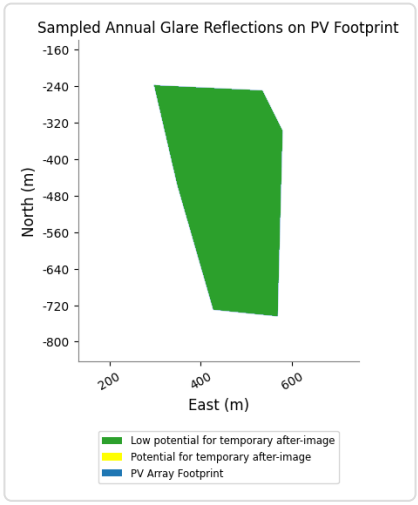
Yellow glare: none

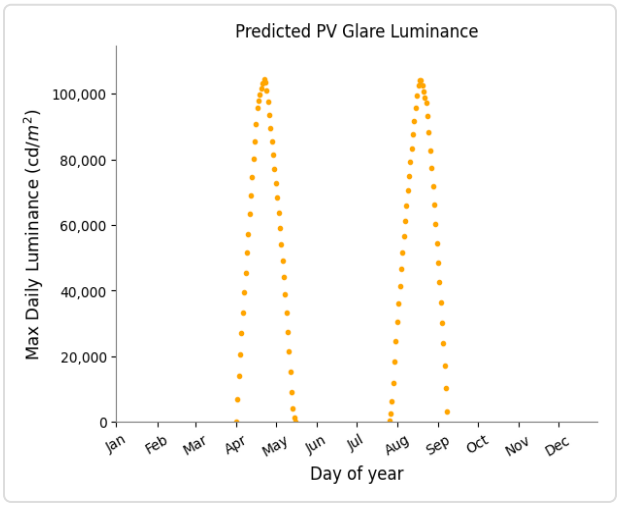
Green glare: 2,267 min.







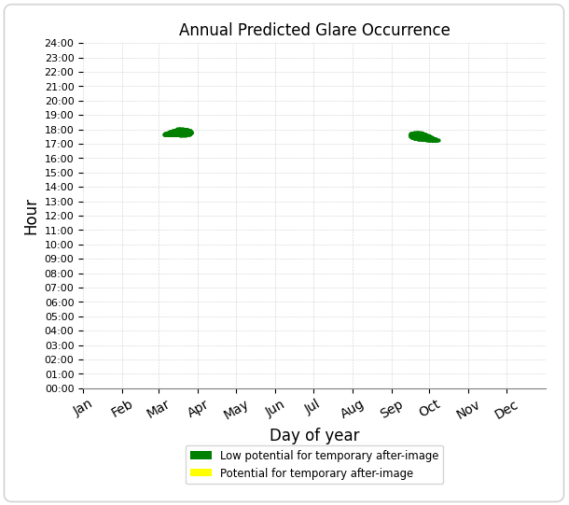


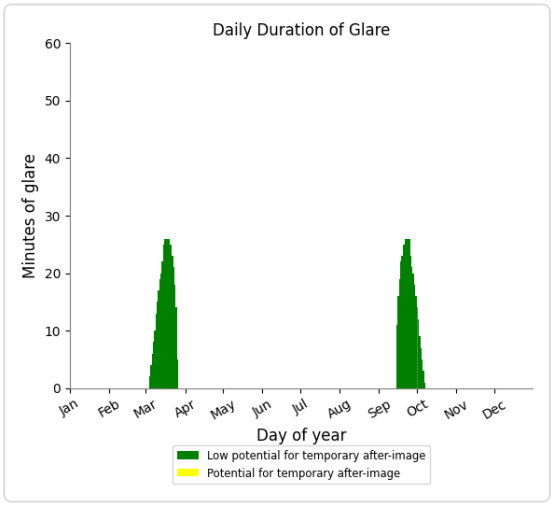


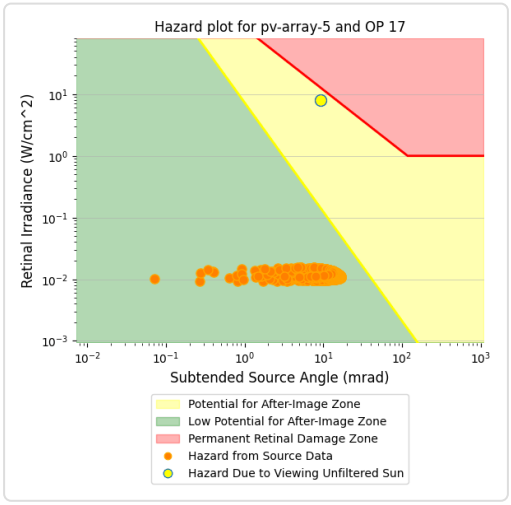
PV array 5 and OP 17

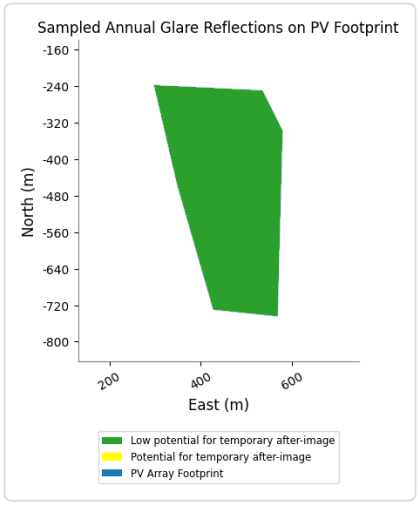
Yellow glare: none

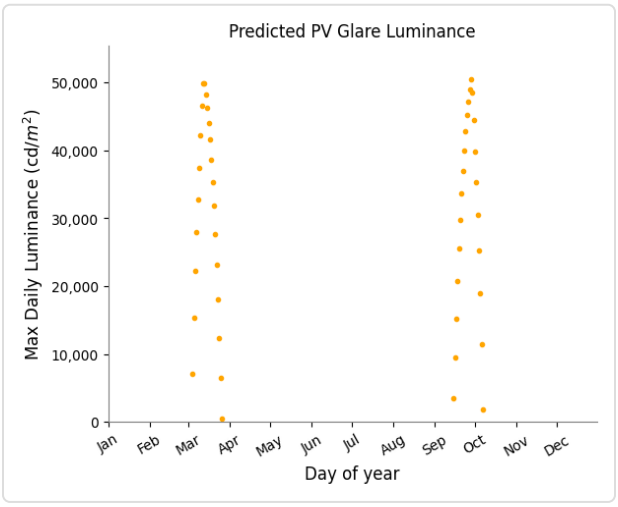
Green glare: 790 min.







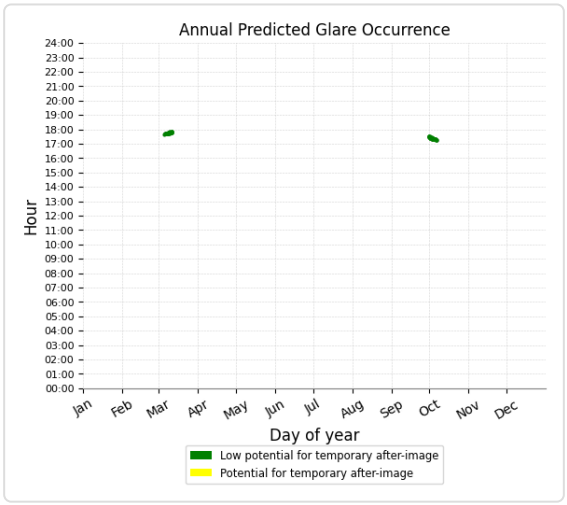


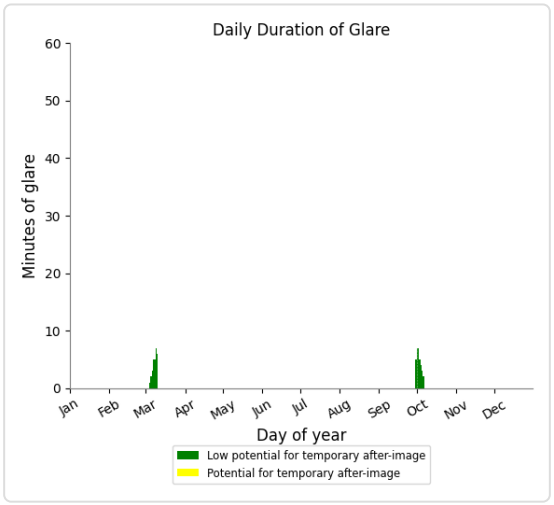


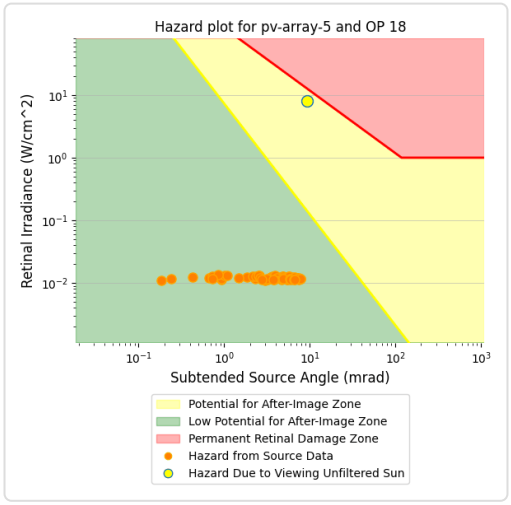
PV array 5 and OP 18

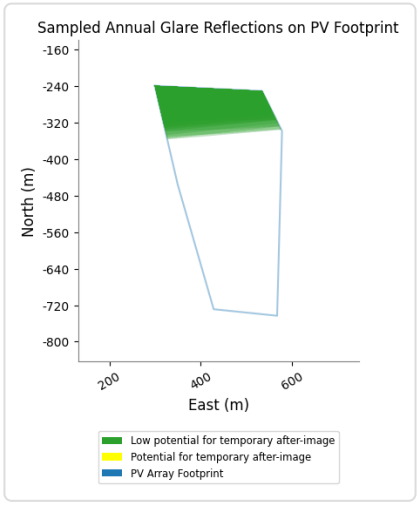
Yellow glare: none

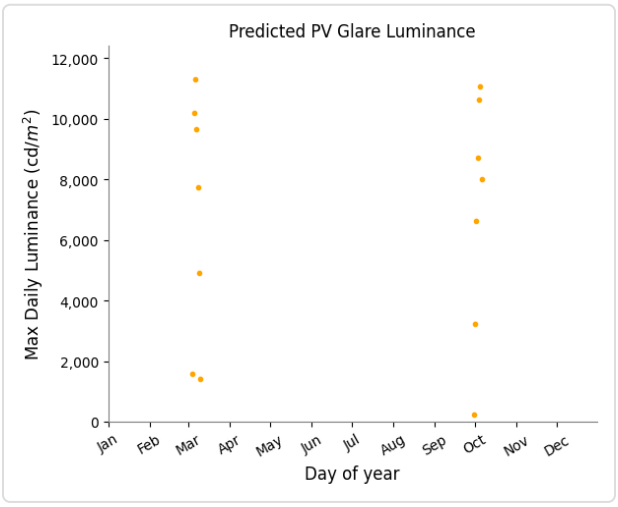
Green glare: 62 min.











PV array 5 and OP 2

No glare found

PV array 5 and OP 3

No glare found

PV array 5 and OP 4

No glare found

PV array 5 and OP 5

No glare found

PV array 5 and OP 6

No glare found

PV array 5 and OP 9

No glare found

PV array 5 and OP 10

No glare found

PV array 5 and OP 11

No glare found

PV array 5 and OP 12

No glare found

PV array 5 and OP 13

No glare found

PV array 5 and OP 19

No glare found

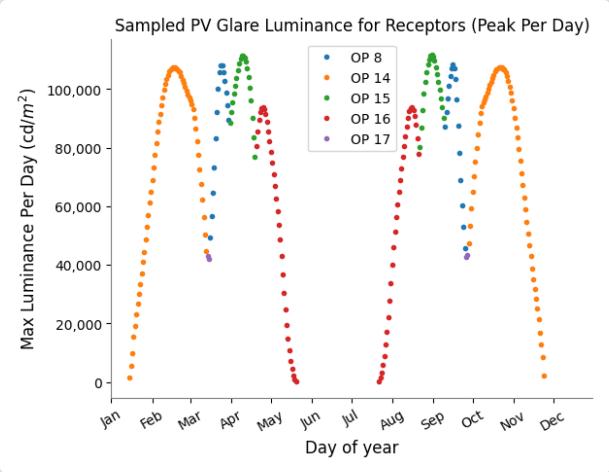
PV array 5 and OP 20

No glare found

PV: PV array 6 low potential for temporary after-image

Receptor results ordered by category of glare

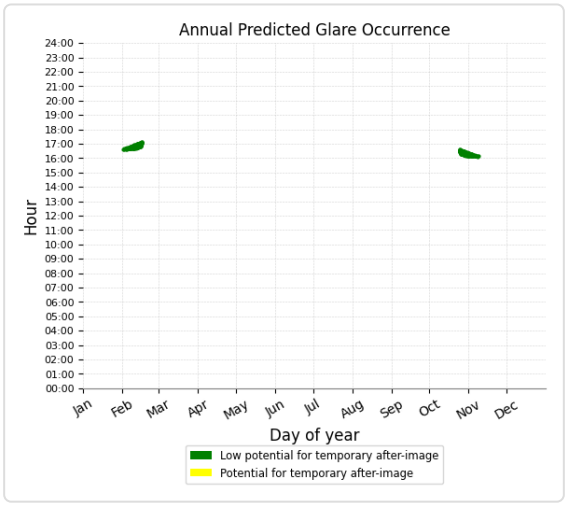
Receptor	Annual Green Glare		Annual Yellow Glare		Peak Luminance
	min	hr	min	hr	cd/m^2
OP 7	332	5.5	0	0.0	63,237
OP 8	1,817	30.3	0	0.0	108,358
OP 14	5,714	95.2	0	0.0	107,492
OP 15	3,084	51.4	0	0.0	111,606
OP 16	2,467	41.1	0	0.0	93,840
OP 17	747	12.4	0	0.0	43,662
OP 18	20	0.3	0	0.0	3,500
OP 1	0	0.0	0	0.0	0
OP 2	0	0.0	0	0.0	0
OP 3	0	0.0	0	0.0	0
OP 4	0	0.0	0	0.0	0
OP 5	0	0.0	0	0.0	0
OP 6	0	0.0	0	0.0	0
OP 9	0	0.0	0	0.0	0
OP 10	0	0.0	0	0.0	0
OP 11	0	0.0	0	0.0	0
OP 12	0	0.0	0	0.0	0
OP 13	0	0.0	0	0.0	0
OP 19	0	0.0	0	0.0	0
OP 20	0	0.0	0	0.0	0

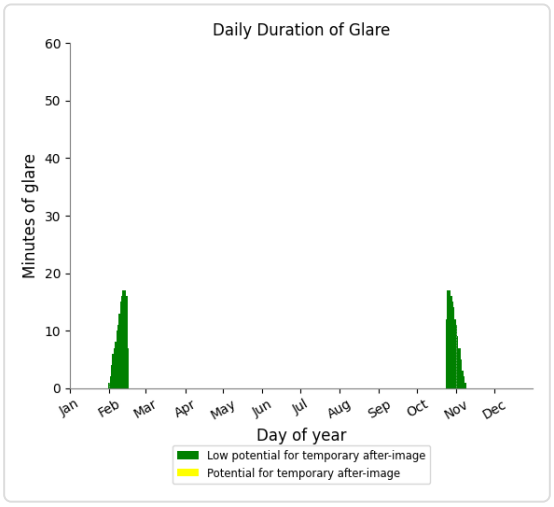


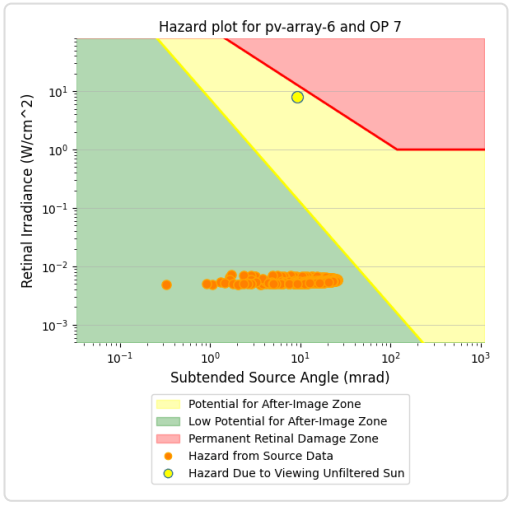
PV array 6 and OP 7

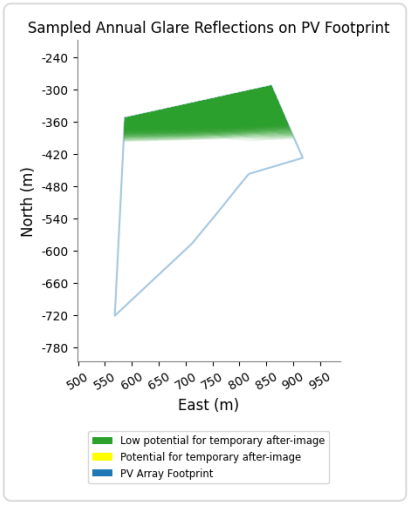
Yellow glare: none

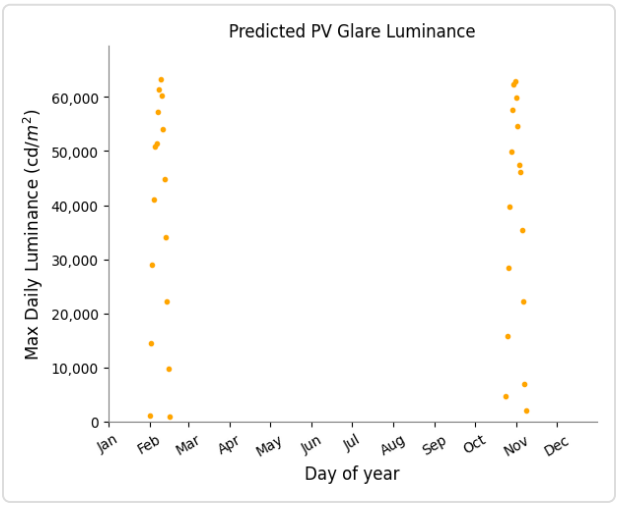
Green glare: 332 min.







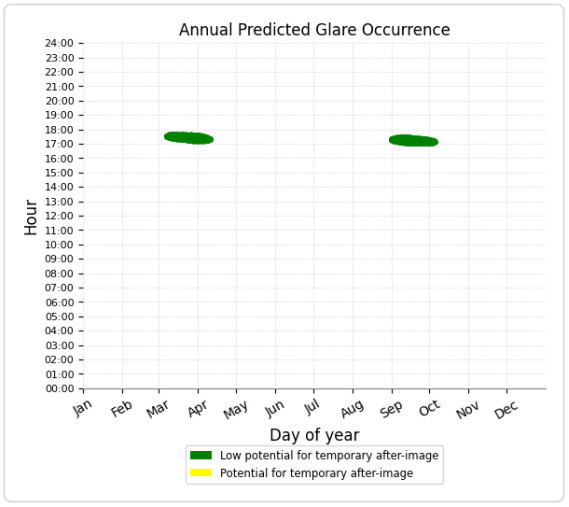


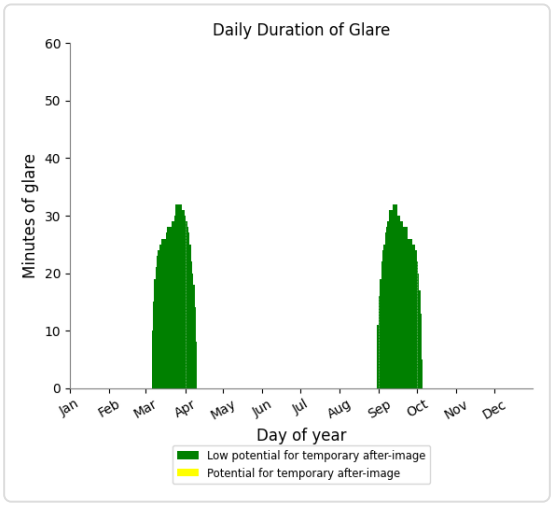


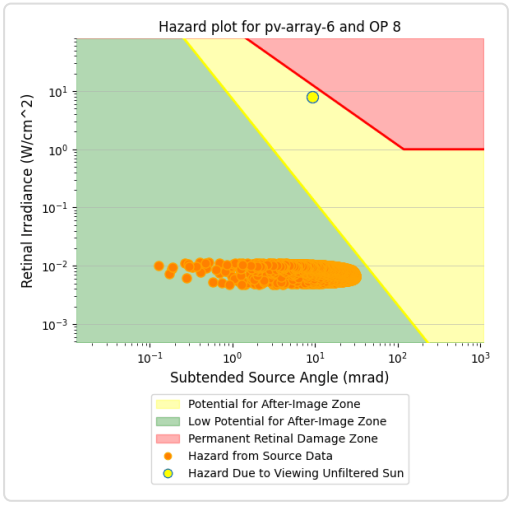
PV array 6 and OP 8

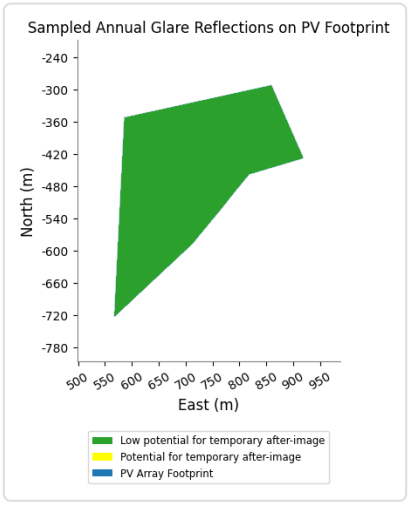
Yellow glare: none

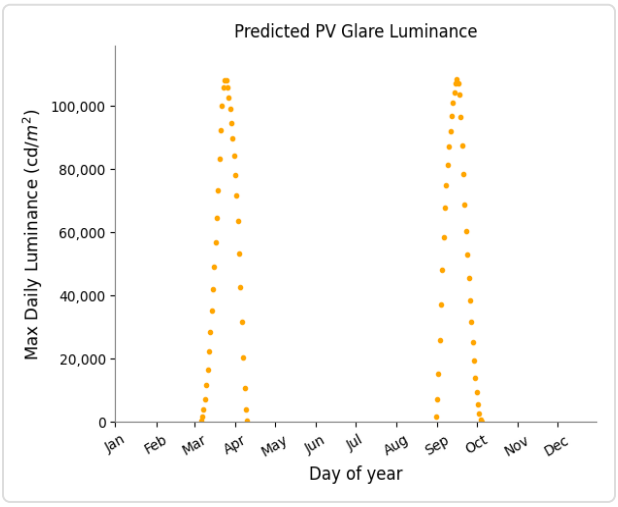
Green glare: 1,817 min.







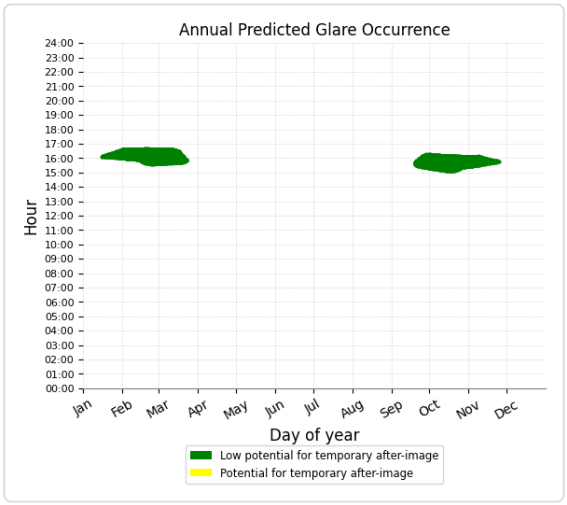


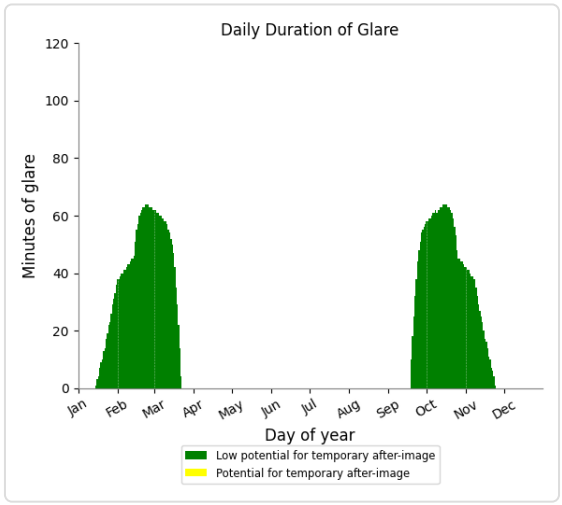


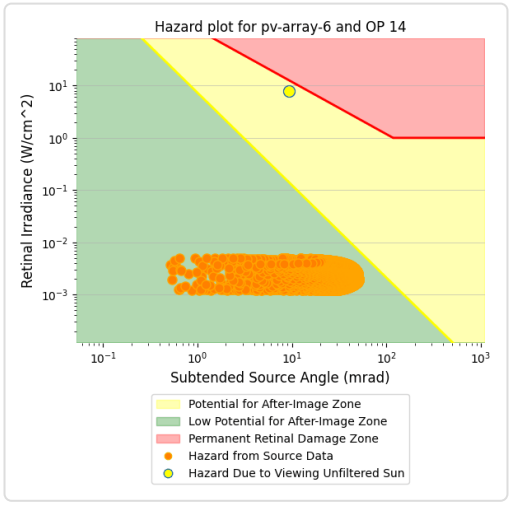
PV array 6 and OP 14

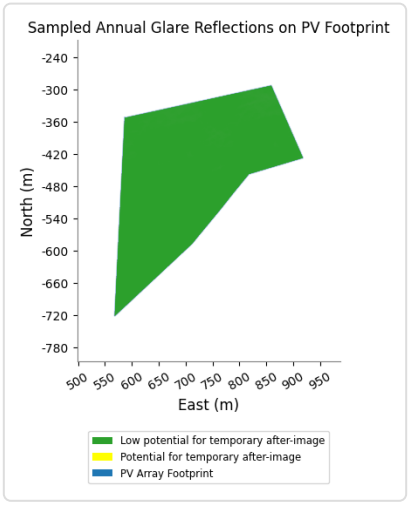
Yellow glare: none

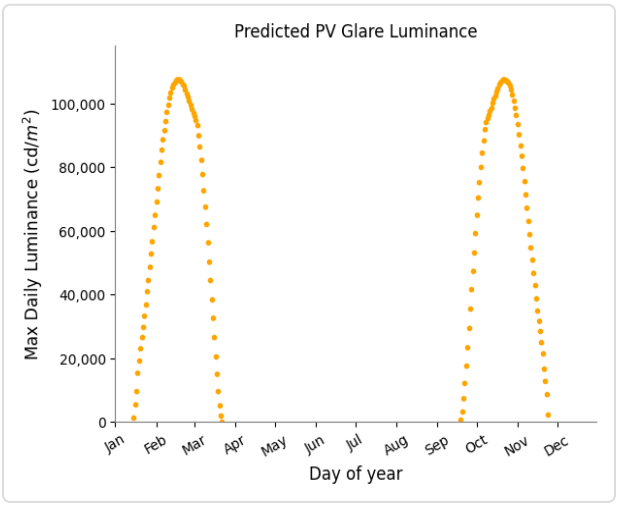
Green glare: 5,714 min.







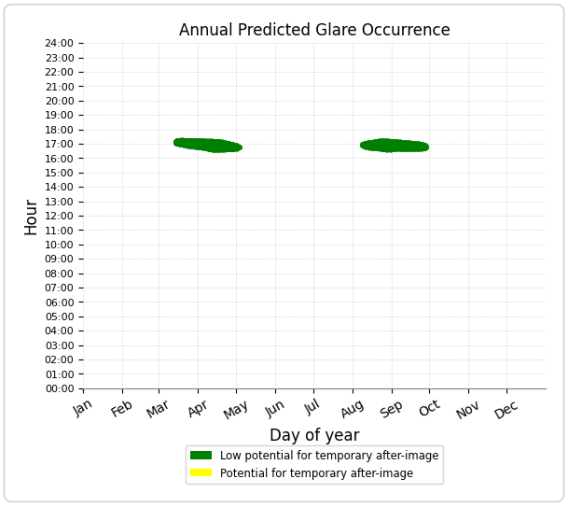


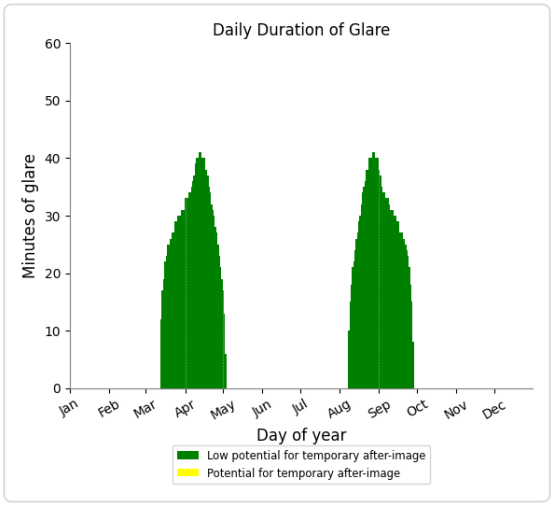


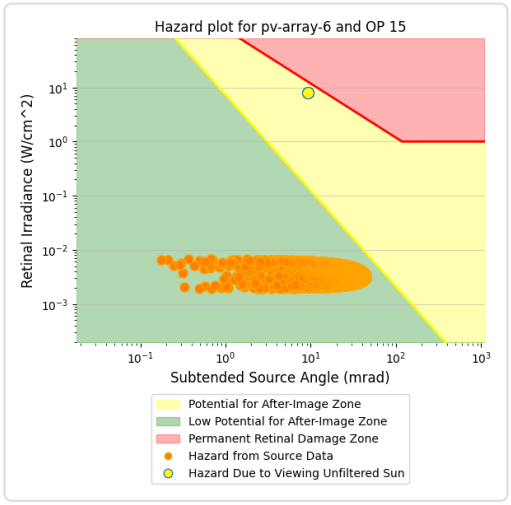
PV array 6 and OP 15

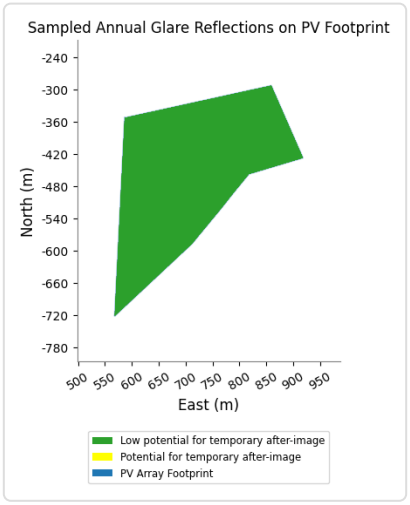
Yellow glare: none

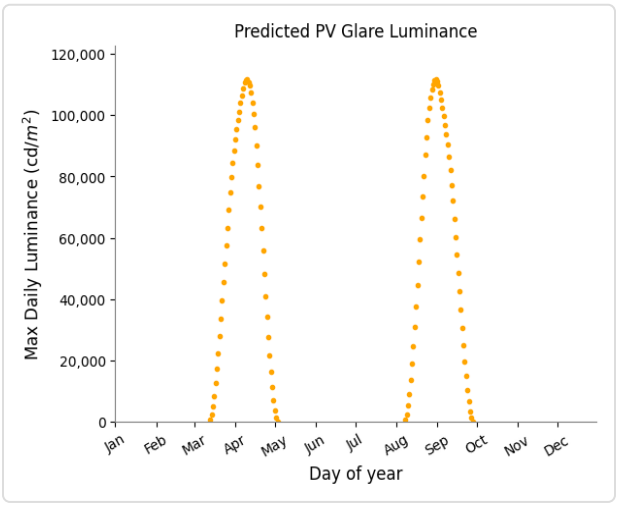
Green glare: 3,084 min.







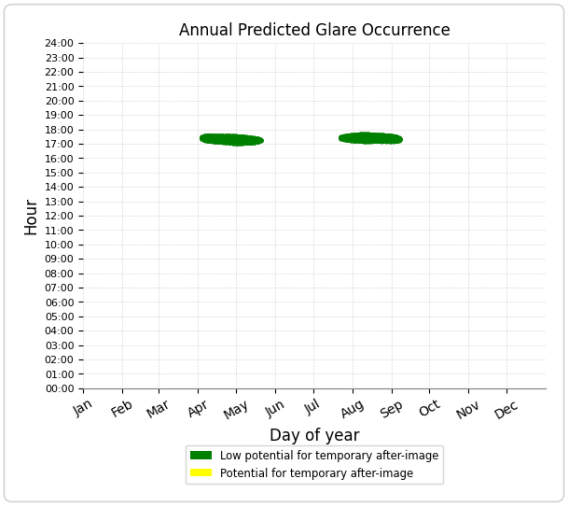


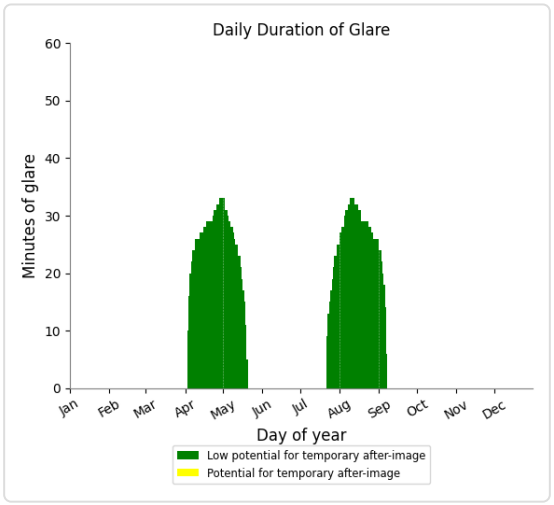


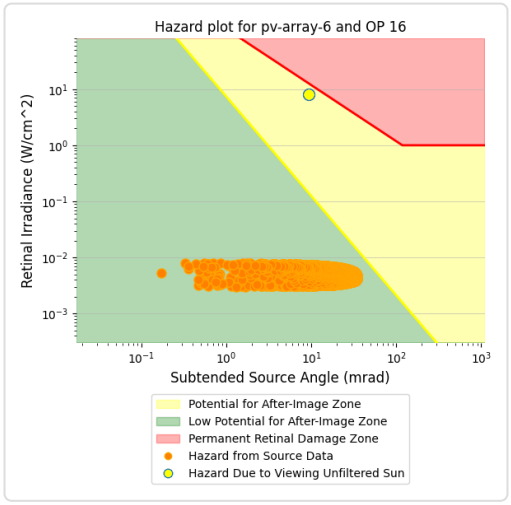
PV array 6 and OP 16

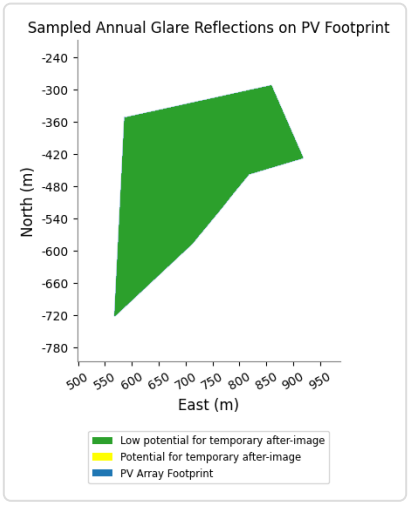
Yellow glare: none

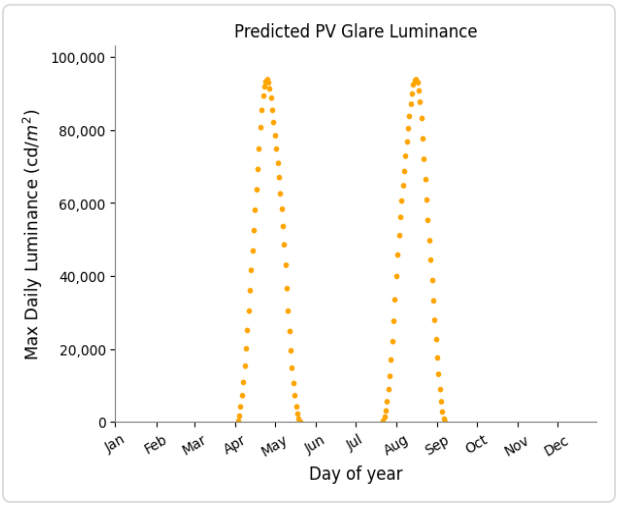
Green glare: 2,467 min.







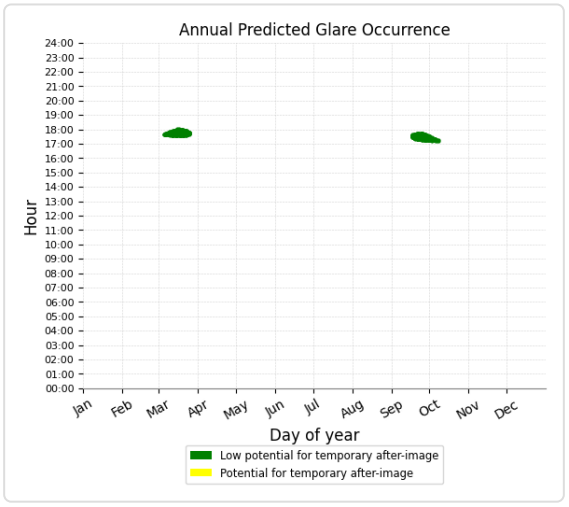


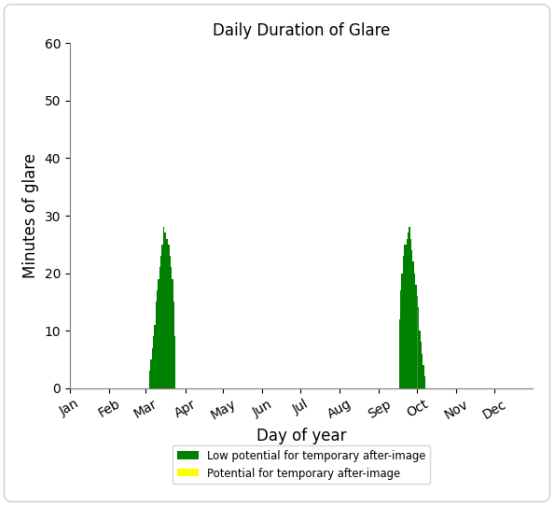


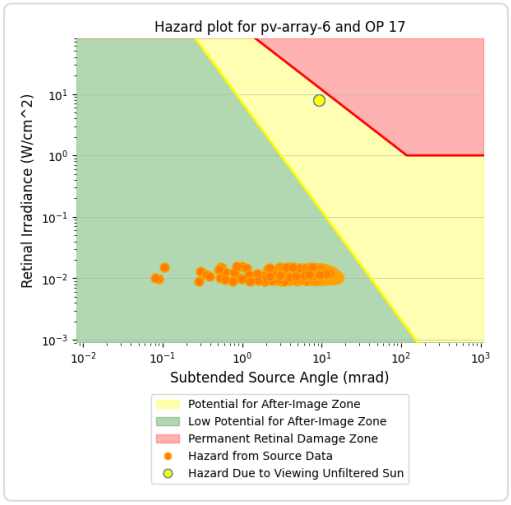
PV array 6 and OP 17

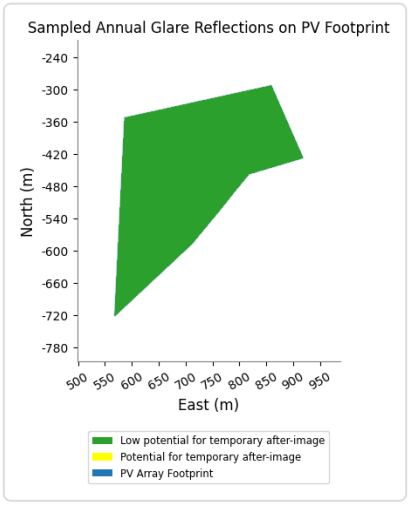
Yellow glare: none

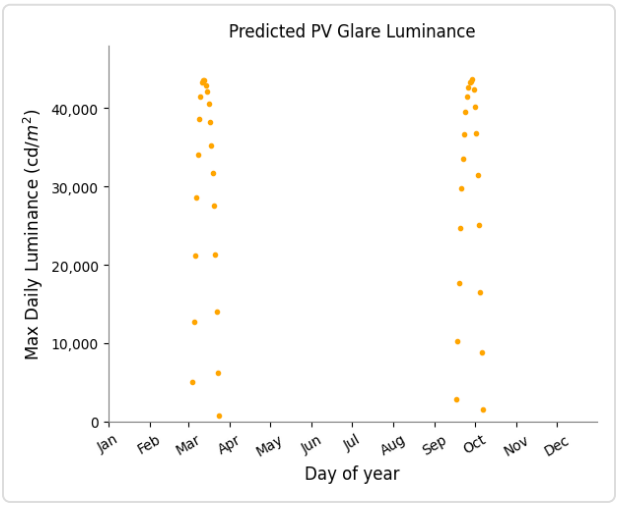
Green glare: 747 min.







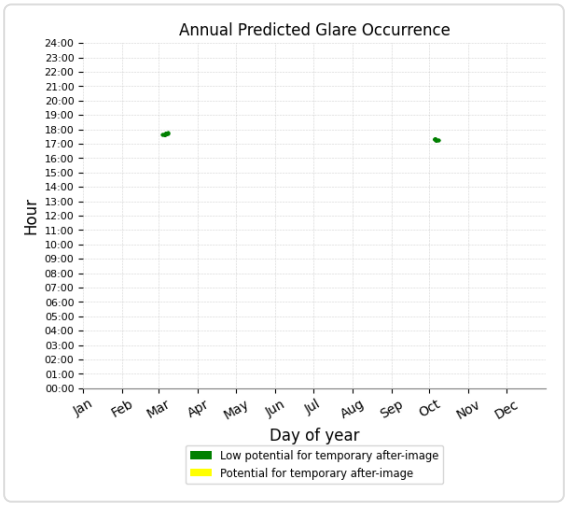


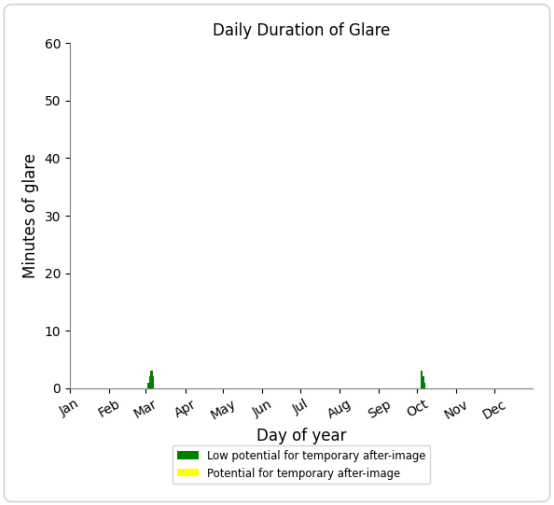


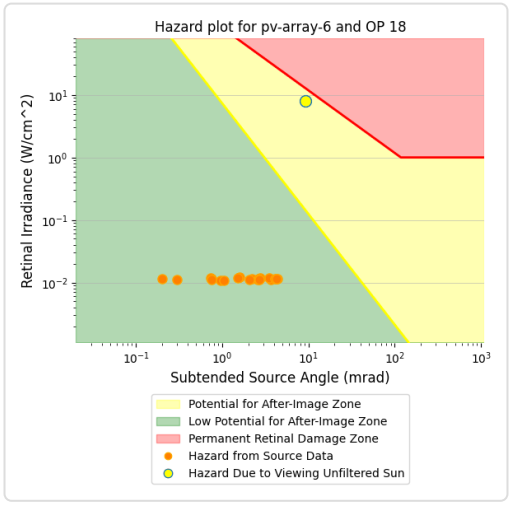
PV array 6 and OP 18

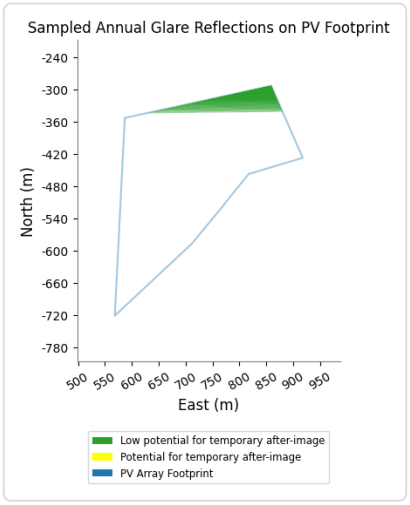
Yellow glare: none

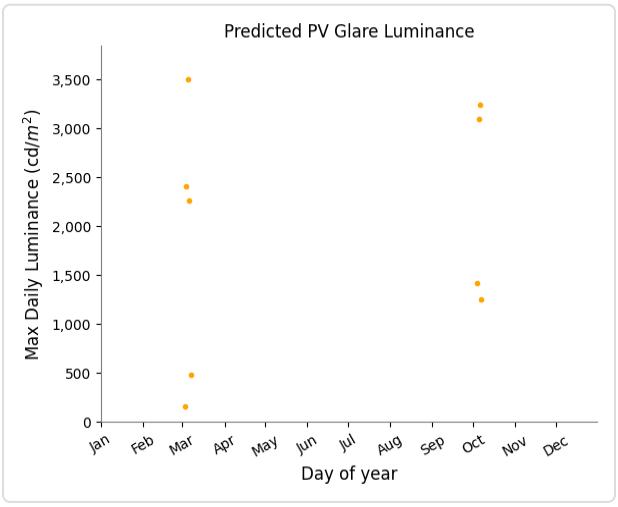
Green glare: 20 min.











PV array 6 and OP 1

No glare found

PV array 6 and OP 2

No glare found

PV array 6 and OP 3

No glare found

PV array 6 and OP 4

No glare found

PV array 6 and OP 5

No glare found

PV array 6 and OP 6

No glare found

PV array 6 and OP 9

No glare found

PV array 6 and OP 10

No glare found

PV array 6 and OP 11

No glare found

PV array 6 and OP 12

No glare found

PV array 6 and OP 13

No glare found

PV array 6 and OP 19

No glare found

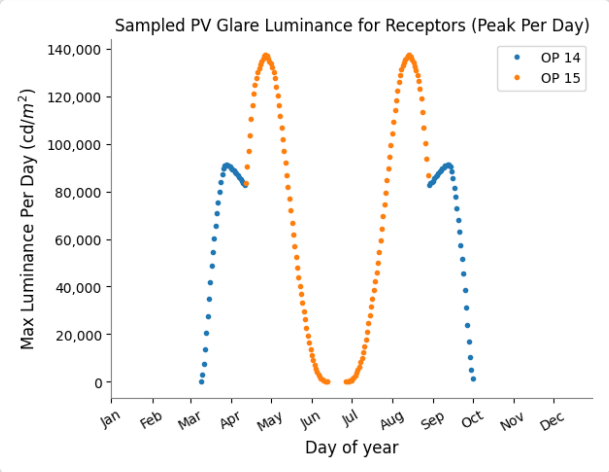
PV array 6 and OP 20

No glare found

PV: PV array 7 low potential for temporary after-image

Receptor results ordered by category of glare

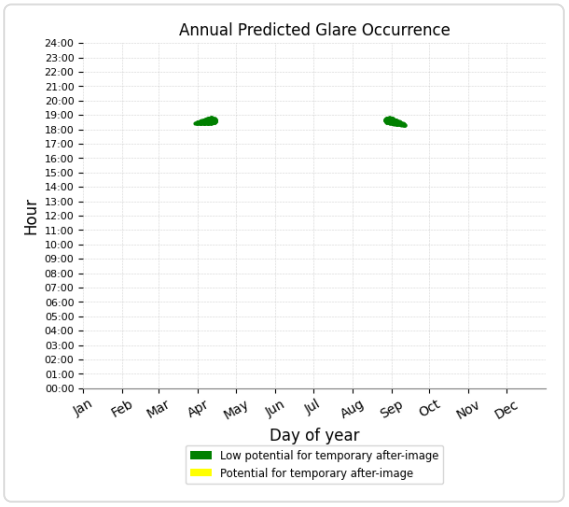
Receptor	Annual Green Glare		Annual Yellow Glare		Peak Luminance
	min	hr	min	hr	cd/m^2
OP 8	456	7.6	0	0.0	78,900
OP 14	7,608	126.8	0	0.0	91,368
OP 15	4,168	69.5	0	0.0	137,300
OP 16	2,413	40.2	0	0.0	115,268
OP 1	0	0.0	0	0.0	0
OP 2	0	0.0	0	0.0	0
OP 3	0	0.0	0	0.0	0
OP 4	0	0.0	0	0.0	0
OP 5	0	0.0	0	0.0	0
OP 6	0	0.0	0	0.0	0
OP 7	0	0.0	0	0.0	0
OP 9	0	0.0	0	0.0	0
OP 10	0	0.0	0	0.0	0
OP 11	0	0.0	0	0.0	0
OP 12	0	0.0	0	0.0	0
OP 13	0	0.0	0	0.0	0
OP 17	0	0.0	0	0.0	0
OP 18	0	0.0	0	0.0	0
OP 19	0	0.0	0	0.0	0
OP 20	0	0.0	0	0.0	0

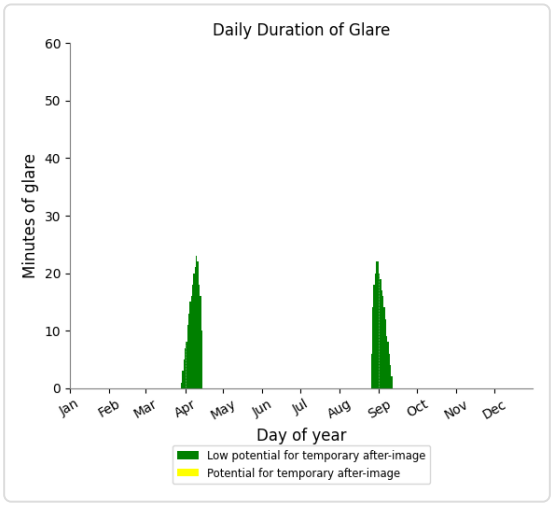


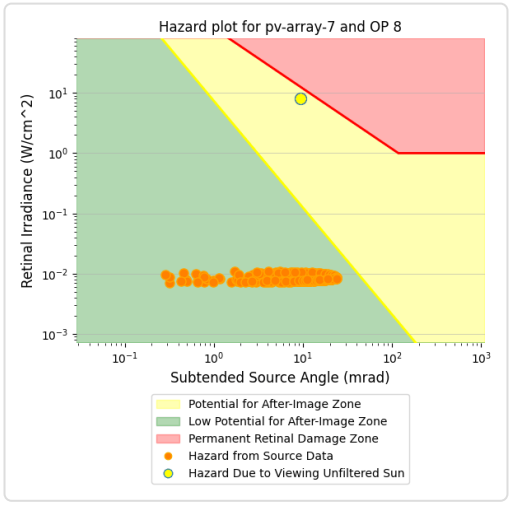
PV array 7 and OP 8

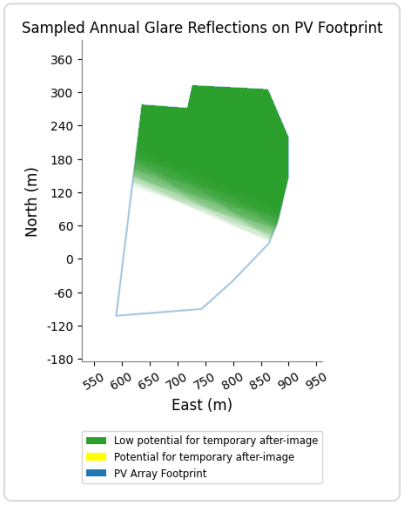
Yellow glare: none

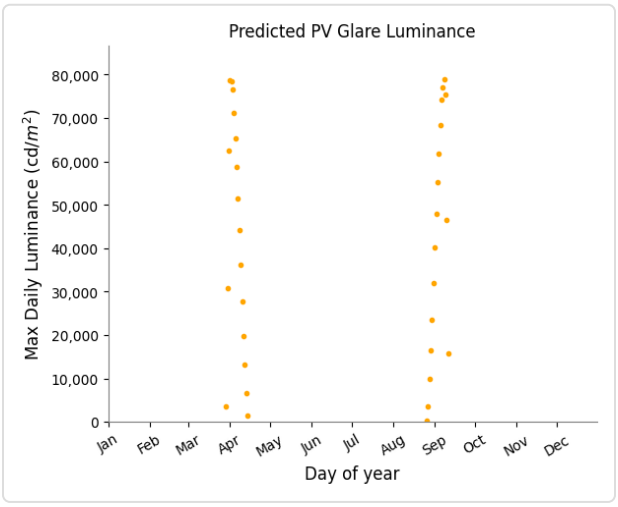
Green glare: 456 min.







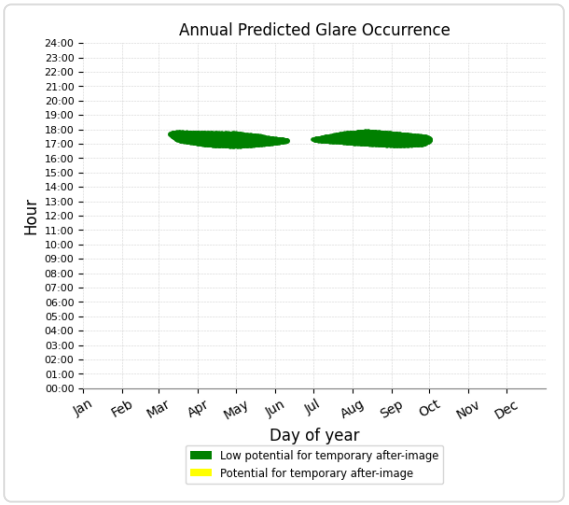


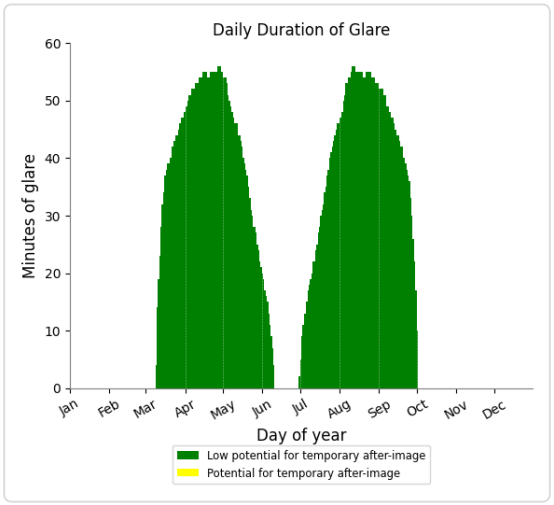


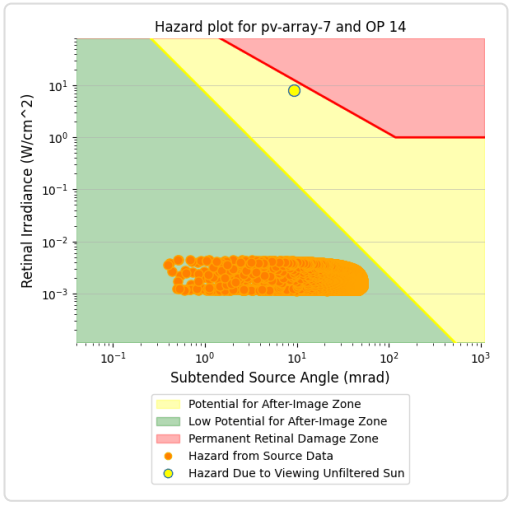
PV array 7 and OP 14

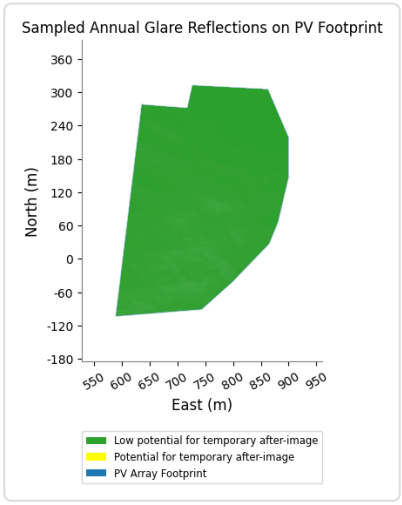
Yellow glare: none

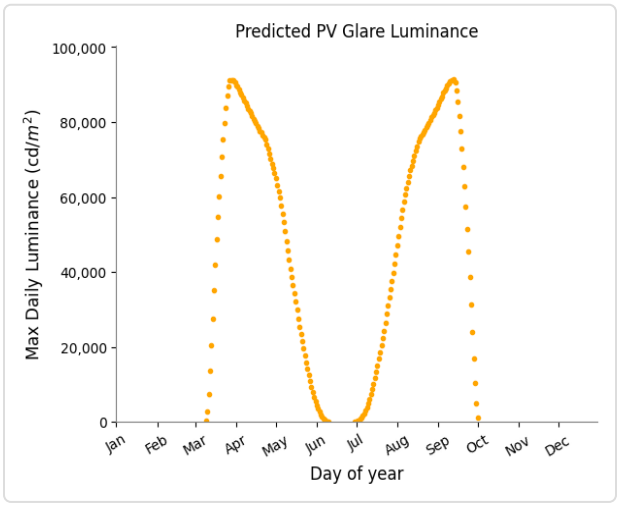
Green glare: 7,608 min.







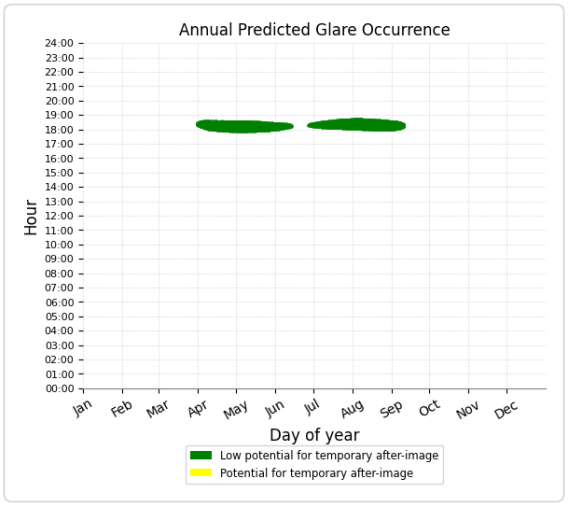


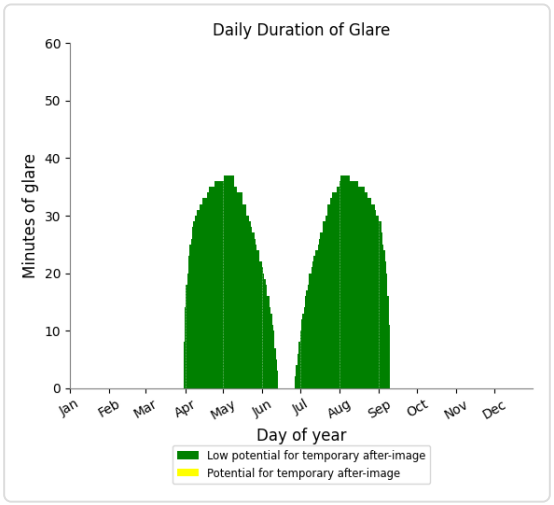


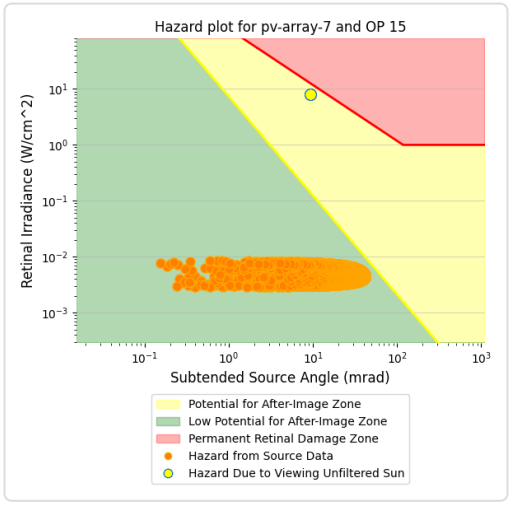
PV array 7 and OP 15

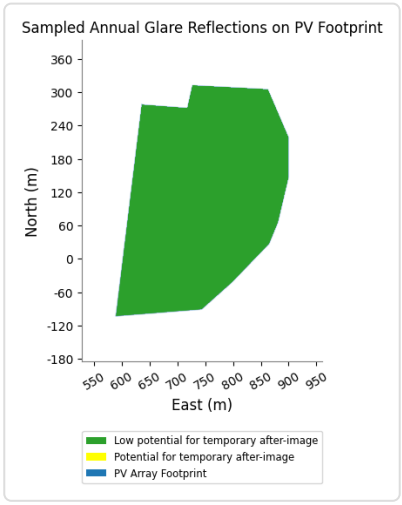
Yellow glare: none

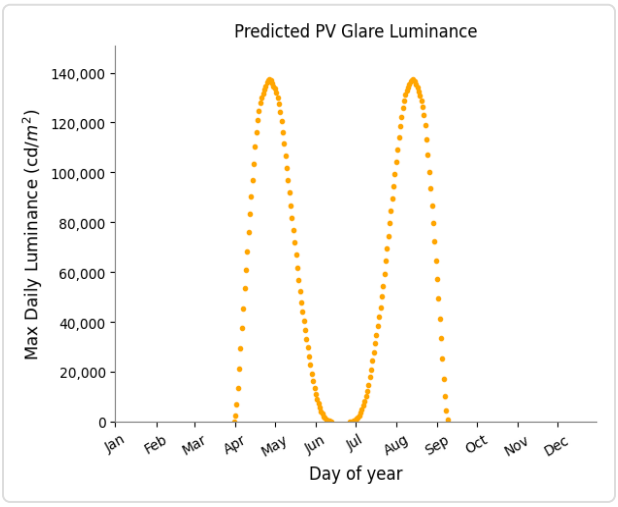
Green glare: 4,168 min.







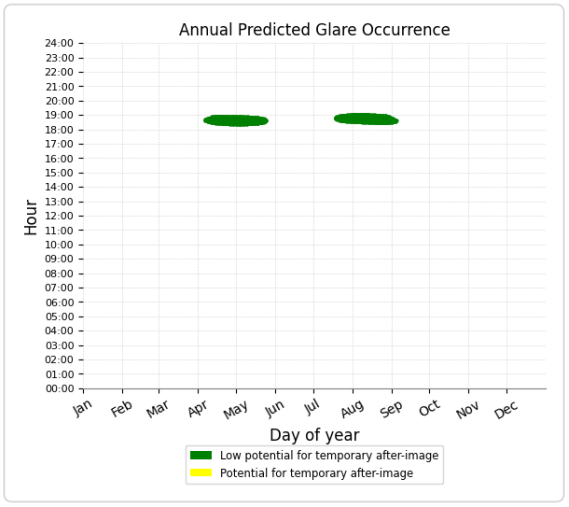


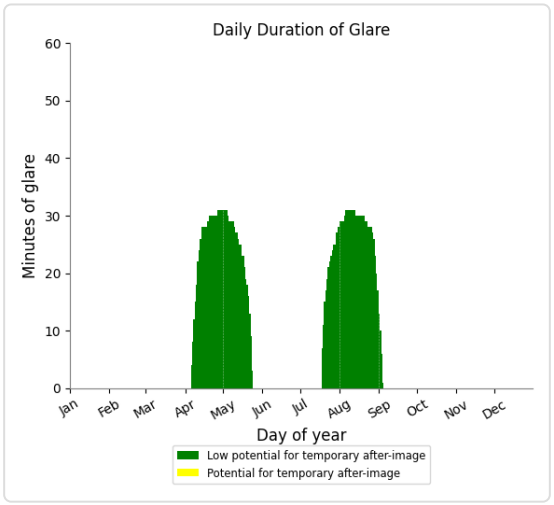


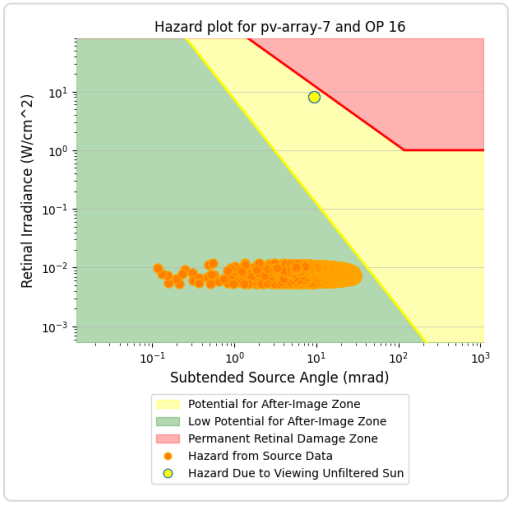
PV array 7 and OP 16

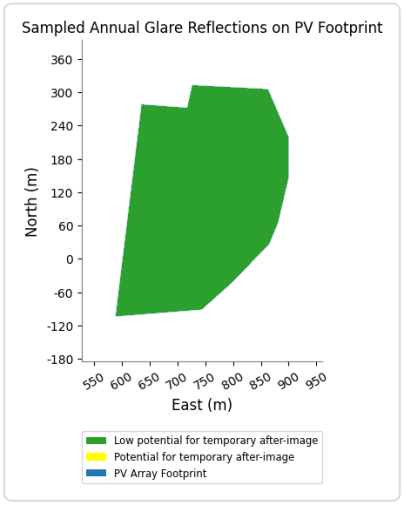
Yellow glare: none

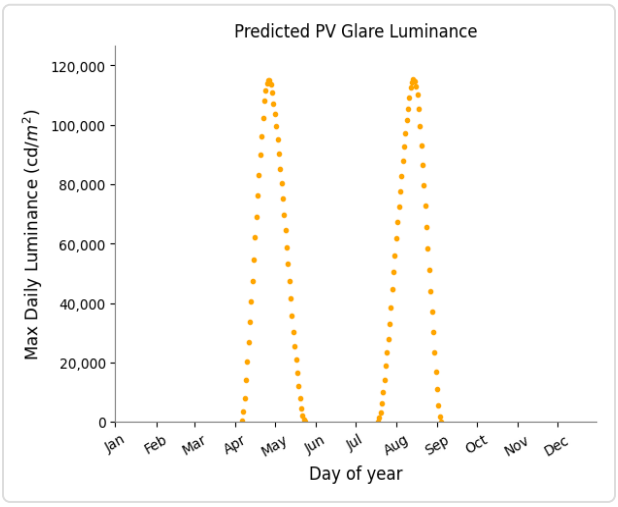
Green glare: 2,413 min.











PV array 7 and OP 1

No glare found

PV array 7 and OP 2

No glare found

PV array 7 and OP 3

No glare found

PV array 7 and OP 4

No glare found

PV array 7 and OP 5

No glare found

PV array 7 and OP 6

No glare found

PV array 7 and OP 7

No glare found

PV array 7 and OP 9

No glare found

PV array 7 and OP 10

No glare found

PV array 7 and OP 11

No glare found

PV array 7 and OP 12

No glare found

PV array 7 and OP 13

No glare found

PV array 7 and OP 17

No glare found

PV array 7 and OP 18

No glare found

PV array 7 and OP 19

No glare found

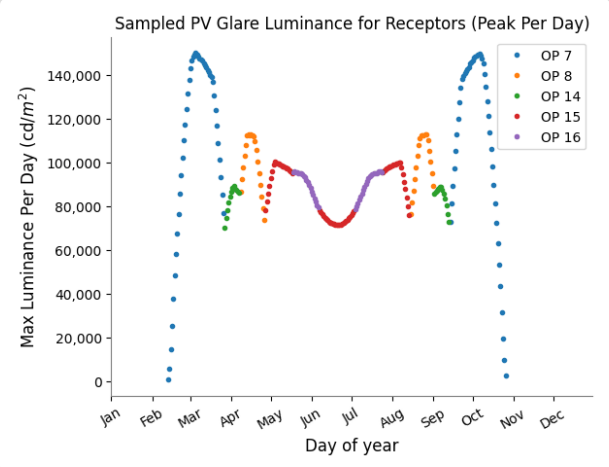
PV array 7 and OP 20

No glare found

PV: PV array 8 low potential for temporary after-image

Receptor results ordered by category of glare

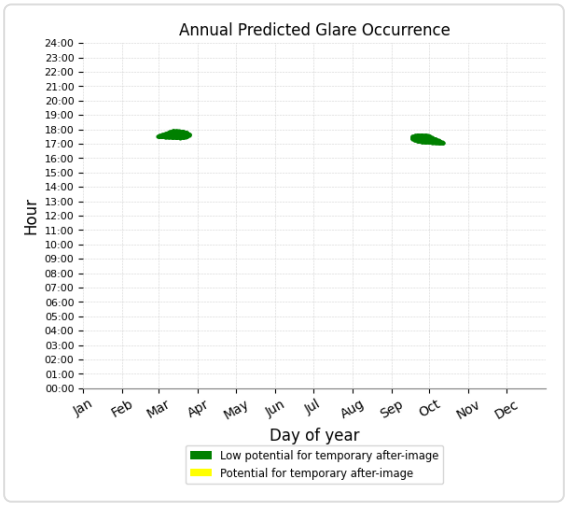
Receptor	Annual Green Glare		Annual Yellow Glare		Peak Luminance
	min	hr	min	hr	cd/m^2
OP 1	966	16.1	0	0.0	90,309
OP 7	2,868	47.8	0	0.0	149,972
OP 8	2,211	36.9	0	0.0	112,843
OP 14	7,897	131.6	0	0.0	89,028
OP 15	4,410	73.5	0	0.0	100,214
OP 16	3,281	54.7	0	0.0	95,744
OP 17	1,347	22.4	0	0.0	67,638
OP 18	630	10.5	0	0.0	51,459
OP 2	0	0.0	0	0.0	0
OP 3	0	0.0	0	0.0	0
OP 4	0	0.0	0	0.0	0
OP 5	0	0.0	0	0.0	0
OP 6	0	0.0	0	0.0	0
OP 9	0	0.0	0	0.0	0
OP 10	0	0.0	0	0.0	0
OP 11	0	0.0	0	0.0	0
OP 12	0	0.0	0	0.0	0
OP 13	0	0.0	0	0.0	0
OP 19	0	0.0	0	0.0	0
OP 20	0	0.0	0	0.0	0

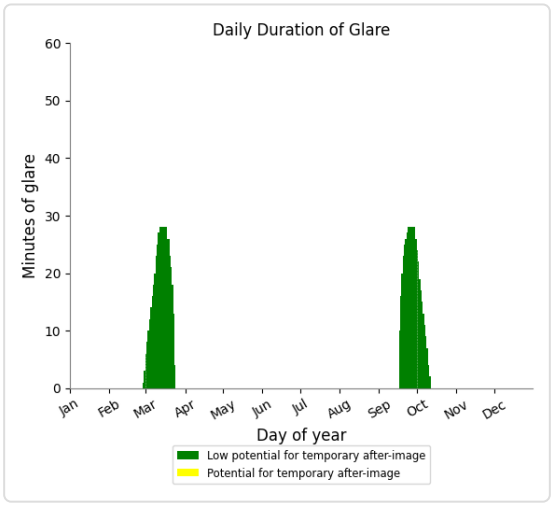


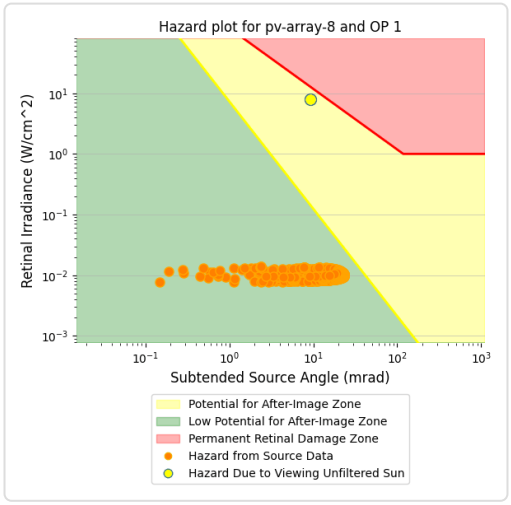
PV array 8 and OP 1

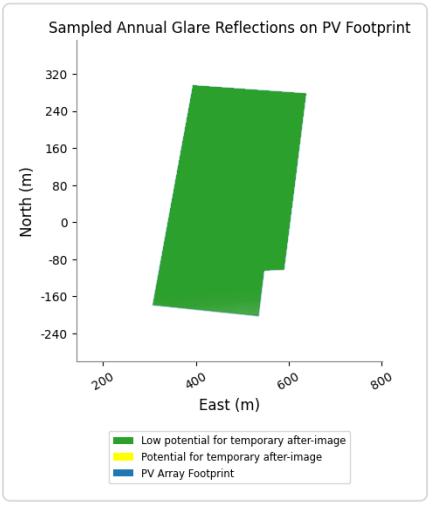
Yellow glare: none

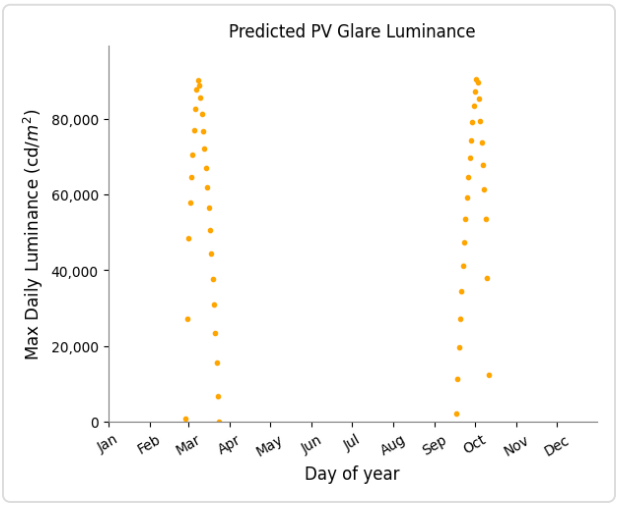
Green glare: 966 min.







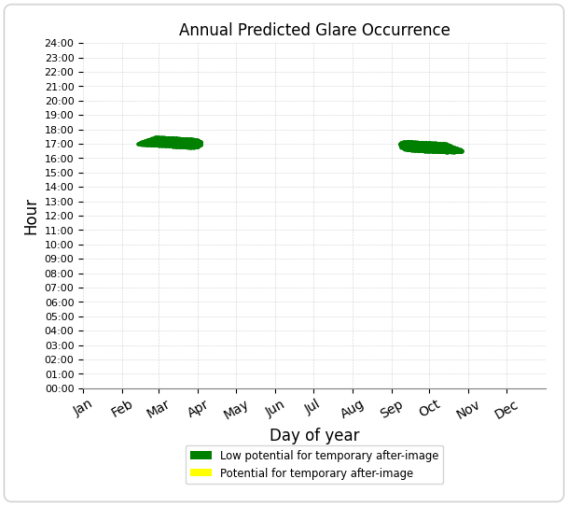


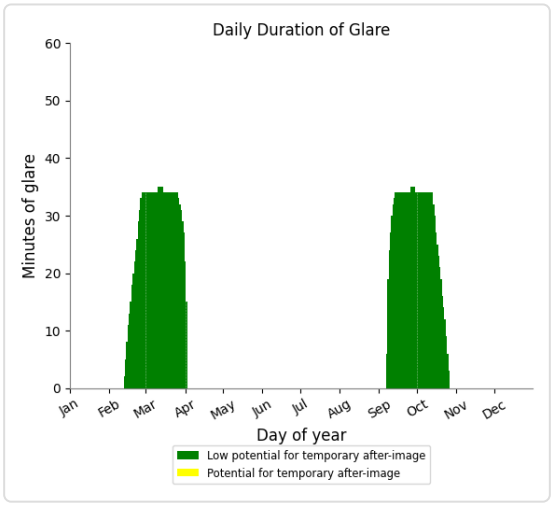


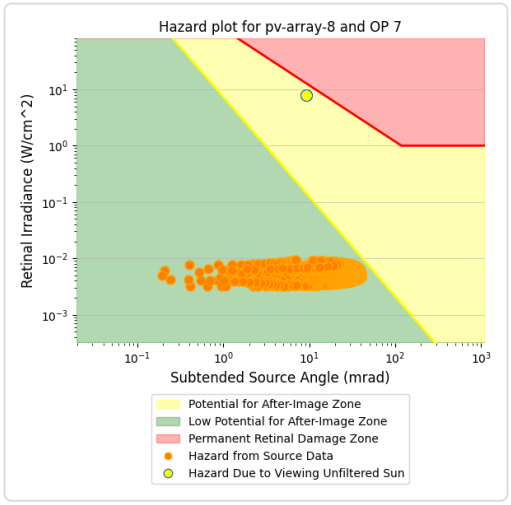
PV array 8 and OP 7

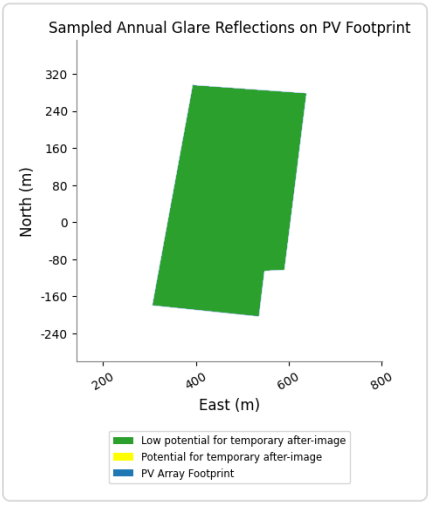
Yellow glare: none

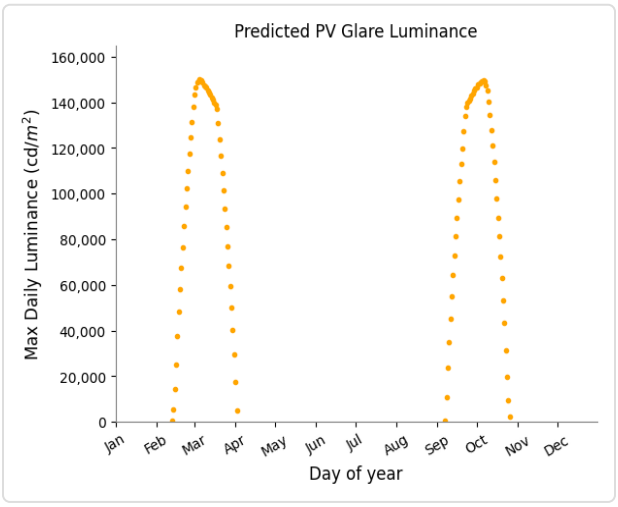
Green glare: 2,868 min.







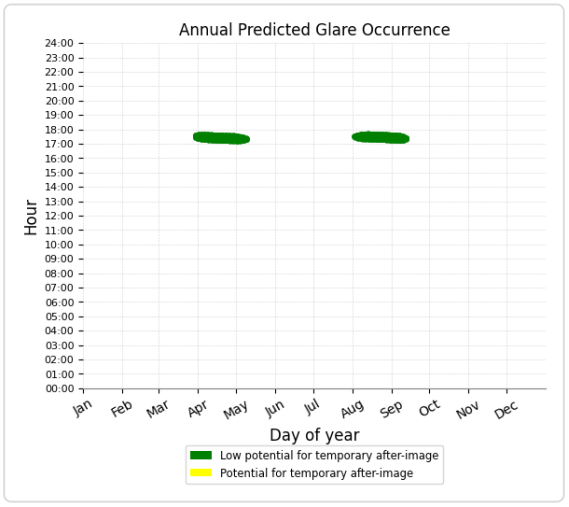


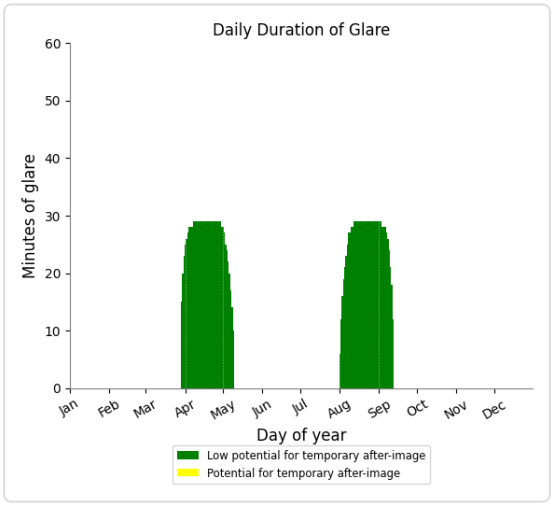


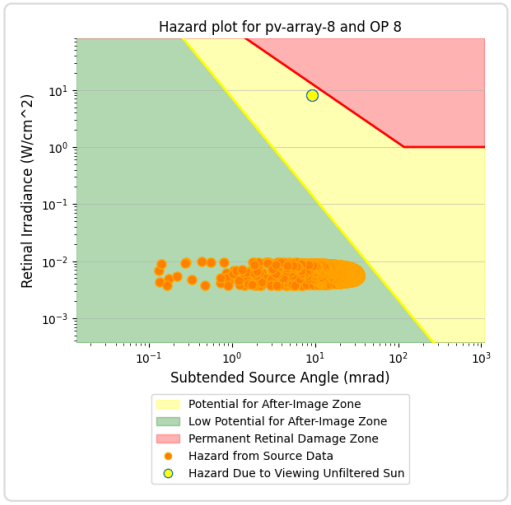
PV array 8 and OP 8

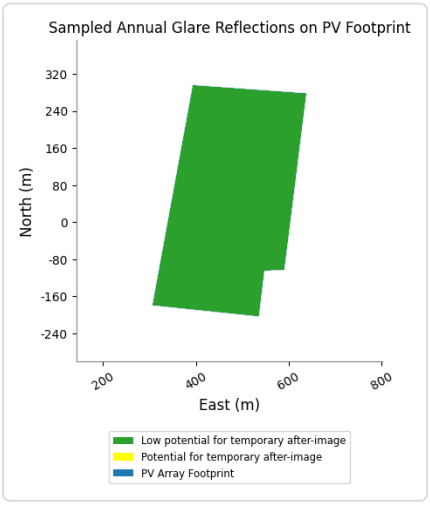
Yellow glare: none

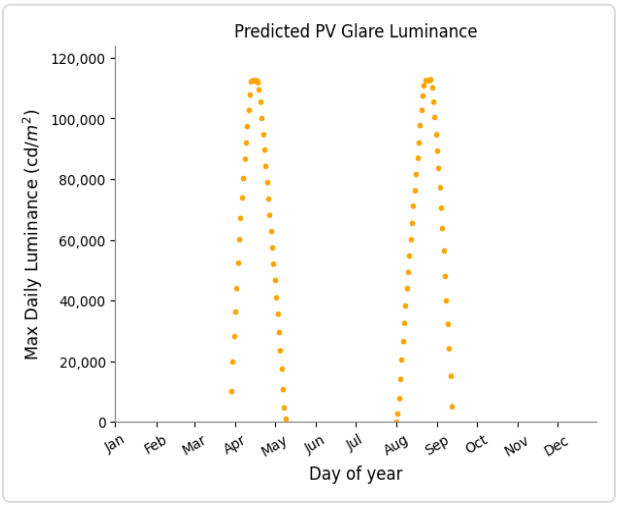
Green glare: 2,211 min.







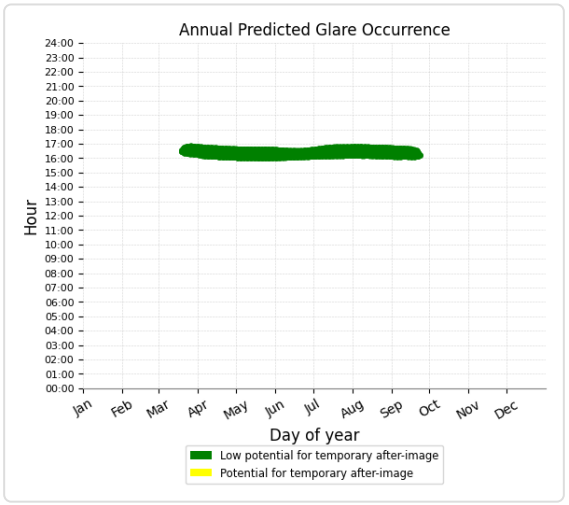


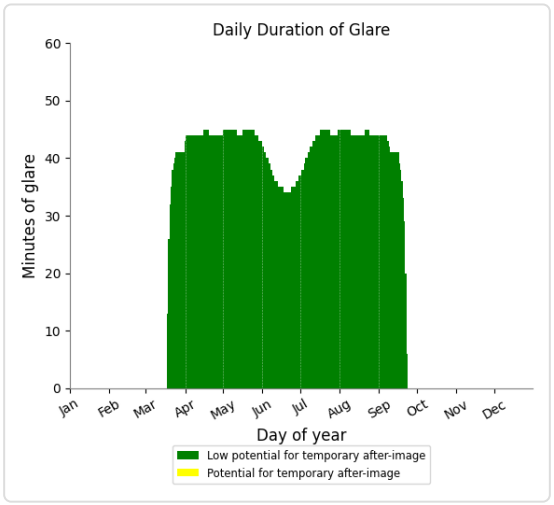


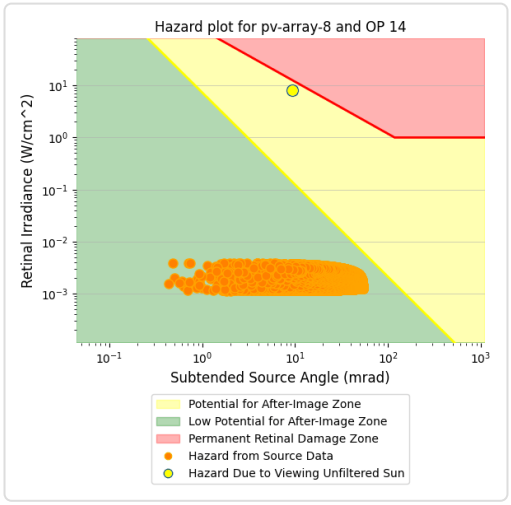
PV array 8 and OP 14

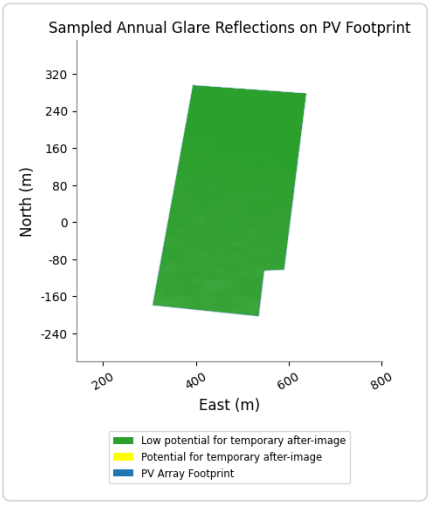
Yellow glare: none

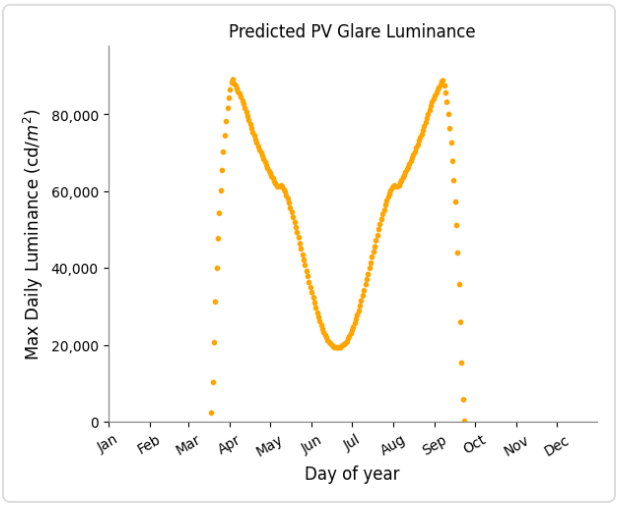
Green glare: 7,897 min.







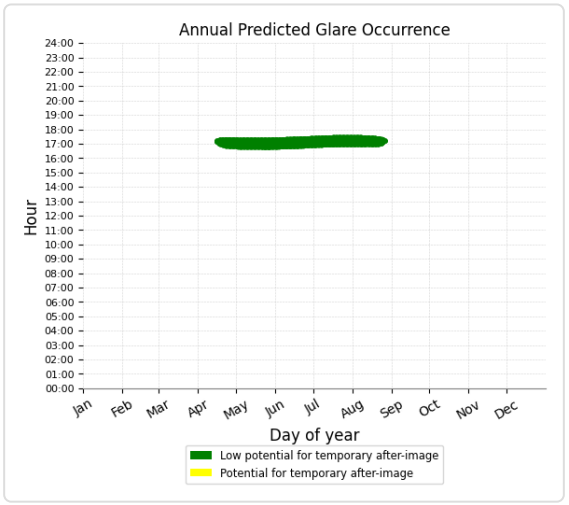


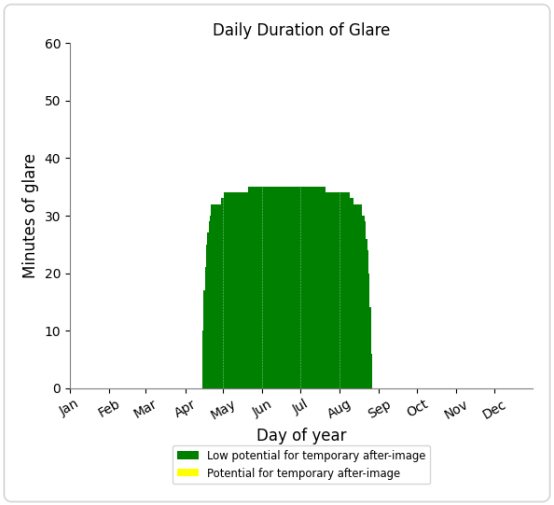


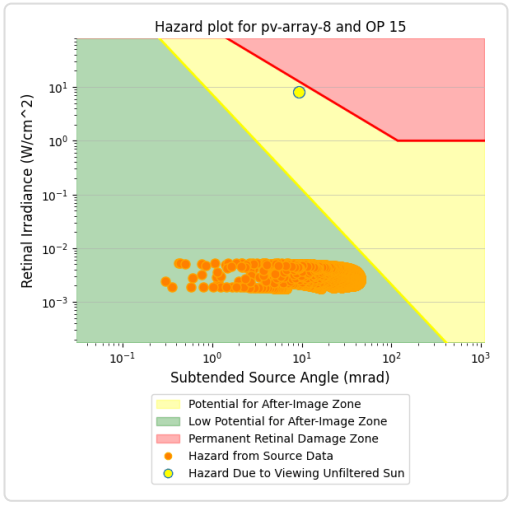
PV array 8 and OP 15

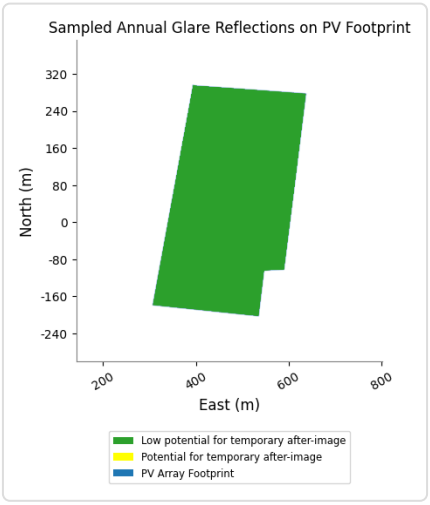
Yellow glare: none

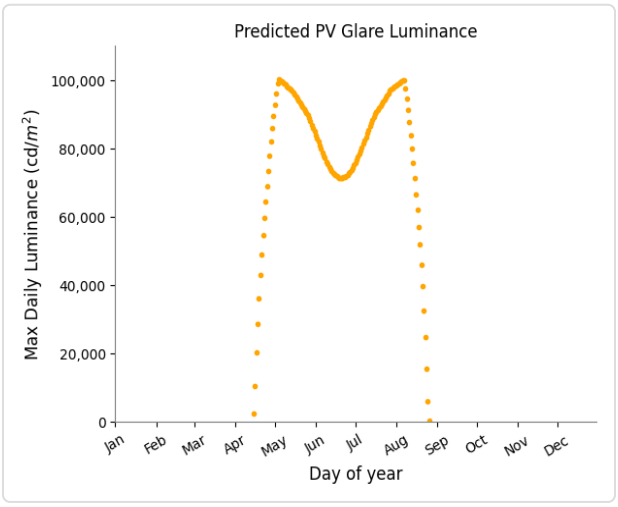
Green glare: 4,410 min.







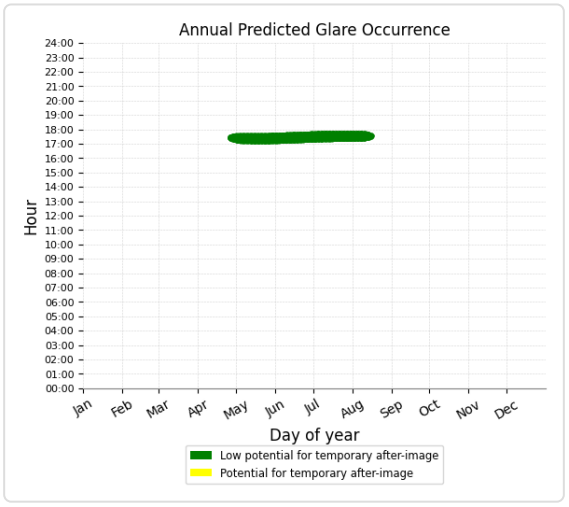


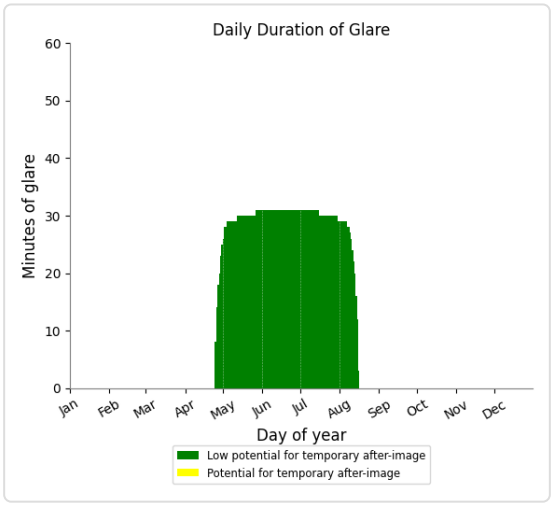


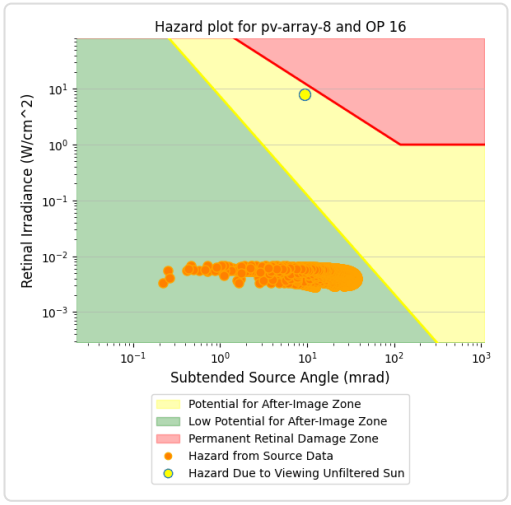
PV array 8 and OP 16

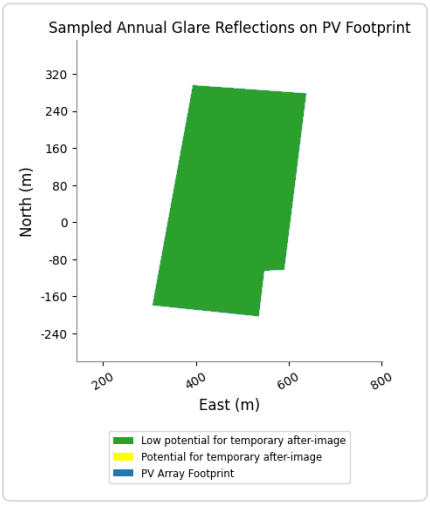
Yellow glare: none

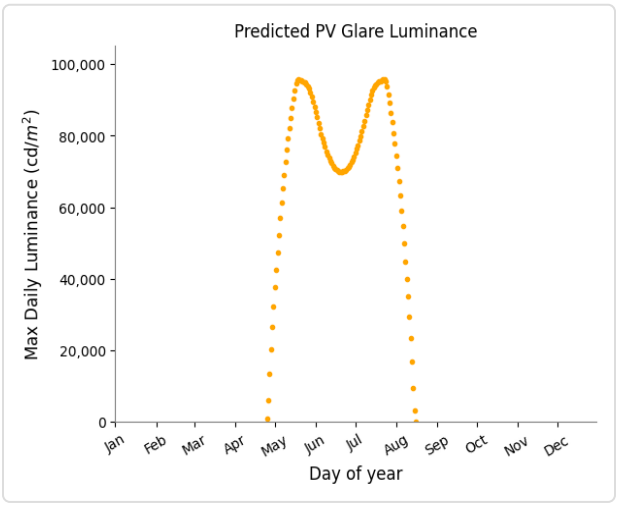
Green glare: 3,281 min.







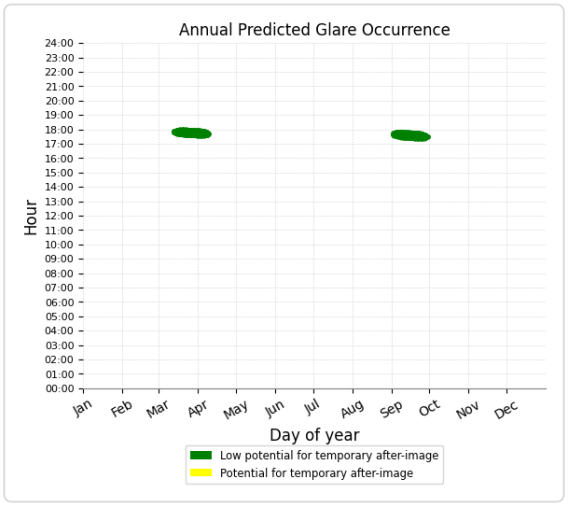


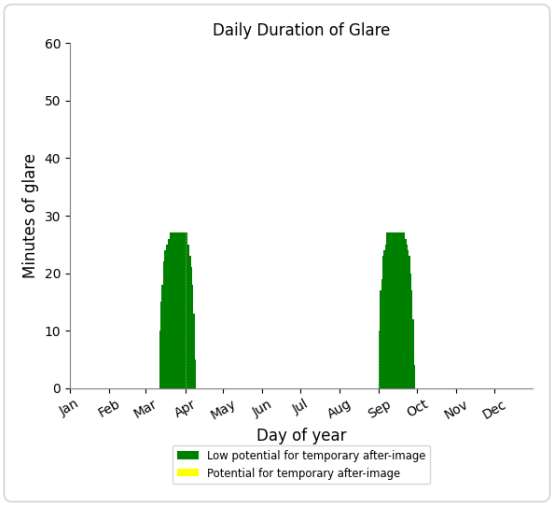


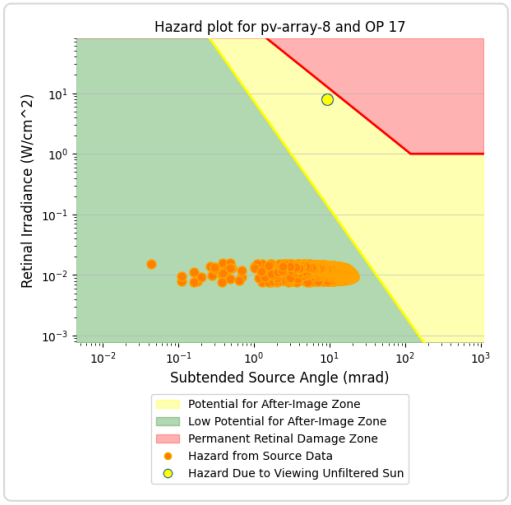
PV array 8 and OP 17

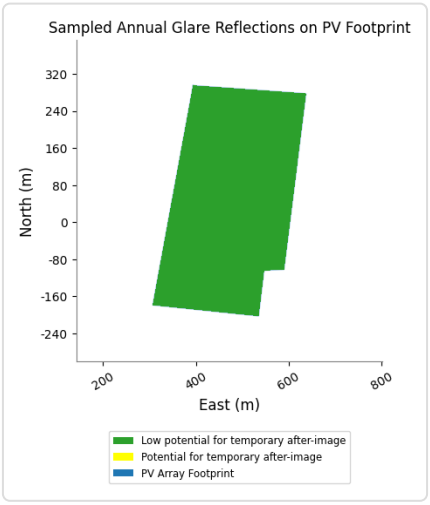
Yellow glare: none

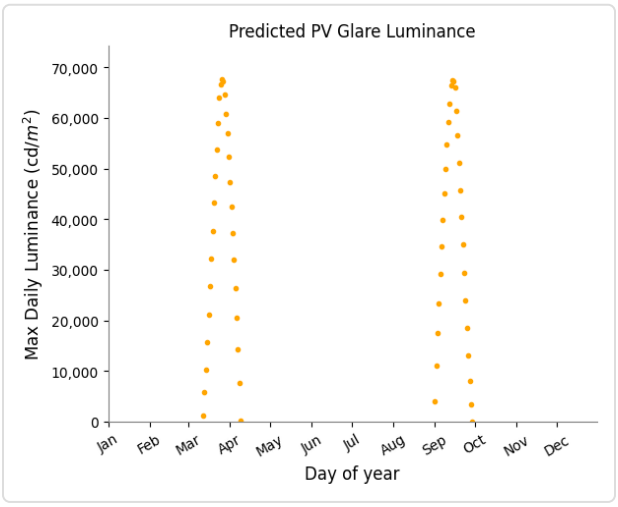
Green glare: 1,347 min.







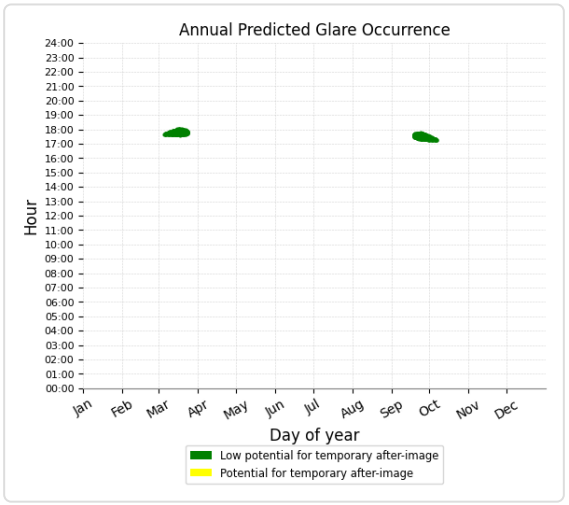


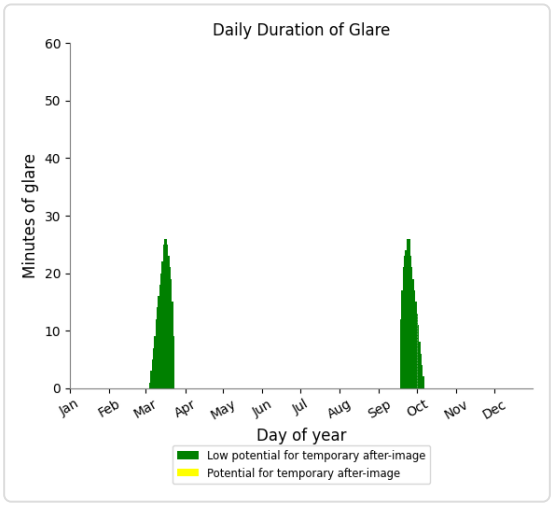


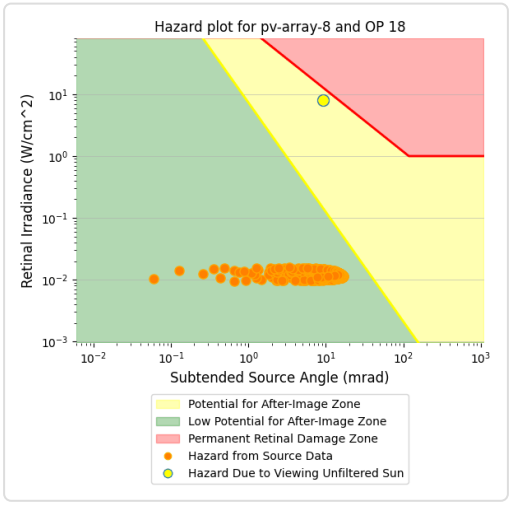
PV array 8 and OP 18

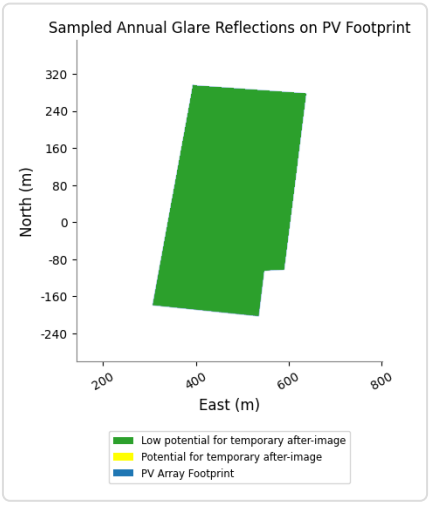
Yellow glare: none

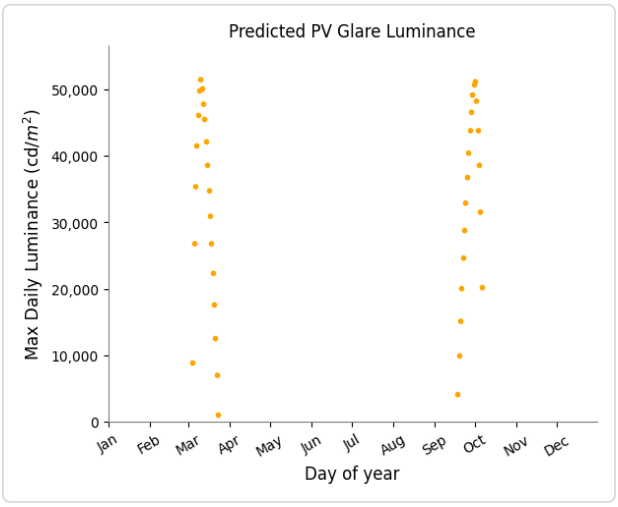
Green glare: 630 min.











PV array 8 and OP 2

No glare found

PV array 8 and OP 3

No glare found

PV array 8 and OP 4

No glare found

PV array 8 and OP 5

No glare found

PV array 8 and OP 6

No glare found

PV array 8 and OP 9

No glare found

PV array 8 and OP 10

No glare found

PV array 8 and OP 11

No glare found

PV array 8 and OP 12

No glare found

PV array 8 and OP 13

No glare found

PV array 8 and OP 19

No glare found

PV array 8 and OP 20

No glare found

Assumptions

"Green" glare is glare with low potential to cause an after-image (flash blindness) when observed prior to a typical blink response time.
"Yellow" glare is glare with potential to cause an after-image (flash blindness) when observed prior to a typical blink response time.
Times associated with glare are denoted in Standard time. For Daylight Savings, add one hour.
The algorithm does not rigorously represent the detailed geometry of a system; detailed features such as gaps between modules, variable height of the PV array, and support structures may impact actual glare results. However, we have validated our models against several systems, including a PV array causing glare to the air-traffic control tower at Manchester-Boston Regional Airport and several sites in Albuquerque, and the tool accurately predicted the occurrence and intensity of glare at different times and days of the year.
Several V1 calculations utilize the PV array centroid, rather than the actual glare spot location, due to algorithm limitations. This may affect results for large PV footprints. Additional analyses of array sub-sections can provide additional information on expected glare. This primarily affects V1 analyses of path receptors.
Random number computations are utilized by various steps of the annual hazard analysis algorithm. Predicted minutes of glare can vary between runs as a result. This limitation primarily affects analyses of Observation Point receptors, including ATCTs. Note that the SGHAT/ ForgeSolar methodology has always relied on an analytical, qualitative approach to accurately determine the overall hazard (i.e. green vs. yellow) of expected glare on an annual basis.
The analysis does not automatically consider obstacles (either man-made or natural) between the observation points and the prescribed solar installation that may obstruct observed glare, such as trees, hills, buildings, etc.
The subtended source angle (glare spot size) is constrained by the PV array footprint size. Partitioning large arrays into smaller sections will reduce the maximum potential subtended angle, potentially impacting results if actual glare spots are larger than the sub-array size. Additional analyses of the combined area of adjacent sub-arrays can provide more information on potential glare hazards. (See previous point on related limitations.)
The variable direct normal irradiance (DNI) feature (if selected) scales the user-prescribed peak DNI using a typical clear-day irradiance profile. This profile has a lower DNI in the mornings and evenings and a maximum at solar noon. The scaling uses a clear-day irradiance profile based on a normalized time relative to sunrise, solar noon, and sunset, which are prescribed by a sun-position algorithm and the latitude and longitude obtained from Google maps. The actual DNI on any given day can be affected by cloud cover, atmospheric attenuation, and other environmental factors.
The ocular hazard predicted by the tool depends on a number of environmental, optical, and human factors, which can be uncertain. We provide input fields and typical ranges of values for these factors so that the user can vary these parameters to see if they have an impact on the results. The speed of SGHAT allows expedited sensitivity and parametric analyses.
The system output calculation is a DNI-based approximation that assumes clear, sunny skies year-round. It should not be used in place of more rigorous modeling methods.
Hazard zone boundaries shown in the Glare Hazard plot are an approximation and visual aid based on aggregated research data. Actual ocular impact outcomes encompass a continuous, not discrete, spectrum.
Glare locations displayed on receptor plots are approximate. Actual glare-spot locations may differ.
Refer to the Help page at **www.forgesolar.com/help/** for assumptions and limitations not listed here.

Default glare analysis parameters and observer eye characteristics (for reference only):

- Analysis time interval: 1 minute
- Ocular transmission coefficient: 0.5
- Pupil diameter: 0.002 meters
- Eye focal length: 0.017 meters
- Sun subtended angle: 9.3 milliradians

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FORGESOLAR GLARE ANALYSIS

Project: **BR10356 Normanton Larches Solar**
Site configuration: **Aviation 2000ft 180 and 205 OPs 21-41**

Created 08 Mar, 2024
Updated 21 Mar, 2024
Time-step 1 minute
Timezone offset UTC0
Minimum sun altitude 0.0 deg
DNI peaks at 1,000.0 W/m^2
Category 10 MW to 100 MW
Site ID 113993.19448

Ocular transmission coefficient 0.5
Pupil diameter 0.002 m
Eye focal length 0.017 m
Sun subtended angle 9.3 mrad
PV analysis methodology V2

Summary of Results

Glare with low potential for temporary after-image predicted

PV Array	Tilt	Orient	Annual Green Glare		Annual Yellow Glare		Energy	Peak Luminance
	°	°	min	hr	min	hr	kWh	cd/m^2
PV array 1	25.0	180.0	11,511	191.8	0	0.0	-	152,339
PV array 2	25.0	180.0	10,656	177.6	0	0.0	-	92,238
PV array 3	25.0	180.0	12,010	200.2	0	0.0	-	159,776
PV array 4	25.0	180.0	11,318	188.6	0	0.0	-	147,495
PV array 5	25.0	180.0	13,302	221.7	0	0.0	-	146,695
PV array 6	25.0	180.0	14,114	235.2	0	0.0	-	152,424
PV array 7	25.0	205.0	10,644	177.4	0	0.0	-	134,770
PV array 8	25.0	180.0	16,258	271.0	0	0.0	-	130,152

Total glare received by each receptor; may include duplicate times of glare from multiple reflective surfaces.

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
OP 1	96	1.6	0	0.0
OP 2	1,989	33.1	0	0.0
OP 3	9,239	154.0	0	0.0
OP 4	14,742	245.7	0	0.0
OP 5	16,225	270.4	0	0.0
OP 6	25,301	421.7	0	0.0
OP 7	20,160	336.0	0	0.0
OP 8	0	0.0	0	0.0

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
OP 9	0	0.0	0	0.0
OP 10	0	0.0	0	0.0
OP 11	0	0.0	0	0.0
OP 12	0	0.0	0	0.0
OP 13	1,288	21.5	0	0.0
OP 14	7,469	124.5	0	0.0
OP 15	3,025	50.4	0	0.0
OP 16	279	4.7	0	0.0
OP 17	0	0.0	0	0.0
OP 18	0	0.0	0	0.0
OP 19	0	0.0	0	0.0
OP 20	0	0.0	0	0.0
OP 21	0	0.0	0	0.0

Component Data

PV Arrays

Name: PV array 1
Axis tracking: Fixed (no rotation)
Tilt: 25.0°
Orientation: 180.0°
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	53.270453	-1.023592	44.16	3.58	47.74
2	53.270382	-1.026510	38.69	3.58	42.27
3	53.270337	-1.028001	42.19	3.58	45.77
4	53.268374	-1.027819	47.55	3.58	51.13
5	53.267835	-1.027411	47.97	3.58	51.55
6	53.268194	-1.025823	42.76	3.58	46.34
7	53.268605	-1.023538	48.05	3.58	51.63

Name: PV array 2
Axis tracking: Fixed (no rotation)
Tilt: 25.0°
Orientation: 180.0°
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	53.272403	-1.022893	44.98	3.58	48.56
2	53.271659	-1.020468	49.10	3.58	52.68
3	53.271146	-1.020629	49.06	3.58	52.64
4	53.270568	-1.020768	49.76	3.58	53.34
5	53.269978	-1.022399	48.94	3.58	52.52
6	53.269490	-1.023494	46.53	3.58	50.11
7	53.270600	-1.023526	44.05	3.58	47.63
8	53.270658	-1.022721	44.52	3.58	48.10

Name: PV array 3
Axis tracking: Fixed (no rotation)
Tilt: 25.0°
Orientation: 180.0°
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	53.267270	-1.027453	49.52	3.58	53.10
2	53.267742	-1.026122	44.46	3.58	48.04
3	53.268066	-1.026004	43.25	3.58	46.83
4	53.268361	-1.024577	44.74	3.58	48.32
5	53.268515	-1.023451	48.43	3.58	52.01
6	53.263789	-1.021096	44.95	3.58	48.53
7	53.263606	-1.026144	50.81	3.58	54.39

Name: PV array 4
Axis tracking: Fixed (no rotation)
Tilt: 25.0°
Orientation: 180.0°
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	53.267296	-1.022818	47.72	3.58	51.30
2	53.267707	-1.018998	49.22	3.58	52.80
3	53.264120	-1.017373	43.17	3.58	46.75
4	53.264126	-1.017861	43.81	3.58	47.39
5	53.263885	-1.017893	45.60	3.58	49.18
6	53.263795	-1.021085	44.91	3.58	48.49

Name: PV array 5
Axis tracking: Fixed (no rotation)
Tilt: 25.0°
Orientation: 180.0°
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	53.268300	-1.019106	51.65	3.58	55.23
2	53.268197	-1.015587	47.94	3.58	51.52
3	53.267411	-1.014932	45.87	3.58	49.45
4	53.263776	-1.015093	42.99	3.58	46.57
5	53.263904	-1.017175	44.48	3.58	48.06
6	53.266359	-1.018355	43.98	3.58	47.56

Name: PV array 6
Axis tracking: Fixed (no rotation)
Tilt: 25.0°
Orientation: 180.0°
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	53.267286	-1.014793	45.26	3.58	48.84
2	53.263975	-1.015072	41.69	3.58	45.27
3	53.265181	-1.012926	37.52	3.58	41.10
4	53.265759	-1.012132	35.68	3.58	39.26
5	53.266067	-1.011724	35.43	3.58	39.01
6	53.266349	-1.011338	34.83	3.58	38.41
7	53.266619	-1.009836	34.68	3.58	38.26
8	53.267825	-1.010716	42.25	3.58	45.83

Name: PV array 7
Axis tracking: Fixed (no rotation)
Tilt: 25.0°
Orientation: 205.0°
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	53.272917	-1.013991	31.10	3.58	34.68
2	53.269551	-1.014819	42.96	3.58	46.54
3	53.269690	-1.012194	40.87	3.58	44.45
4	53.270056	-1.011583	34.82	3.58	38.40
5	53.270428	-1.011003	31.24	3.58	34.82
6	53.271057	-1.010373	28.85	3.58	32.43
7	53.271814	-1.010150	28.14	3.58	31.72
8	53.272468	-1.010156	28.05	3.58	31.63
9	53.273126	-1.010762	28.00	3.58	31.58
10	53.273257	-1.012704	29.04	3.58	32.62
11	53.272869	-1.012854	29.81	3.58	33.39

Name: PV array 8
Axis tracking: Fixed (no rotation)
Tilt: 25.0°
Orientation: 180.0°
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	53.273046	-1.017601	39.95	3.58	43.53
2	53.268862	-1.018975	51.54	3.58	55.12
3	53.268622	-1.015574	47.82	3.58	51.40
4	53.269528	-1.015434	43.74	3.58	47.32
4	53.269528	-1.015434	43.74	3.58	47.32
4	53.269528	-1.015434	43.74	3.58	47.32
5	53.269550	-1.014823	42.96	3.58	46.54
5	53.269550	-1.014823	42.96	3.58	46.54
5	53.269550	-1.014823	42.96	3.58	46.54
6	53.272917	-1.013997	31.12	3.58	34.70

Discrete Observation Point Receptors

Name	ID	Latitude (°)	Longitude (°)	Elevation (m)	Height (m)
OP 1	1	53.279168	-0.962682	22.00	609.60
OP 2	2	53.275011	-0.957188	26.00	609.60
OP 3	3	53.265823	-0.946545	20.99	609.60
OP 4	4	53.258892	-0.954442	41.64	609.60
OP 5	5	53.253860	-0.968518	33.27	609.60
OP 6	6	53.259816	-0.979075	30.66	609.60
OP 7	7	53.270494	-0.993838	27.91	609.60
OP 8	8	53.282145	-1.005425	52.69	609.60
OP 9	9	53.287327	-0.996241	34.00	609.60
OP 10	10	53.291175	-0.981221	26.10	609.60
OP 11	11	53.286506	-0.974955	25.68	609.60
OP 12	12	53.281991	-0.989976	45.11	609.60
OP 13	13	53.277526	-0.995040	54.66	609.60
OP 14	14	53.268852	-0.946545	21.82	609.60
OP 15	15	53.273523	-0.934529	23.38	609.60
OP 16	16	53.279168	-0.926461	24.89	609.60
OP 17	17	53.284095	-0.934872	29.10	609.60
OP 18	18	53.291278	-0.946460	23.41	609.60
OP 19	19	53.296049	-0.954528	37.14	609.60
OP 20	20	53.293535	-0.965342	36.12	609.60
OP 21	21	53.288918	-0.971350	22.98	609.60

Glare Analysis Results

Summary of Results

Glare with low potential for temporary after-image predicted

PV Array	Tilt	Orient	Annual Green Glare		Annual Yellow Glare		Energy	Peak Luminance
	°	°	min	hr	min	hr	kWh	cd/m^2
PV array 1	25.0	180.0	11,511	191.8	0	0.0	-	152,339
PV array 2	25.0	180.0	10,656	177.6	0	0.0	-	92,238
PV array 3	25.0	180.0	12,010	200.2	0	0.0	-	159,776
PV array 4	25.0	180.0	11,318	188.6	0	0.0	-	147,495
PV array 5	25.0	180.0	13,302	221.7	0	0.0	-	146,695
PV array 6	25.0	180.0	14,114	235.2	0	0.0	-	152,424
PV array 7	25.0	205.0	10,644	177.4	0	0.0	-	134,770
PV array 8	25.0	180.0	16,258	271.0	0	0.0	-	130,152

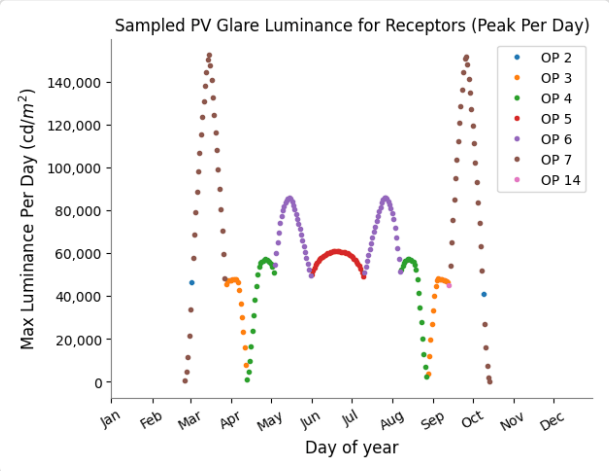
Total glare received by each receptor; may include duplicate times of glare from multiple reflective surfaces.

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
OP 1	96	1.6	0	0.0
OP 2	1,989	33.1	0	0.0
OP 3	9,239	154.0	0	0.0
OP 4	14,742	245.7	0	0.0
OP 5	16,225	270.4	0	0.0
OP 6	25,301	421.7	0	0.0
OP 7	20,160	336.0	0	0.0
OP 8	0	0.0	0	0.0
OP 9	0	0.0	0	0.0
OP 10	0	0.0	0	0.0
OP 11	0	0.0	0	0.0
OP 12	0	0.0	0	0.0
OP 13	1,288	21.5	0	0.0
OP 14	7,469	124.5	0	0.0
OP 15	3,025	50.4	0	0.0
OP 16	279	4.7	0	0.0
OP 17	0	0.0	0	0.0
OP 18	0	0.0	0	0.0
OP 19	0	0.0	0	0.0
OP 20	0	0.0	0	0.0
OP 21	0	0.0	0	0.0

PV: PV array 1 low potential for temporary after-image

Receptor results ordered by category of glare

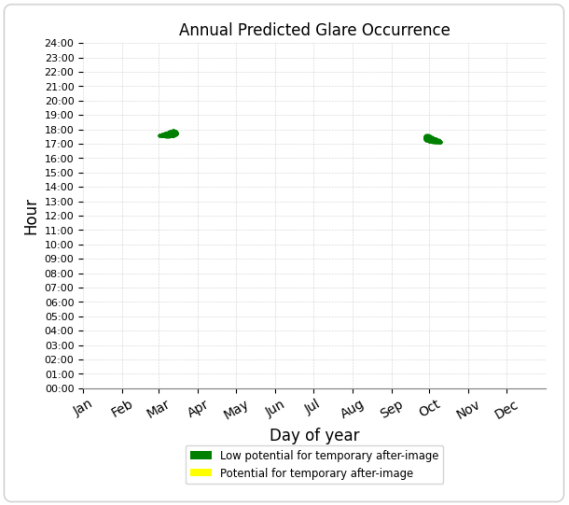
Receptor	Annual Green Glare		Annual Yellow Glare		Peak Luminance
	min	hr	min	hr	cd/m^2
OP 2	341	5.7	0	0.0	46,957
OP 3	1,094	18.2	0	0.0	48,048
OP 4	1,515	25.2	0	0.0	57,126
OP 5	1,950	32.5	0	0.0	60,906
OP 6	3,099	51.6	0	0.0	85,949
OP 7	1,961	32.7	0	0.0	152,339
OP 14	1,058	17.6	0	0.0	46,221
OP 15	493	8.2	0	0.0	30,863
OP 1	0	0.0	0	0.0	0
OP 8	0	0.0	0	0.0	0
OP 9	0	0.0	0	0.0	0
OP 10	0	0.0	0	0.0	0
OP 11	0	0.0	0	0.0	0
OP 12	0	0.0	0	0.0	0
OP 13	0	0.0	0	0.0	0
OP 16	0	0.0	0	0.0	0
OP 17	0	0.0	0	0.0	0
OP 18	0	0.0	0	0.0	0
OP 19	0	0.0	0	0.0	0
OP 20	0	0.0	0	0.0	0
OP 21	0	0.0	0	0.0	0

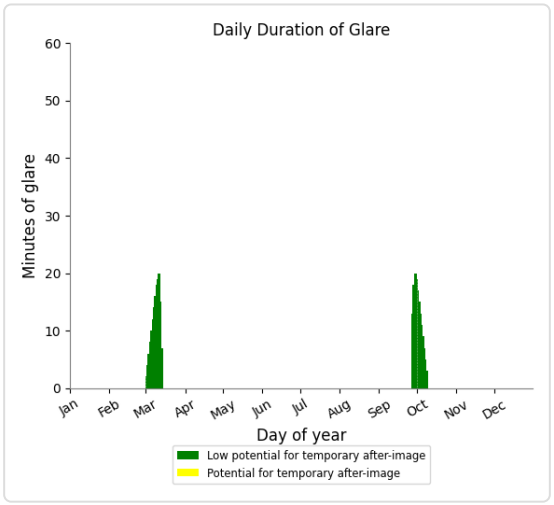


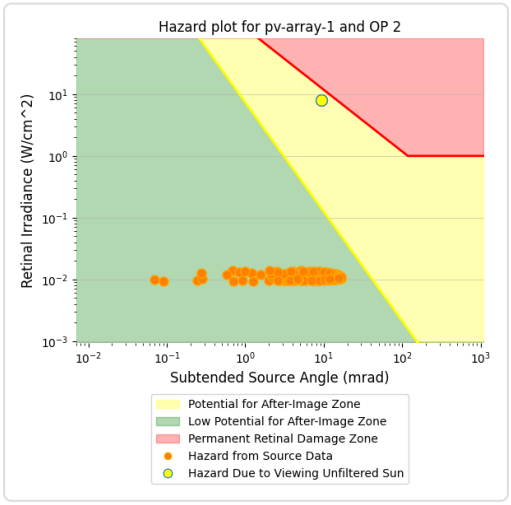
PV array 1 and OP 2

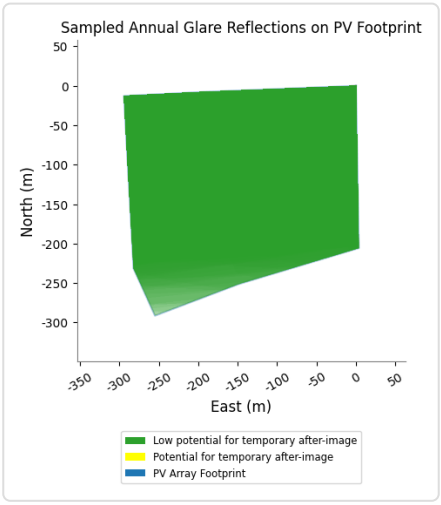
Yellow glare: none

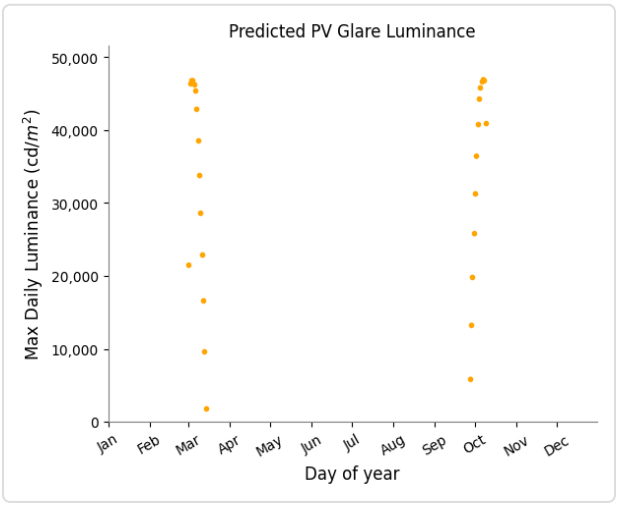
Green glare: 341 min.







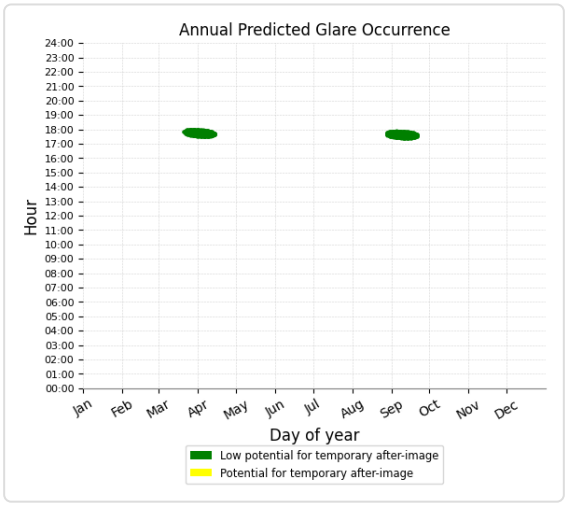


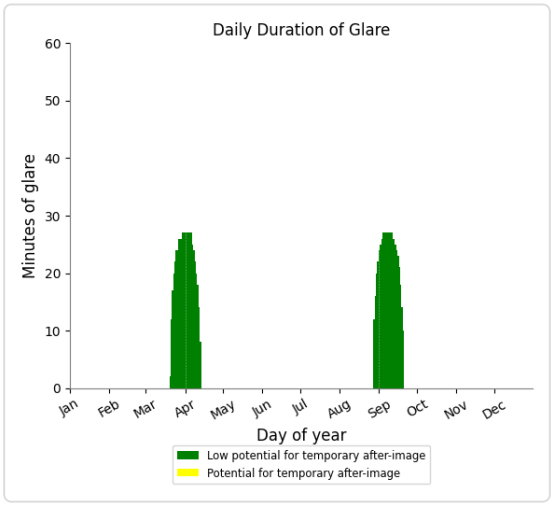


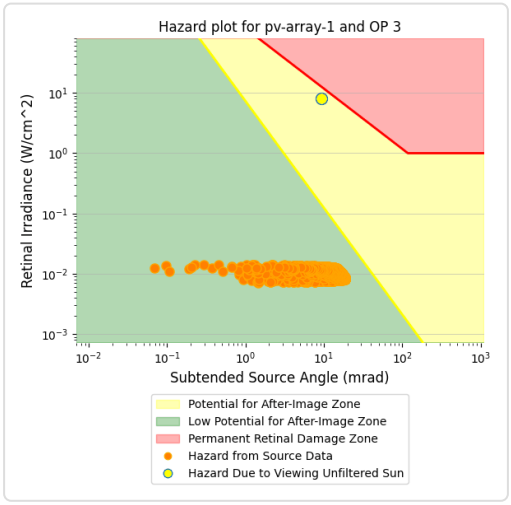
PV array 1 and OP 3

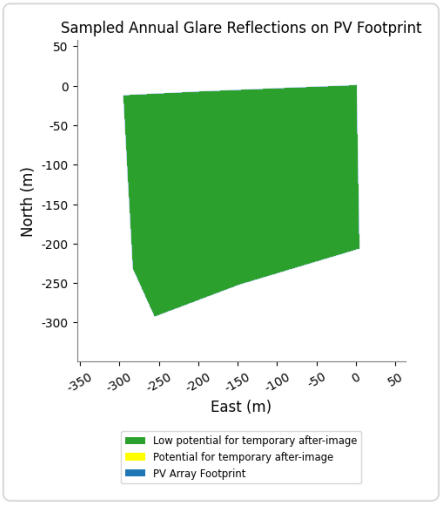
Yellow glare: none

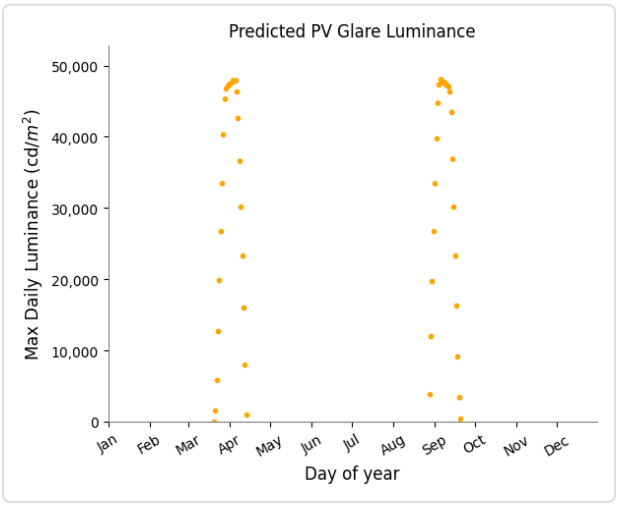
Green glare: 1,094 min.







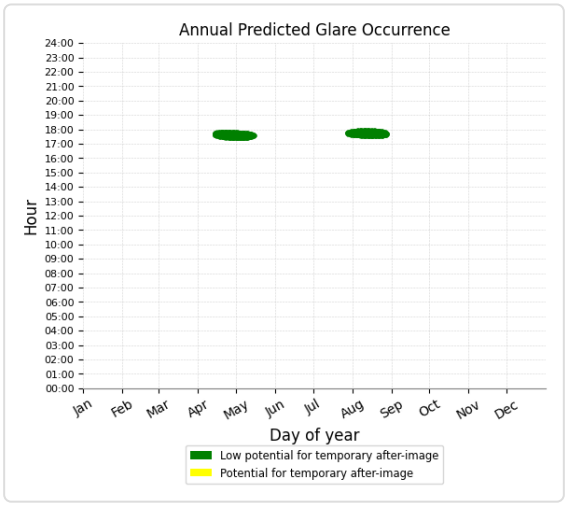


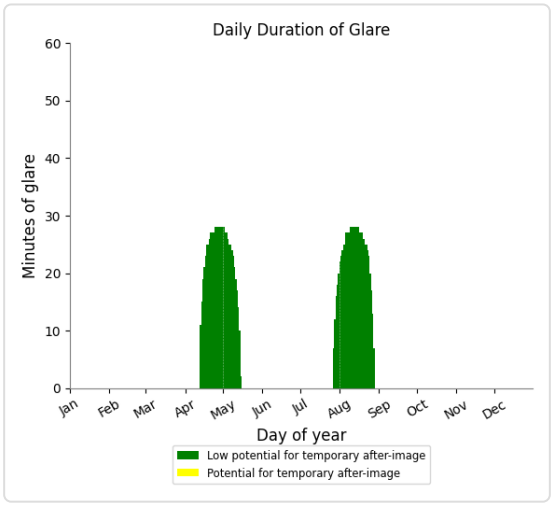


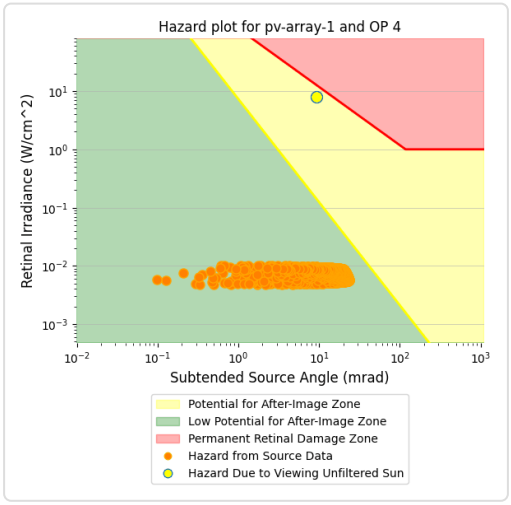
PV array 1 and OP 4

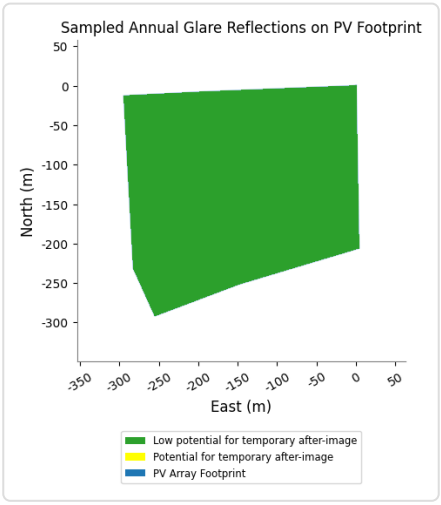
Yellow glare: none

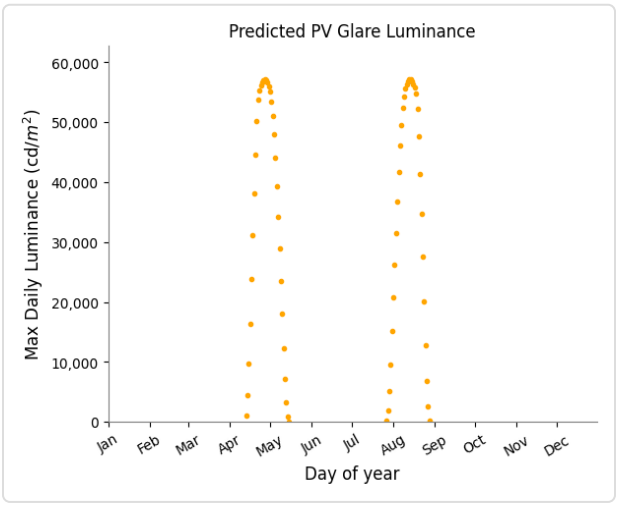
Green glare: 1,515 min.







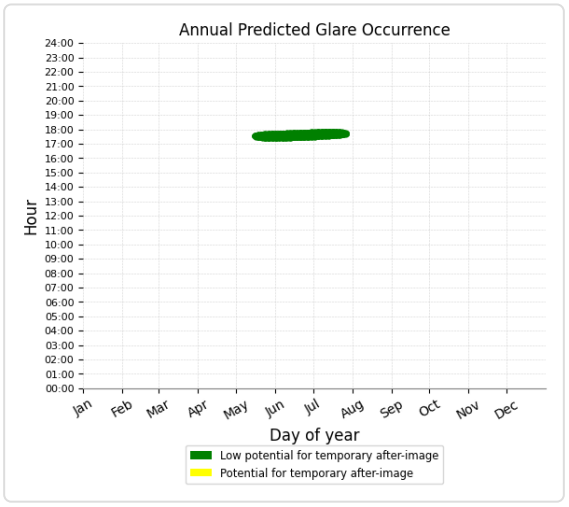


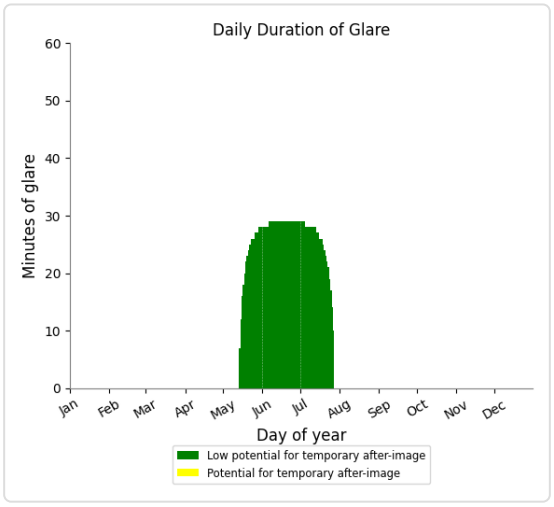


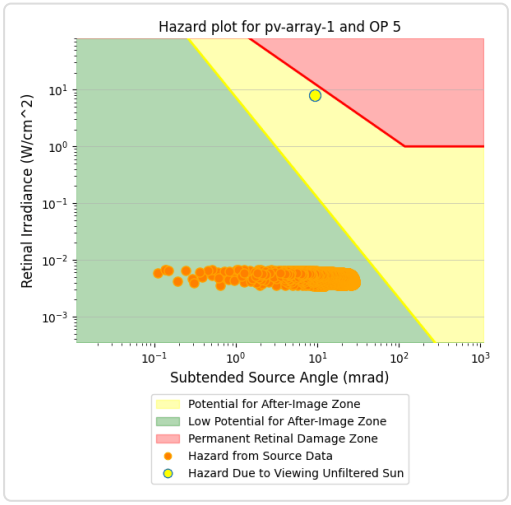
PV array 1 and OP 5

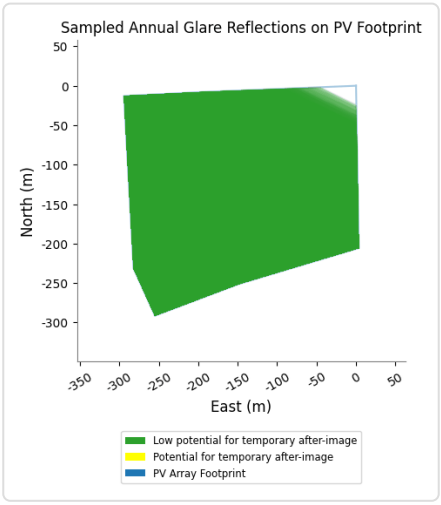
Yellow glare: none

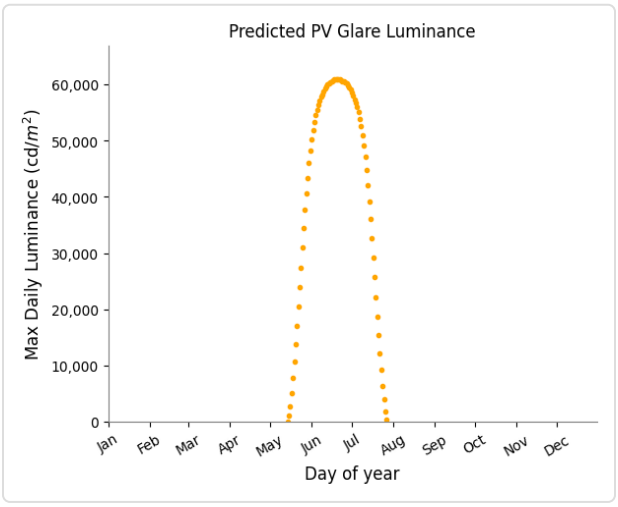
Green glare: 1,950 min.







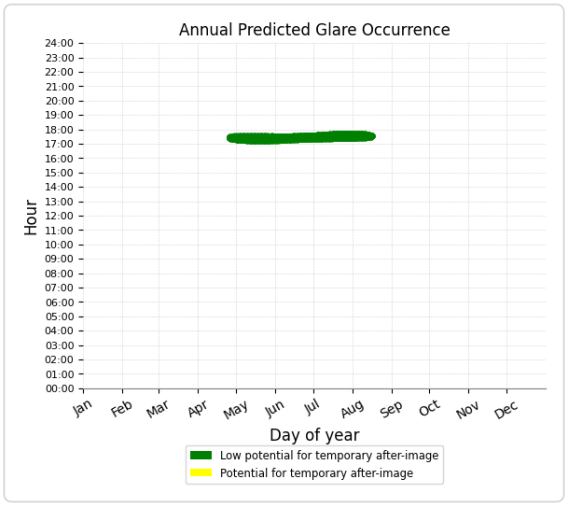


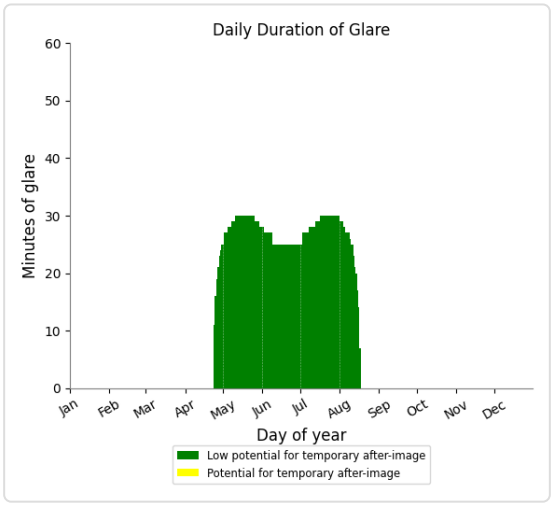


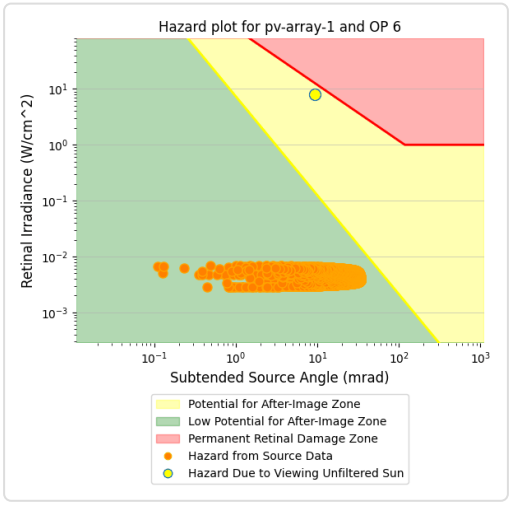
PV array 1 and OP 6

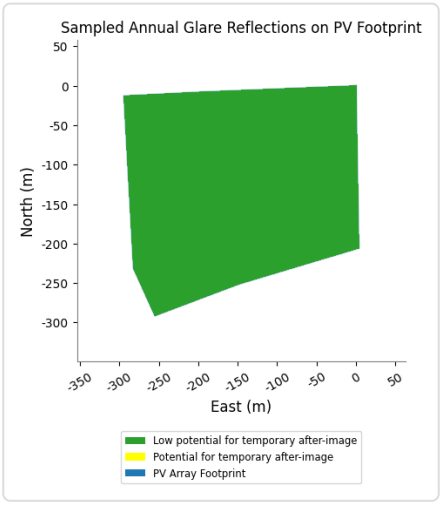
Yellow glare: none

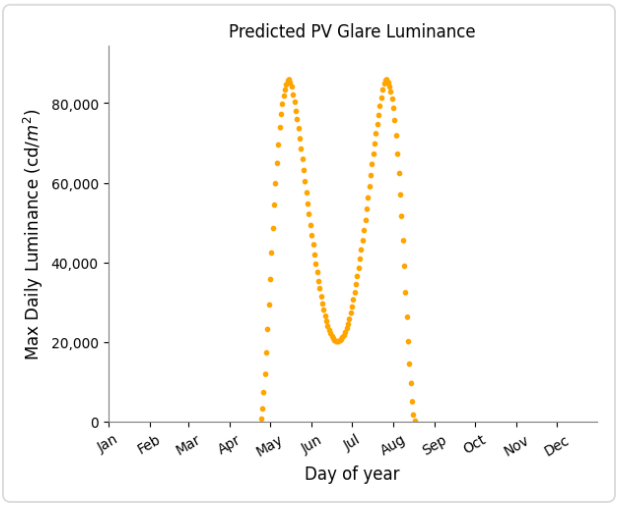
Green glare: 3,099 min.







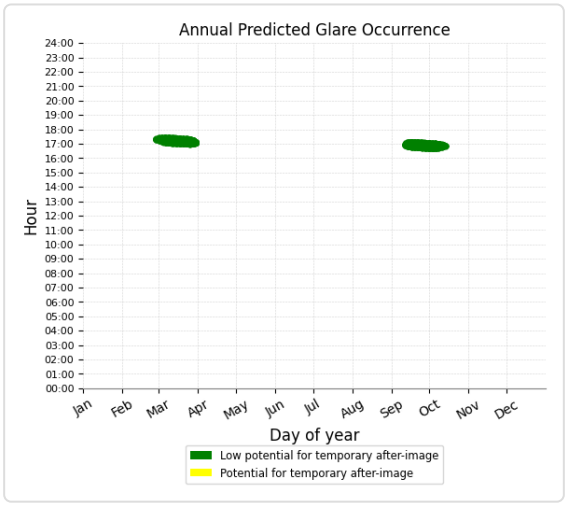


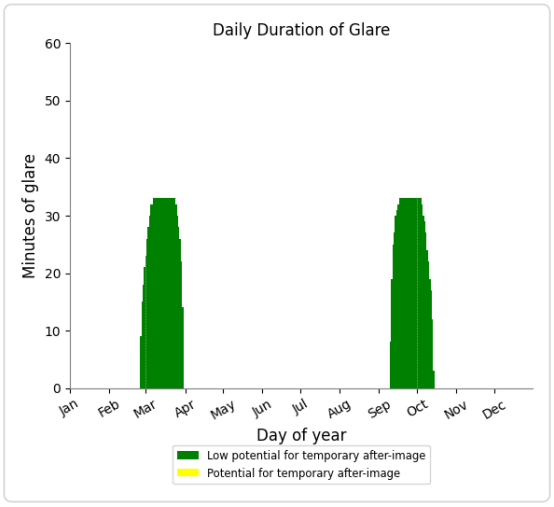


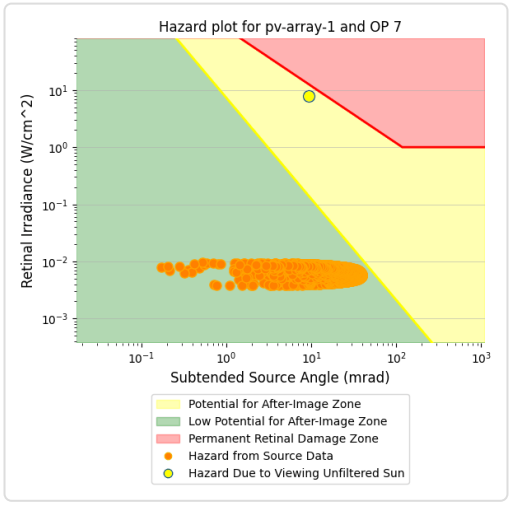
PV array 1 and OP 7

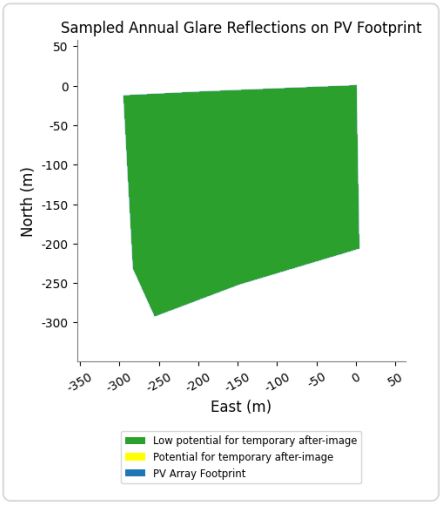
Yellow glare: none

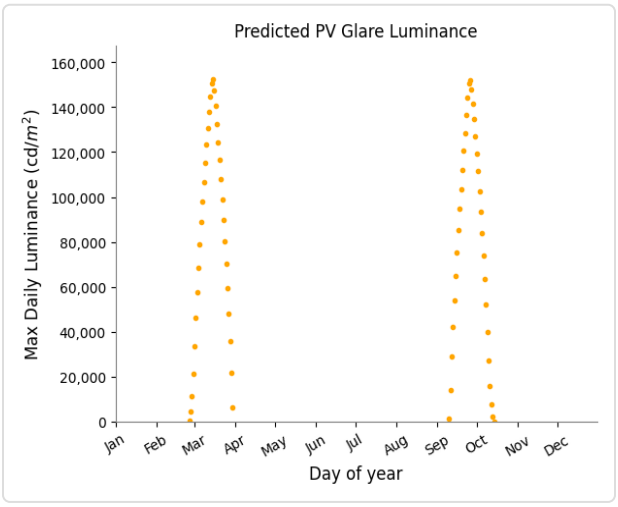
Green glare: 1,961 min.







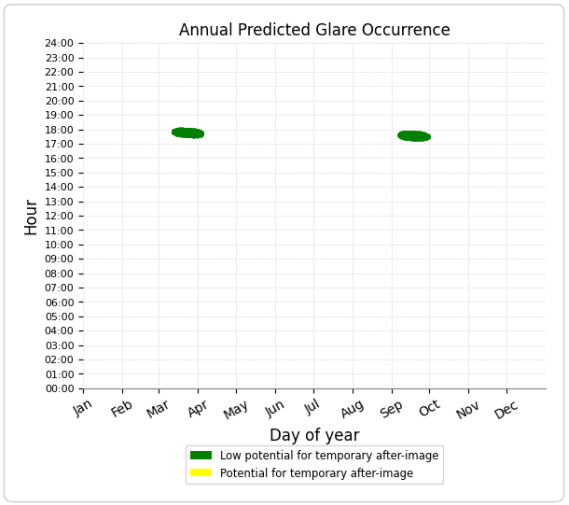


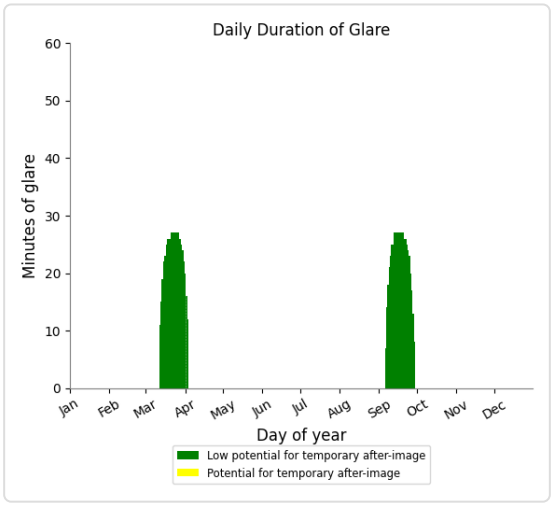


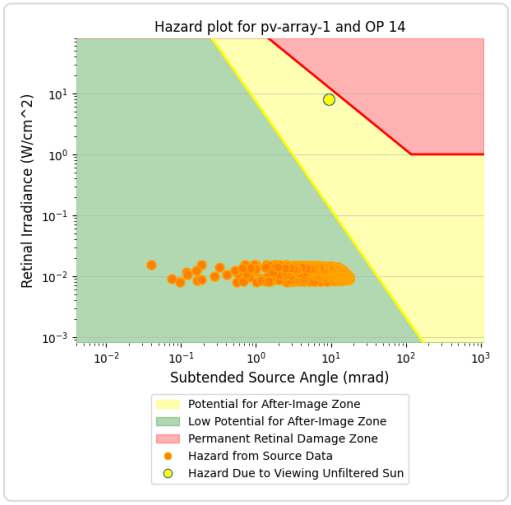
PV array 1 and OP 14

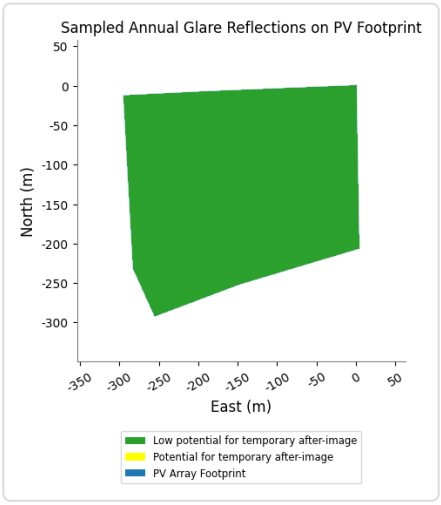
Yellow glare: none

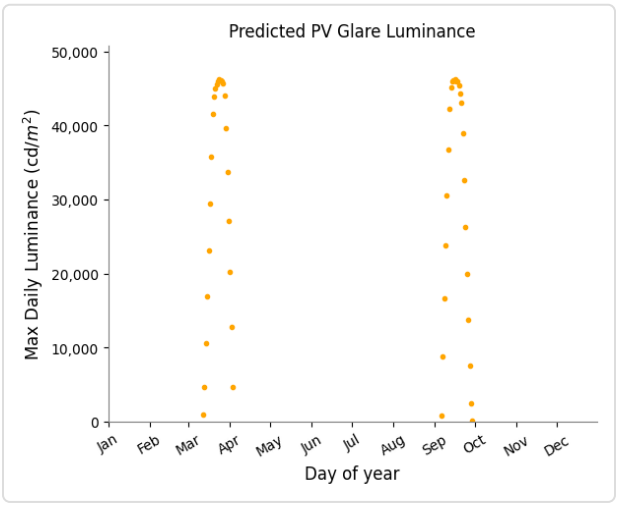
Green glare: 1,058 min.







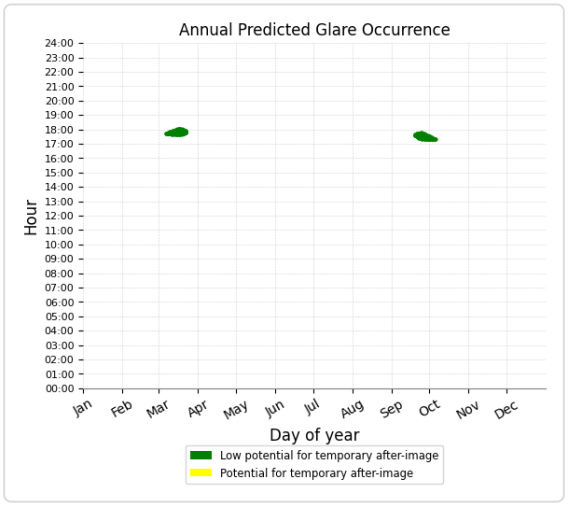


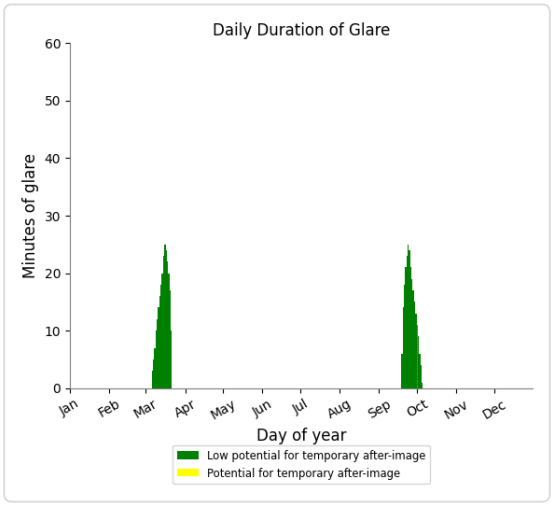


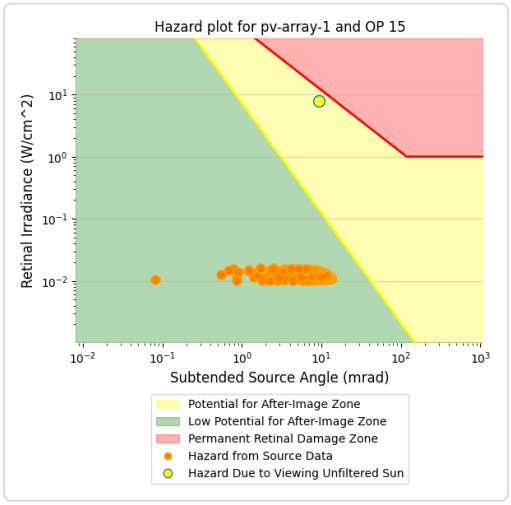
PV array 1 and OP 15

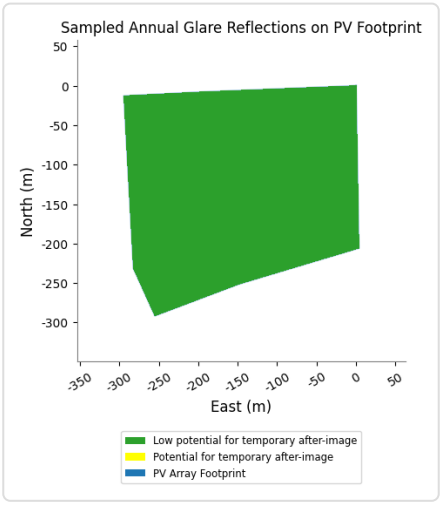
Yellow glare: none

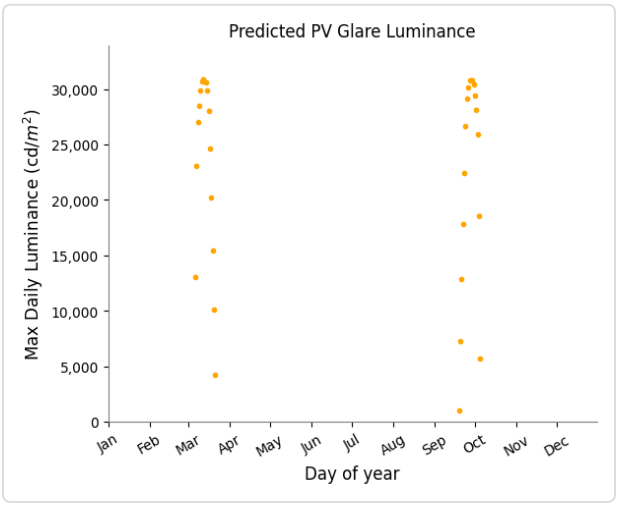
Green glare: 493 min.











PV array 1 and OP 1

No glare found

PV array 1 and OP 8

No glare found

PV array 1 and OP 9

No glare found

PV array 1 and OP 10

No glare found

PV array 1 and OP 11

No glare found

PV array 1 and OP 12

No glare found

PV array 1 and OP 13

No glare found

PV array 1 and OP 16

No glare found

PV array 1 and OP 17

No glare found

PV array 1 and OP 18

No glare found

PV array 1 and OP 19

No glare found

PV array 1 and OP 20

No glare found

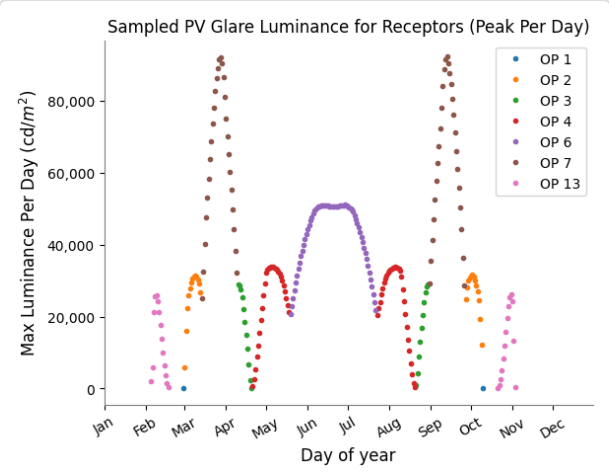
PV array 1 and OP 21

No glare found

PV: PV array 2 low potential for temporary after-image

Receptor results ordered by category of glare

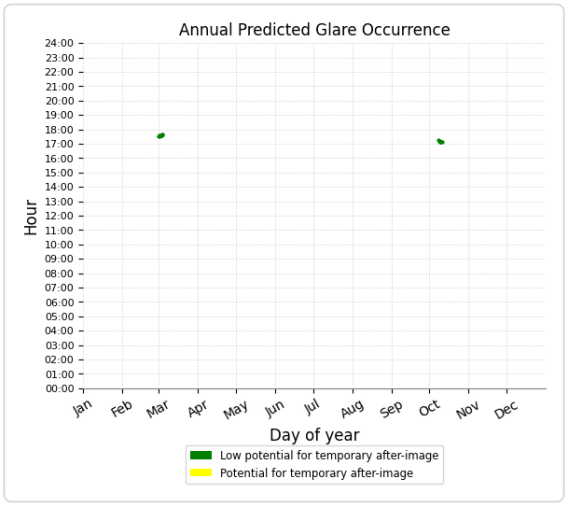
Receptor	Annual Green Glare		Annual Yellow Glare		Peak Luminance
	min	hr	min	hr	cd/m^2
OP 1	17	0.3	0	0.0	1,177
OP 2	665	11.1	0	0.0	31,572
OP 3	1,145	19.1	0	0.0	28,953
OP 4	1,757	29.3	0	0.0	33,833
OP 5	557	9.3	0	0.0	3,866
OP 6	2,316	38.6	0	0.0	51,041
OP 7	2,007	33.5	0	0.0	92,238
OP 13	235	3.9	0	0.0	26,101
OP 14	1,102	18.4	0	0.0	28,297
OP 15	744	12.4	0	0.0	19,340
OP 16	111	1.9	0	0.0	8,145
OP 8	0	0.0	0	0.0	0
OP 9	0	0.0	0	0.0	0
OP 10	0	0.0	0	0.0	0
OP 11	0	0.0	0	0.0	0
OP 12	0	0.0	0	0.0	0
OP 17	0	0.0	0	0.0	0
OP 18	0	0.0	0	0.0	0
OP 19	0	0.0	0	0.0	0
OP 20	0	0.0	0	0.0	0
OP 21	0	0.0	0	0.0	0

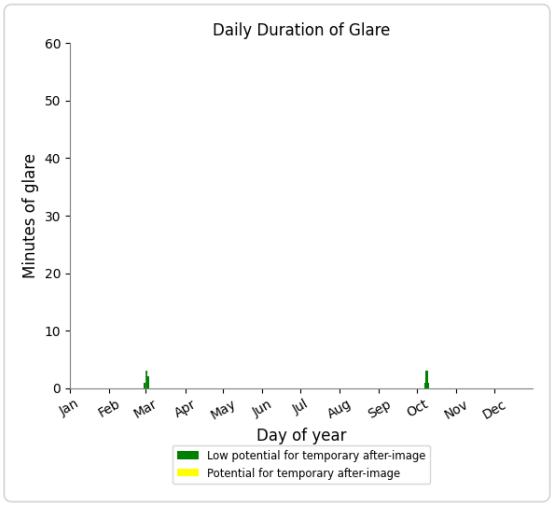


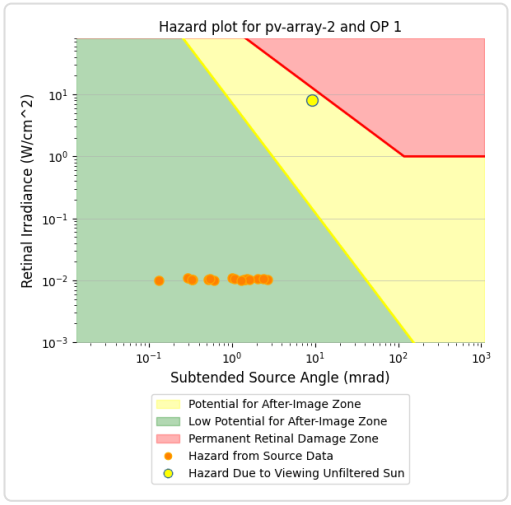
PV array 2 and OP 1

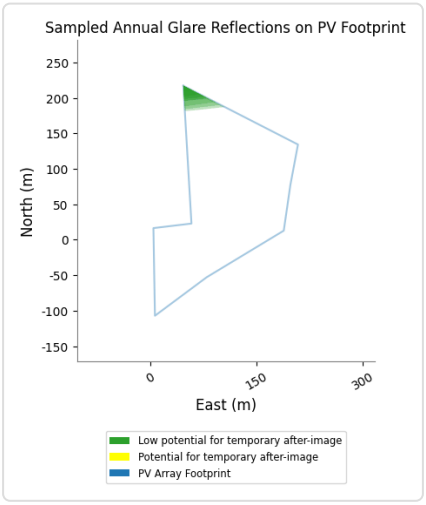
Yellow glare: none

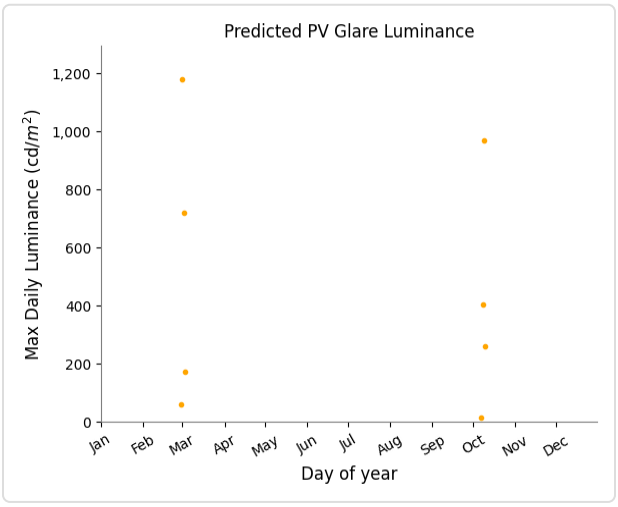
Green glare: 17 min.







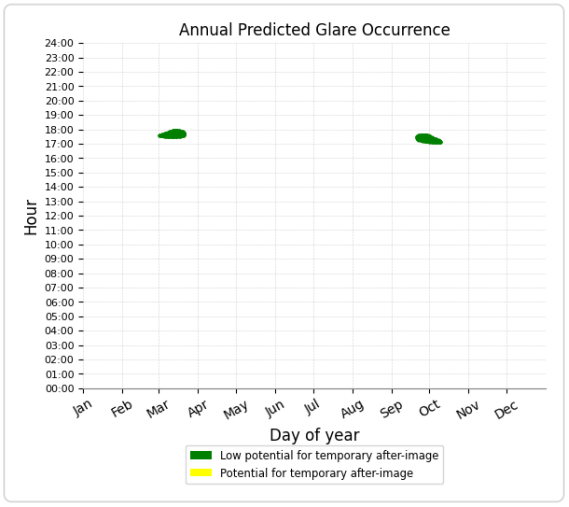


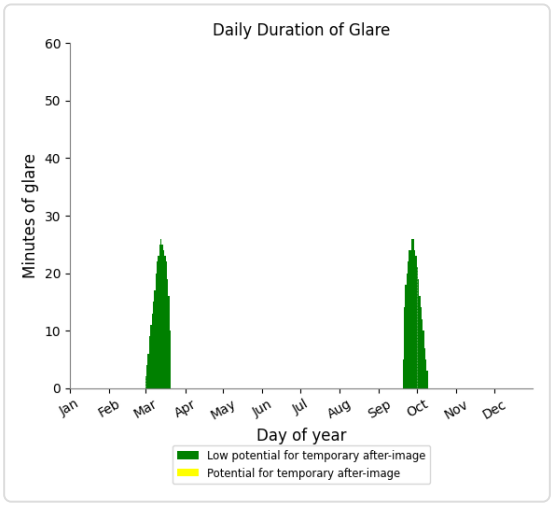


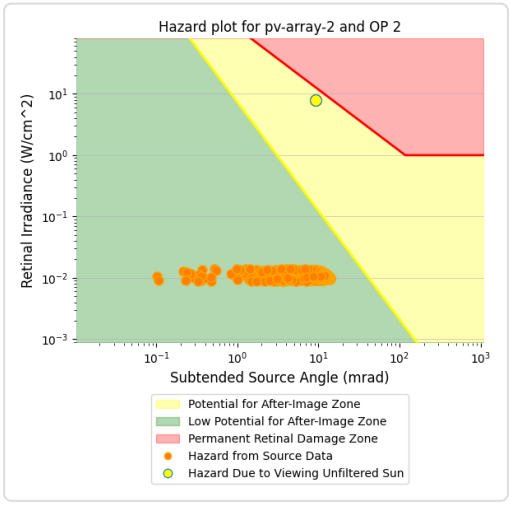
PV array 2 and OP 2

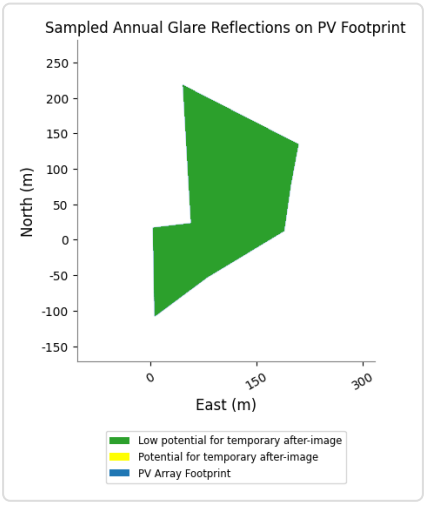
Yellow glare: none

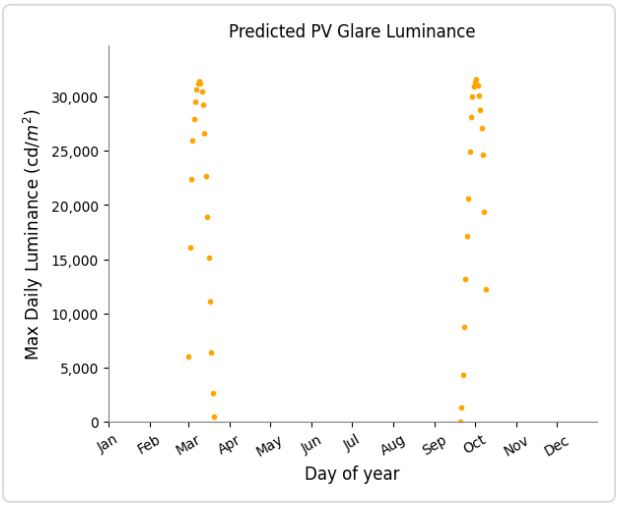
Green glare: 665 min.







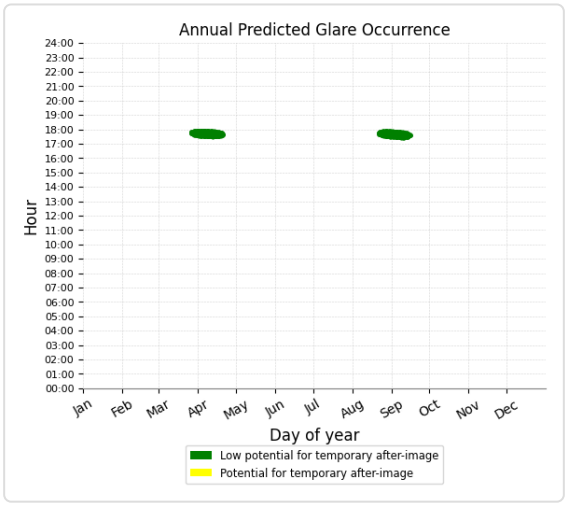


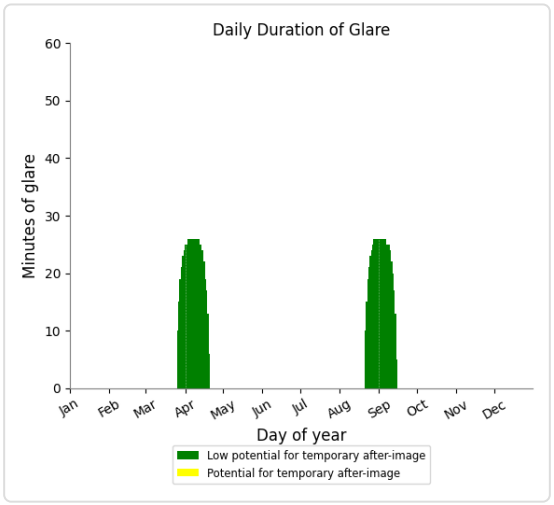


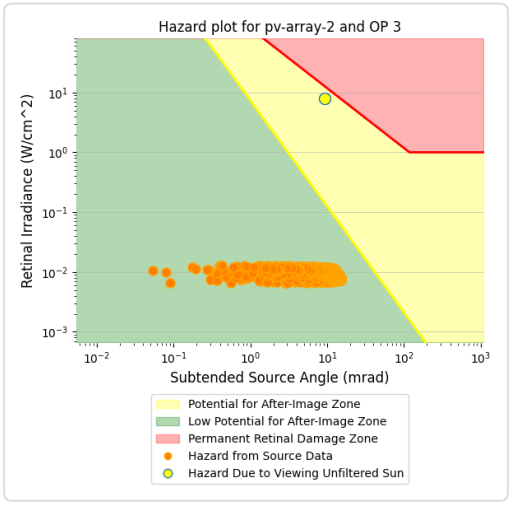
PV array 2 and OP 3

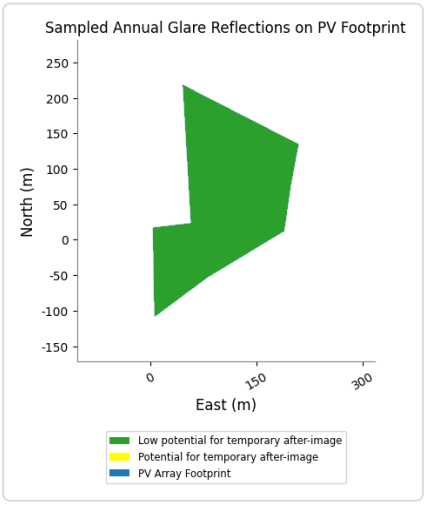
Yellow glare: none

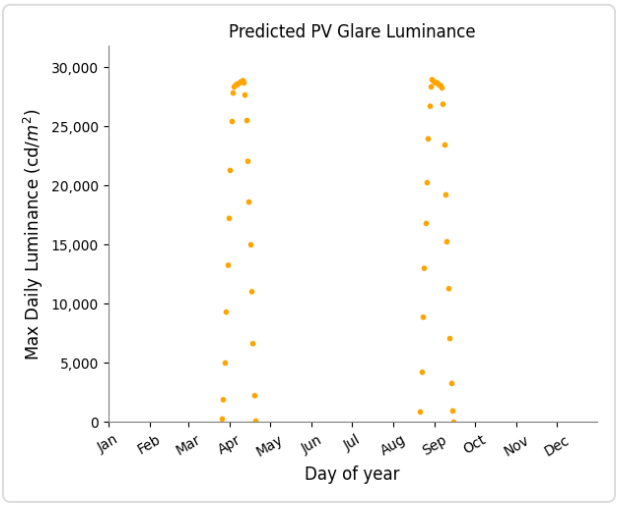
Green glare: 1,145 min.







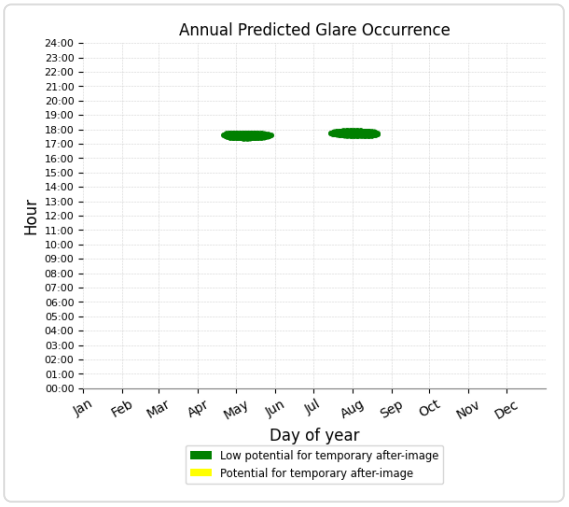


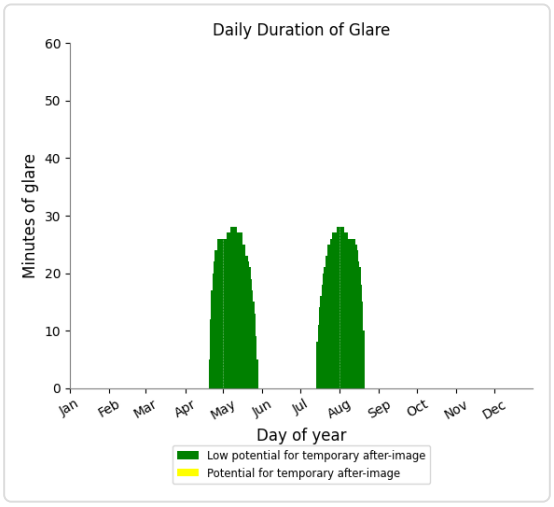


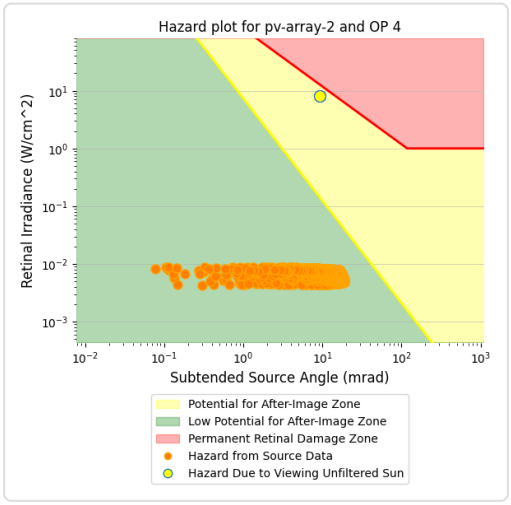
PV array 2 and OP 4

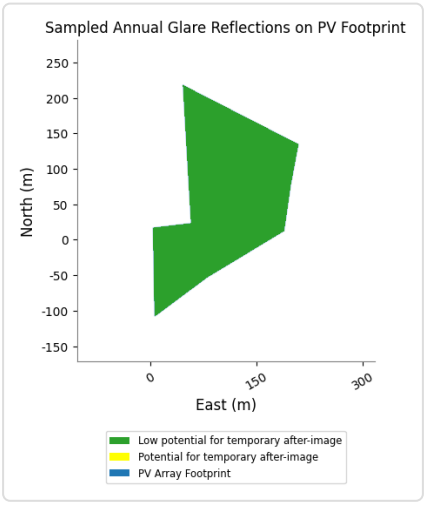
Yellow glare: none

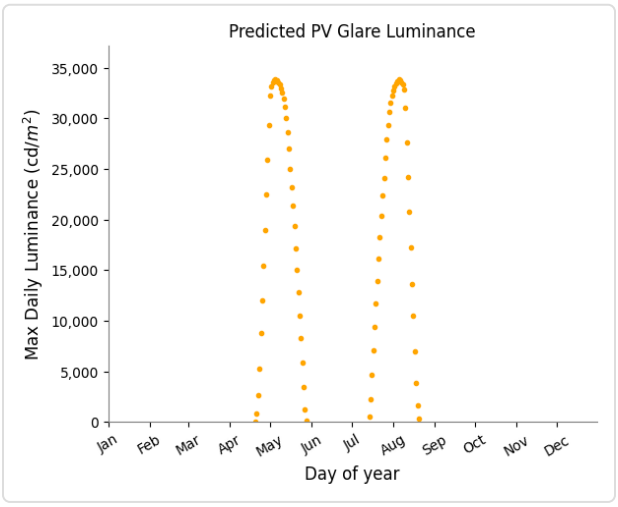
Green glare: 1,757 min.







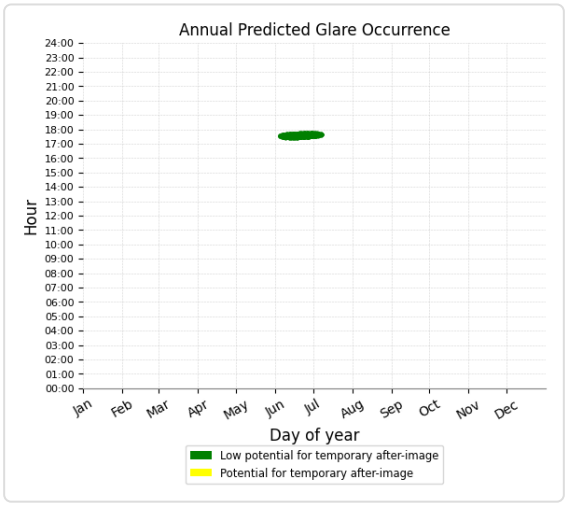


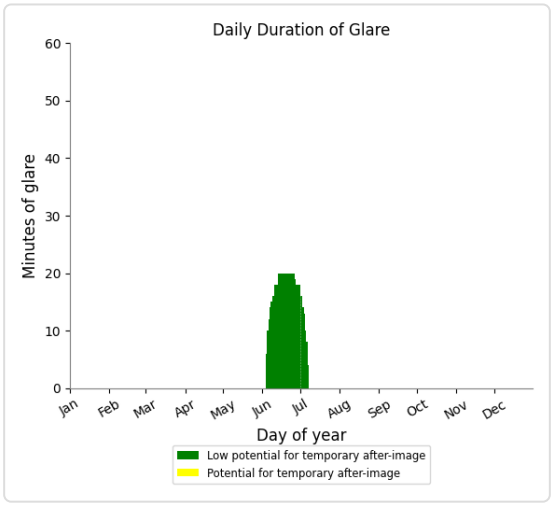


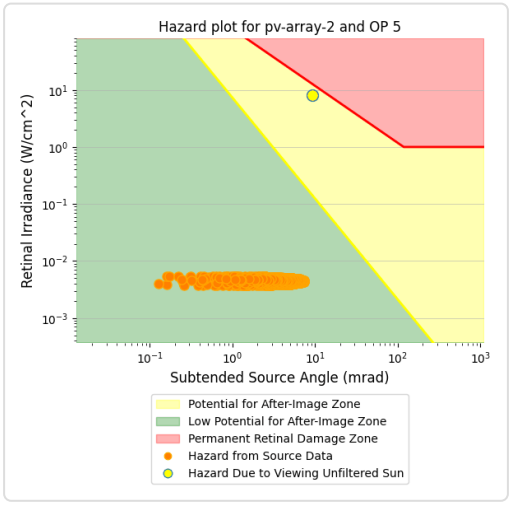
PV array 2 and OP 5

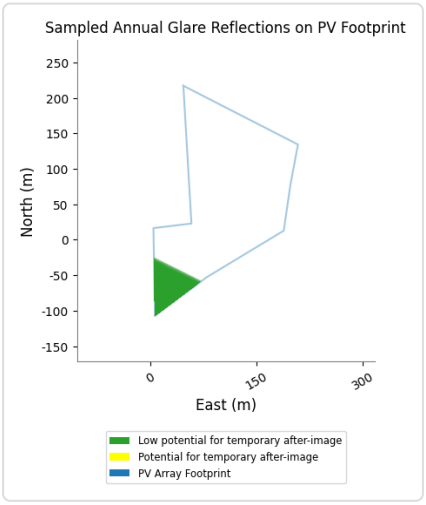
Yellow glare: none

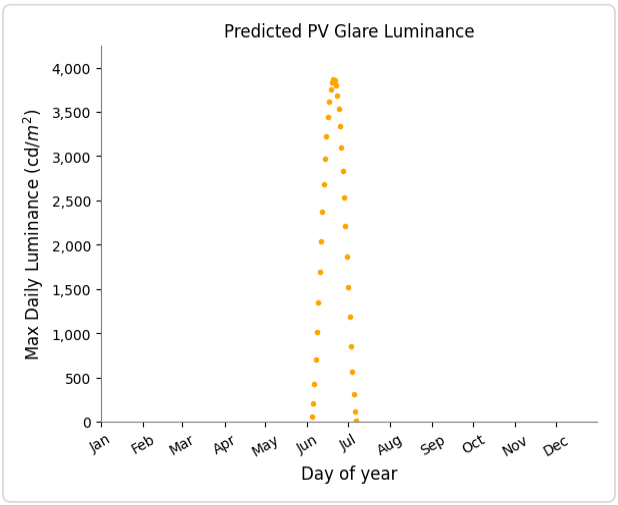
Green glare: 557 min.







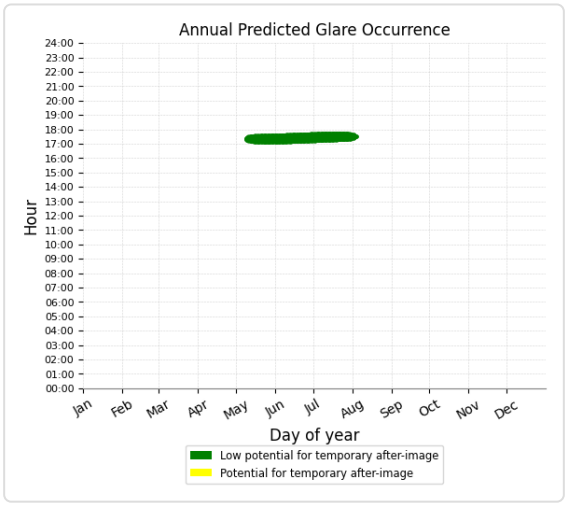


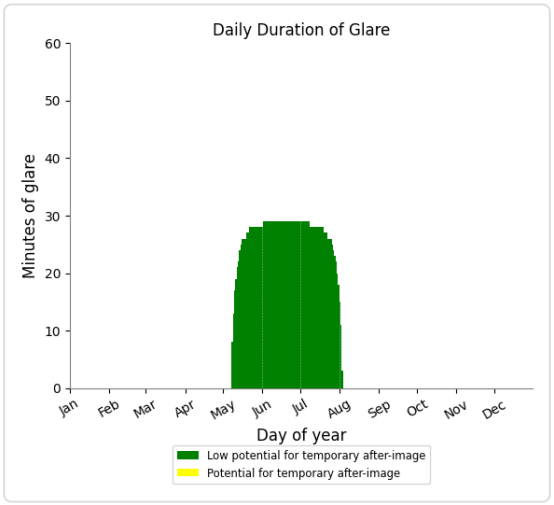


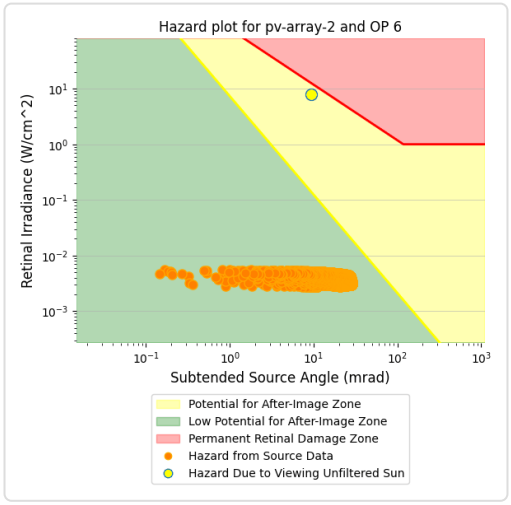
PV array 2 and OP 6

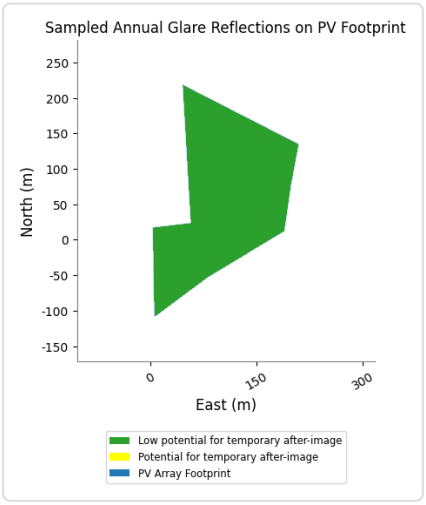
Yellow glare: none

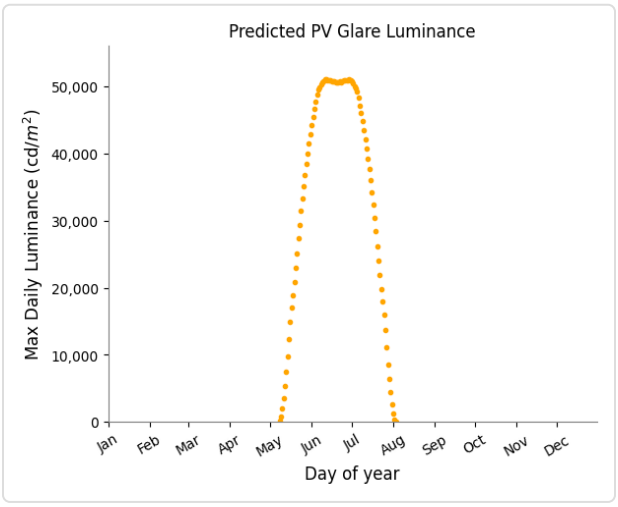
Green glare: 2,316 min.







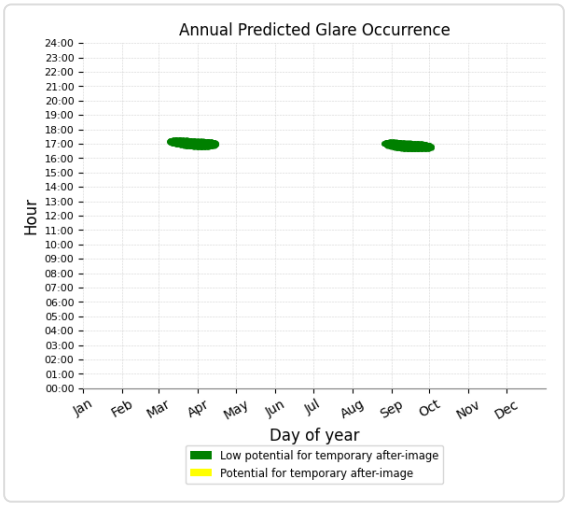


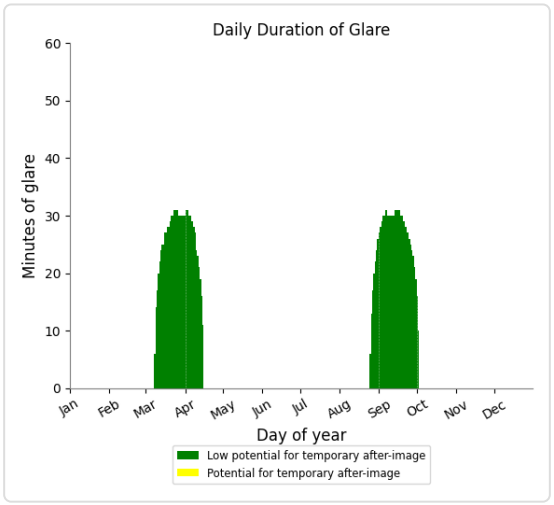


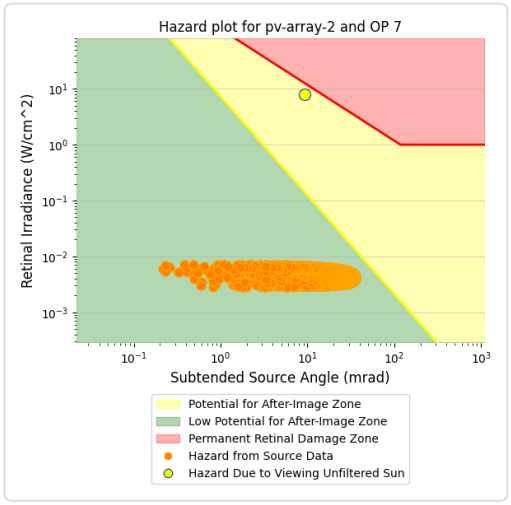
PV array 2 and OP 7

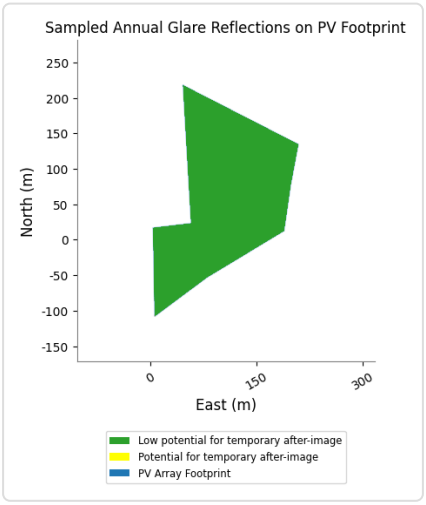
Yellow glare: none

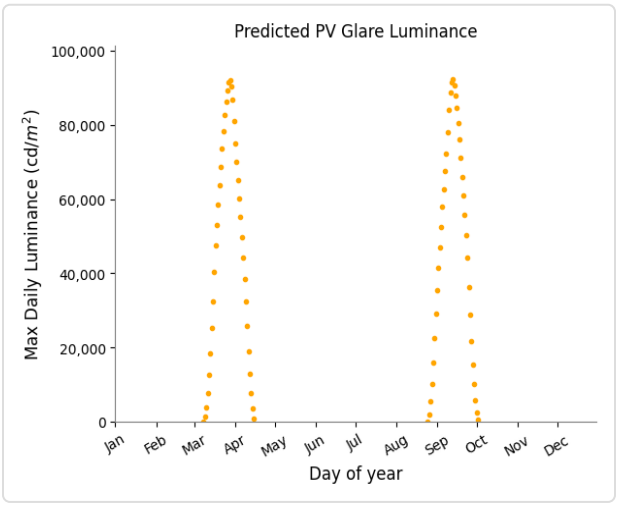
Green glare: 2,007 min.







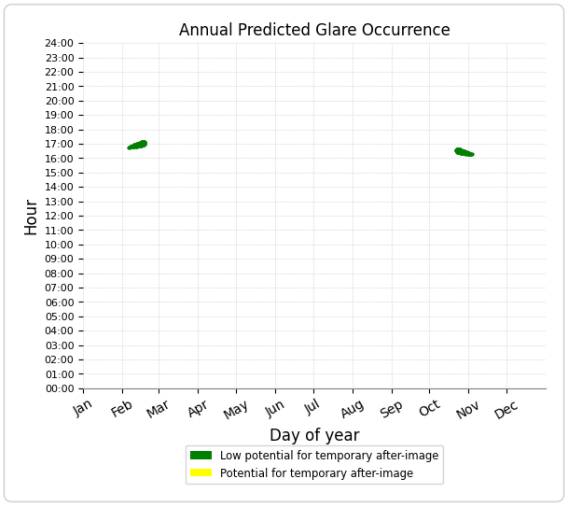


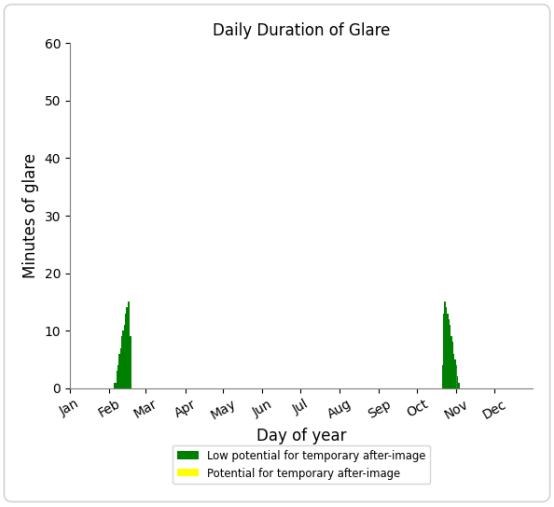


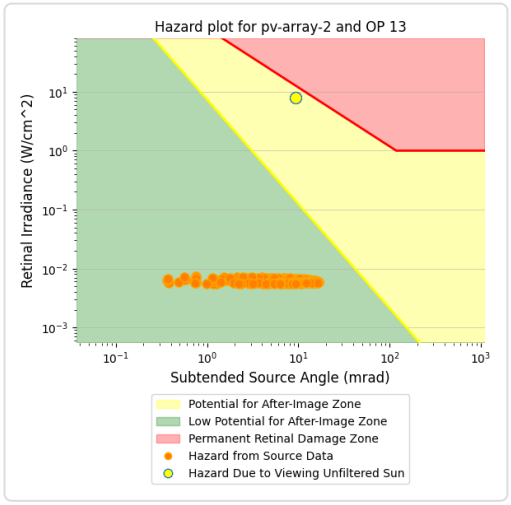
PV array 2 and OP 13

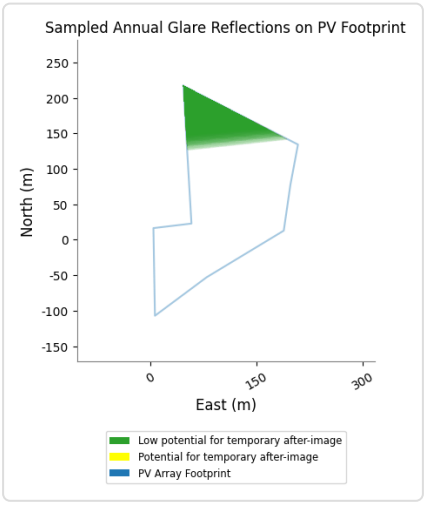
Yellow glare: none

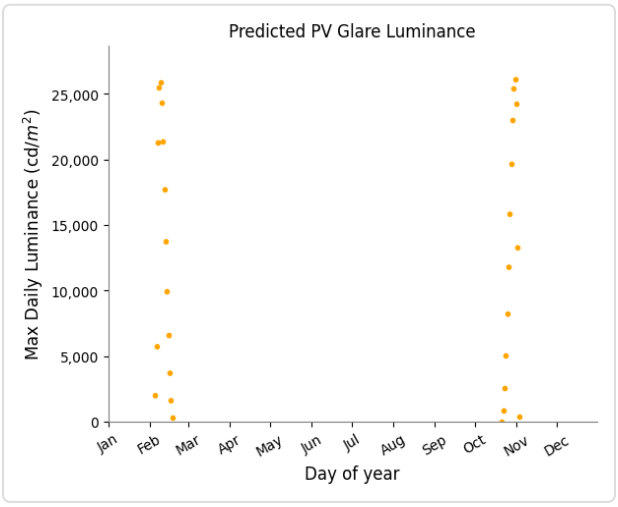
Green glare: 235 min.







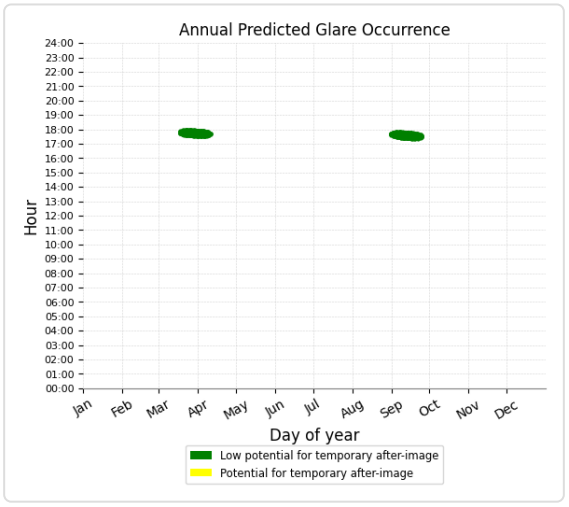


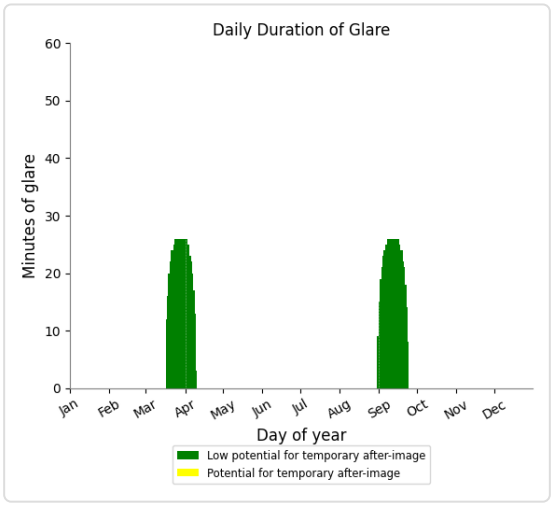


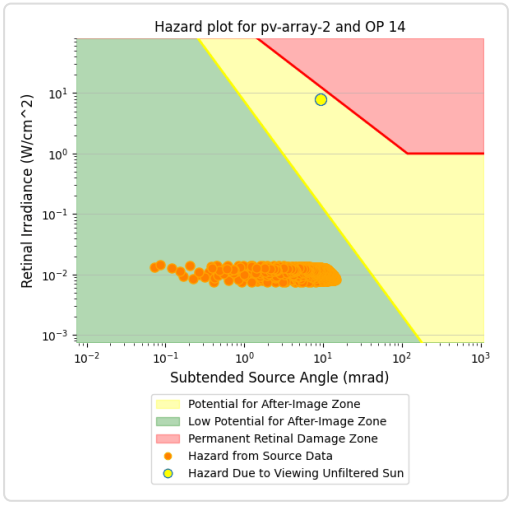
PV array 2 and OP 14

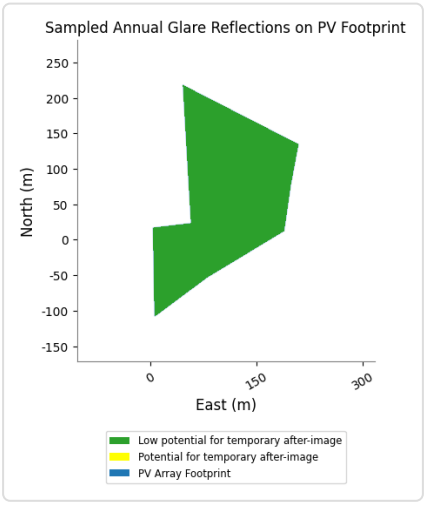
Yellow glare: none

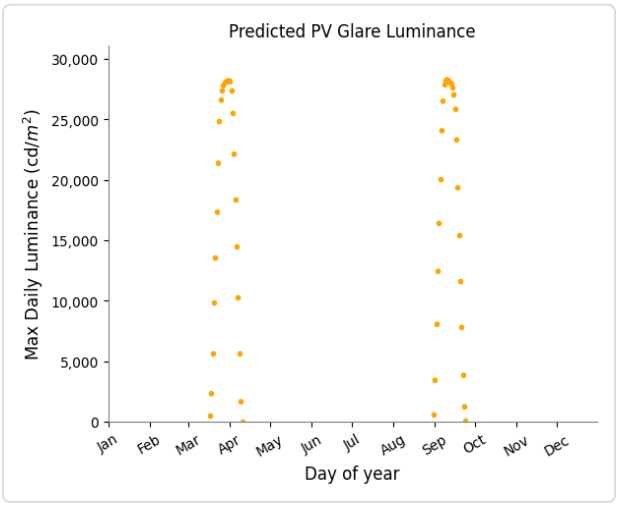
Green glare: 1,102 min.







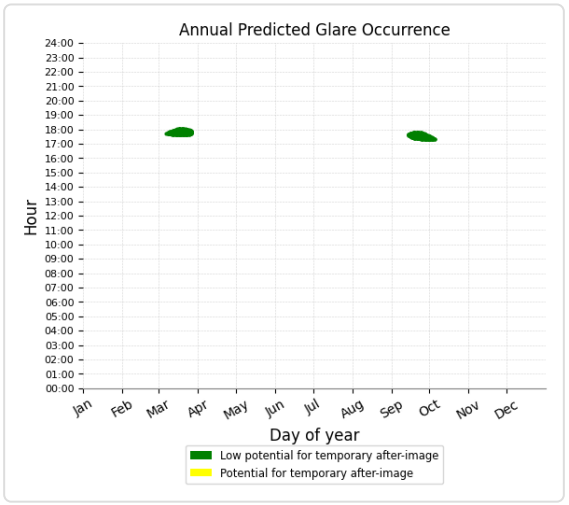


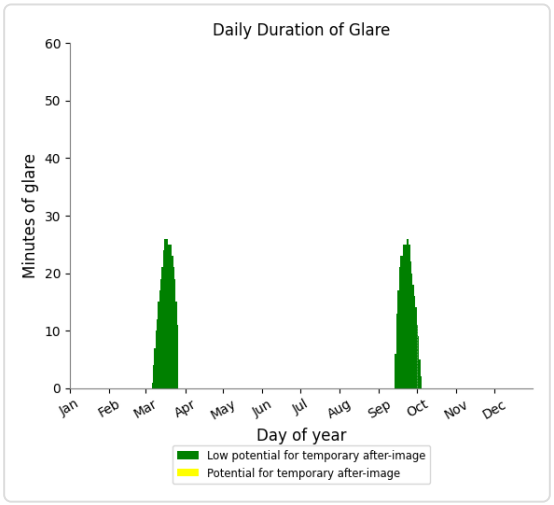


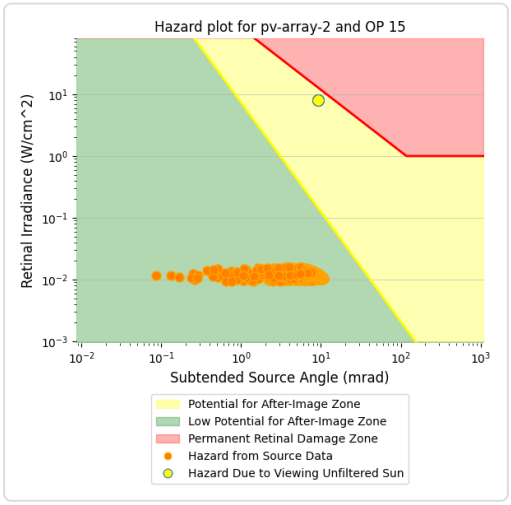
PV array 2 and OP 15

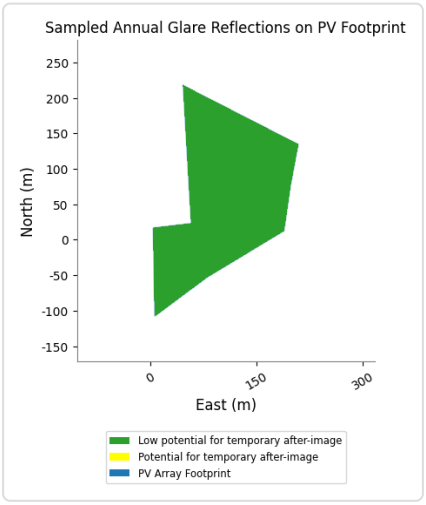
Yellow glare: none

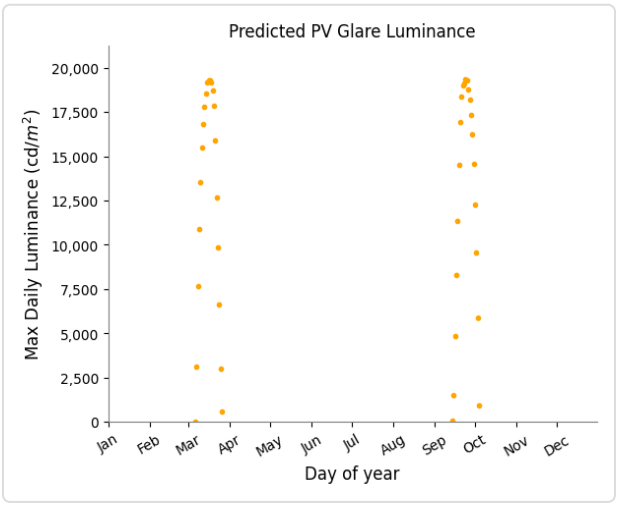
Green glare: 744 min.







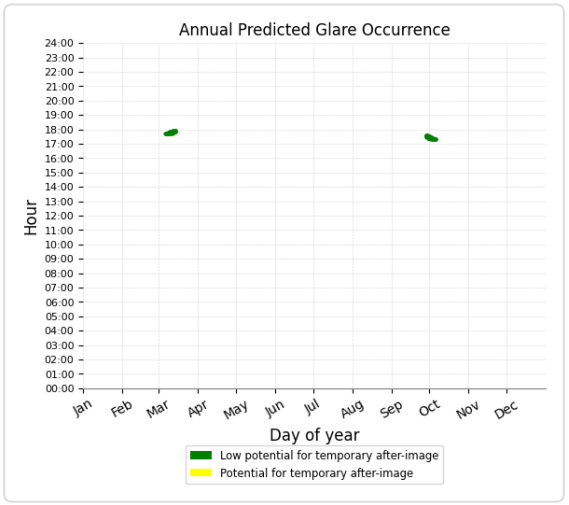


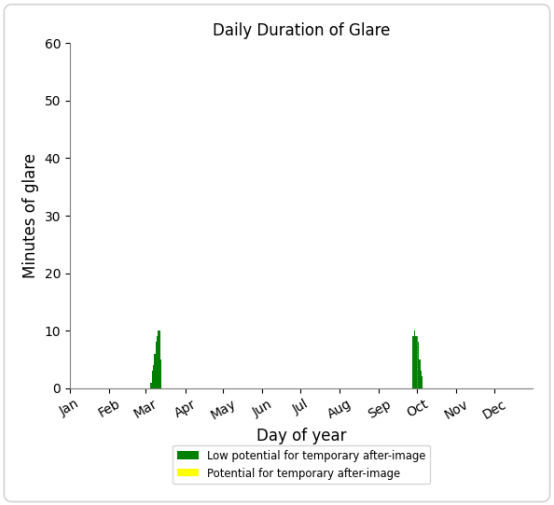


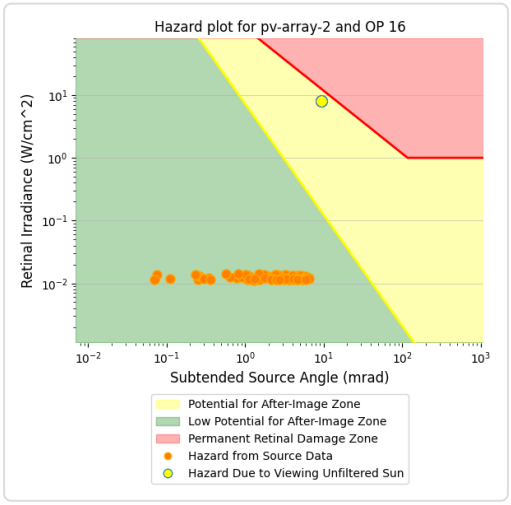
PV array 2 and OP 16

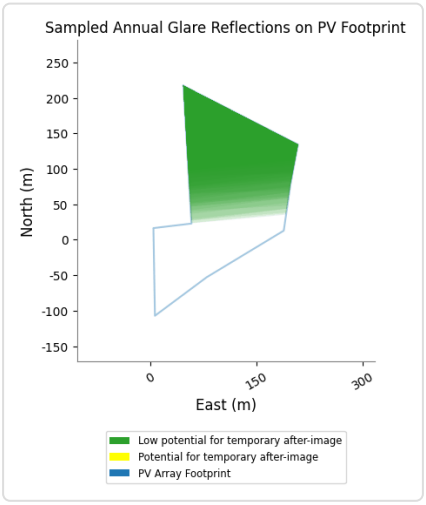
Yellow glare: none

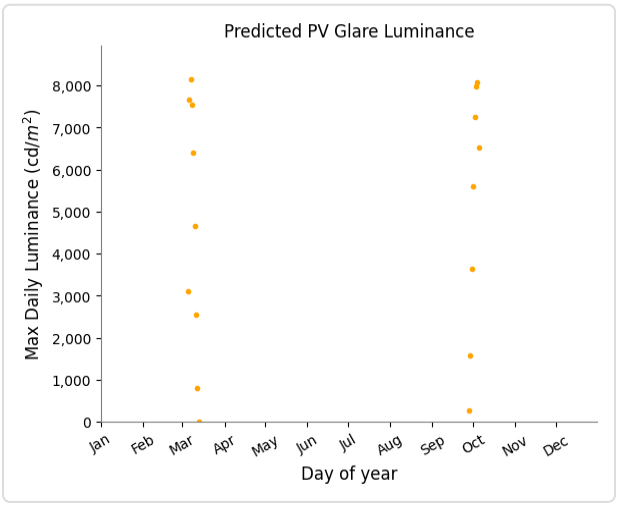
Green glare: 111 min.











PV array 2 and OP 8

No glare found

PV array 2 and OP 9

No glare found

PV array 2 and OP 10

No glare found

PV array 2 and OP 11

No glare found

PV array 2 and OP 12

No glare found

PV array 2 and OP 17

No glare found

PV array 2 and OP 18

No glare found

PV array 2 and OP 19

No glare found

PV array 2 and OP 20

No glare found

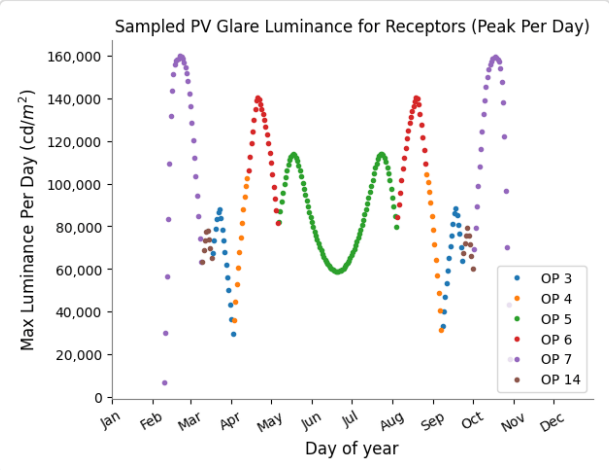
PV array 2 and OP 21

No glare found

PV: PV array 3 low potential for temporary after-image

Receptor results ordered by category of glare

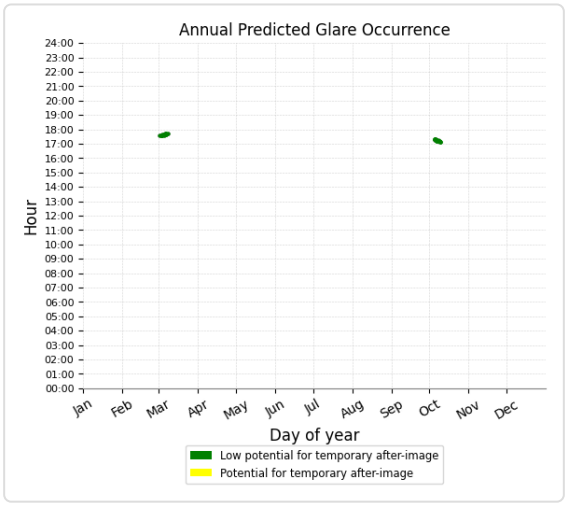
Receptor	Annual Green Glare		Annual Yellow Glare		Peak Luminance
	min	hr	min	hr	cd/m^2
OP 2	60	1.0	0	0.0	11,749
OP 3	1,360	22.7	0	0.0	88,194
OP 4	1,753	29.2	0	0.0	107,825
OP 5	3,200	53.3	0	0.0	113,958
OP 6	2,842	47.4	0	0.0	140,411
OP 7	1,582	26.4	0	0.0	159,776
OP 14	953	15.9	0	0.0	79,089
OP 15	260	4.3	0	0.0	34,498
OP 1	0	0.0	0	0.0	0
OP 8	0	0.0	0	0.0	0
OP 9	0	0.0	0	0.0	0
OP 10	0	0.0	0	0.0	0
OP 11	0	0.0	0	0.0	0
OP 12	0	0.0	0	0.0	0
OP 13	0	0.0	0	0.0	0
OP 16	0	0.0	0	0.0	0
OP 17	0	0.0	0	0.0	0
OP 18	0	0.0	0	0.0	0
OP 19	0	0.0	0	0.0	0
OP 20	0	0.0	0	0.0	0
OP 21	0	0.0	0	0.0	0

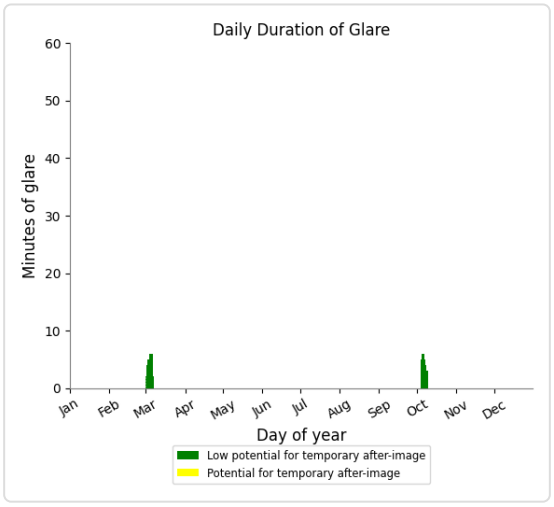


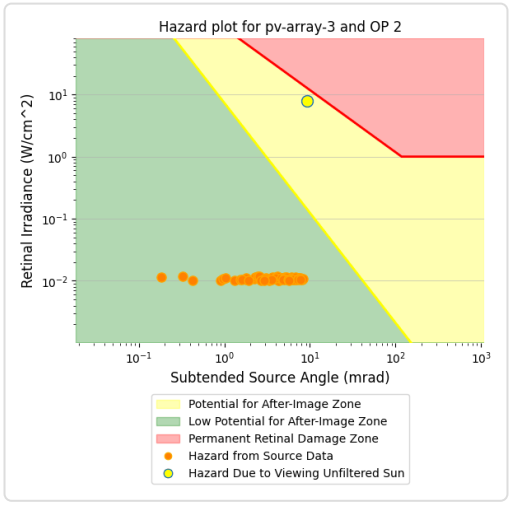
PV array 3 and OP 2

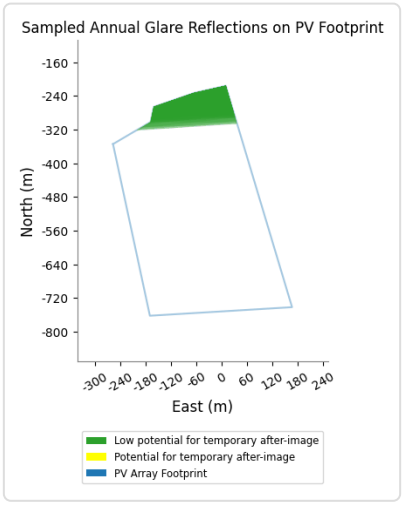
Yellow glare: none

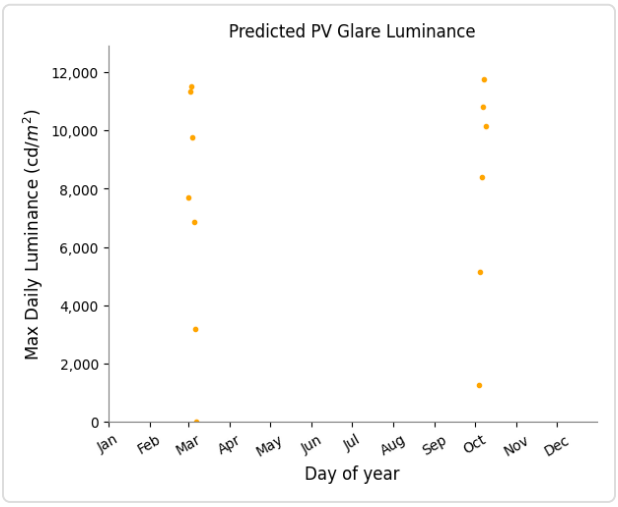
Green glare: 60 min.







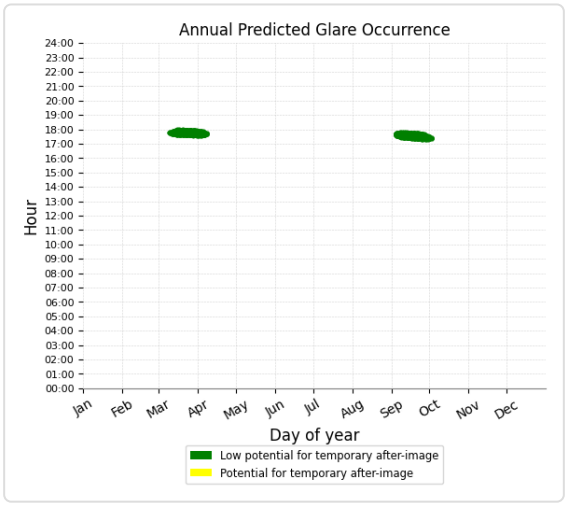


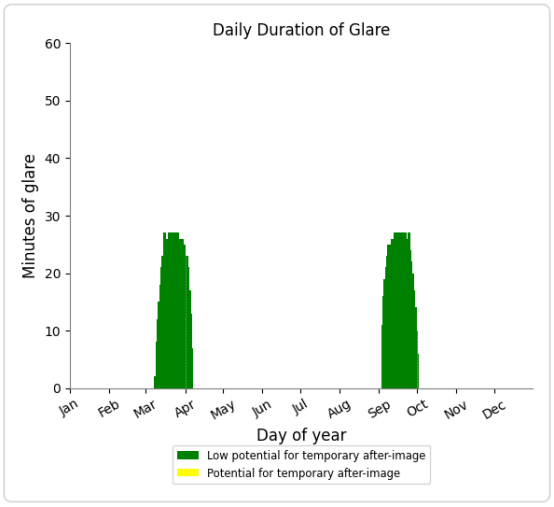


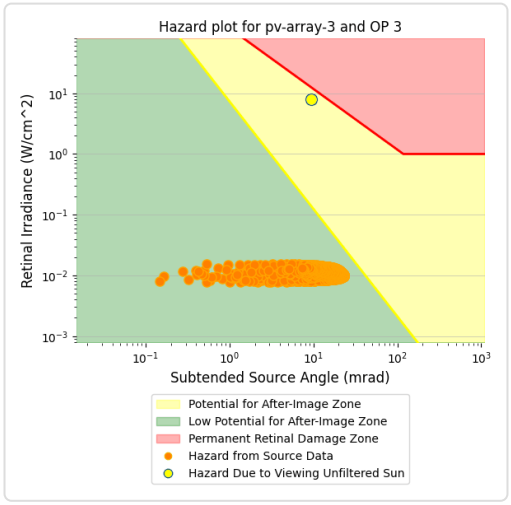
PV array 3 and OP 3

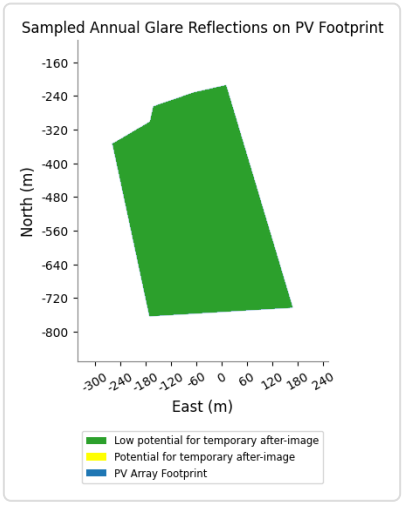
Yellow glare: none

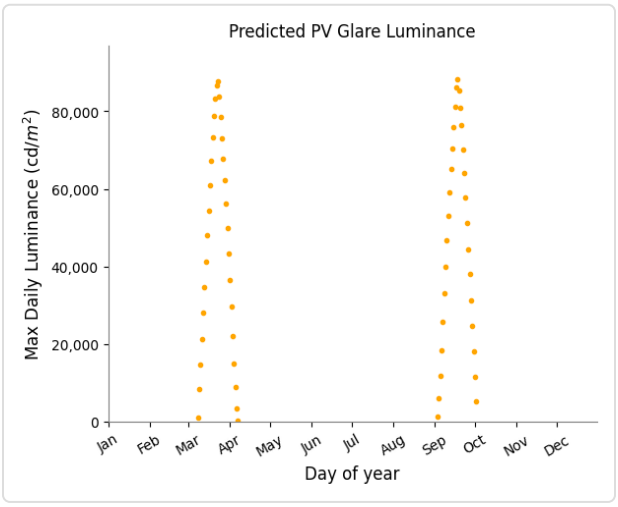
Green glare: 1,360 min.







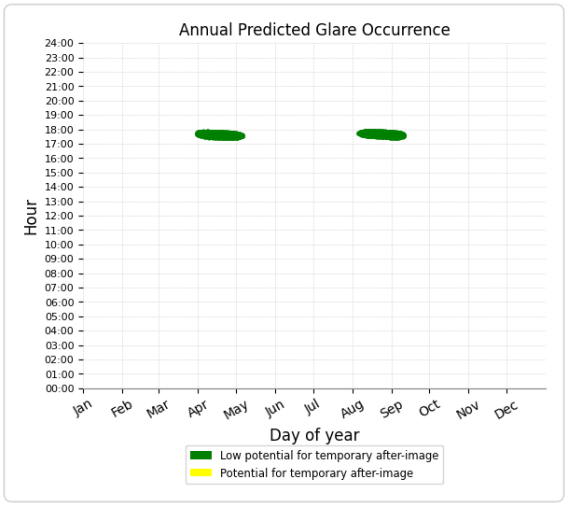


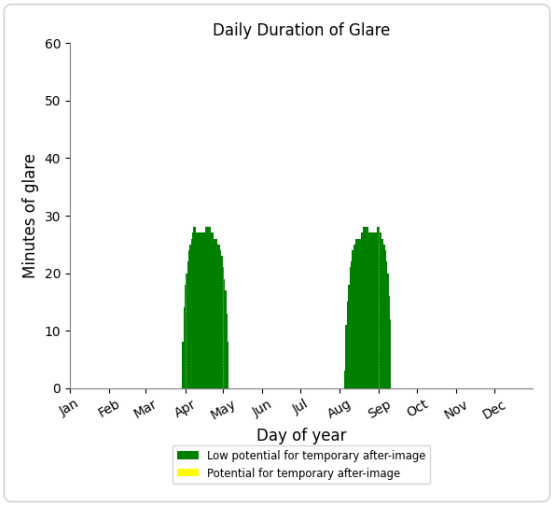


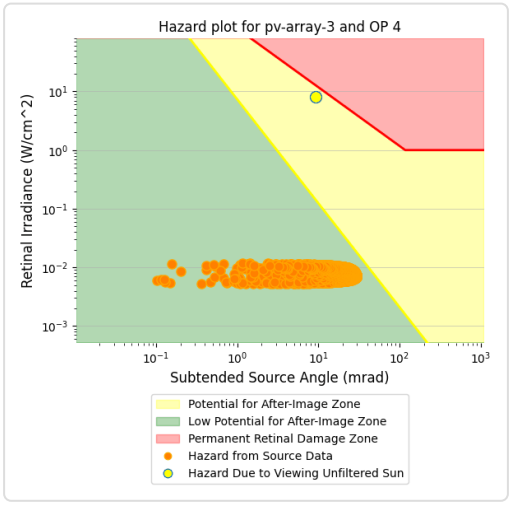
PV array 3 and OP 4

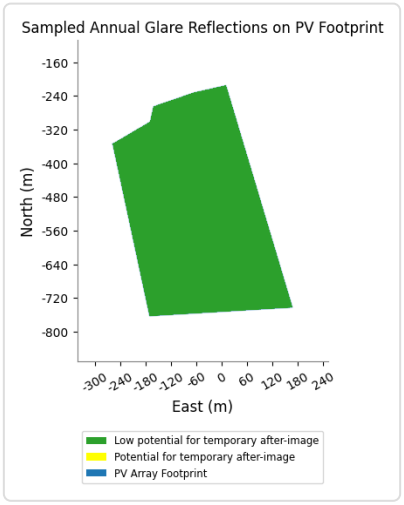
Yellow glare: none

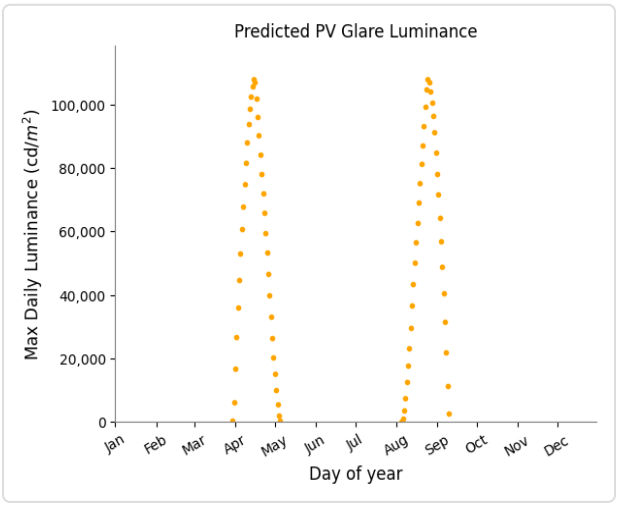
Green glare: 1,753 min.







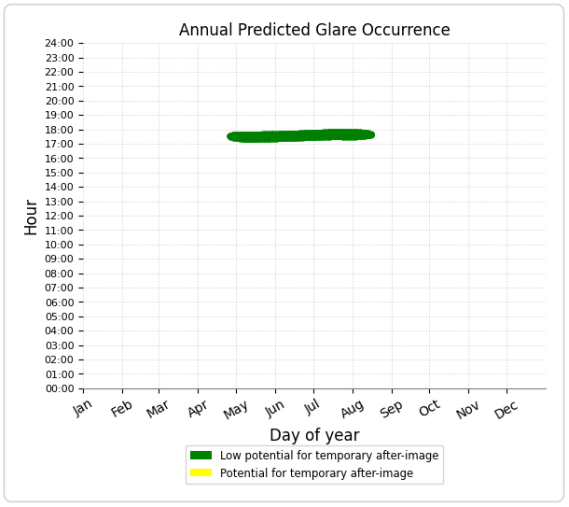


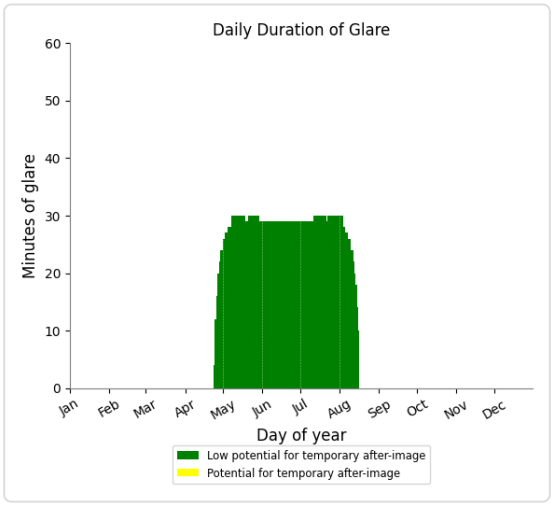


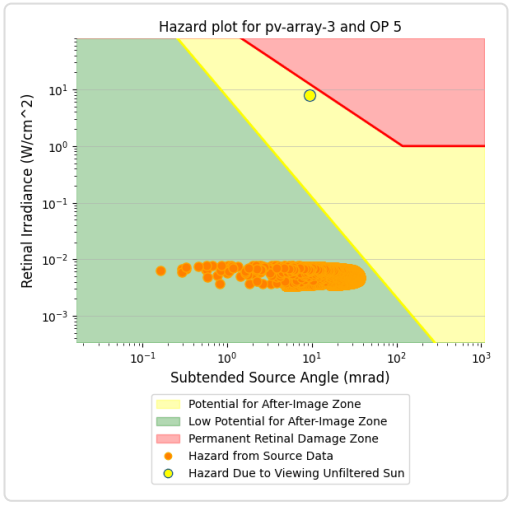
PV array 3 and OP 5

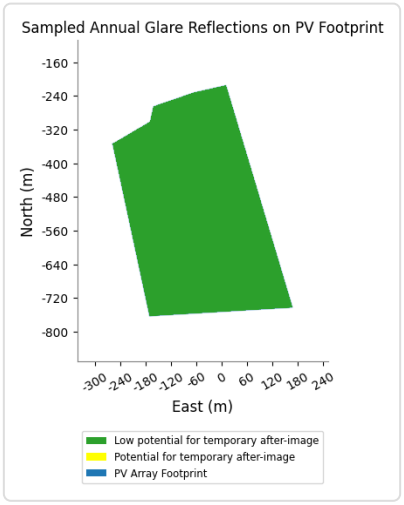
Yellow glare: none

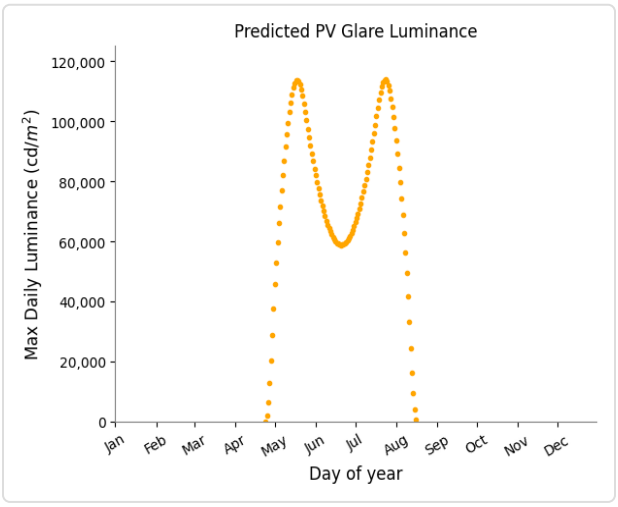
Green glare: 3,200 min.







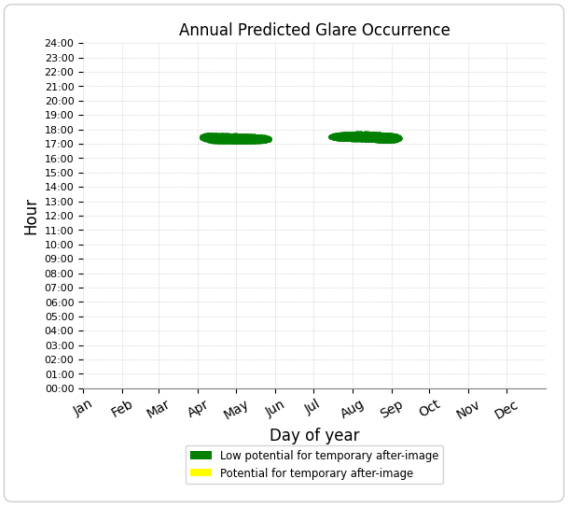


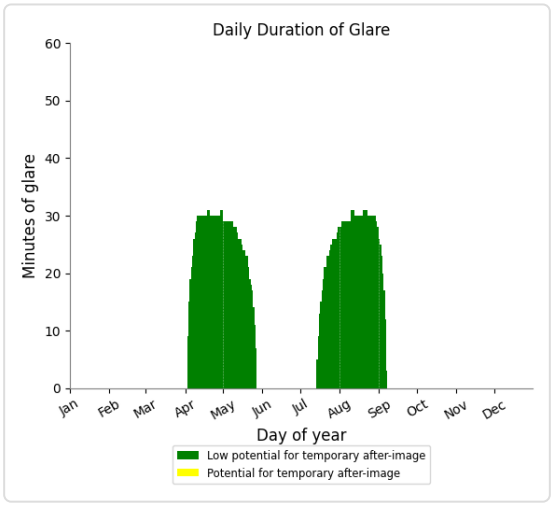


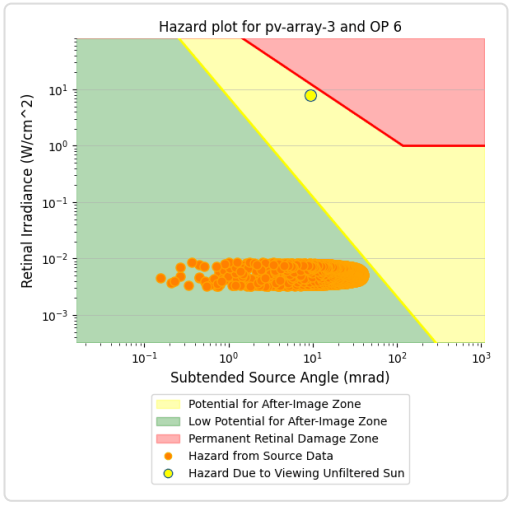
PV array 3 and OP 6

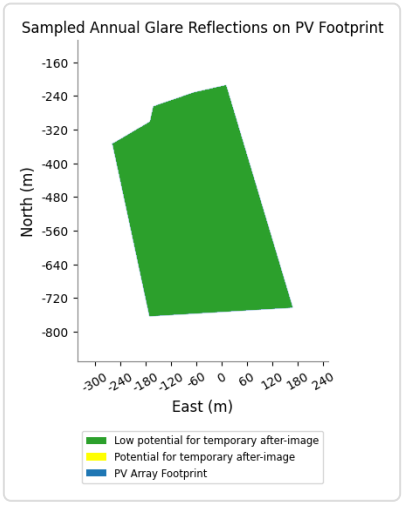
Yellow glare: none

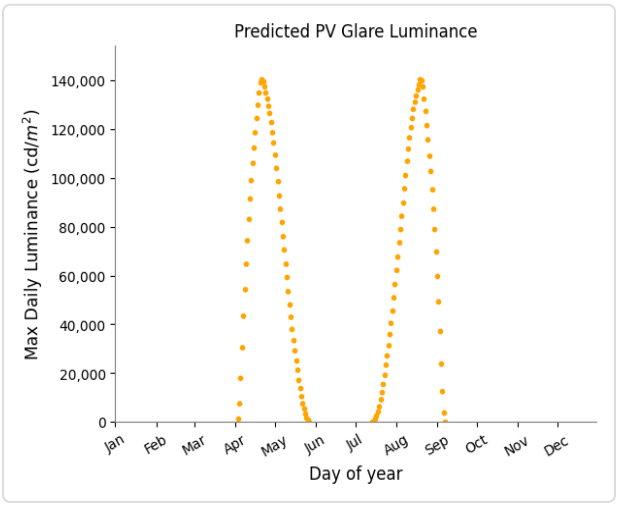
Green glare: 2,842 min.







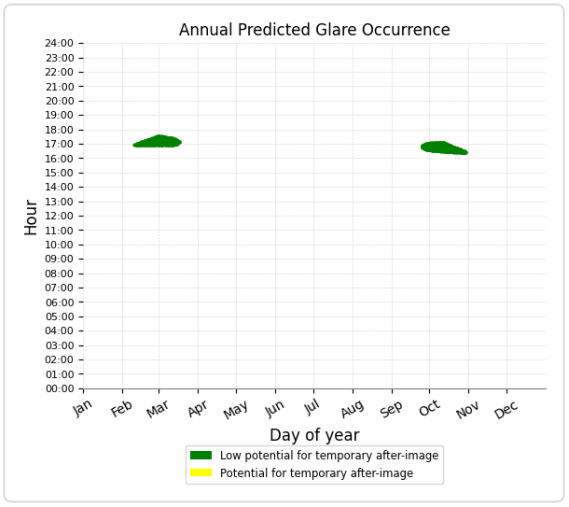


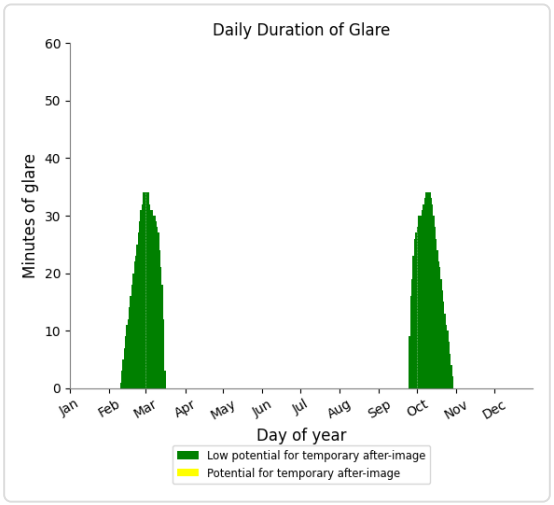


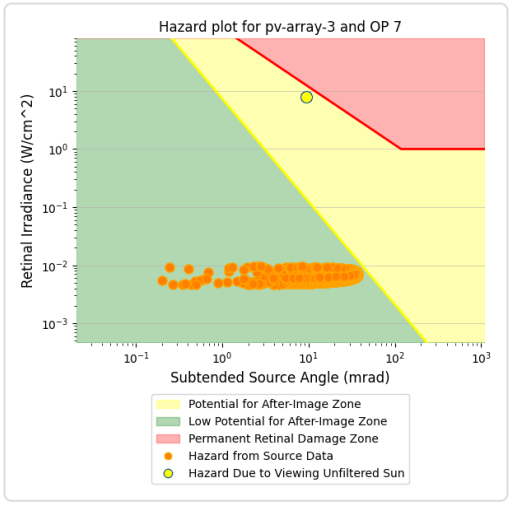
PV array 3 and OP 7

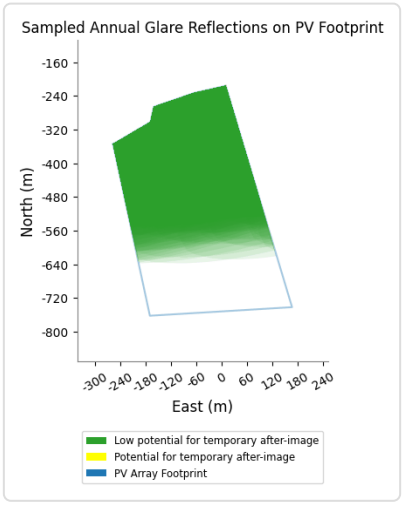
Yellow glare: none

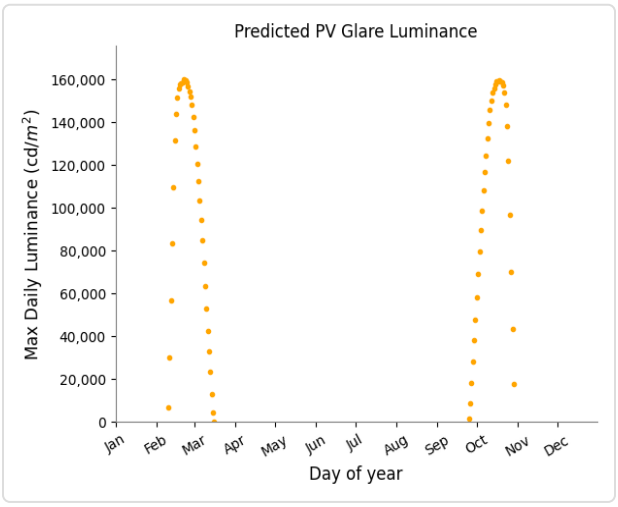
Green glare: 1,582 min.







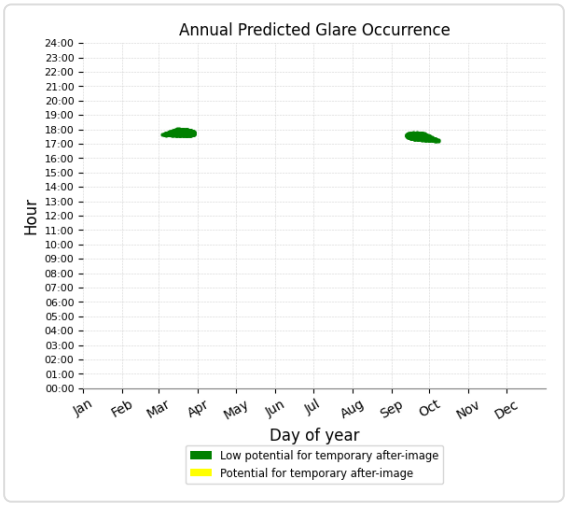


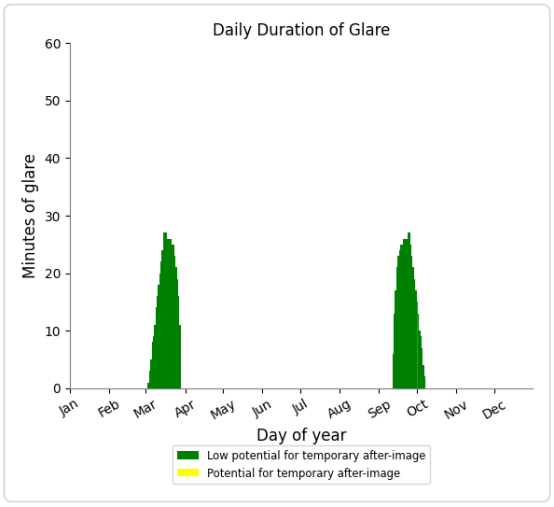


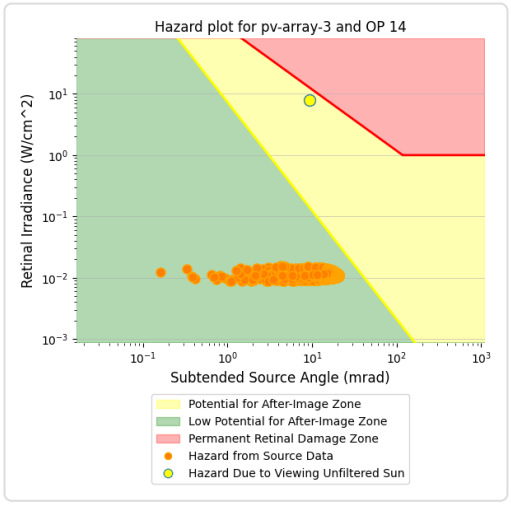
PV array 3 and OP 14

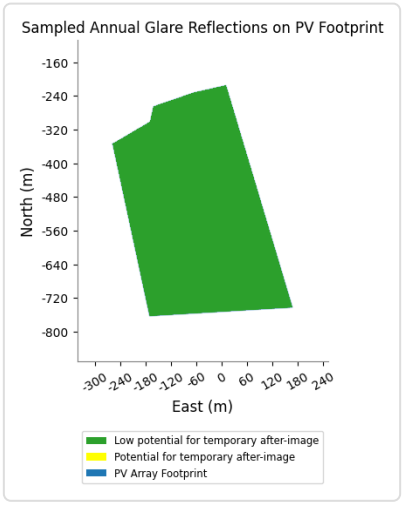
Yellow glare: none

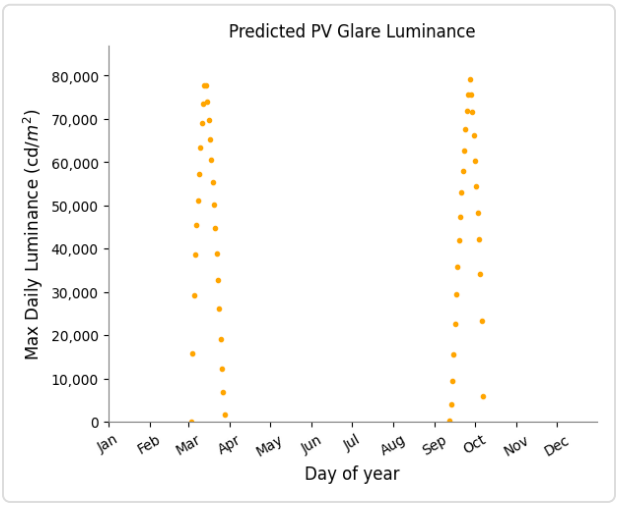
Green glare: 953 min.







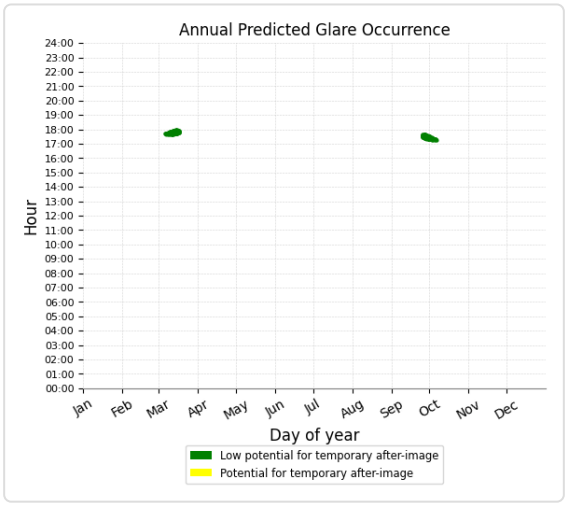


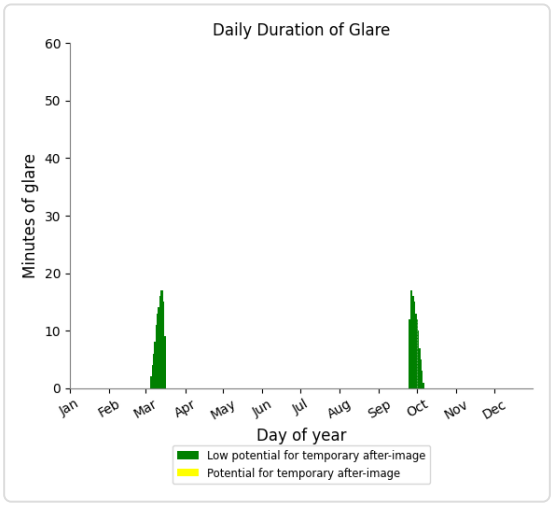


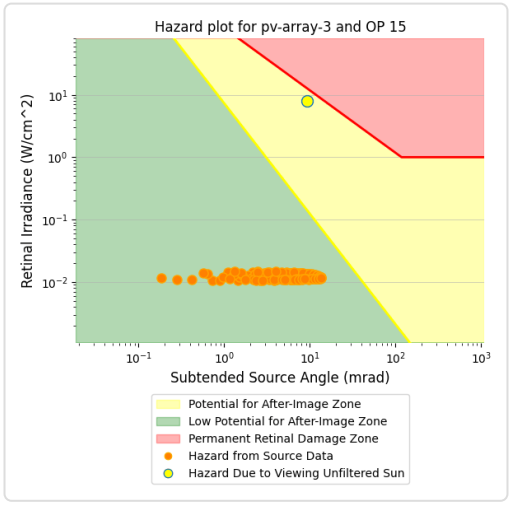
PV array 3 and OP 15

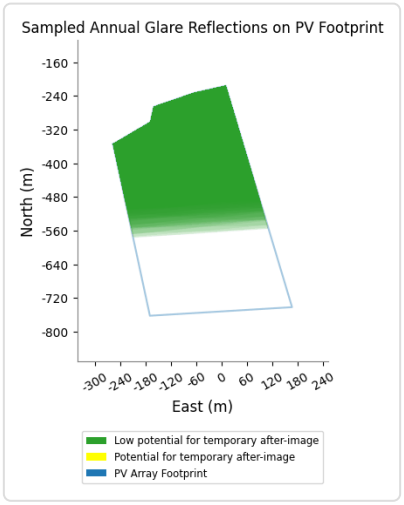
Yellow glare: none

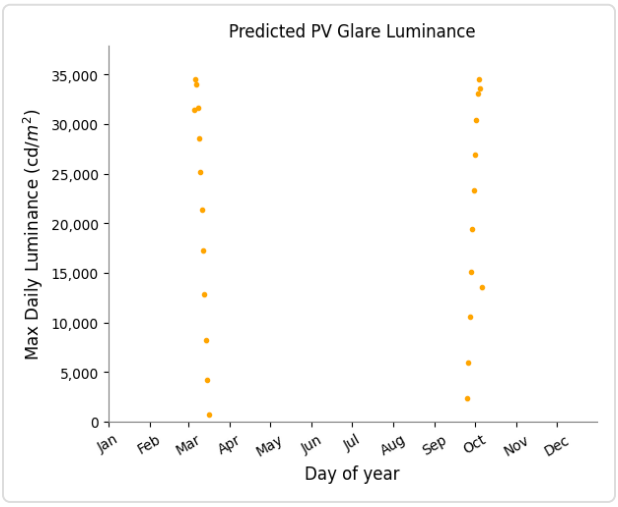
Green glare: 260 min.











PV array 3 and OP 1

No glare found

PV array 3 and OP 8

No glare found

PV array 3 and OP 9

No glare found

PV array 3 and OP 10

No glare found

PV array 3 and OP 11

No glare found

PV array 3 and OP 12

No glare found

PV array 3 and OP 13

No glare found

PV array 3 and OP 16

No glare found

PV array 3 and OP 17

No glare found

PV array 3 and OP 18

No glare found

PV array 3 and OP 19

No glare found

PV array 3 and OP 20

No glare found

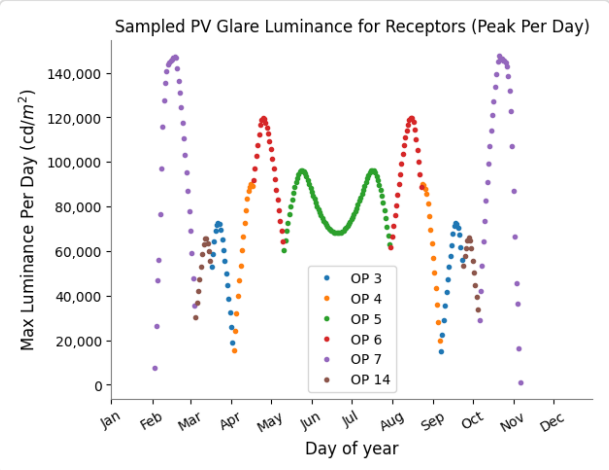
PV array 3 and OP 21

No glare found

PV: PV array 4 low potential for temporary after-image

Receptor results ordered by category of glare

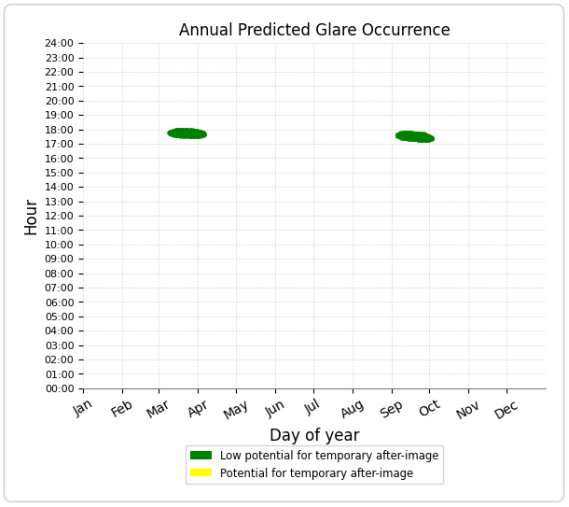
Receptor	Annual Green Glare		Annual Yellow Glare		Peak Luminance
	min	hr	min	hr	cd/m^2
OP 3	1,286	21.4	0	0.0	72,584
OP 4	1,633	27.2	0	0.0	90,188
OP 5	2,999	50.0	0	0.0	96,256
OP 6	2,760	46.0	0	0.0	119,703
OP 7	1,572	26.2	0	0.0	147,495
OP 14	888	14.8	0	0.0	66,108
OP 15	180	3.0	0	0.0	26,499
OP 1	0	0.0	0	0.0	0
OP 2	0	0.0	0	0.0	0
OP 8	0	0.0	0	0.0	0
OP 9	0	0.0	0	0.0	0
OP 10	0	0.0	0	0.0	0
OP 11	0	0.0	0	0.0	0
OP 12	0	0.0	0	0.0	0
OP 13	0	0.0	0	0.0	0
OP 16	0	0.0	0	0.0	0
OP 17	0	0.0	0	0.0	0
OP 18	0	0.0	0	0.0	0
OP 19	0	0.0	0	0.0	0
OP 20	0	0.0	0	0.0	0
OP 21	0	0.0	0	0.0	0

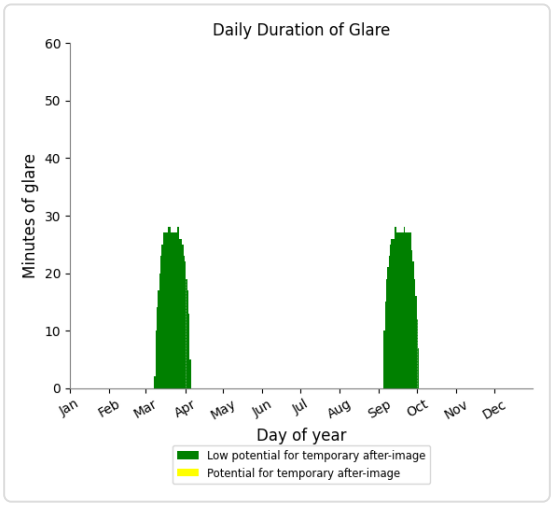


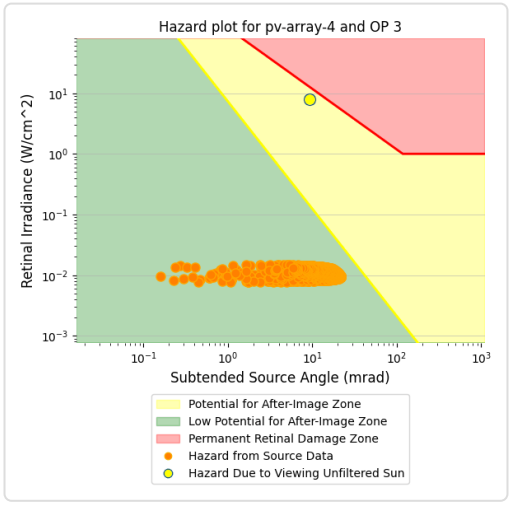
PV array 4 and OP 3

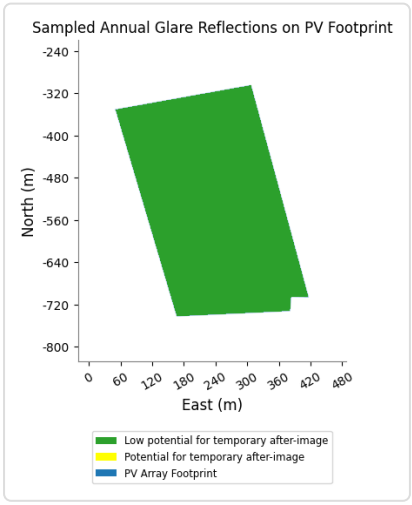
Yellow glare: none

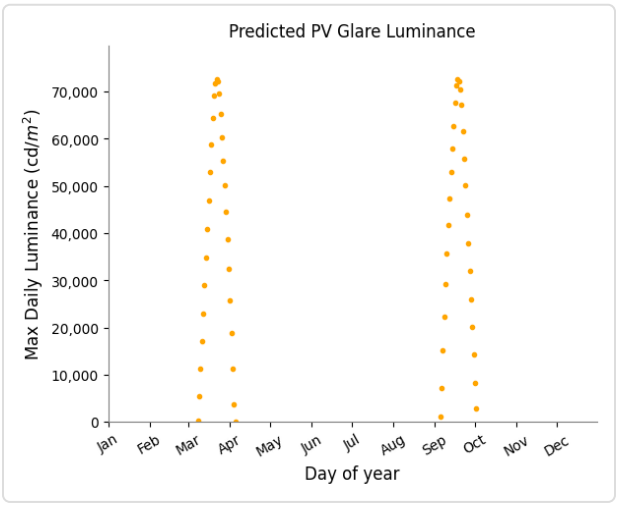
Green glare: 1,286 min.







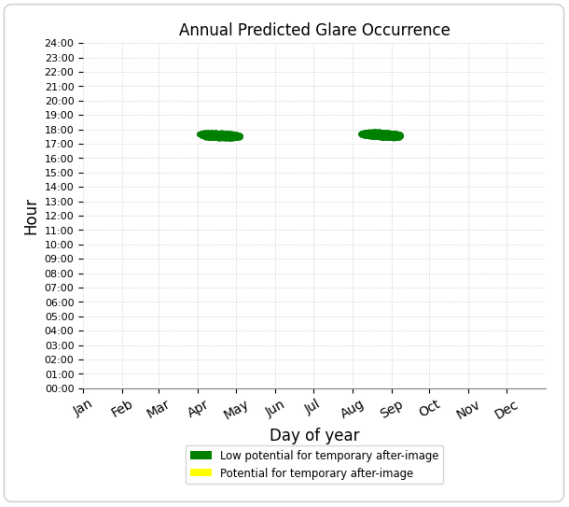


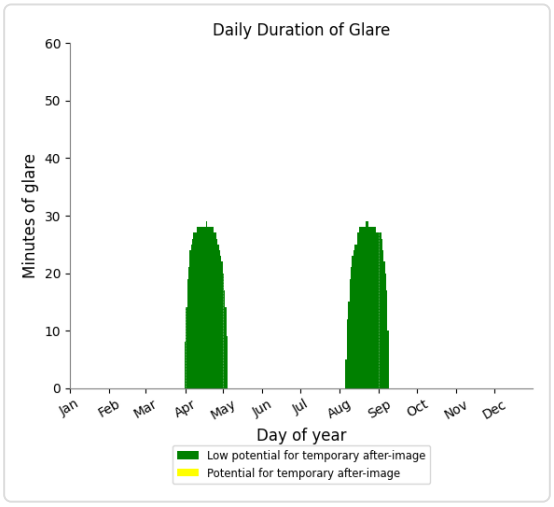


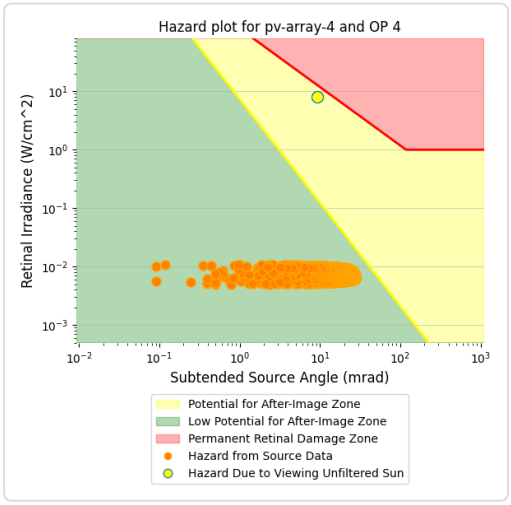
PV array 4 and OP 4

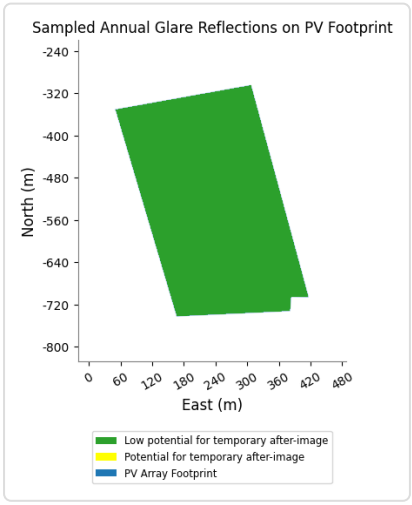
Yellow glare: none

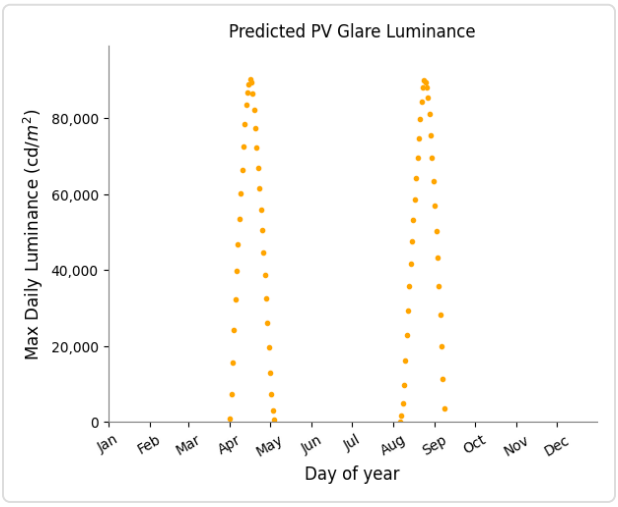
Green glare: 1,633 min.







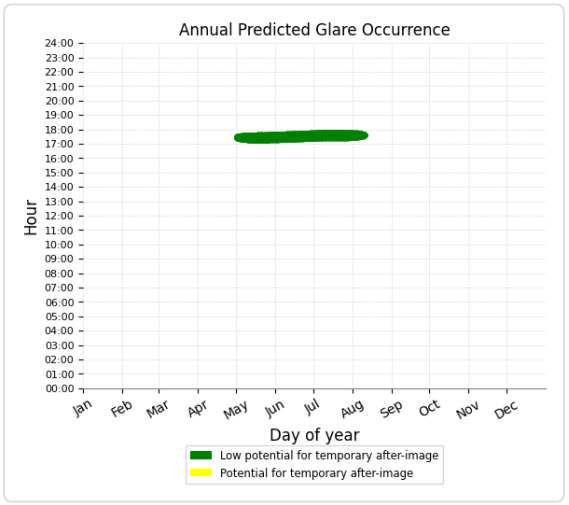


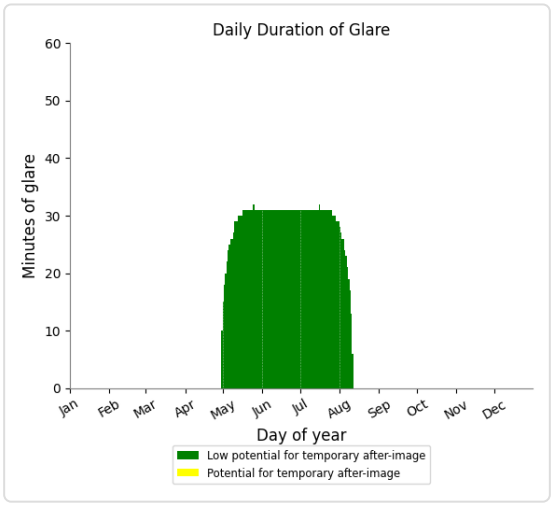


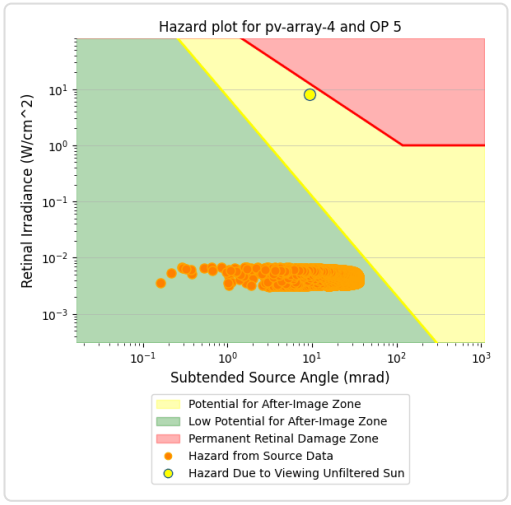
PV array 4 and OP 5

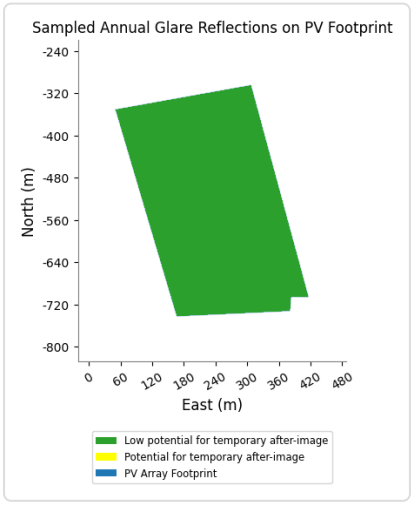
Yellow glare: none

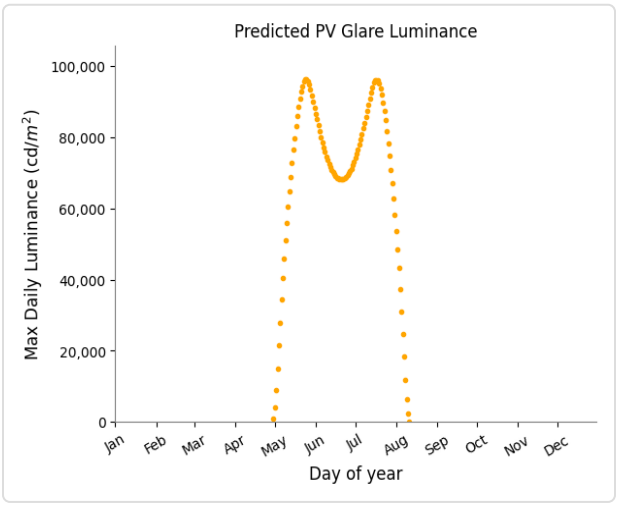
Green glare: 2,999 min.







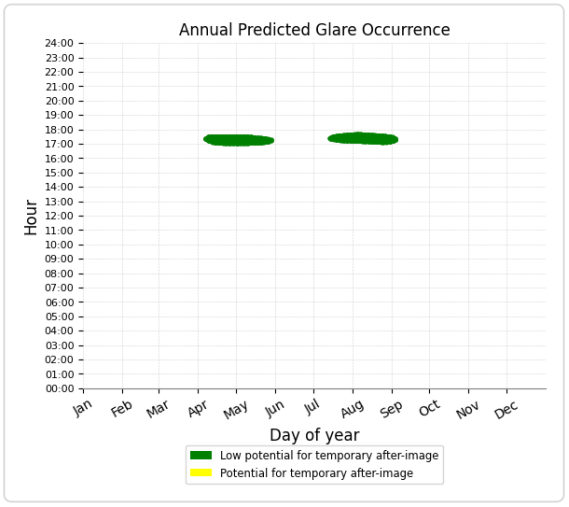


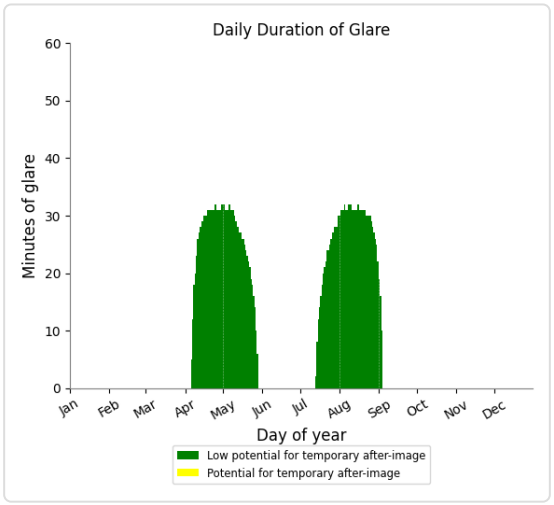


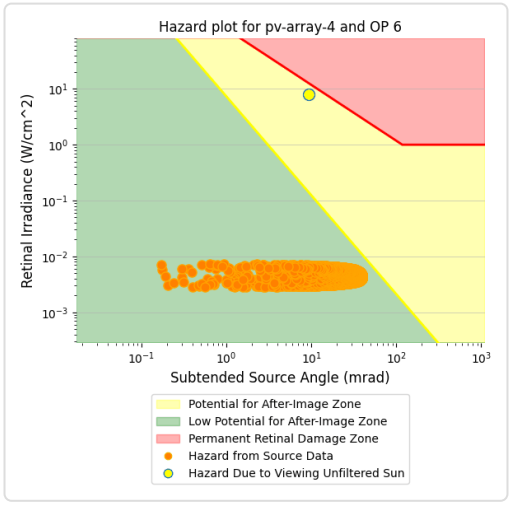
PV array 4 and OP 6

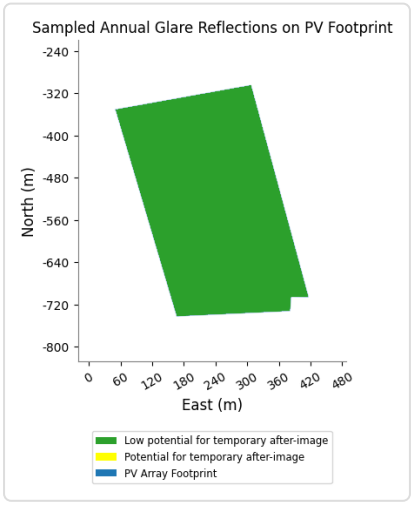
Yellow glare: none

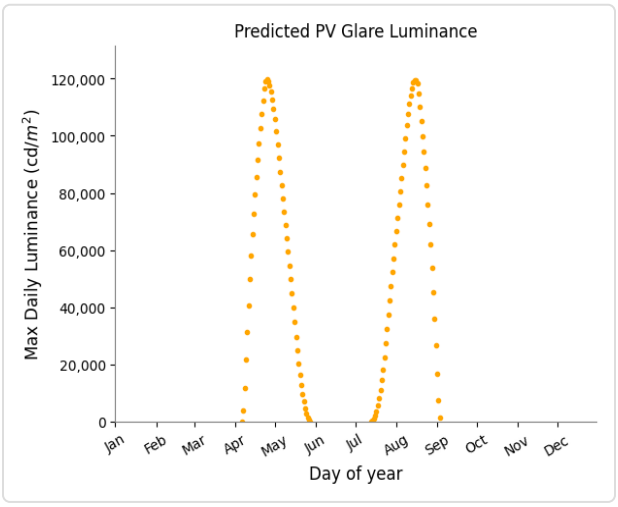
Green glare: 2,760 min.







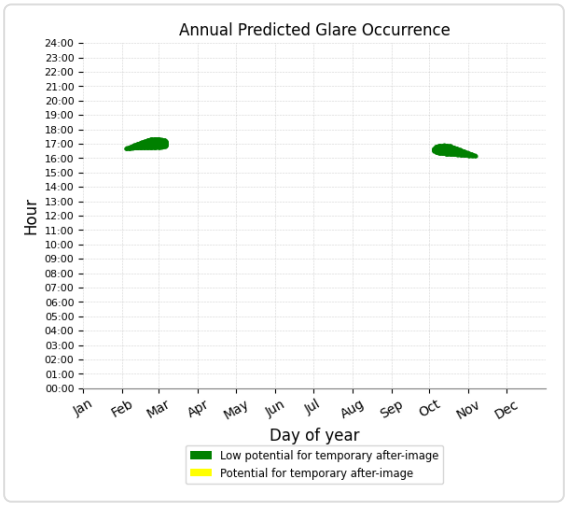


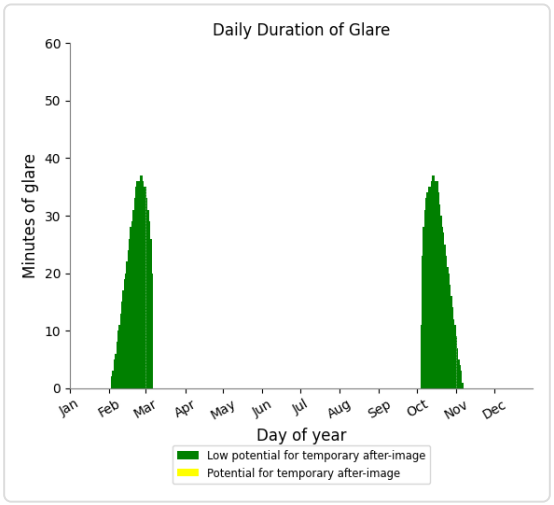


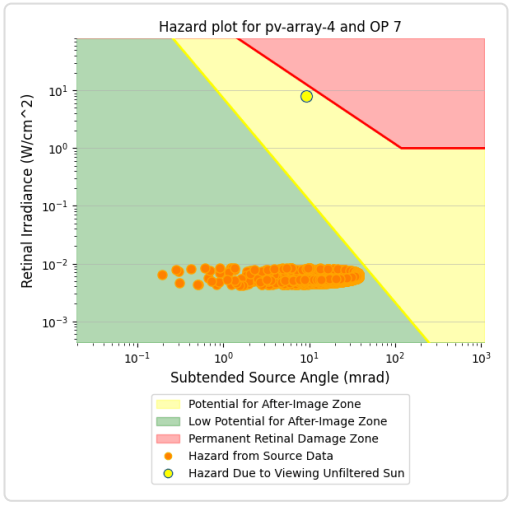
PV array 4 and OP 7

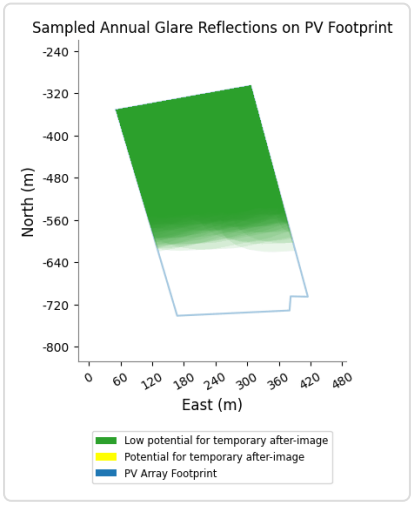
Yellow glare: none

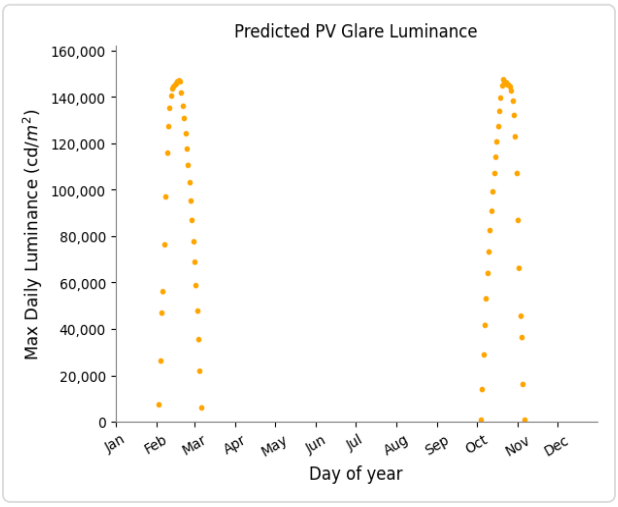
Green glare: 1,572 min.







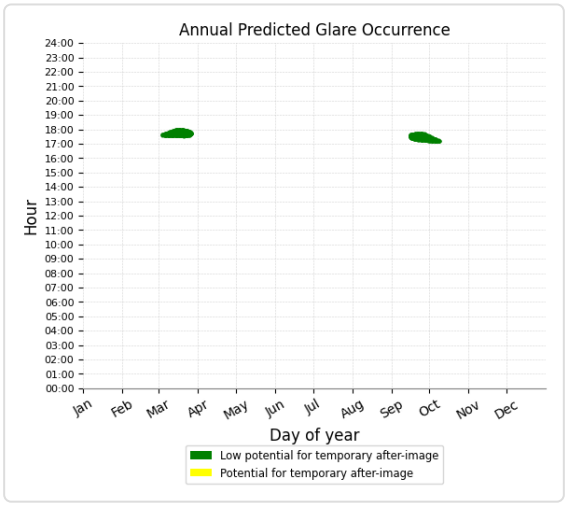


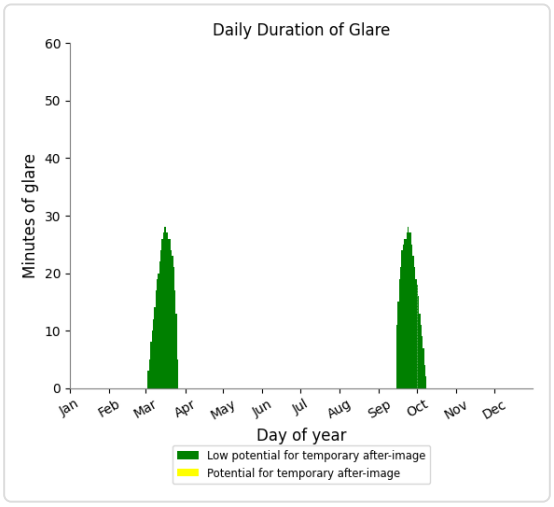


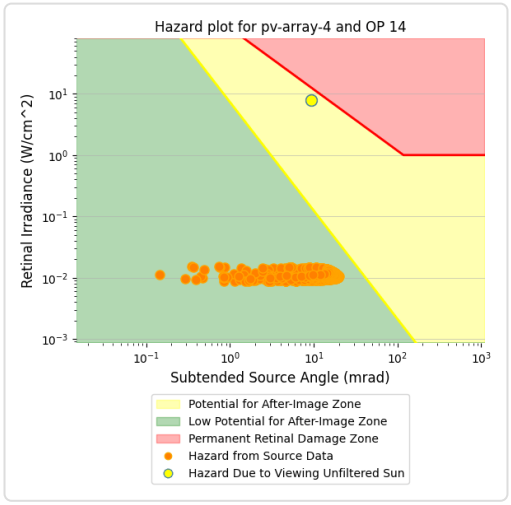
PV array 4 and OP 14

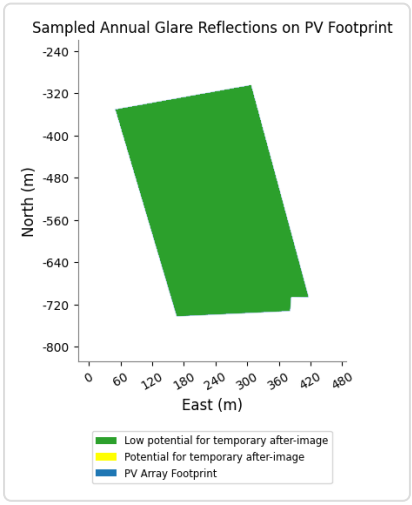
Yellow glare: none

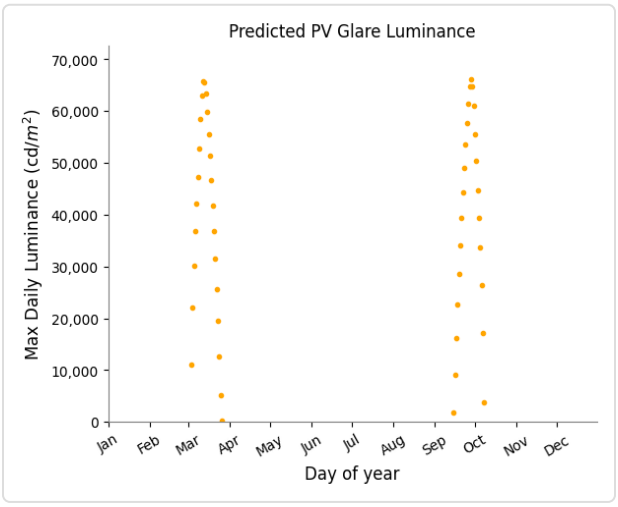
Green glare: 888 min.







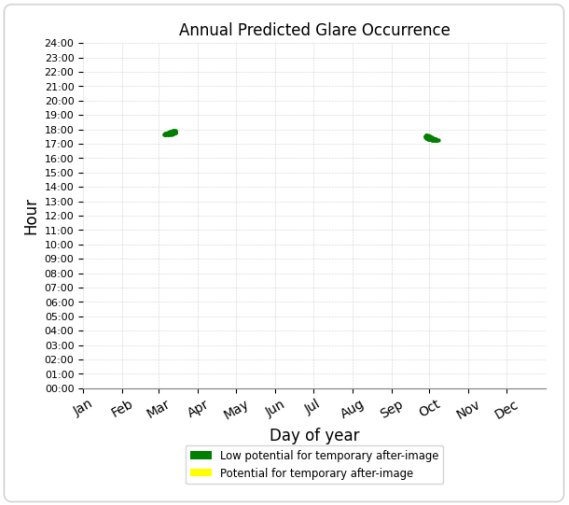


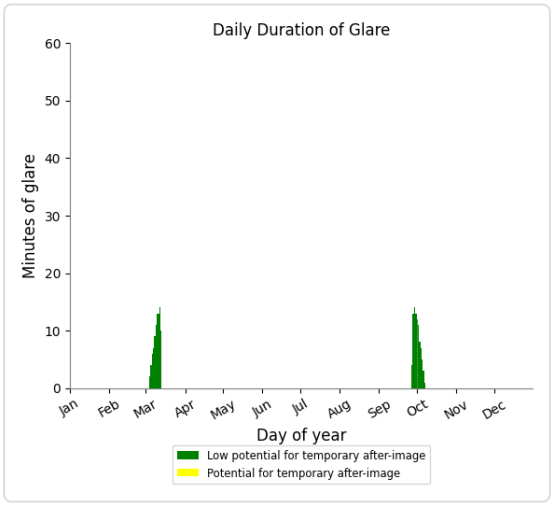


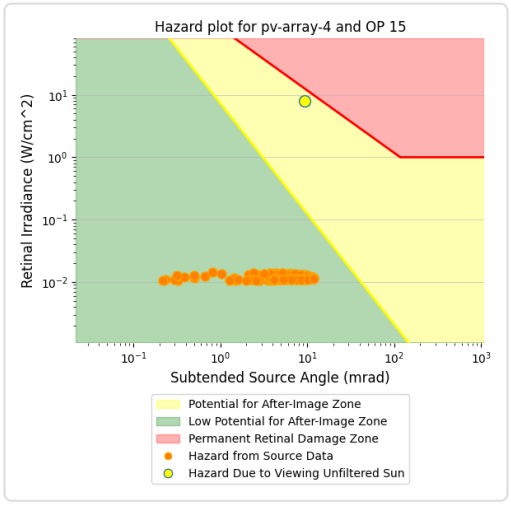
PV array 4 and OP 15

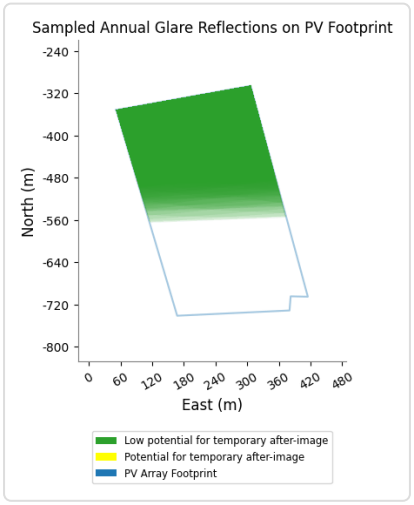
Yellow glare: none

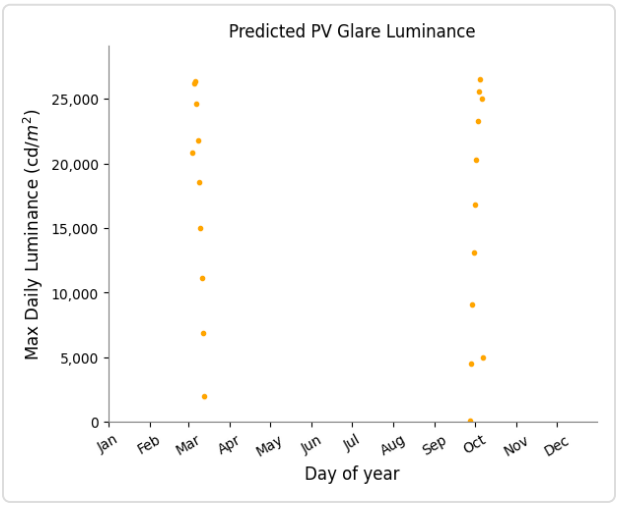
Green glare: 180 min.











PV array 4 and OP 1

No glare found

PV array 4 and OP 2

No glare found

PV array 4 and OP 8

No glare found

PV array 4 and OP 9

No glare found

PV array 4 and OP 10

No glare found

PV array 4 and OP 11

No glare found

PV array 4 and OP 12

No glare found

PV array 4 and OP 13

No glare found

PV array 4 and OP 16

No glare found

PV array 4 and OP 17

No glare found

PV array 4 and OP 18

No glare found

PV array 4 and OP 19

No glare found

PV array 4 and OP 20

No glare found

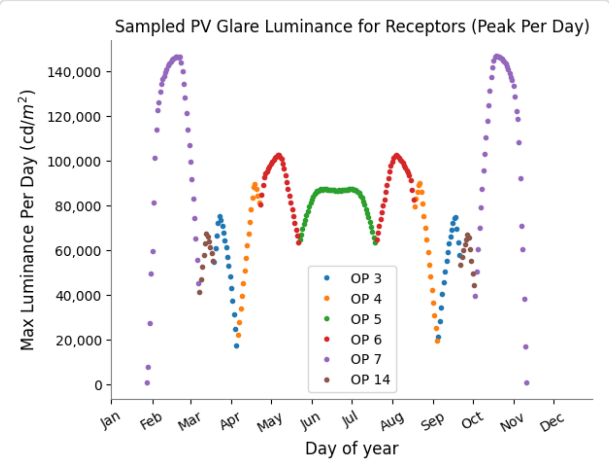
PV array 4 and OP 21

No glare found

PV: PV array 5 low potential for temporary after-image

Receptor results ordered by category of glare

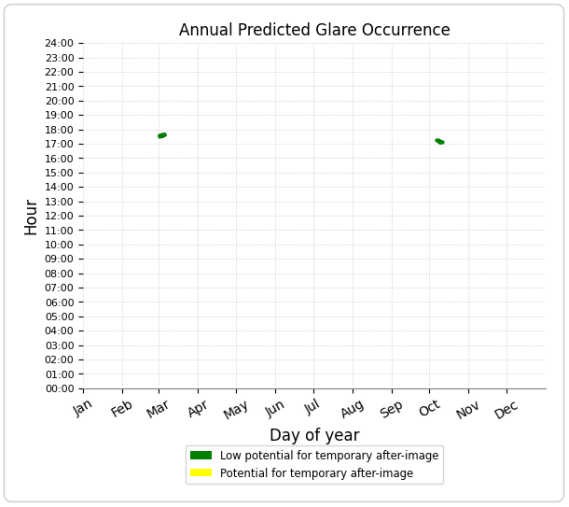
Receptor	Annual Green Glare		Annual Yellow Glare		Peak Luminance
	min	hr	min	hr	cd/m^2
OP 2	25	0.4	0	0.0	7,596
OP 3	1,414	23.6	0	0.0	75,135
OP 4	1,802	30.0	0	0.0	89,743
OP 5	2,625	43.8	0	0.0	87,160
OP 6	3,910	65.2	0	0.0	102,455
OP 7	2,269	37.8	0	0.0	146,695
OP 14	1,014	16.9	0	0.0	67,149
OP 15	243	4.0	0	0.0	31,997
OP 1	0	0.0	0	0.0	0
OP 8	0	0.0	0	0.0	0
OP 9	0	0.0	0	0.0	0
OP 10	0	0.0	0	0.0	0
OP 11	0	0.0	0	0.0	0
OP 12	0	0.0	0	0.0	0
OP 13	0	0.0	0	0.0	0
OP 16	0	0.0	0	0.0	0
OP 17	0	0.0	0	0.0	0
OP 18	0	0.0	0	0.0	0
OP 19	0	0.0	0	0.0	0
OP 20	0	0.0	0	0.0	0
OP 21	0	0.0	0	0.0	0

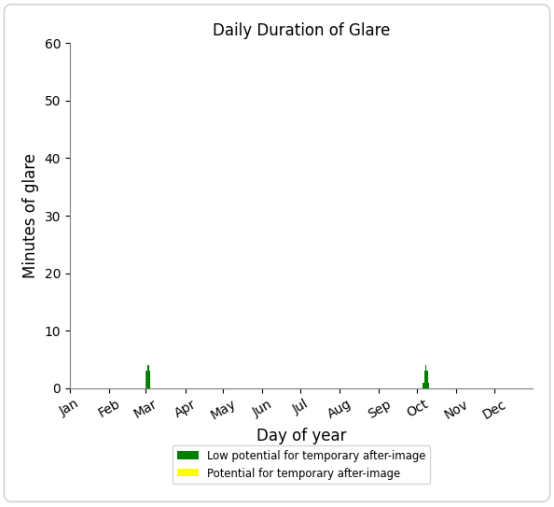


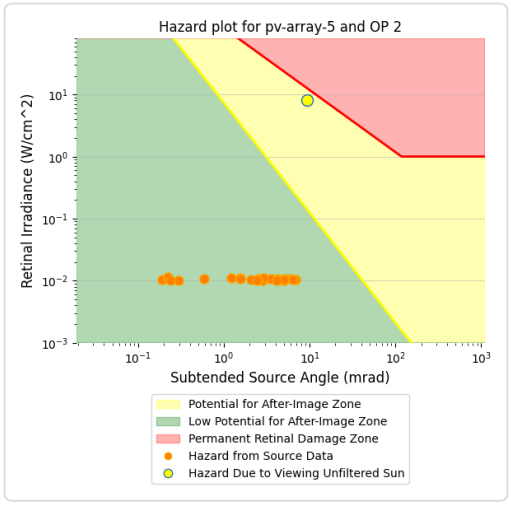
PV array 5 and OP 2

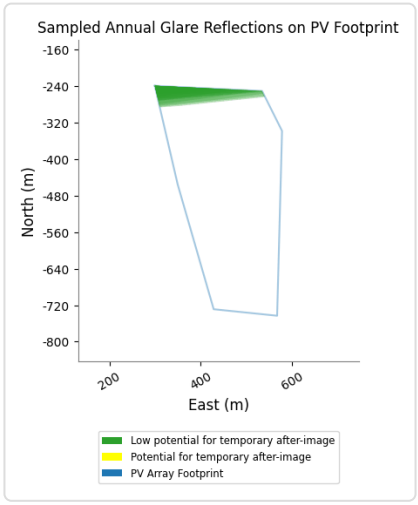
Yellow glare: none

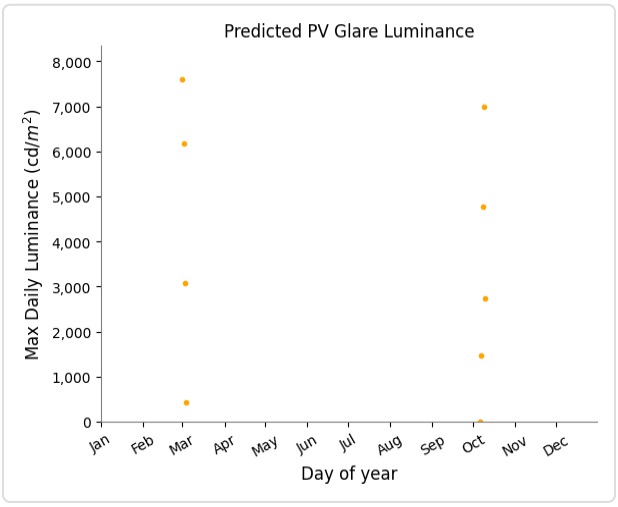
Green glare: 25 min.







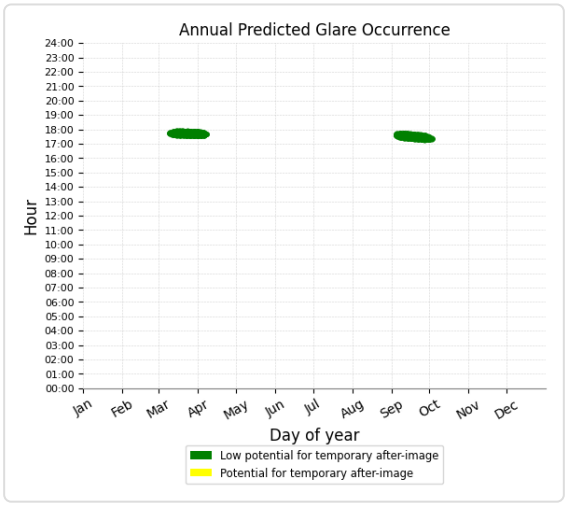


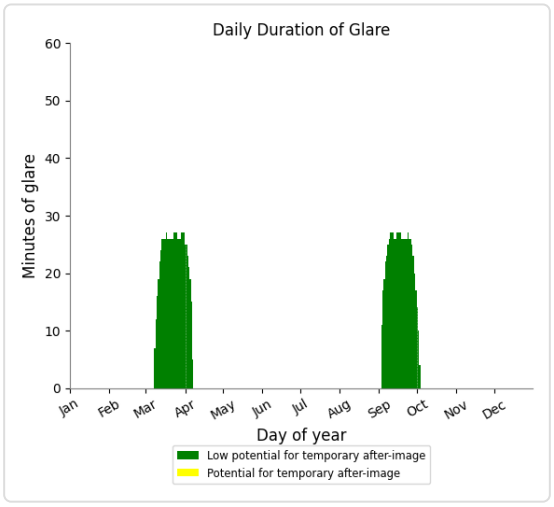


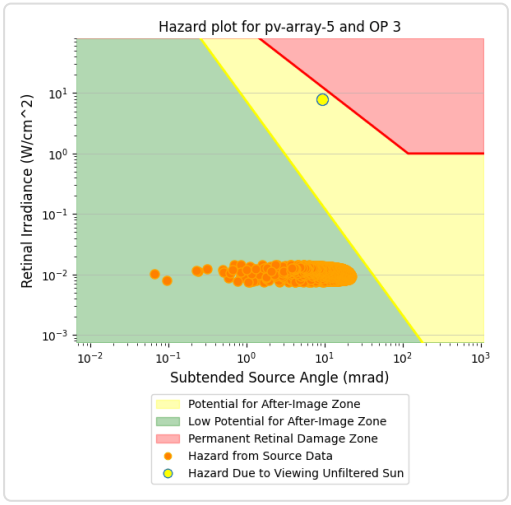
PV array 5 and OP 3

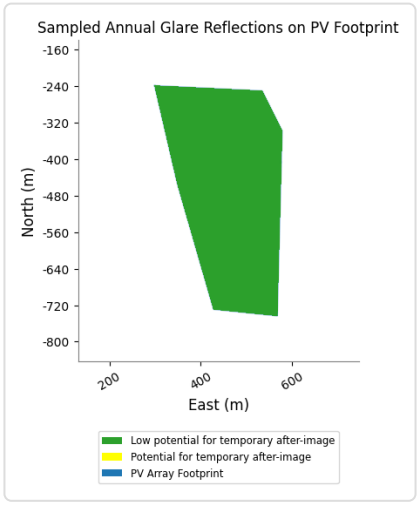
Yellow glare: none

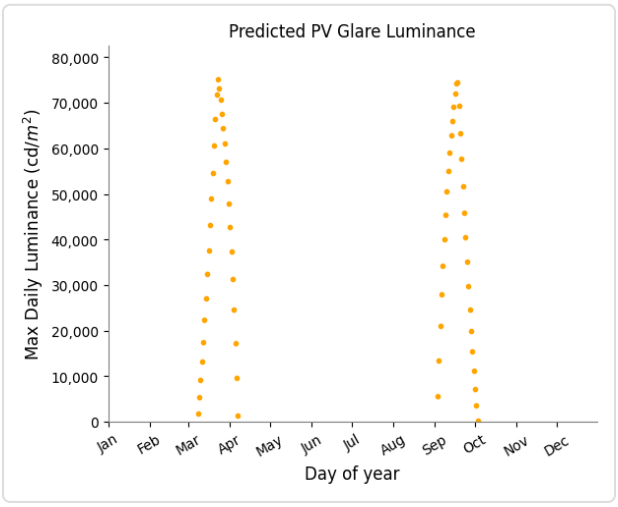
Green glare: 1,414 min.







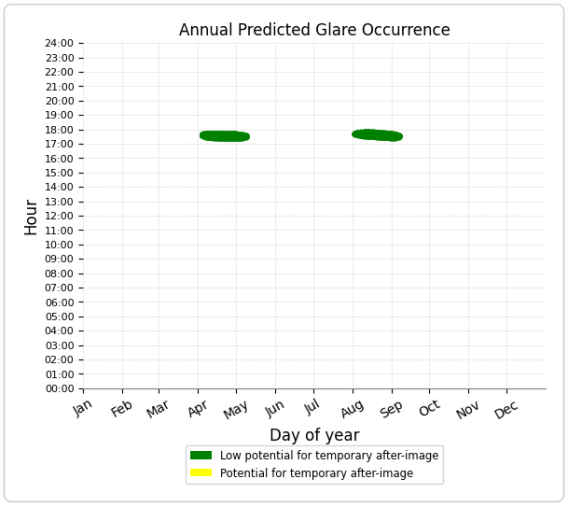


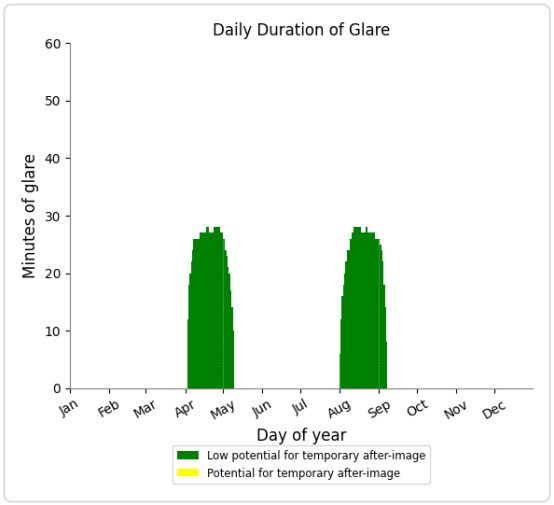


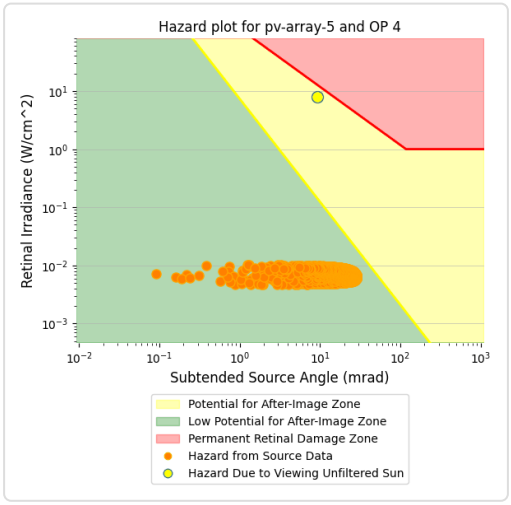
PV array 5 and OP 4

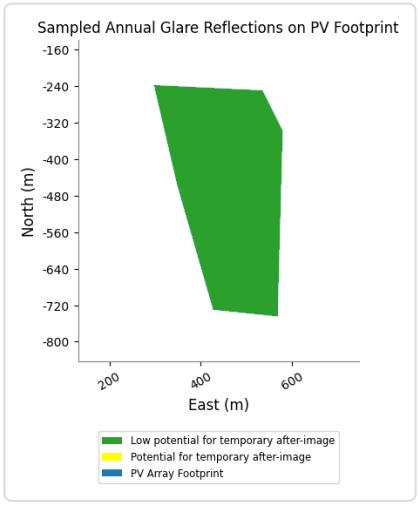
Yellow glare: none

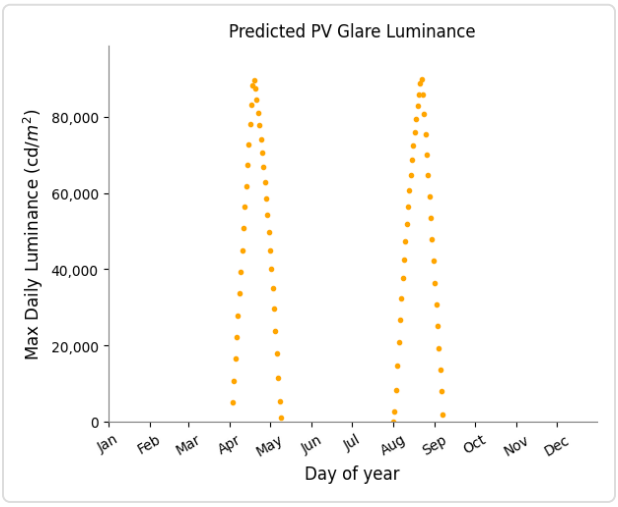
Green glare: 1,802 min.







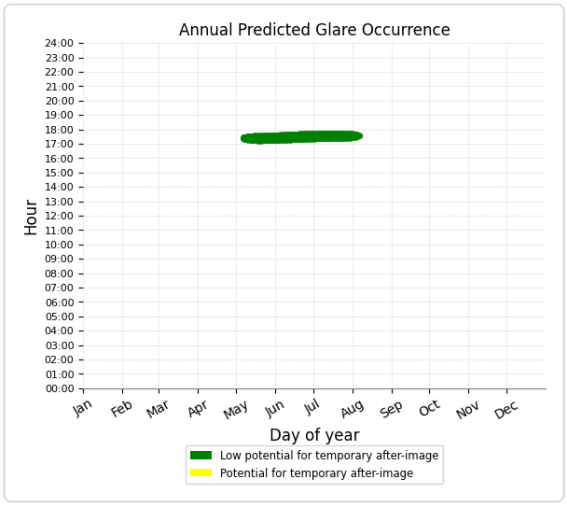


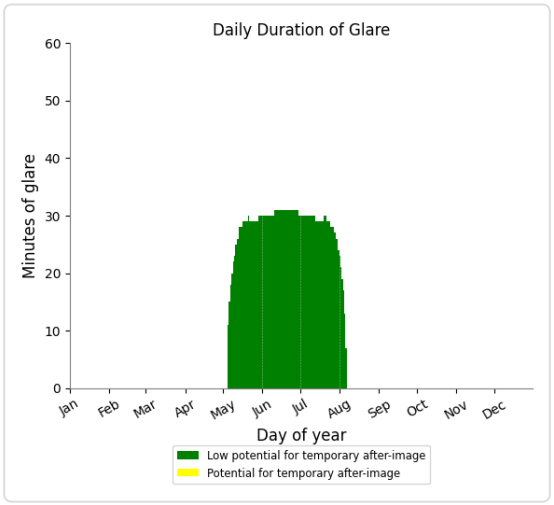


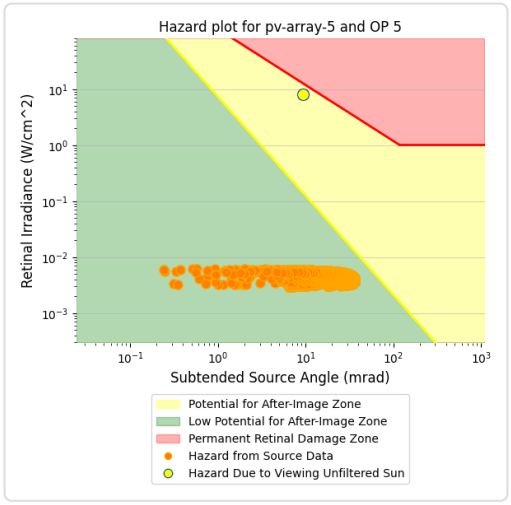
PV array 5 and OP 5

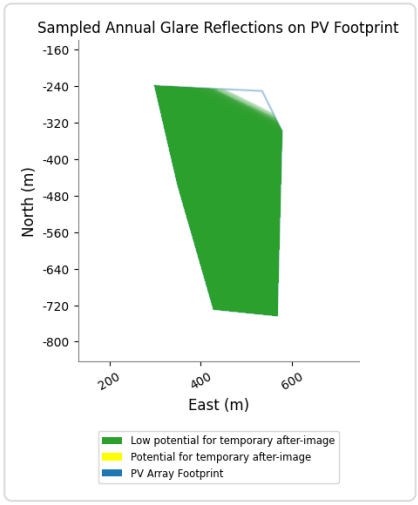
Yellow glare: none

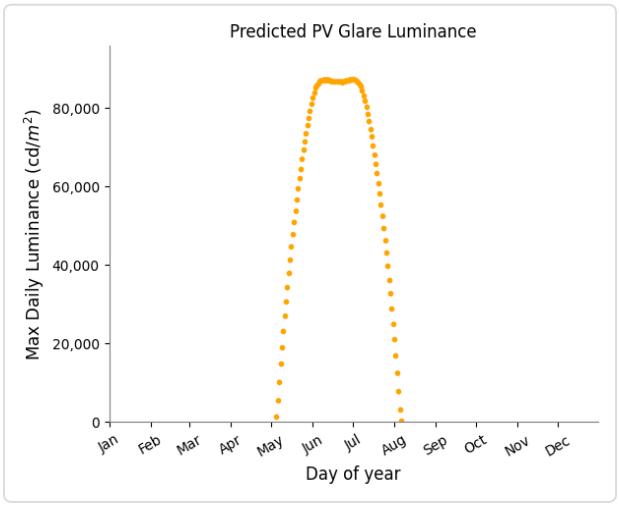
Green glare: 2,625 min.







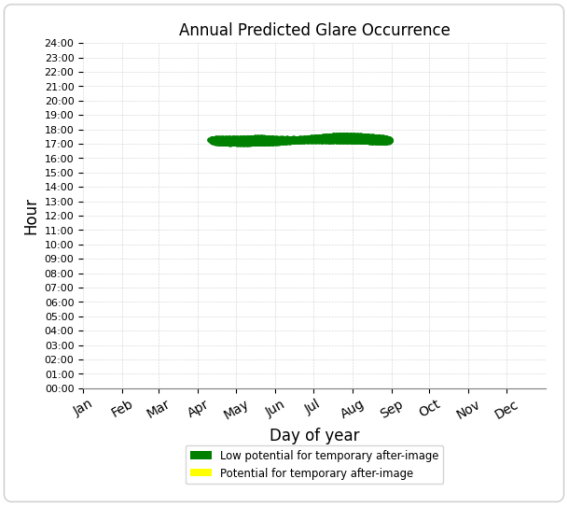


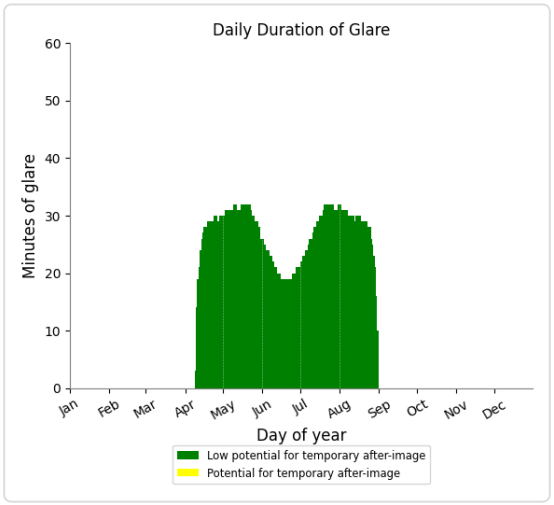


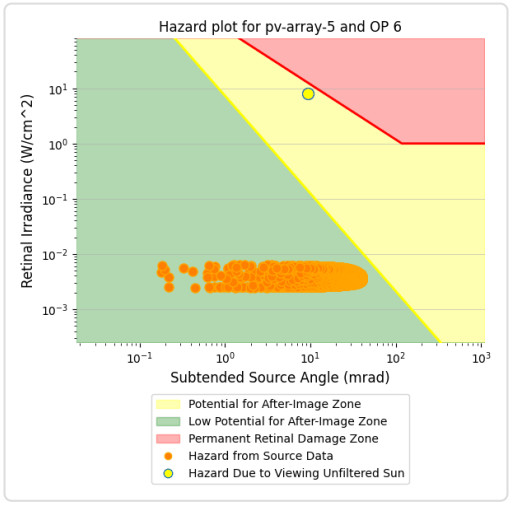
PV array 5 and OP 6

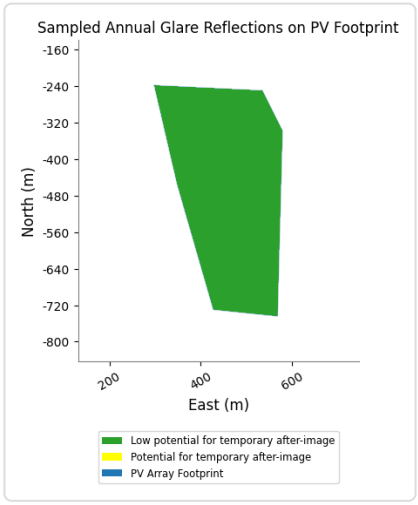
Yellow glare: none

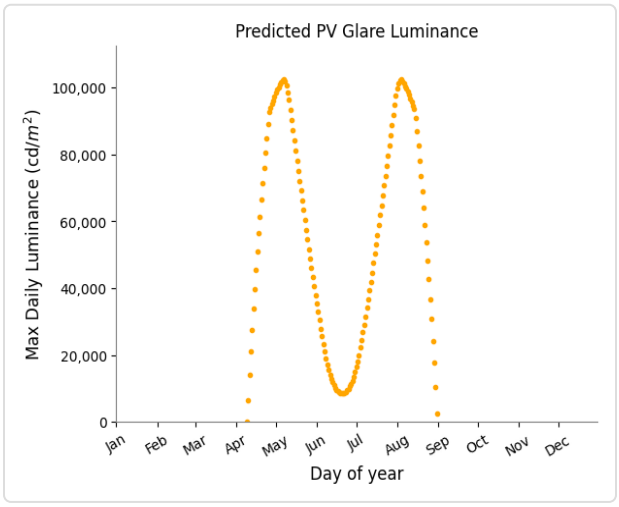
Green glare: 3,910 min.







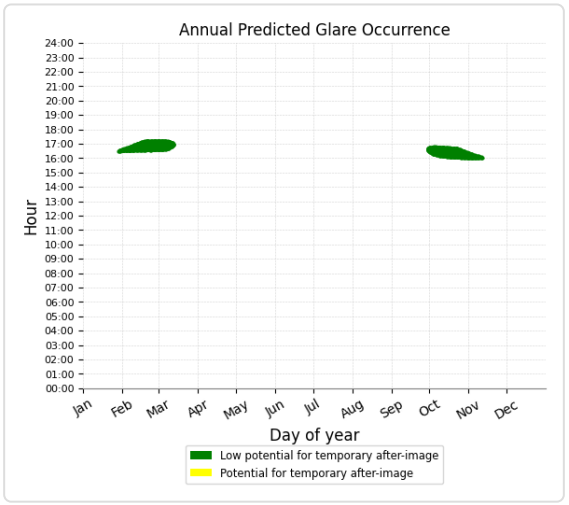


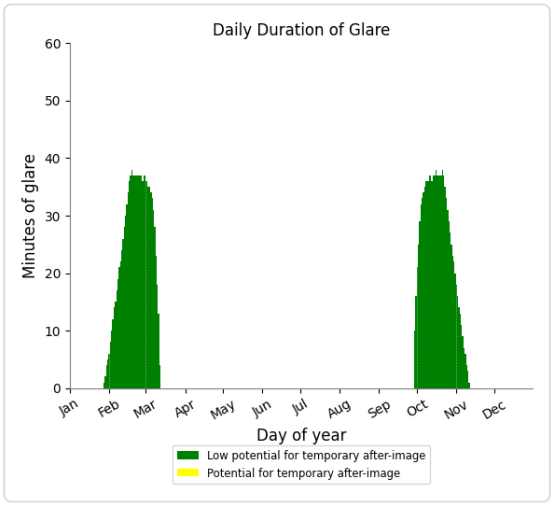


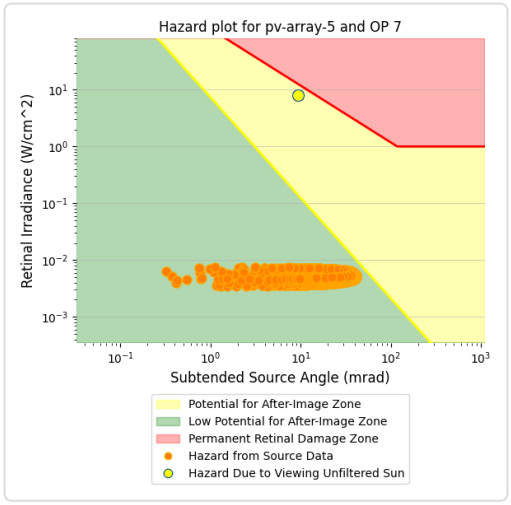
PV array 5 and OP 7

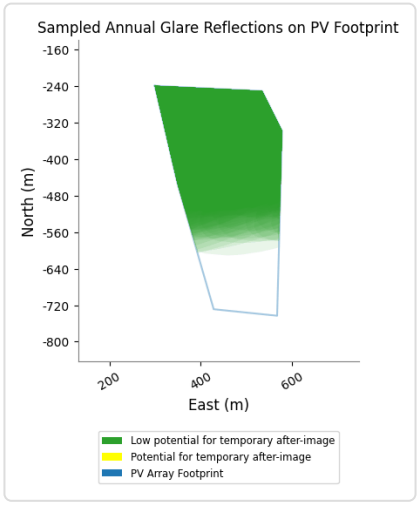
Yellow glare: none

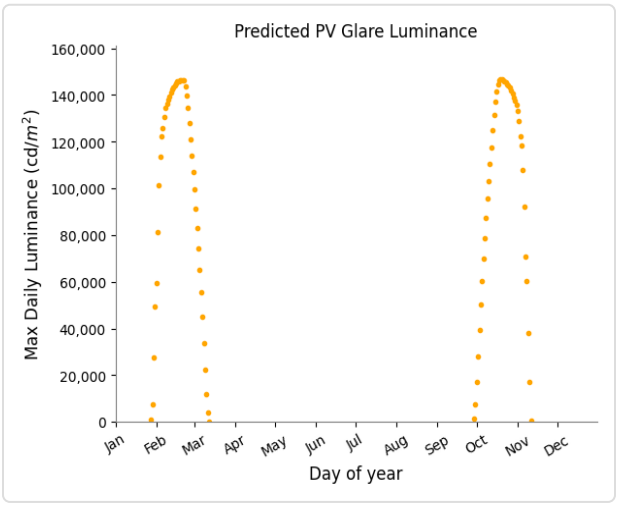
Green glare: 2,269 min.







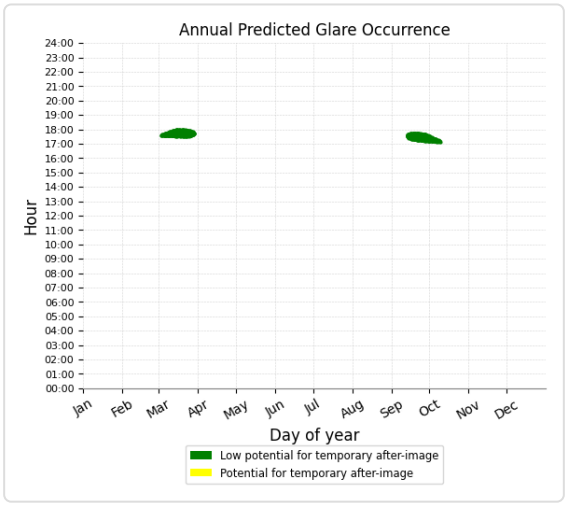


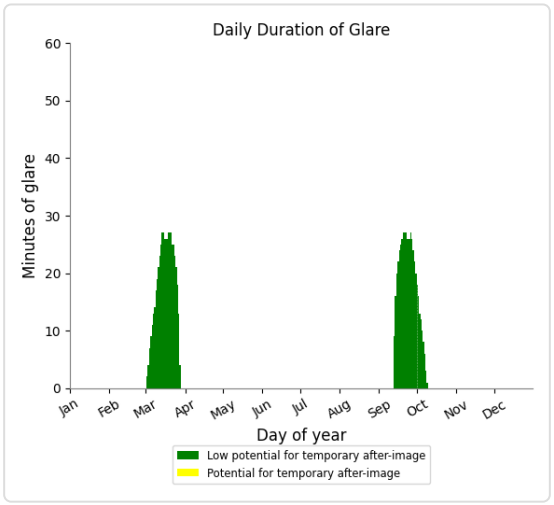


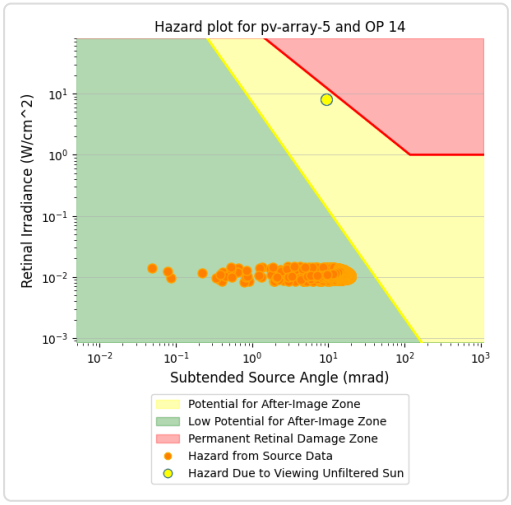
PV array 5 and OP 14

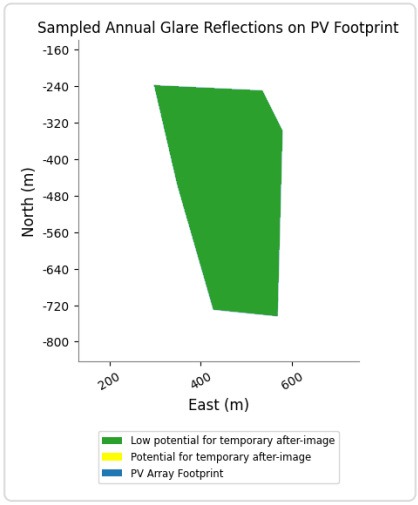
Yellow glare: none

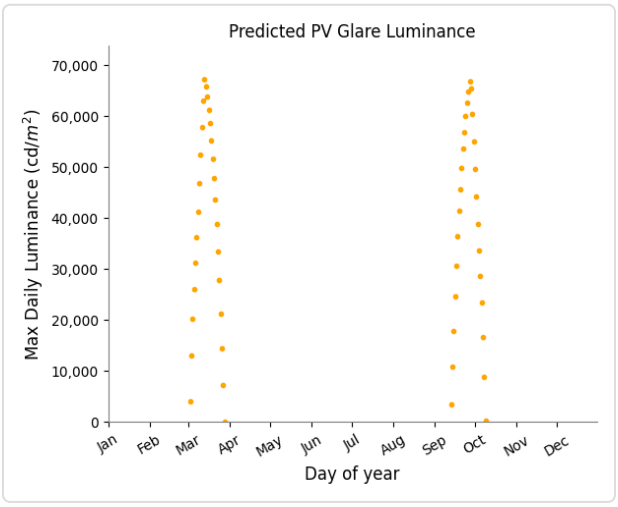
Green glare: 1,014 min.







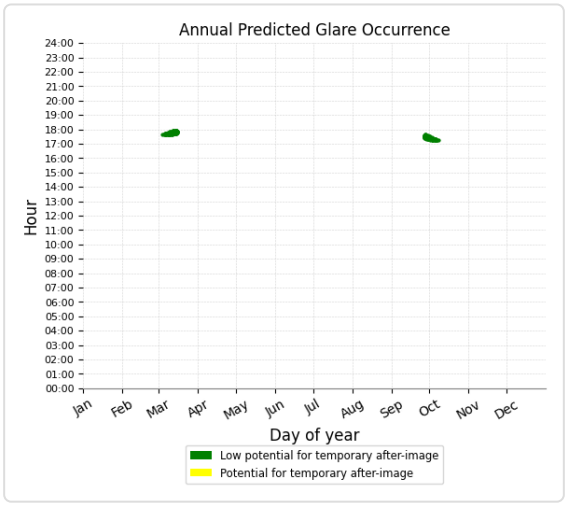


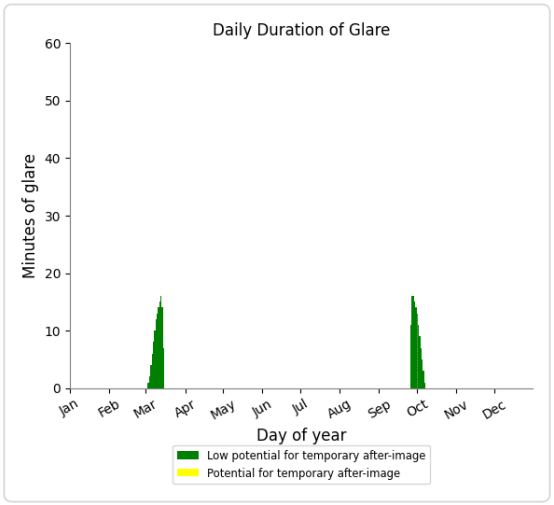


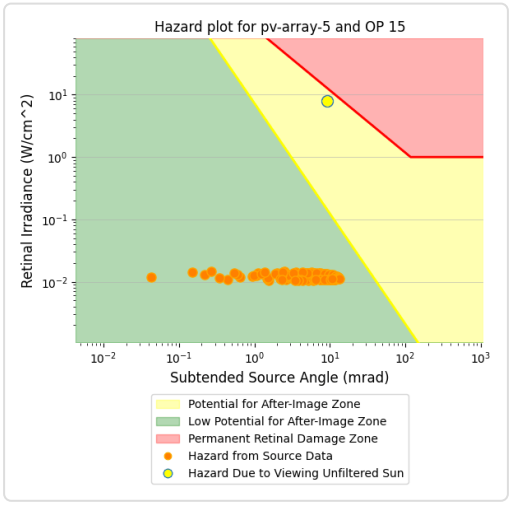
PV array 5 and OP 15

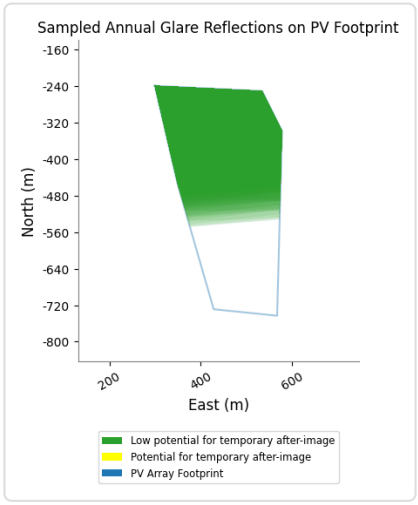
Yellow glare: none

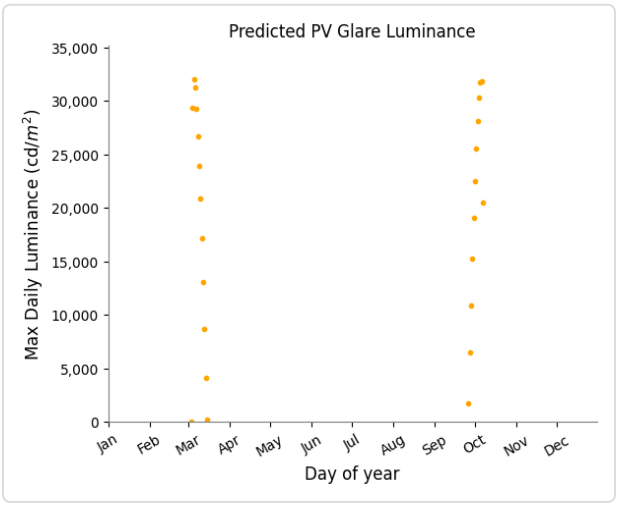
Green glare: 243 min.











PV array 5 and OP 1

No glare found

PV array 5 and OP 8

No glare found

PV array 5 and OP 9

No glare found

PV array 5 and OP 10

No glare found

PV array 5 and OP 11

No glare found

PV array 5 and OP 12

No glare found

PV array 5 and OP 13

No glare found

PV array 5 and OP 16

No glare found

PV array 5 and OP 17

No glare found

PV array 5 and OP 18

No glare found

PV array 5 and OP 19

No glare found

PV array 5 and OP 20

No glare found

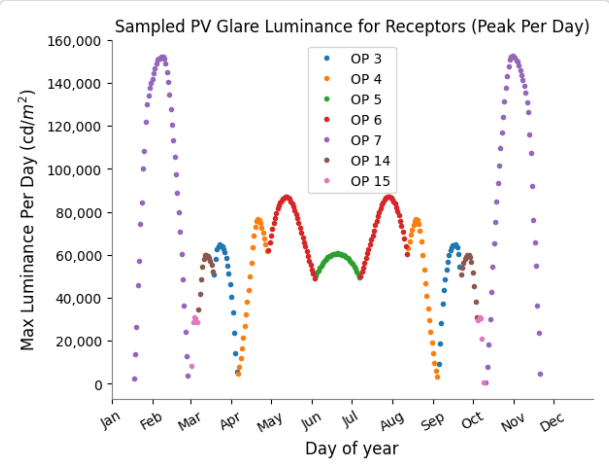
PV array 5 and OP 21

No glare found

PV: PV array 6 low potential for temporary after-image

Receptor results ordered by category of glare

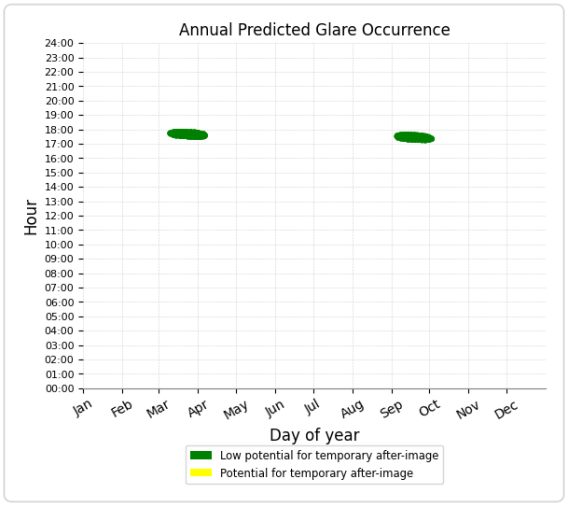
Receptor	Annual Green Glare		Annual Yellow Glare		Peak Luminance
	min	hr	min	hr	cd/m^2
OP 3	1,374	22.9	0	0.0	64,749
OP 4	1,897	31.6	0	0.0	76,735
OP 5	2,385	39.8	0	0.0	60,574
OP 6	4,251	70.8	0	0.0	87,145
OP 7	3,053	50.9	0	0.0	152,424
OP 14	965	16.1	0	0.0	59,884
OP 15	189	3.1	0	0.0	30,760
OP 1	0	0.0	0	0.0	0
OP 2	0	0.0	0	0.0	0
OP 8	0	0.0	0	0.0	0
OP 9	0	0.0	0	0.0	0
OP 10	0	0.0	0	0.0	0
OP 11	0	0.0	0	0.0	0
OP 12	0	0.0	0	0.0	0
OP 13	0	0.0	0	0.0	0
OP 16	0	0.0	0	0.0	0
OP 17	0	0.0	0	0.0	0
OP 18	0	0.0	0	0.0	0
OP 19	0	0.0	0	0.0	0
OP 20	0	0.0	0	0.0	0
OP 21	0	0.0	0	0.0	0

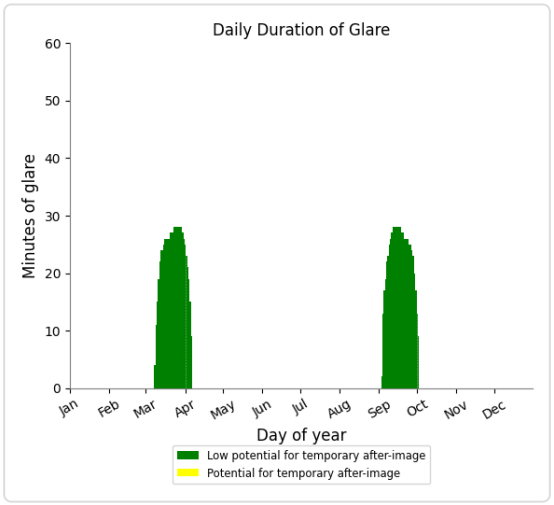


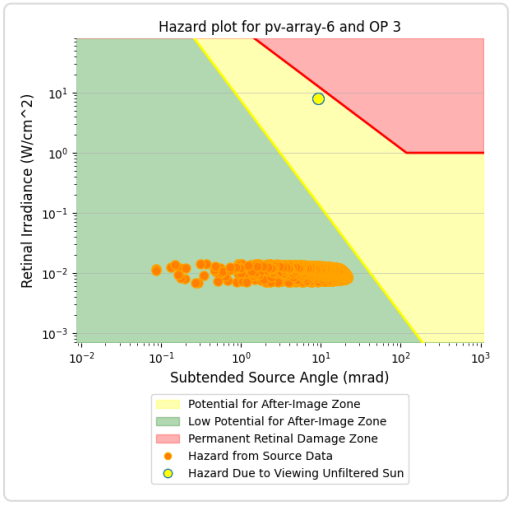
PV array 6 and OP 3

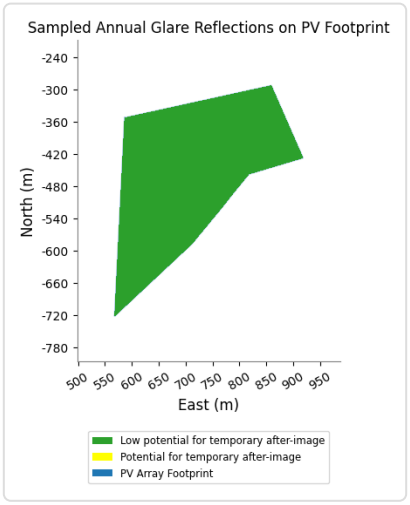
Yellow glare: none

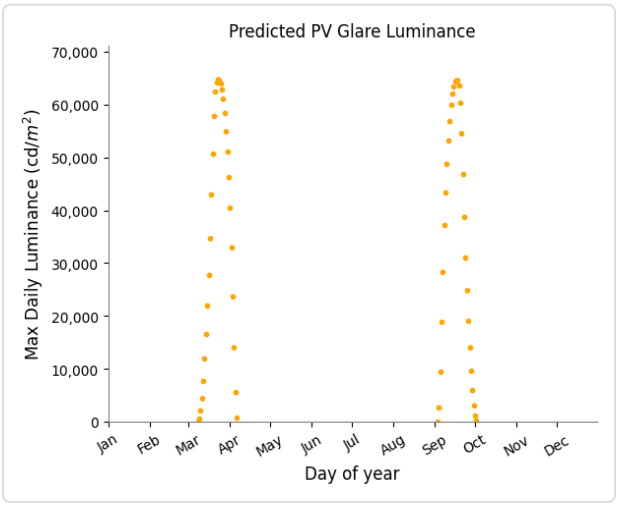
Green glare: 1,374 min.







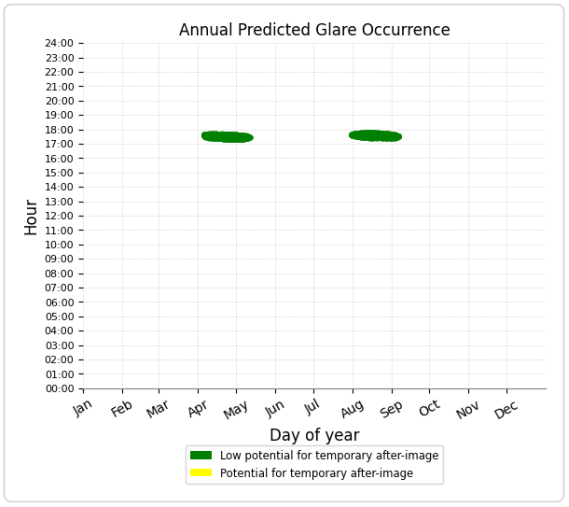


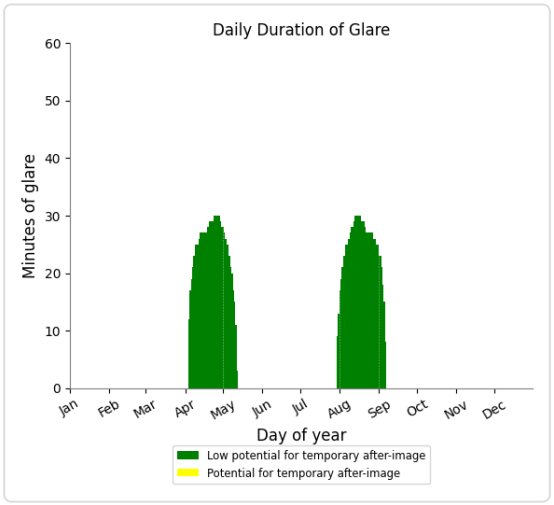


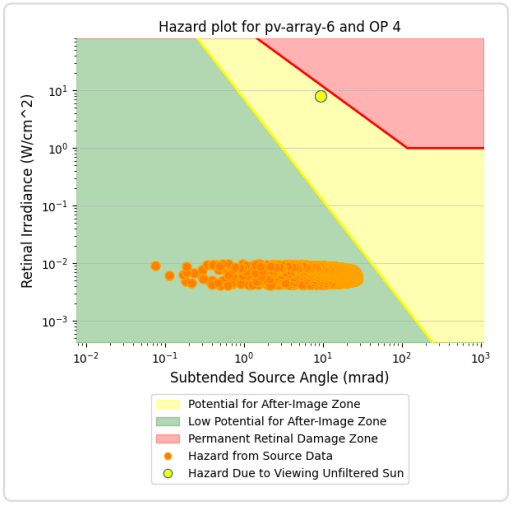
PV array 6 and OP 4

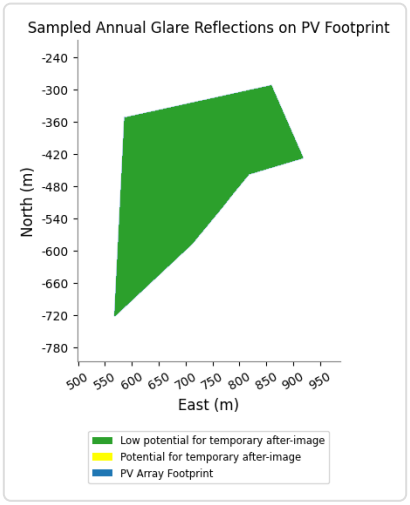
Yellow glare: none

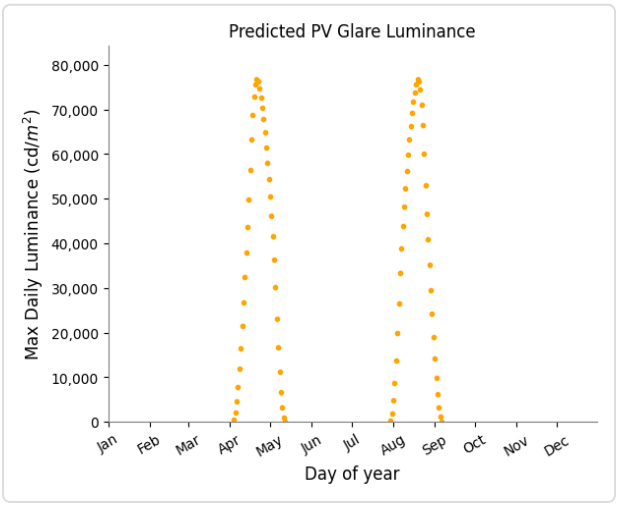
Green glare: 1,897 min.







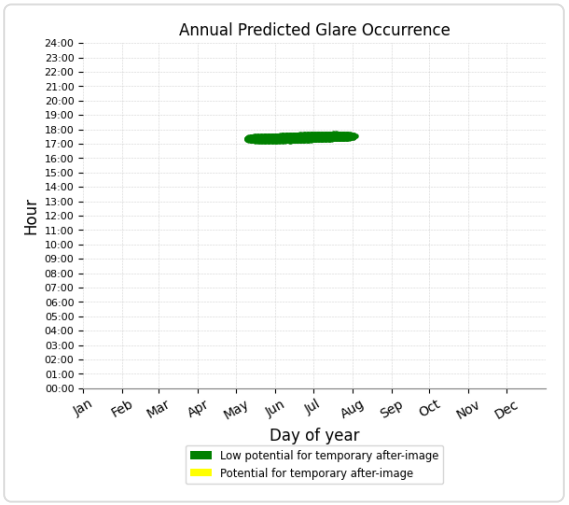


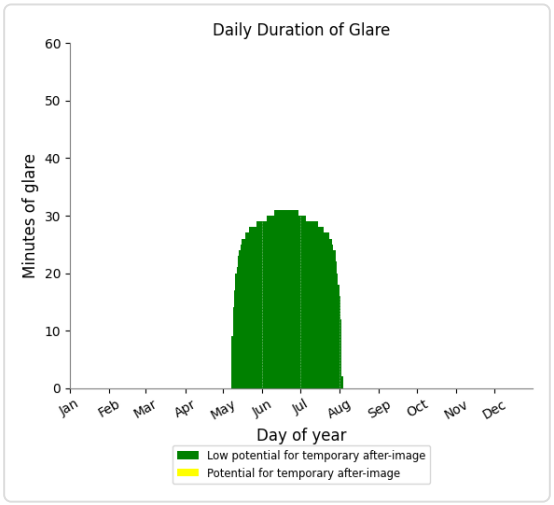


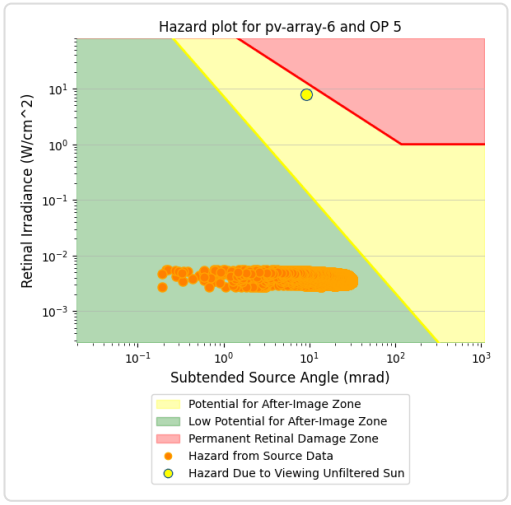
PV array 6 and OP 5

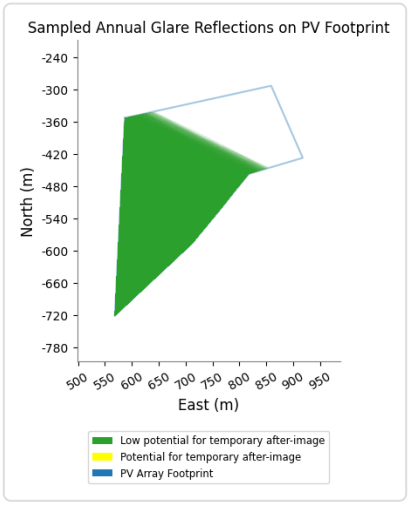
Yellow glare: none

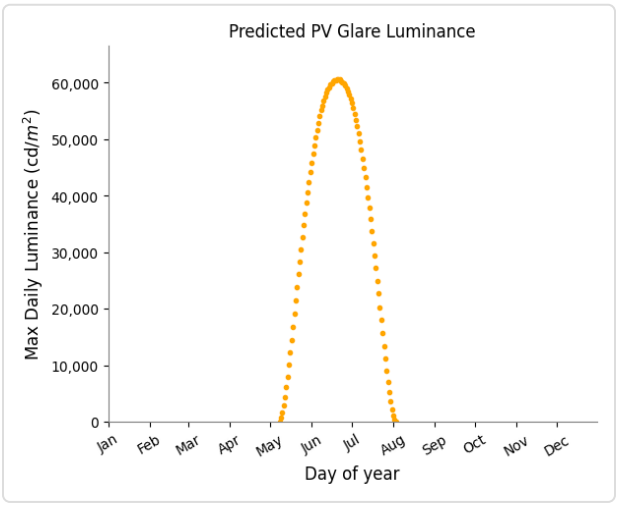
Green glare: 2,385 min.







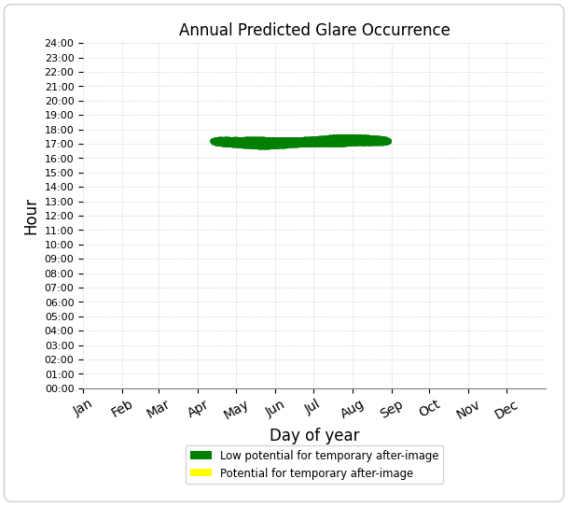


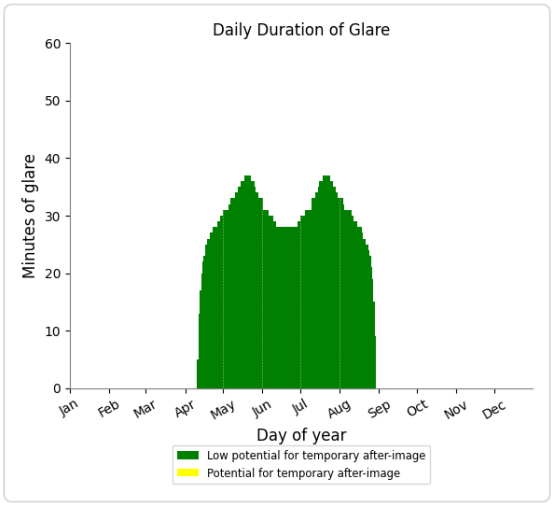


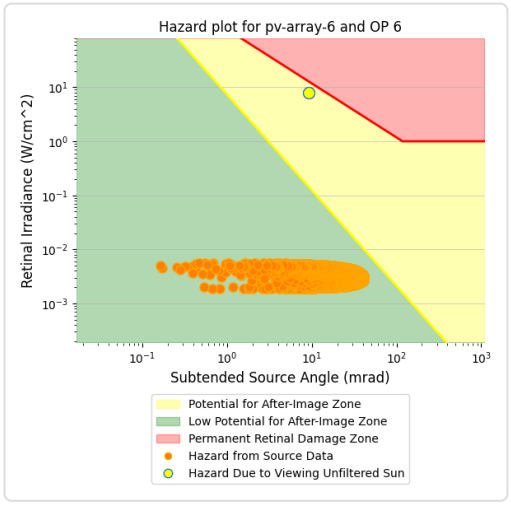
PV array 6 and OP 6

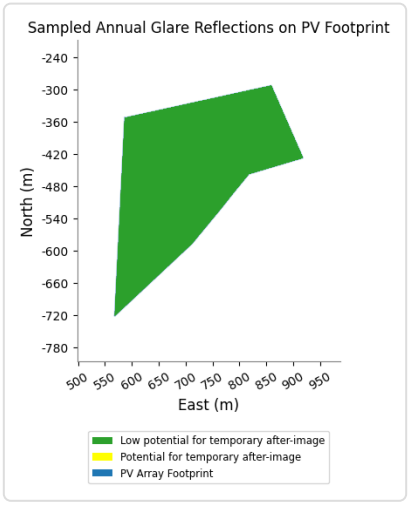
Yellow glare: none

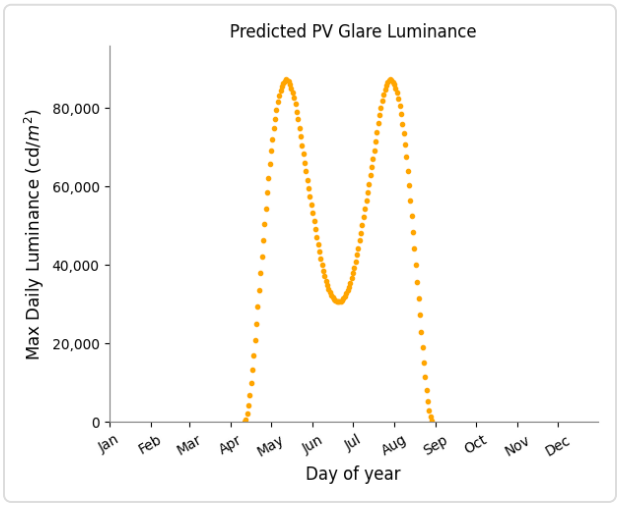
Green glare: 4,251 min.







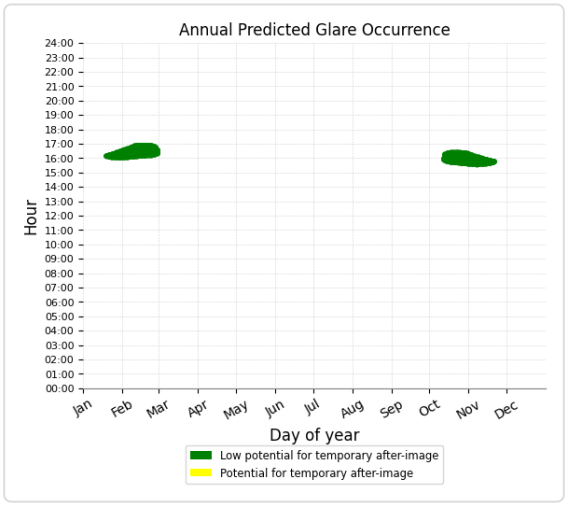


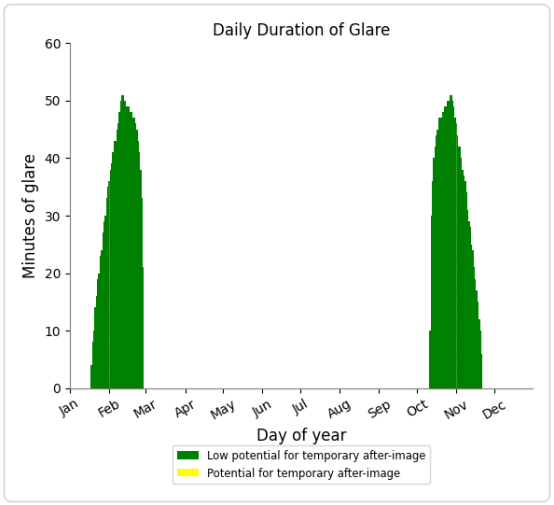


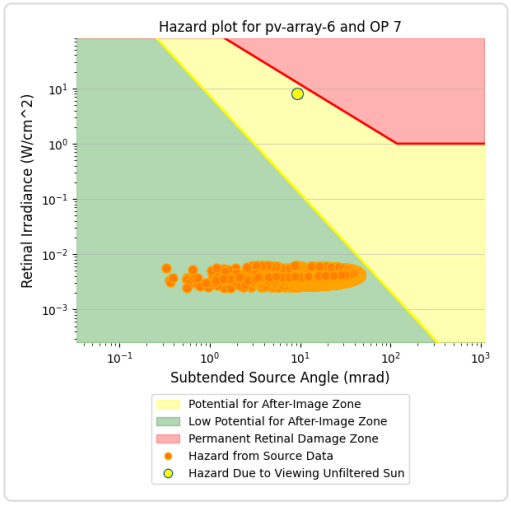
PV array 6 and OP 7

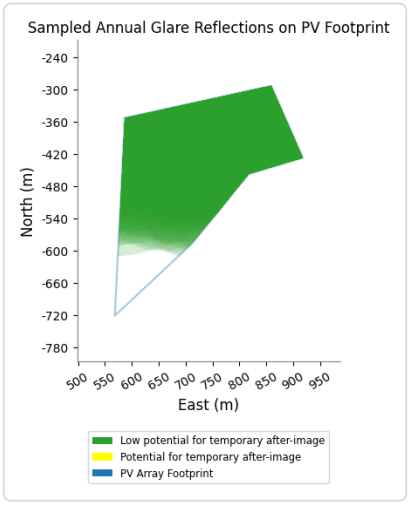
Yellow glare: none

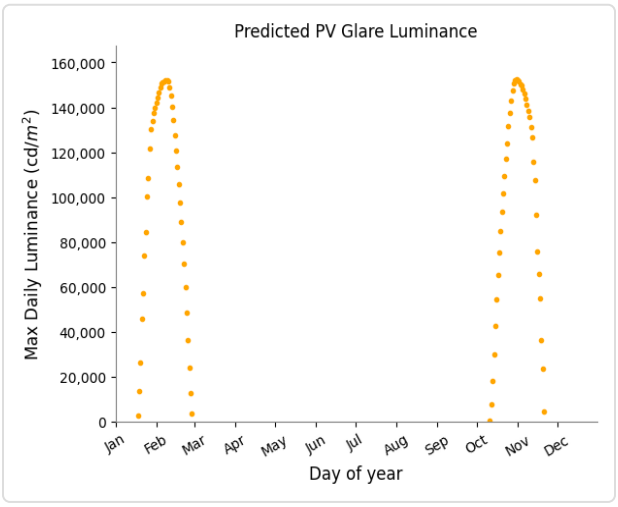
Green glare: 3,053 min.







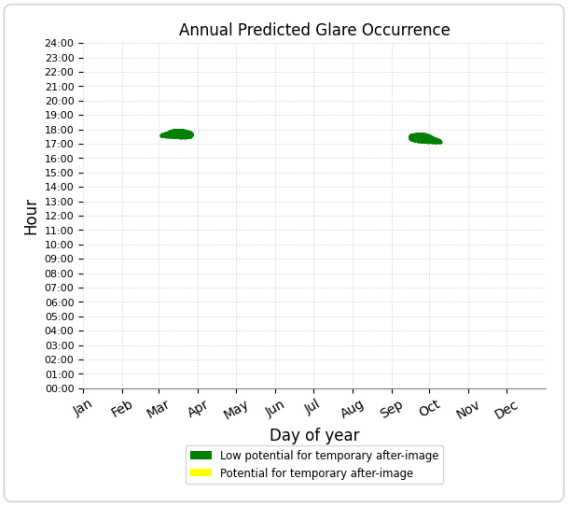


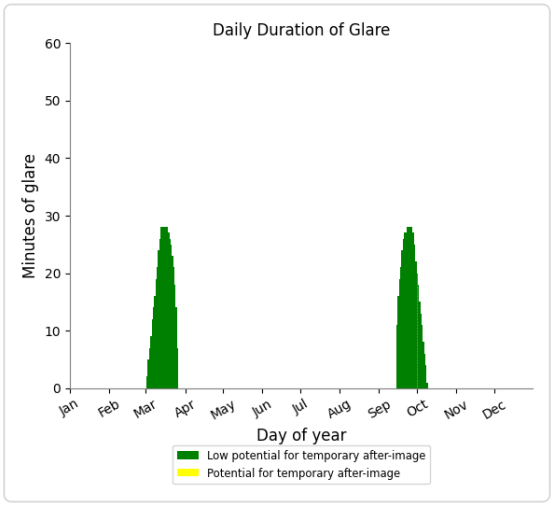


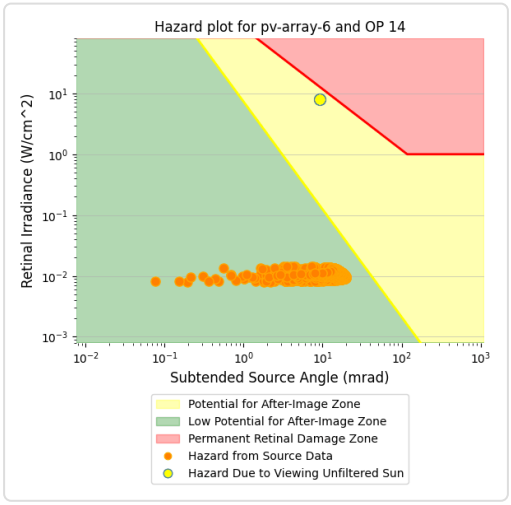
PV array 6 and OP 14

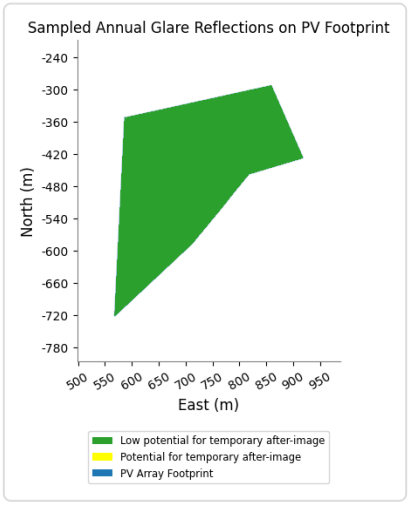
Yellow glare: none

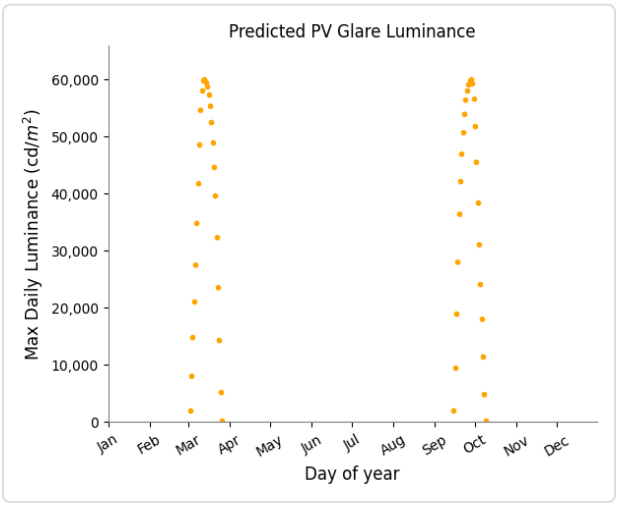
Green glare: 965 min.







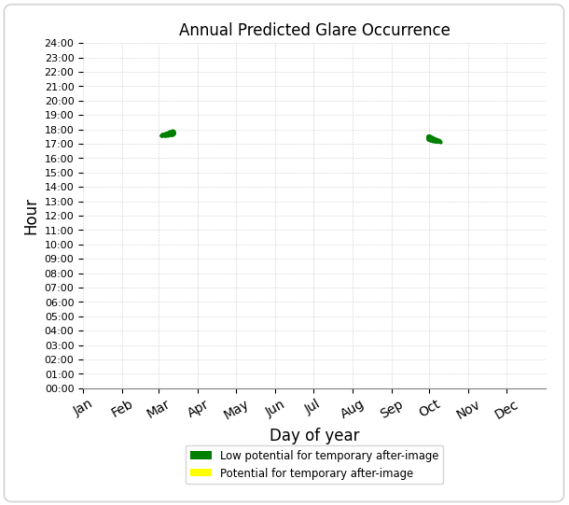


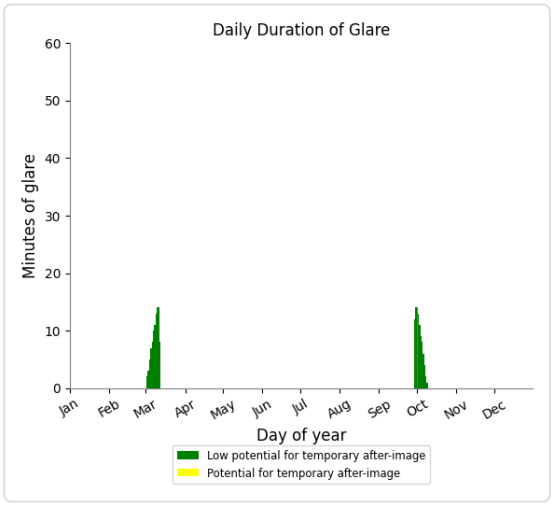


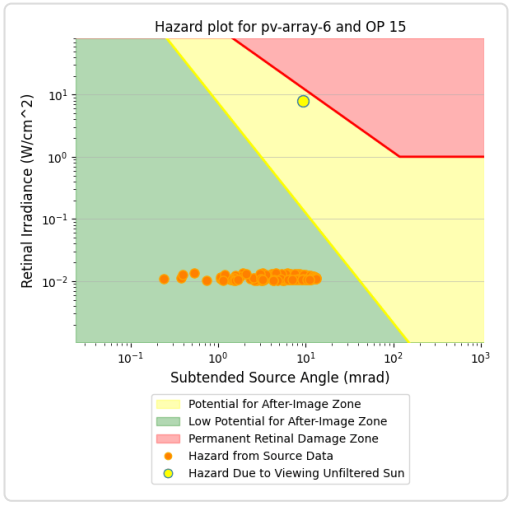
PV array 6 and OP 15

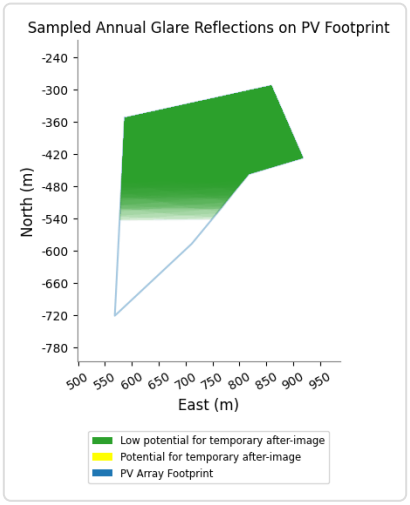
Yellow glare: none

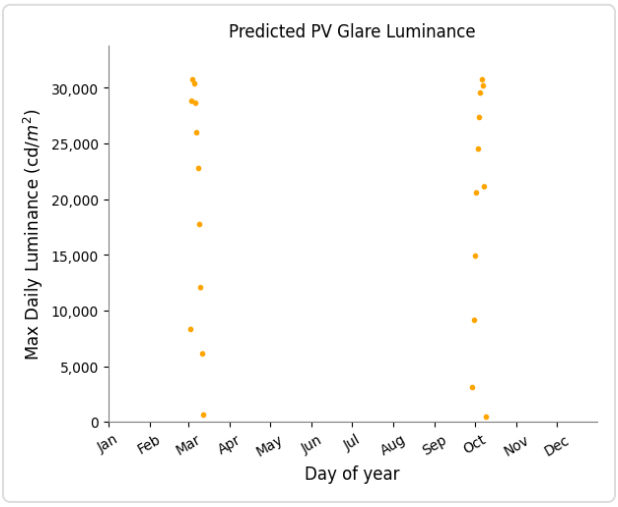
Green glare: 189 min.











PV array 6 and OP 1

No glare found

PV array 6 and OP 2

No glare found

PV array 6 and OP 8

No glare found

PV array 6 and OP 9

No glare found

PV array 6 and OP 10

No glare found

PV array 6 and OP 11

No glare found

PV array 6 and OP 12

No glare found

PV array 6 and OP 13

No glare found

PV array 6 and OP 16

No glare found

PV array 6 and OP 17

No glare found

PV array 6 and OP 18

No glare found

PV array 6 and OP 19

No glare found

PV array 6 and OP 20

No glare found

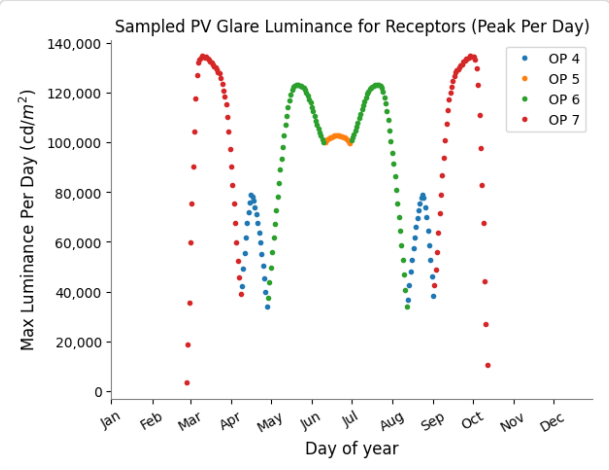
PV array 6 and OP 21

No glare found

PV: PV array 7 low potential for temporary after-image

Receptor results ordered by category of glare

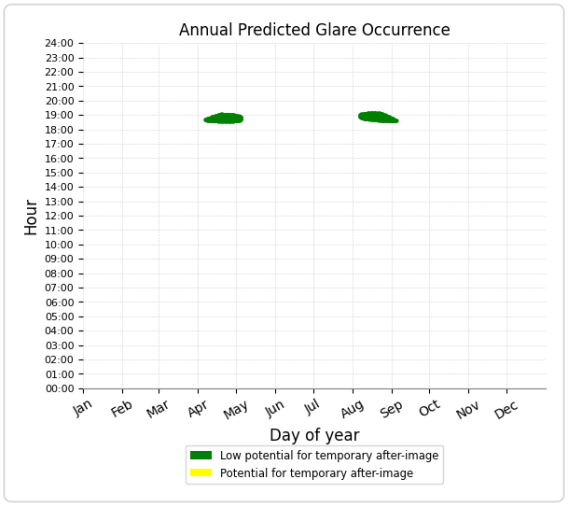
Receptor	Annual Green Glare		Annual Yellow Glare		Peak Luminance
	min	hr	min	hr	cd/m^2
OP 4	1,197	19.9	0	0.0	78,908
OP 5	2,509	41.8	0	0.0	102,776
OP 6	3,754	62.6	0	0.0	123,236
OP 7	3,184	53.1	0	0.0	134,770
OP 1	0	0.0	0	0.0	0
OP 2	0	0.0	0	0.0	0
OP 3	0	0.0	0	0.0	0
OP 8	0	0.0	0	0.0	0
OP 9	0	0.0	0	0.0	0
OP 10	0	0.0	0	0.0	0
OP 11	0	0.0	0	0.0	0
OP 12	0	0.0	0	0.0	0
OP 13	0	0.0	0	0.0	0
OP 14	0	0.0	0	0.0	0
OP 15	0	0.0	0	0.0	0
OP 16	0	0.0	0	0.0	0
OP 17	0	0.0	0	0.0	0
OP 18	0	0.0	0	0.0	0
OP 19	0	0.0	0	0.0	0
OP 20	0	0.0	0	0.0	0
OP 21	0	0.0	0	0.0	0

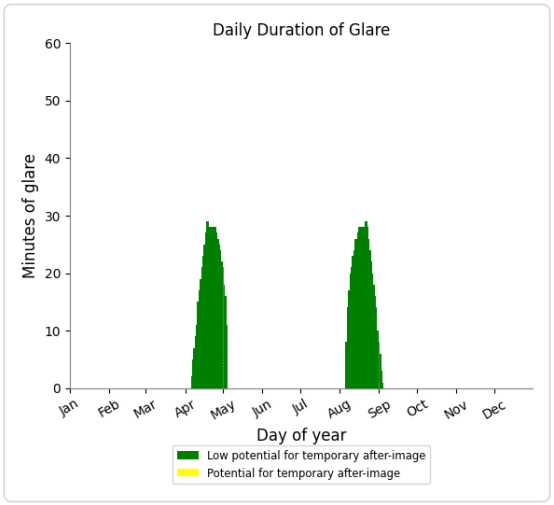


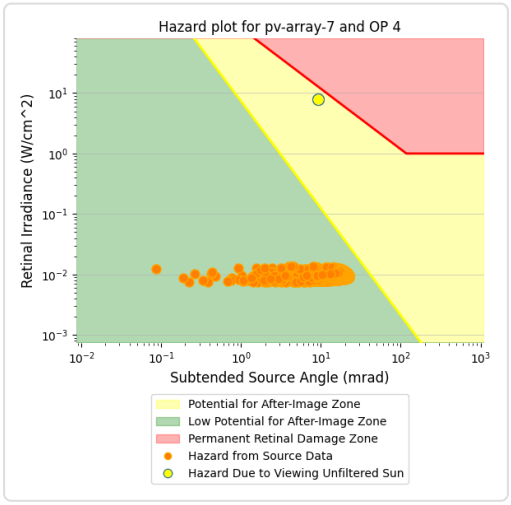
PV array 7 and OP 4

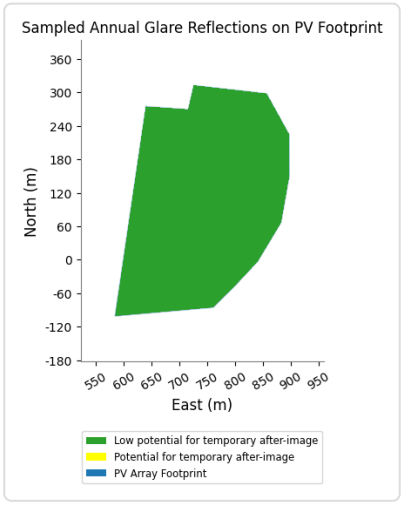
Yellow glare: none

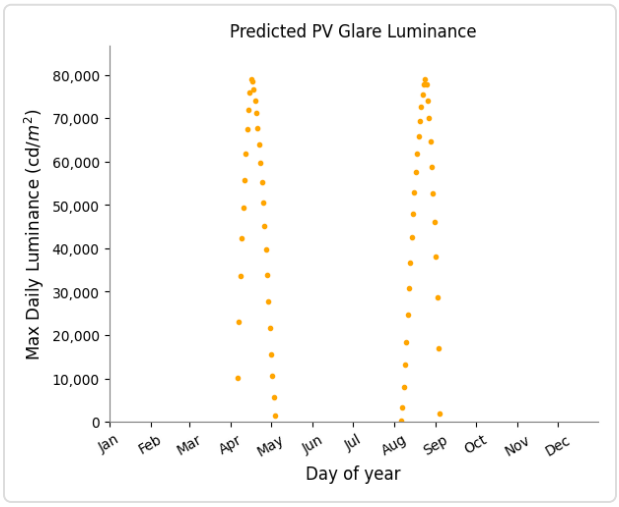
Green glare: 1,197 min.







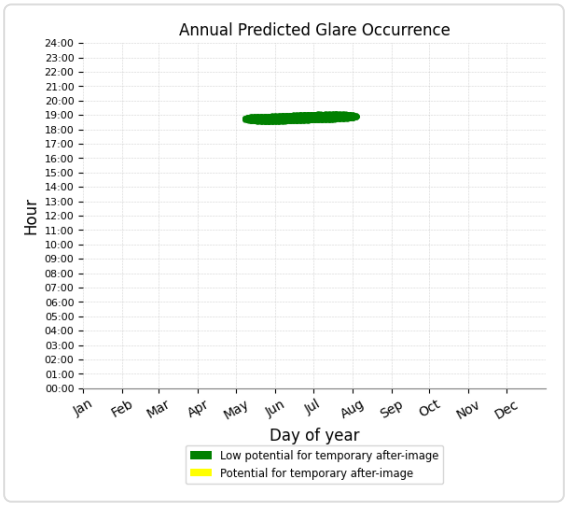


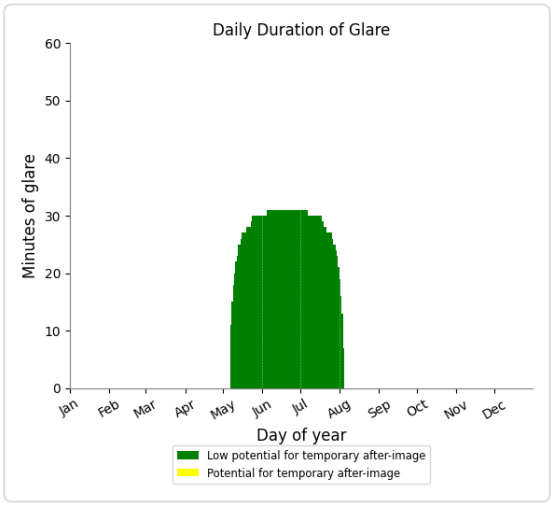


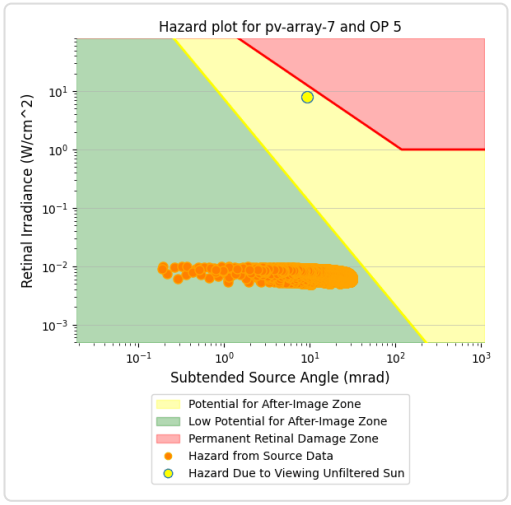
PV array 7 and OP 5

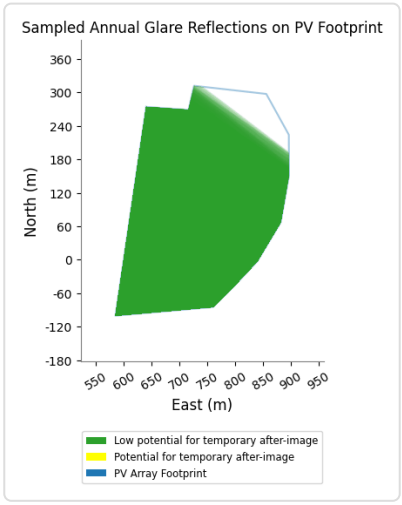
Yellow glare: none

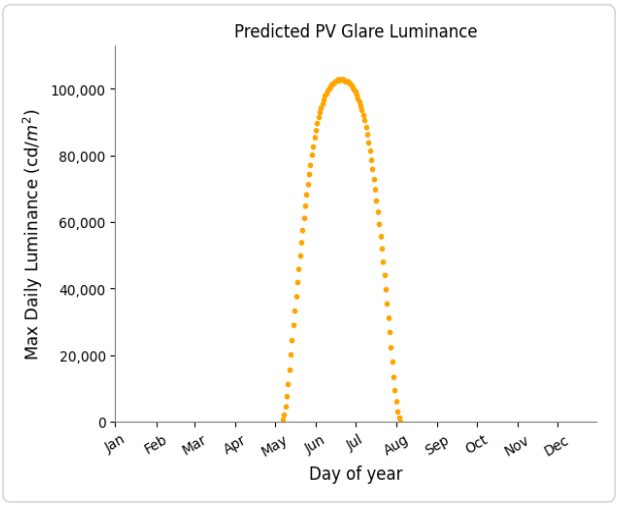
Green glare: 2,509 min.







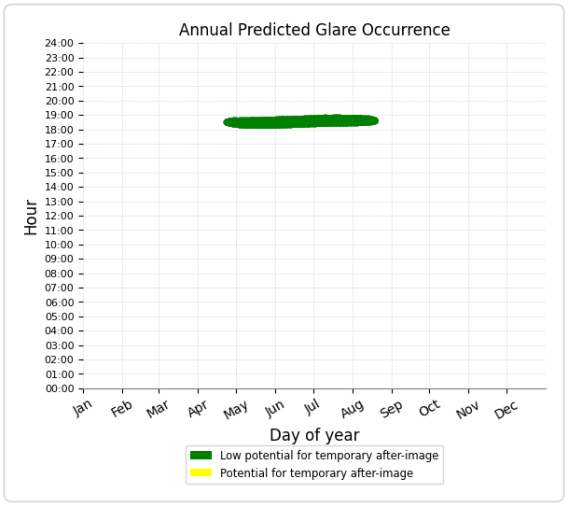


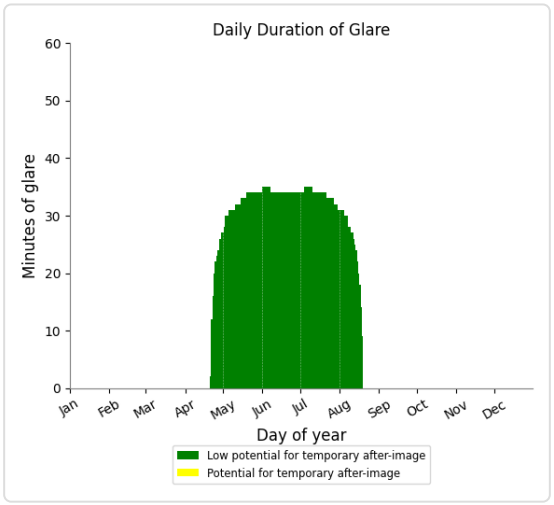


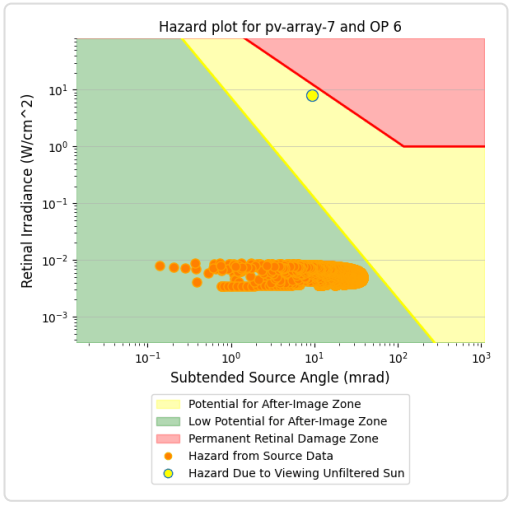
PV array 7 and OP 6

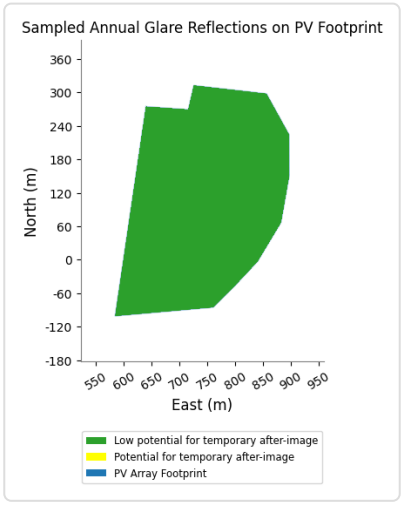
Yellow glare: none

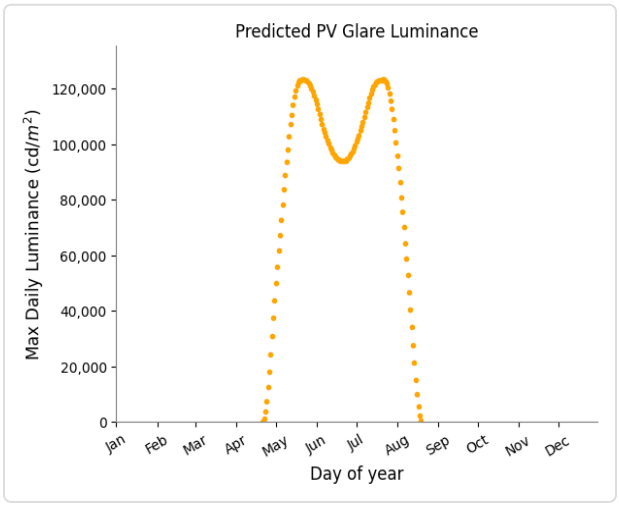
Green glare: 3,754 min.







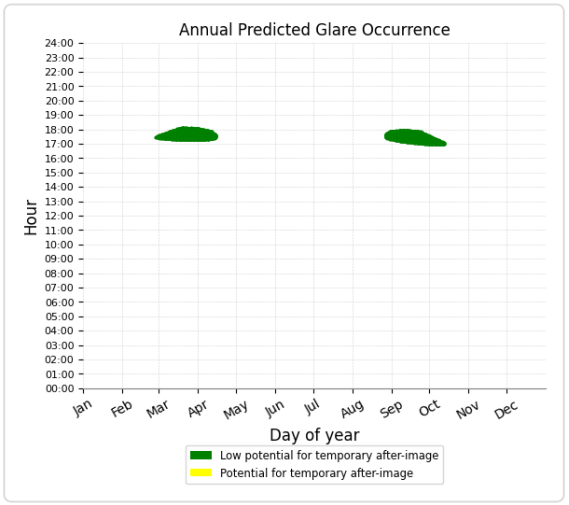


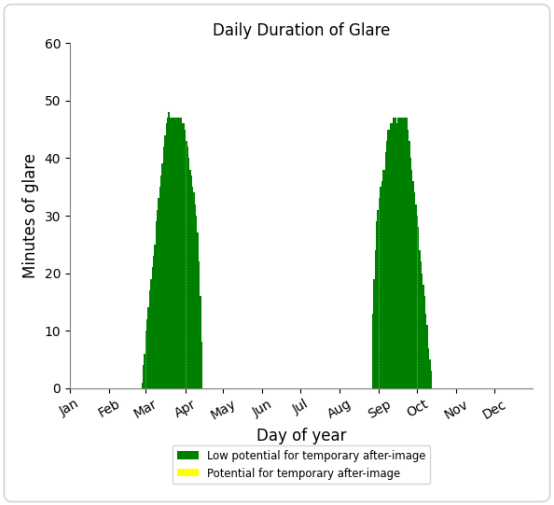


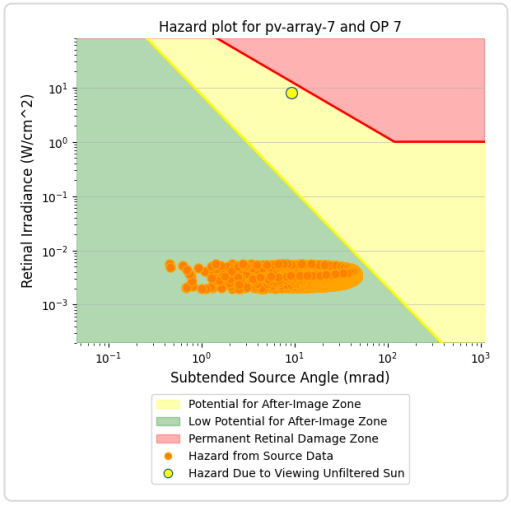
PV array 7 and OP 7

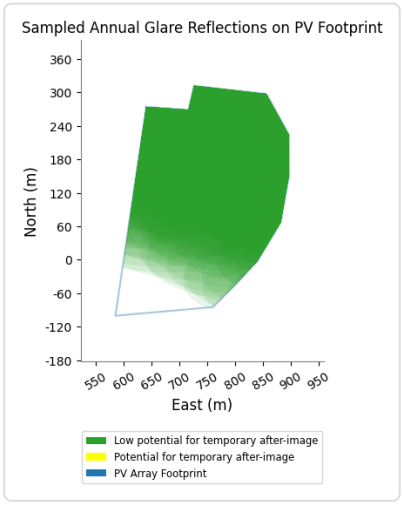
Yellow glare: none

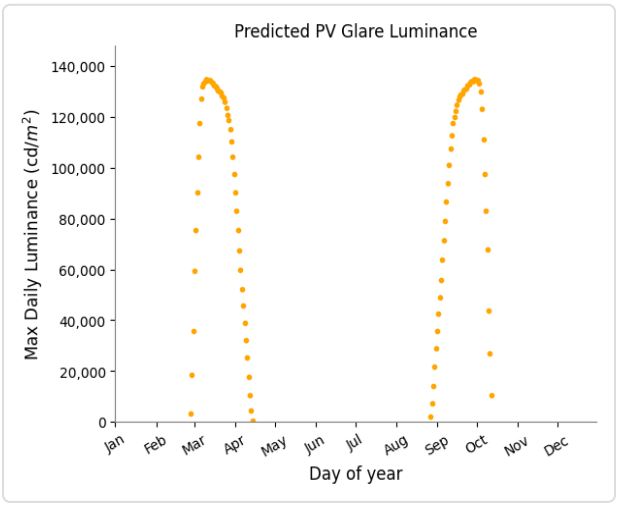
Green glare: 3,184 min.











PV array 7 and OP 1

No glare found

PV array 7 and OP 2

No glare found

PV array 7 and OP 3

No glare found

PV array 7 and OP 8

No glare found

PV array 7 and OP 9

No glare found

PV array 7 and OP 10

No glare found

PV array 7 and OP 11

No glare found

PV array 7 and OP 12

No glare found

PV array 7 and OP 13

No glare found

PV array 7 and OP 14

No glare found

PV array 7 and OP 15

No glare found

PV array 7 and OP 16

No glare found

PV array 7 and OP 17

No glare found

PV array 7 and OP 18

No glare found

PV array 7 and OP 19

No glare found

PV array 7 and OP 20

No glare found

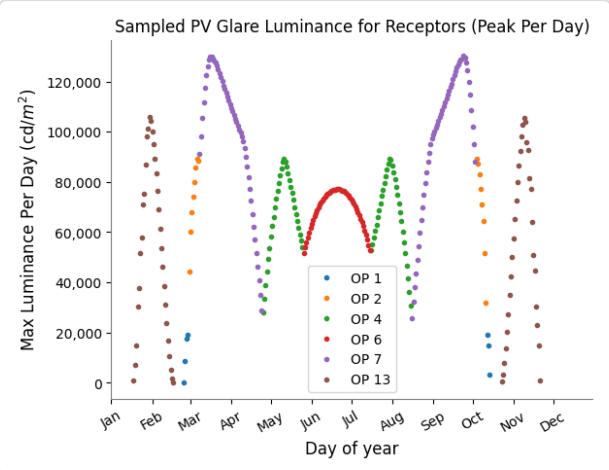
PV array 7 and OP 21

No glare found

PV: PV array 8 low potential for temporary after-image

Receptor results ordered by category of glare

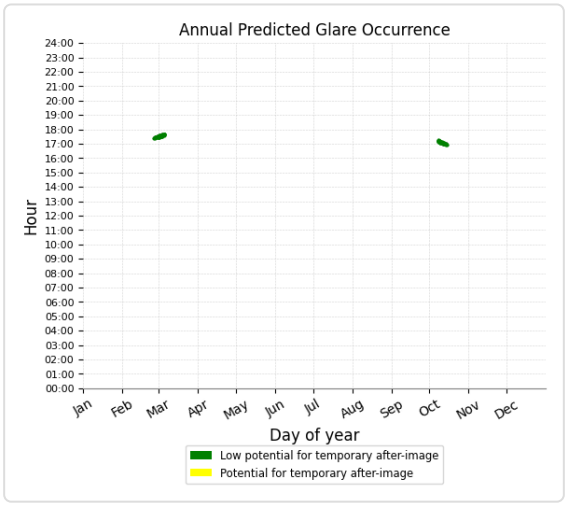
Receptor	Annual Green Glare		Annual Yellow Glare		Peak Luminance
	min	hr	min	hr	cd/m^2
OP 1	79	1.3	0	0.0	19,303
OP 2	898	15.0	0	0.0	89,103
OP 3	1,566	26.1	0	0.0	88,786
OP 4	3,188	53.1	0	0.0	89,267
OP 6	2,369	39.5	0	0.0	77,103
OP 7	4,532	75.5	0	0.0	130,152
OP 13	1,053	17.6	0	0.0	105,725
OP 14	1,489	24.8	0	0.0	86,995
OP 15	916	15.3	0	0.0	59,944
OP 16	168	2.8	0	0.0	23,157
OP 5	0	0.0	0	0.0	0
OP 8	0	0.0	0	0.0	0
OP 9	0	0.0	0	0.0	0
OP 10	0	0.0	0	0.0	0
OP 11	0	0.0	0	0.0	0
OP 12	0	0.0	0	0.0	0
OP 17	0	0.0	0	0.0	0
OP 18	0	0.0	0	0.0	0
OP 19	0	0.0	0	0.0	0
OP 20	0	0.0	0	0.0	0
OP 21	0	0.0	0	0.0	0

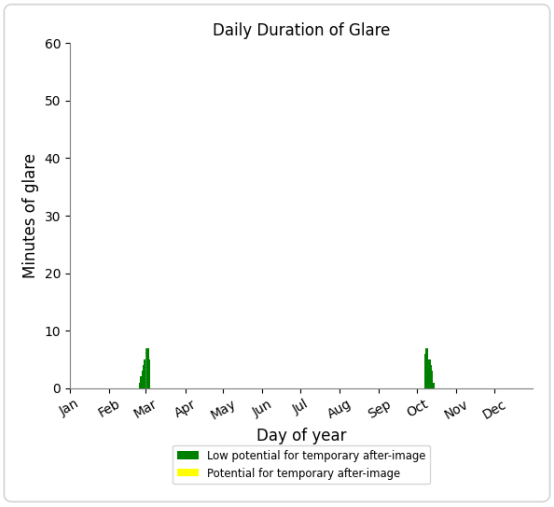


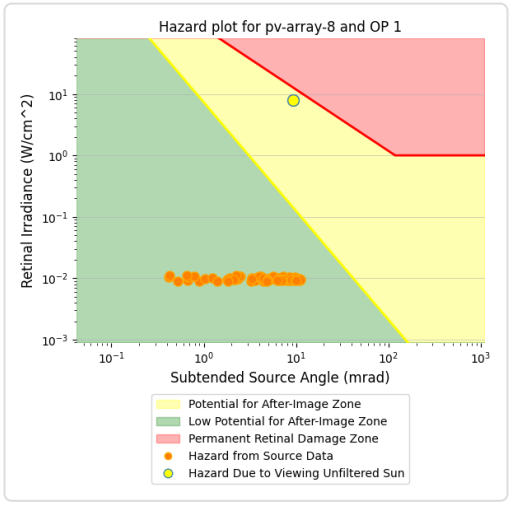
PV array 8 and OP 1

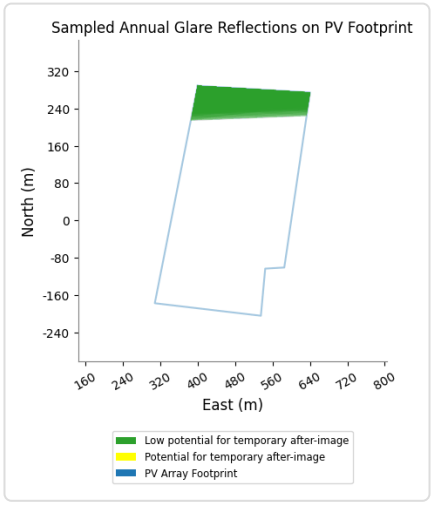
Yellow glare: none

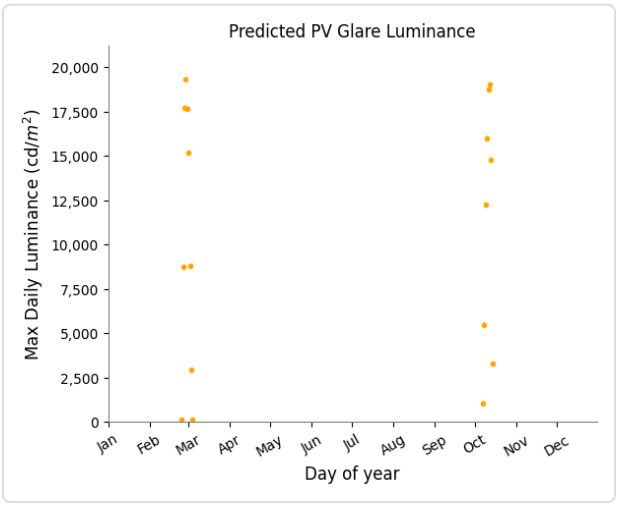
Green glare: 79 min.







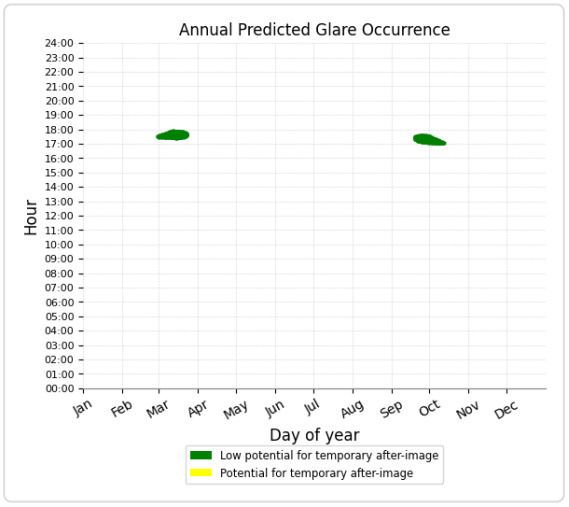


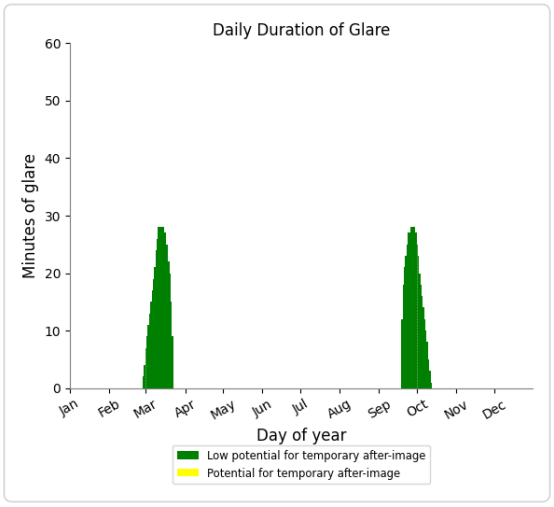


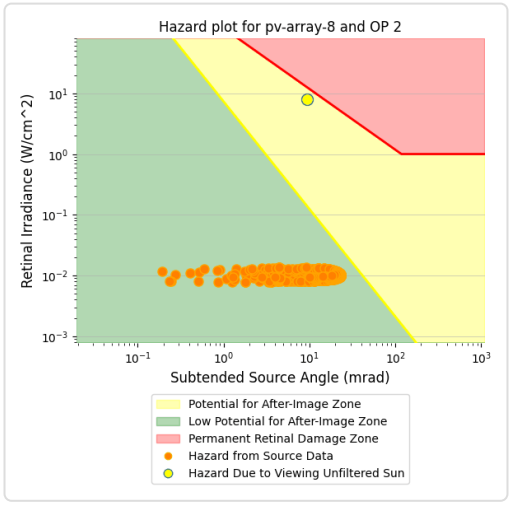
PV array 8 and OP 2

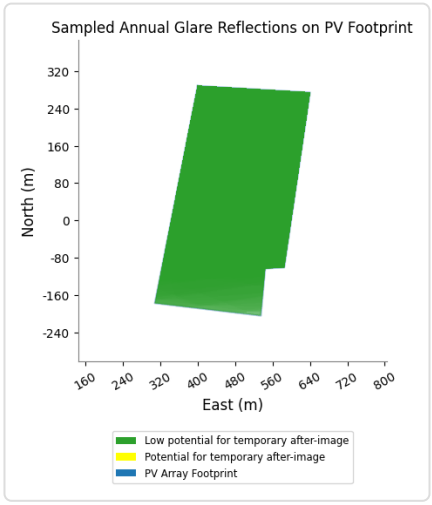
Yellow glare: none

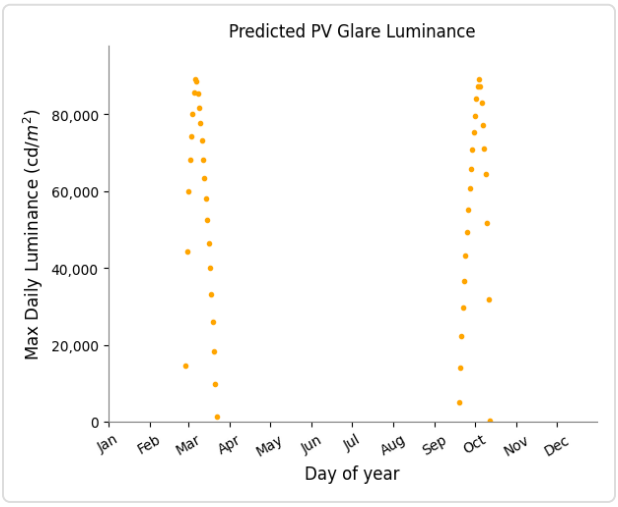
Green glare: 898 min.







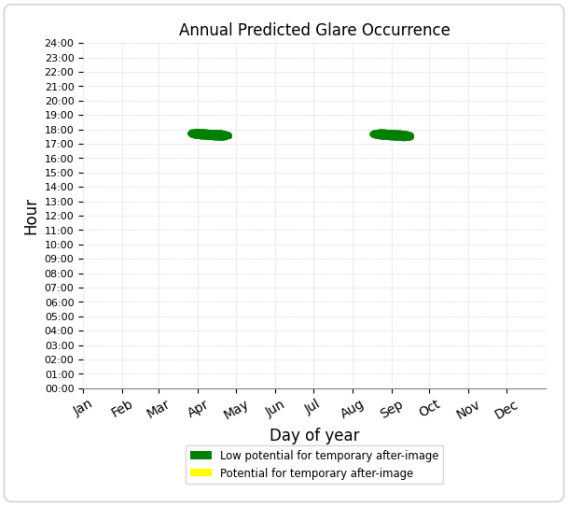


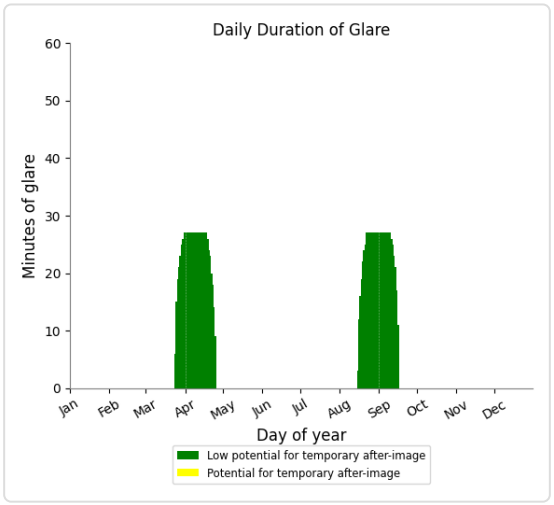


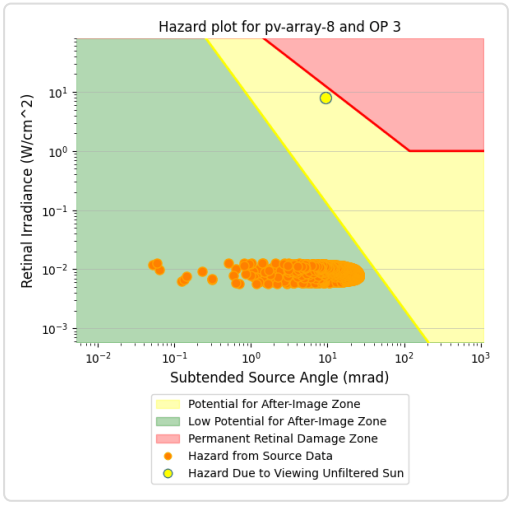
PV array 8 and OP 3

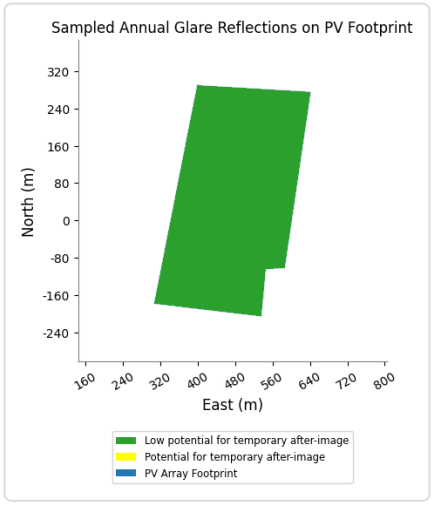
Yellow glare: none

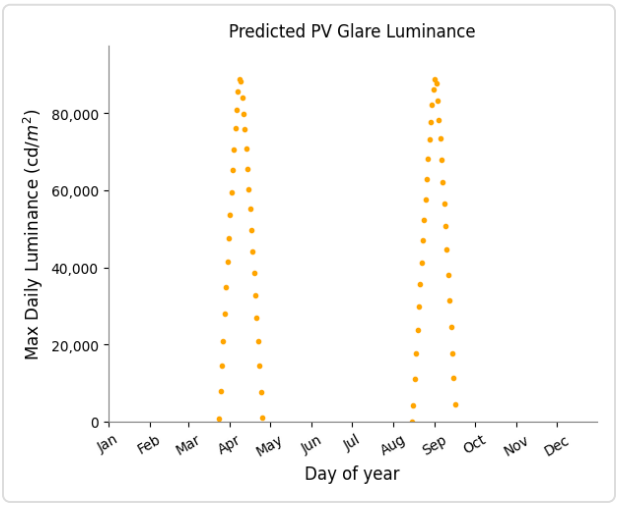
Green glare: 1,566 min.







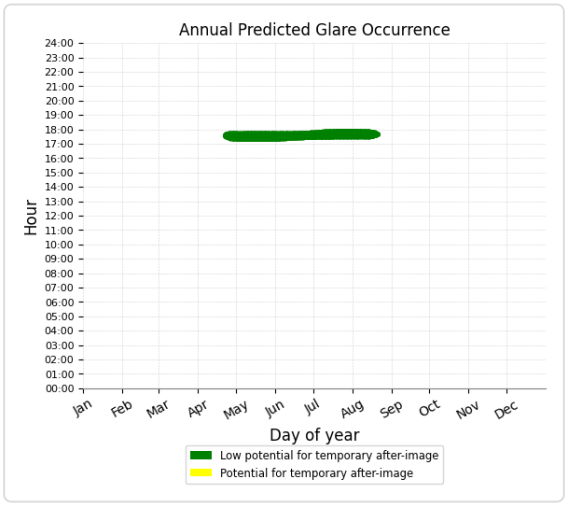


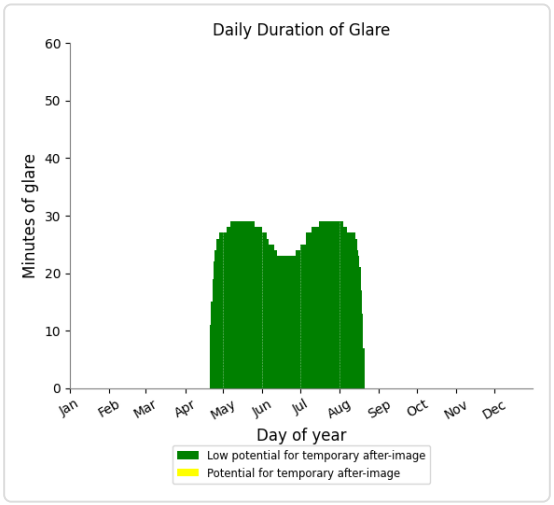


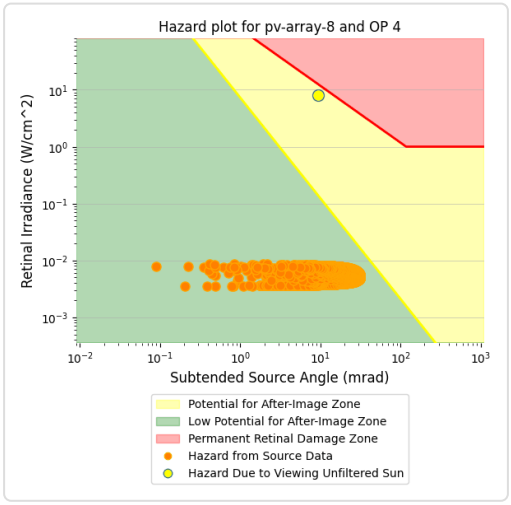
PV array 8 and OP 4

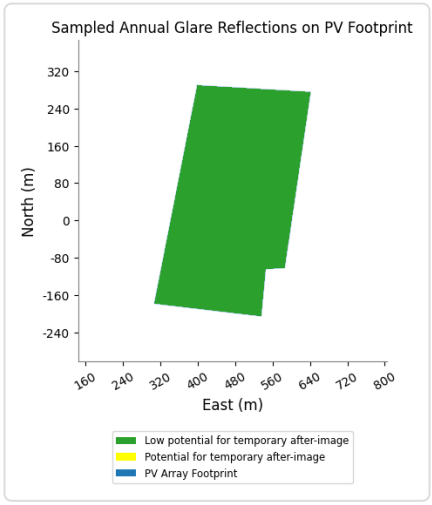
Yellow glare: none

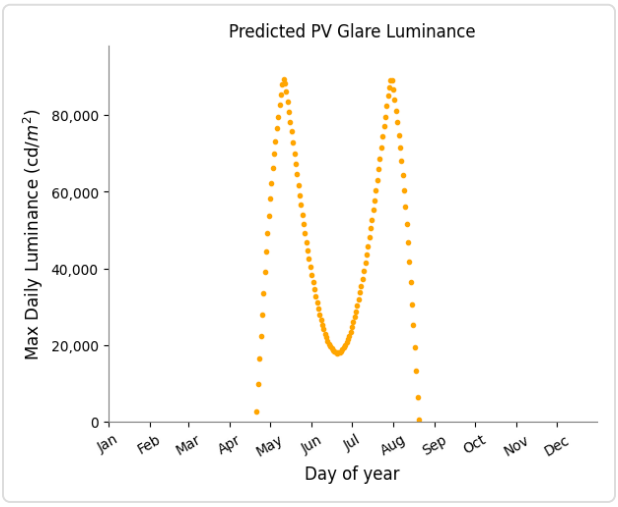
Green glare: 3,188 min.







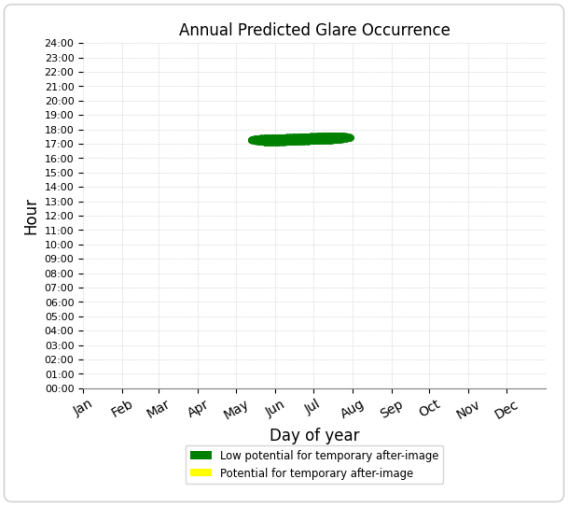


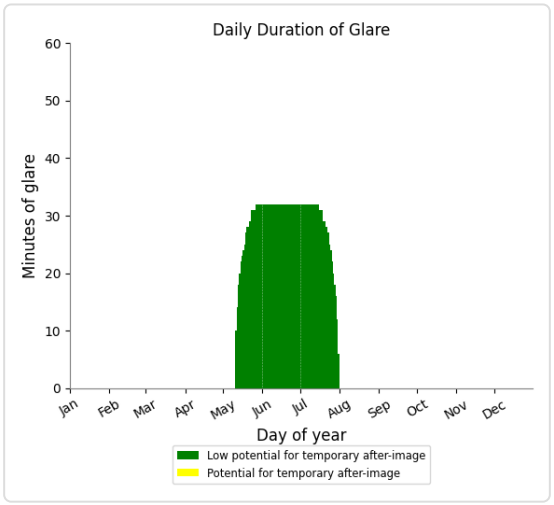


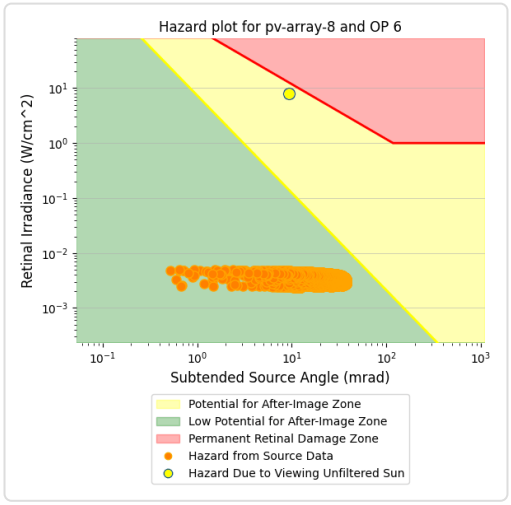
PV array 8 and OP 6

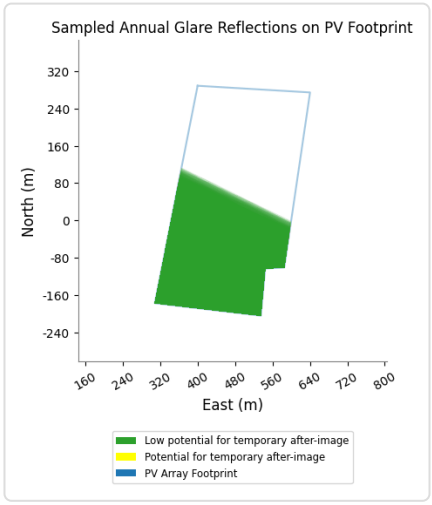
Yellow glare: none

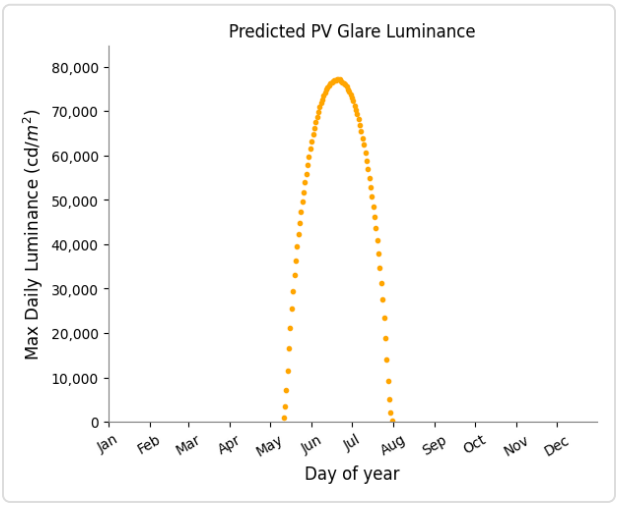
Green glare: 2,369 min.







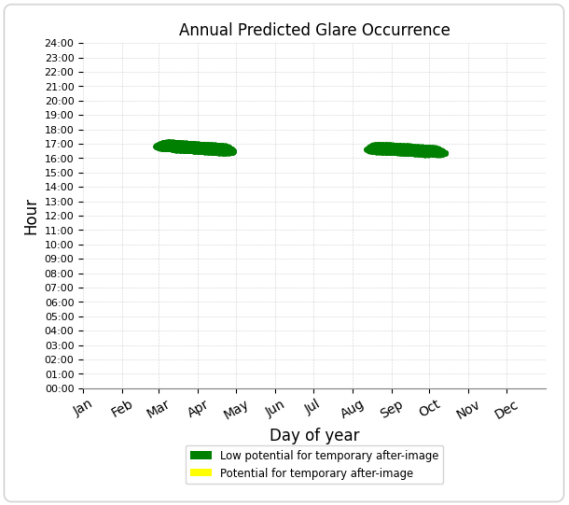


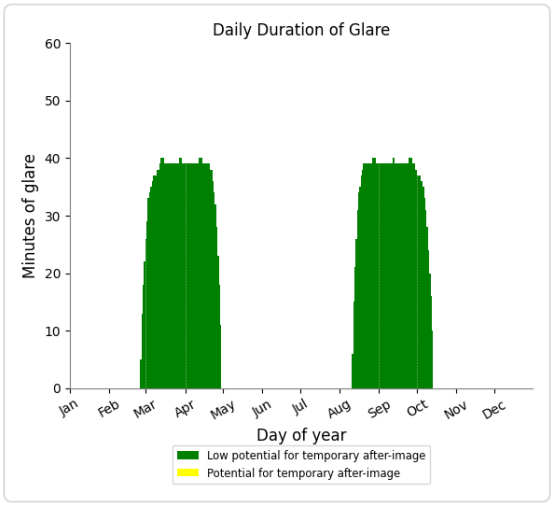


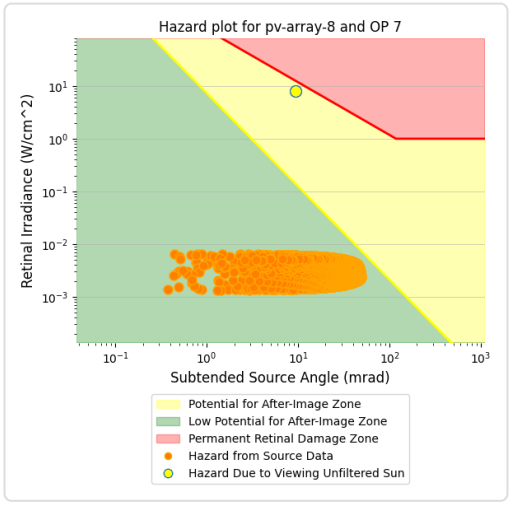
PV array 8 and OP 7

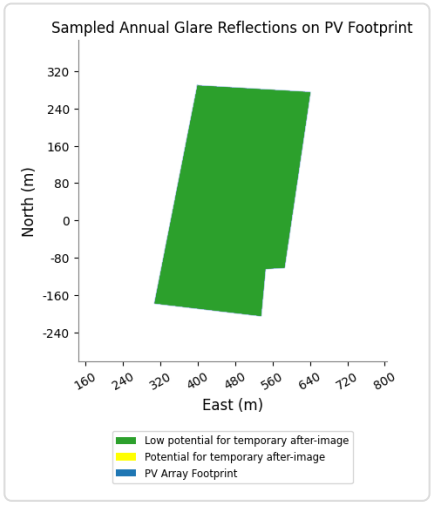
Yellow glare: none

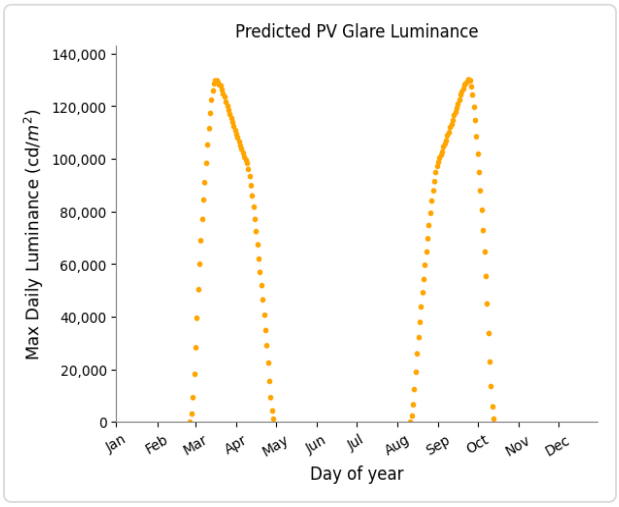
Green glare: 4,532 min.







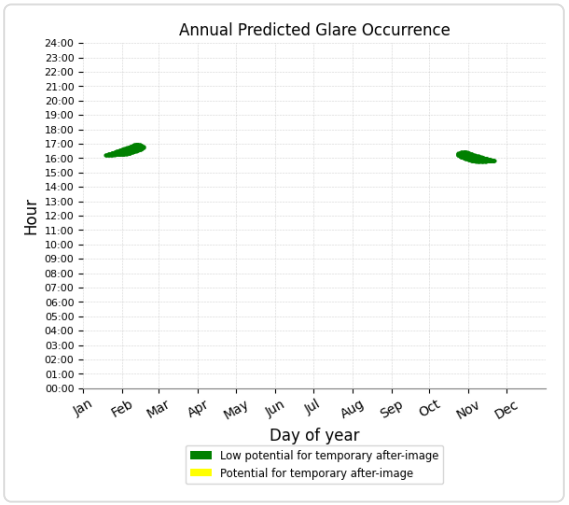


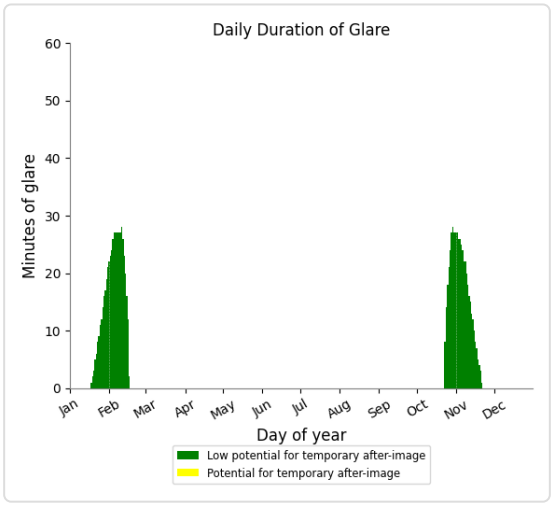


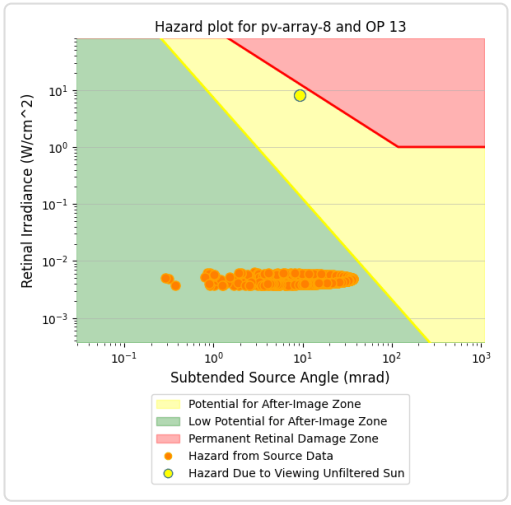
PV array 8 and OP 13

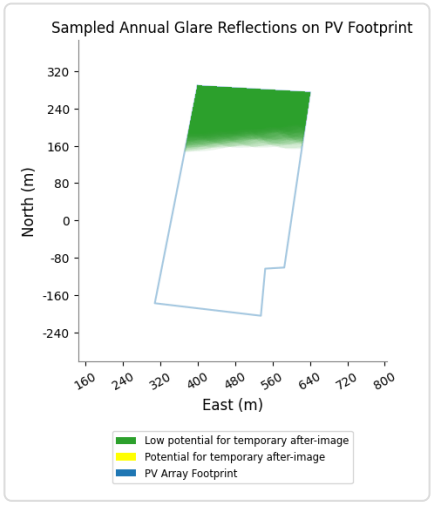
Yellow glare: none

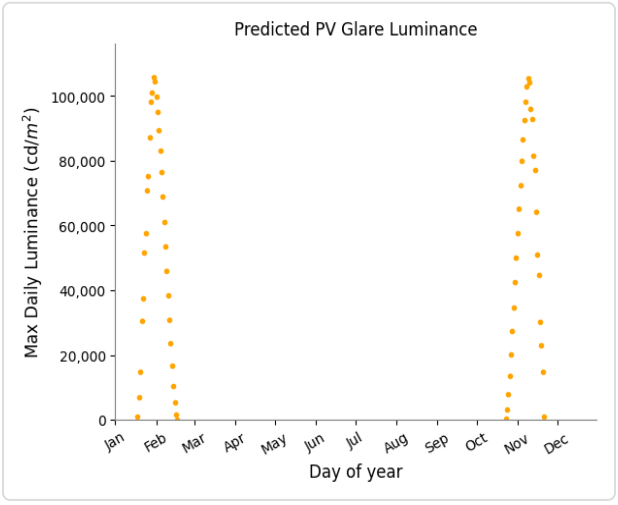
Green glare: 1,053 min.







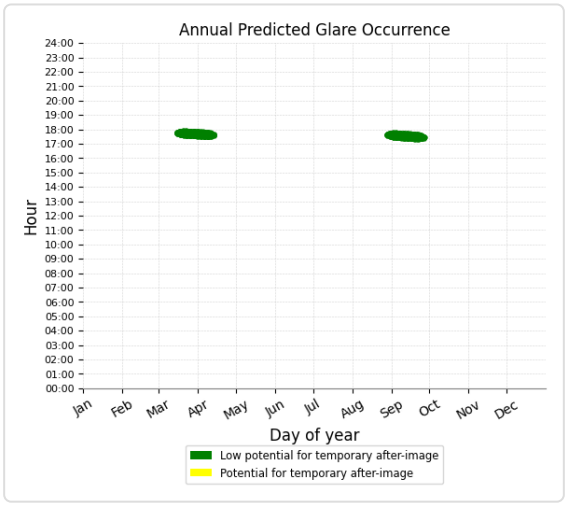


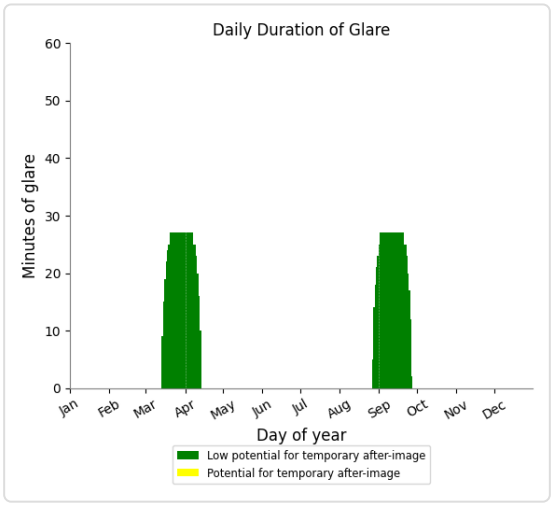


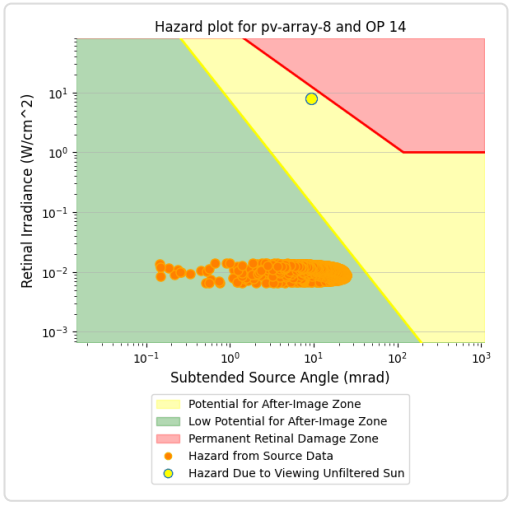
PV array 8 and OP 14

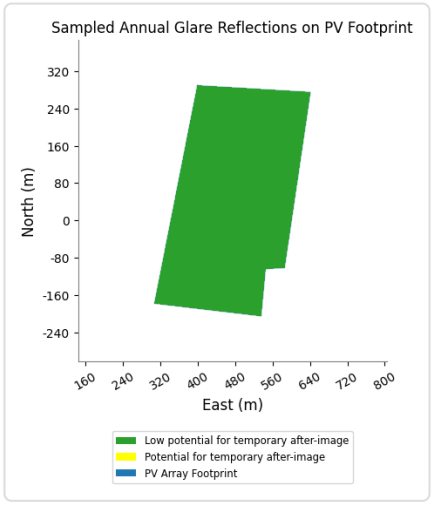
Yellow glare: none

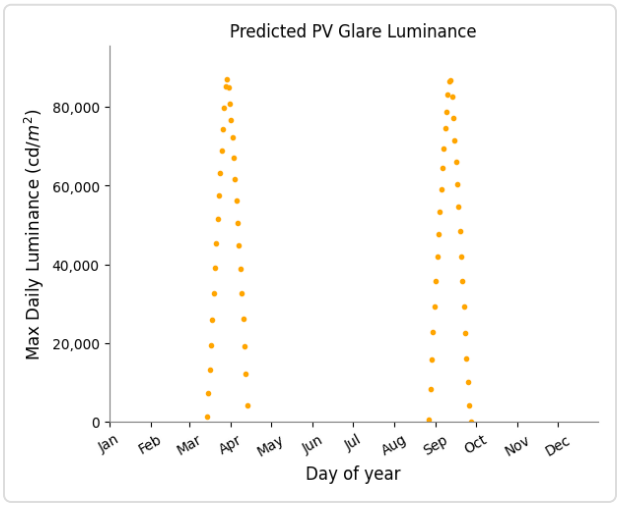
Green glare: 1,489 min.







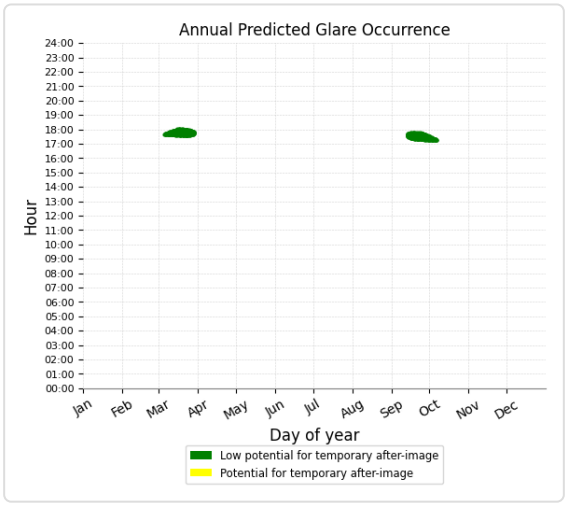


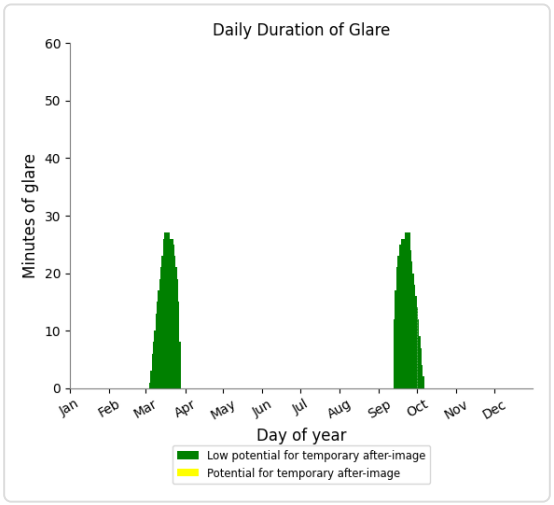


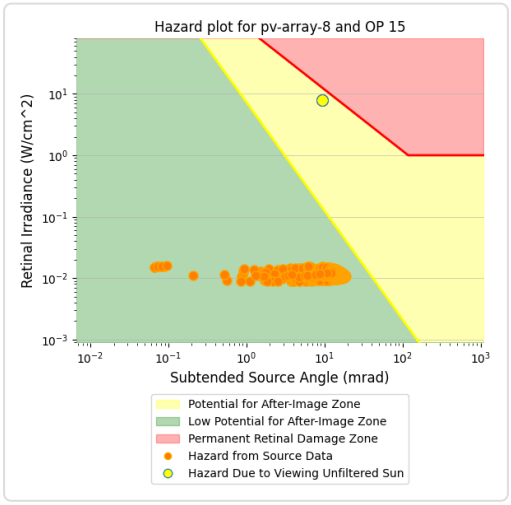
PV array 8 and OP 15

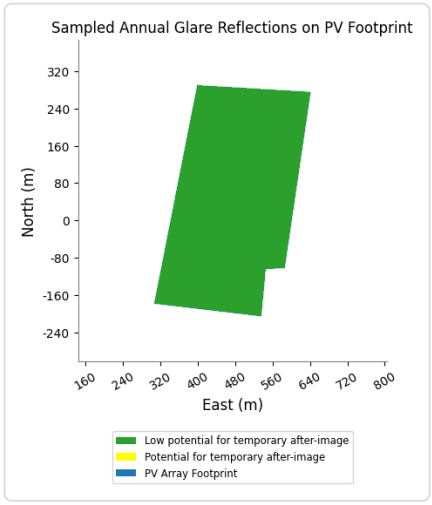
Yellow glare: none

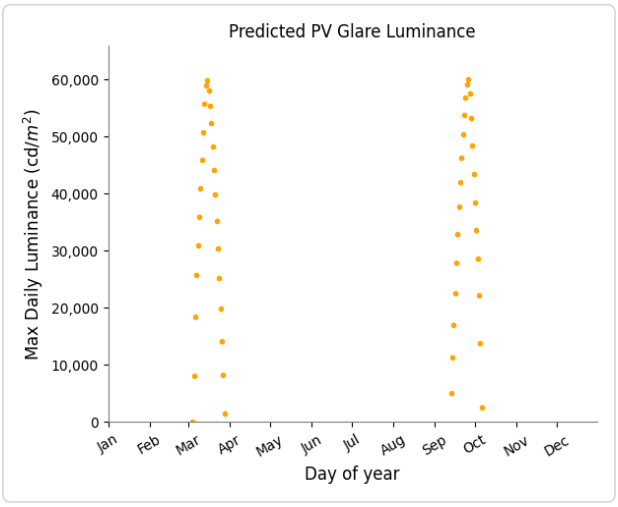
Green glare: 916 min.







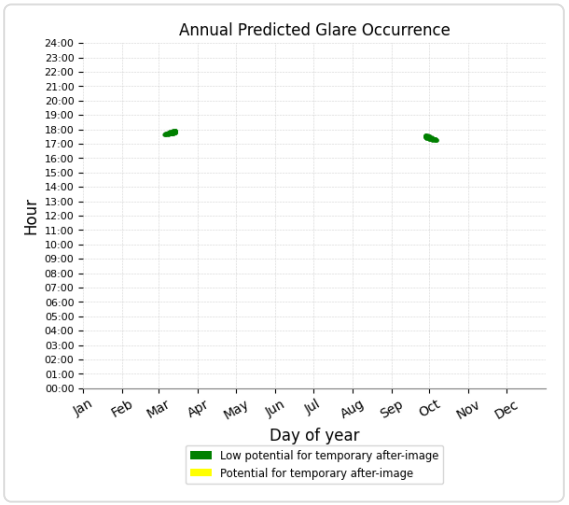


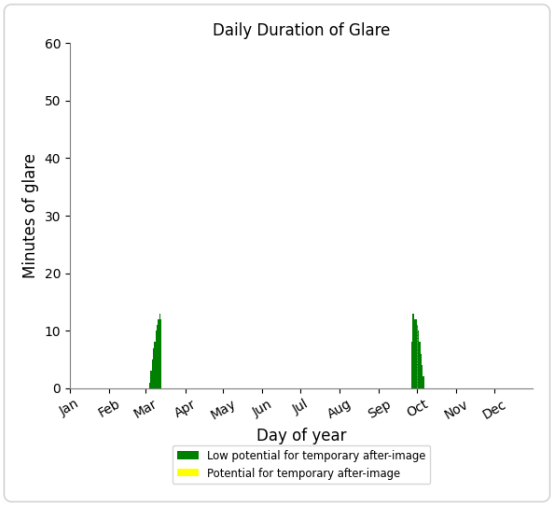


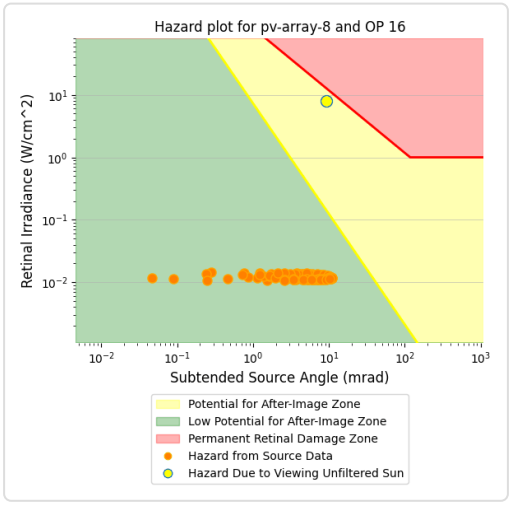
PV array 8 and OP 16

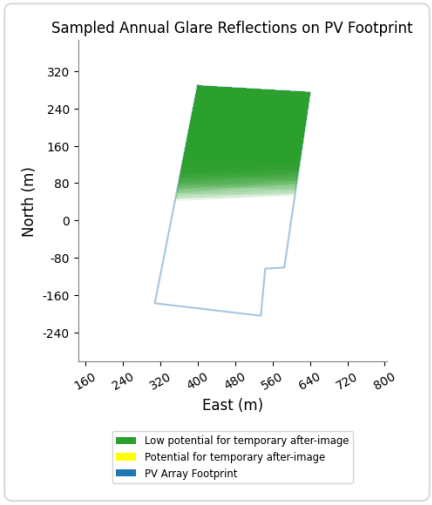
Yellow glare: none

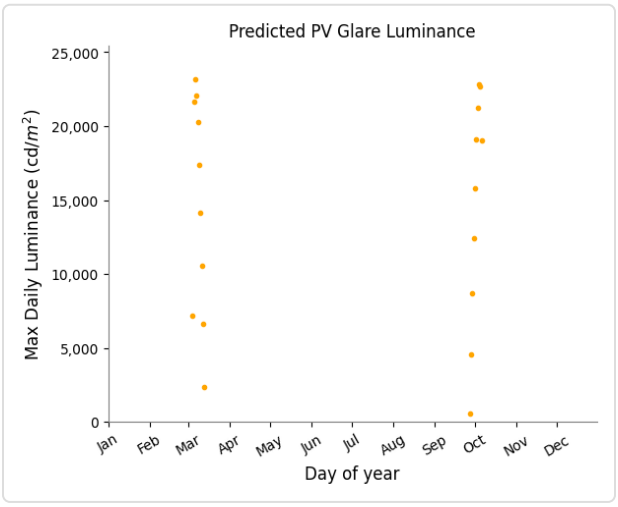
Green glare: 168 min.











PV array 8 and OP 5

No glare found

PV array 8 and OP 8

No glare found

PV array 8 and OP 9

No glare found

PV array 8 and OP 10

No glare found

PV array 8 and OP 11

No glare found

PV array 8 and OP 12

No glare found

PV array 8 and OP 17

No glare found

PV array 8 and OP 18

No glare found

PV array 8 and OP 19

No glare found

PV array 8 and OP 20

No glare found

PV array 8 and OP 21

No glare found

Assumptions

"Green" glare is glare with low potential to cause an after-image (flash blindness) when observed prior to a typical blink response time.
"Yellow" glare is glare with potential to cause an after-image (flash blindness) when observed prior to a typical blink response time.
Times associated with glare are denoted in Standard time. For Daylight Savings, add one hour.
The algorithm does not rigorously represent the detailed geometry of a system; detailed features such as gaps between modules, variable height of the PV array, and support structures may impact actual glare results. However, we have validated our models against several systems, including a PV array causing glare to the air-traffic control tower at Manchester-Boston Regional Airport and several sites in Albuquerque, and the tool accurately predicted the occurrence and intensity of glare at different times and days of the year.
Several V1 calculations utilize the PV array centroid, rather than the actual glare spot location, due to algorithm limitations. This may affect results for large PV footprints. Additional analyses of array sub-sections can provide additional information on expected glare. This primarily affects V1 analyses of path receptors.
Random number computations are utilized by various steps of the annual hazard analysis algorithm. Predicted minutes of glare can vary between runs as a result. This limitation primarily affects analyses of Observation Point receptors, including ATCTs. Note that the SGHAT/ ForgeSolar methodology has always relied on an analytical, qualitative approach to accurately determine the overall hazard (i.e. green vs. yellow) of expected glare on an annual basis.
The analysis does not automatically consider obstacles (either man-made or natural) between the observation points and the prescribed solar installation that may obstruct observed glare, such as trees, hills, buildings, etc.
The subtended source angle (glare spot size) is constrained by the PV array footprint size. Partitioning large arrays into smaller sections will reduce the maximum potential subtended angle, potentially impacting results if actual glare spots are larger than the sub-array size. Additional analyses of the combined area of adjacent sub-arrays can provide more information on potential glare hazards. (See previous point on related limitations.)
The variable direct normal irradiance (DNI) feature (if selected) scales the user-prescribed peak DNI using a typical clear-day irradiance profile. This profile has a lower DNI in the mornings and evenings and a maximum at solar noon. The scaling uses a clear-day irradiance profile based on a normalized time relative to sunrise, solar noon, and sunset, which are prescribed by a sun-position algorithm and the latitude and longitude obtained from Google maps. The actual DNI on any given day can be affected by cloud cover, atmospheric attenuation, and other environmental factors.
The ocular hazard predicted by the tool depends on a number of environmental, optical, and human factors, which can be uncertain. We provide input fields and typical ranges of values for these factors so that the user can vary these parameters to see if they have an impact on the results. The speed of SGHAT allows expedited sensitivity and parametric analyses.
The system output calculation is a DNI-based approximation that assumes clear, sunny skies year-round. It should not be used in place of more rigorous modeling methods.
Hazard zone boundaries shown in the Glare Hazard plot are an approximation and visual aid based on aggregated research data. Actual ocular impact outcomes encompass a continuous, not discrete, spectrum.
Glare locations displayed on receptor plots are approximate. Actual glare-spot locations may differ.
Refer to the Help page at **www.forgesolar.com/help/** for assumptions and limitations not listed here.

Default glare analysis parameters and observer eye characteristics (for reference only):

- Analysis time interval: 1 minute
- Ocular transmission coefficient: 0.5
- Pupil diameter: 0.002 meters
- Eye focal length: 0.017 meters
- Sun subtended angle: 9.3 milliradians

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FORGESOLAR GLARE ANALYSIS

Project: **BR10356 Normanton Larches Solar**
Site configuration: **Aviation 200ft 180 and 205 OP21-41**

Created 15 Mar, 2024
Updated 21 Mar, 2024
Time-step 1 minute
Timezone offset UTC0
Minimum sun altitude 0.0 deg
DNI peaks at 1,000.0 W/m^2
Category 10 MW to 100 MW
Site ID 114495.19448

Ocular transmission coefficient 0.5
Pupil diameter 0.002 m
Eye focal length 0.017 m
Sun subtended angle 9.3 mrad
PV analysis methodology V2

Summary of Results

Glare with low potential for temporary after-image predicted

PV Array	Tilt	Orient	Annual Green Glare		Annual Yellow Glare		Energy	Peak Luminance
	°	°	min	hr	min	hr	kWh	cd/m^2
PV array 1	25.0	180.0	4,188	69.8	0	0.0	-	113,346
PV array 2	25.0	180.0	5,411	90.2	0	0.0	-	82,198
PV array 3	25.0	180.0	2,133	35.5	0	0.0	-	161,759
PV array 4	25.0	180.0	6,178	103.0	0	0.0	-	162,609
PV array 5	25.0	180.0	1,083	18.1	0	0.0	-	89,415
PV array 6	25.0	180.0	8,634	143.9	0	0.0	-	156,293
PV array 7	25.0	205.0	3,565	59.4	0	0.0	-	132,286
PV array 8	25.0	180.0	8,034	133.9	0	0.0	-	211,494

Total glare received by each receptor; may include duplicate times of glare from multiple reflective surfaces.

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
OP 1	0	0.0	0	0.0
OP 2	0	0.0	0	0.0
OP 3	3,298	55.0	0	0.0
OP 4	8,239	137.3	0	0.0
OP 5	9,658	161.0	0	0.0
OP 6	13,542	225.7	0	0.0
OP 7	2,894	48.2	0	0.0
OP 8	0	0.0	0	0.0

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
OP 9	0	0.0	0	0.0
OP 10	0	0.0	0	0.0
OP 11	0	0.0	0	0.0
OP 12	0	0.0	0	0.0
OP 13	0	0.0	0	0.0
OP 14	1,536	25.6	0	0.0
OP 15	59	1.0	0	0.0
OP 16	0	0.0	0	0.0
OP 17	0	0.0	0	0.0
OP 18	0	0.0	0	0.0
OP 19	0	0.0	0	0.0
OP 20	0	0.0	0	0.0
OP 21	0	0.0	0	0.0

Component Data

PV Arrays

Name: PV array 1
Axis tracking: Fixed (no rotation)
Tilt: 25.0°
Orientation: 180.0°
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	53.270453	-1.023592	44.16	3.58	47.74
2	53.270382	-1.026510	38.69	3.58	42.27
3	53.270337	-1.028001	42.19	3.58	45.77
4	53.268374	-1.027819	47.55	3.58	51.13
5	53.267835	-1.027411	47.97	3.58	51.55
6	53.268194	-1.025823	42.76	3.58	46.34
7	53.268605	-1.023538	48.05	3.58	51.63

Name: PV array 2
Axis tracking: Fixed (no rotation)
Tilt: 25.0°
Orientation: 180.0°
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	53.272403	-1.022893	44.98	3.58	48.56
2	53.271659	-1.020468	49.10	3.58	52.68
3	53.271146	-1.020629	49.06	3.58	52.64
4	53.270568	-1.020768	49.76	3.58	53.34
5	53.269978	-1.022399	48.94	3.58	52.52
6	53.269490	-1.023494	46.53	3.58	50.11
7	53.270600	-1.023526	44.05	3.58	47.63
8	53.270658	-1.022721	44.52	3.58	48.10

Name: PV array 3
Axis tracking: Fixed (no rotation)
Tilt: 25.0°
Orientation: 180.0°
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	53.267270	-1.027453	49.52	3.58	53.10
2	53.267742	-1.026122	44.46	3.58	48.04
3	53.268066	-1.026004	43.25	3.58	46.83
4	53.268361	-1.024577	44.74	3.58	48.32
5	53.268515	-1.023451	48.43	3.58	52.01
6	53.263789	-1.021096	44.95	3.58	48.53
7	53.263606	-1.026144	50.81	3.58	54.39

Name: PV array 4
Axis tracking: Fixed (no rotation)
Tilt: 25.0°
Orientation: 180.0°
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	53.267296	-1.022818	47.72	3.58	51.30
2	53.267707	-1.018998	49.22	3.58	52.80
3	53.264120	-1.017373	43.17	3.58	46.75
4	53.264126	-1.017861	43.81	3.58	47.39
5	53.263885	-1.017893	45.60	3.58	49.18
6	53.263795	-1.021085	44.91	3.58	48.49

Name: PV array 5
Axis tracking: Fixed (no rotation)
Tilt: 25.0°
Orientation: 180.0°
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	53.268300	-1.019106	51.65	3.58	55.23
2	53.268197	-1.015587	47.94	3.58	51.52
3	53.267411	-1.014932	45.87	3.58	49.45
4	53.263776	-1.015093	42.99	3.58	46.57
5	53.263904	-1.017175	44.48	3.58	48.06
6	53.266359	-1.018355	43.98	3.58	47.56

Name: PV array 6
Axis tracking: Fixed (no rotation)
Tilt: 25.0°
Orientation: 180.0°
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	53.267286	-1.014793	45.26	3.58	48.84
2	53.263975	-1.015072	41.69	3.58	45.27
3	53.265181	-1.012926	37.52	3.58	41.10
4	53.265759	-1.012132	35.68	3.58	39.26
5	53.266067	-1.011724	35.43	3.58	39.01
6	53.266349	-1.011338	34.83	3.58	38.41
7	53.266619	-1.009836	34.68	3.58	38.26
8	53.267825	-1.010716	42.25	3.58	45.83

Name: PV array 7
Axis tracking: Fixed (no rotation)
Tilt: 25.0°
Orientation: 205.0°
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	53.272879	-1.014026	31.28	3.58	34.86
2	53.271380	-1.014364	35.18	3.58	38.76
3	53.269552	-1.014772	42.95	3.58	46.53
4	53.269638	-1.012272	41.53	3.58	45.11
5	53.270745	-1.010528	29.54	3.58	33.12
6	53.271798	-1.010105	28.06	3.58	31.64
7	53.272449	-1.010271	28.12	3.58	31.70
8	53.273094	-1.010657	28.00	3.58	31.58
9	53.273235	-1.012706	29.10	3.58	32.68
10	53.272843	-1.012851	29.86	3.58	33.44

Name: PV array 8
Axis tracking: Fixed (no rotation)
Tilt: 25.0°
Orientation: 180.0°
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	53.268629	-1.015626	47.69	3.58	51.27
2	53.268835	-1.019016	51.81	3.58	55.39
3	53.273050	-1.017750	40.72	3.58	44.30
4	53.272880	-1.014022	31.26	3.58	34.84
5	53.269547	-1.014811	42.96	3.58	46.54
6	53.269531	-1.015438	43.75	3.58	47.33

Discrete Observation Point Receptors

Name	ID	Latitude (°)	Longitude (°)	Elevation (m)	Height (m)
OP 1	1	53.279168	-0.962682	22.00	60.96
OP 2	2	53.275011	-0.957188	26.00	60.96
OP 3	3	53.265823	-0.946545	20.99	60.96
OP 4	4	53.258892	-0.954442	41.64	60.96
OP 5	5	53.253860	-0.968518	33.27	60.96
OP 6	6	53.259816	-0.979075	30.66	60.96
OP 7	7	53.270494	-0.993838	27.91	60.96
OP 8	8	53.282145	-1.005425	52.69	60.96
OP 9	9	53.287327	-0.996241	34.00	60.96
OP 10	10	53.291175	-0.981221	26.10	60.96
OP 11	11	53.286506	-0.974955	25.68	60.96
OP 12	12	53.281991	-0.989976	45.11	60.96
OP 13	13	53.277526	-0.995040	54.66	60.96
OP 14	14	53.268852	-0.946545	21.82	60.96
OP 15	15	53.273523	-0.934529	23.38	60.96
OP 16	16	53.279168	-0.926461	24.89	60.96
OP 17	17	53.284095	-0.934872	29.10	60.96
OP 18	18	53.291278	-0.946460	23.41	60.96
OP 19	19	53.296049	-0.954528	37.14	60.96
OP 20	20	53.293535	-0.965342	36.12	60.96
OP 21	21	53.288918	-0.971350	22.98	60.96

Glare Analysis Results

Summary of Results

Glare with low potential for temporary after-image predicted

PV Array	Tilt	Orient	Annual Green Glare		Annual Yellow Glare		Energy	Peak Luminance
	°	°	min	hr	min	hr	kWh	cd/m^2
PV array 1	25.0	180.0	4,188	69.8	0	0.0	-	113,346
PV array 2	25.0	180.0	5,411	90.2	0	0.0	-	82,198
PV array 3	25.0	180.0	2,133	35.5	0	0.0	-	161,759
PV array 4	25.0	180.0	6,178	103.0	0	0.0	-	162,609
PV array 5	25.0	180.0	1,083	18.1	0	0.0	-	89,415
PV array 6	25.0	180.0	8,634	143.9	0	0.0	-	156,293
PV array 7	25.0	205.0	3,565	59.4	0	0.0	-	132,286
PV array 8	25.0	180.0	8,034	133.9	0	0.0	-	211,494

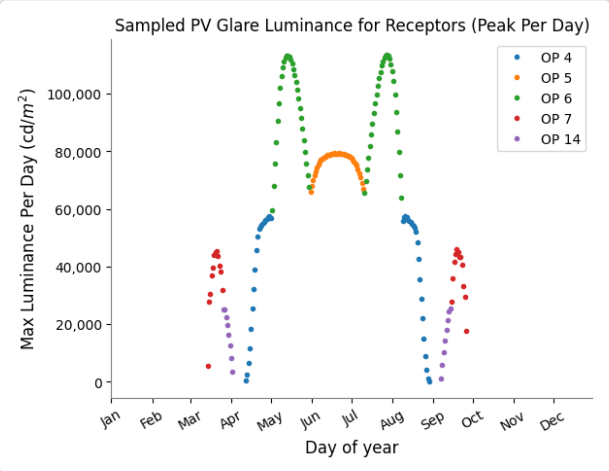
Total glare received by each receptor; may include duplicate times of glare from multiple reflective surfaces.

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
OP 1	0	0.0	0	0.0
OP 2	0	0.0	0	0.0
OP 3	3,298	55.0	0	0.0
OP 4	8,239	137.3	0	0.0
OP 5	9,658	161.0	0	0.0
OP 6	13,542	225.7	0	0.0
OP 7	2,894	48.2	0	0.0
OP 8	0	0.0	0	0.0
OP 9	0	0.0	0	0.0
OP 10	0	0.0	0	0.0
OP 11	0	0.0	0	0.0
OP 12	0	0.0	0	0.0
OP 13	0	0.0	0	0.0
OP 14	1,536	25.6	0	0.0
OP 15	59	1.0	0	0.0
OP 16	0	0.0	0	0.0
OP 17	0	0.0	0	0.0
OP 18	0	0.0	0	0.0
OP 19	0	0.0	0	0.0
OP 20	0	0.0	0	0.0
OP 21	0	0.0	0	0.0

PV: PV array 1 low potential for temporary after-image

Receptor results ordered by category of glare

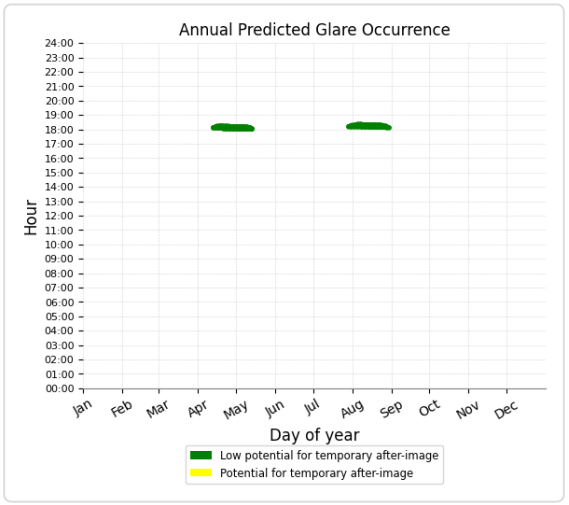
Receptor	Annual Green Glare		Annual Yellow Glare		Peak Luminance
	min	hr	min	hr	cd/m^2
OP 4	690	11.5	0	0.0	57,455
OP 5	1,294	21.6	0	0.0	79,245
OP 6	1,696	28.3	0	0.0	113,346
OP 7	301	5.0	0	0.0	45,911
OP 14	207	3.5	0	0.0	27,354
OP 1	0	0.0	0	0.0	0
OP 2	0	0.0	0	0.0	0
OP 3	0	0.0	0	0.0	0
OP 8	0	0.0	0	0.0	0
OP 9	0	0.0	0	0.0	0
OP 10	0	0.0	0	0.0	0
OP 11	0	0.0	0	0.0	0
OP 12	0	0.0	0	0.0	0
OP 13	0	0.0	0	0.0	0
OP 15	0	0.0	0	0.0	0
OP 16	0	0.0	0	0.0	0
OP 17	0	0.0	0	0.0	0
OP 18	0	0.0	0	0.0	0
OP 19	0	0.0	0	0.0	0
OP 20	0	0.0	0	0.0	0
OP 21	0	0.0	0	0.0	0

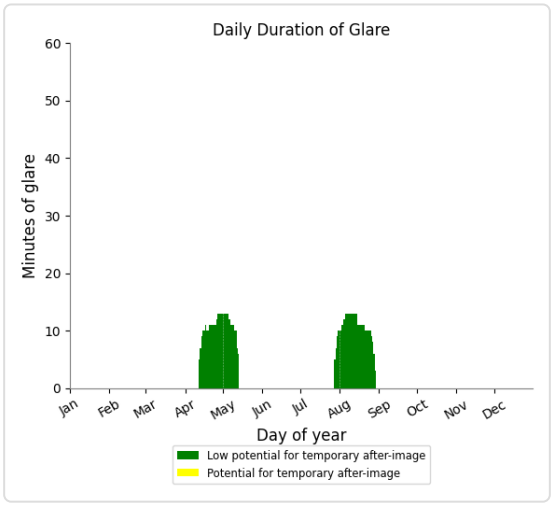


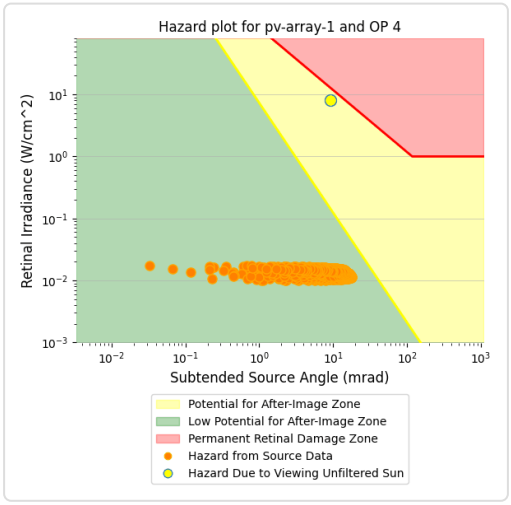
PV array 1 and OP 4

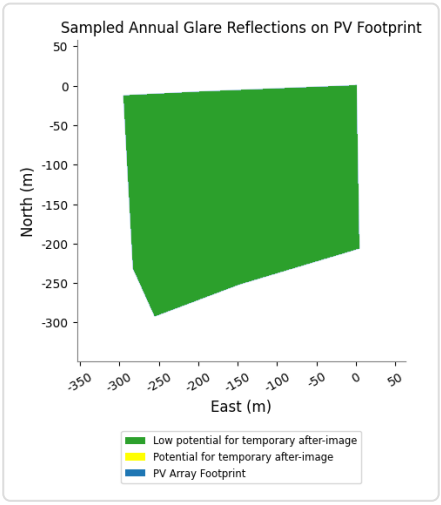
Yellow glare: none

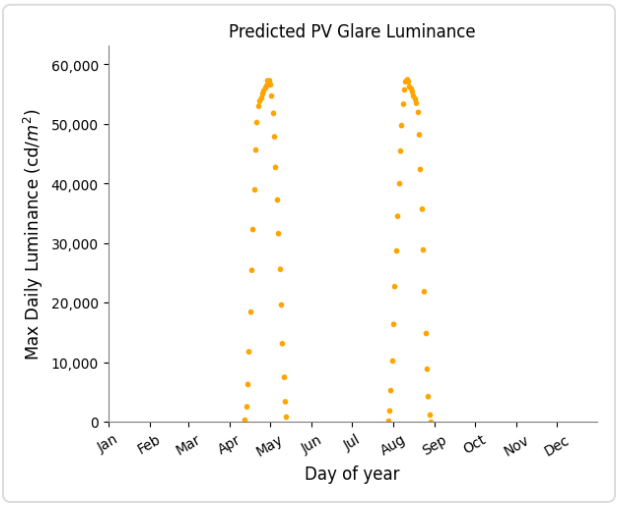
Green glare: 690 min.







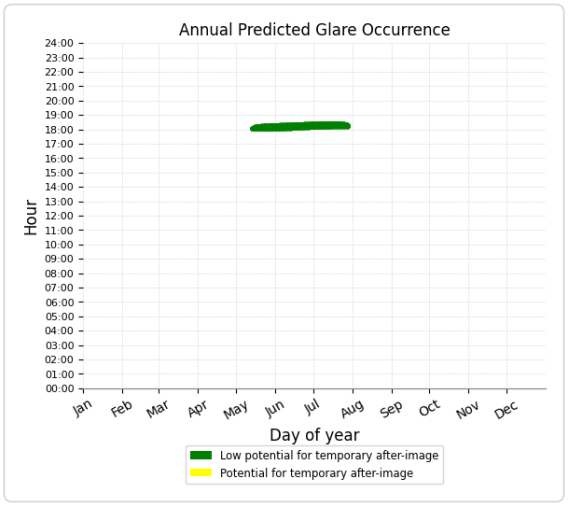


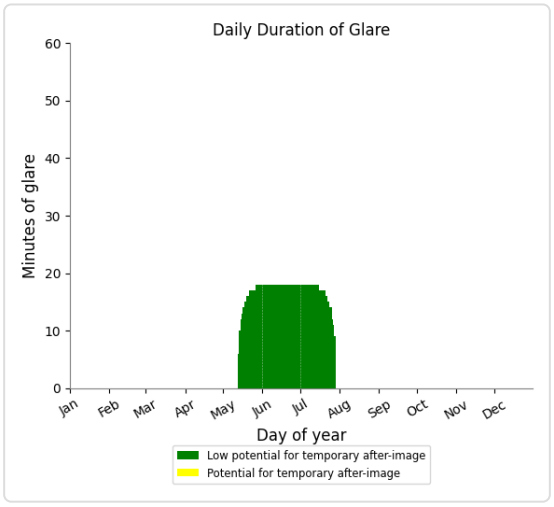


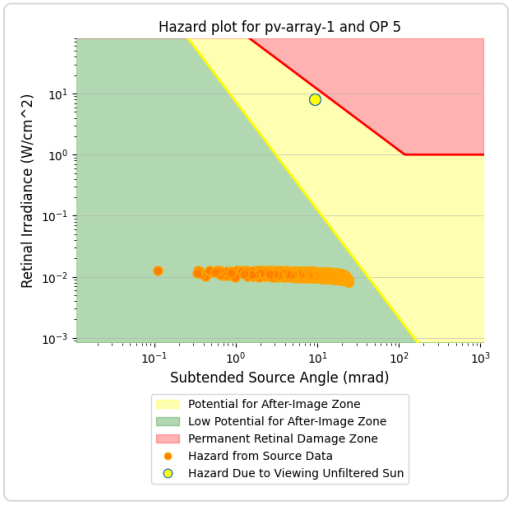
PV array 1 and OP 5

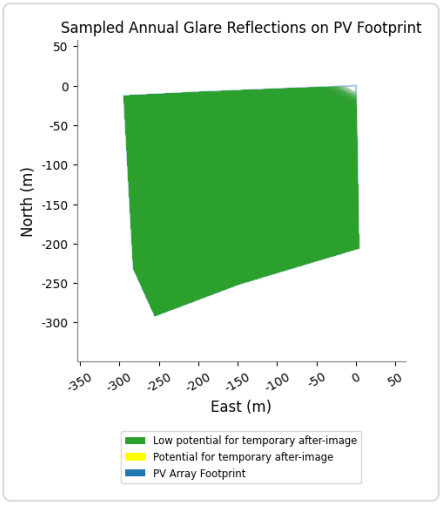
Yellow glare: none

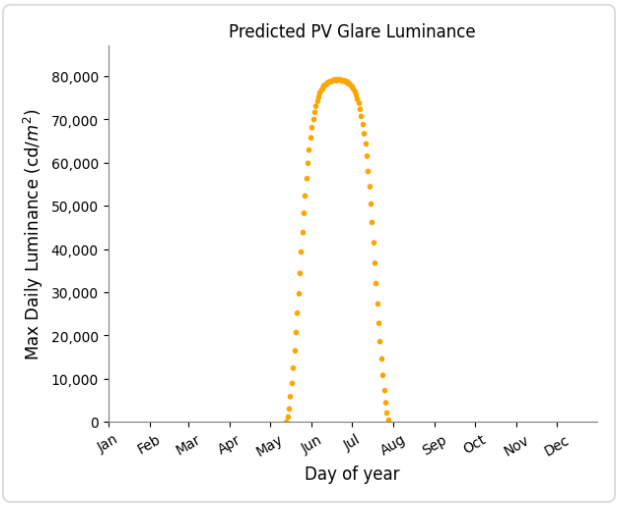
Green glare: 1,294 min.







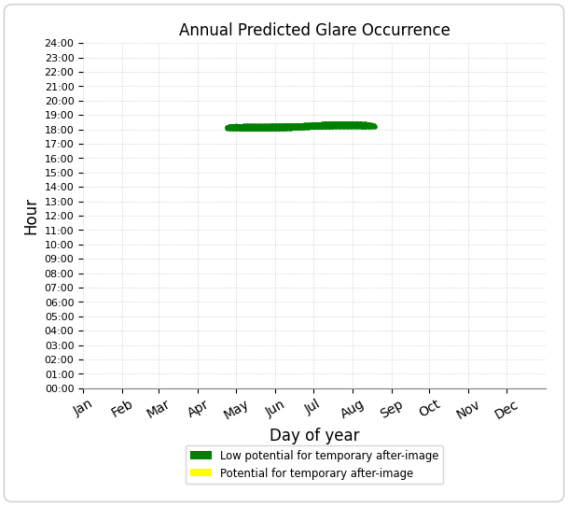


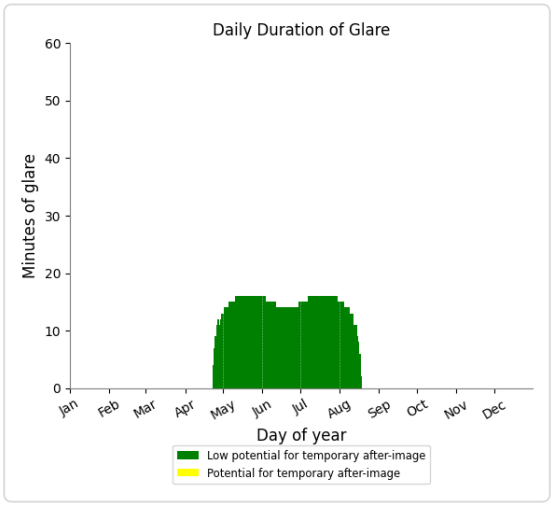


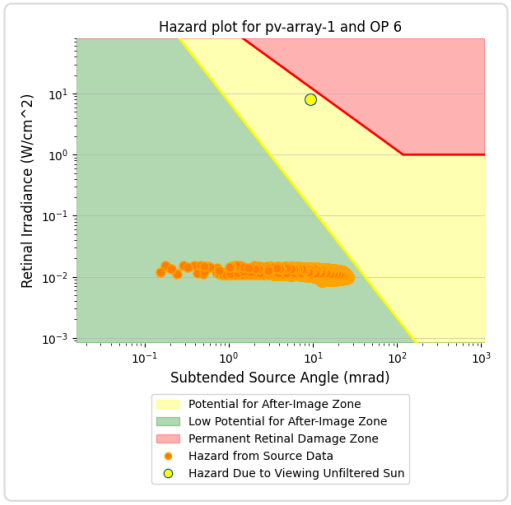
PV array 1 and OP 6

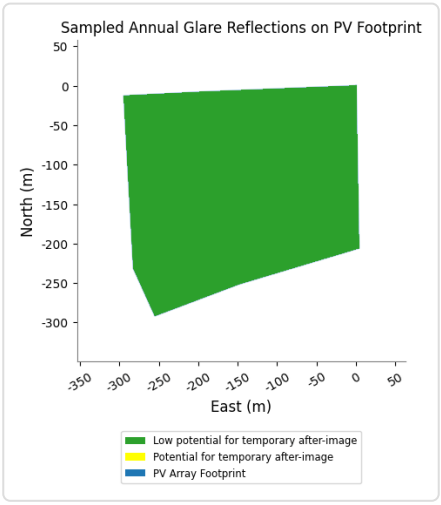
Yellow glare: none

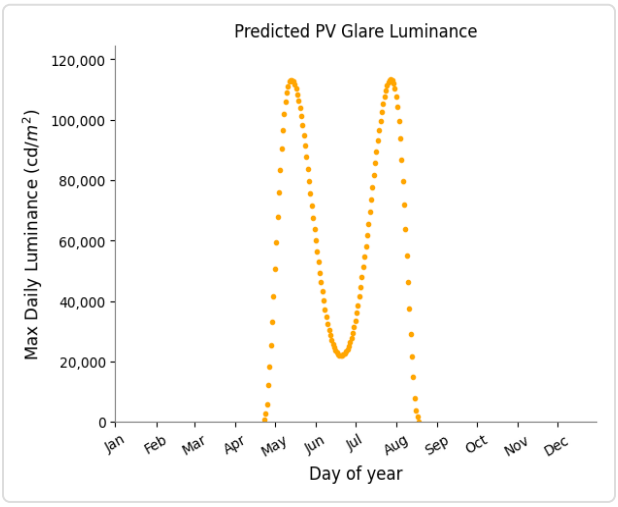
Green glare: 1,696 min.







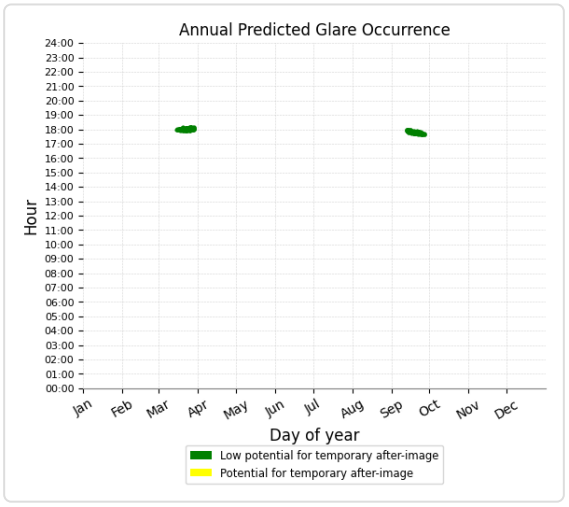


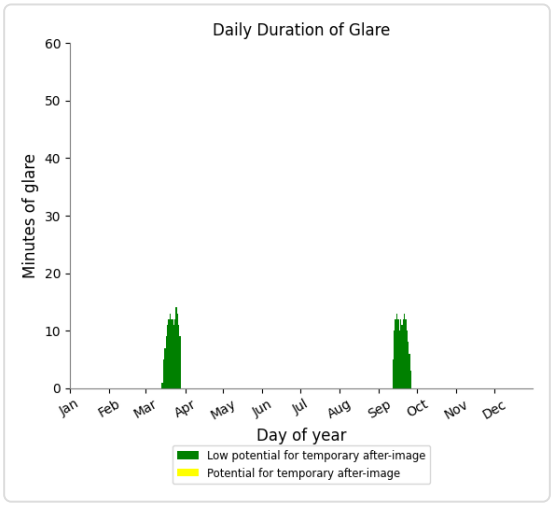


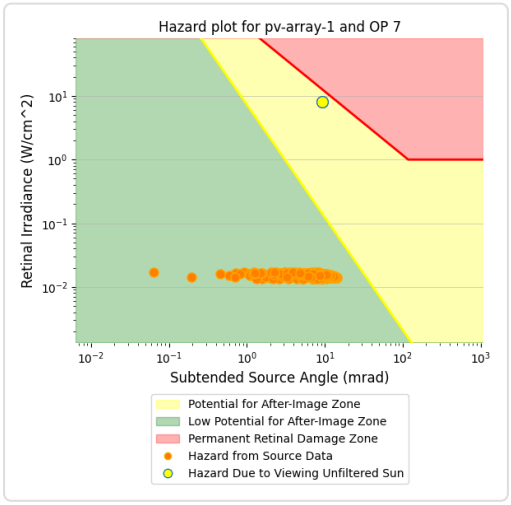
PV array 1 and OP 7

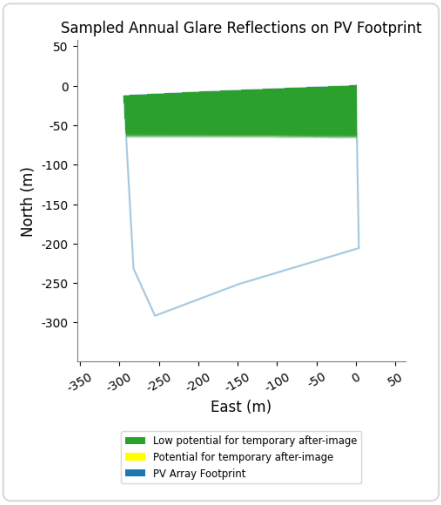
Yellow glare: none

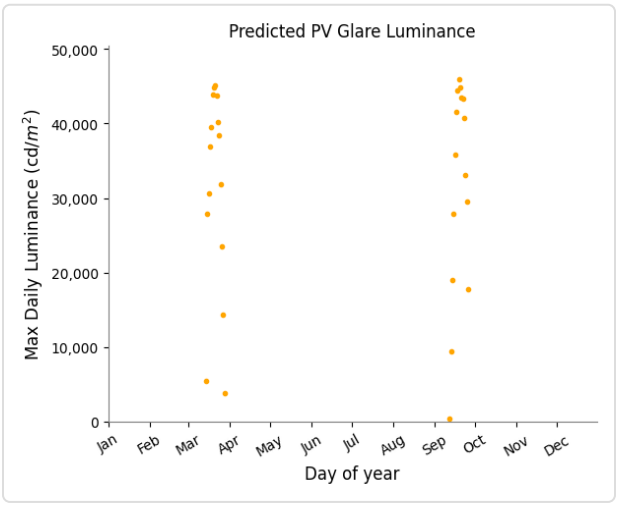
Green glare: 301 min.







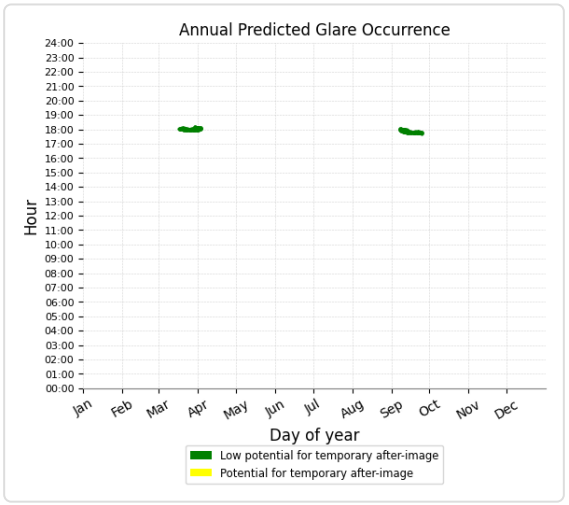


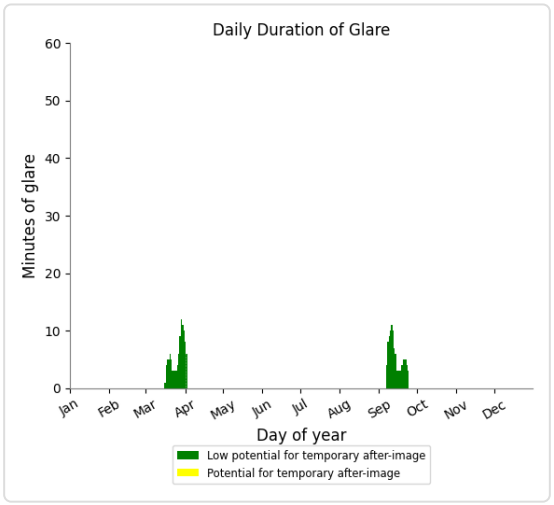


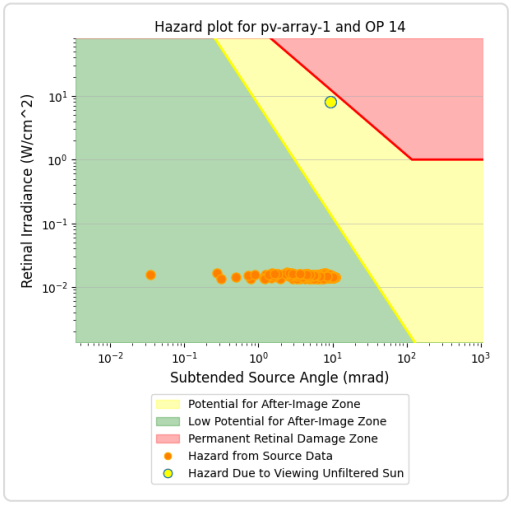
PV array 1 and OP 14

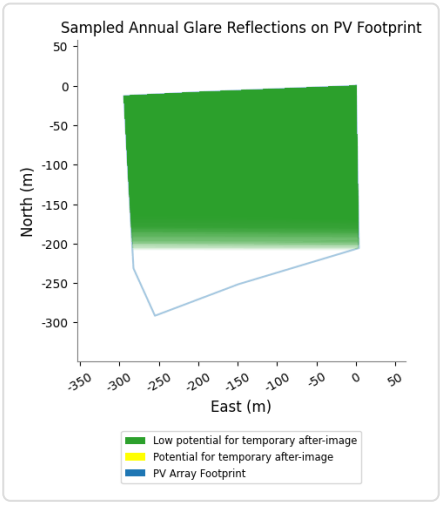
Yellow glare: none

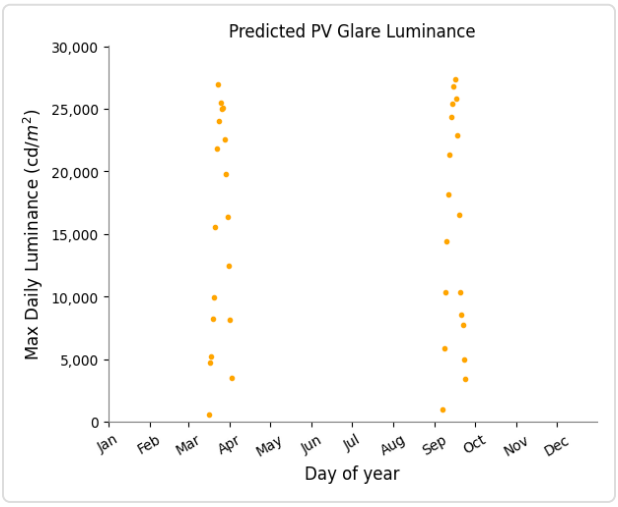
Green glare: 207 min.











PV array 1 and OP 1

No glare found

PV array 1 and OP 2

No glare found

PV array 1 and OP 3

No glare found

PV array 1 and OP 8

No glare found

PV array 1 and OP 9

No glare found

PV array 1 and OP 10

No glare found

PV array 1 and OP 11

No glare found

PV array 1 and OP 12

No glare found

PV array 1 and OP 13

No glare found

PV array 1 and OP 15

No glare found

PV array 1 and OP 16

No glare found

PV array 1 and OP 17

No glare found

PV array 1 and OP 18

No glare found

PV array 1 and OP 19

No glare found

PV array 1 and OP 20

No glare found

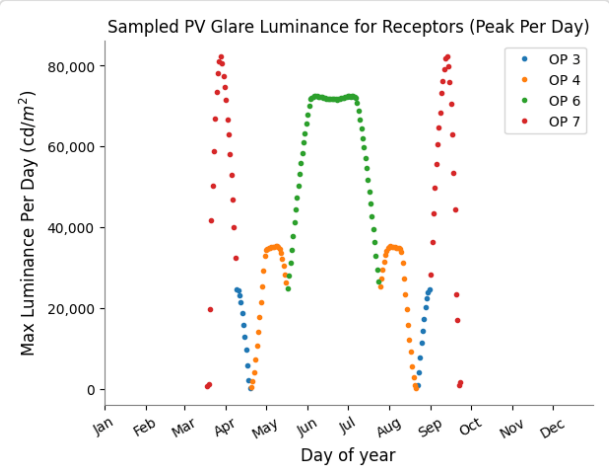
PV array 1 and OP 21

No glare found

PV: PV array 2 low potential for temporary after-image

Receptor results ordered by category of glare

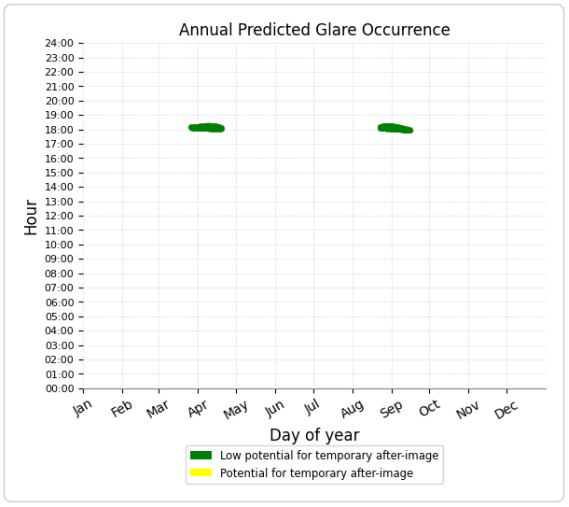
Receptor	Annual Green Glare		Annual Yellow Glare		Peak Luminance
	min	hr	min	hr	cd/m^2
OP 3	787	13.1	0	0.0	24,708
OP 4	1,285	21.4	0	0.0	35,316
OP 5	576	9.6	0	0.0	6,648
OP 6	1,674	27.9	0	0.0	72,500
OP 7	610	10.2	0	0.0	82,198
OP 14	479	8.0	0	0.0	19,713
OP 1	0	0.0	0	0.0	0
OP 2	0	0.0	0	0.0	0
OP 8	0	0.0	0	0.0	0
OP 9	0	0.0	0	0.0	0
OP 10	0	0.0	0	0.0	0
OP 11	0	0.0	0	0.0	0
OP 12	0	0.0	0	0.0	0
OP 13	0	0.0	0	0.0	0
OP 15	0	0.0	0	0.0	0
OP 16	0	0.0	0	0.0	0
OP 17	0	0.0	0	0.0	0
OP 18	0	0.0	0	0.0	0
OP 19	0	0.0	0	0.0	0
OP 20	0	0.0	0	0.0	0
OP 21	0	0.0	0	0.0	0

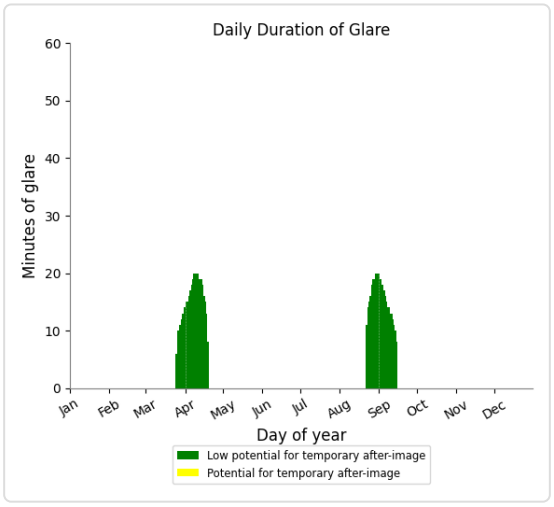


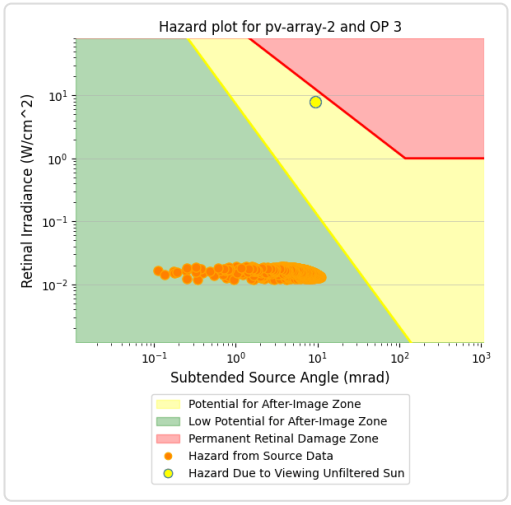
PV array 2 and OP 3

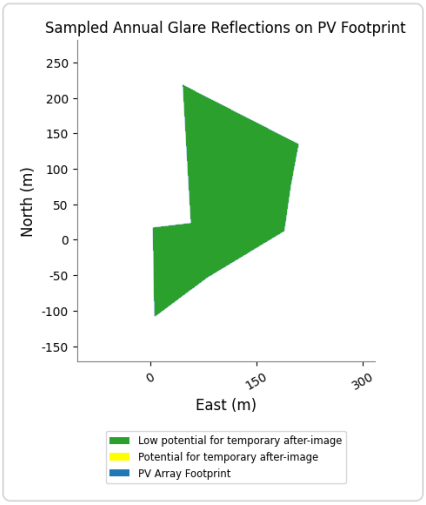
Yellow glare: none

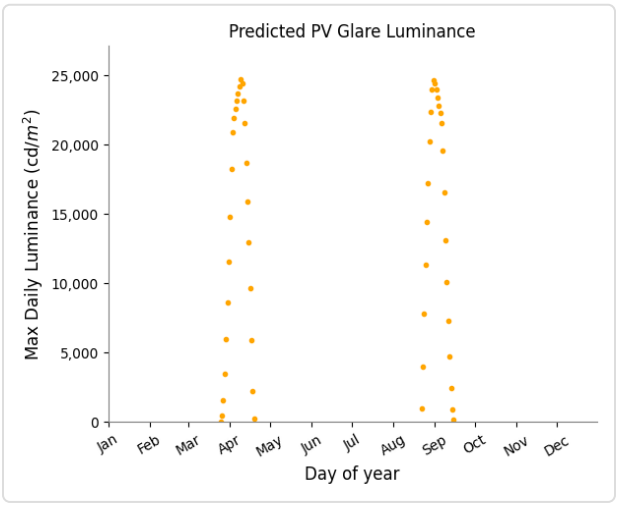
Green glare: 787 min.







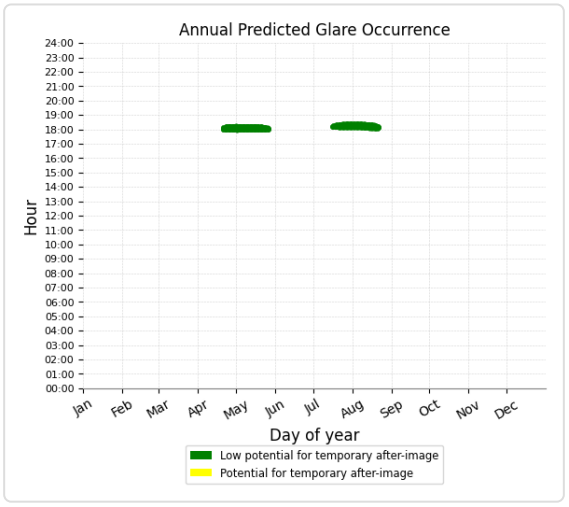


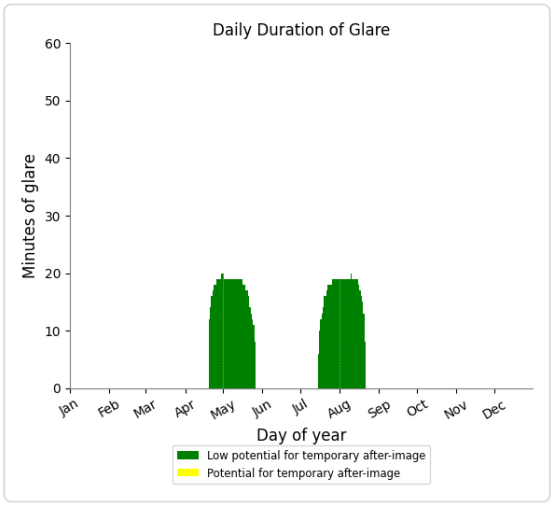


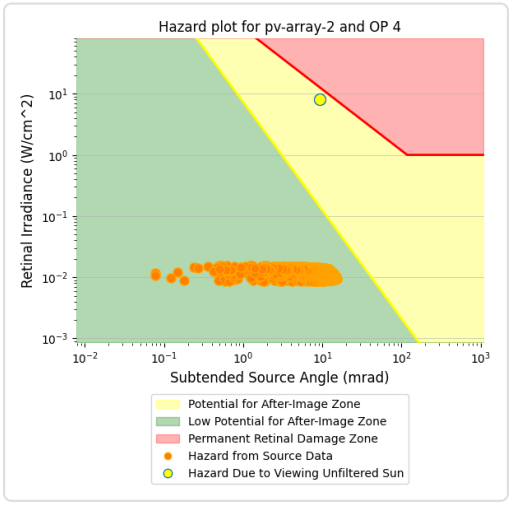
PV array 2 and OP 4

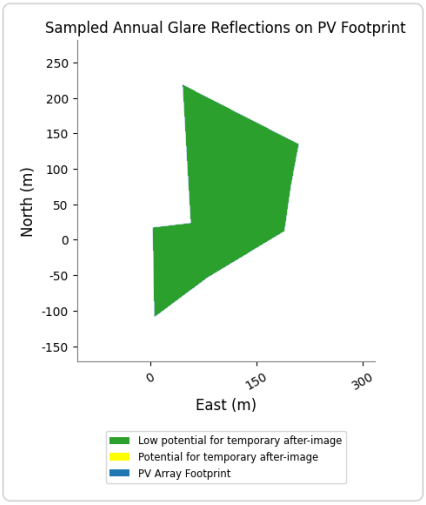
Yellow glare: none

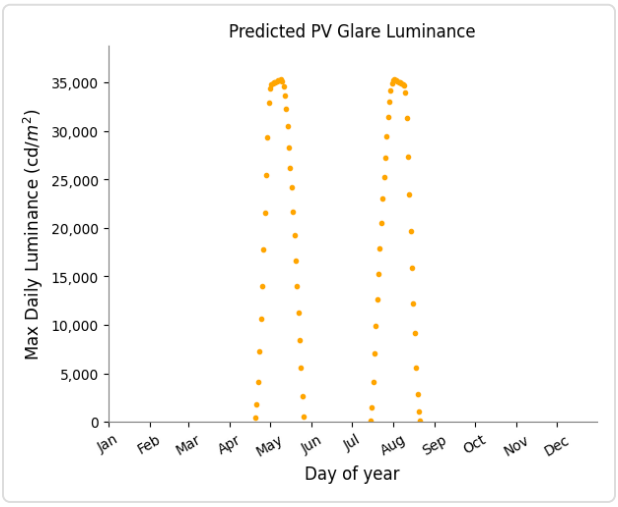
Green glare: 1,285 min.







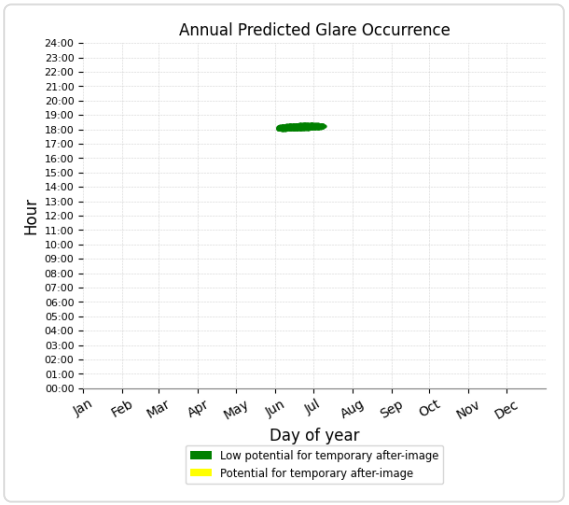


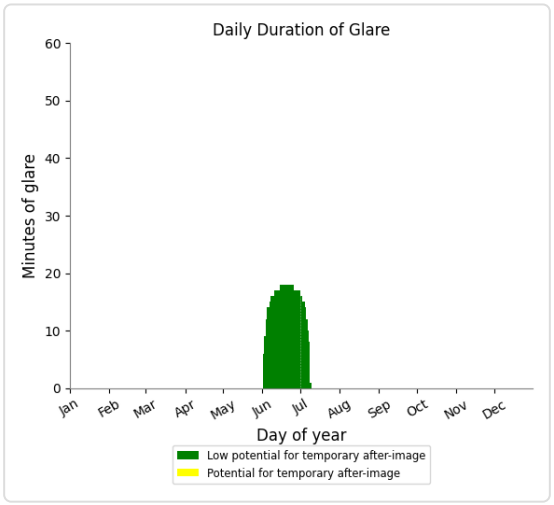


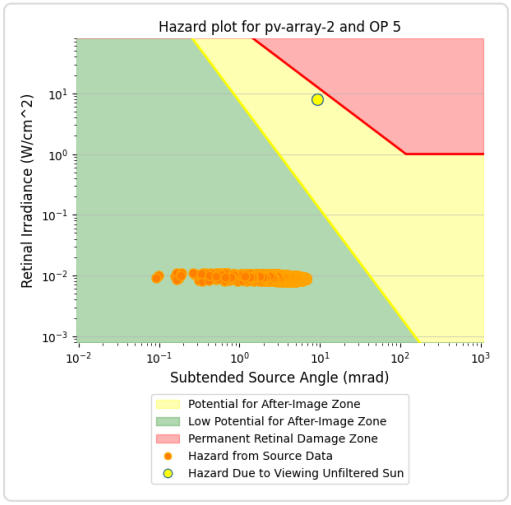
PV array 2 and OP 5

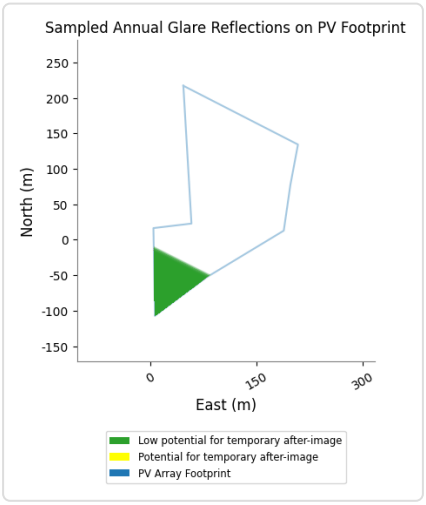
Yellow glare: none

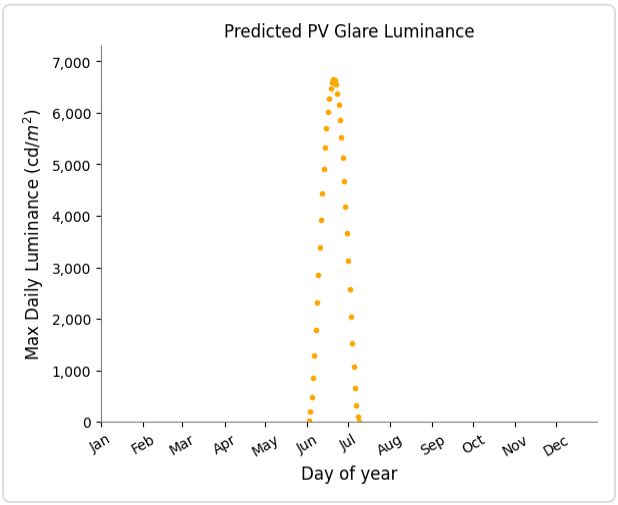
Green glare: 576 min.







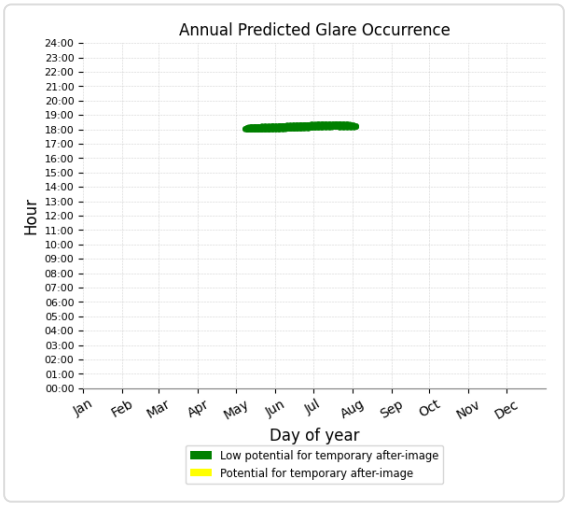


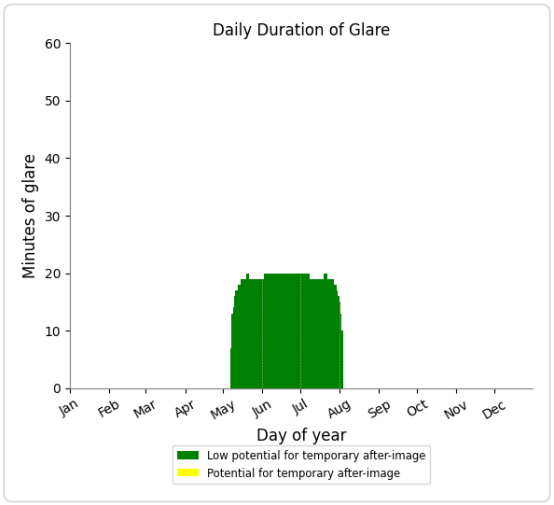


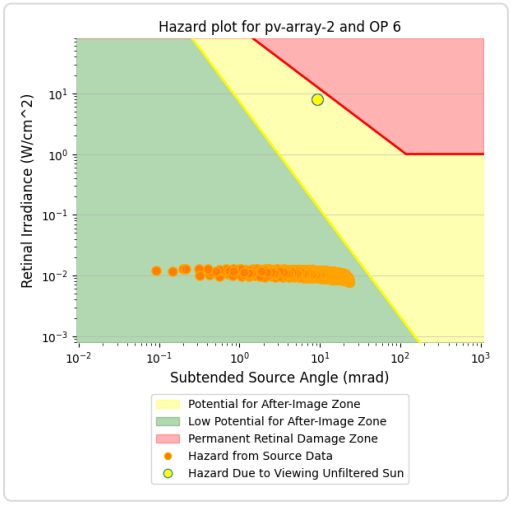
PV array 2 and OP 6

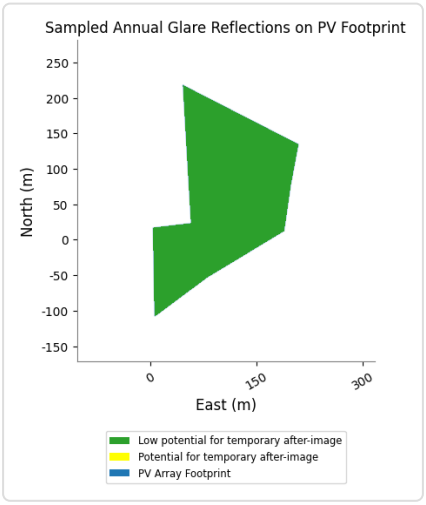
Yellow glare: none

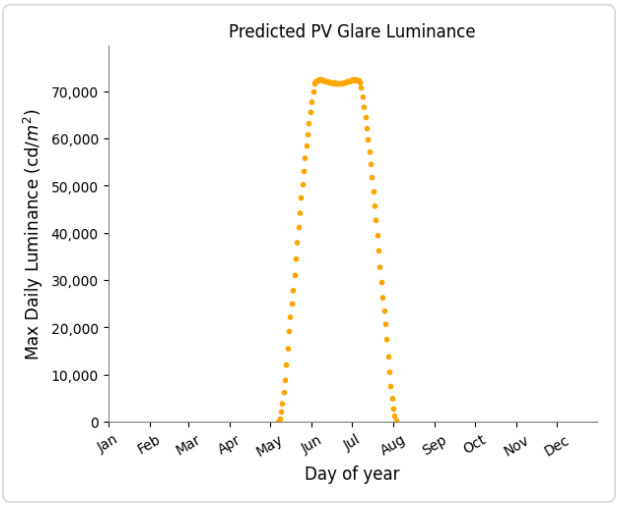
Green glare: 1,674 min.







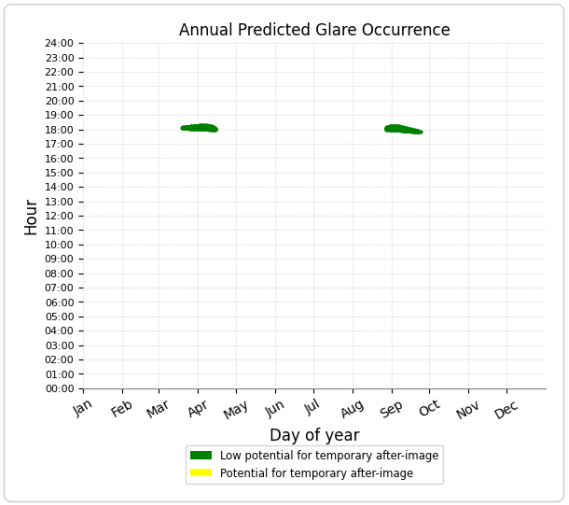


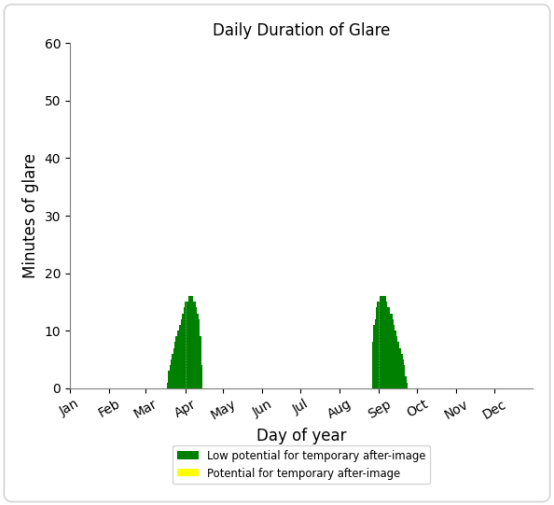


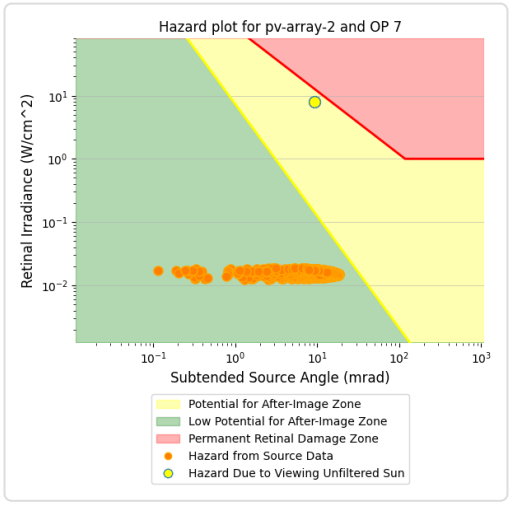
PV array 2 and OP 7

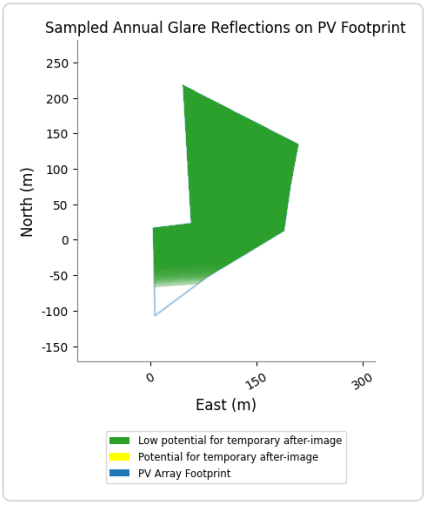
Yellow glare: none

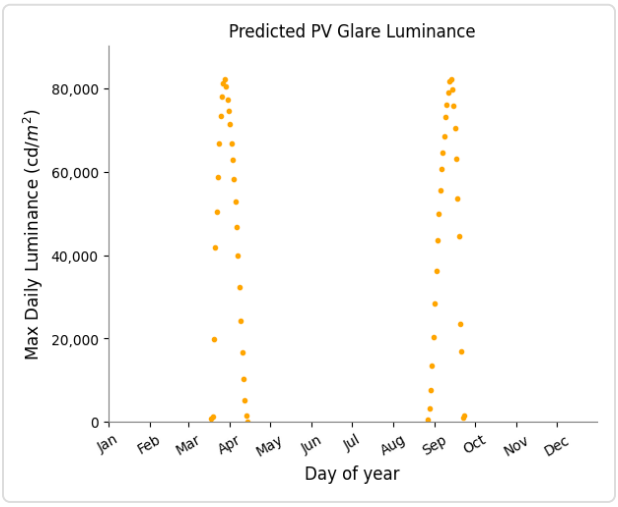
Green glare: 610 min.







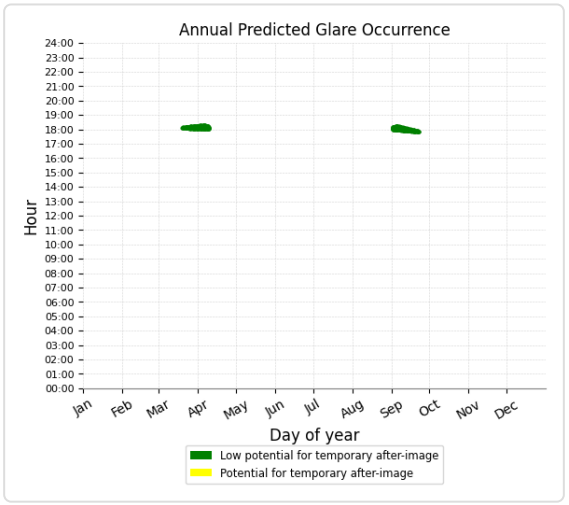


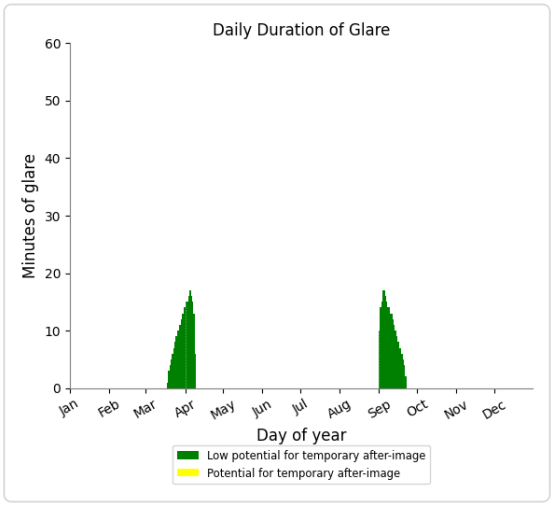


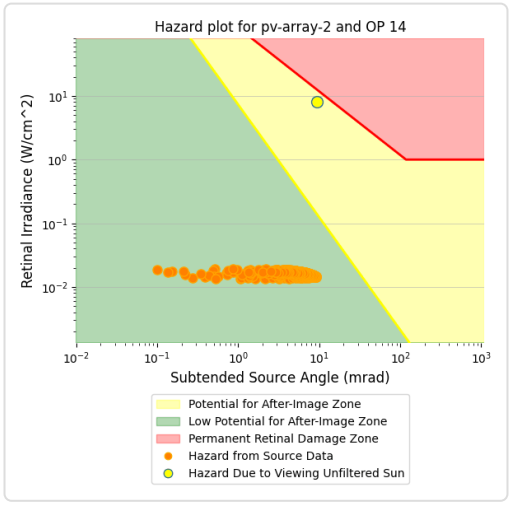
PV array 2 and OP 14

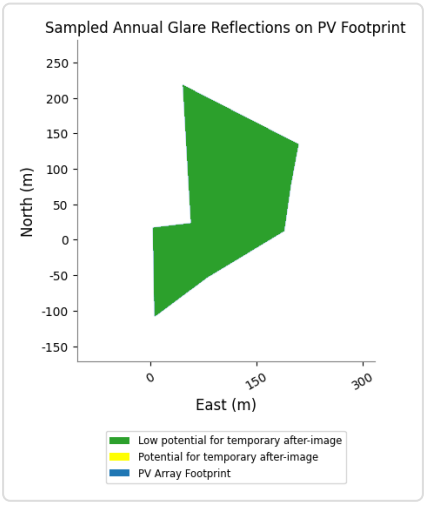
Yellow glare: none

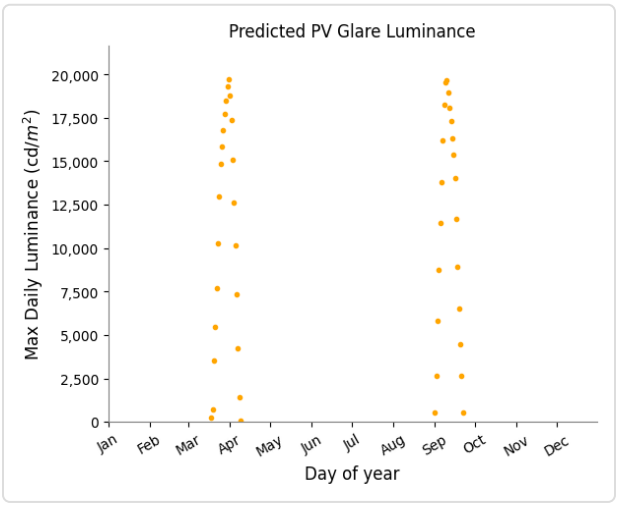
Green glare: 479 min.











PV array 2 and OP 1

No glare found

PV array 2 and OP 2

No glare found

PV array 2 and OP 8

No glare found

PV array 2 and OP 9

No glare found

PV array 2 and OP 10

No glare found

PV array 2 and OP 11

No glare found

PV array 2 and OP 12

No glare found

PV array 2 and OP 13

No glare found

PV array 2 and OP 15

No glare found

PV array 2 and OP 16

No glare found

PV array 2 and OP 17

No glare found

PV array 2 and OP 18

No glare found

PV array 2 and OP 19

No glare found

PV array 2 and OP 20

No glare found

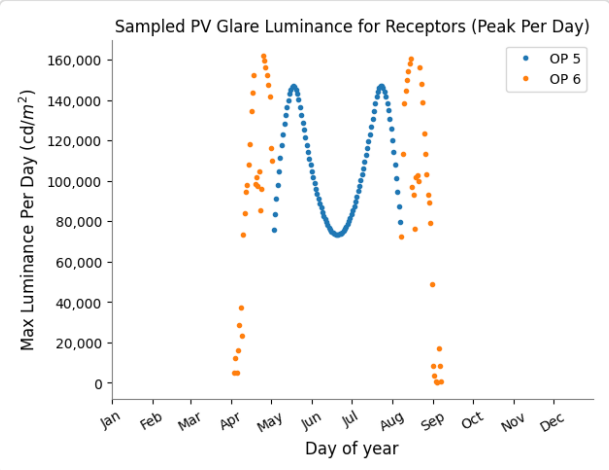
PV array 2 and OP 21

No glare found

PV: PV array 3 low potential for temporary after-image

Receptor results ordered by category of glare

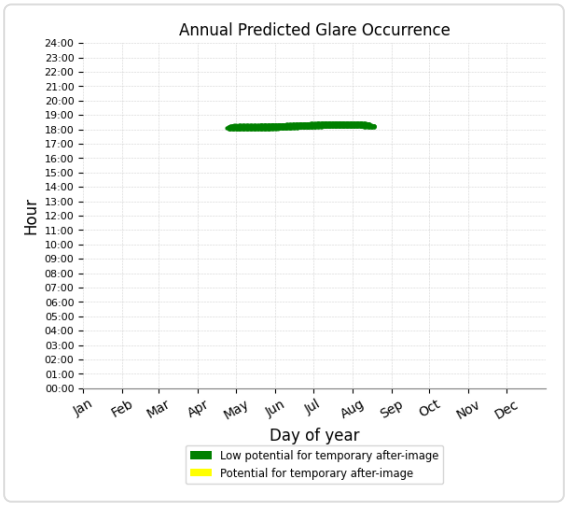
Receptor	Annual Green Glare		Annual Yellow Glare		Peak Luminance
	min	hr	min	hr	cd/m^2
OP 5	1,553	25.9	0	0.0	147,163
OP 6	580	9.7	0	0.0	161,759
OP 1	0	0.0	0	0.0	0
OP 2	0	0.0	0	0.0	0
OP 3	0	0.0	0	0.0	0
OP 4	0	0.0	0	0.0	0
OP 7	0	0.0	0	0.0	0
OP 8	0	0.0	0	0.0	0
OP 9	0	0.0	0	0.0	0
OP 10	0	0.0	0	0.0	0
OP 11	0	0.0	0	0.0	0
OP 12	0	0.0	0	0.0	0
OP 13	0	0.0	0	0.0	0
OP 14	0	0.0	0	0.0	0
OP 15	0	0.0	0	0.0	0
OP 16	0	0.0	0	0.0	0
OP 17	0	0.0	0	0.0	0
OP 18	0	0.0	0	0.0	0
OP 19	0	0.0	0	0.0	0
OP 20	0	0.0	0	0.0	0
OP 21	0	0.0	0	0.0	0

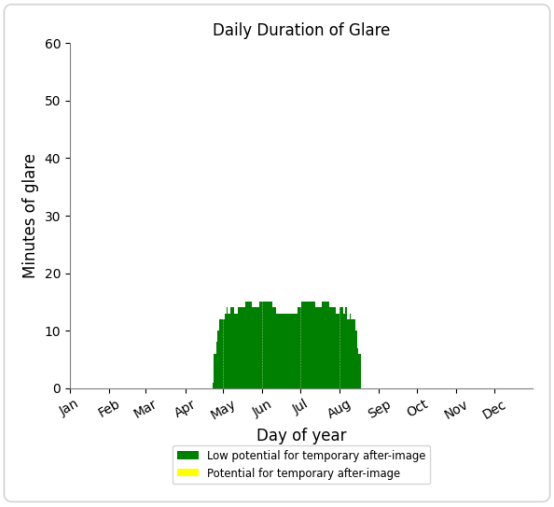


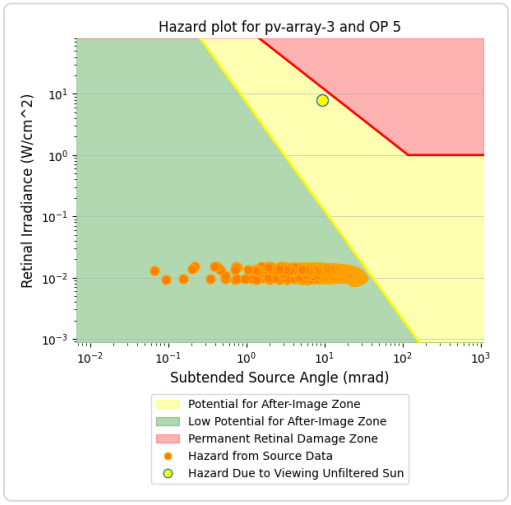
PV array 3 and OP 5

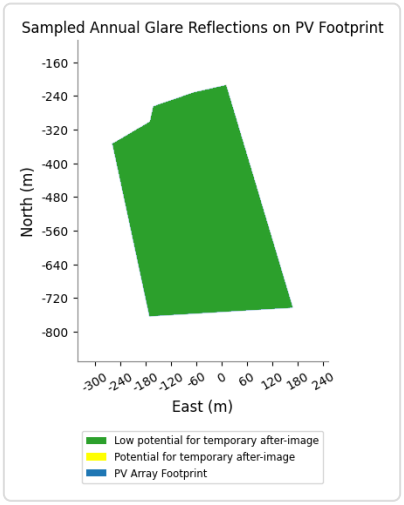
Yellow glare: none

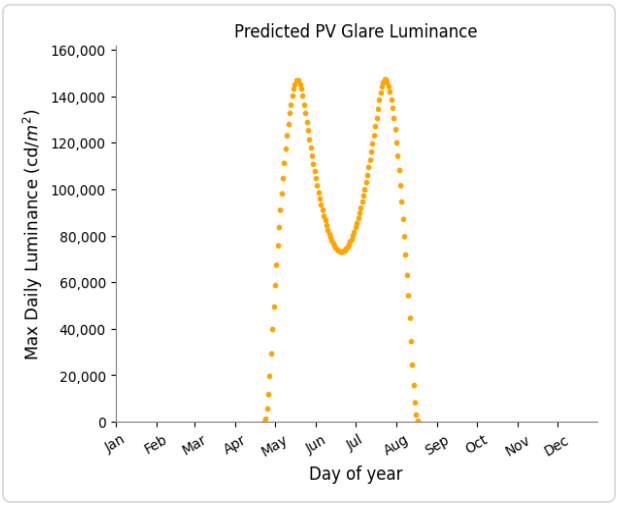
Green glare: 1,553 min.







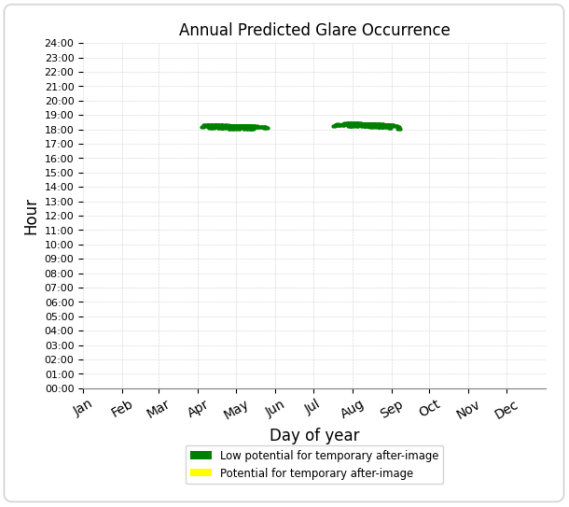


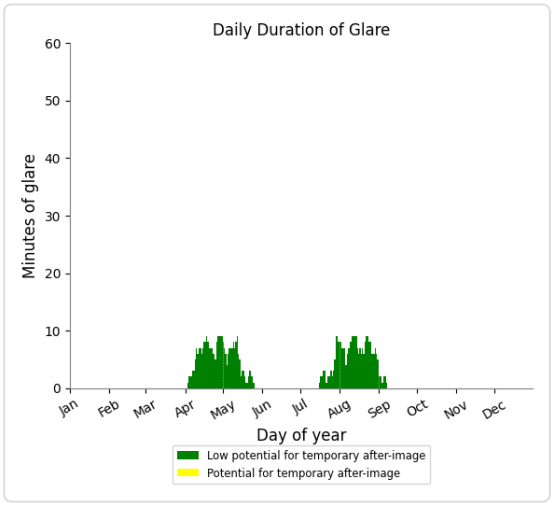


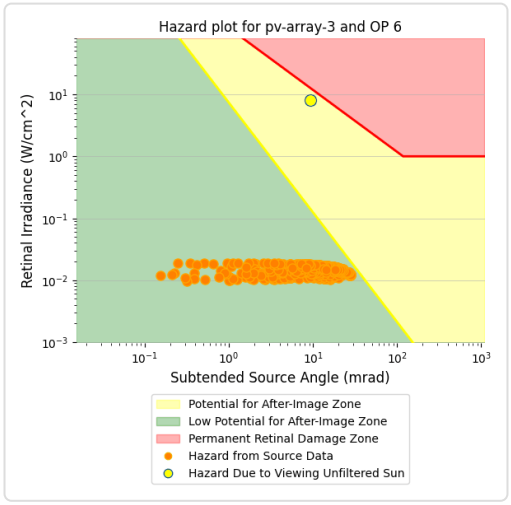
PV array 3 and OP 6

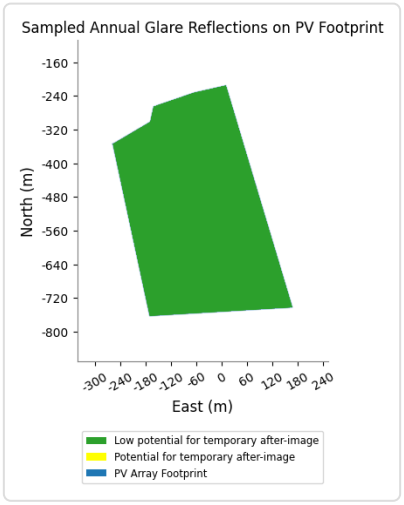
Yellow glare: none

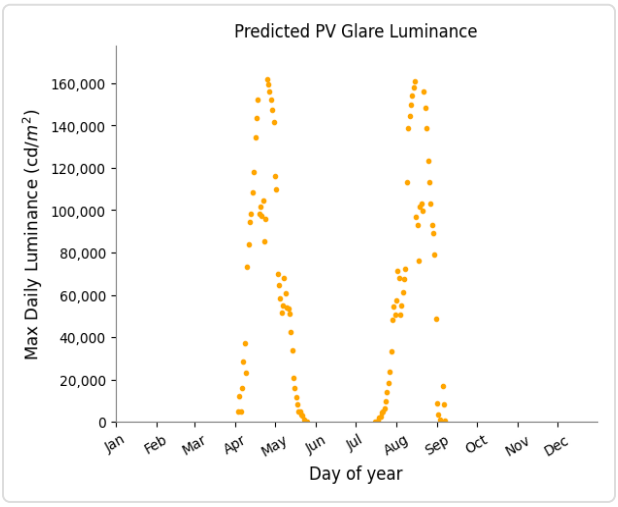
Green glare: 580 min.











PV array 3 and OP 1

No glare found

PV array 3 and OP 2

No glare found

PV array 3 and OP 3

No glare found

PV array 3 and OP 4

No glare found

PV array 3 and OP 7

No glare found

PV array 3 and OP 8

No glare found

PV array 3 and OP 9

No glare found

PV array 3 and OP 10

No glare found

PV array 3 and OP 11

No glare found

PV array 3 and OP 12

No glare found

PV array 3 and OP 13

No glare found

PV array 3 and OP 14

No glare found

PV array 3 and OP 15

No glare found

PV array 3 and OP 16

No glare found

PV array 3 and OP 17

No glare found

PV array 3 and OP 18

No glare found

PV array 3 and OP 19

No glare found

PV array 3 and OP 20

No glare found

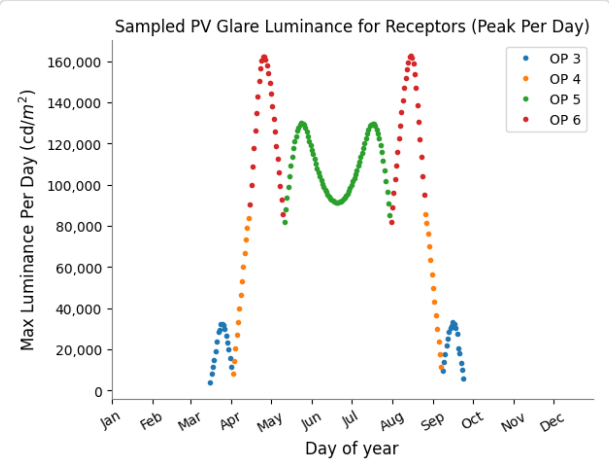
PV array 3 and OP 21

No glare found

PV: PV array 4 low potential for temporary after-image

Receptor results ordered by category of glare

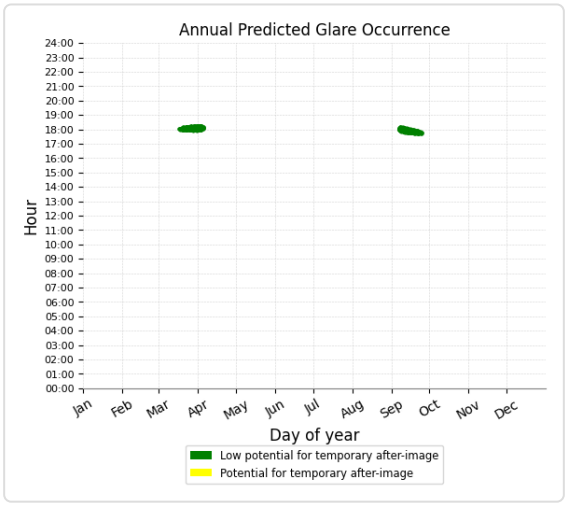
Receptor	Annual Green Glare		Annual Yellow Glare		Peak Luminance
	min	hr	min	hr	cd/m^2
OP 3	531	8.8	0	0.0	33,322
OP 4	1,308	21.8	0	0.0	88,809
OP 5	2,207	36.8	0	0.0	130,042
OP 6	2,132	35.5	0	0.0	162,609
OP 1	0	0.0	0	0.0	0
OP 2	0	0.0	0	0.0	0
OP 7	0	0.0	0	0.0	0
OP 8	0	0.0	0	0.0	0
OP 9	0	0.0	0	0.0	0
OP 10	0	0.0	0	0.0	0
OP 11	0	0.0	0	0.0	0
OP 12	0	0.0	0	0.0	0
OP 13	0	0.0	0	0.0	0
OP 14	0	0.0	0	0.0	0
OP 15	0	0.0	0	0.0	0
OP 16	0	0.0	0	0.0	0
OP 17	0	0.0	0	0.0	0
OP 18	0	0.0	0	0.0	0
OP 19	0	0.0	0	0.0	0
OP 20	0	0.0	0	0.0	0
OP 21	0	0.0	0	0.0	0

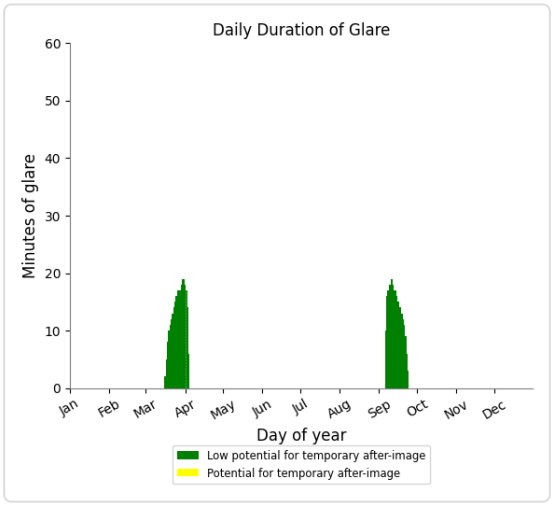


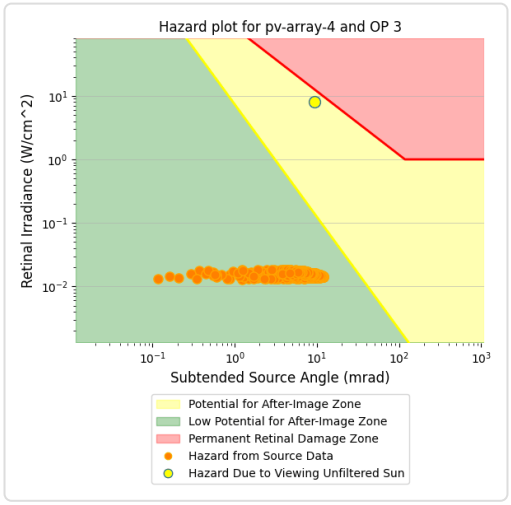
PV array 4 and OP 3

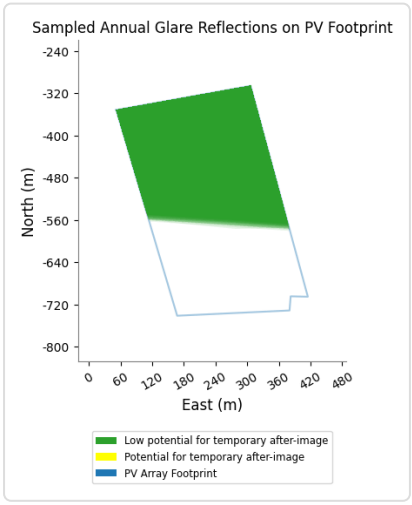
Yellow glare: none

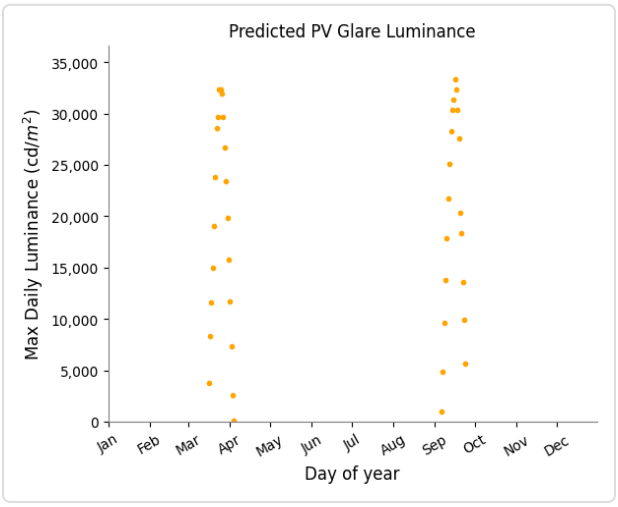
Green glare: 531 min.







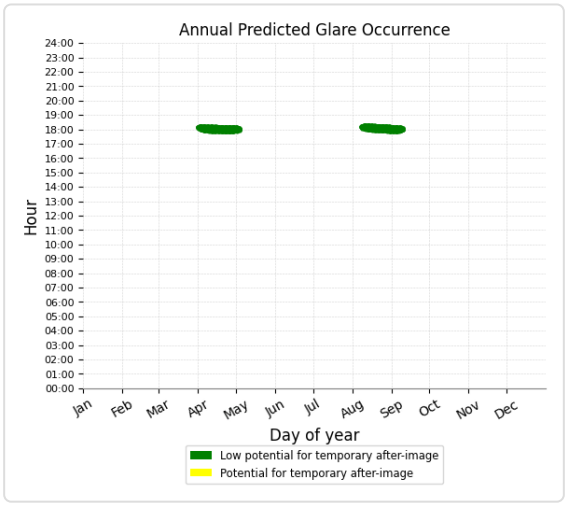


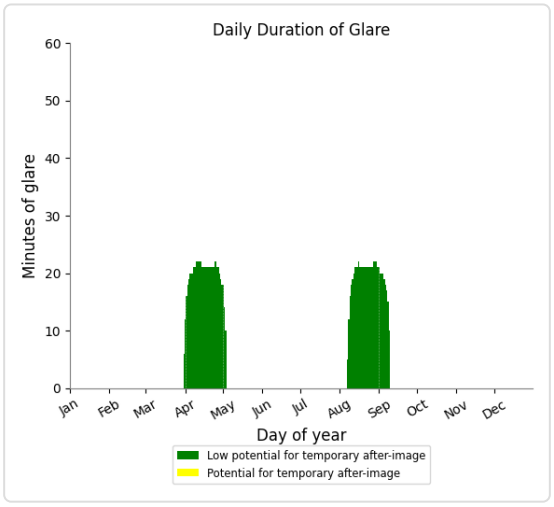


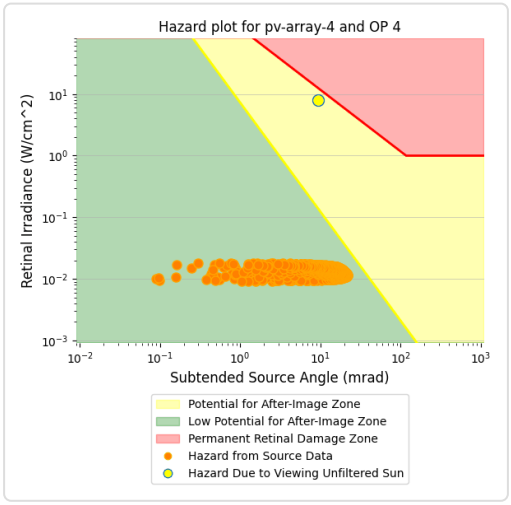
PV array 4 and OP 4

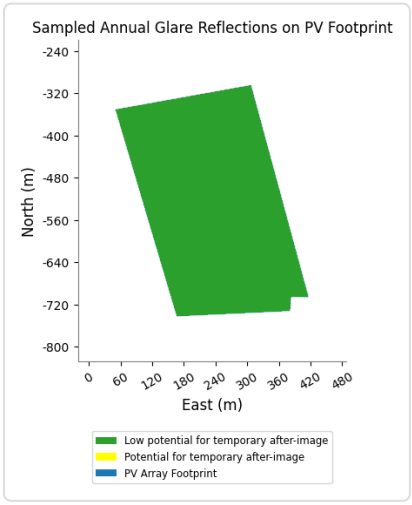
Yellow glare: none

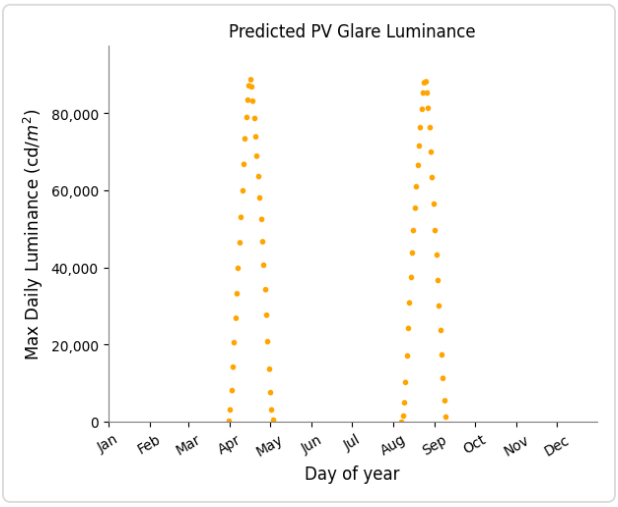
Green glare: 1,308 min.







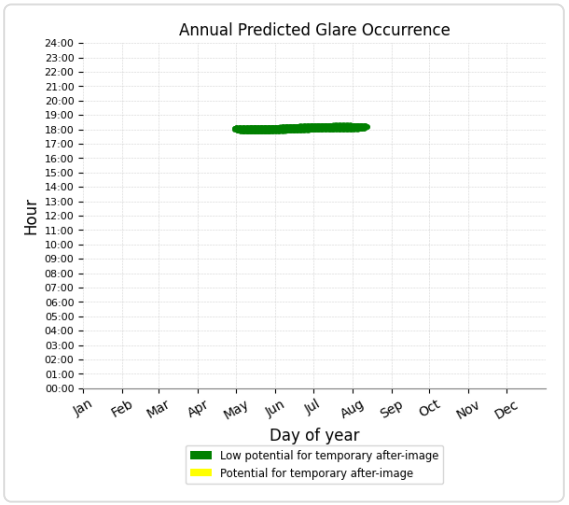


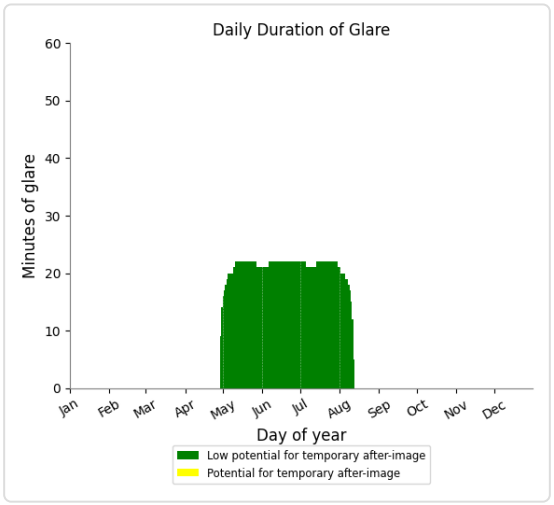


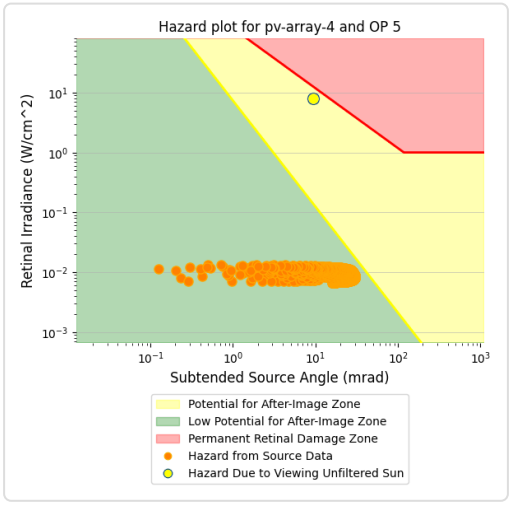
PV array 4 and OP 5

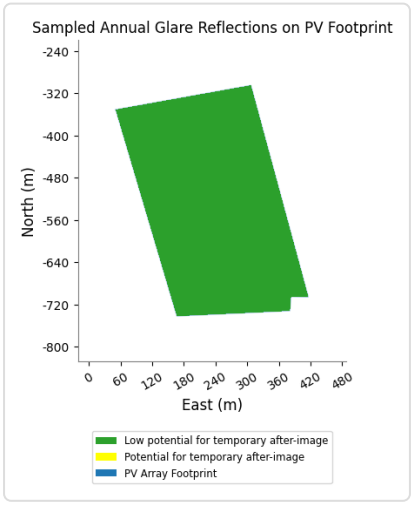
Yellow glare: none

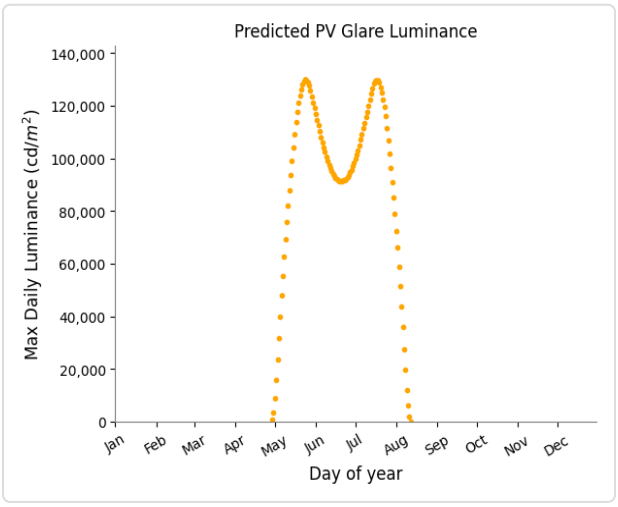
Green glare: 2,207 min.







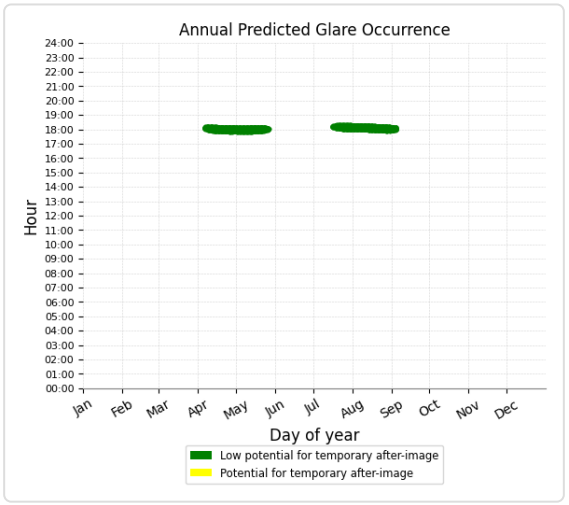


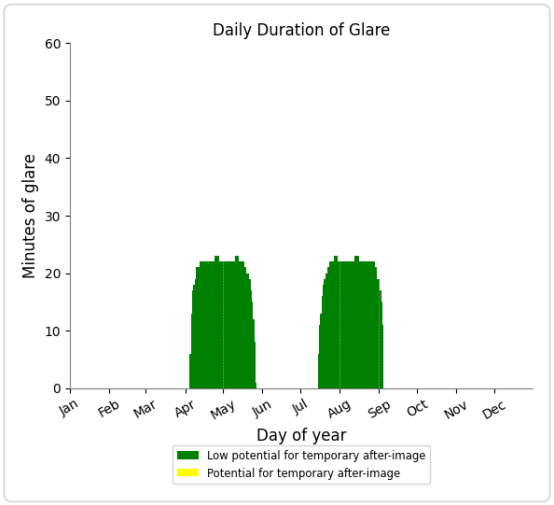


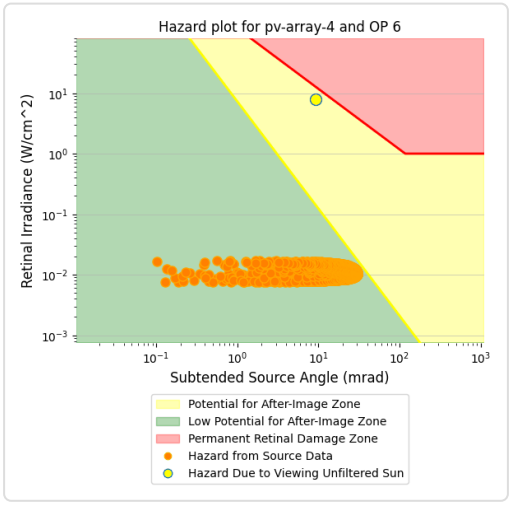
PV array 4 and OP 6

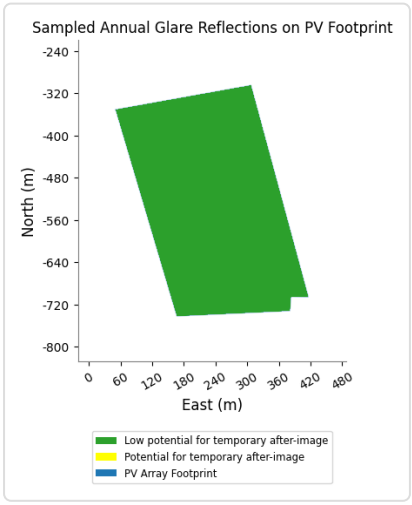
Yellow glare: none

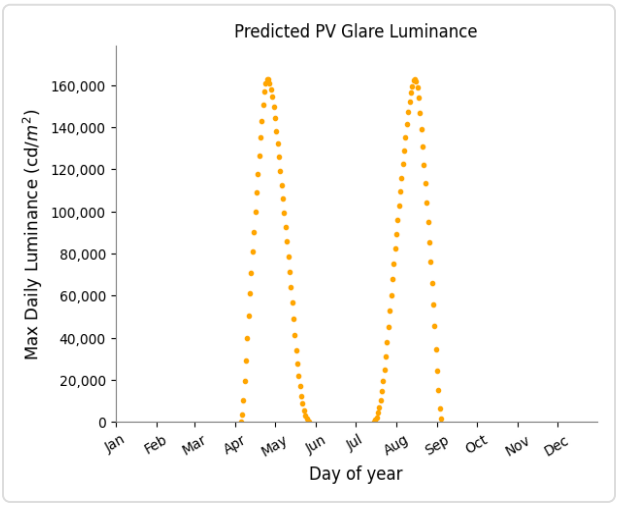
Green glare: 2,132 min.











PV array 4 and OP 1

No glare found

PV array 4 and OP 2

No glare found

PV array 4 and OP 7

No glare found

PV array 4 and OP 8

No glare found

PV array 4 and OP 9

No glare found

PV array 4 and OP 10

No glare found

PV array 4 and OP 11

No glare found

PV array 4 and OP 12

No glare found

PV array 4 and OP 13

No glare found

PV array 4 and OP 14

No glare found

PV array 4 and OP 15

No glare found

PV array 4 and OP 16

No glare found

PV array 4 and OP 17

No glare found

PV array 4 and OP 18

No glare found

PV array 4 and OP 19

No glare found

PV array 4 and OP 20

No glare found

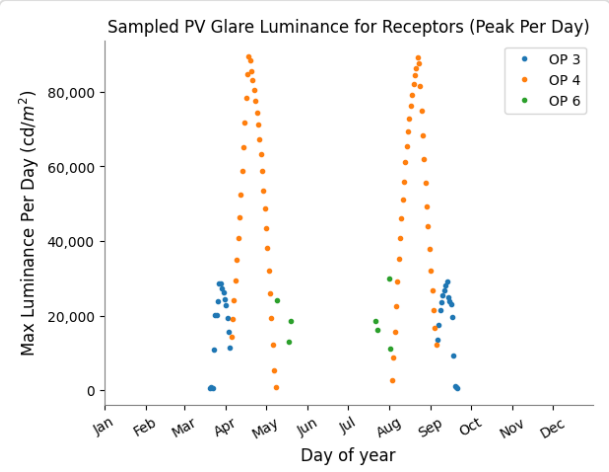
PV array 4 and OP 21

No glare found

PV: PV array 5 low potential for temporary after-image

Receptor results ordered by category of glare

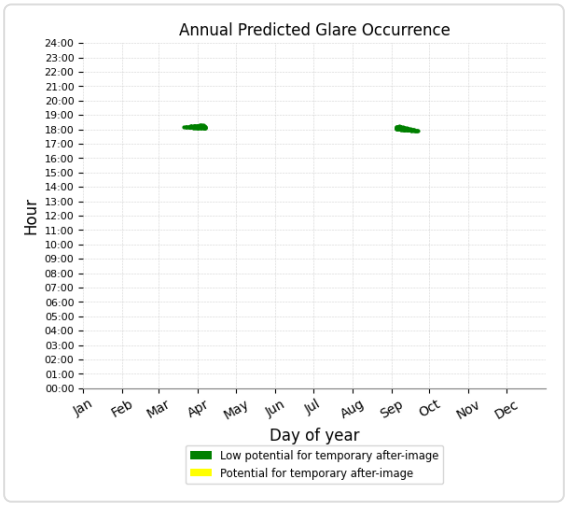
Receptor	Annual Green Glare		Annual Yellow Glare		Peak Luminance
	min	hr	min	hr	cd/m^2
OP 3	239	4.0	0	0.0	29,174
OP 4	829	13.8	0	0.0	89,415
OP 6	15	0.2	0	0.0	29,936
OP 1	0	0.0	0	0.0	0
OP 2	0	0.0	0	0.0	0
OP 5	0	0.0	0	0.0	0
OP 7	0	0.0	0	0.0	0
OP 8	0	0.0	0	0.0	0
OP 9	0	0.0	0	0.0	0
OP 10	0	0.0	0	0.0	0
OP 11	0	0.0	0	0.0	0
OP 12	0	0.0	0	0.0	0
OP 13	0	0.0	0	0.0	0
OP 14	0	0.0	0	0.0	0
OP 15	0	0.0	0	0.0	0
OP 16	0	0.0	0	0.0	0
OP 17	0	0.0	0	0.0	0
OP 18	0	0.0	0	0.0	0
OP 19	0	0.0	0	0.0	0
OP 20	0	0.0	0	0.0	0
OP 21	0	0.0	0	0.0	0

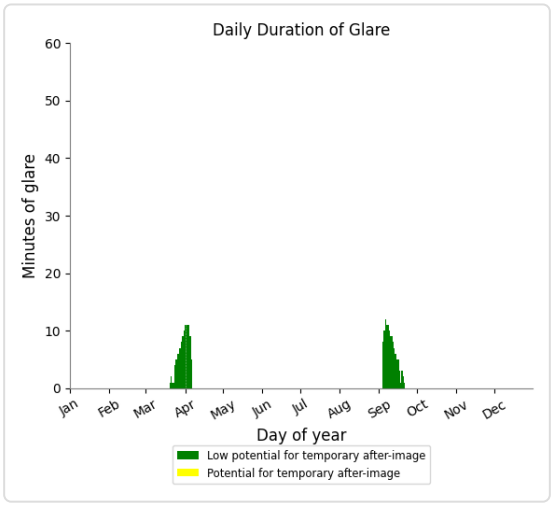


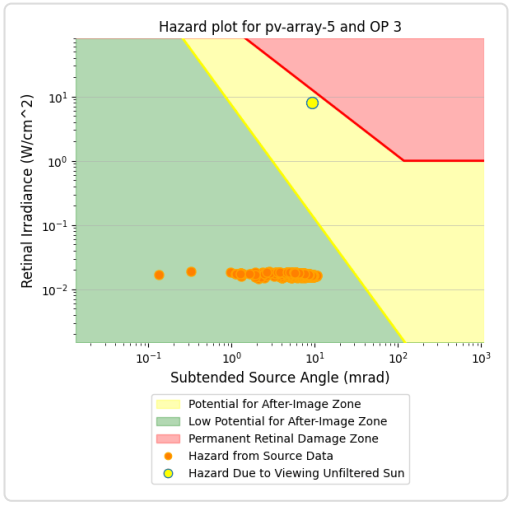
PV array 5 and OP 3

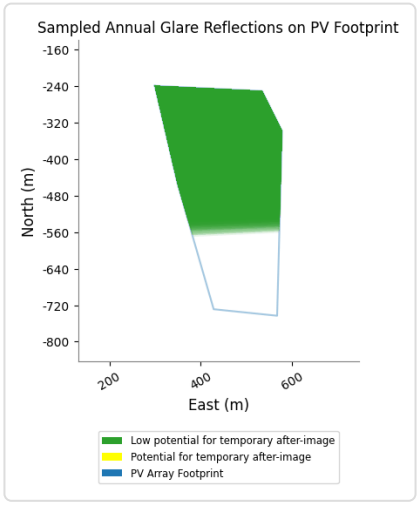
Yellow glare: none

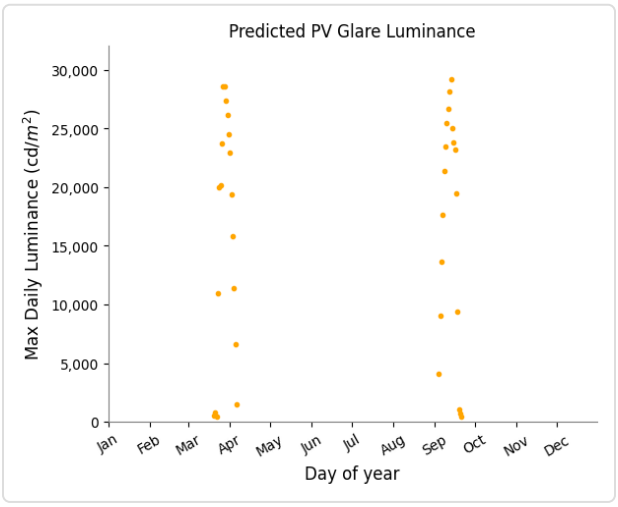
Green glare: 239 min.







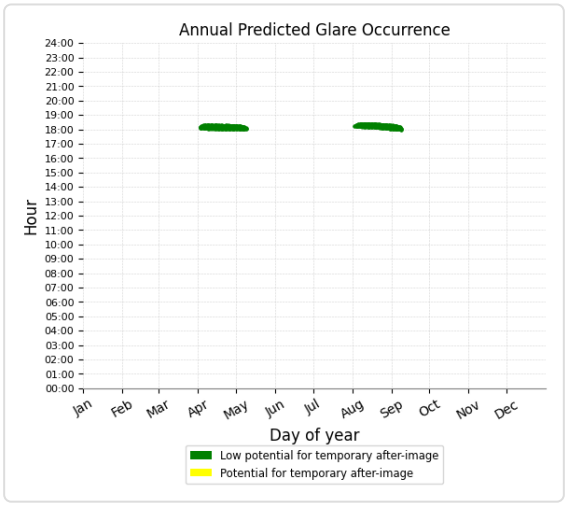


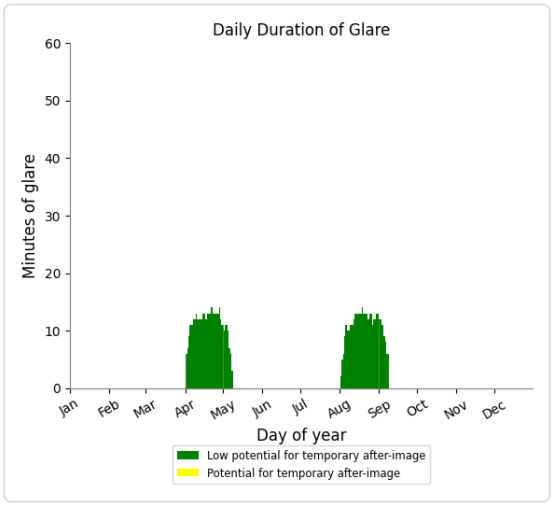


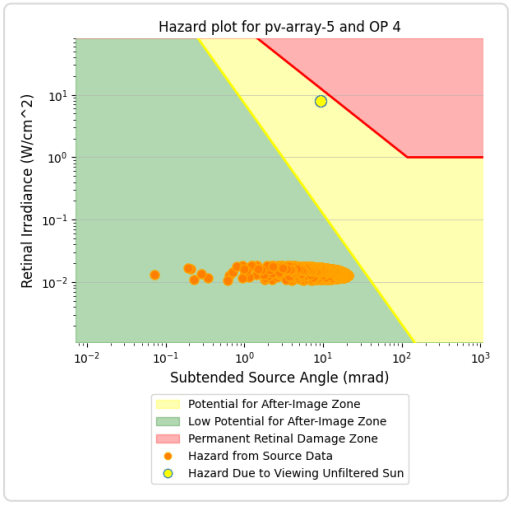
PV array 5 and OP 4

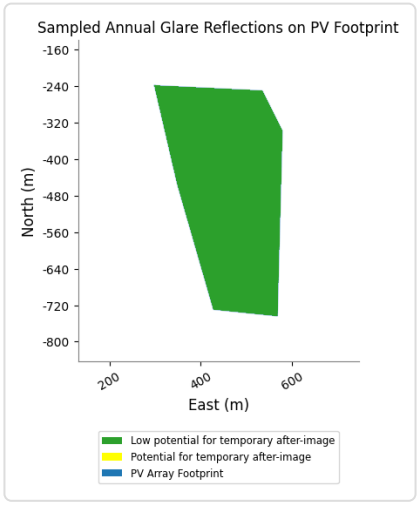
Yellow glare: none

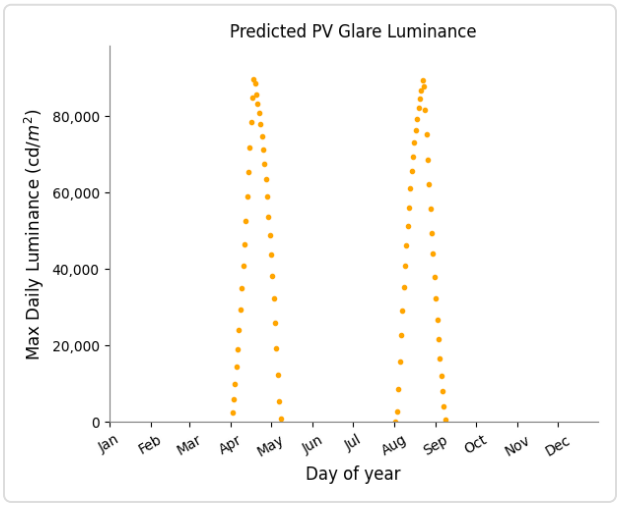
Green glare: 829 min.







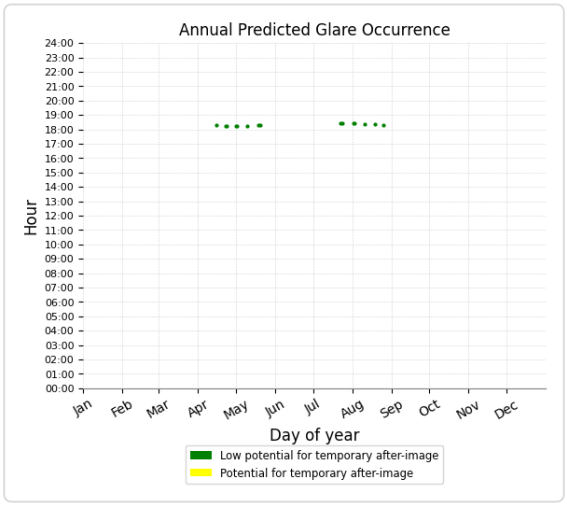


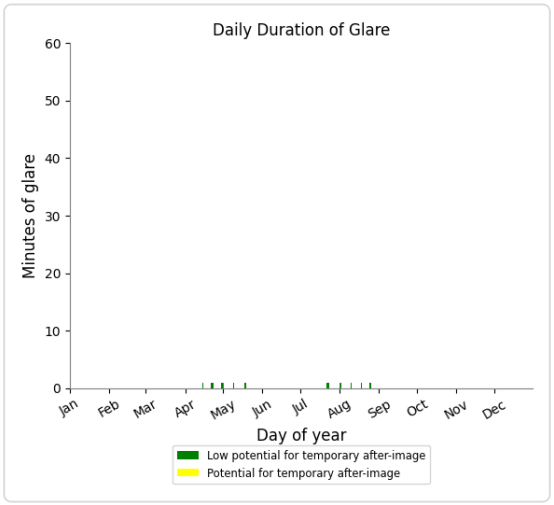


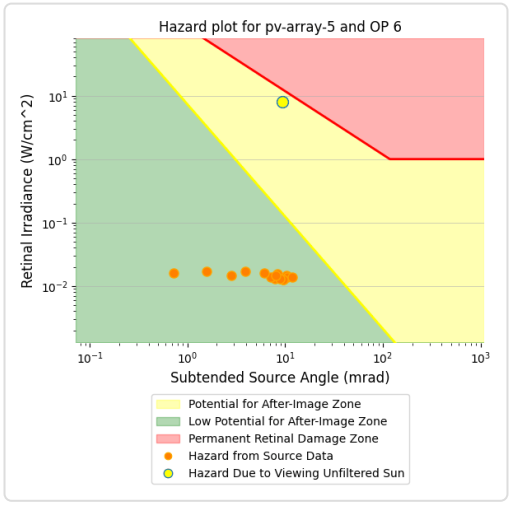
PV array 5 and OP 6

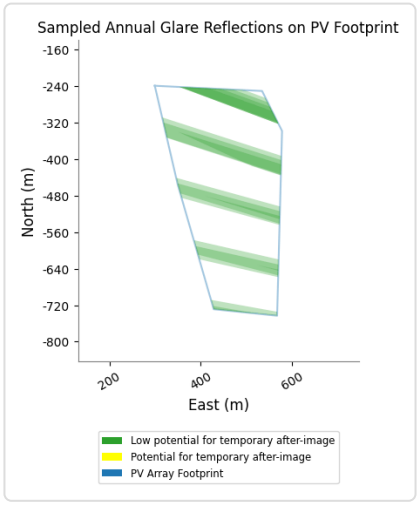
Yellow glare: none

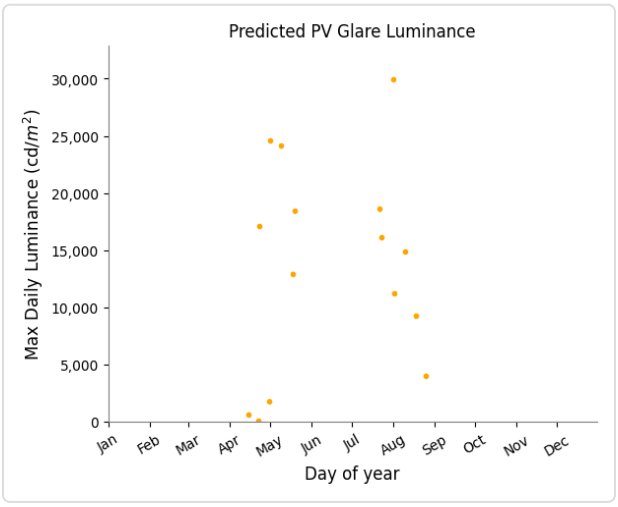
Green glare: 15 min.











PV array 5 and OP 1

No glare found

PV array 5 and OP 2

No glare found

PV array 5 and OP 5

No glare found

PV array 5 and OP 7

No glare found

PV array 5 and OP 8

No glare found

PV array 5 and OP 9

No glare found

PV array 5 and OP 10

No glare found

PV array 5 and OP 11

No glare found

PV array 5 and OP 12

No glare found

PV array 5 and OP 13

No glare found

PV array 5 and OP 14

No glare found

PV array 5 and OP 15

No glare found

PV array 5 and OP 16

No glare found

PV array 5 and OP 17

No glare found

PV array 5 and OP 18

No glare found

PV array 5 and OP 19

No glare found

PV array 5 and OP 20

No glare found

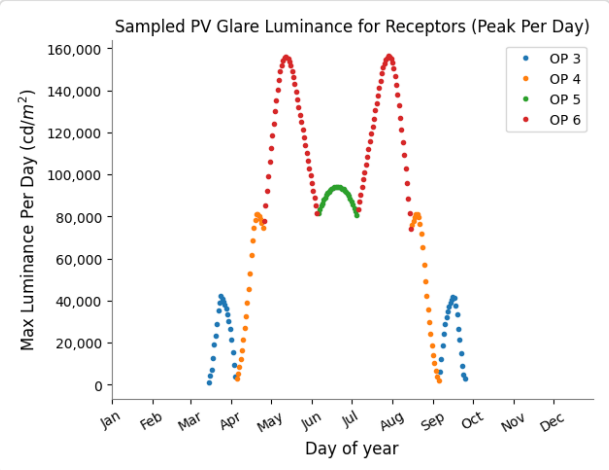
PV array 5 and OP 21

No glare found

PV: PV array 6 low potential for temporary after-image

Receptor results ordered by category of glare

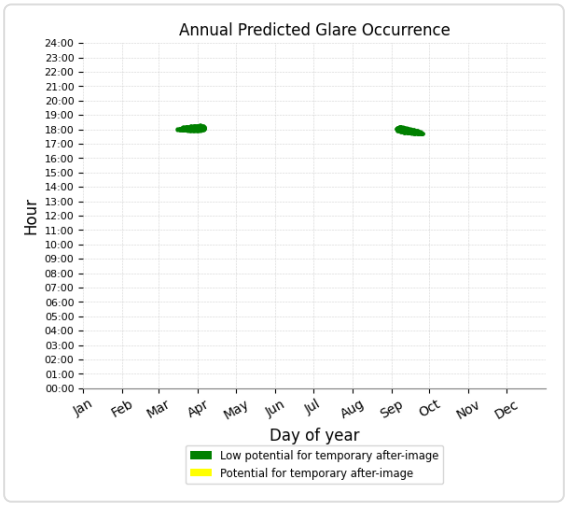
Receptor	Annual Green Glare		Annual Yellow Glare		Peak Luminance
	min	hr	min	hr	cd/m^2
OP 3	630	10.5	0	0.0	42,189
OP 4	1,814	30.2	0	0.0	81,308
OP 5	2,371	39.5	0	0.0	94,218
OP 6	3,819	63.6	0	0.0	156,293
OP 1	0	0.0	0	0.0	0
OP 2	0	0.0	0	0.0	0
OP 7	0	0.0	0	0.0	0
OP 8	0	0.0	0	0.0	0
OP 9	0	0.0	0	0.0	0
OP 10	0	0.0	0	0.0	0
OP 11	0	0.0	0	0.0	0
OP 12	0	0.0	0	0.0	0
OP 13	0	0.0	0	0.0	0
OP 14	0	0.0	0	0.0	0
OP 15	0	0.0	0	0.0	0
OP 16	0	0.0	0	0.0	0
OP 17	0	0.0	0	0.0	0
OP 18	0	0.0	0	0.0	0
OP 19	0	0.0	0	0.0	0
OP 20	0	0.0	0	0.0	0
OP 21	0	0.0	0	0.0	0

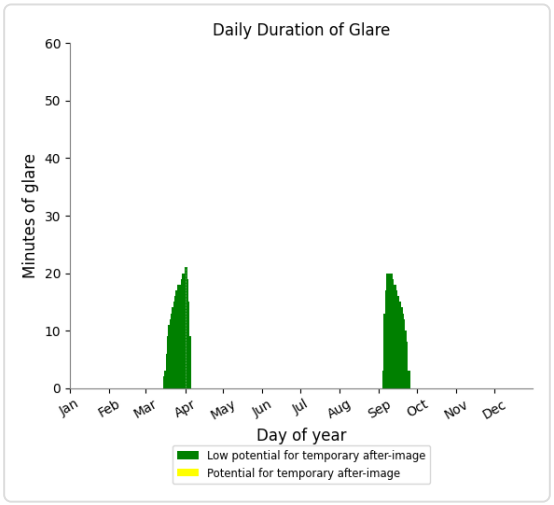


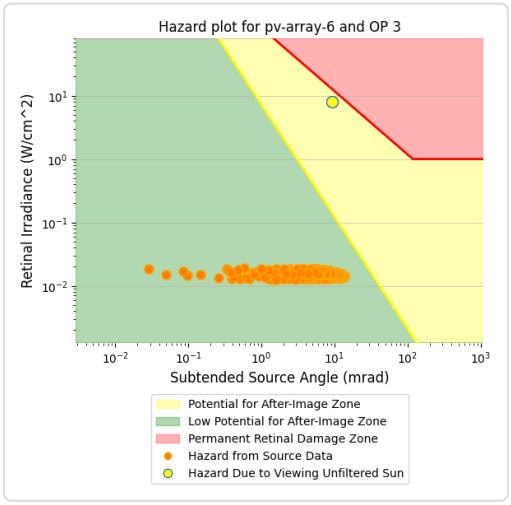
PV array 6 and OP 3

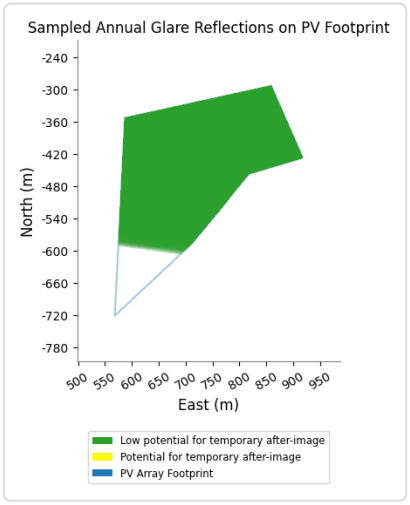
Yellow glare: none

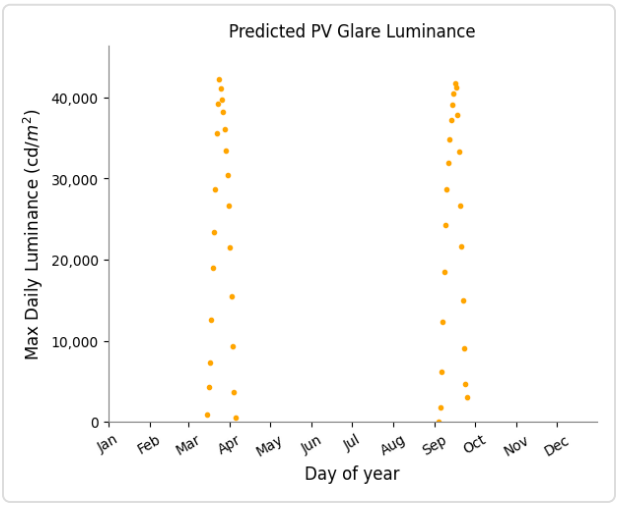
Green glare: 630 min.







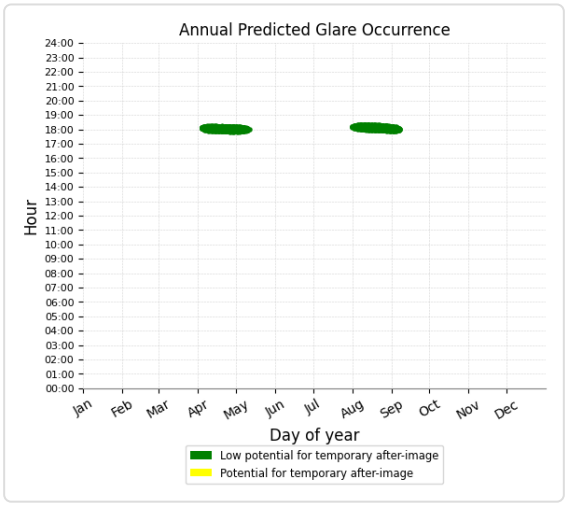


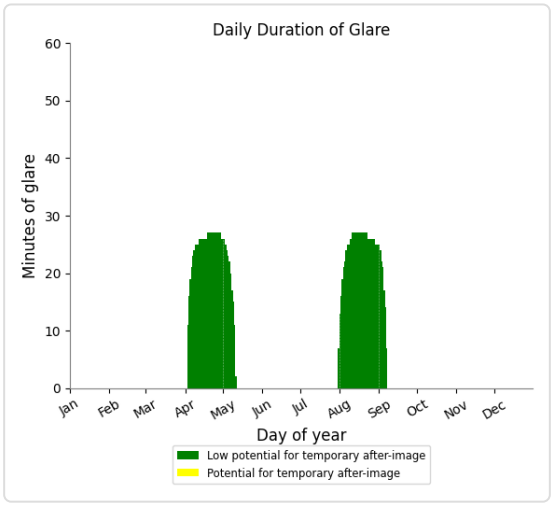


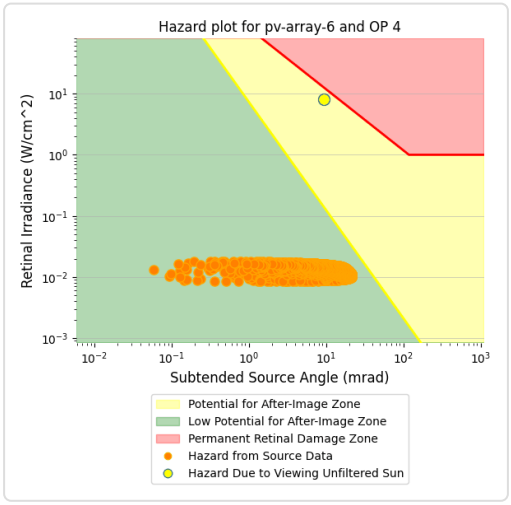
PV array 6 and OP 4

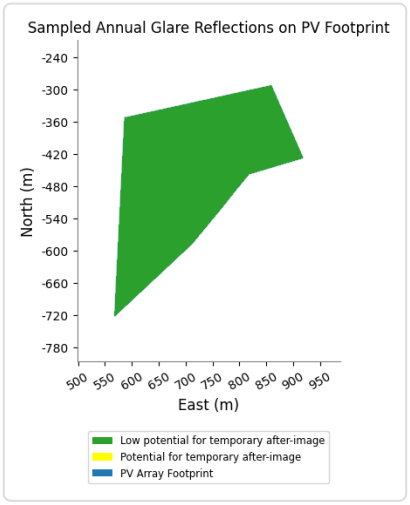
Yellow glare: none

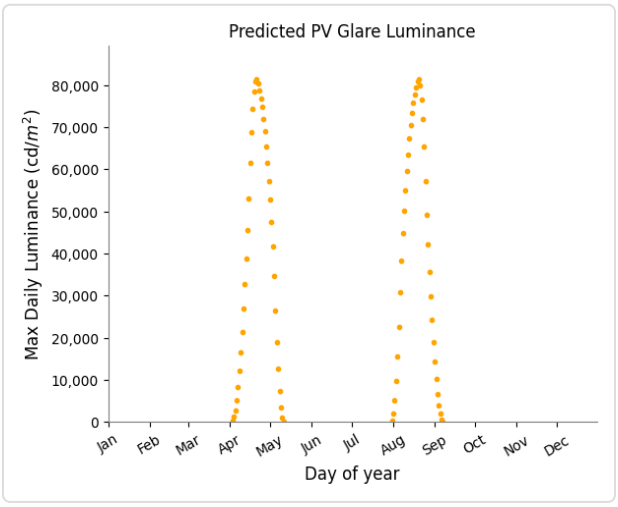
Green glare: 1,814 min.







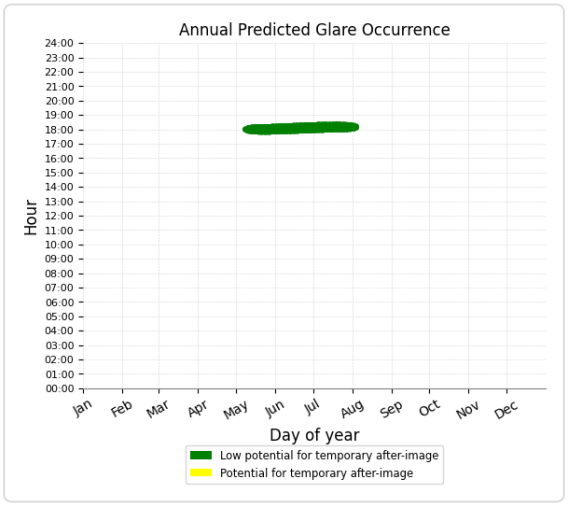


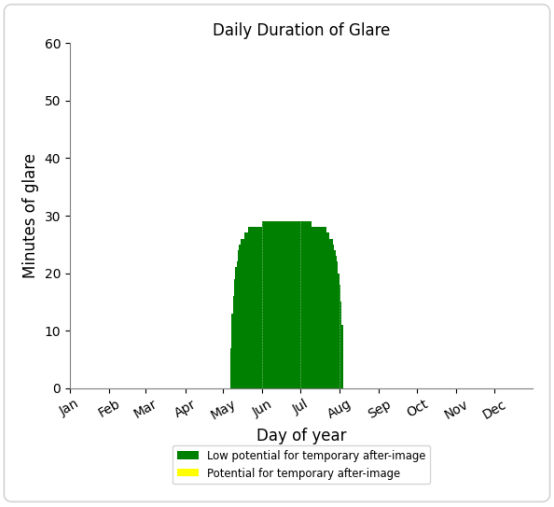


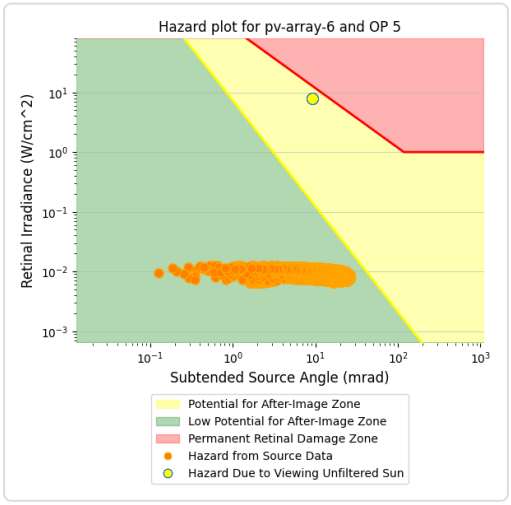
PV array 6 and OP 5

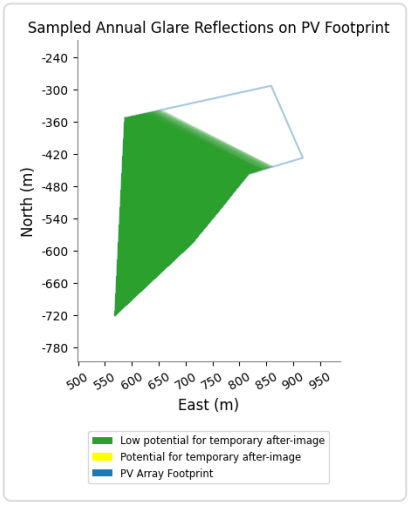
Yellow glare: none

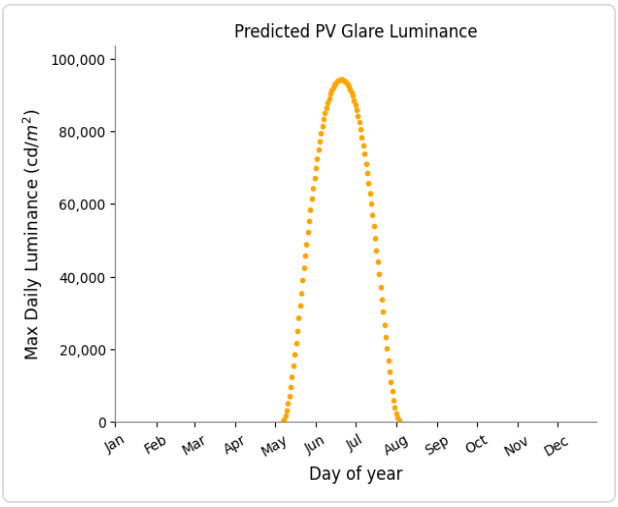
Green glare: 2,371 min.







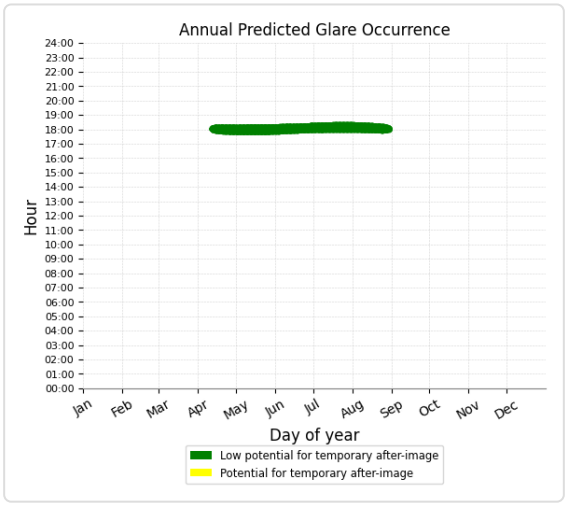


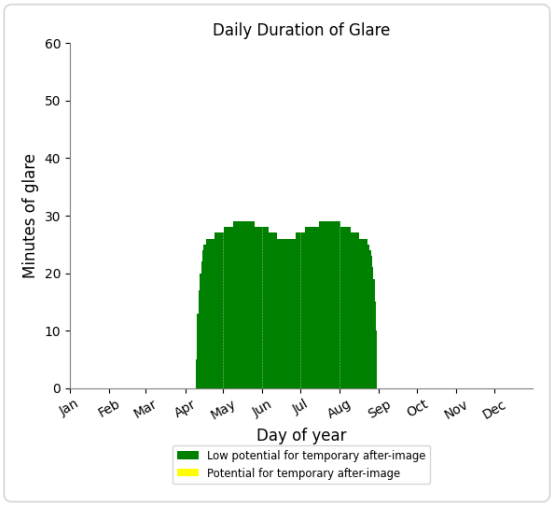


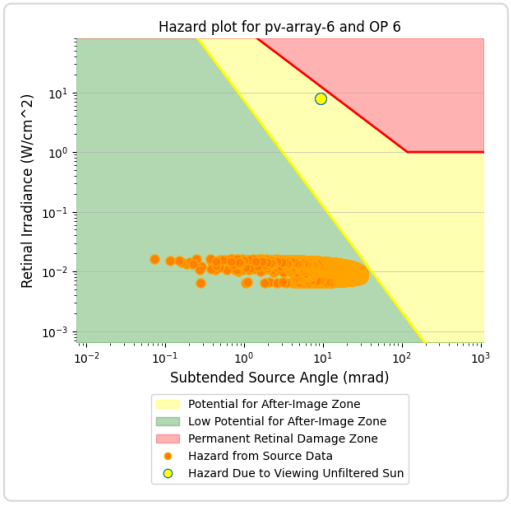
PV array 6 and OP 6

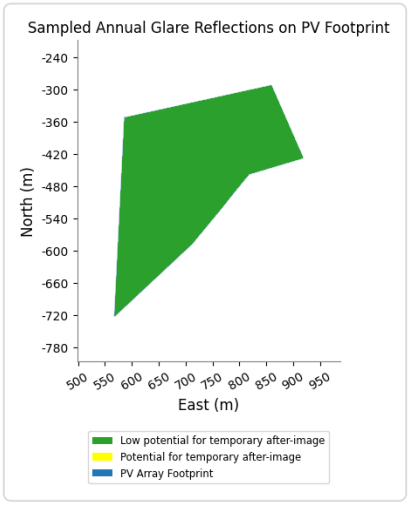
Yellow glare: none

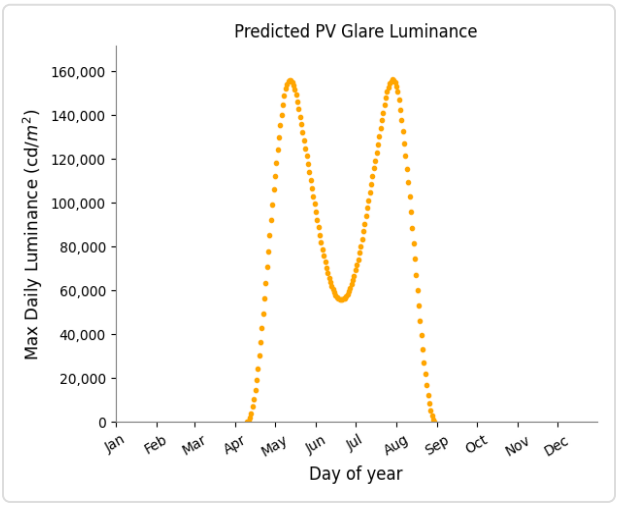
Green glare: 3,819 min.











PV array 6 and OP 1

No glare found

PV array 6 and OP 2

No glare found

PV array 6 and OP 7

No glare found

PV array 6 and OP 8

No glare found

PV array 6 and OP 9

No glare found

PV array 6 and OP 10

No glare found

PV array 6 and OP 11

No glare found

PV array 6 and OP 12

No glare found

PV array 6 and OP 13

No glare found

PV array 6 and OP 14

No glare found

PV array 6 and OP 15

No glare found

PV array 6 and OP 16

No glare found

PV array 6 and OP 17

No glare found

PV array 6 and OP 18

No glare found

PV array 6 and OP 19

No glare found

PV array 6 and OP 20

No glare found

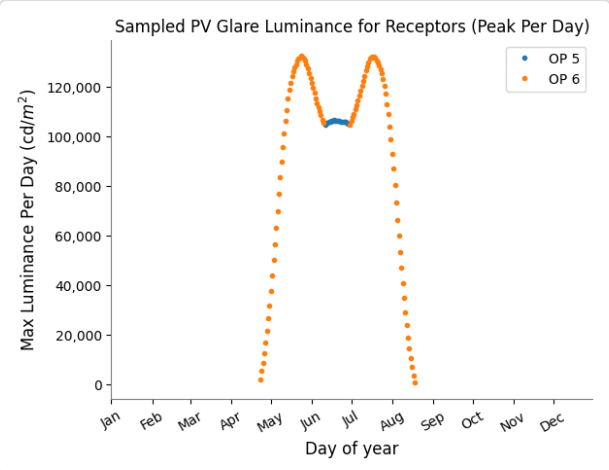
PV array 6 and OP 21

No glare found

PV: PV array 7 low potential for temporary after-image

Receptor results ordered by category of glare

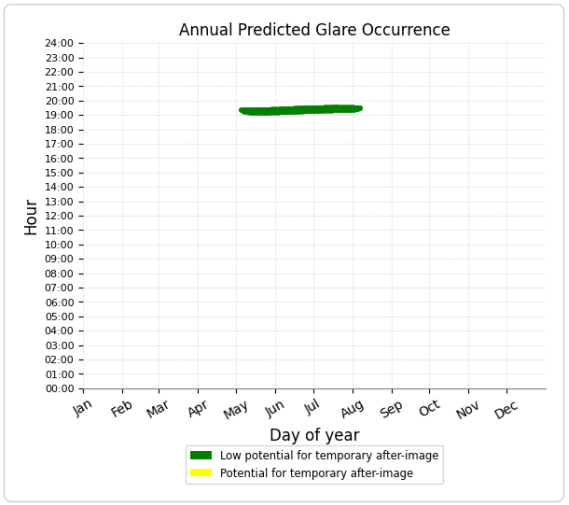
Receptor	Annual Green Glare		Annual Yellow Glare		Peak Luminance
	min	hr	min	hr	cd/m^2
OP 5	1,520	25.3	0	0.0	106,363
OP 6	2,045	34.1	0	0.0	132,286
OP 1	0	0.0	0	0.0	0
OP 2	0	0.0	0	0.0	0
OP 3	0	0.0	0	0.0	0
OP 4	0	0.0	0	0.0	0
OP 7	0	0.0	0	0.0	0
OP 8	0	0.0	0	0.0	0
OP 9	0	0.0	0	0.0	0
OP 10	0	0.0	0	0.0	0
OP 11	0	0.0	0	0.0	0
OP 12	0	0.0	0	0.0	0
OP 13	0	0.0	0	0.0	0
OP 14	0	0.0	0	0.0	0
OP 15	0	0.0	0	0.0	0
OP 16	0	0.0	0	0.0	0
OP 17	0	0.0	0	0.0	0
OP 18	0	0.0	0	0.0	0
OP 19	0	0.0	0	0.0	0
OP 20	0	0.0	0	0.0	0
OP 21	0	0.0	0	0.0	0

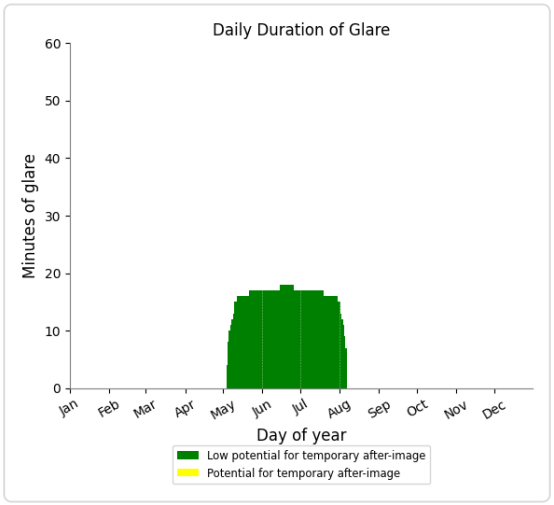


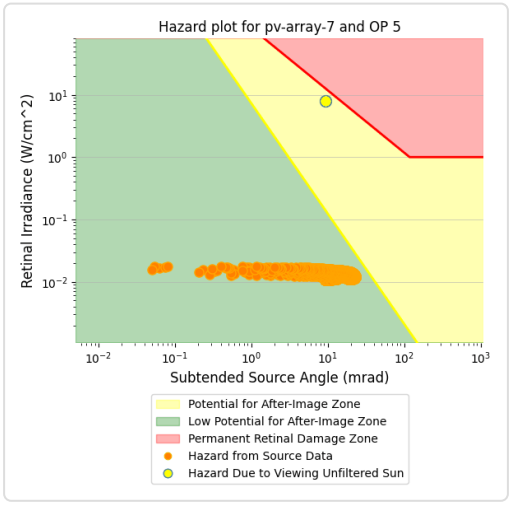
PV array 7 and OP 5

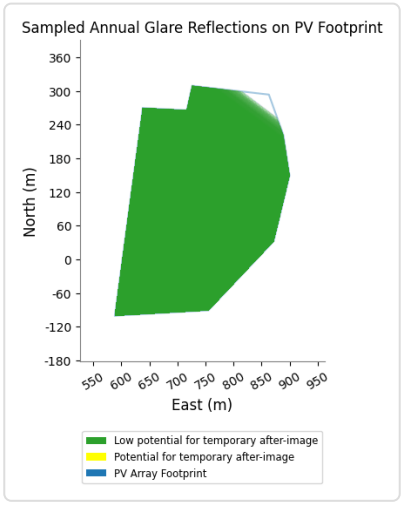
Yellow glare: none

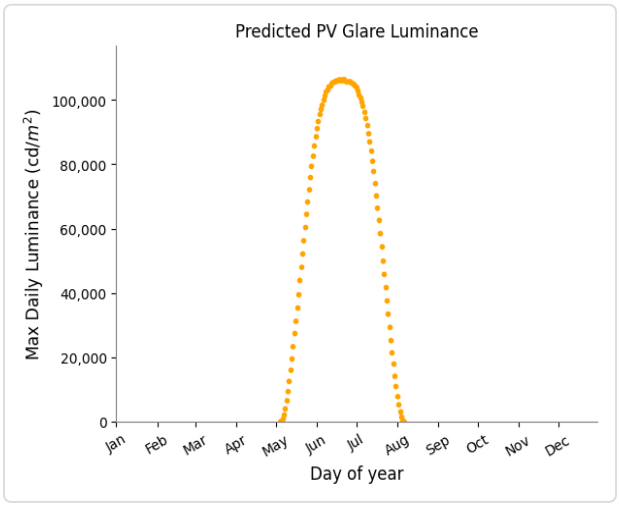
Green glare: 1,520 min.







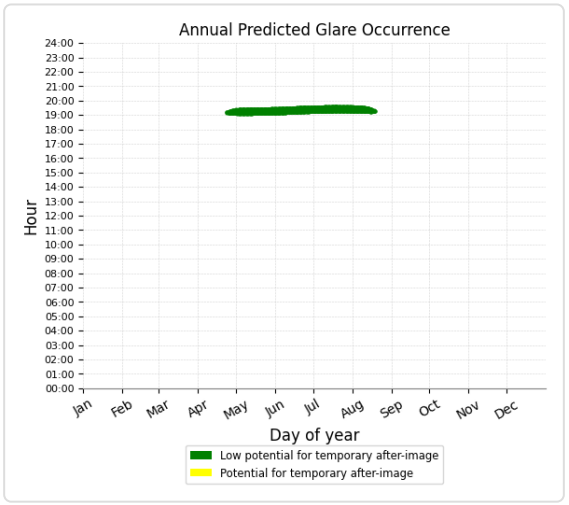


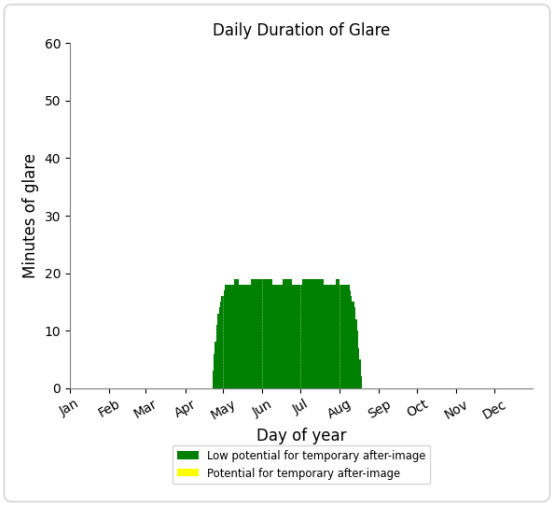


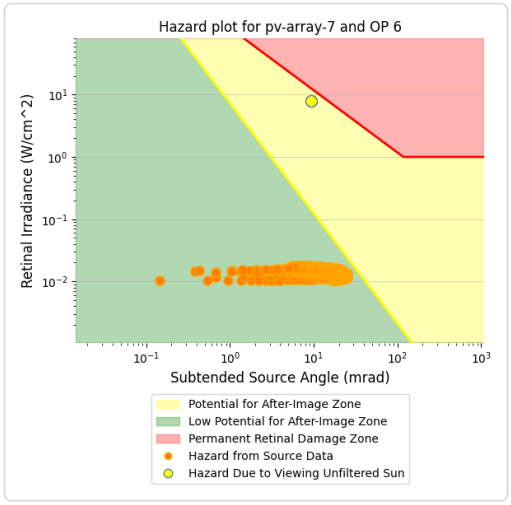
PV array 7 and OP 6

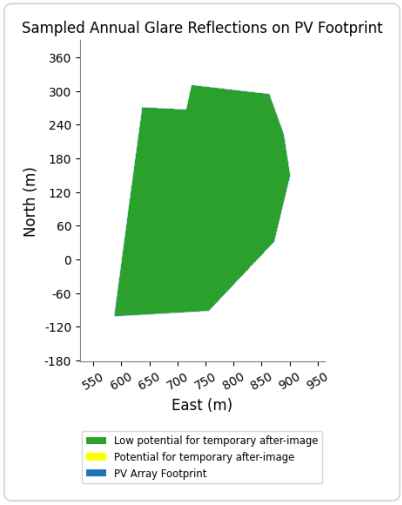
Yellow glare: none

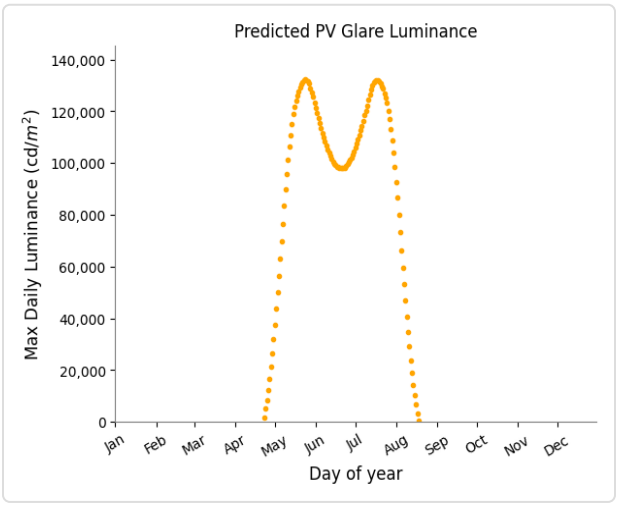
Green glare: 2,045 min.











PV array 7 and OP 1

No glare found

PV array 7 and OP 2

No glare found

PV array 7 and OP 3

No glare found

PV array 7 and OP 4

No glare found

PV array 7 and OP 7

No glare found

PV array 7 and OP 8

No glare found

PV array 7 and OP 9

No glare found

PV array 7 and OP 10

No glare found

PV array 7 and OP 11

No glare found

PV array 7 and OP 12

No glare found

PV array 7 and OP 13

No glare found

PV array 7 and OP 14

No glare found

PV array 7 and OP 15

No glare found

PV array 7 and OP 16

No glare found

PV array 7 and OP 17

No glare found

PV array 7 and OP 18

No glare found

PV array 7 and OP 19

No glare found

PV array 7 and OP 20

No glare found

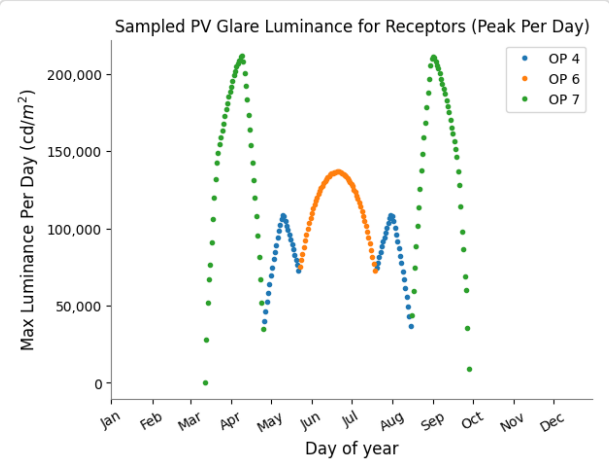
PV array 7 and OP 21

No glare found

PV: PV array 8 low potential for temporary after-image

Receptor results ordered by category of glare

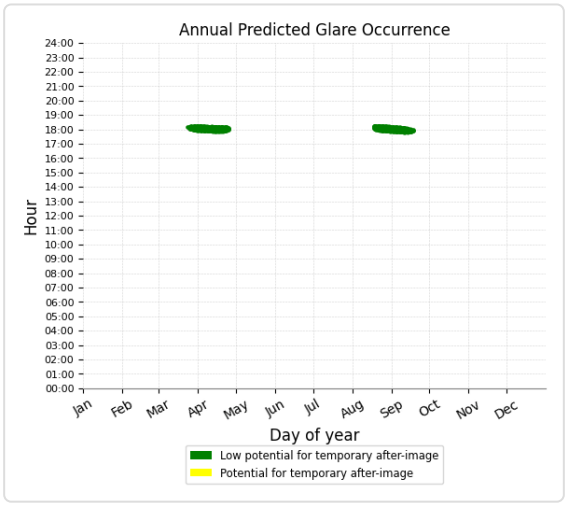
Receptor	Annual Green Glare		Annual Yellow Glare		Peak Luminance
	min	hr	min	hr	cd/m^2
OP 3	1,111	18.5	0	0.0	77,912
OP 4	2,313	38.5	0	0.0	108,345
OP 5	137	2.3	0	0.0	1,079
OP 6	1,581	26.4	0	0.0	136,651
OP 7	1,983	33.0	0	0.0	211,494
OP 14	850	14.2	0	0.0	60,865
OP 15	59	1.0	0	0.0	2,585
OP 1	0	0.0	0	0.0	0
OP 2	0	0.0	0	0.0	0
OP 8	0	0.0	0	0.0	0
OP 9	0	0.0	0	0.0	0
OP 10	0	0.0	0	0.0	0
OP 11	0	0.0	0	0.0	0
OP 12	0	0.0	0	0.0	0
OP 13	0	0.0	0	0.0	0
OP 16	0	0.0	0	0.0	0
OP 17	0	0.0	0	0.0	0
OP 18	0	0.0	0	0.0	0
OP 19	0	0.0	0	0.0	0
OP 20	0	0.0	0	0.0	0
OP 21	0	0.0	0	0.0	0

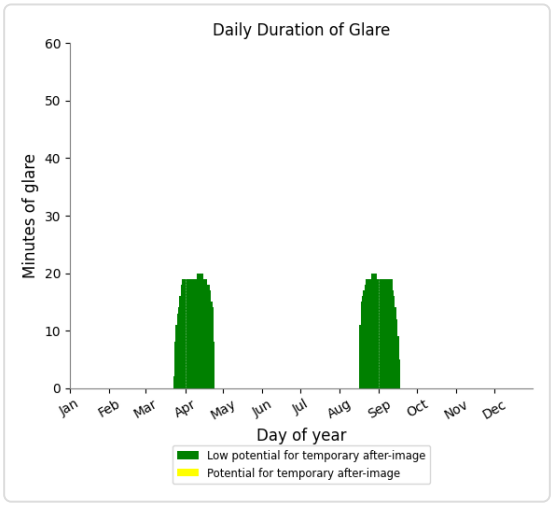


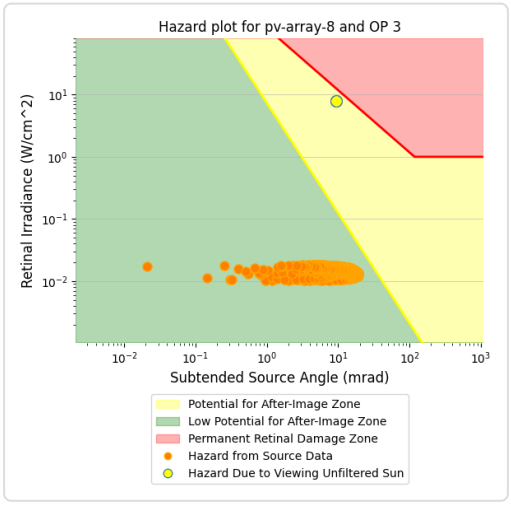
PV array 8 and OP 3

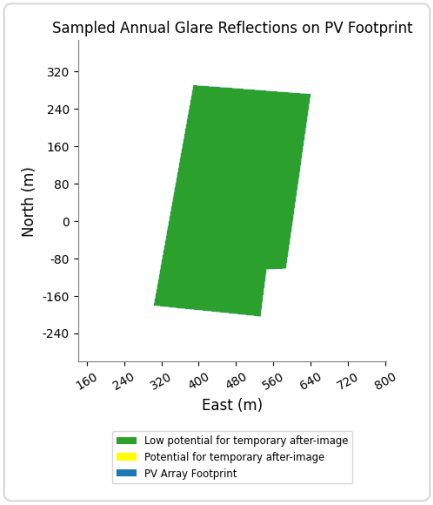
Yellow glare: none

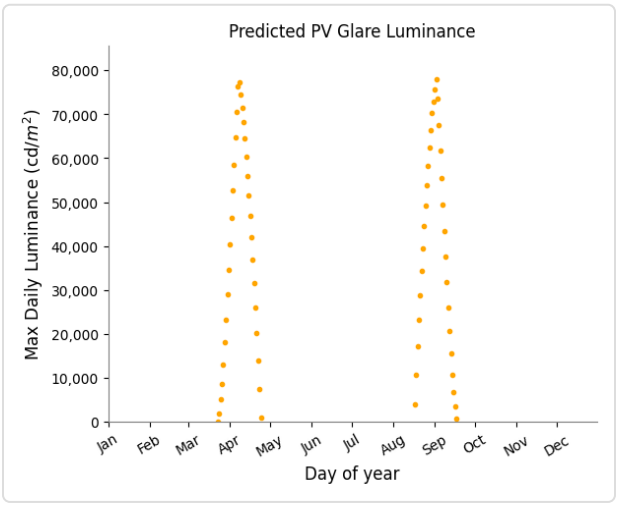
Green glare: 1,111 min.







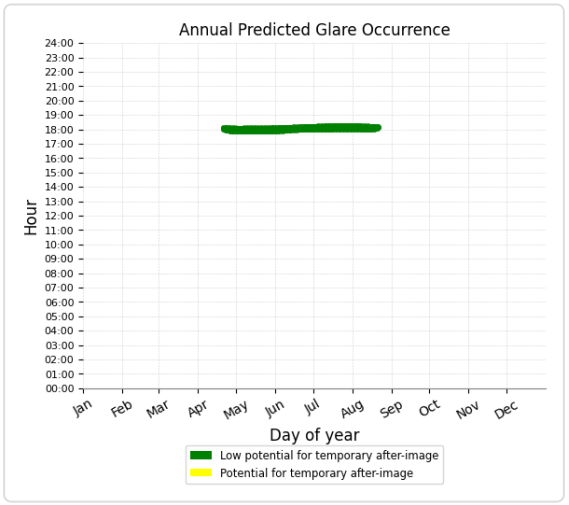


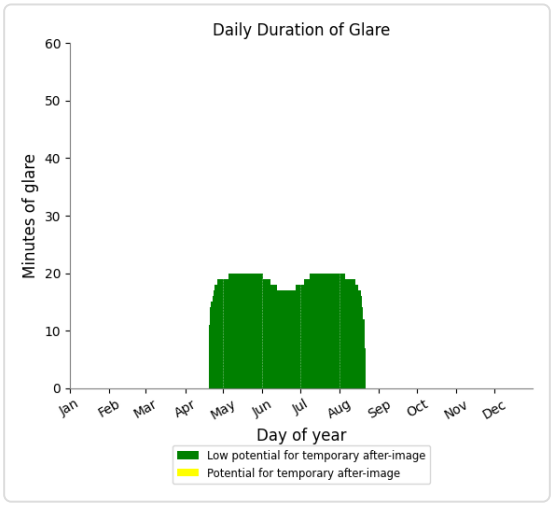


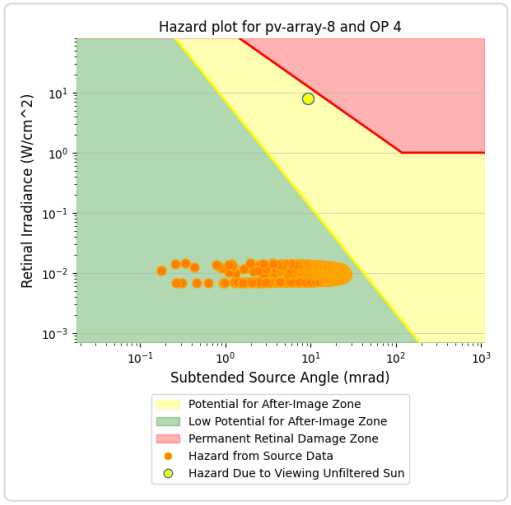
PV array 8 and OP 4

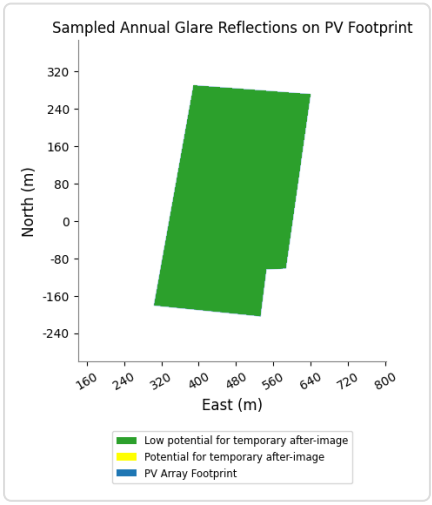
Yellow glare: none

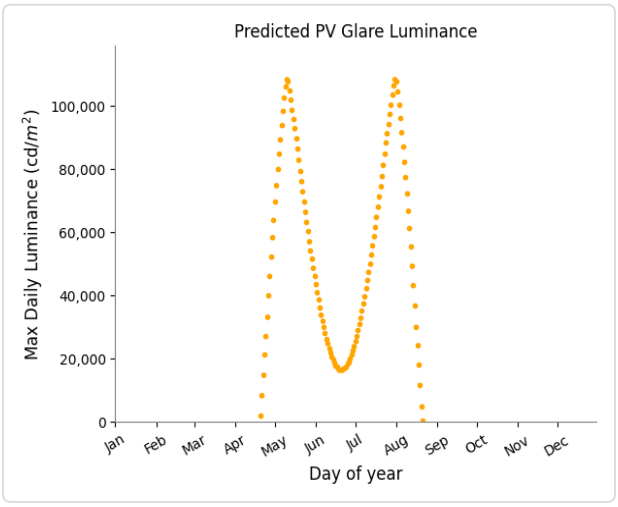
Green glare: 2,313 min.







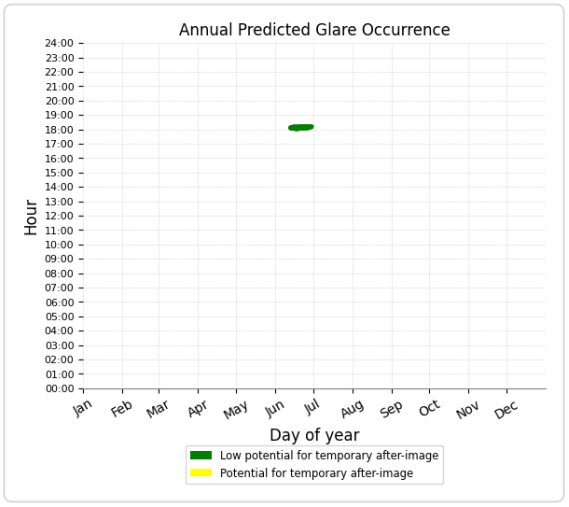


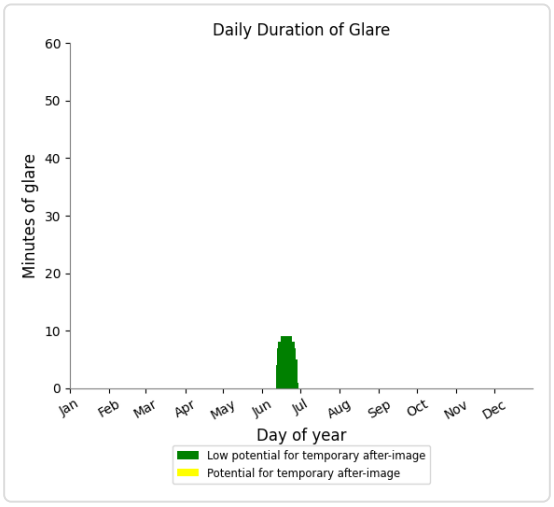


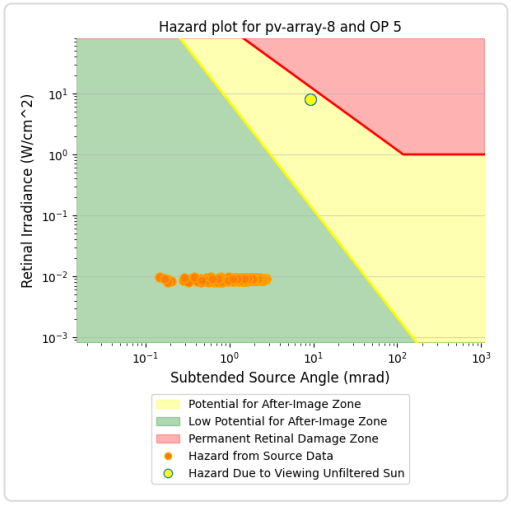
PV array 8 and OP 5

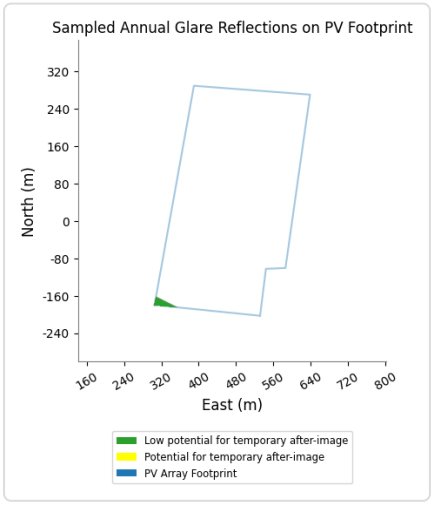
Yellow glare: none

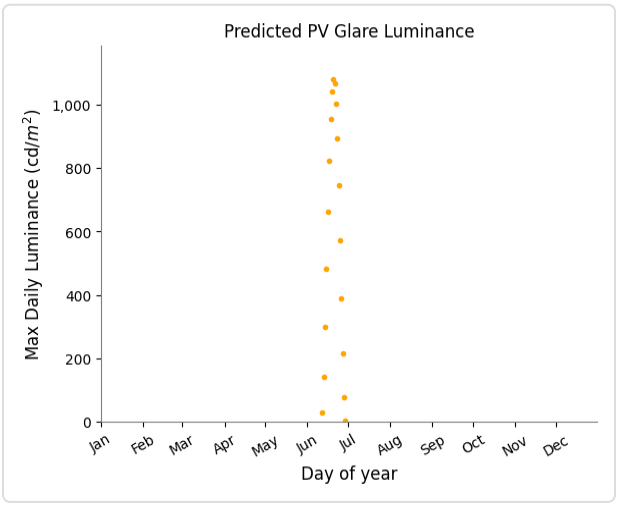
Green glare: 137 min.







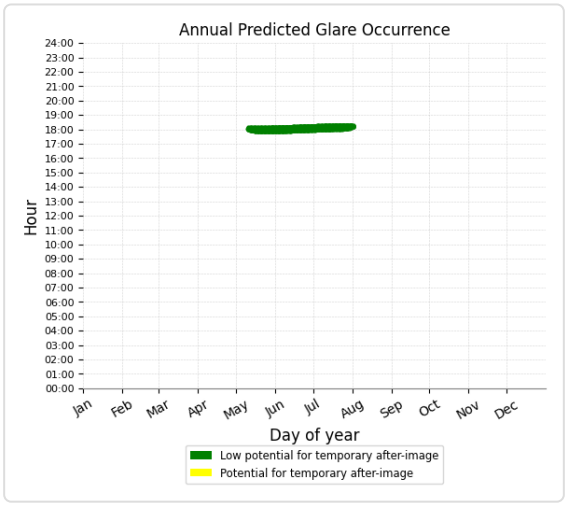


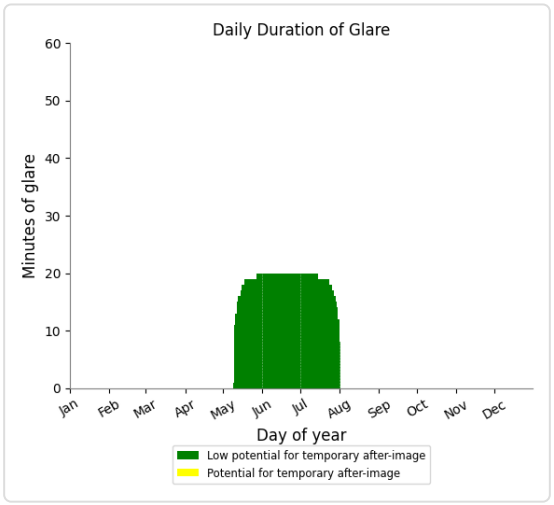


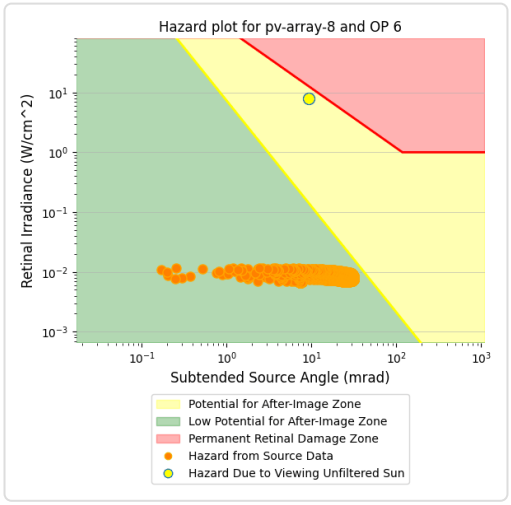
PV array 8 and OP 6

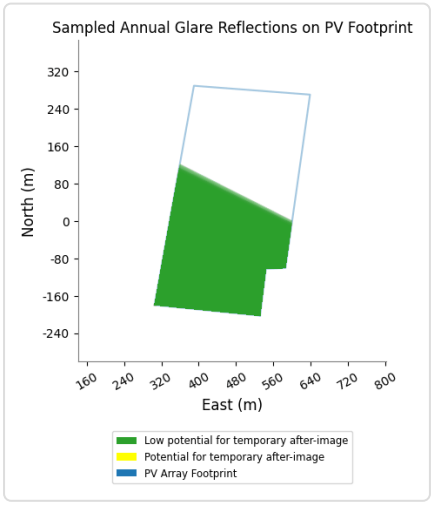
Yellow glare: none

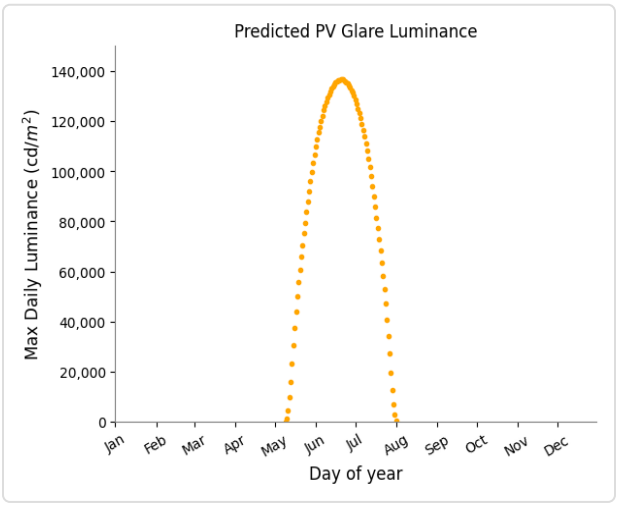
Green glare: 1,581 min.







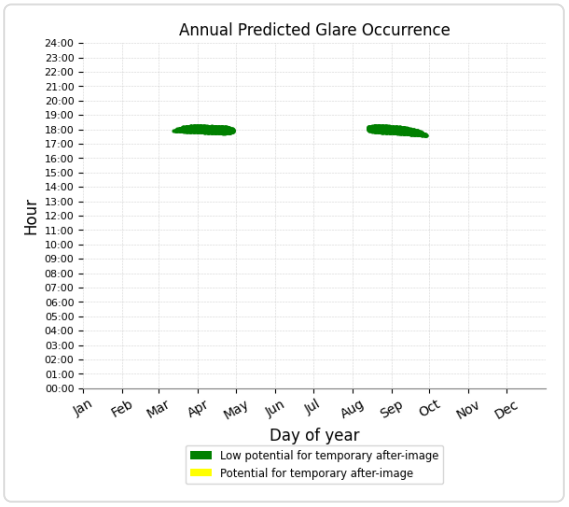


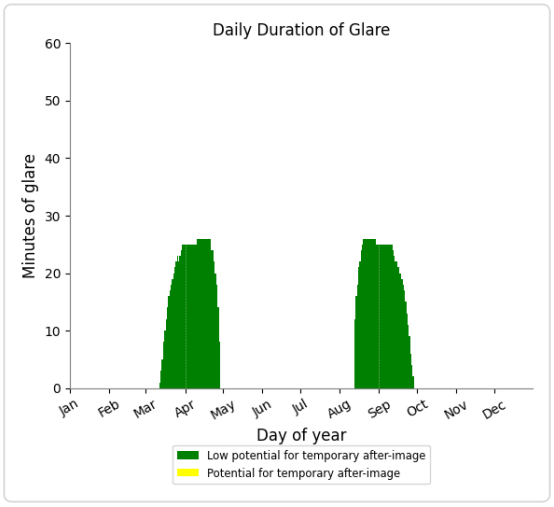


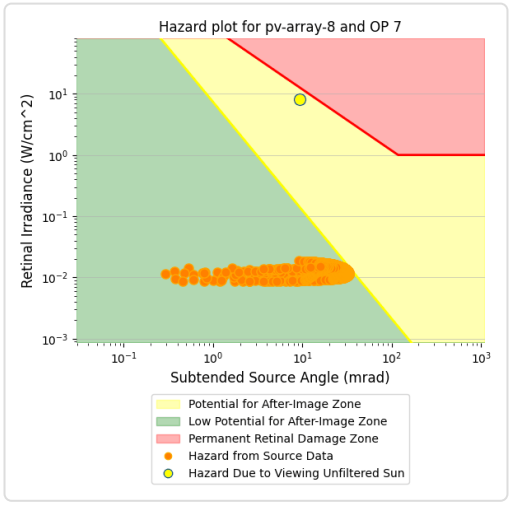
PV array 8 and OP 7

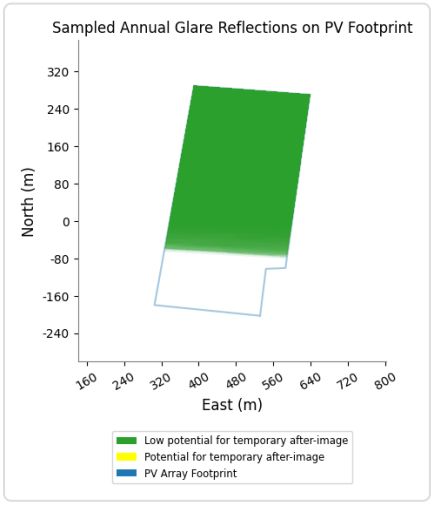
Yellow glare: none

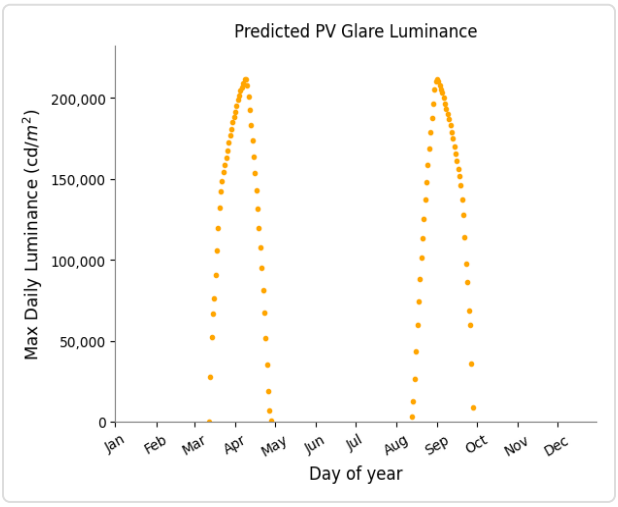
Green glare: 1,983 min.







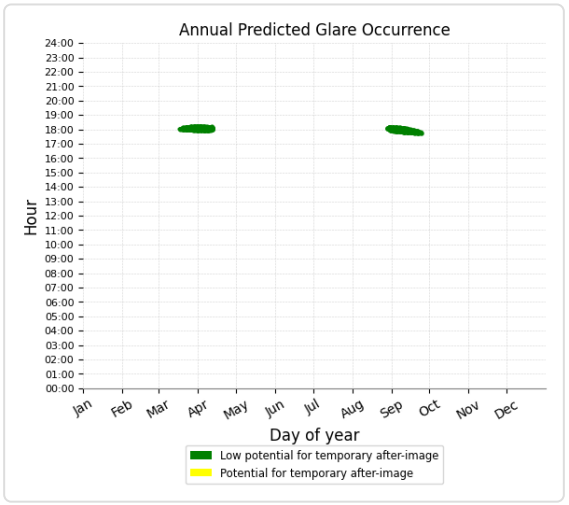


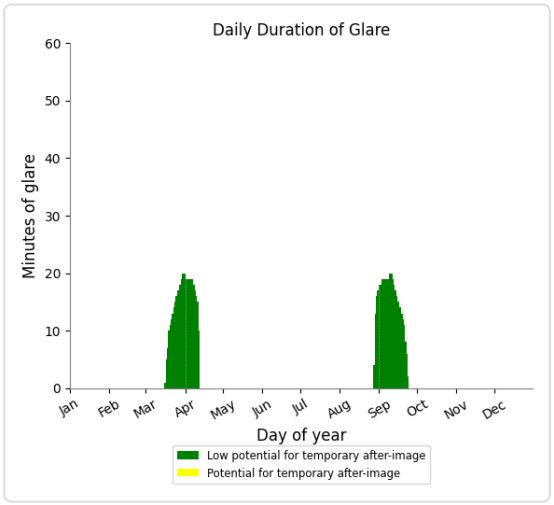


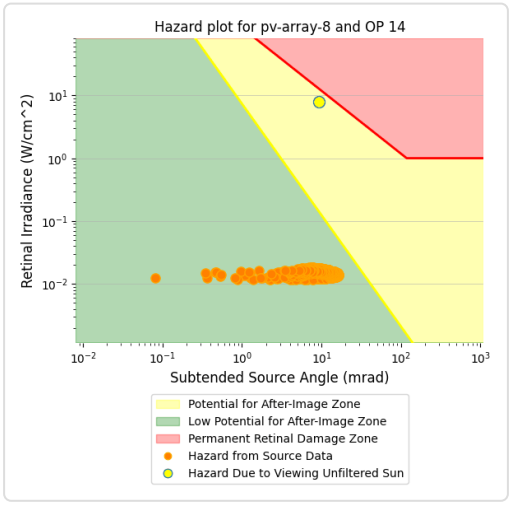
PV array 8 and OP 14

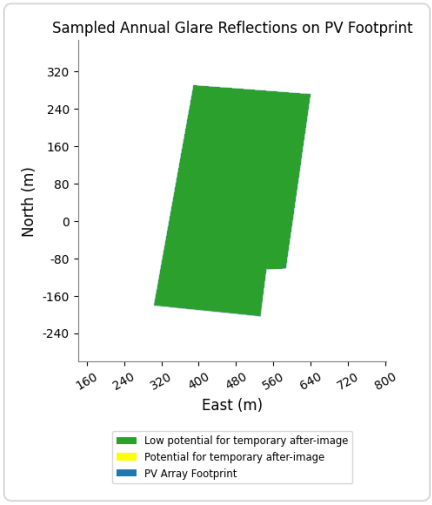
Yellow glare: none

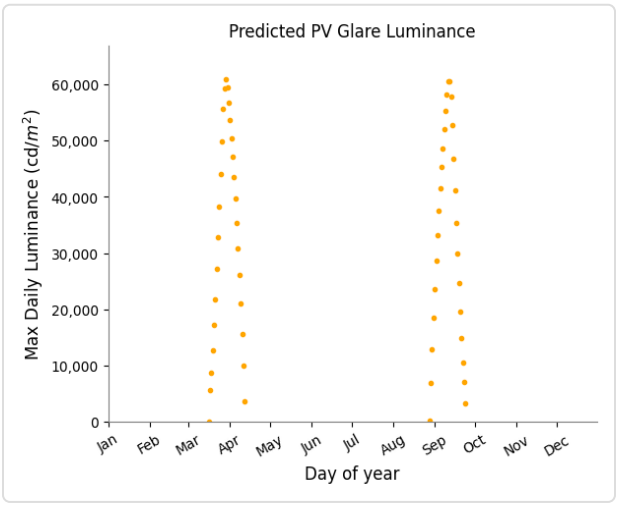
Green glare: 850 min.







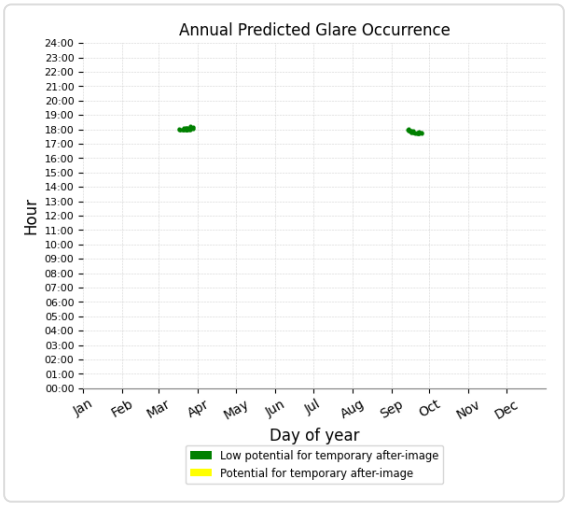


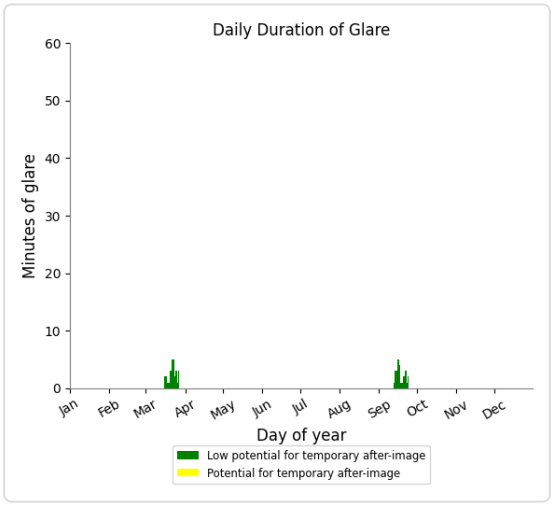


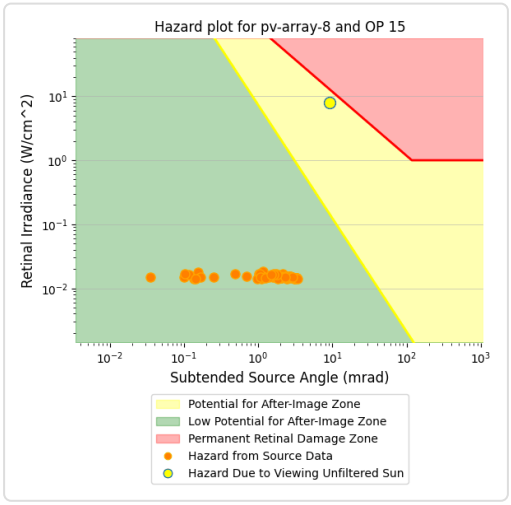
PV array 8 and OP 15

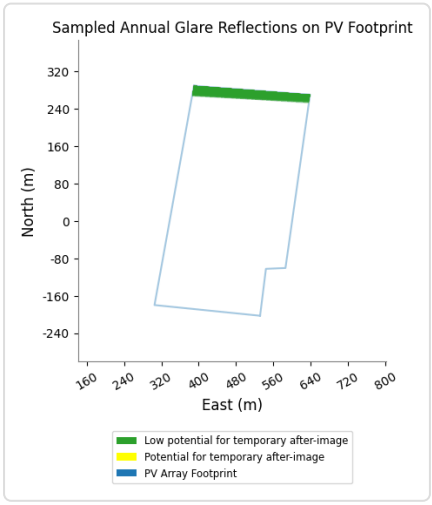
Yellow glare: none

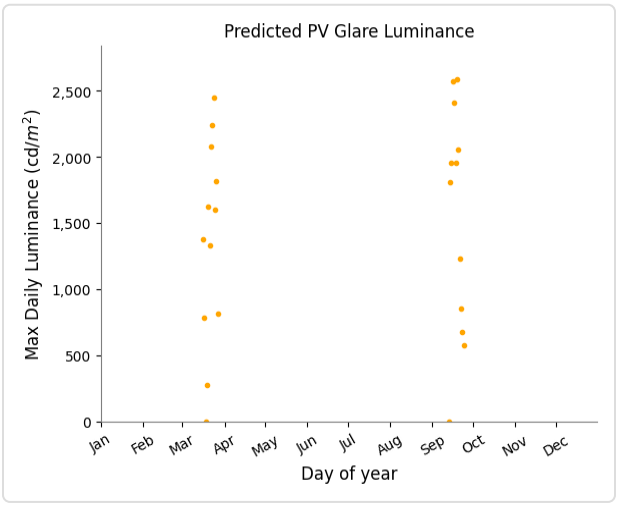
Green glare: 59 min.











PV array 8 and OP 1

No glare found

PV array 8 and OP 2

No glare found

PV array 8 and OP 8

No glare found

PV array 8 and OP 9

No glare found

PV array 8 and OP 10

No glare found

PV array 8 and OP 11

No glare found

PV array 8 and OP 12

No glare found

PV array 8 and OP 13

No glare found

PV array 8 and OP 16

No glare found

PV array 8 and OP 17

No glare found

PV array 8 and OP 18

No glare found

PV array 8 and OP 19

No glare found

PV array 8 and OP 20

No glare found

PV array 8 and OP 21

No glare found

Assumptions

"Green" glare is glare with low potential to cause an after-image (flash blindness) when observed prior to a typical blink response time.
"Yellow" glare is glare with potential to cause an after-image (flash blindness) when observed prior to a typical blink response time.
Times associated with glare are denoted in Standard time. For Daylight Savings, add one hour.
The algorithm does not rigorously represent the detailed geometry of a system; detailed features such as gaps between modules, variable height of the PV array, and support structures may impact actual glare results. However, we have validated our models against several systems, including a PV array causing glare to the air-traffic control tower at Manchester-Boston Regional Airport and several sites in Albuquerque, and the tool accurately predicted the occurrence and intensity of glare at different times and days of the year.
Several V1 calculations utilize the PV array centroid, rather than the actual glare spot location, due to algorithm limitations. This may affect results for large PV footprints. Additional analyses of array sub-sections can provide additional information on expected glare. This primarily affects V1 analyses of path receptors.
Random number computations are utilized by various steps of the annual hazard analysis algorithm. Predicted minutes of glare can vary between runs as a result. This limitation primarily affects analyses of Observation Point receptors, including ATCTs. Note that the SGHAT/ ForgeSolar methodology has always relied on an analytical, qualitative approach to accurately determine the overall hazard (i.e. green vs. yellow) of expected glare on an annual basis.
The analysis does not automatically consider obstacles (either man-made or natural) between the observation points and the prescribed solar installation that may obstruct observed glare, such as trees, hills, buildings, etc.
The subtended source angle (glare spot size) is constrained by the PV array footprint size. Partitioning large arrays into smaller sections will reduce the maximum potential subtended angle, potentially impacting results if actual glare spots are larger than the sub-array size. Additional analyses of the combined area of adjacent sub-arrays can provide more information on potential glare hazards. (See previous point on related limitations.)
The variable direct normal irradiance (DNI) feature (if selected) scales the user-prescribed peak DNI using a typical clear-day irradiance profile. This profile has a lower DNI in the mornings and evenings and a maximum at solar noon. The scaling uses a clear-day irradiance profile based on a normalized time relative to sunrise, solar noon, and sunset, which are prescribed by a sun-position algorithm and the latitude and longitude obtained from Google maps. The actual DNI on any given day can be affected by cloud cover, atmospheric attenuation, and other environmental factors.
The ocular hazard predicted by the tool depends on a number of environmental, optical, and human factors, which can be uncertain. We provide input fields and typical ranges of values for these factors so that the user can vary these parameters to see if they have an impact on the results. The speed of SGHAT allows expedited sensitivity and parametric analyses.
The system output calculation is a DNI-based approximation that assumes clear, sunny skies year-round. It should not be used in place of more rigorous modeling methods.
Hazard zone boundaries shown in the Glare Hazard plot are an approximation and visual aid based on aggregated research data. Actual ocular impact outcomes encompass a continuous, not discrete, spectrum.
Glare locations displayed on receptor plots are approximate. Actual glare-spot locations may differ.
Refer to the Help page at **www.forgesolar.com/help/** for assumptions and limitations not listed here.

Default glare analysis parameters and observer eye characteristics (for reference only):

- Analysis time interval: 1 minute
- Ocular transmission coefficient: 0.5
- Pupil diameter: 0.002 meters
- Eye focal length: 0.017 meters
- Sun subtended angle: 9.3 milliradians

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FORGESOLAR GLARE ANALYSIS

Project: **BR10356 Normanton Larches Solar**
Site configuration: **Aviation 200ft 180 and 205 OPs 1-20**

Created 15 Mar, 2024
Updated 21 Mar, 2024
Time-step 1 minute
Timezone offset UTC0
Minimum sun altitude 0.0 deg
DNI peaks at 1,000.0 W/m^2
Category 10 MW to 100 MW
Site ID 114506.19448

Ocular transmission coefficient 0.5
Pupil diameter 0.002 m
Eye focal length 0.017 m
Sun subtended angle 9.3 mrad
PV analysis methodology V2

Summary of Results

Glare with low potential for temporary after-image predicted

PV Array	Tilt	Orient	Annual Green Glare		Annual Yellow Glare		Energy	Peak Luminance
	°	°	min	hr	min	hr	kWh	cd/m^2
PV array 1	25.0	180.0	2,234	37.2	0	0.0	-	159,719
PV array 2	25.0	180.0	6,270	104.5	0	0.0	-	140,073
PV array 3	25.0	180.0	1,650	27.5	0	0.0	-	136,039
PV array 4	25.0	180.0	3,723	62.0	0	0.0	-	137,832
PV array 5	25.0	180.0	2,188	36.5	0	0.0	-	142,537
PV array 6	25.0	180.0	5,563	92.7	0	0.0	-	181,909
PV array 7	25.0	205.0	5,149	85.8	0	0.0	-	214,160
PV array 8	25.0	180.0	12,874	214.6	0	0.0	-	259,668

Total glare received by each receptor; may include duplicate times of glare from multiple reflective surfaces.

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
OP 1	0	0.0	0	0.0
OP 2	0	0.0	0	0.0
OP 3	0	0.0	0	0.0
OP 4	0	0.0	0	0.0
OP 5	0	0.0	0	0.0
OP 6	0	0.0	0	0.0
OP 7	658	11.0	0	0.0
OP 8	5,349	89.2	0	0.0

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
OP 9	0	0.0	0	0.0
OP 10	0	0.0	0	0.0
OP 11	0	0.0	0	0.0
OP 12	0	0.0	0	0.0
OP 13	0	0.0	0	0.0
OP 14	10,439	174.0	0	0.0
OP 15	11,393	189.9	0	0.0
OP 16	10,695	178.2	0	0.0
OP 17	1,117	18.6	0	0.0
OP 18	0	0.0	0	0.0
OP 19	0	0.0	0	0.0
OP 20	0	0.0	0	0.0

Component Data

PV Arrays

Name: PV array 1
Axis tracking: Fixed (no rotation)
Tilt: 25.0°
Orientation: 180.0°
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	53.270453	-1.023592	44.16	3.58	47.74
2	53.270382	-1.026510	38.69	3.58	42.27
3	53.270337	-1.028001	42.19	3.58	45.77
4	53.268374	-1.027819	47.55	3.58	51.13
5	53.267835	-1.027411	47.97	3.58	51.55
6	53.268194	-1.025823	42.76	3.58	46.34
7	53.268605	-1.023538	48.05	3.58	51.63

Name: PV array 2
Axis tracking: Fixed (no rotation)
Tilt: 25.0°
Orientation: 180.0°
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	53.272403	-1.022893	44.98	3.58	48.56
2	53.271659	-1.020468	49.10	3.58	52.68
3	53.271146	-1.020629	49.06	3.58	52.64
4	53.270568	-1.020768	49.76	3.58	53.34
5	53.269978	-1.022399	48.94	3.58	52.52
6	53.269490	-1.023494	46.53	3.58	50.11
7	53.270600	-1.023526	44.05	3.58	47.63
8	53.270658	-1.022721	44.52	3.58	48.10

Name: PV array 3
Axis tracking: Fixed (no rotation)
Tilt: 25.0°
Orientation: 180.0°
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	53.267270	-1.027453	49.52	3.58	53.10
2	53.267742	-1.026122	44.46	3.58	48.04
3	53.268066	-1.026004	43.25	3.58	46.83
4	53.268361	-1.024577	44.74	3.58	48.32
5	53.268515	-1.023451	48.43	3.58	52.01
6	53.263789	-1.021096	44.95	3.58	48.53
7	53.263606	-1.026144	50.81	3.58	54.39

Name: PV array 4
Axis tracking: Fixed (no rotation)
Tilt: 25.0°
Orientation: 180.0°
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	53.267296	-1.022818	47.72	3.58	51.30
2	53.267707	-1.018998	49.22	3.58	52.80
3	53.264120	-1.017373	43.17	3.58	46.75
4	53.264126	-1.017861	43.81	3.58	47.39
5	53.263885	-1.017893	45.60	3.58	49.18
6	53.263795	-1.021085	44.91	3.58	48.49

Name: PV array 5
Axis tracking: Fixed (no rotation)
Tilt: 25.0°
Orientation: 180.0°
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	53.268300	-1.019106	51.65	3.58	55.23
2	53.268197	-1.015587	47.94	3.58	51.52
3	53.267411	-1.014932	45.87	3.58	49.45
4	53.263776	-1.015093	42.99	3.58	46.57
5	53.263904	-1.017175	44.48	3.58	48.06
6	53.266359	-1.018355	43.98	3.58	47.56

Name: PV array 6
Axis tracking: Fixed (no rotation)
Tilt: 25.0°
Orientation: 180.0°
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	53.267286	-1.014793	45.26	3.58	48.84
2	53.263975	-1.015072	41.69	3.58	45.27
3	53.265181	-1.012926	37.52	3.58	41.10
4	53.265759	-1.012132	35.68	3.58	39.26
5	53.266067	-1.011724	35.43	3.58	39.01
6	53.266349	-1.011338	34.83	3.58	38.41
7	53.266619	-1.009836	34.68	3.58	38.26
8	53.267825	-1.010716	42.25	3.58	45.83

Name: PV array 7
Axis tracking: Fixed (no rotation)
Tilt: 25.0°
Orientation: 205.0°
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	53.272914	-1.013927	31.05	3.58	34.63
2	53.272160	-1.014136	33.50	3.58	37.08
3	53.271227	-1.014345	35.44	3.58	39.02
4	53.269543	-1.014764	43.02	3.58	46.60
5	53.269645	-1.012344	41.35	3.58	44.93
6	53.270749	-1.010542	29.55	3.58	33.13
7	53.271852	-1.010113	28.08	3.58	31.66
8	53.272545	-1.010220	28.05	3.58	31.63
9	53.273187	-1.010842	28.00	3.58	31.58
10	53.273257	-1.012677	29.01	3.58	32.59
11	53.272860	-1.012827	29.81	3.58	33.39

Name: PV array 8
Axis tracking: Fixed (no rotation)
Tilt: 25.0°
Orientation: 180.0°
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	53.273062	-1.017713	40.48	3.58	44.06
2	53.272915	-1.013947	31.07	3.58	34.65
3	53.269546	-1.014790	42.95	3.58	46.53
4	53.269521	-1.015417	43.78	3.58	47.36
5	53.268629	-1.015632	47.69	3.58	51.27
6	53.268892	-1.019001	51.64	3.58	55.22

Discrete Observation Point Receptors

Name	ID	Latitude (°)	Longitude (°)	Elevation (m)	Height (m)
OP 1	1	53.274658	-0.956085	26.85	60.96
OP 2	2	53.280560	-0.951536	27.44	60.96
OP 3	3	53.287000	-0.946429	23.00	60.96
OP 4	4	53.298511	-0.952811	33.00	60.96
OP 5	5	53.299640	-0.964398	28.38	60.96
OP 6	6	53.287225	-0.974011	23.92	60.96
OP 7	7	53.272753	-0.986371	37.57	60.96
OP 8	8	53.265874	-0.967488	33.88	60.96
OP 9	9	53.299127	-0.939421	18.00	60.96
OP 10	10	53.306154	-0.950150	29.17	60.96
OP 11	11	53.308462	-0.963540	37.62	60.96
OP 12	12	53.296511	-0.979762	23.67	60.96
OP 13	13	53.283581	-0.992722	40.63	60.96
OP 14	14	53.268595	-0.997529	38.41	60.96
OP 15	15	53.264437	-0.984998	29.15	60.96
OP 16	16	53.260330	-0.969119	37.98	60.96
OP 17	17	53.269570	-0.934272	22.21	60.96
OP 18	18	53.275422	-0.930581	24.95	60.96
OP 19	19	53.281734	-0.928263	23.00	60.96
OP 20	20	53.283581	-0.968861	22.00	60.96

Glare Analysis Results

Summary of Results

Glare with low potential for temporary after-image predicted

PV Array	Tilt	Orient	Annual Green Glare		Annual Yellow Glare		Energy	Peak Luminance
	°	°	min	hr	min	hr	kWh	cd/m^2
PV array 1	25.0	180.0	2,234	37.2	0	0.0	-	159,719
PV array 2	25.0	180.0	6,270	104.5	0	0.0	-	140,073
PV array 3	25.0	180.0	1,650	27.5	0	0.0	-	136,039
PV array 4	25.0	180.0	3,723	62.0	0	0.0	-	137,832
PV array 5	25.0	180.0	2,188	36.5	0	0.0	-	142,537
PV array 6	25.0	180.0	5,563	92.7	0	0.0	-	181,909
PV array 7	25.0	205.0	5,149	85.8	0	0.0	-	214,160
PV array 8	25.0	180.0	12,874	214.6	0	0.0	-	259,668

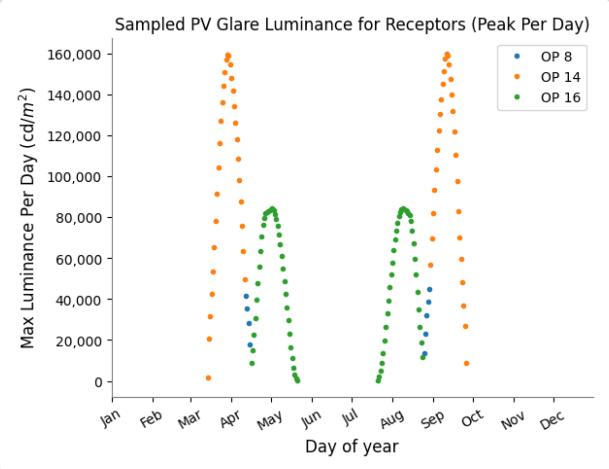
Total glare received by each receptor; may include duplicate times of glare from multiple reflective surfaces.

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
OP 1	0	0.0	0	0.0
OP 2	0	0.0	0	0.0
OP 3	0	0.0	0	0.0
OP 4	0	0.0	0	0.0
OP 5	0	0.0	0	0.0
OP 6	0	0.0	0	0.0
OP 7	658	11.0	0	0.0
OP 8	5,349	89.2	0	0.0
OP 9	0	0.0	0	0.0
OP 10	0	0.0	0	0.0
OP 11	0	0.0	0	0.0
OP 12	0	0.0	0	0.0
OP 13	0	0.0	0	0.0
OP 14	10,439	174.0	0	0.0
OP 15	11,393	189.9	0	0.0
OP 16	10,695	178.2	0	0.0
OP 17	1,117	18.6	0	0.0
OP 18	0	0.0	0	0.0
OP 19	0	0.0	0	0.0
OP 20	0	0.0	0	0.0

PV: PV array 1 low potential for temporary after-image

Receptor results ordered by category of glare

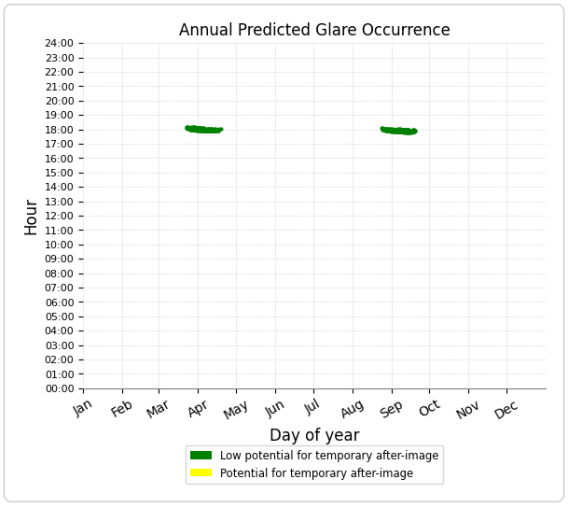
Receptor	Annual Green Glare		Annual Yellow Glare		Peak Luminance
	min	hr	min	hr	cd/m^2
OP 8	413	6.9	0	0.0	69,732
OP 14	914	15.2	0	0.0	159,719
OP 16	816	13.6	0	0.0	84,141
OP 17	91	1.5	0	0.0	14,298
OP 1	0	0.0	0	0.0	0
OP 2	0	0.0	0	0.0	0
OP 3	0	0.0	0	0.0	0
OP 4	0	0.0	0	0.0	0
OP 5	0	0.0	0	0.0	0
OP 6	0	0.0	0	0.0	0
OP 7	0	0.0	0	0.0	0
OP 9	0	0.0	0	0.0	0
OP 10	0	0.0	0	0.0	0
OP 11	0	0.0	0	0.0	0
OP 12	0	0.0	0	0.0	0
OP 13	0	0.0	0	0.0	0
OP 15	0	0.0	0	0.0	0
OP 18	0	0.0	0	0.0	0
OP 19	0	0.0	0	0.0	0
OP 20	0	0.0	0	0.0	0

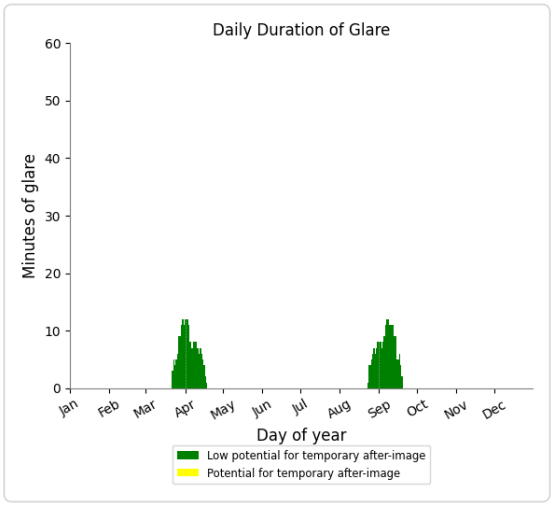


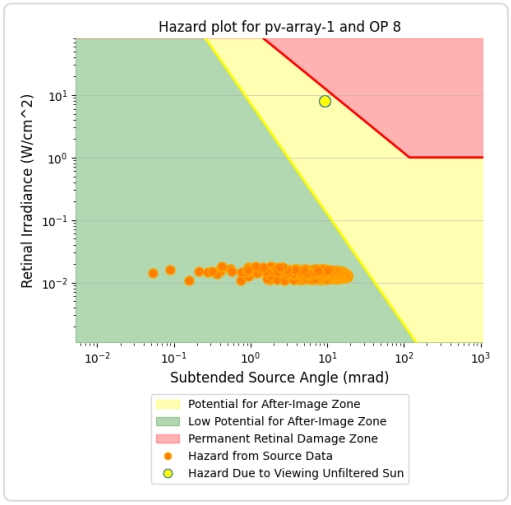
PV array 1 and OP 8

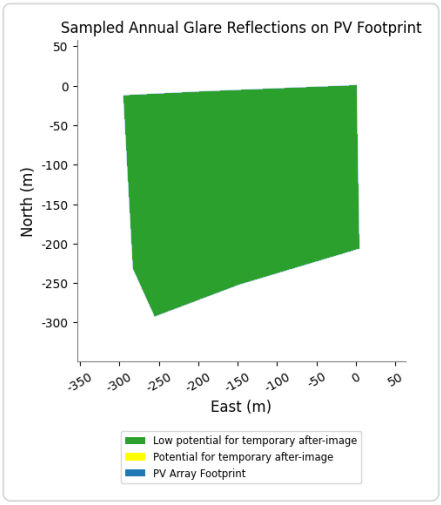
Yellow glare: none

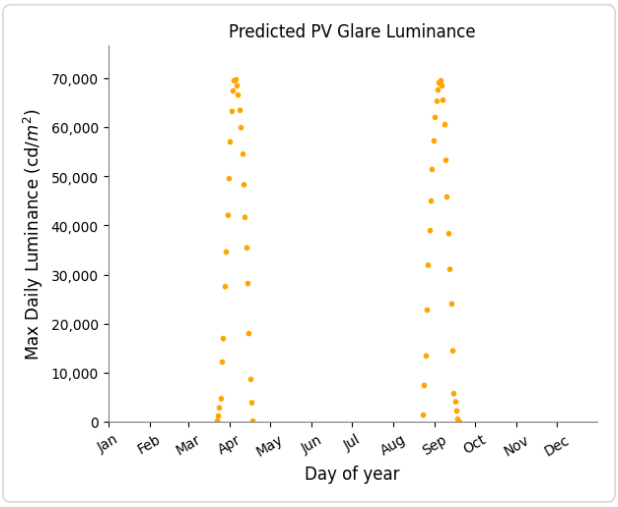
Green glare: 413 min.







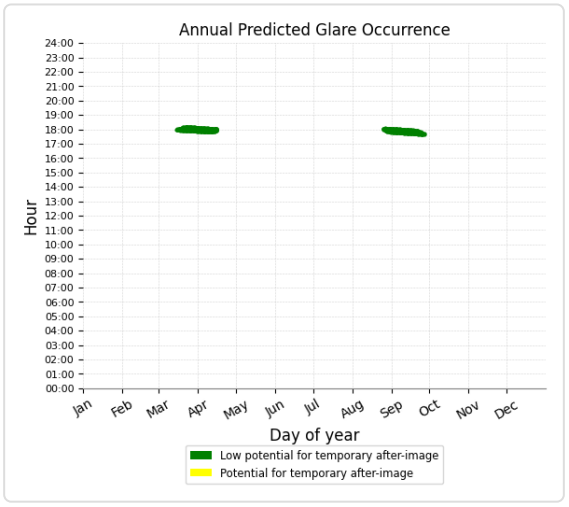


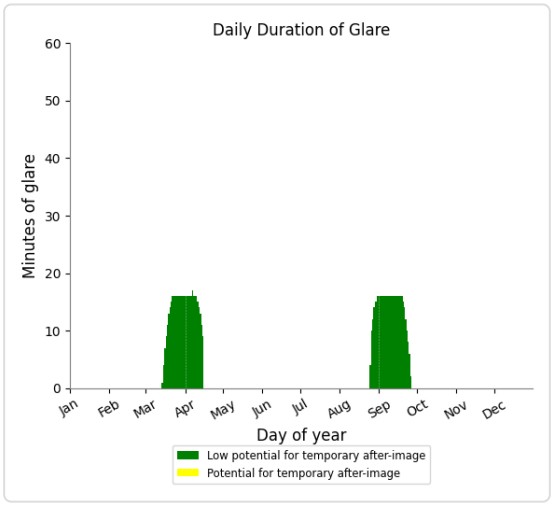


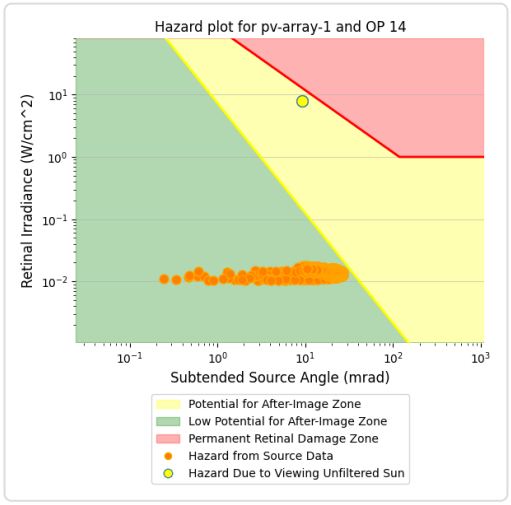
PV array 1 and OP 14

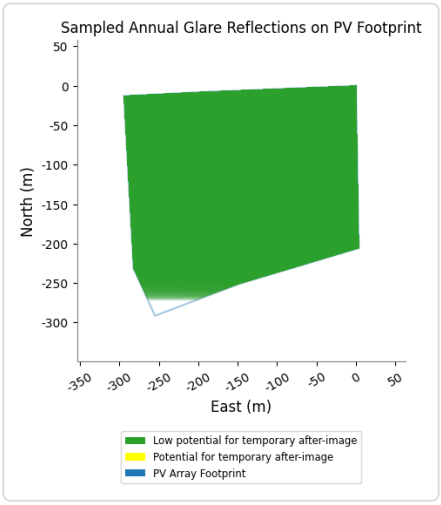
Yellow glare: none

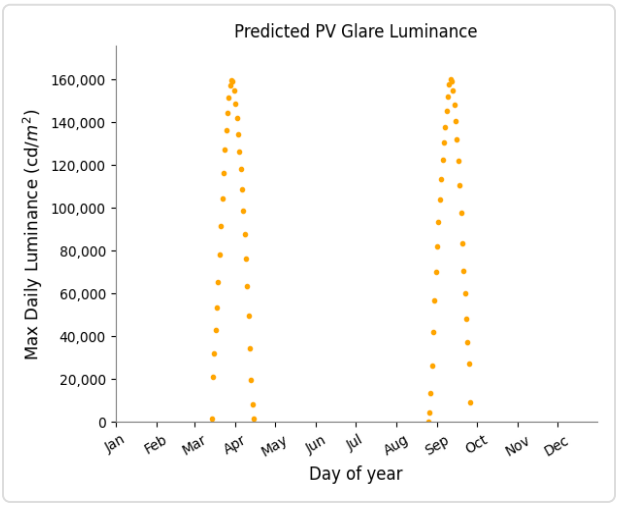
Green glare: 914 min.







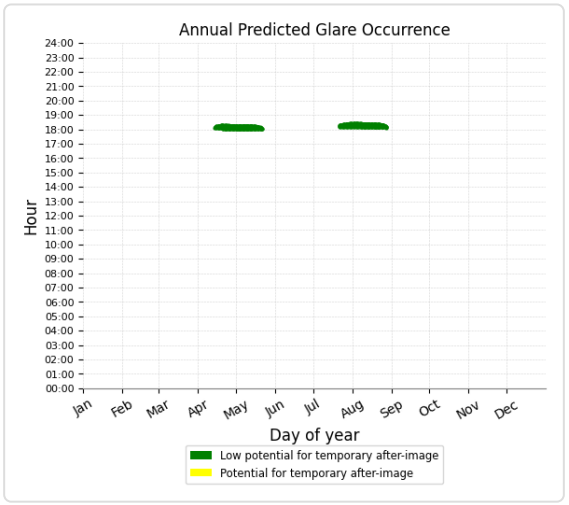


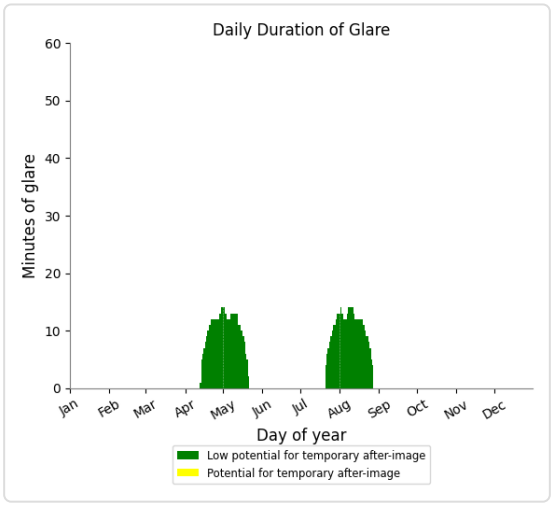


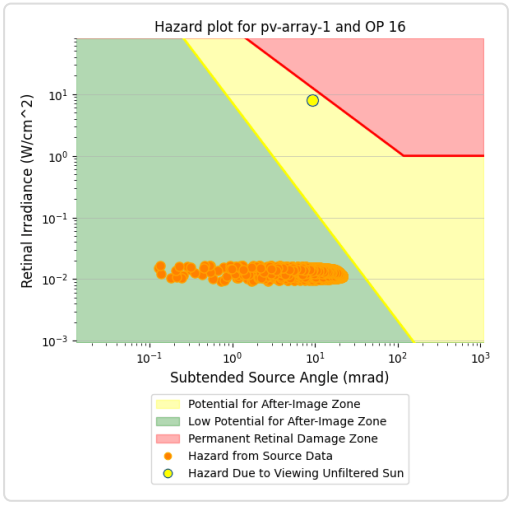
PV array 1 and OP 16

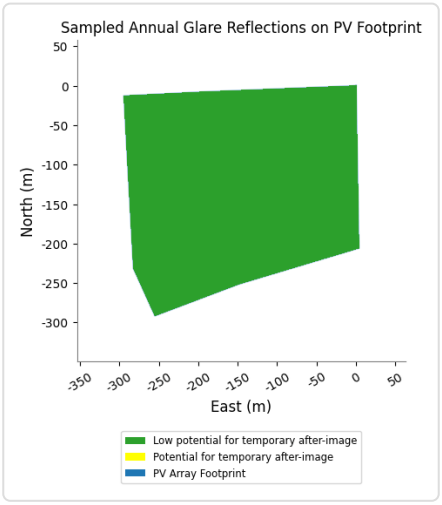
Yellow glare: none

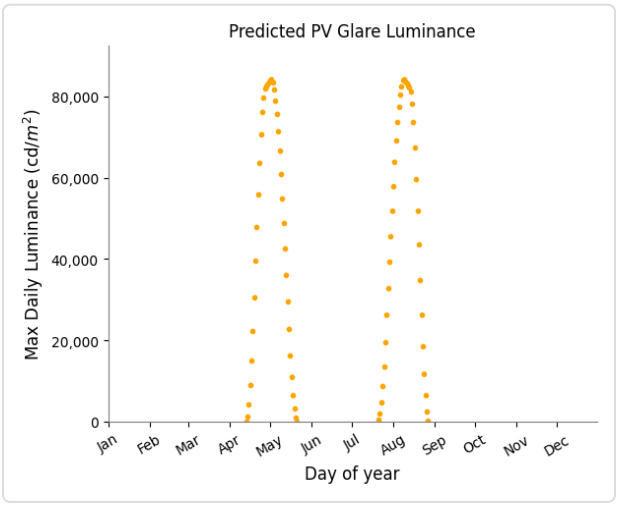
Green glare: 816 min.







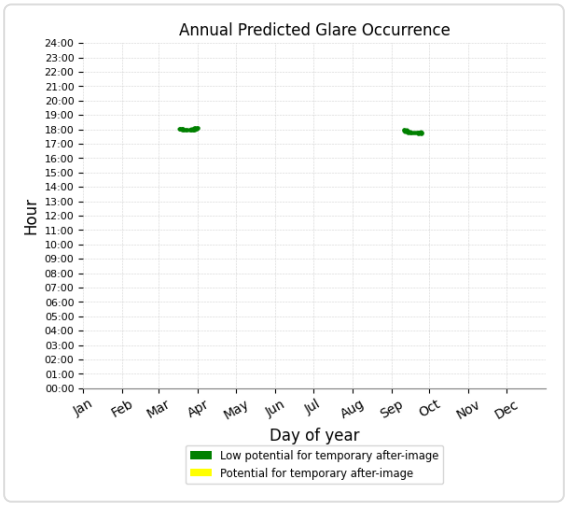


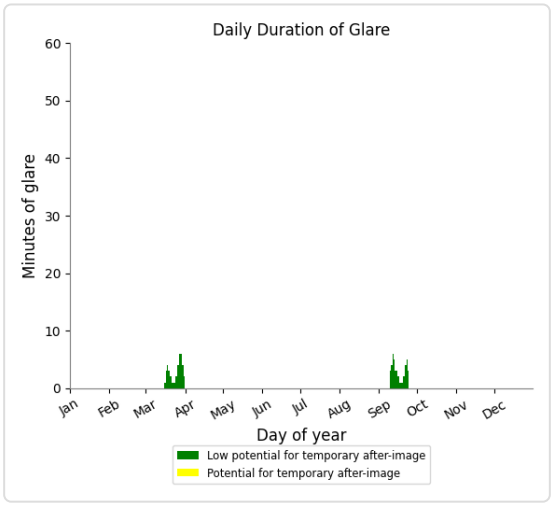


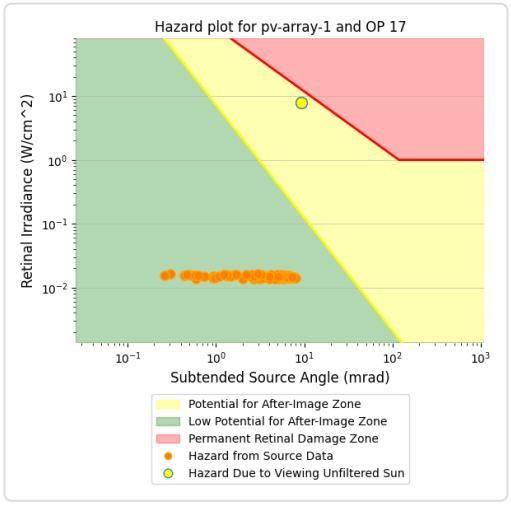
PV array 1 and OP 17

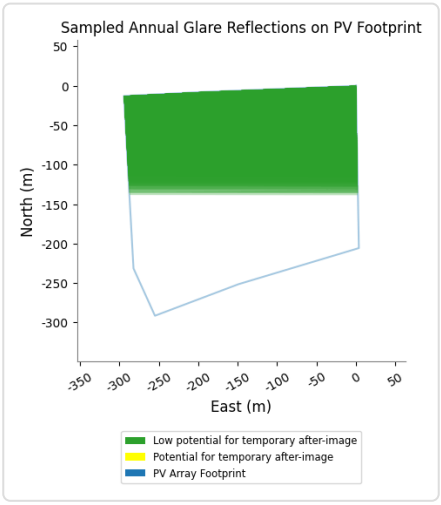
Yellow glare: none

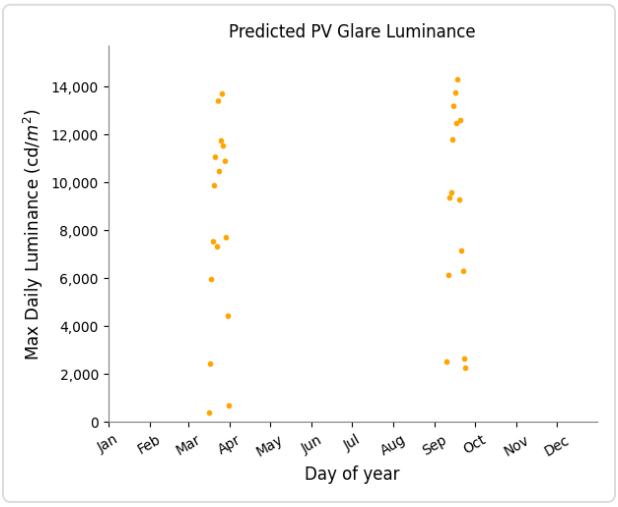
Green glare: 91 min.











PV array 1 and OP 1

No glare found

PV array 1 and OP 2

No glare found

PV array 1 and OP 3

No glare found

PV array 1 and OP 4

No glare found

PV array 1 and OP 5

No glare found

PV array 1 and OP 6

No glare found

PV array 1 and OP 7

No glare found

PV array 1 and OP 9

No glare found

PV array 1 and OP 10

No glare found

PV array 1 and OP 11

No glare found

PV array 1 and OP 12

No glare found

PV array 1 and OP 13

No glare found

PV array 1 and OP 15

No glare found

PV array 1 and OP 18

No glare found

PV array 1 and OP 19

No glare found

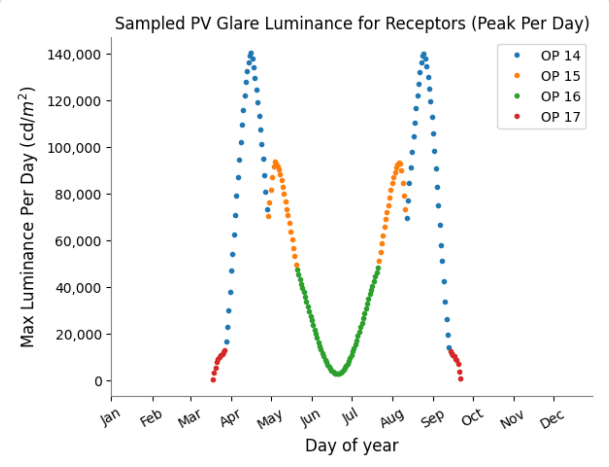
PV array 1 and OP 20

No glare found

PV: PV array 2 low potential for temporary after-image

Receptor results ordered by category of glare

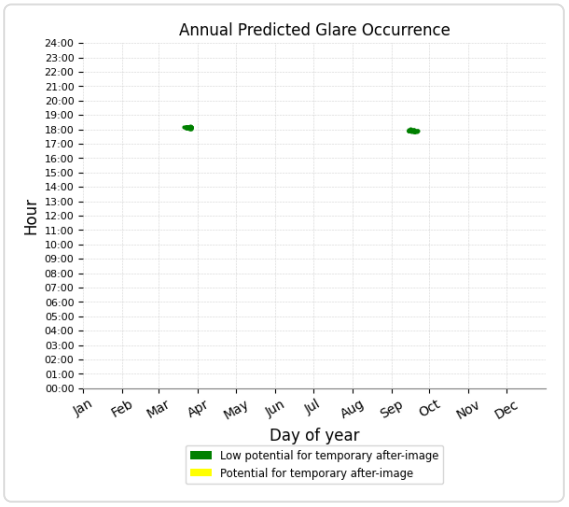
Receptor	Annual Green Glare		Annual Yellow Glare		Peak Luminance
	min	hr	min	hr	cd/m^2
OP 7	86	1.4	0	0.0	4,745
OP 8	994	16.6	0	0.0	46,838
OP 14	1,220	20.3	0	0.0	140,073
OP 15	1,679	28.0	0	0.0	93,509
OP 16	1,929	32.1	0	0.0	53,053
OP 17	362	6.0	0	0.0	13,566
OP 1	0	0.0	0	0.0	0
OP 2	0	0.0	0	0.0	0
OP 3	0	0.0	0	0.0	0
OP 4	0	0.0	0	0.0	0
OP 5	0	0.0	0	0.0	0
OP 6	0	0.0	0	0.0	0
OP 9	0	0.0	0	0.0	0
OP 10	0	0.0	0	0.0	0
OP 11	0	0.0	0	0.0	0
OP 12	0	0.0	0	0.0	0
OP 13	0	0.0	0	0.0	0
OP 18	0	0.0	0	0.0	0
OP 19	0	0.0	0	0.0	0
OP 20	0	0.0	0	0.0	0

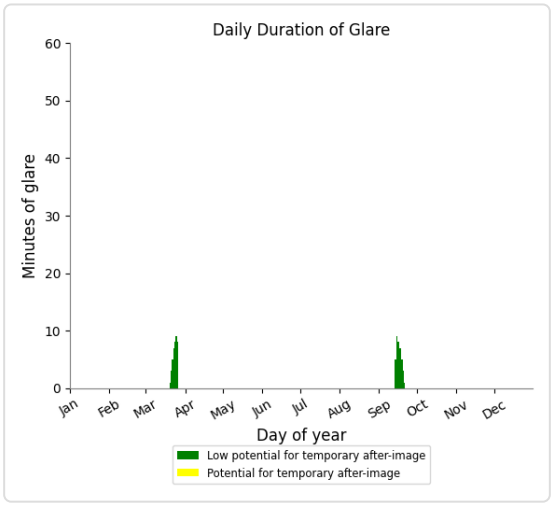


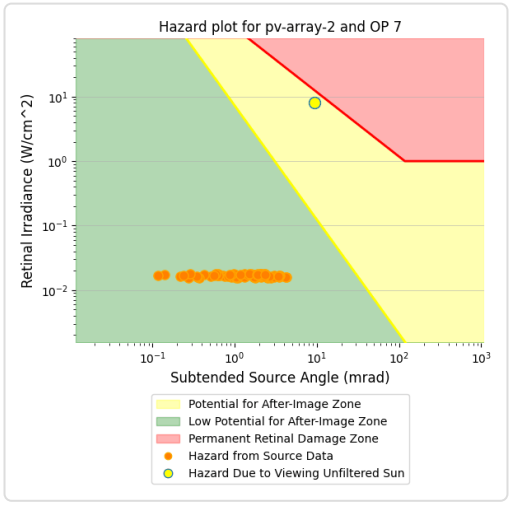
PV array 2 and OP 7

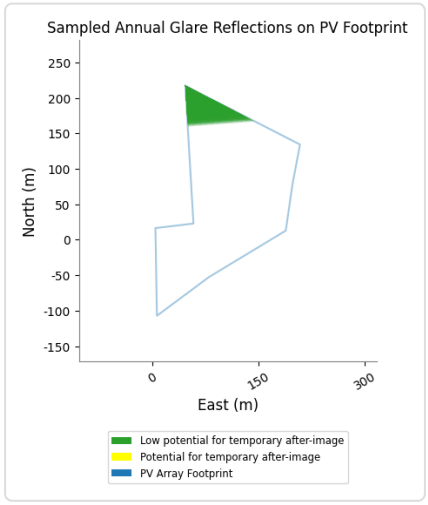
Yellow glare: none

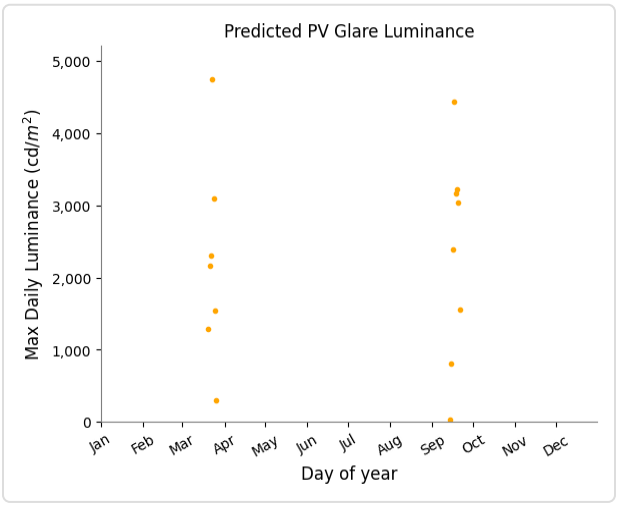
Green glare: 86 min.







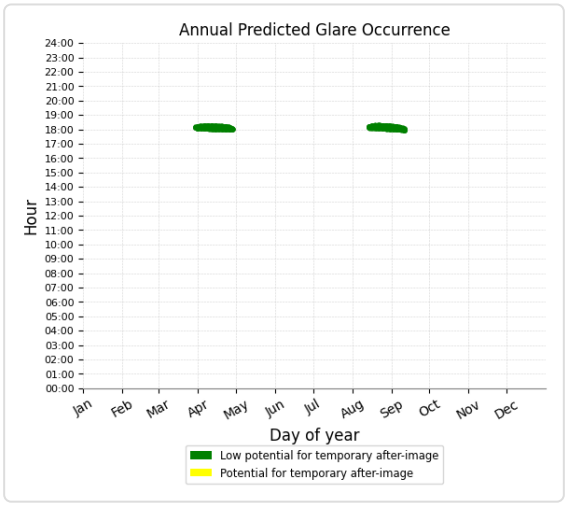


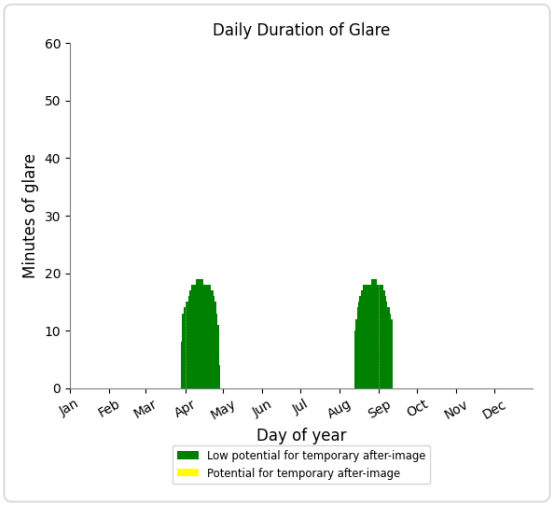


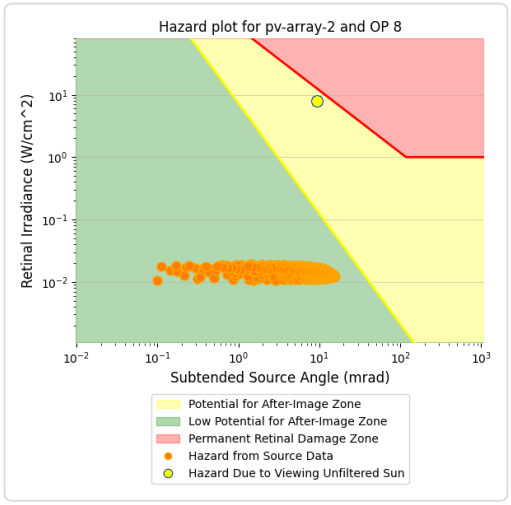
PV array 2 and OP 8

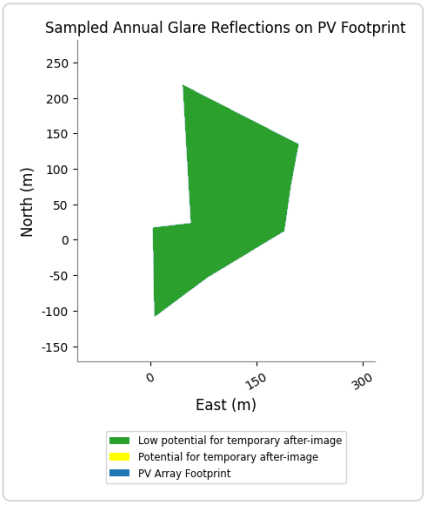
Yellow glare: none

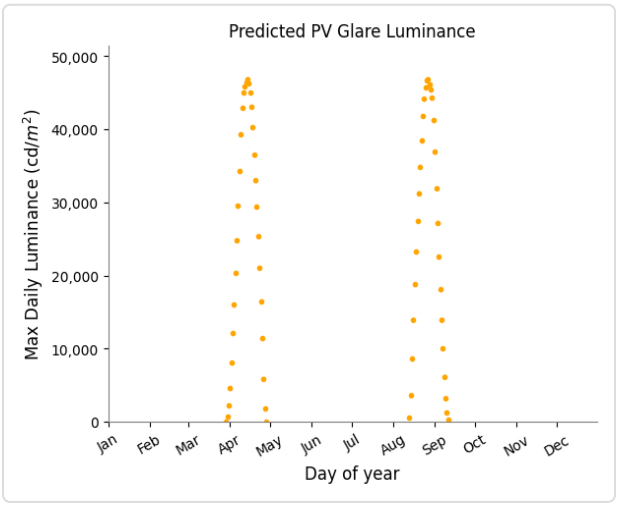
Green glare: 994 min.







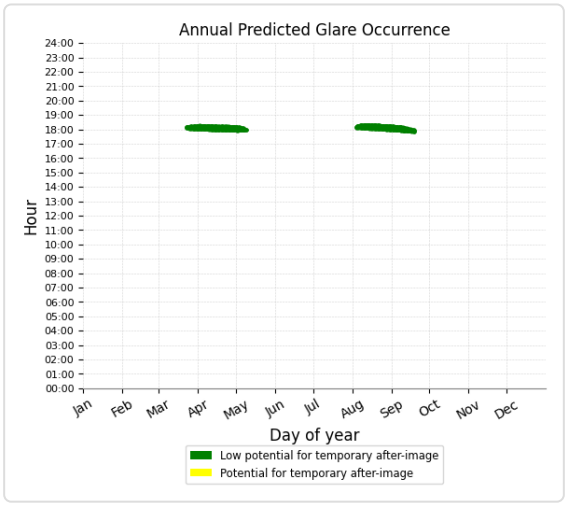


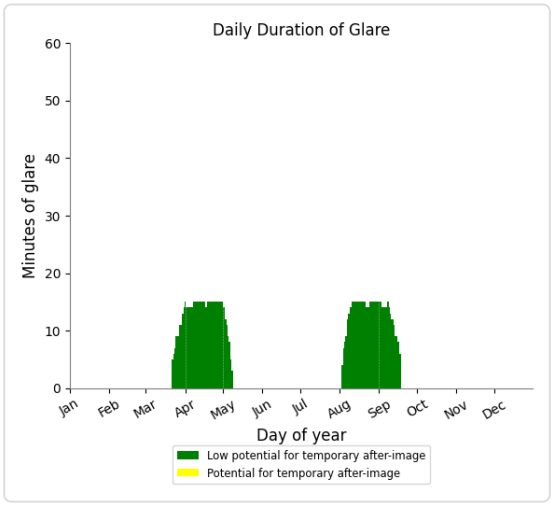


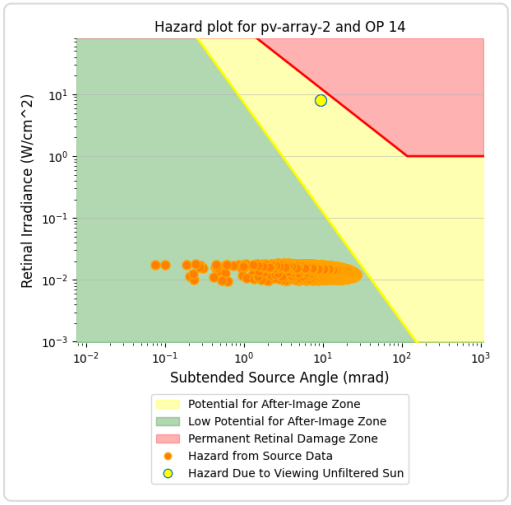
PV array 2 and OP 14

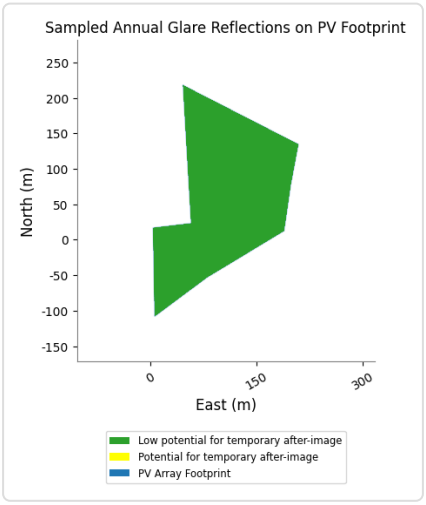
Yellow glare: none

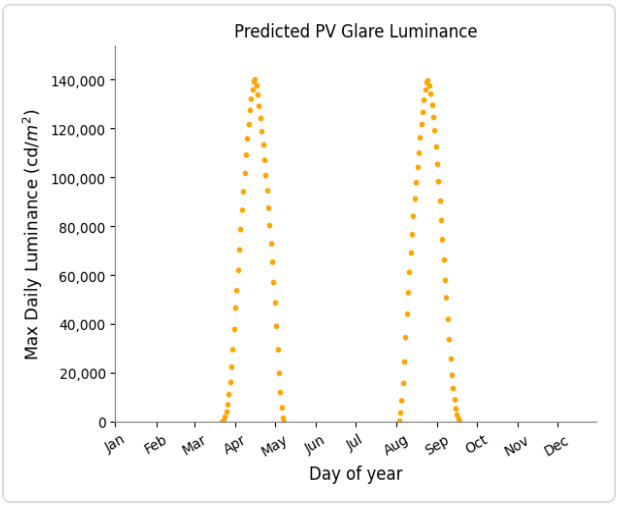
Green glare: 1,220 min.







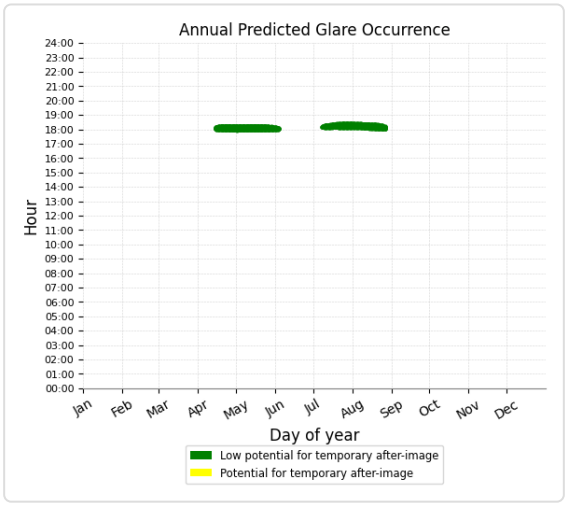


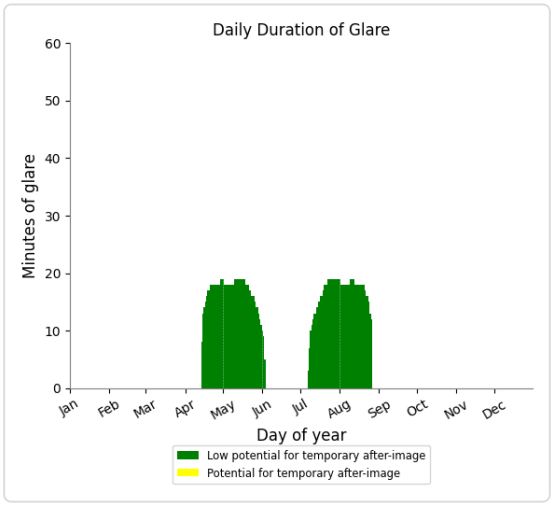


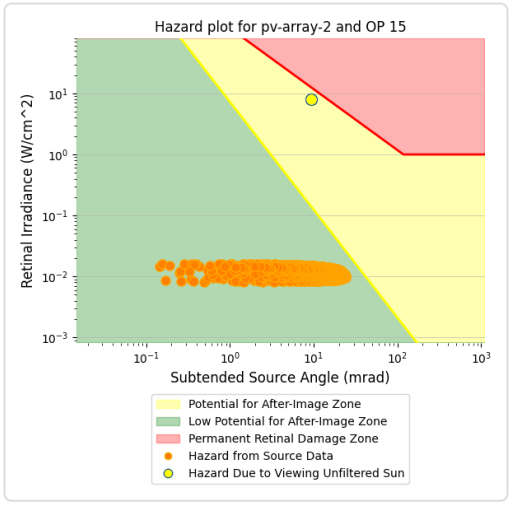
PV array 2 and OP 15

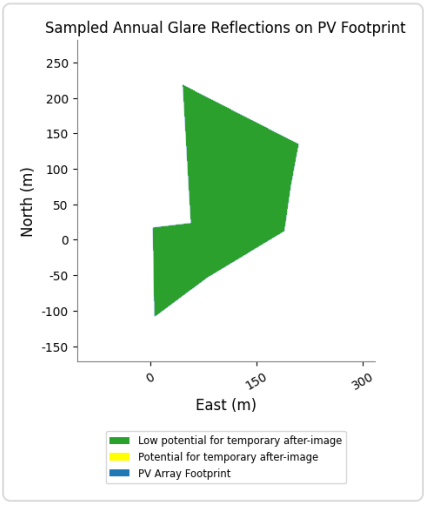
Yellow glare: none

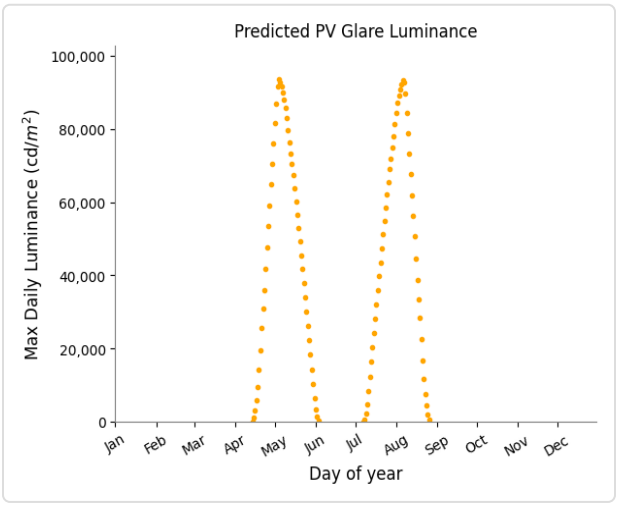
Green glare: 1,679 min.







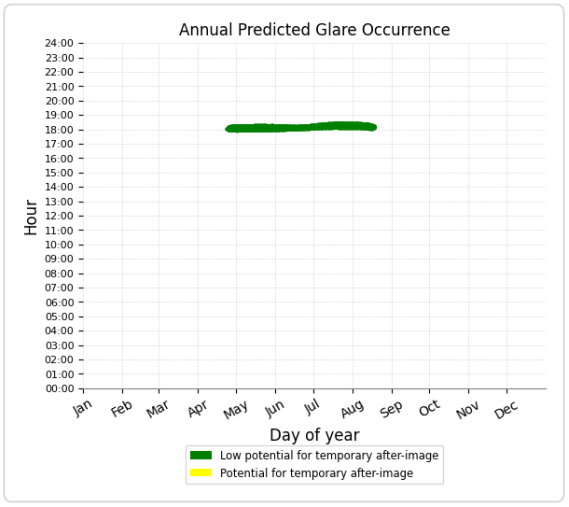


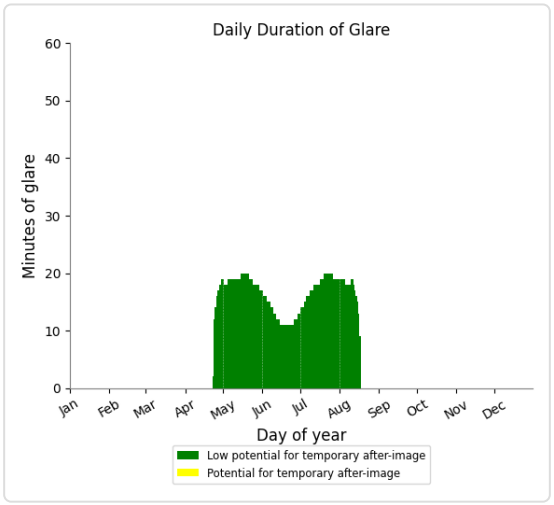


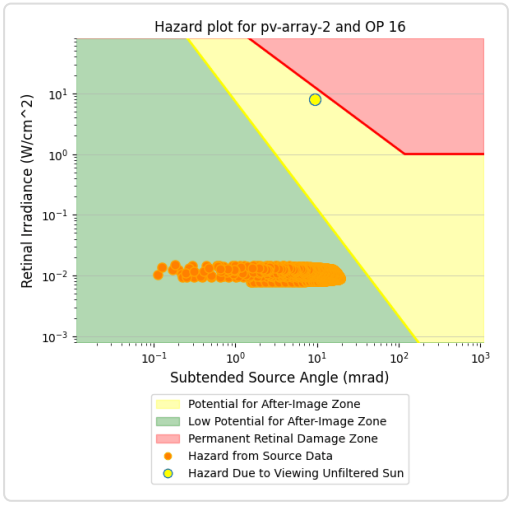
PV array 2 and OP 16

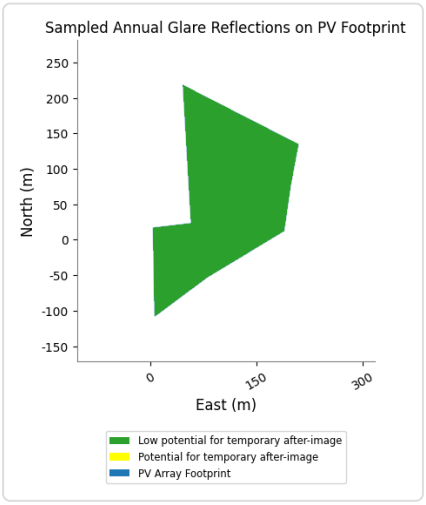
Yellow glare: none

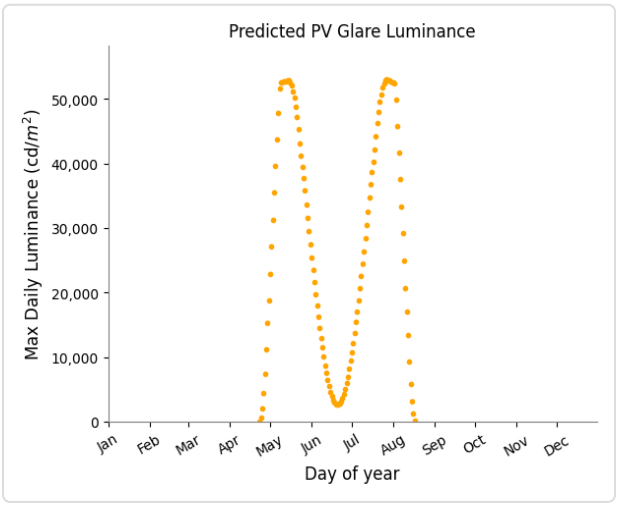
Green glare: 1,929 min.







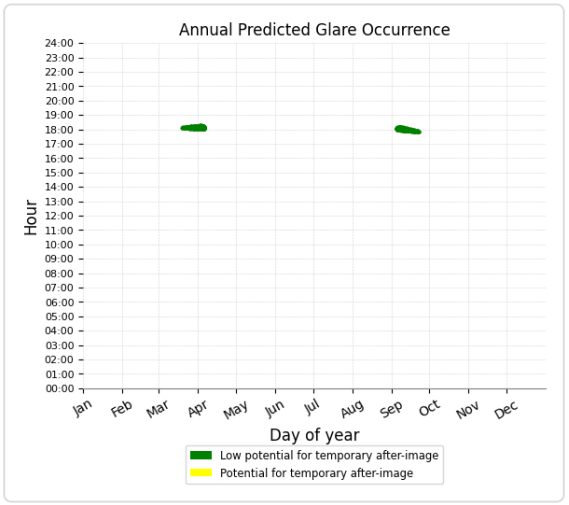


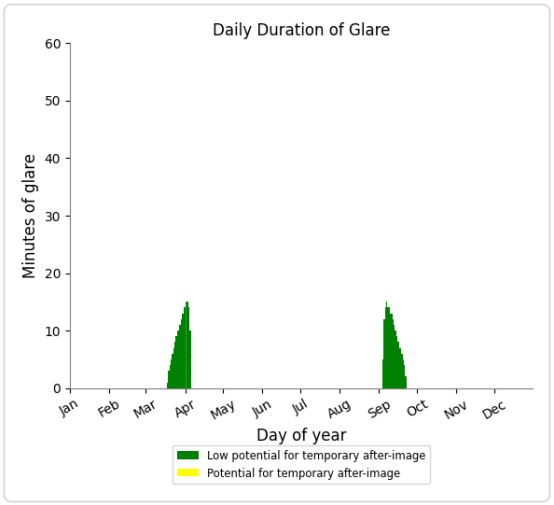


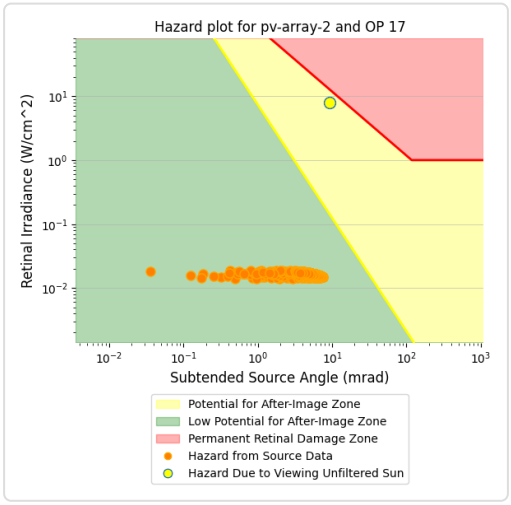
PV array 2 and OP 17

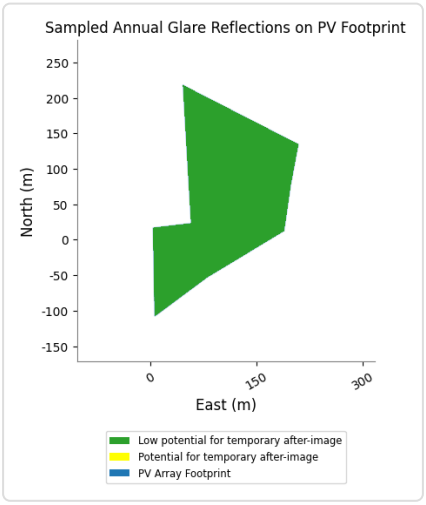
Yellow glare: none

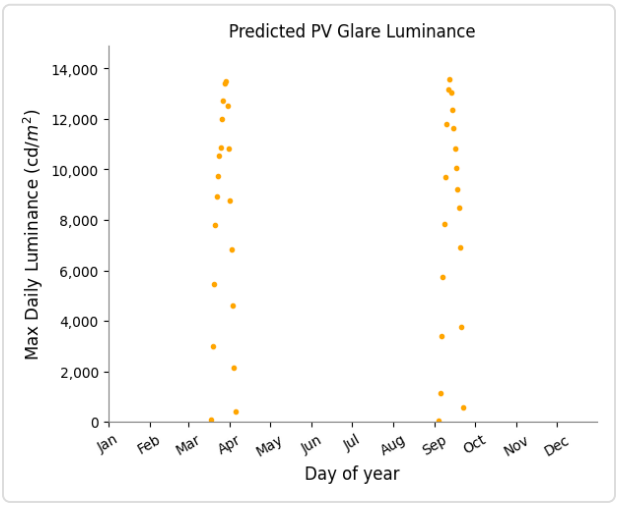
Green glare: 362 min.











PV array 2 and OP 1

No glare found

PV array 2 and OP 2

No glare found

PV array 2 and OP 3

No glare found

PV array 2 and OP 4

No glare found

PV array 2 and OP 5

No glare found

PV array 2 and OP 6

No glare found

PV array 2 and OP 9

No glare found

PV array 2 and OP 10

No glare found

PV array 2 and OP 11

No glare found

PV array 2 and OP 12

No glare found

PV array 2 and OP 13

No glare found

PV array 2 and OP 18

No glare found

PV array 2 and OP 19

No glare found

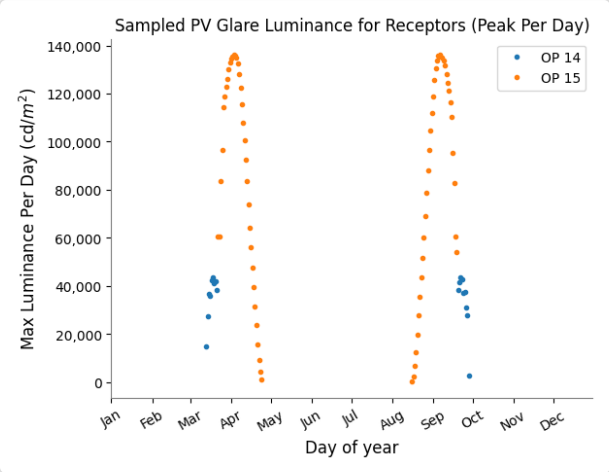
PV array 2 and OP 20

No glare found

PV: PV array 3 low potential for temporary after-image

Receptor results ordered by category of glare

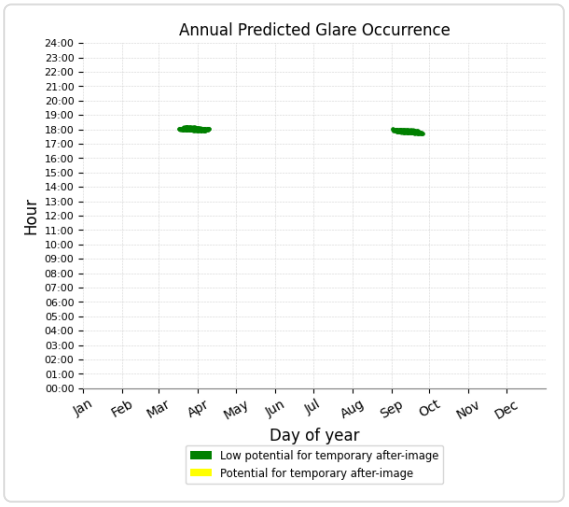
Receptor	Annual Green Glare		Annual Yellow Glare		Peak Luminance
	min	hr	min	hr	cd/m^2
OP 8	415	6.9	0	0.0	68,864
OP 14	385	6.4	0	0.0	43,576
OP 15	850	14.2	0	0.0	136,039
OP 1	0	0.0	0	0.0	0
OP 2	0	0.0	0	0.0	0
OP 3	0	0.0	0	0.0	0
OP 4	0	0.0	0	0.0	0
OP 5	0	0.0	0	0.0	0
OP 6	0	0.0	0	0.0	0
OP 7	0	0.0	0	0.0	0
OP 9	0	0.0	0	0.0	0
OP 10	0	0.0	0	0.0	0
OP 11	0	0.0	0	0.0	0
OP 12	0	0.0	0	0.0	0
OP 13	0	0.0	0	0.0	0
OP 16	0	0.0	0	0.0	0
OP 17	0	0.0	0	0.0	0
OP 18	0	0.0	0	0.0	0
OP 19	0	0.0	0	0.0	0
OP 20	0	0.0	0	0.0	0

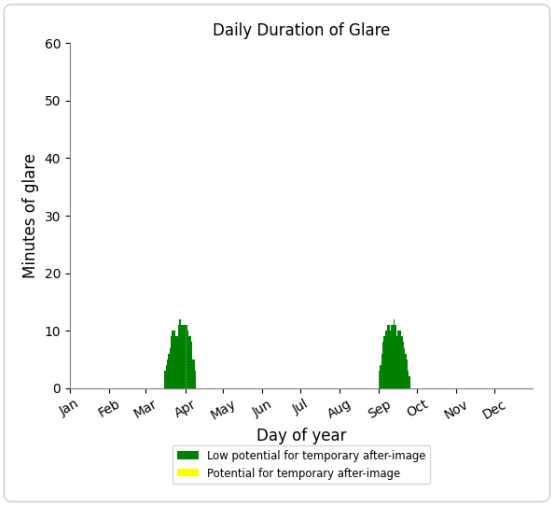


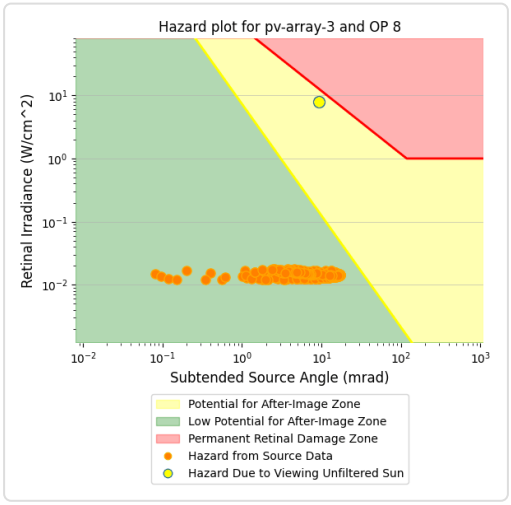
PV array 3 and OP 8

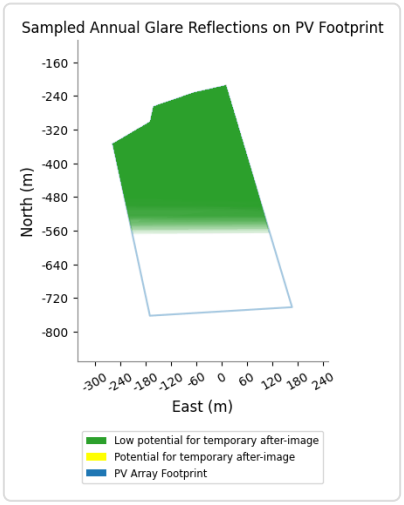
Yellow glare: none

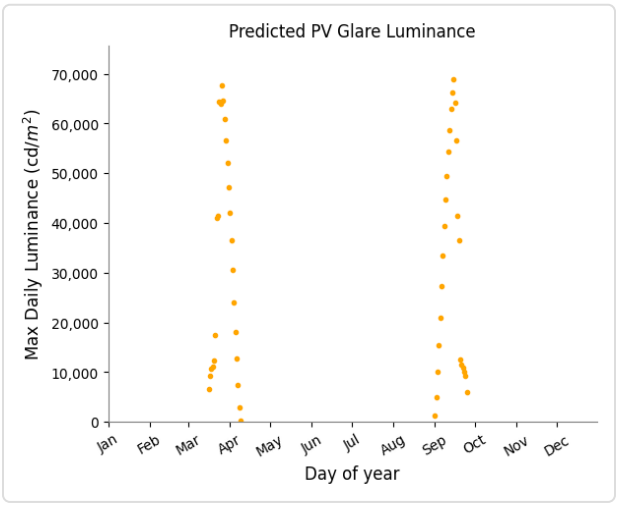
Green glare: 415 min.







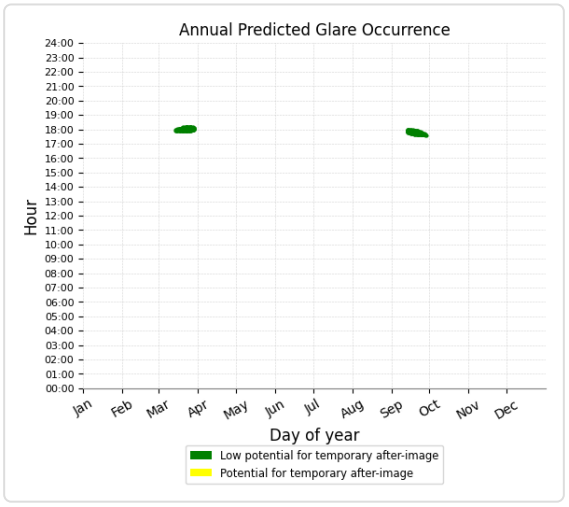


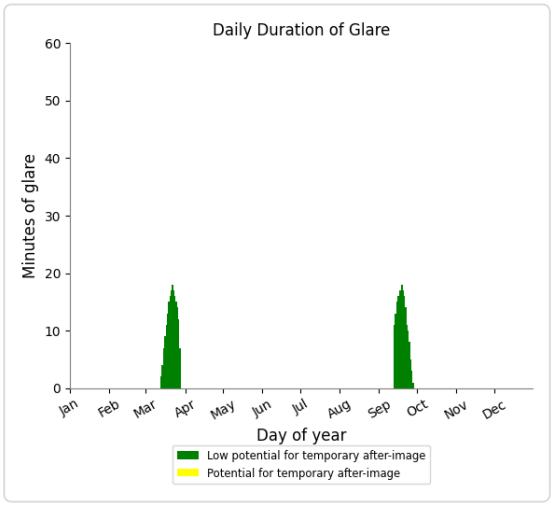


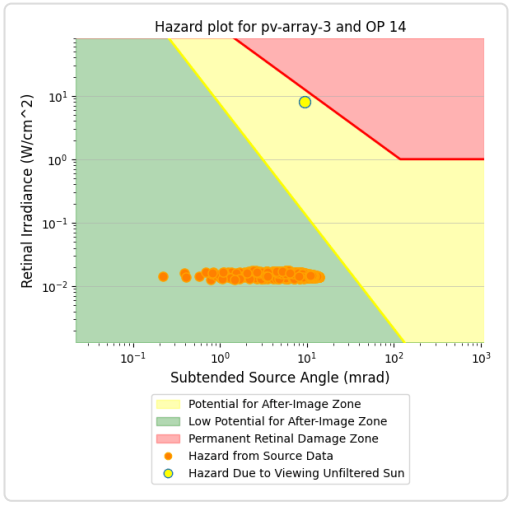
PV array 3 and OP 14

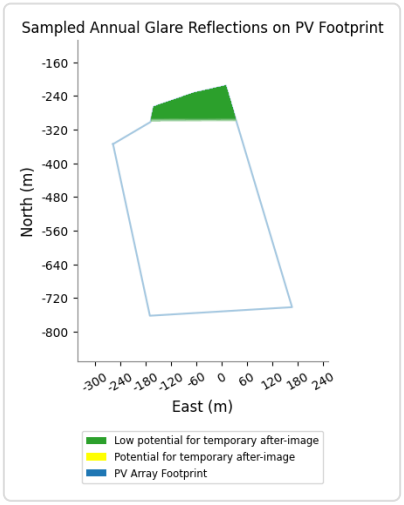
Yellow glare: none

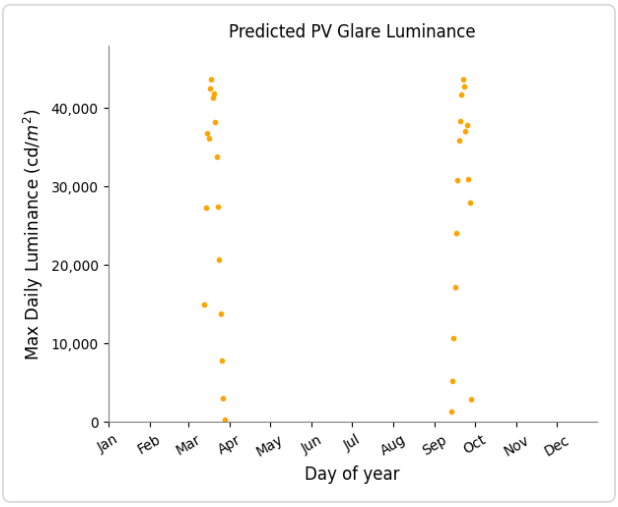
Green glare: 385 min.







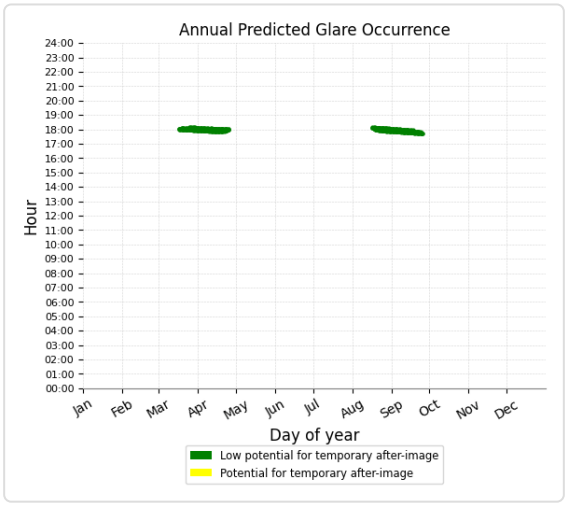


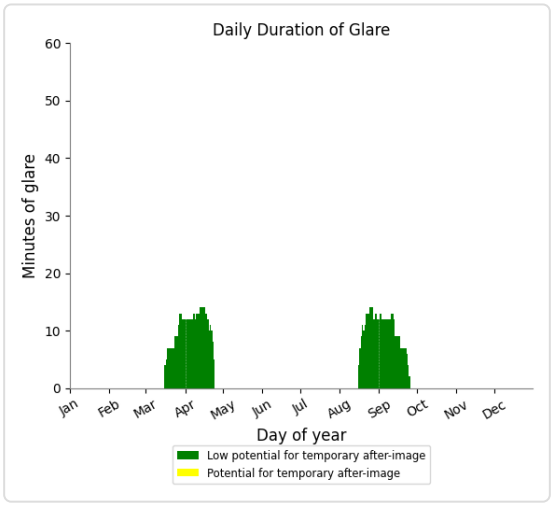


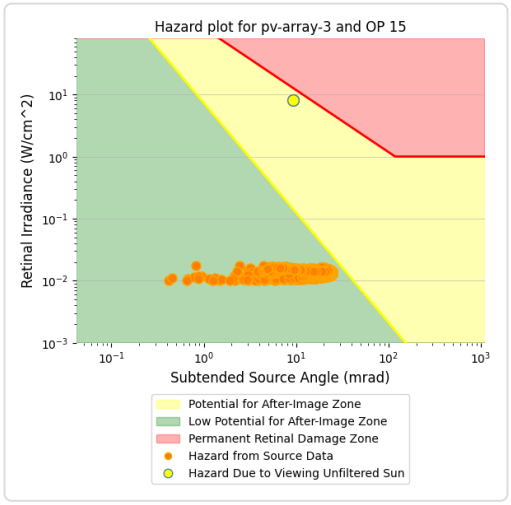
PV array 3 and OP 15

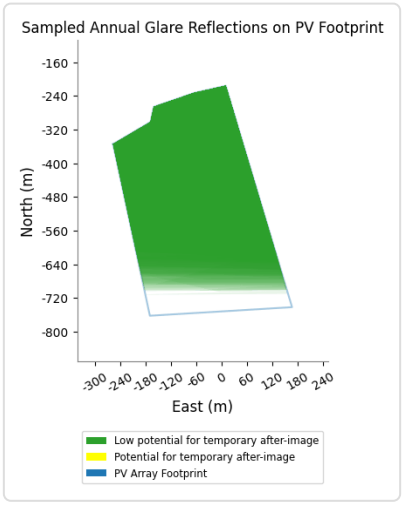
Yellow glare: none

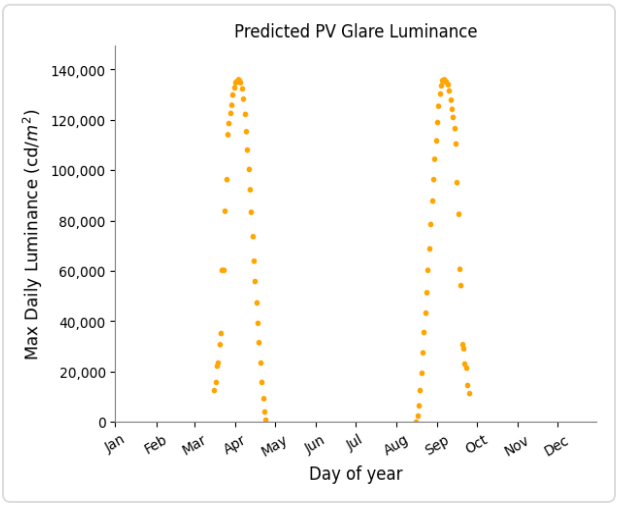
Green glare: 850 min.











PV array 3 and OP 1

No glare found

PV array 3 and OP 2

No glare found

PV array 3 and OP 3

No glare found

PV array 3 and OP 4

No glare found

PV array 3 and OP 5

No glare found

PV array 3 and OP 6

No glare found

PV array 3 and OP 7

No glare found

PV array 3 and OP 9

No glare found

PV array 3 and OP 10

No glare found

PV array 3 and OP 11

No glare found

PV array 3 and OP 12

No glare found

PV array 3 and OP 13

No glare found

PV array 3 and OP 16

No glare found

PV array 3 and OP 17

No glare found

PV array 3 and OP 18

No glare found

PV array 3 and OP 19

No glare found

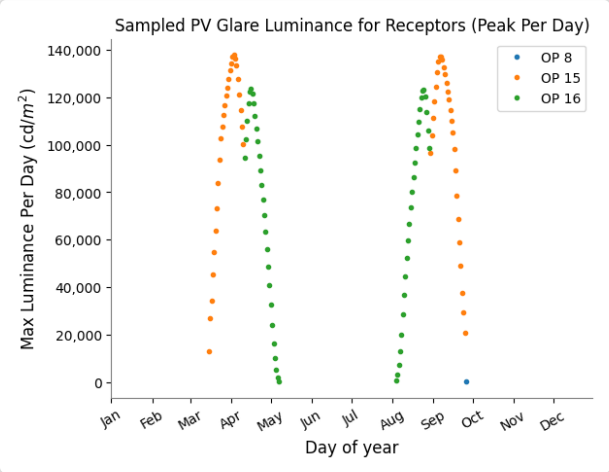
PV array 3 and OP 20

No glare found

PV: PV array 4 low potential for temporary after-image

Receptor results ordered by category of glare

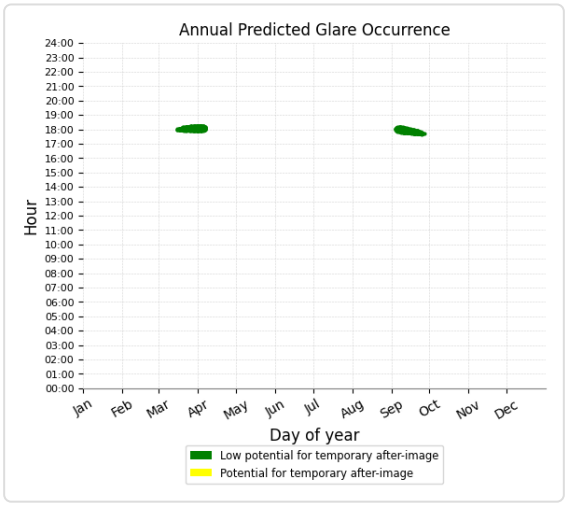
Receptor	Annual Green Glare		Annual Yellow Glare		Peak Luminance
	min	hr	min	hr	cd/m^2
OP 8	704	11.7	0	0.0	63,335
OP 15	1,455	24.2	0	0.0	137,832
OP 16	1,564	26.1	0	0.0	123,445
OP 1	0	0.0	0	0.0	0
OP 2	0	0.0	0	0.0	0
OP 3	0	0.0	0	0.0	0
OP 4	0	0.0	0	0.0	0
OP 5	0	0.0	0	0.0	0
OP 6	0	0.0	0	0.0	0
OP 7	0	0.0	0	0.0	0
OP 9	0	0.0	0	0.0	0
OP 10	0	0.0	0	0.0	0
OP 11	0	0.0	0	0.0	0
OP 12	0	0.0	0	0.0	0
OP 13	0	0.0	0	0.0	0
OP 14	0	0.0	0	0.0	0
OP 17	0	0.0	0	0.0	0
OP 18	0	0.0	0	0.0	0
OP 19	0	0.0	0	0.0	0
OP 20	0	0.0	0	0.0	0

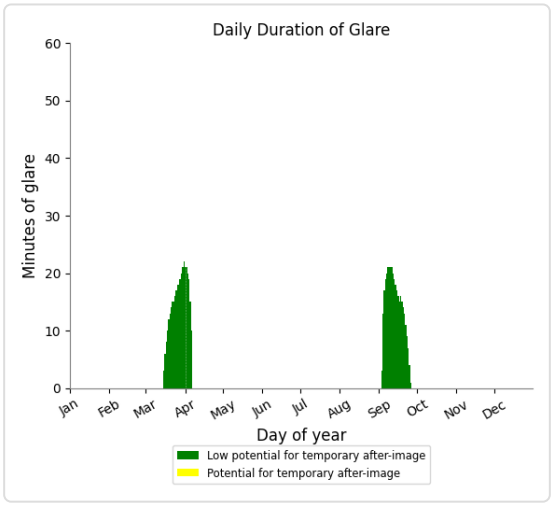


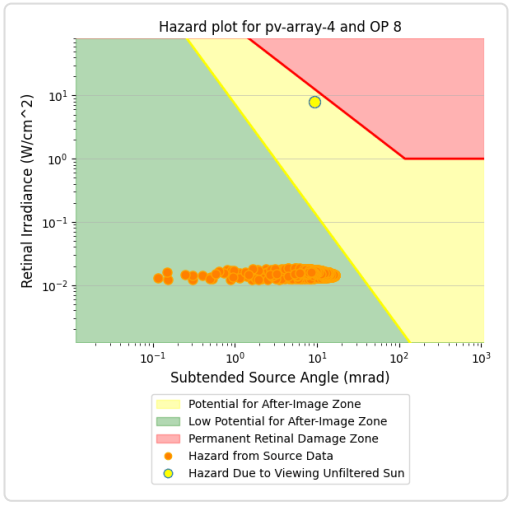
PV array 4 and OP 8

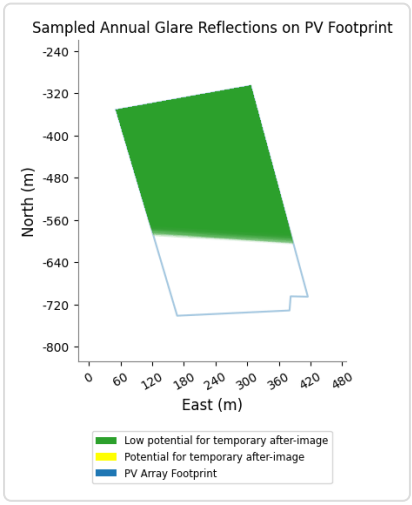
Yellow glare: none

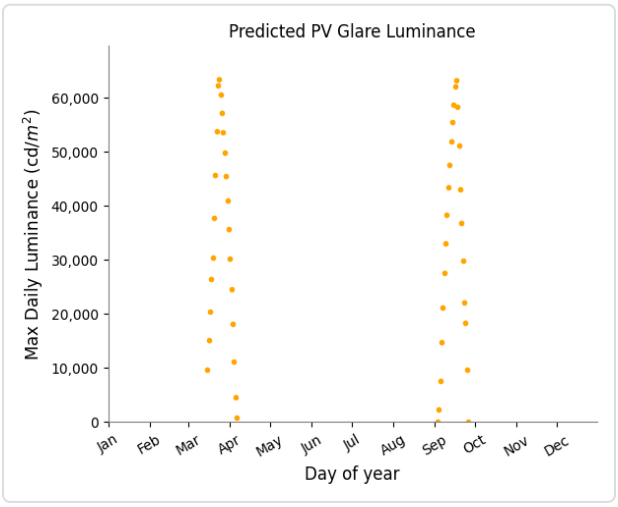
Green glare: 704 min.







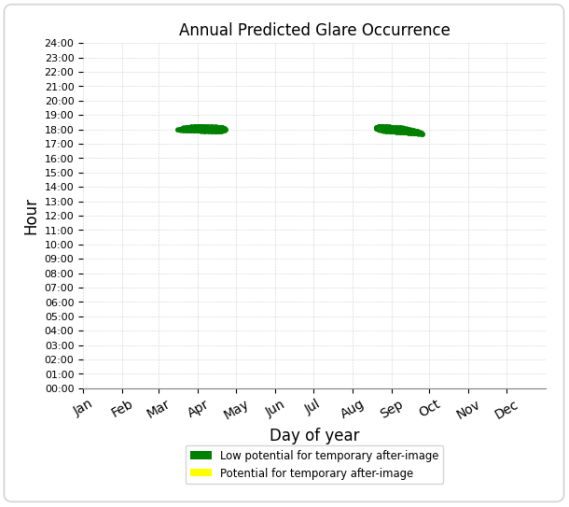


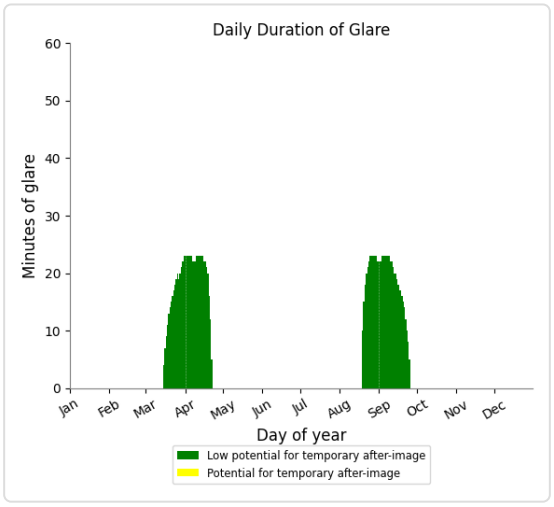


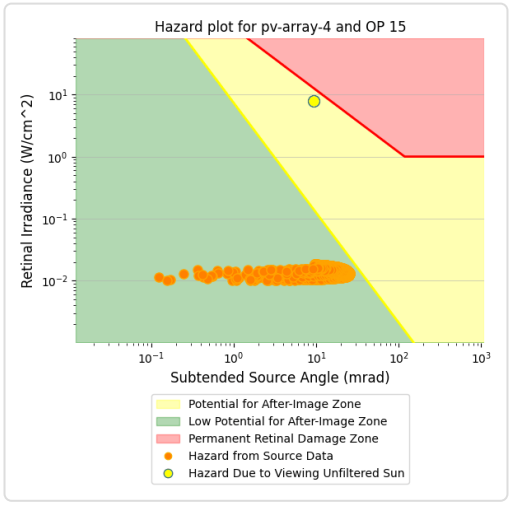
PV array 4 and OP 15

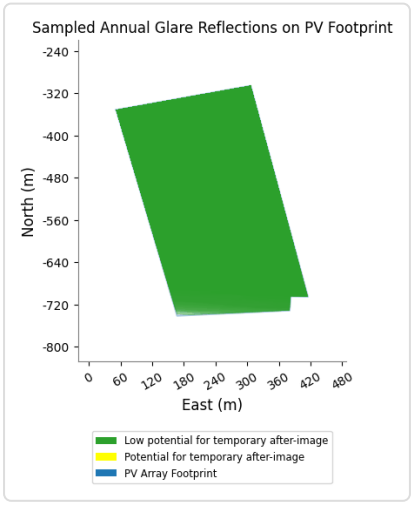
Yellow glare: none

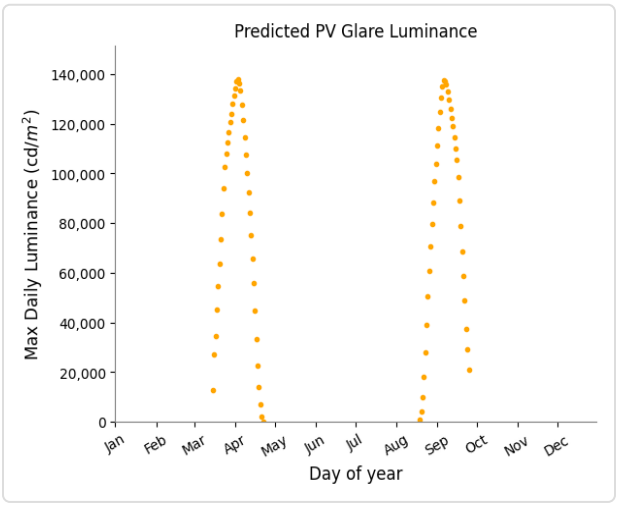
Green glare: 1,455 min.







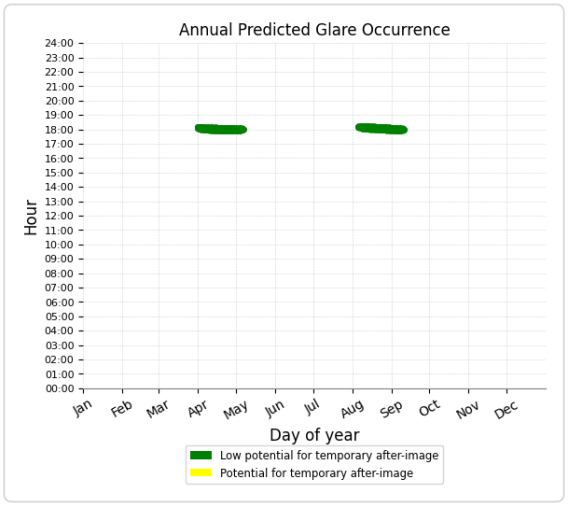


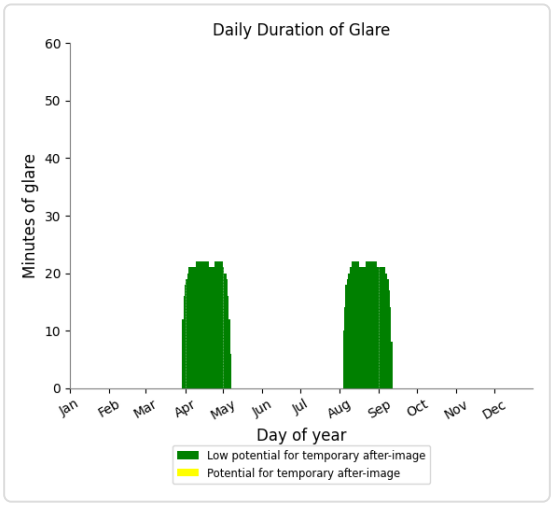


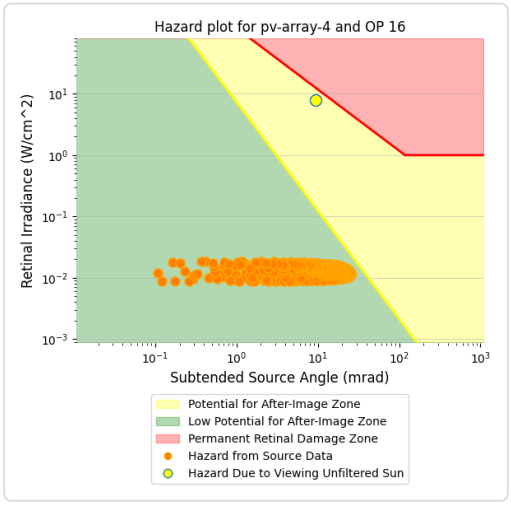
PV array 4 and OP 16

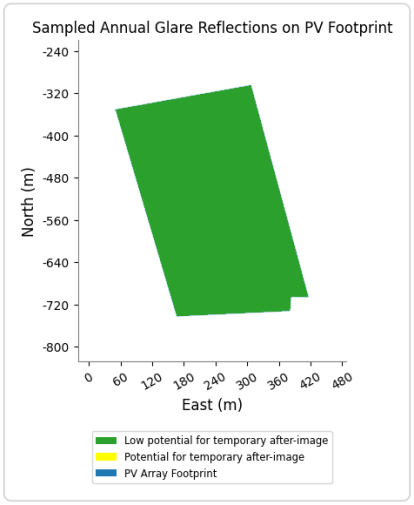
Yellow glare: none

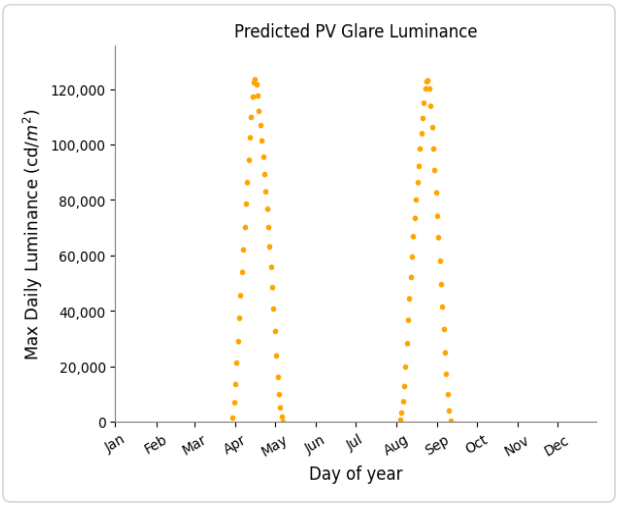
Green glare: 1,564 min.











PV array 4 and OP 1

No glare found

PV array 4 and OP 2

No glare found

PV array 4 and OP 3

No glare found

PV array 4 and OP 4

No glare found

PV array 4 and OP 5

No glare found

PV array 4 and OP 6

No glare found

PV array 4 and OP 7

No glare found

PV array 4 and OP 9

No glare found

PV array 4 and OP 10

No glare found

PV array 4 and OP 11

No glare found

PV array 4 and OP 12

No glare found

PV array 4 and OP 13

No glare found

PV array 4 and OP 14

No glare found

PV array 4 and OP 17

No glare found

PV array 4 and OP 18

No glare found

PV array 4 and OP 19

No glare found

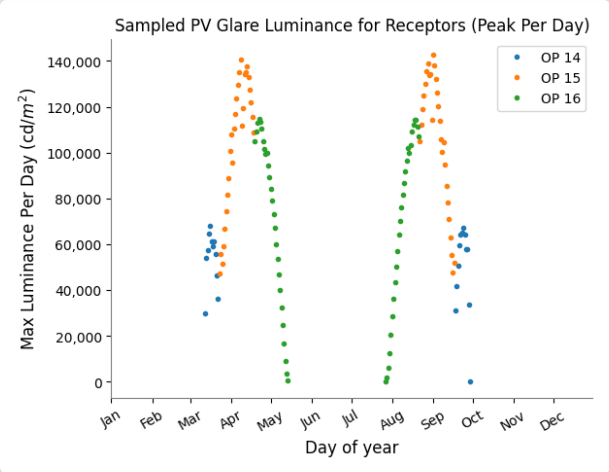
PV array 4 and OP 20

No glare found

PV: PV array 5 low potential for temporary after-image

Receptor results ordered by category of glare

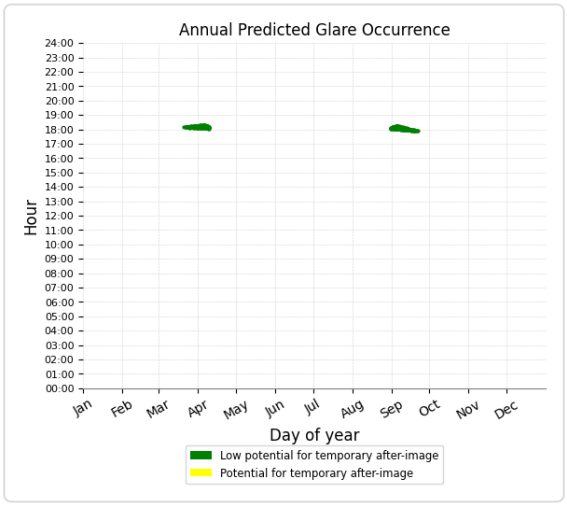
Receptor	Annual Green Glare		Annual Yellow Glare		Peak Luminance
	min	hr	min	hr	cd/m^2
OP 8	319	5.3	0	0.0	53,336
OP 14	225	3.8	0	0.0	68,226
OP 15	722	12.0	0	0.0	142,537
OP 16	922	15.4	0	0.0	114,490
OP 1	0	0.0	0	0.0	0
OP 2	0	0.0	0	0.0	0
OP 3	0	0.0	0	0.0	0
OP 4	0	0.0	0	0.0	0
OP 5	0	0.0	0	0.0	0
OP 6	0	0.0	0	0.0	0
OP 7	0	0.0	0	0.0	0
OP 9	0	0.0	0	0.0	0
OP 10	0	0.0	0	0.0	0
OP 11	0	0.0	0	0.0	0
OP 12	0	0.0	0	0.0	0
OP 13	0	0.0	0	0.0	0
OP 17	0	0.0	0	0.0	0
OP 18	0	0.0	0	0.0	0
OP 19	0	0.0	0	0.0	0
OP 20	0	0.0	0	0.0	0

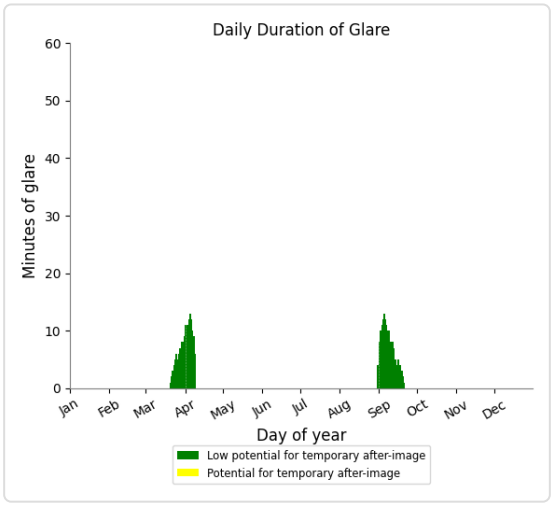


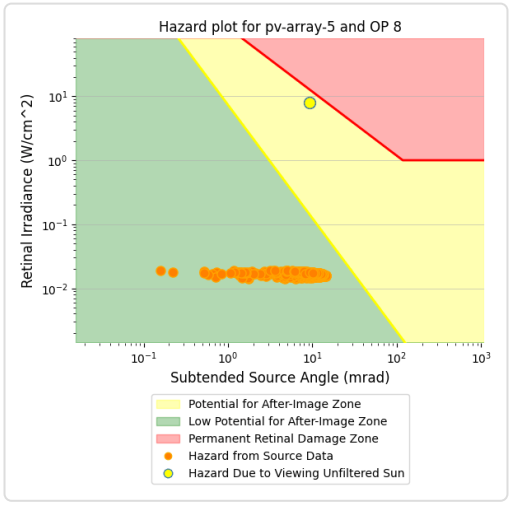
PV array 5 and OP 8

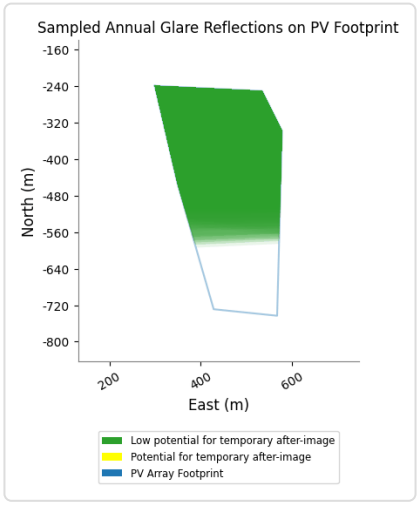
Yellow glare: none

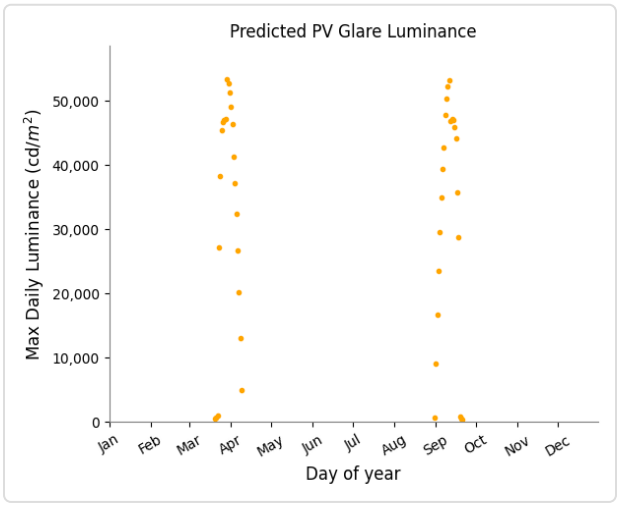
Green glare: 319 min.







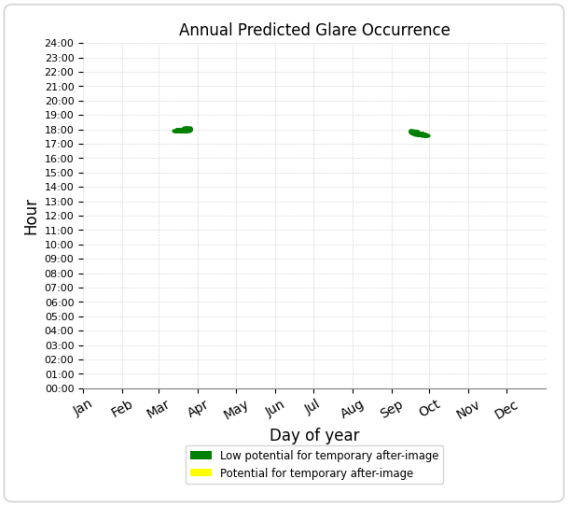


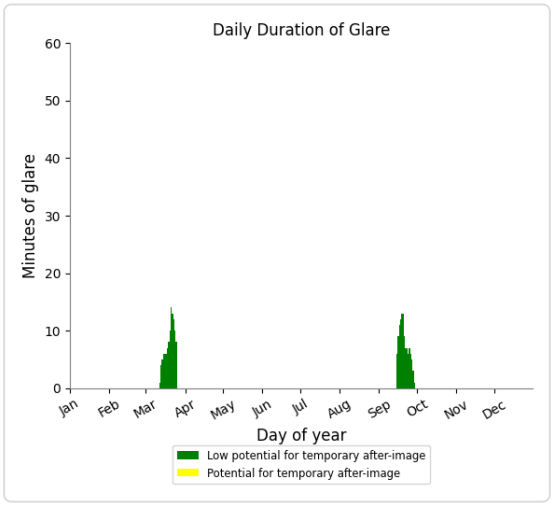


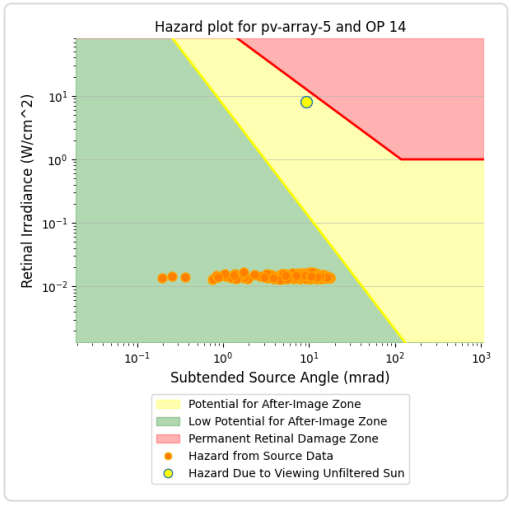
PV array 5 and OP 14

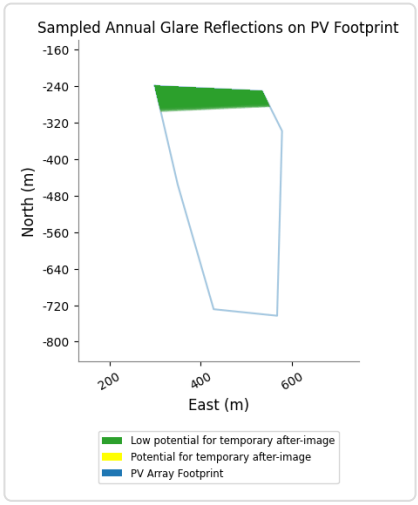
Yellow glare: none

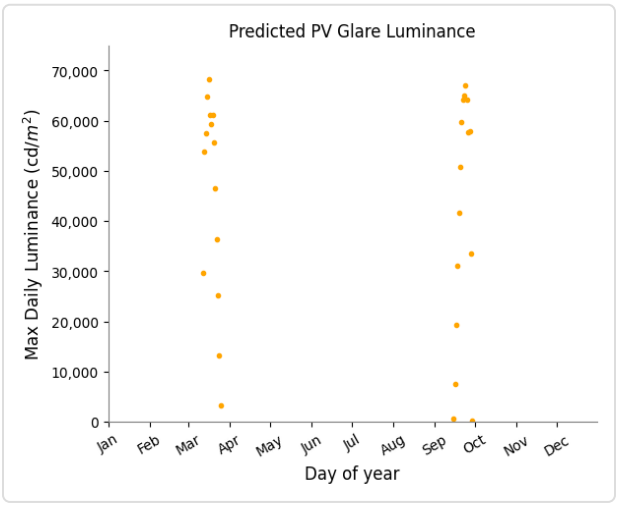
Green glare: 225 min.







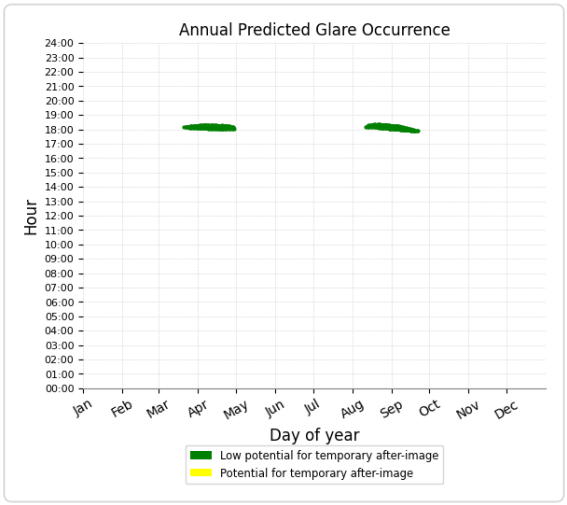


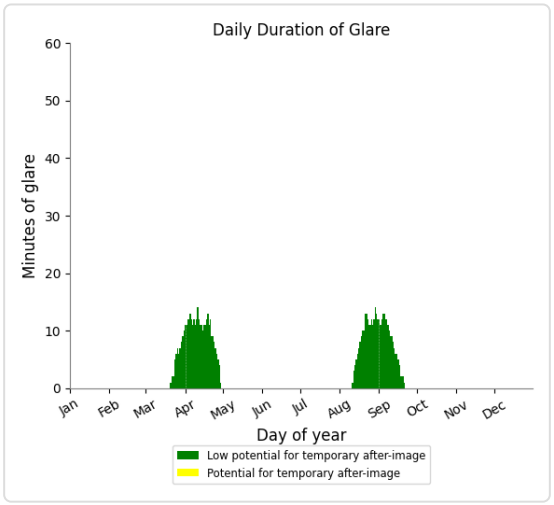


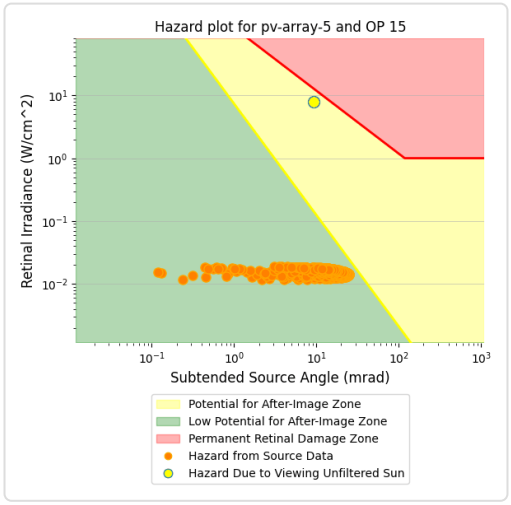
PV array 5 and OP 15

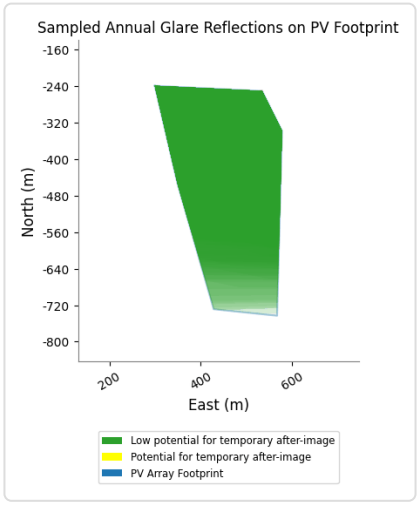
Yellow glare: none

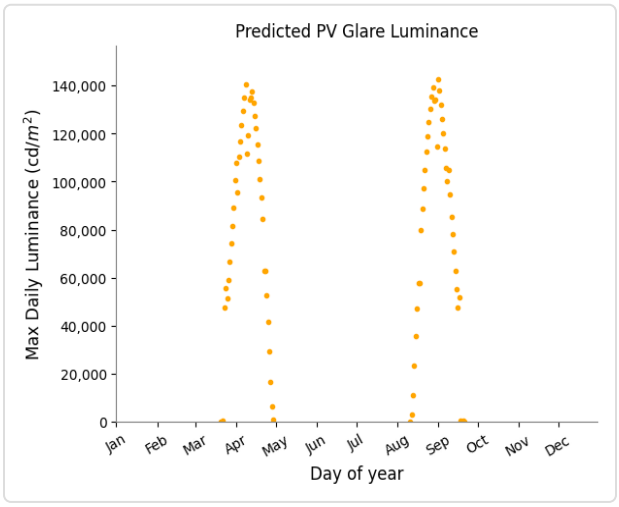
Green glare: 722 min.







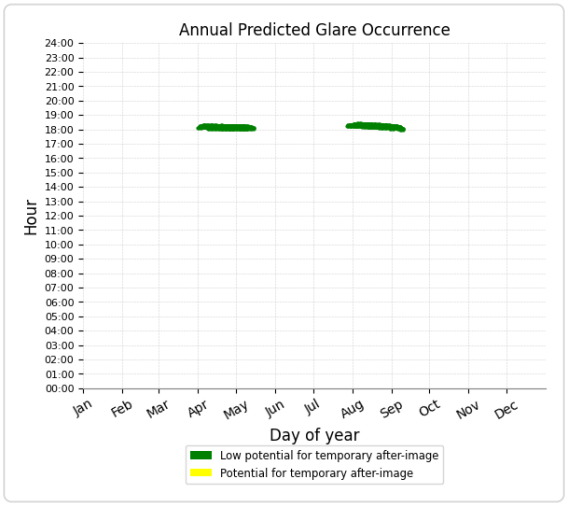


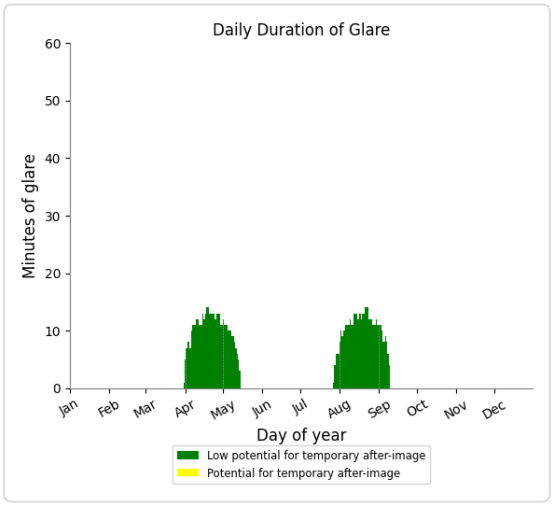


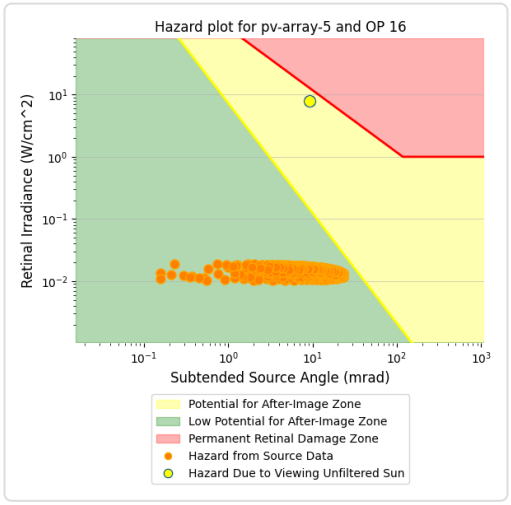
PV array 5 and OP 16

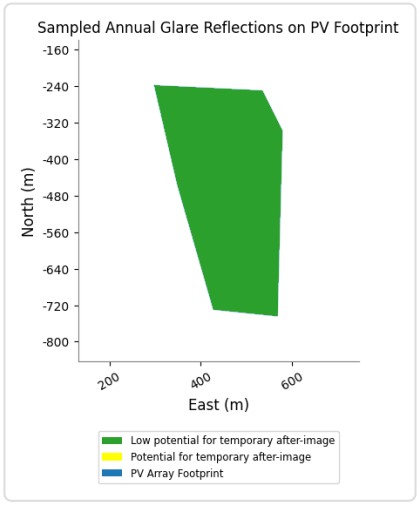
Yellow glare: none

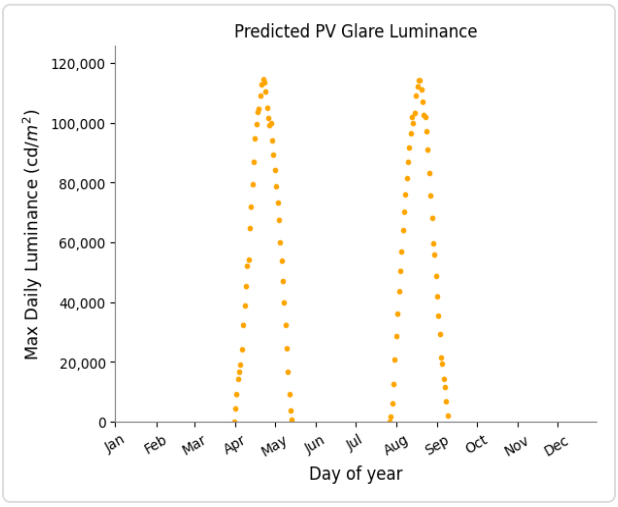
Green glare: 922 min.











PV array 5 and OP 1

No glare found

PV array 5 and OP 2

No glare found

PV array 5 and OP 3

No glare found

PV array 5 and OP 4

No glare found

PV array 5 and OP 5

No glare found

PV array 5 and OP 6

No glare found

PV array 5 and OP 7

No glare found

PV array 5 and OP 9

No glare found

PV array 5 and OP 10

No glare found

PV array 5 and OP 11

No glare found

PV array 5 and OP 12

No glare found

PV array 5 and OP 13

No glare found

PV array 5 and OP 17

No glare found

PV array 5 and OP 18

No glare found

PV array 5 and OP 19

No glare found

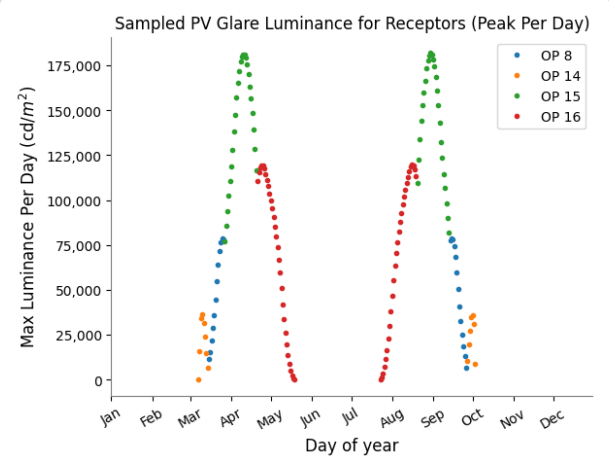
PV array 5 and OP 20

No glare found

PV: PV array 6 low potential for temporary after-image

Receptor results ordered by category of glare

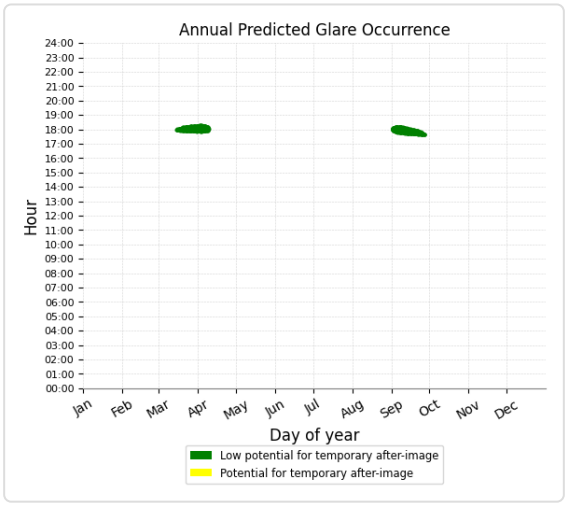
Receptor	Annual Green Glare		Annual Yellow Glare		Peak Luminance
	min	hr	min	hr	cd/m^2
OP 8	889	14.8	0	0.0	78,899
OP 14	122	2.0	0	0.0	36,513
OP 15	2,250	37.5	0	0.0	181,909
OP 16	2,302	38.4	0	0.0	119,697
OP 1	0	0.0	0	0.0	0
OP 2	0	0.0	0	0.0	0
OP 3	0	0.0	0	0.0	0
OP 4	0	0.0	0	0.0	0
OP 5	0	0.0	0	0.0	0
OP 6	0	0.0	0	0.0	0
OP 7	0	0.0	0	0.0	0
OP 9	0	0.0	0	0.0	0
OP 10	0	0.0	0	0.0	0
OP 11	0	0.0	0	0.0	0
OP 12	0	0.0	0	0.0	0
OP 13	0	0.0	0	0.0	0
OP 17	0	0.0	0	0.0	0
OP 18	0	0.0	0	0.0	0
OP 19	0	0.0	0	0.0	0
OP 20	0	0.0	0	0.0	0

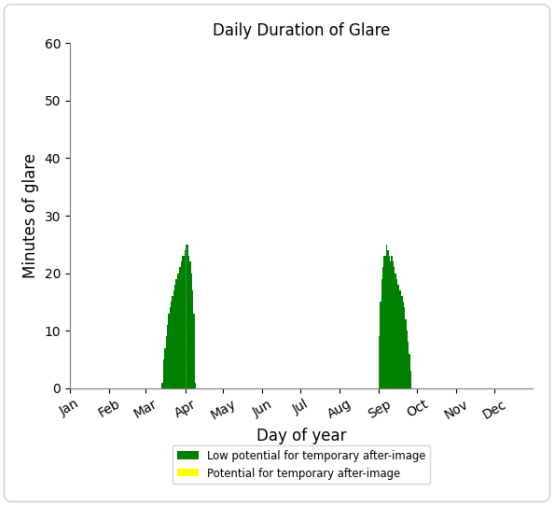


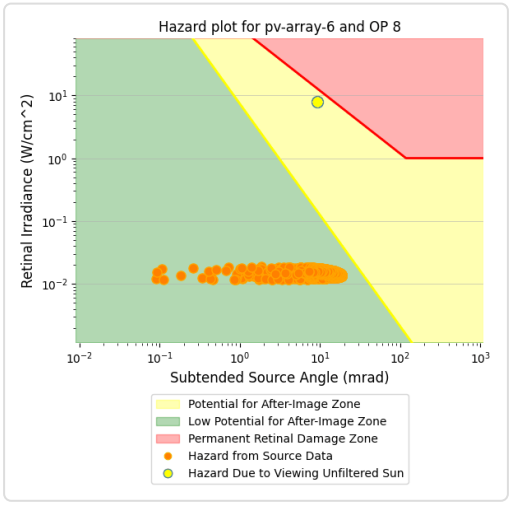
PV array 6 and OP 8

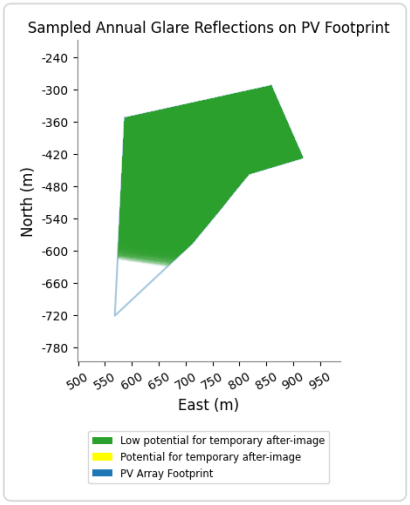
Yellow glare: none

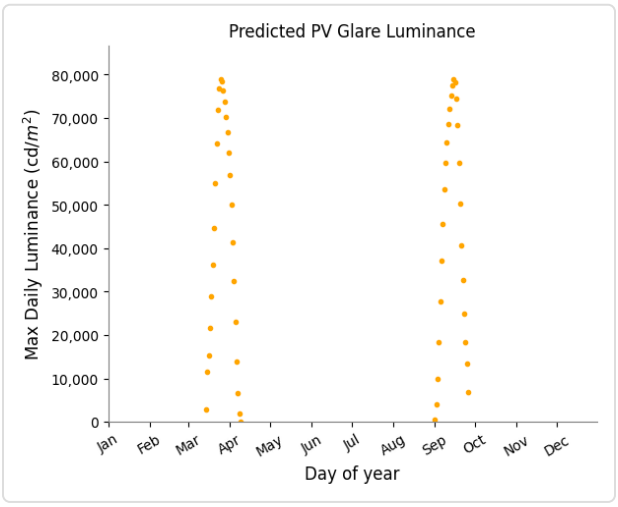
Green glare: 889 min.







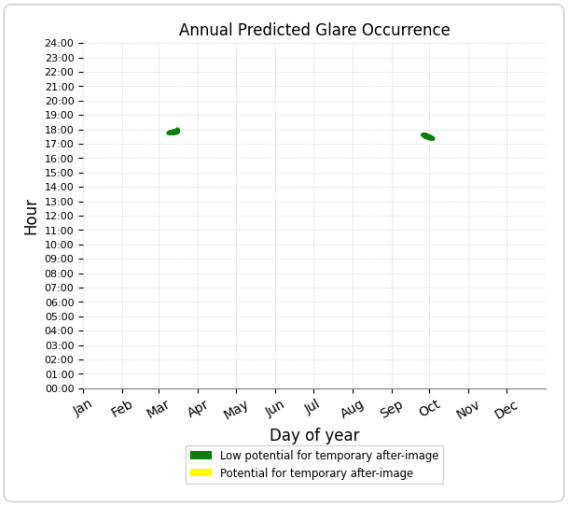


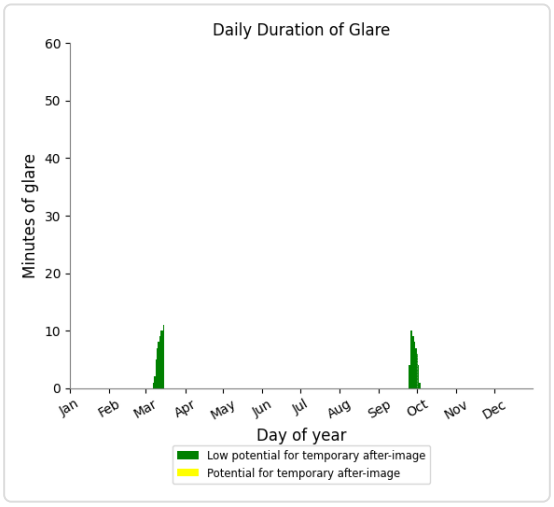


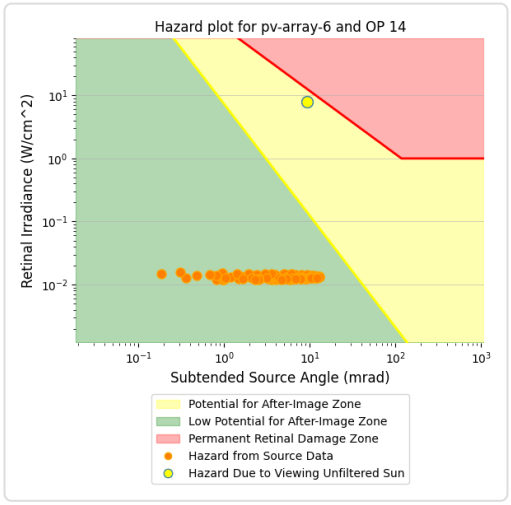
PV array 6 and OP 14

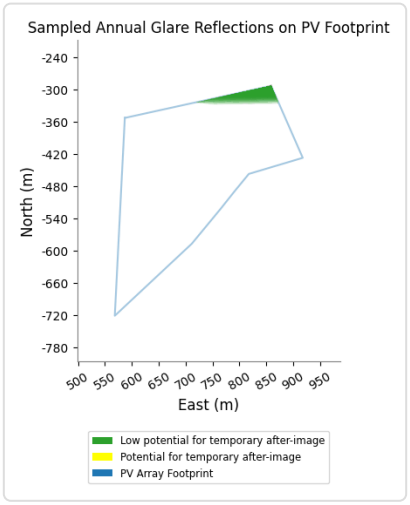
Yellow glare: none

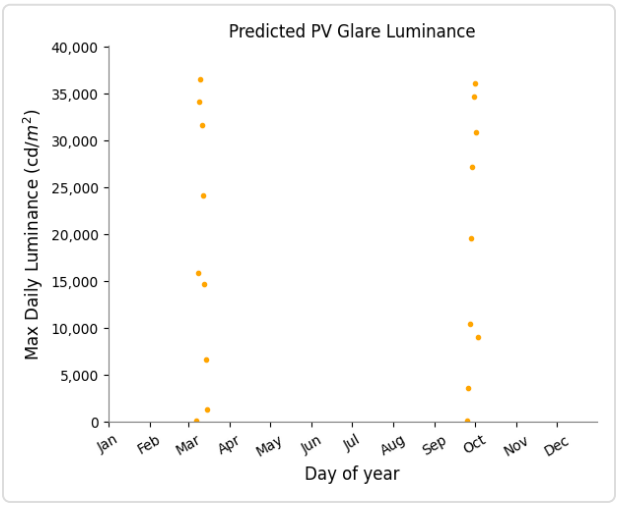
Green glare: 122 min.







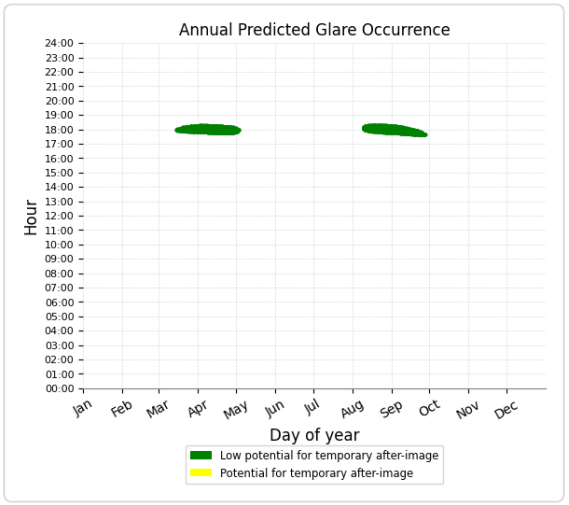


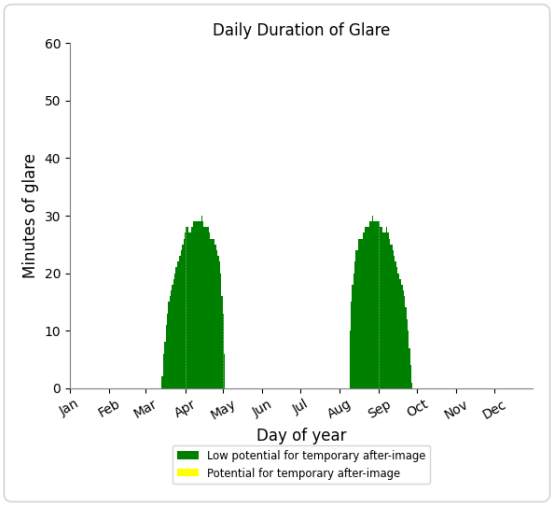


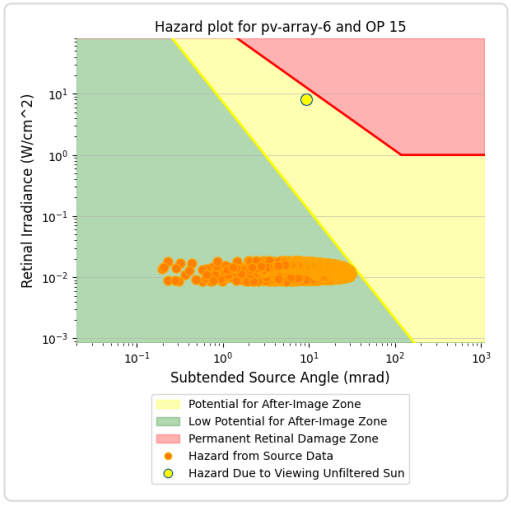
PV array 6 and OP 15

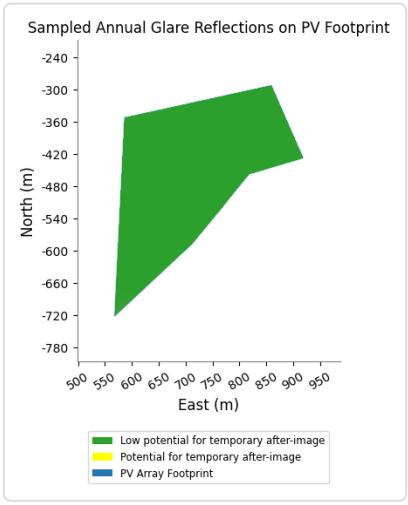
Yellow glare: none

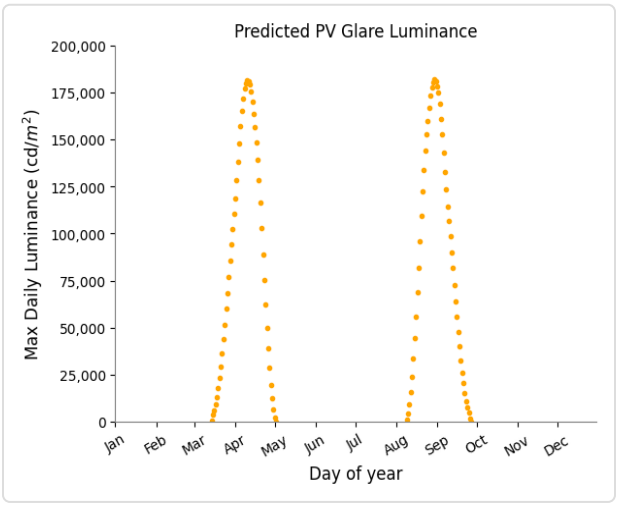
Green glare: 2,250 min.







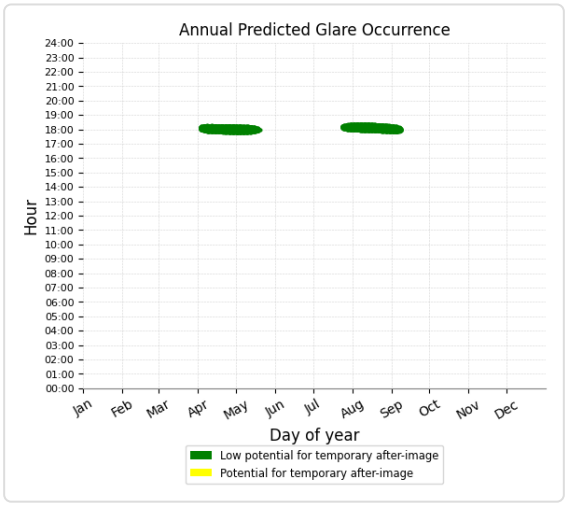


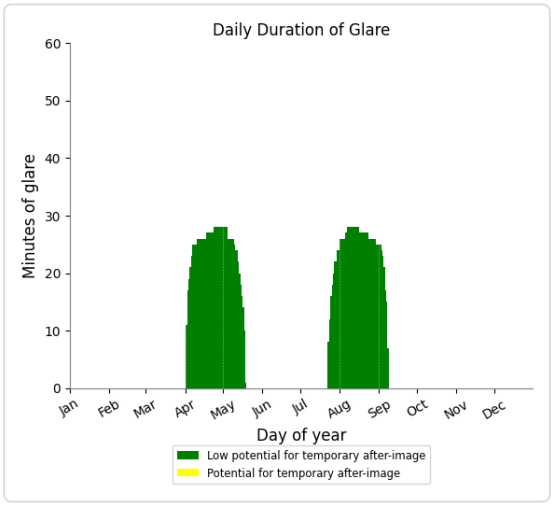


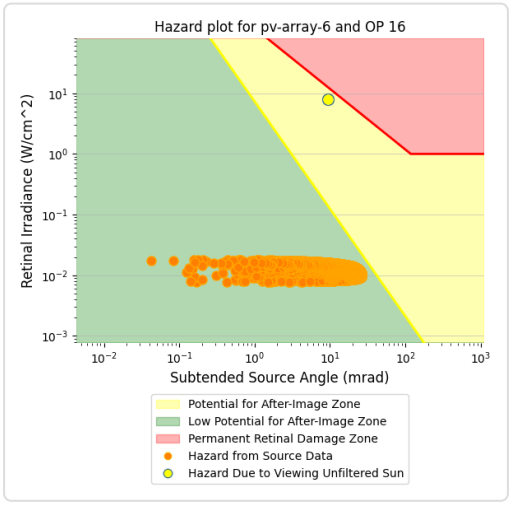
PV array 6 and OP 16

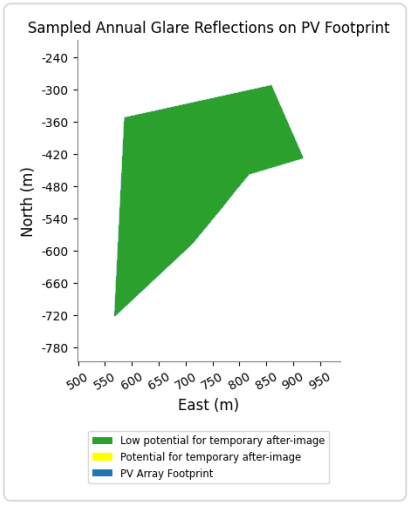
Yellow glare: none

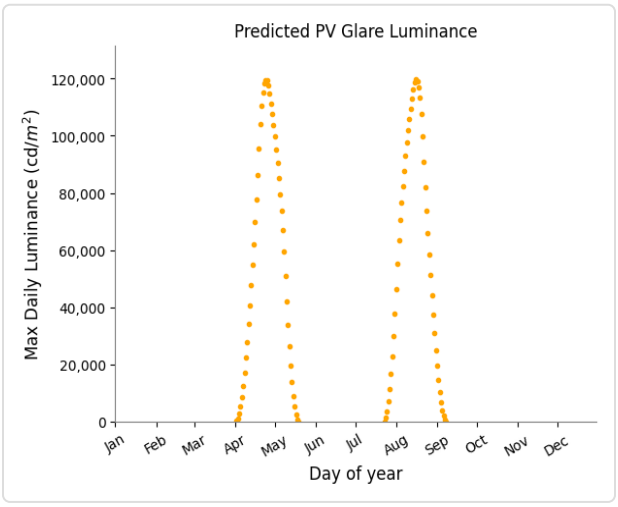
Green glare: 2,302 min.











PV array 6 and OP 1

No glare found

PV array 6 and OP 2

No glare found

PV array 6 and OP 3

No glare found

PV array 6 and OP 4

No glare found

PV array 6 and OP 5

No glare found

PV array 6 and OP 6

No glare found

PV array 6 and OP 7

No glare found

PV array 6 and OP 9

No glare found

PV array 6 and OP 10

No glare found

PV array 6 and OP 11

No glare found

PV array 6 and OP 12

No glare found

PV array 6 and OP 13

No glare found

PV array 6 and OP 17

No glare found

PV array 6 and OP 18

No glare found

PV array 6 and OP 19

No glare found

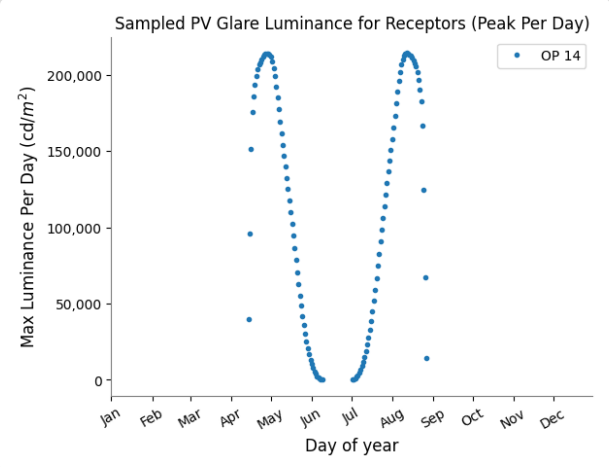
PV array 6 and OP 20

No glare found

PV: PV array 7 low potential for temporary after-image

Receptor results ordered by category of glare

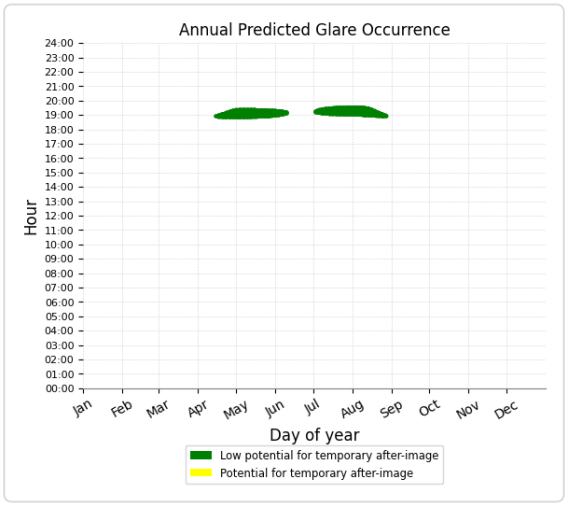
Receptor	Annual Green Glare		Annual Yellow Glare		Peak Luminance
	min	hr	min	hr	cd/m^2
OP 14	2,500	41.7	0	0.0	214,160
OP 15	1,692	28.2	0	0.0	119,119
OP 16	957	15.9	0	0.0	60,947
OP 1	0	0.0	0	0.0	0
OP 2	0	0.0	0	0.0	0
OP 3	0	0.0	0	0.0	0
OP 4	0	0.0	0	0.0	0
OP 5	0	0.0	0	0.0	0
OP 6	0	0.0	0	0.0	0
OP 7	0	0.0	0	0.0	0
OP 8	0	0.0	0	0.0	0
OP 9	0	0.0	0	0.0	0
OP 10	0	0.0	0	0.0	0
OP 11	0	0.0	0	0.0	0
OP 12	0	0.0	0	0.0	0
OP 13	0	0.0	0	0.0	0
OP 17	0	0.0	0	0.0	0
OP 18	0	0.0	0	0.0	0
OP 19	0	0.0	0	0.0	0
OP 20	0	0.0	0	0.0	0

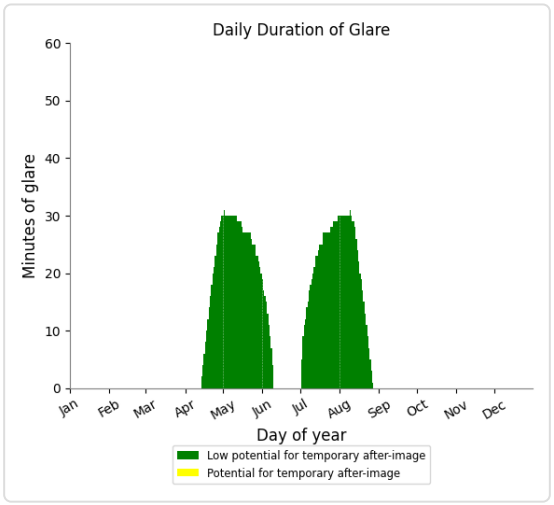


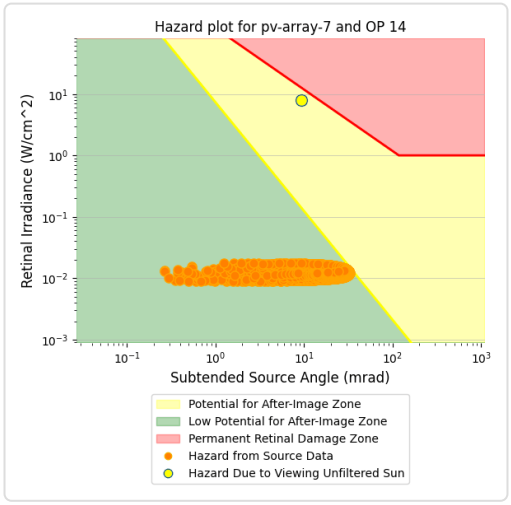
PV array 7 and OP 14

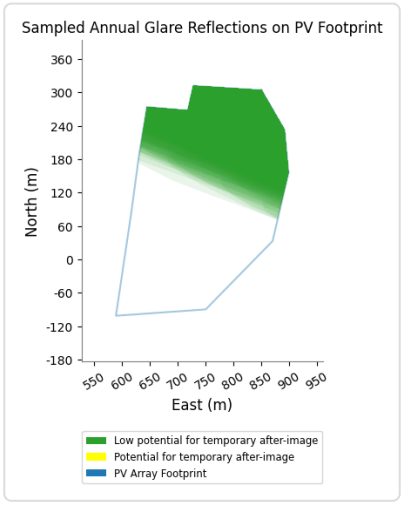
Yellow glare: none

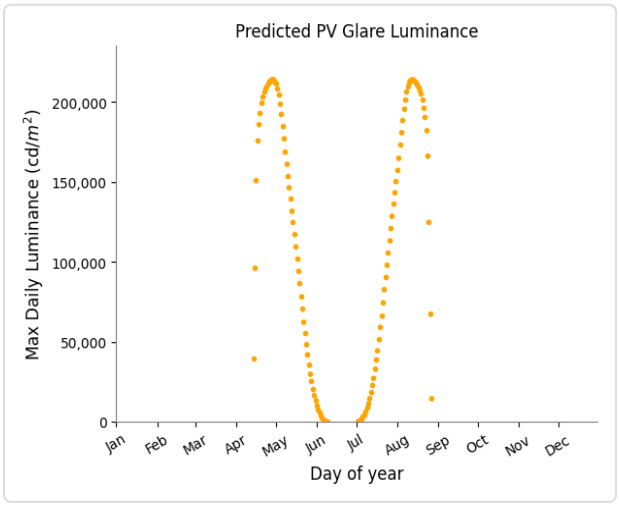
Green glare: 2,500 min.







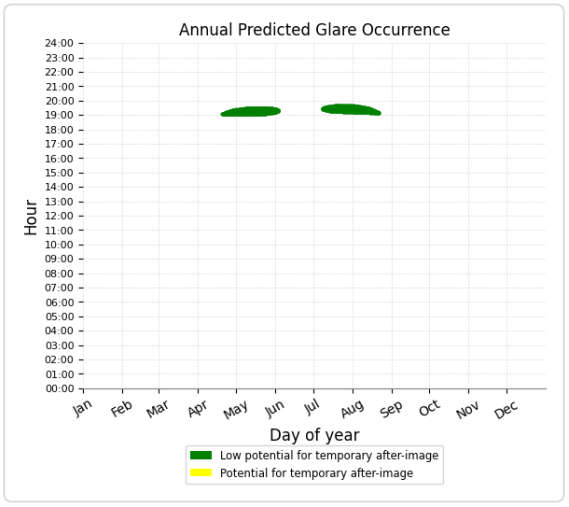


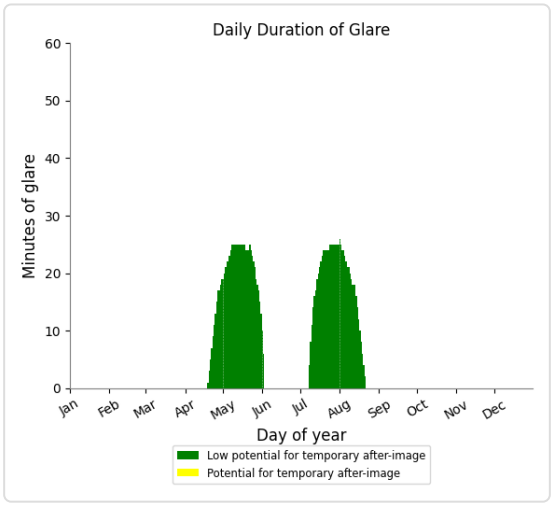


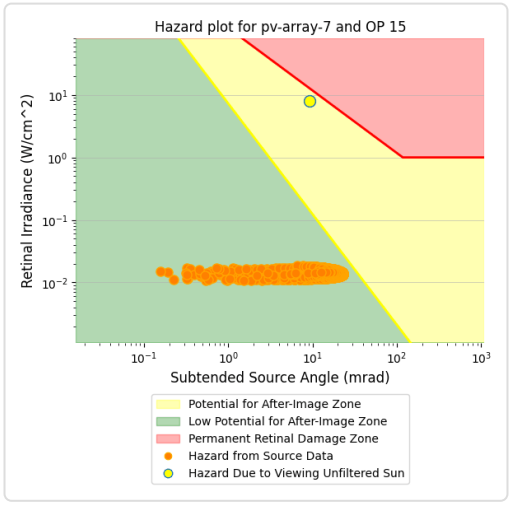
PV array 7 and OP 15

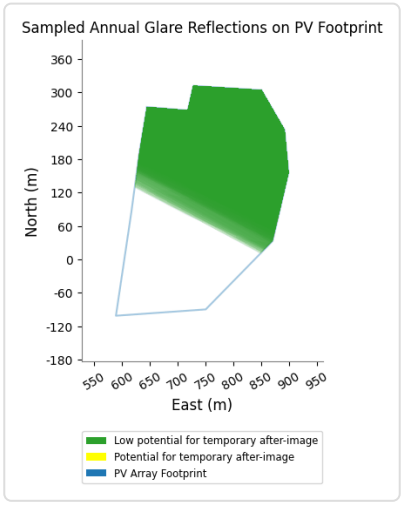
Yellow glare: none

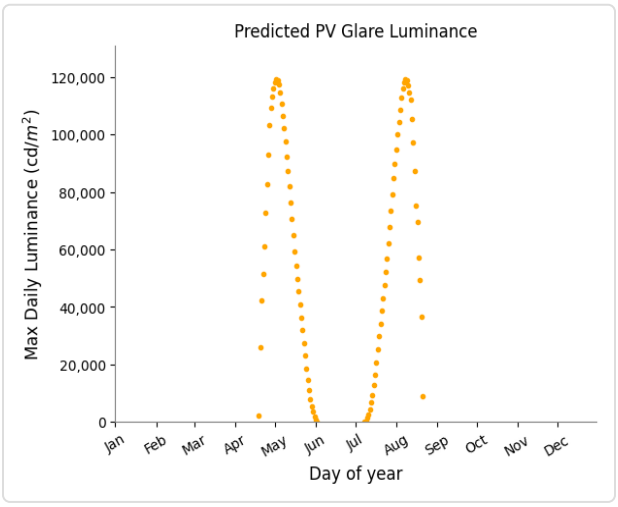
Green glare: 1,692 min.







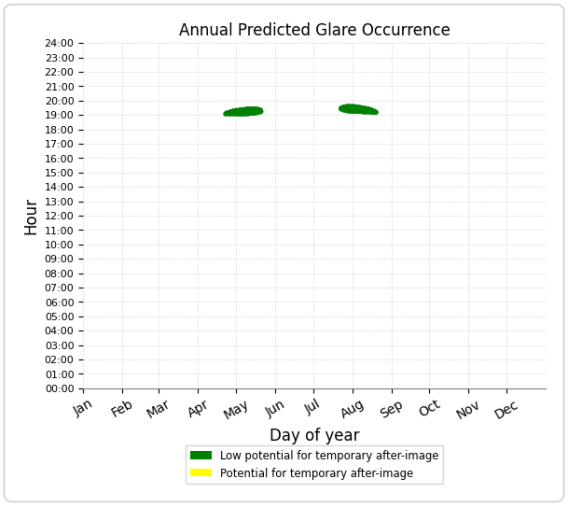


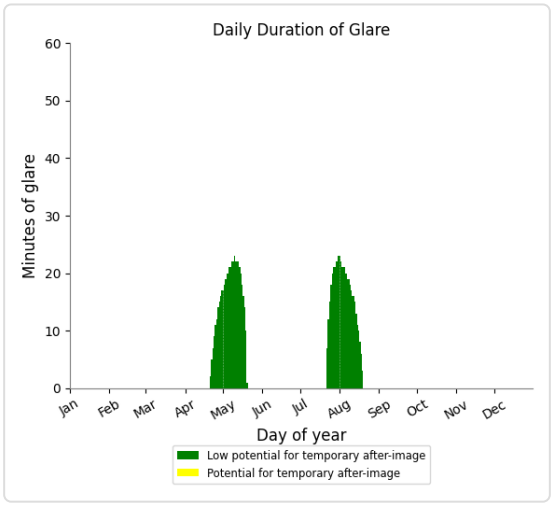


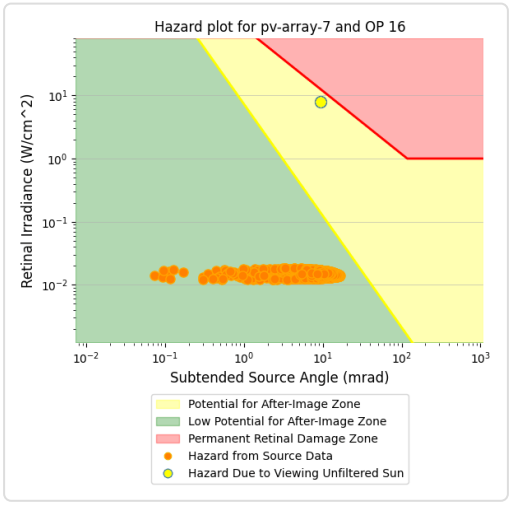
PV array 7 and OP 16

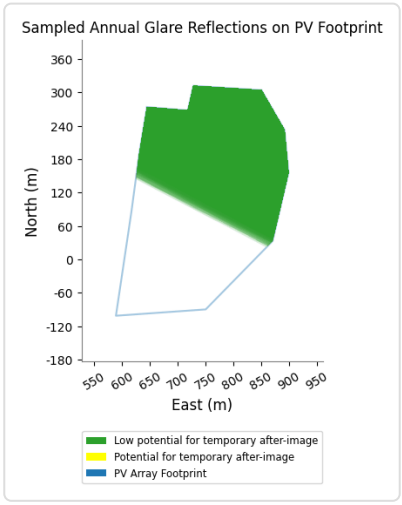
Yellow glare: none

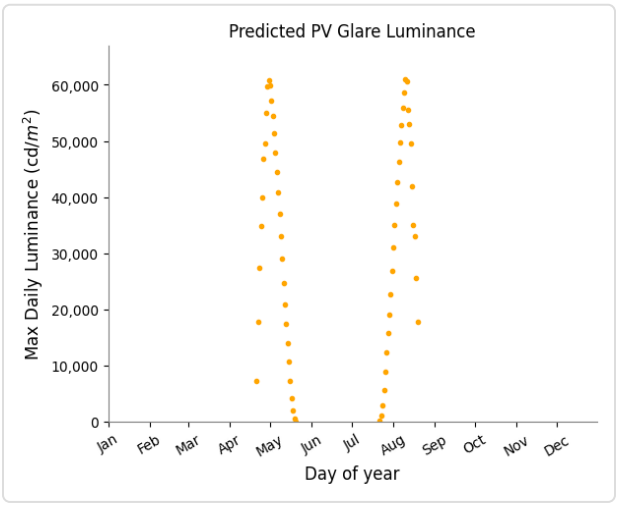
Green glare: 957 min.











PV array 7 and OP 1

No glare found

PV array 7 and OP 2

No glare found

PV array 7 and OP 3

No glare found

PV array 7 and OP 4

No glare found

PV array 7 and OP 5

No glare found

PV array 7 and OP 6

No glare found

PV array 7 and OP 7

No glare found

PV array 7 and OP 8

No glare found

PV array 7 and OP 9

No glare found

PV array 7 and OP 10

No glare found

PV array 7 and OP 11

No glare found

PV array 7 and OP 12

No glare found

PV array 7 and OP 13

No glare found

PV array 7 and OP 17

No glare found

PV array 7 and OP 18

No glare found

PV array 7 and OP 19

No glare found

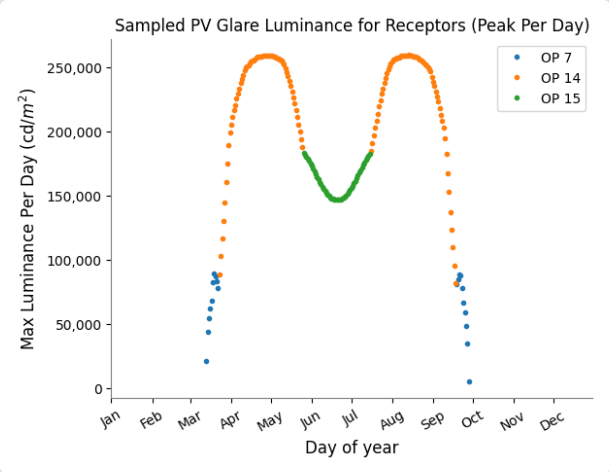
PV array 7 and OP 20

No glare found

PV: PV array 8 low potential for temporary after-image

Receptor results ordered by category of glare

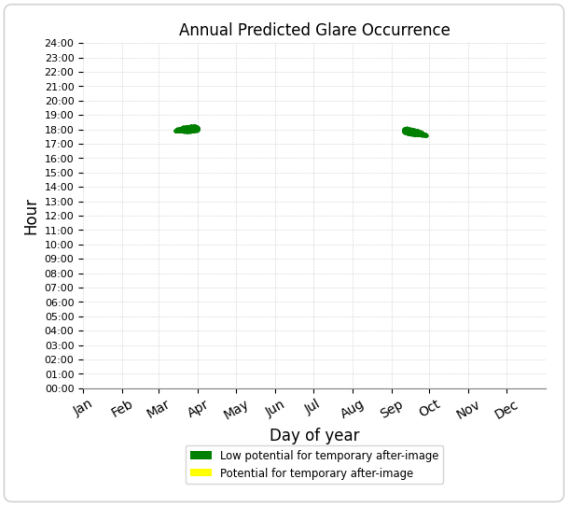
Receptor	Annual Green Glare		Annual Yellow Glare		Peak Luminance
	min	hr	min	hr	cd/m^2
OP 7	572	9.5	0	0.0	89,552
OP 8	1,615	26.9	0	0.0	125,561
OP 14	5,073	84.5	0	0.0	259,668
OP 15	2,745	45.8	0	0.0	187,836
OP 16	2,205	36.8	0	0.0	137,459
OP 17	664	11.1	0	0.0	44,011
OP 1	0	0.0	0	0.0	0
OP 2	0	0.0	0	0.0	0
OP 3	0	0.0	0	0.0	0
OP 4	0	0.0	0	0.0	0
OP 5	0	0.0	0	0.0	0
OP 6	0	0.0	0	0.0	0
OP 9	0	0.0	0	0.0	0
OP 10	0	0.0	0	0.0	0
OP 11	0	0.0	0	0.0	0
OP 12	0	0.0	0	0.0	0
OP 13	0	0.0	0	0.0	0
OP 18	0	0.0	0	0.0	0
OP 19	0	0.0	0	0.0	0
OP 20	0	0.0	0	0.0	0

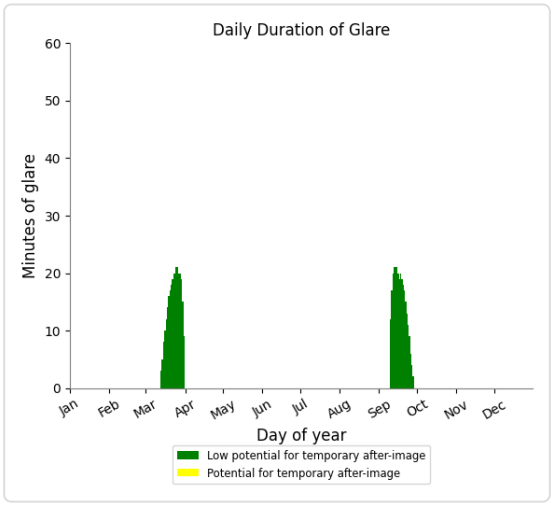


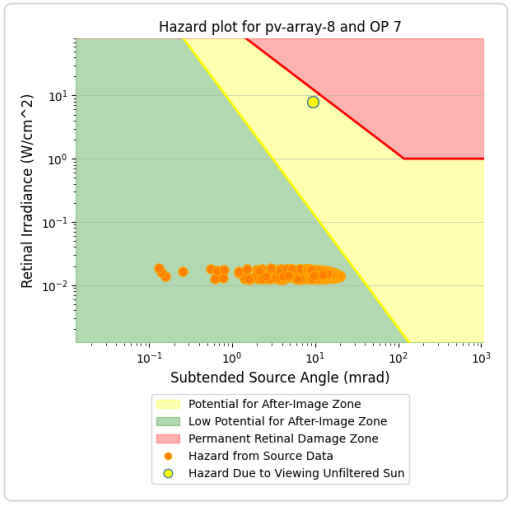
PV array 8 and OP 7

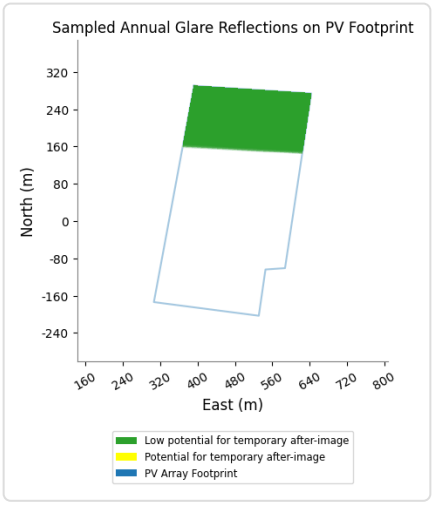
Yellow glare: none

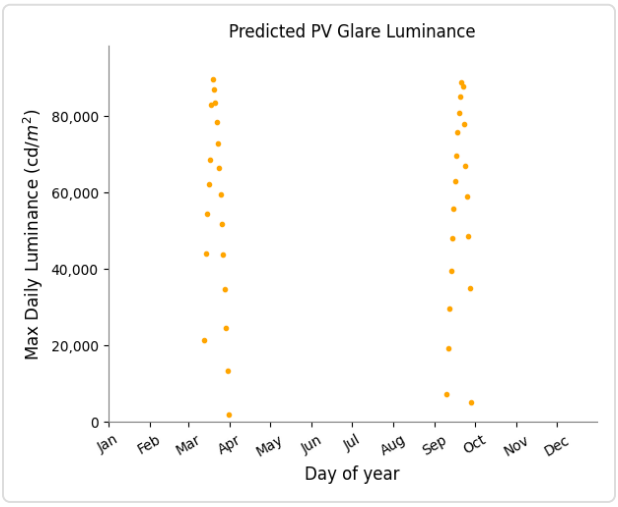
Green glare: 572 min.







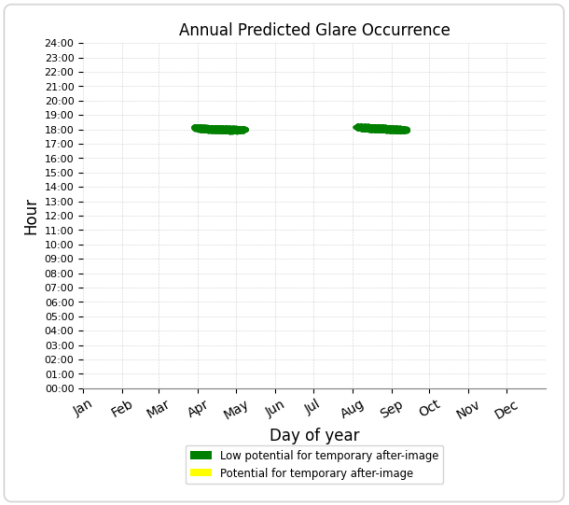


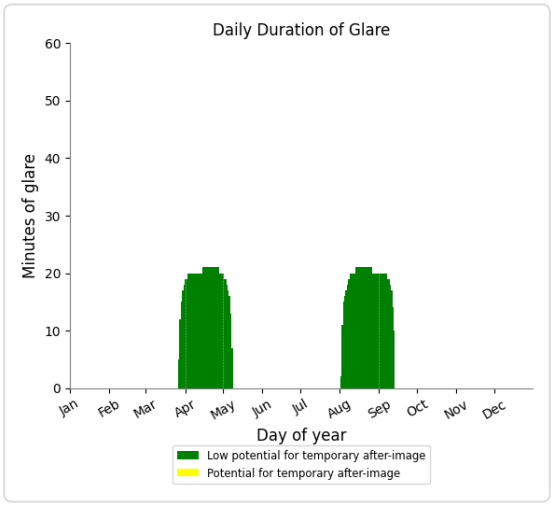


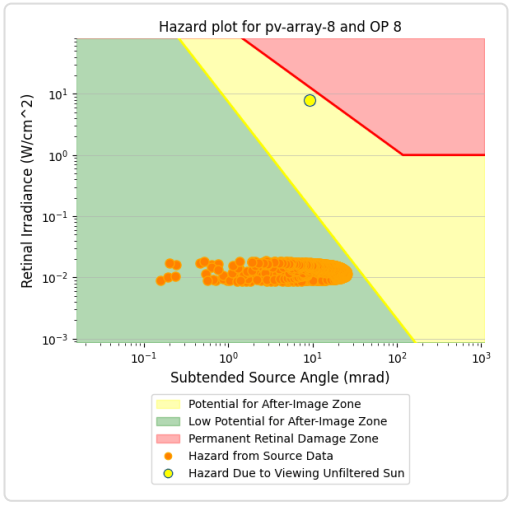
PV array 8 and OP 8

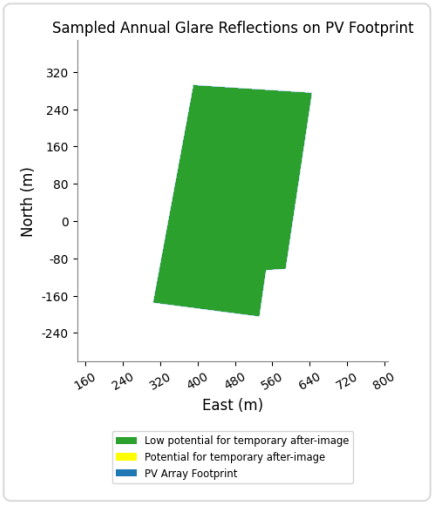
Yellow glare: none

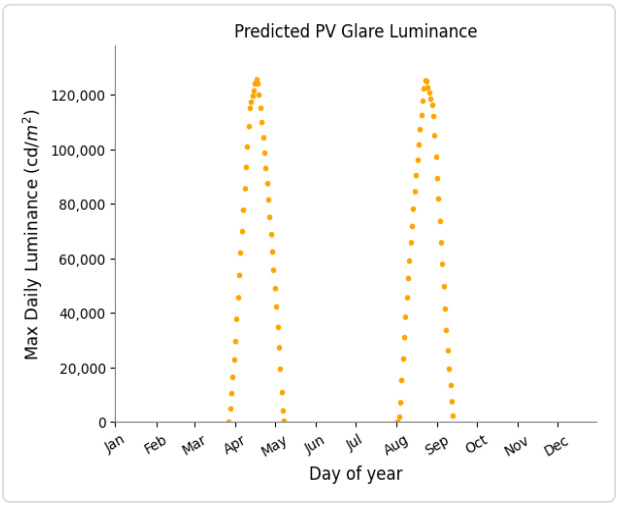
Green glare: 1,615 min.







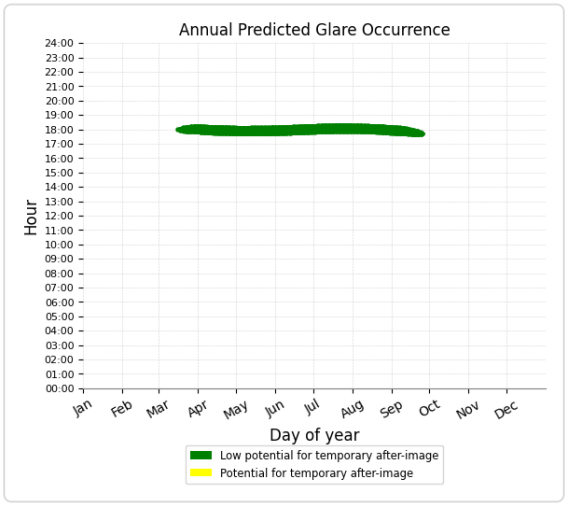


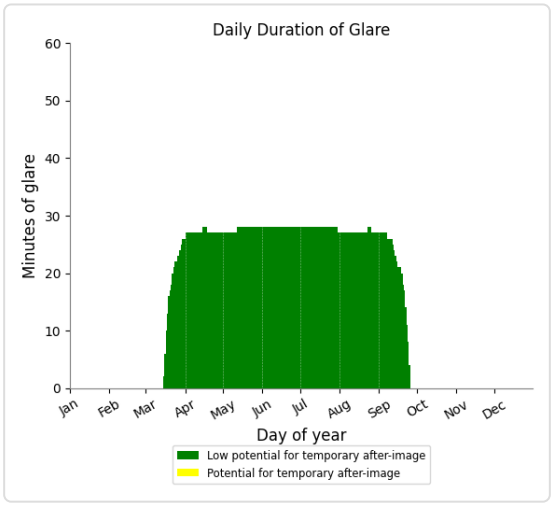


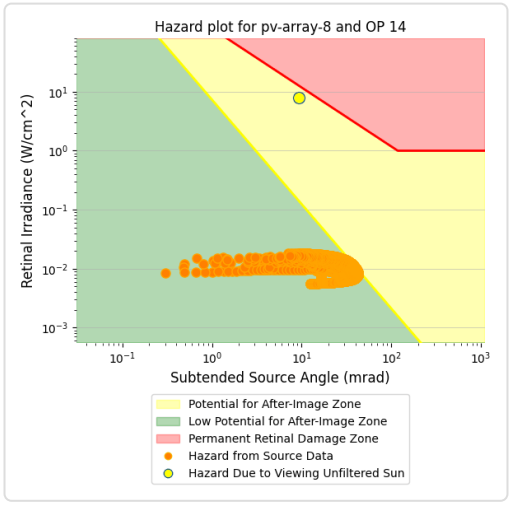
PV array 8 and OP 14

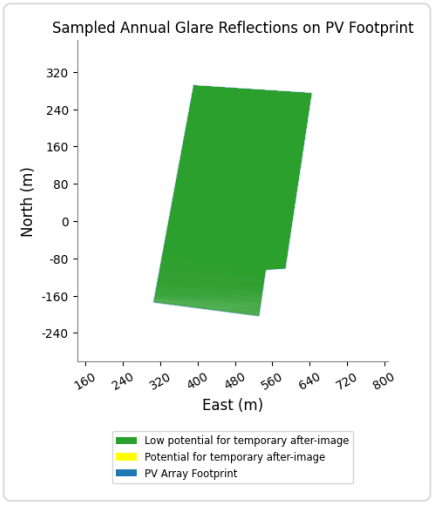
Yellow glare: none

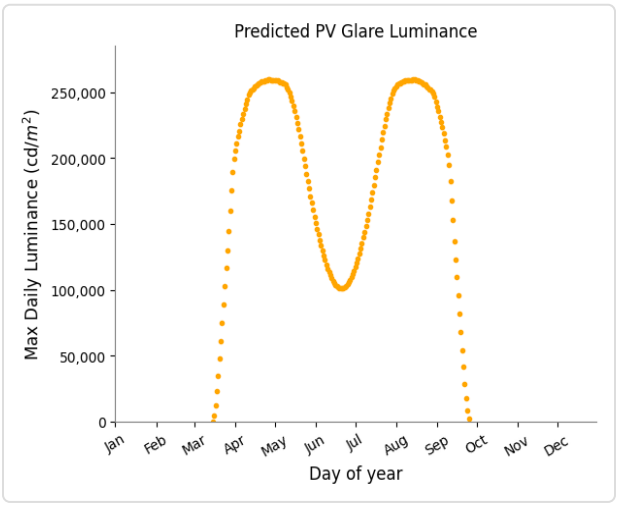
Green glare: 5,073 min.







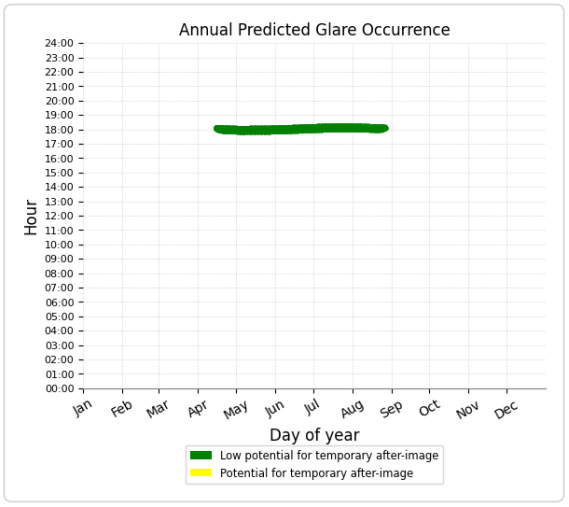


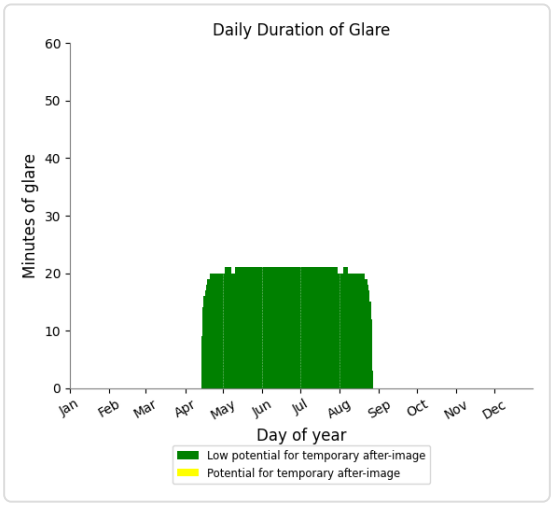


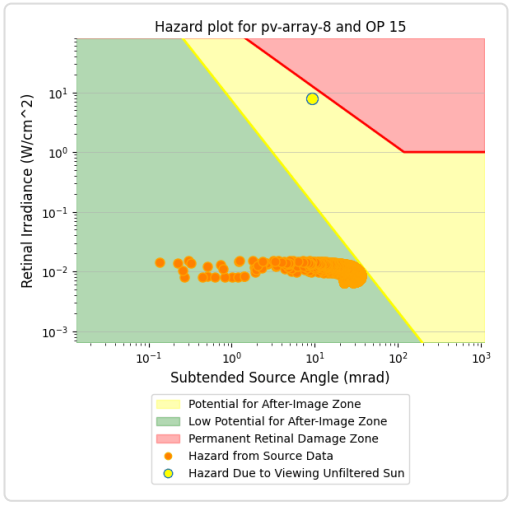
PV array 8 and OP 15

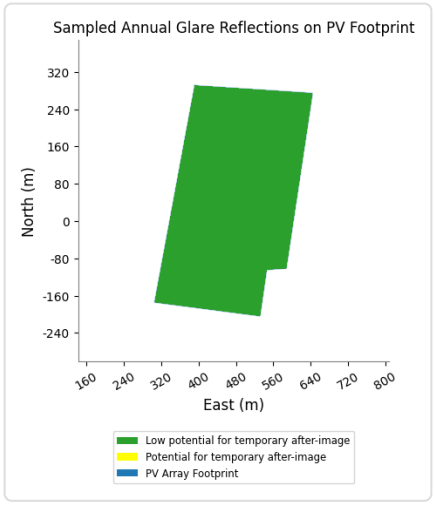
Yellow glare: none

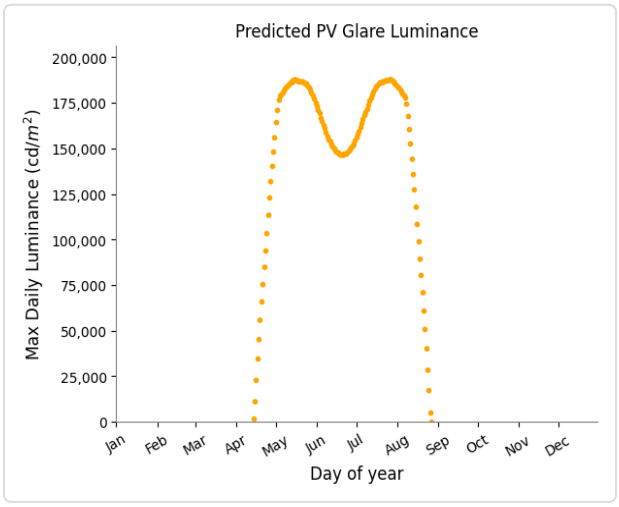
Green glare: 2,745 min.







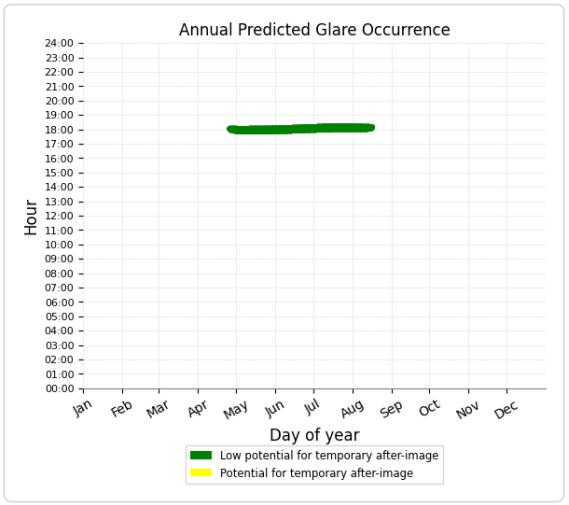


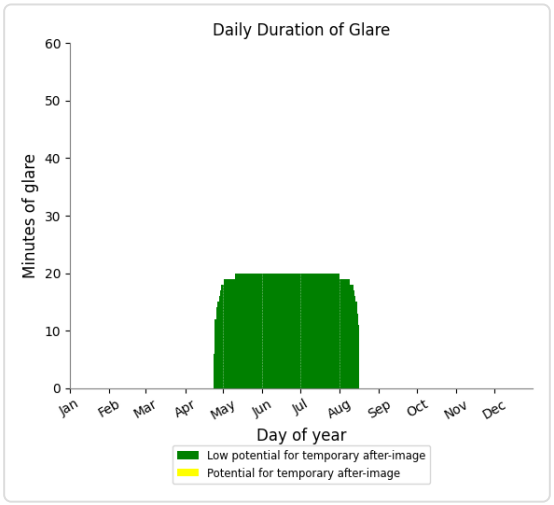


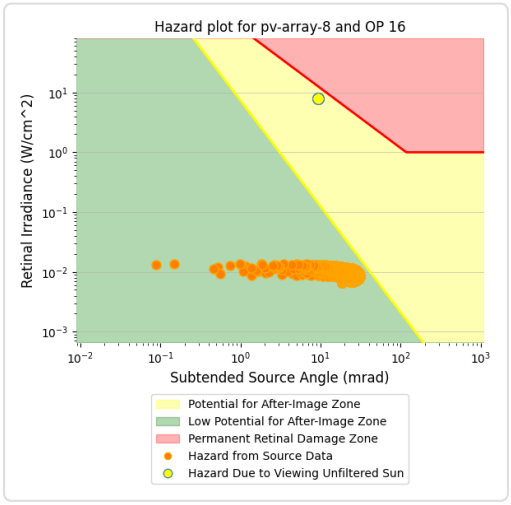
PV array 8 and OP 16

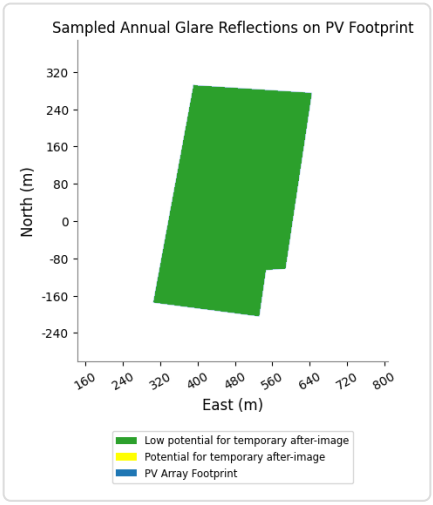
Yellow glare: none

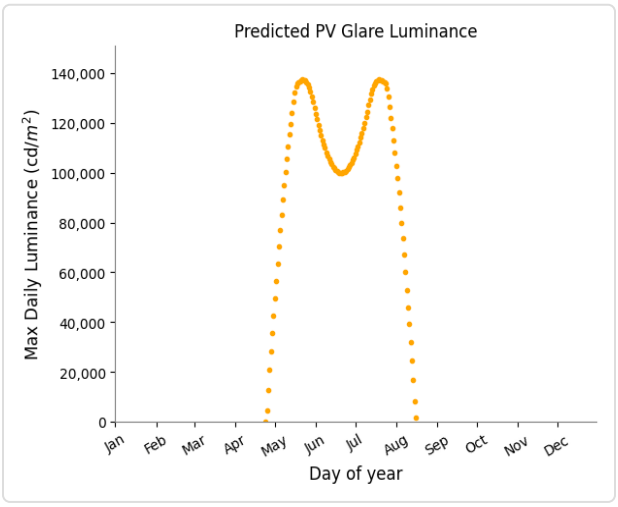
Green glare: 2,205 min.







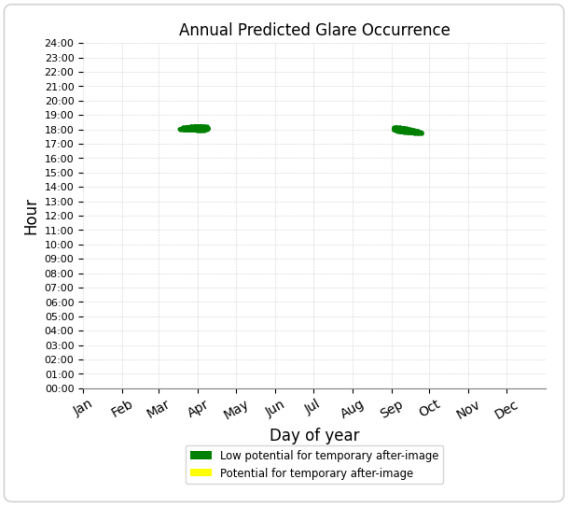


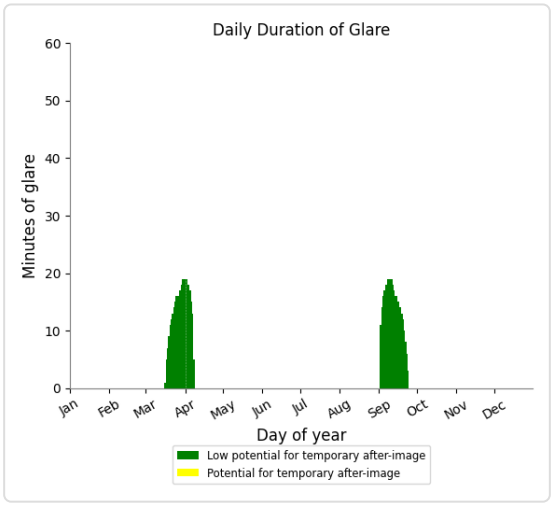


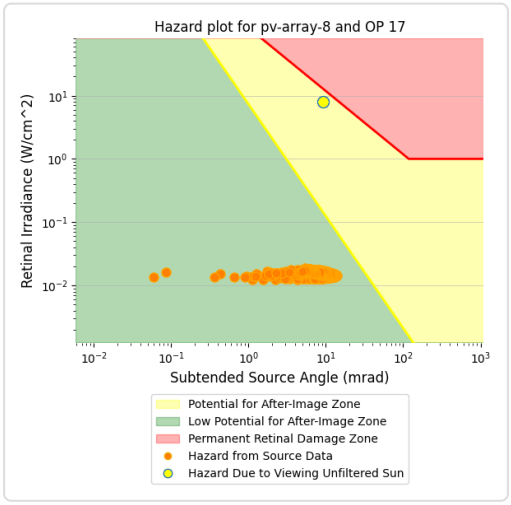
PV array 8 and OP 17

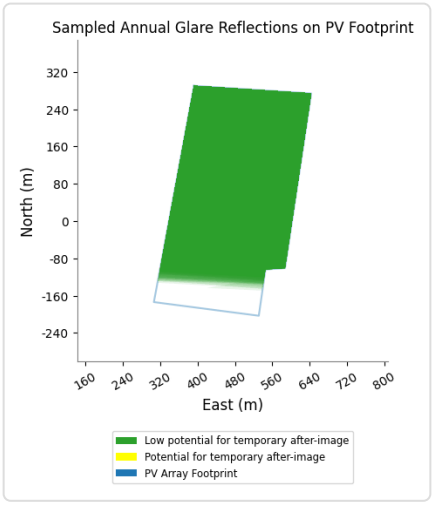
Yellow glare: none

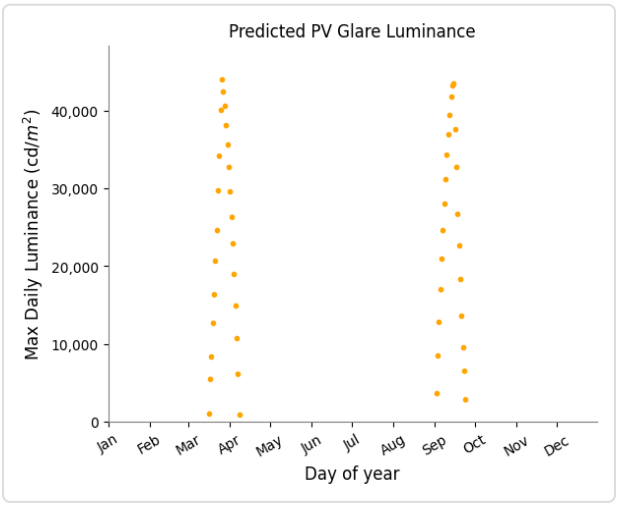
Green glare: 664 min.











PV array 8 and OP 1

No glare found

PV array 8 and OP 2

No glare found

PV array 8 and OP 3

No glare found

PV array 8 and OP 4

No glare found

PV array 8 and OP 5

No glare found

PV array 8 and OP 6

No glare found

PV array 8 and OP 9

No glare found

PV array 8 and OP 10

No glare found

PV array 8 and OP 11

No glare found

PV array 8 and OP 12

No glare found

PV array 8 and OP 13

No glare found

PV array 8 and OP 18

No glare found

PV array 8 and OP 19

No glare found

PV array 8 and OP 20

No glare found

Assumptions

"Green" glare is glare with low potential to cause an after-image (flash blindness) when observed prior to a typical blink response time.
"Yellow" glare is glare with potential to cause an after-image (flash blindness) when observed prior to a typical blink response time.
Times associated with glare are denoted in Standard time. For Daylight Savings, add one hour.
The algorithm does not rigorously represent the detailed geometry of a system; detailed features such as gaps between modules, variable height of the PV array, and support structures may impact actual glare results. However, we have validated our models against several systems, including a PV array causing glare to the air-traffic control tower at Manchester-Boston Regional Airport and several sites in Albuquerque, and the tool accurately predicted the occurrence and intensity of glare at different times and days of the year.
Several V1 calculations utilize the PV array centroid, rather than the actual glare spot location, due to algorithm limitations. This may affect results for large PV footprints. Additional analyses of array sub-sections can provide additional information on expected glare. This primarily affects V1 analyses of path receptors.
Random number computations are utilized by various steps of the annual hazard analysis algorithm. Predicted minutes of glare can vary between runs as a result. This limitation primarily affects analyses of Observation Point receptors, including ATCTs. Note that the SGHAT/ ForgeSolar methodology has always relied on an analytical, qualitative approach to accurately determine the overall hazard (i.e. green vs. yellow) of expected glare on an annual basis.
The analysis does not automatically consider obstacles (either man-made or natural) between the observation points and the prescribed solar installation that may obstruct observed glare, such as trees, hills, buildings, etc.
The subtended source angle (glare spot size) is constrained by the PV array footprint size. Partitioning large arrays into smaller sections will reduce the maximum potential subtended angle, potentially impacting results if actual glare spots are larger than the sub-array size. Additional analyses of the combined area of adjacent sub-arrays can provide more information on potential glare hazards. (See previous point on related limitations.)
The variable direct normal irradiance (DNI) feature (if selected) scales the user-prescribed peak DNI using a typical clear-day irradiance profile. This profile has a lower DNI in the mornings and evenings and a maximum at solar noon. The scaling uses a clear-day irradiance profile based on a normalized time relative to sunrise, solar noon, and sunset, which are prescribed by a sun-position algorithm and the latitude and longitude obtained from Google maps. The actual DNI on any given day can be affected by cloud cover, atmospheric attenuation, and other environmental factors.
The ocular hazard predicted by the tool depends on a number of environmental, optical, and human factors, which can be uncertain. We provide input fields and typical ranges of values for these factors so that the user can vary these parameters to see if they have an impact on the results. The speed of SGHAT allows expedited sensitivity and parametric analyses.
The system output calculation is a DNI-based approximation that assumes clear, sunny skies year-round. It should not be used in place of more rigorous modeling methods.
Hazard zone boundaries shown in the Glare Hazard plot are an approximation and visual aid based on aggregated research data. Actual ocular impact outcomes encompass a continuous, not discrete, spectrum.
Glare locations displayed on receptor plots are approximate. Actual glare-spot locations may differ.
Refer to the Help page at **www.forgesolar.com/help/** for assumptions and limitations not listed here.

Default glare analysis parameters and observer eye characteristics (for reference only):

- Analysis time interval: 1 minute
- Ocular transmission coefficient: 0.5
- Pupil diameter: 0.002 meters
- Eye focal length: 0.017 meters
- Sun subtended angle: 9.3 milliradians

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FORGESOLAR GLARE ANALYSIS

Project: **BR10356 Normanton Larches Solar**
Site configuration: **Aviation 500ft 180 and 205 OP21-41**

Created 15 Mar, 2024
Updated 21 Mar, 2024
Time-step 1 minute
Timezone offset UTC0
Minimum sun altitude 0.0 deg
DNI peaks at 1,000.0 W/m^2
Category 10 MW to 100 MW
Site ID 114501.19448

Ocular transmission coefficient 0.5
Pupil diameter 0.002 m
Eye focal length 0.017 m
Sun subtended angle 9.3 mrad
PV analysis methodology V2

Summary of Results

Glare with low potential for temporary after-image predicted

PV Array	Tilt	Orient	Annual Green Glare		Annual Yellow Glare		Energy	Peak Luminance
	°	°	min	hr	min	hr	kWh	cd/m^2
PV array 1	25.0	180.0	5,523	92.0	0	0.0	-	121,980
PV array 2	25.0	180.0	4,328	72.1	0	0.0	-	110,782
PV array 3	25.0	180.0	5,882	98.0	0	0.0	-	174,039
PV array 4	25.0	180.0	7,909	131.8	0	0.0	-	163,630
PV array 5	25.0	180.0	6,224	103.7	0	0.0	-	155,496
PV array 6	25.0	180.0	9,221	153.7	0	0.0	-	149,436
PV array 7	25.0	205.0	6,159	102.7	0	0.0	-	148,928
PV array 8	25.0	180.0	10,633	177.2	0	0.0	-	213,947

Total glare received by each receptor; may include duplicate times of glare from multiple reflective surfaces.

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
OP 1	0	0.0	0	0.0
OP 2	152	2.5	0	0.0
OP 3	5,256	87.6	0	0.0
OP 4	10,661	177.7	0	0.0
OP 5	12,550	209.2	0	0.0
OP 6	19,162	319.4	0	0.0
OP 7	4,625	77.1	0	0.0
OP 8	0	0.0	0	0.0

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
OP 9	0	0.0	0	0.0
OP 10	0	0.0	0	0.0
OP 11	0	0.0	0	0.0
OP 12	0	0.0	0	0.0
OP 13	0	0.0	0	0.0
OP 14	3,033	50.5	0	0.0
OP 15	440	7.3	0	0.0
OP 16	0	0.0	0	0.0
OP 17	0	0.0	0	0.0
OP 18	0	0.0	0	0.0
OP 19	0	0.0	0	0.0
OP 20	0	0.0	0	0.0
OP 21	0	0.0	0	0.0

Component Data

PV Arrays

Name: PV array 1
Axis tracking: Fixed (no rotation)
Tilt: 25.0°
Orientation: 180.0°
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	53.270453	-1.023592	44.16	3.58	47.74
2	53.270382	-1.026510	38.69	3.58	42.27
3	53.270337	-1.028001	42.19	3.58	45.77
4	53.268374	-1.027819	47.55	3.58	51.13
5	53.267835	-1.027411	47.97	3.58	51.55
6	53.268194	-1.025823	42.76	3.58	46.34
7	53.268605	-1.023538	48.05	3.58	51.63

Name: PV array 2
Axis tracking: Fixed (no rotation)
Tilt: 25.0°
Orientation: 180.0°
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	53.272403	-1.022893	44.98	3.58	48.56
2	53.271659	-1.020468	49.10	3.58	52.68
3	53.271146	-1.020629	49.06	3.58	52.64
4	53.270568	-1.020768	49.76	3.58	53.34
5	53.269978	-1.022399	48.94	3.58	52.52
6	53.269490	-1.023494	46.53	3.58	50.11
7	53.270600	-1.023526	44.05	3.58	47.63
8	53.270658	-1.022721	44.52	3.58	48.10

Name: PV array 3
Axis tracking: Fixed (no rotation)
Tilt: 25.0°
Orientation: 180.0°
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	53.267270	-1.027453	49.52	3.58	53.10
2	53.267742	-1.026122	44.46	3.58	48.04
3	53.268066	-1.026004	43.25	3.58	46.83
4	53.268361	-1.024577	44.74	3.58	48.32
5	53.268515	-1.023451	48.43	3.58	52.01
6	53.263789	-1.021096	44.95	3.58	48.53
7	53.263606	-1.026144	50.81	3.58	54.39

Name: PV array 4
Axis tracking: Fixed (no rotation)
Tilt: 25.0°
Orientation: 180.0°
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	53.267296	-1.022818	47.72	3.58	51.30
2	53.267707	-1.018998	49.22	3.58	52.80
3	53.264120	-1.017373	43.17	3.58	46.75
4	53.264126	-1.017861	43.81	3.58	47.39
5	53.263885	-1.017893	45.60	3.58	49.18
6	53.263795	-1.021085	44.91	3.58	48.49

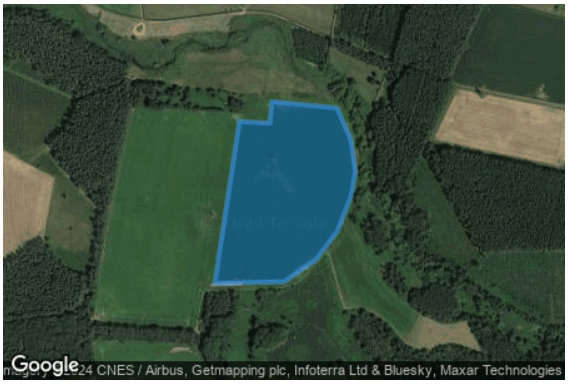
Name: PV array 5
Axis tracking: Fixed (no rotation)
Tilt: 25.0°
Orientation: 180.0°
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	53.268300	-1.019106	51.65	3.58	55.23
2	53.268197	-1.015587	47.94	3.58	51.52
3	53.267411	-1.014932	45.87	3.58	49.45
4	53.263776	-1.015093	42.99	3.58	46.57
5	53.263904	-1.017175	44.48	3.58	48.06
6	53.266359	-1.018355	43.98	3.58	47.56

Name: PV array 6
Axis tracking: Fixed (no rotation)
Tilt: 25.0°
Orientation: 180.0°
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	53.267286	-1.014793	45.26	3.58	48.84
2	53.263975	-1.015072	41.69	3.58	45.27
3	53.265181	-1.012926	37.52	3.58	41.10
4	53.265759	-1.012132	35.68	3.58	39.26
5	53.266067	-1.011724	35.43	3.58	39.01
6	53.266349	-1.011338	34.83	3.58	38.41
7	53.266619	-1.009836	34.68	3.58	38.26
8	53.267825	-1.010716	42.25	3.58	45.83

Name: PV array 7
Axis tracking: Fixed (no rotation)
Tilt: 25.0°
Orientation: 205.0°
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material



Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	53.272851	-1.014098	31.47	3.58	35.05
2	53.272825	-1.013046	30.13	3.58	33.71
3	53.273261	-1.012982	29.24	3.58	32.82
4	53.273133	-1.010739	28.00	3.58	31.58
5	53.272466	-1.010257	28.10	3.58	31.68
6	53.271837	-1.010106	28.08	3.58	31.66
7	53.271330	-1.010257	28.30	3.58	31.88
8	53.270592	-1.010739	30.16	3.58	33.74
9	53.270027	-1.011464	34.67	3.58	38.25
10	53.269572	-1.012563	42.29	3.58	45.87
11	53.269540	-1.014945	43.15	3.58	46.73

Name: PV array 8
Axis tracking: Fixed (no rotation)
Tilt: 25.0°
Orientation: 180.0°
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	53.273043	-1.017702	40.49	3.58	44.07
2	53.272889	-1.014130	31.40	3.58	34.98
3	53.269533	-1.014988	43.26	3.58	46.84
4	53.269527	-1.015492	43.81	3.58	47.39
5	53.268667	-1.015718	47.38	3.58	50.96
6	53.268917	-1.018936	51.30	3.58	54.88

Discrete Observation Point Receptors

Name	ID	Latitude (°)	Longitude (°)	Elevation (m)	Height (m)
OP 1	1	53.279168	-0.962682	22.00	152.40
OP 2	2	53.275011	-0.957188	26.00	152.40
OP 3	3	53.265823	-0.946545	20.99	152.40
OP 4	4	53.258892	-0.954442	41.64	152.40
OP 5	5	53.253860	-0.968518	33.27	152.40
OP 6	6	53.259816	-0.979075	30.66	152.40
OP 7	7	53.270494	-0.993838	27.91	152.40
OP 8	8	53.282145	-1.005425	52.69	152.40
OP 9	9	53.287327	-0.996241	34.00	152.40
OP 10	10	53.291175	-0.981221	26.10	152.40
OP 11	11	53.286506	-0.974955	25.68	152.40
OP 12	12	53.281991	-0.989976	45.11	152.40
OP 13	13	53.277526	-0.995040	54.66	152.40
OP 14	14	53.268852	-0.946545	21.82	152.40
OP 15	15	53.273523	-0.934529	23.38	152.40
OP 16	16	53.279168	-0.926461	24.89	152.40
OP 17	17	53.284095	-0.934872	29.10	152.40
OP 18	18	53.291278	-0.946460	23.41	152.40
OP 19	19	53.296049	-0.954528	37.14	152.40
OP 20	20	53.293535	-0.965342	36.12	152.40
OP 21	21	53.288918	-0.971350	22.98	152.40

Glare Analysis Results

Summary of Results

Glare with low potential for temporary after-image predicted

PV Array	Tilt	Orient	Annual Green Glare		Annual Yellow Glare		Energy	Peak Luminance
	°	°	min	hr	min	hr	kWh	cd/m^2
PV array 1	25.0	180.0	5,523	92.0	0	0.0	-	121,980
PV array 2	25.0	180.0	4,328	72.1	0	0.0	-	110,782
PV array 3	25.0	180.0	5,882	98.0	0	0.0	-	174,039
PV array 4	25.0	180.0	7,909	131.8	0	0.0	-	163,630
PV array 5	25.0	180.0	6,224	103.7	0	0.0	-	155,496
PV array 6	25.0	180.0	9,221	153.7	0	0.0	-	149,436
PV array 7	25.0	205.0	6,159	102.7	0	0.0	-	148,928
PV array 8	25.0	180.0	10,633	177.2	0	0.0	-	213,947

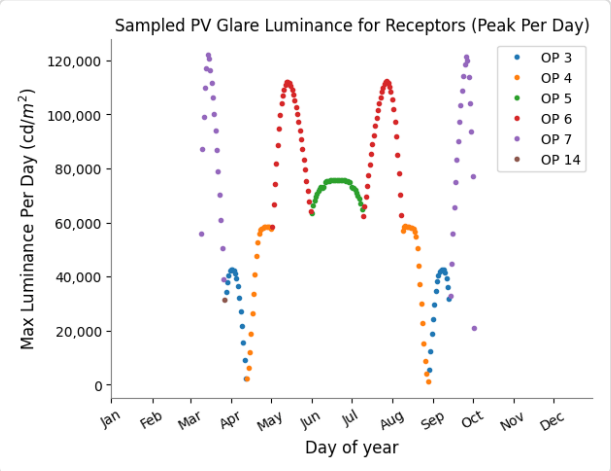
Total glare received by each receptor; may include duplicate times of glare from multiple reflective surfaces.

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
OP 1	0	0.0	0	0.0
OP 2	152	2.5	0	0.0
OP 3	5,256	87.6	0	0.0
OP 4	10,661	177.7	0	0.0
OP 5	12,550	209.2	0	0.0
OP 6	19,162	319.4	0	0.0
OP 7	4,625	77.1	0	0.0
OP 8	0	0.0	0	0.0
OP 9	0	0.0	0	0.0
OP 10	0	0.0	0	0.0
OP 11	0	0.0	0	0.0
OP 12	0	0.0	0	0.0
OP 13	0	0.0	0	0.0
OP 14	3,033	50.5	0	0.0
OP 15	440	7.3	0	0.0
OP 16	0	0.0	0	0.0
OP 17	0	0.0	0	0.0
OP 18	0	0.0	0	0.0
OP 19	0	0.0	0	0.0
OP 20	0	0.0	0	0.0
OP 21	0	0.0	0	0.0

PV: PV array 1 low potential for temporary after-image

Receptor results ordered by category of glare

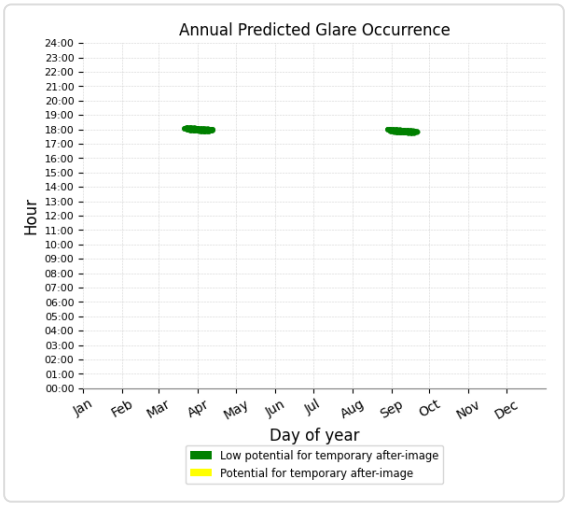
Receptor	Annual Green Glare		Annual Yellow Glare		Peak Luminance
	min	hr	min	hr	cd/m^2
OP 3	658	11.0	0	0.0	42,660
OP 4	866	14.4	0	0.0	58,629
OP 5	904	15.1	0	0.0	75,825
OP 6	1,901	31.7	0	0.0	112,265
OP 7	683	11.4	0	0.0	121,980
OP 14	511	8.5	0	0.0	35,408
OP 1	0	0.0	0	0.0	0
OP 2	0	0.0	0	0.0	0
OP 8	0	0.0	0	0.0	0
OP 9	0	0.0	0	0.0	0
OP 10	0	0.0	0	0.0	0
OP 11	0	0.0	0	0.0	0
OP 12	0	0.0	0	0.0	0
OP 13	0	0.0	0	0.0	0
OP 15	0	0.0	0	0.0	0
OP 16	0	0.0	0	0.0	0
OP 17	0	0.0	0	0.0	0
OP 18	0	0.0	0	0.0	0
OP 19	0	0.0	0	0.0	0
OP 20	0	0.0	0	0.0	0
OP 21	0	0.0	0	0.0	0

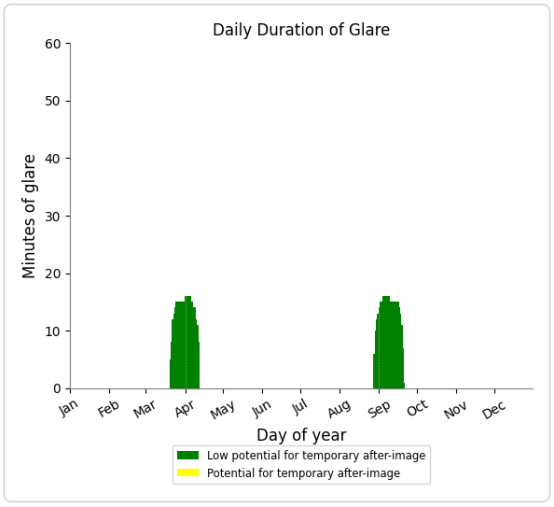


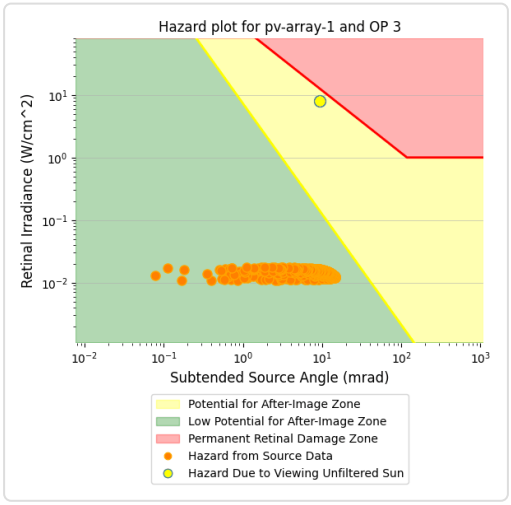
PV array 1 and OP 3

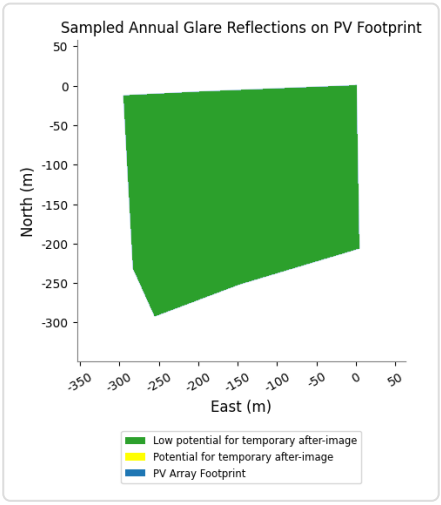
Yellow glare: none

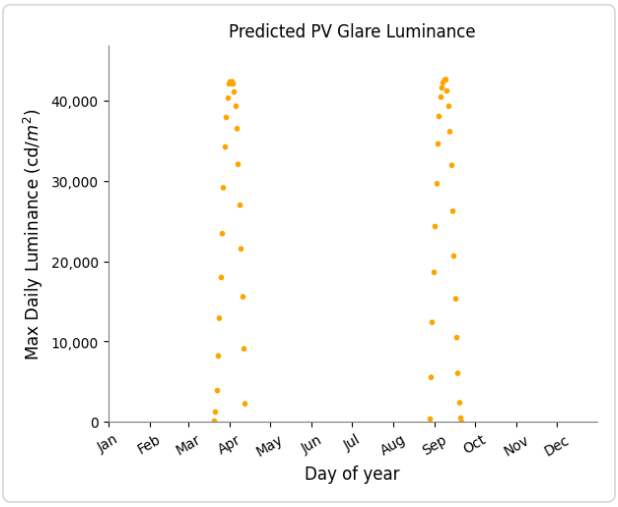
Green glare: 658 min.







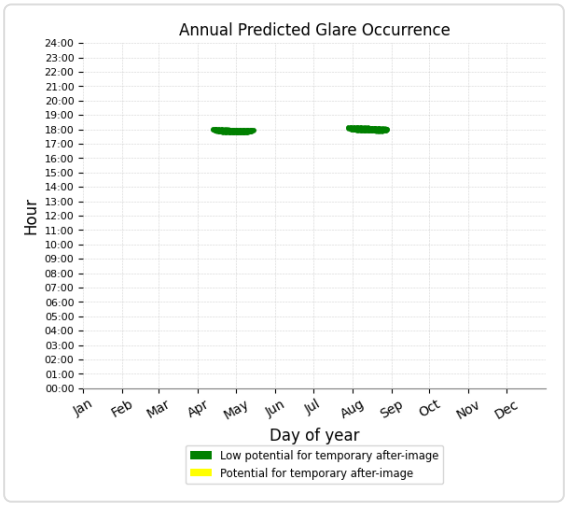


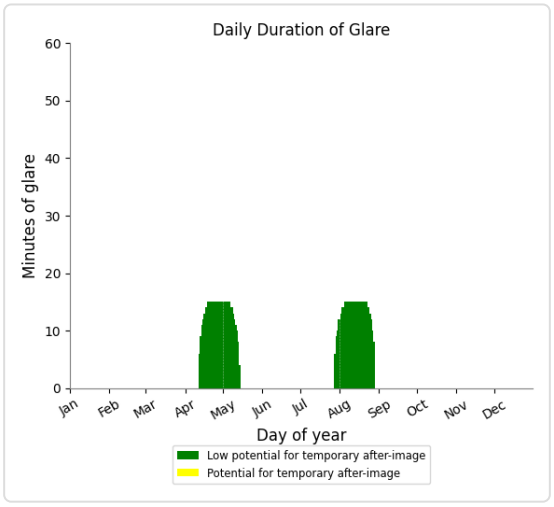


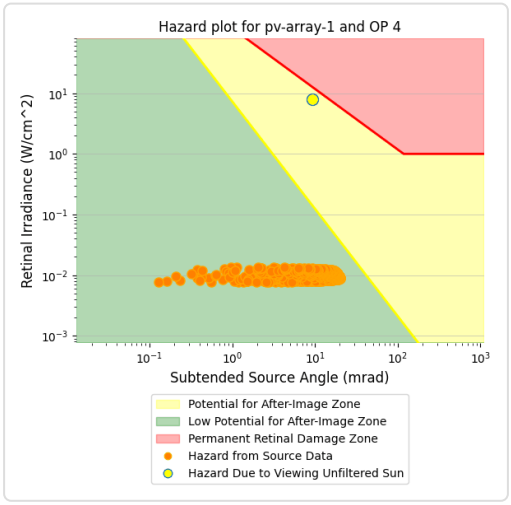
PV array 1 and OP 4

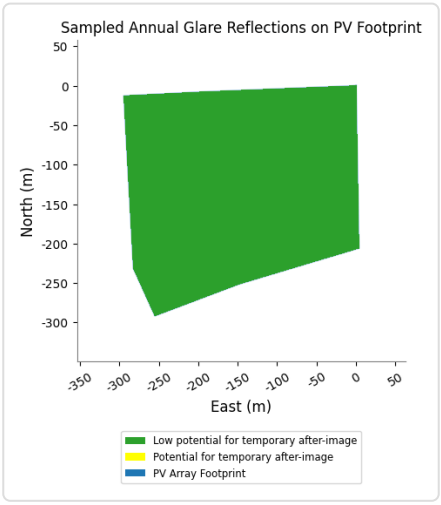
Yellow glare: none

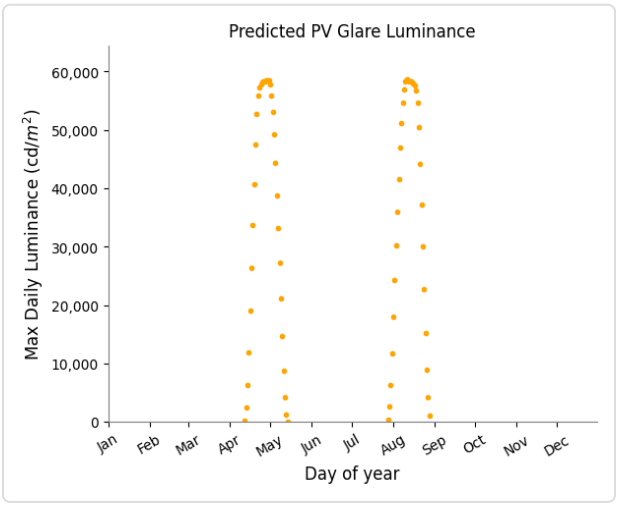
Green glare: 866 min.







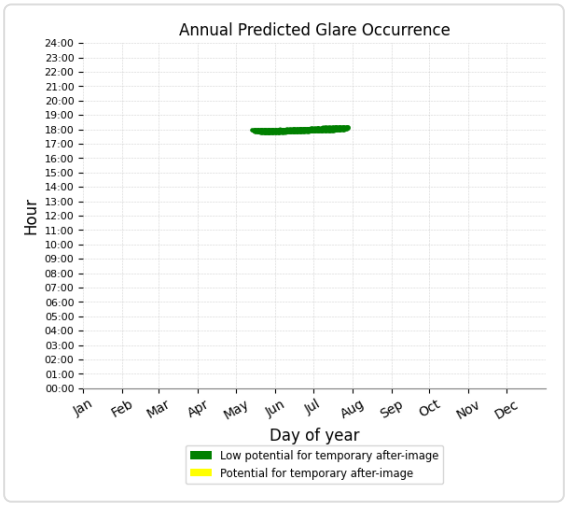


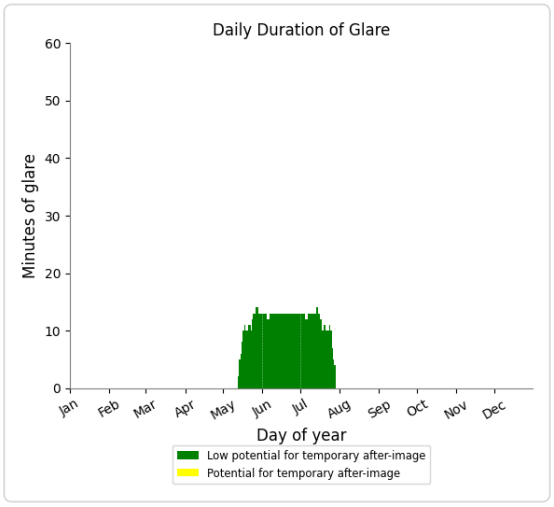


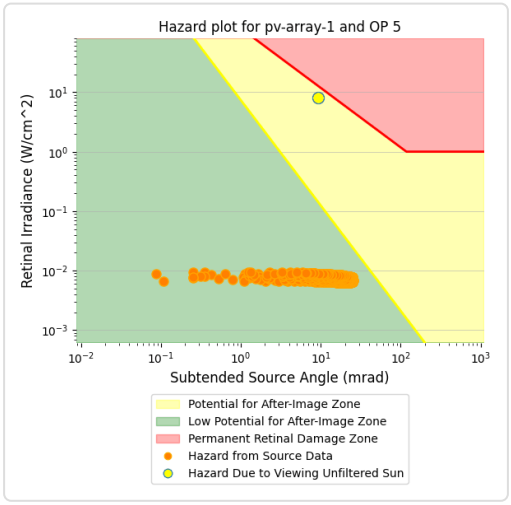
PV array 1 and OP 5

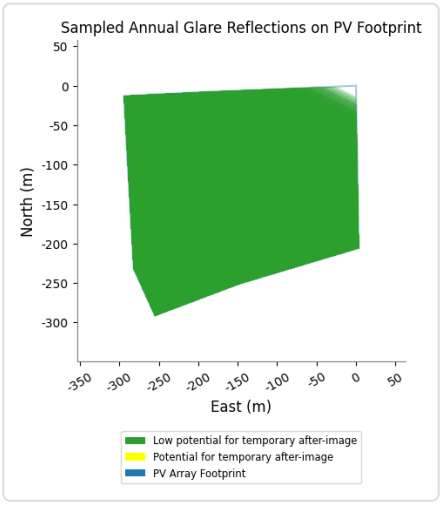
Yellow glare: none

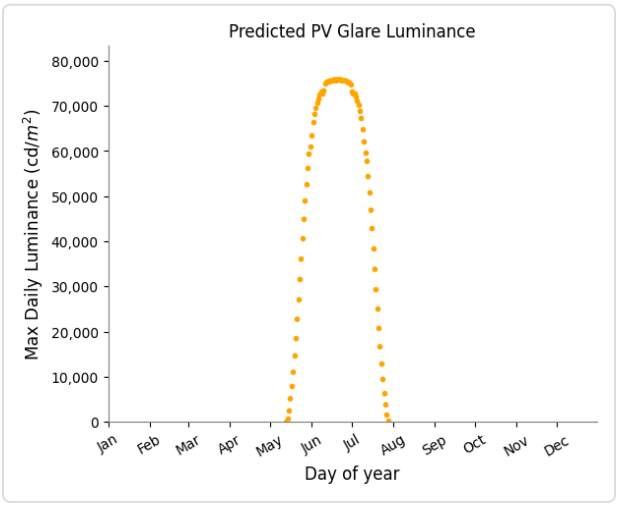
Green glare: 904 min.







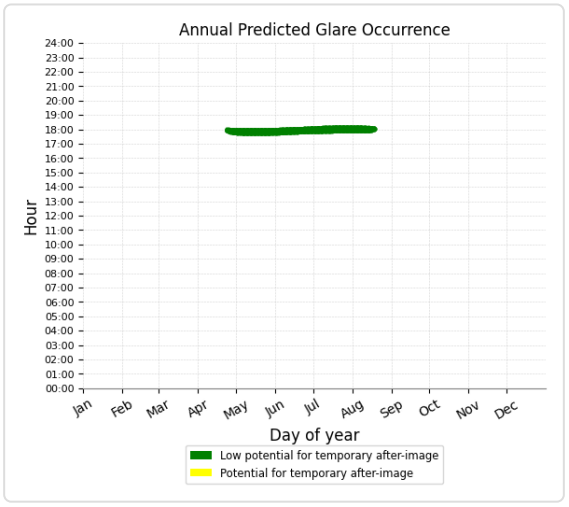


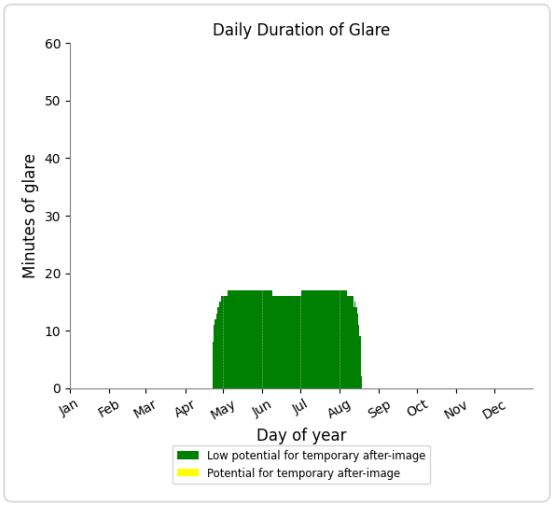


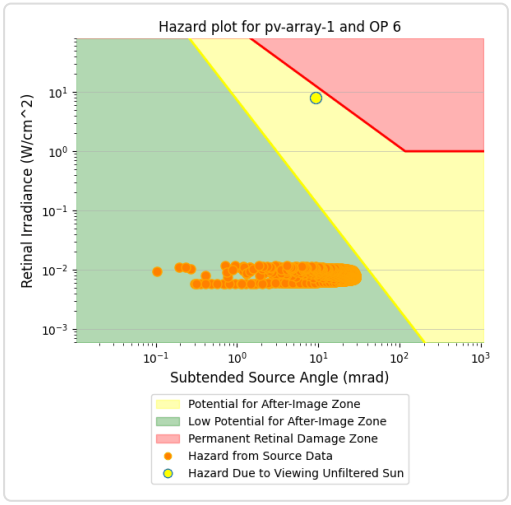
PV array 1 and OP 6

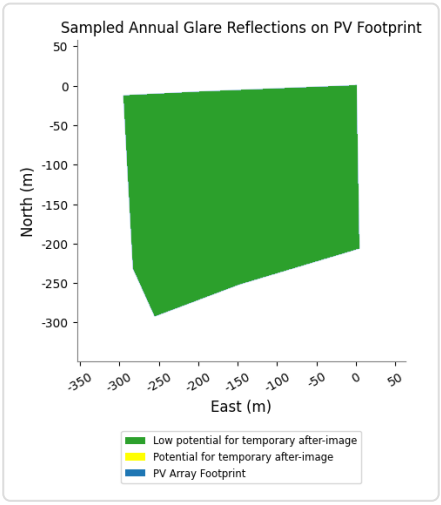
Yellow glare: none

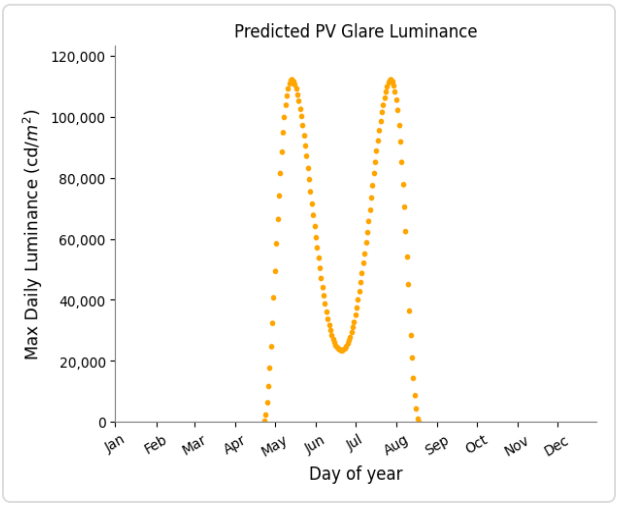
Green glare: 1,901 min.







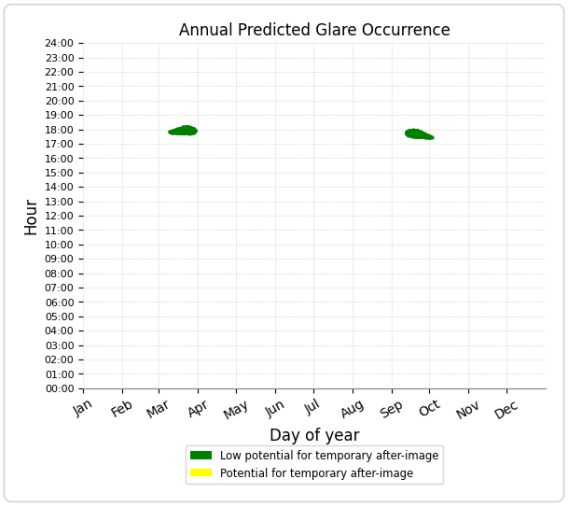


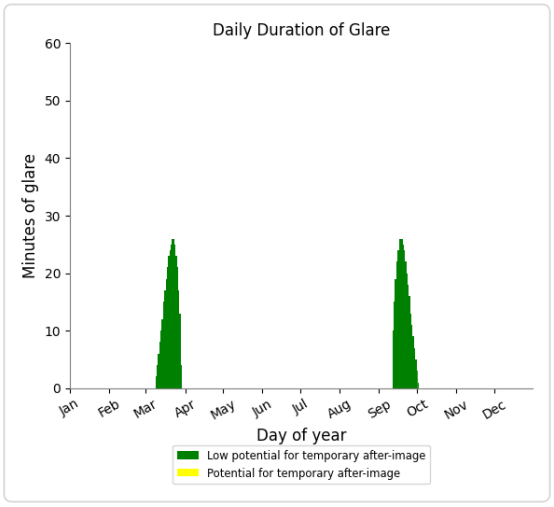


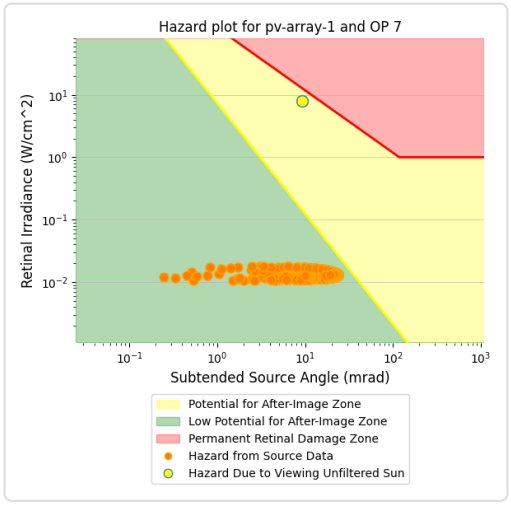
PV array 1 and OP 7

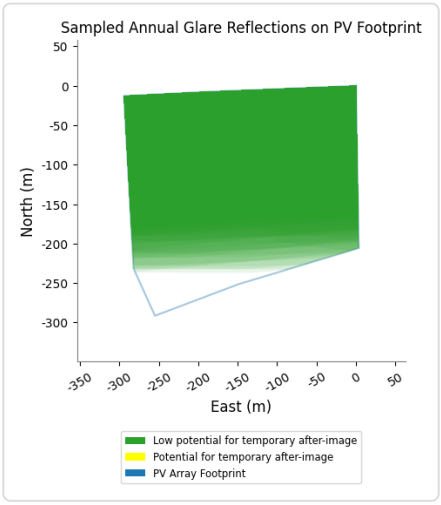
Yellow glare: none

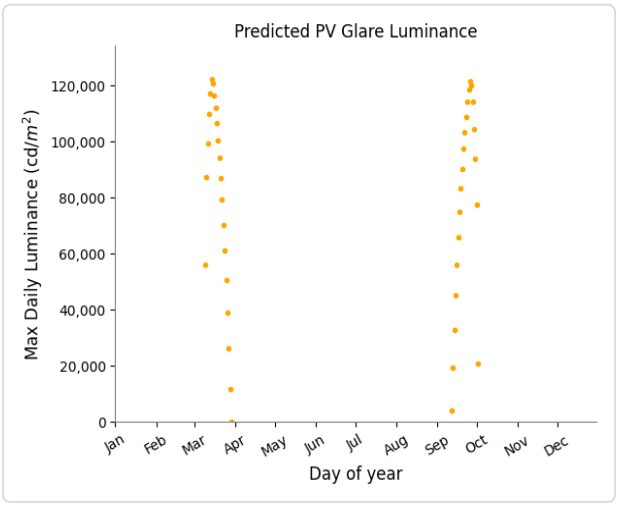
Green glare: 683 min.







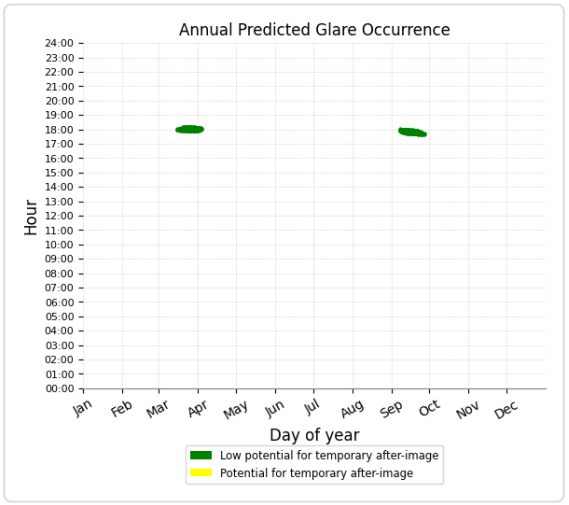


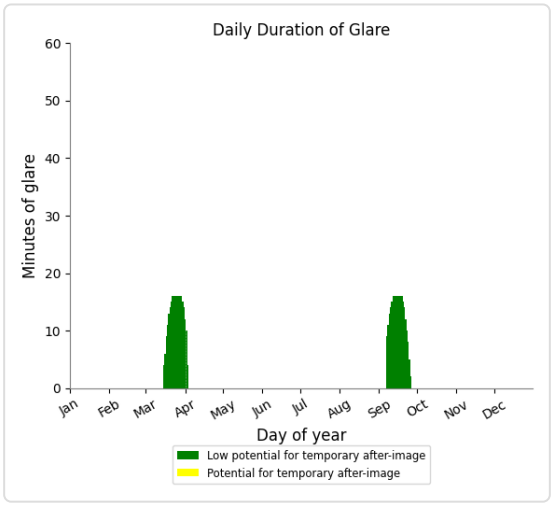


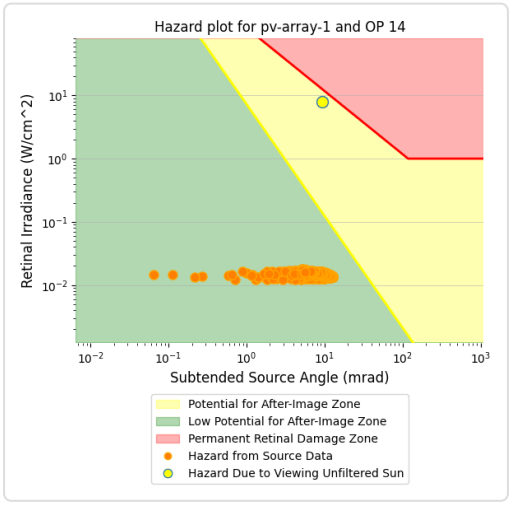
PV array 1 and OP 14

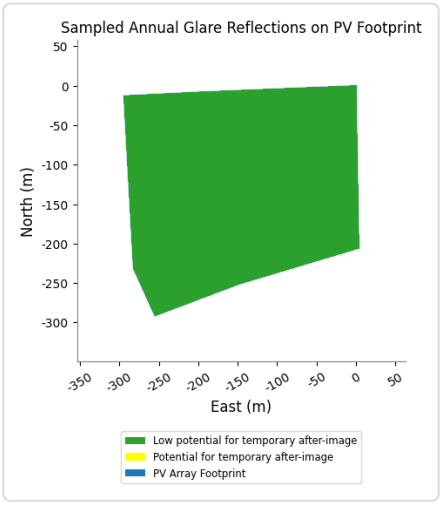
Yellow glare: none

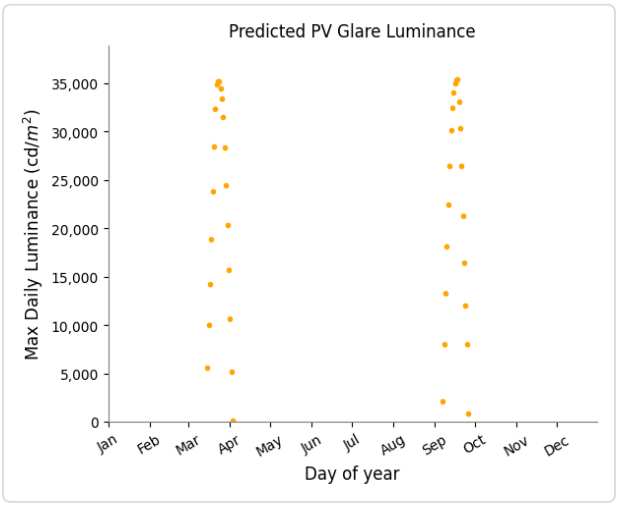
Green glare: 511 min.











PV array 1 and OP 1

No glare found

PV array 1 and OP 2

No glare found

PV array 1 and OP 8

No glare found

PV array 1 and OP 9

No glare found

PV array 1 and OP 10

No glare found

PV array 1 and OP 11

No glare found

PV array 1 and OP 12

No glare found

PV array 1 and OP 13

No glare found

PV array 1 and OP 15

No glare found

PV array 1 and OP 16

No glare found

PV array 1 and OP 17

No glare found

PV array 1 and OP 18

No glare found

PV array 1 and OP 19

No glare found

PV array 1 and OP 20

No glare found

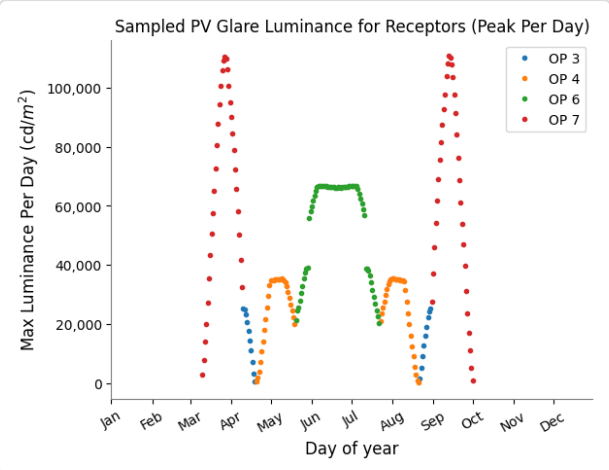
PV array 1 and OP 21

No glare found

PV: PV array 2 low potential for temporary after-image

Receptor results ordered by category of glare

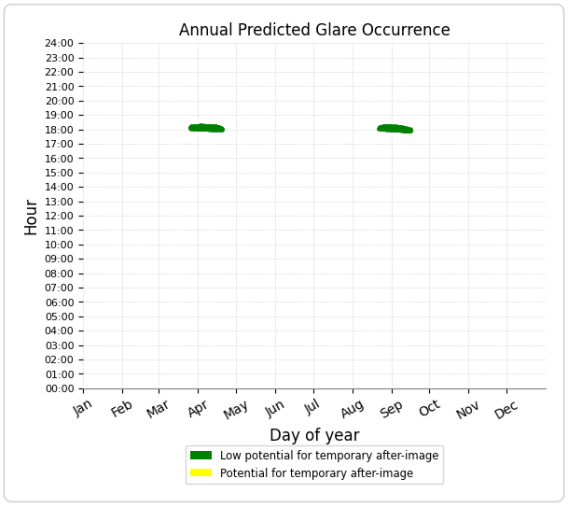
Receptor	Annual Green Glare		Annual Yellow Glare		Peak Luminance
	min	hr	min	hr	cd/m^2
OP 3	673	11.2	0	0.0	25,106
OP 4	953	15.9	0	0.0	35,317
OP 5	336	5.6	0	0.0	5,884
OP 6	634	10.6	0	0.0	66,896
OP 7	1,210	20.2	0	0.0	110,782
OP 14	442	7.4	0	0.0	20,324
OP 15	80	1.3	0	0.0	3,352
OP 1	0	0.0	0	0.0	0
OP 2	0	0.0	0	0.0	0
OP 8	0	0.0	0	0.0	0
OP 9	0	0.0	0	0.0	0
OP 10	0	0.0	0	0.0	0
OP 11	0	0.0	0	0.0	0
OP 12	0	0.0	0	0.0	0
OP 13	0	0.0	0	0.0	0
OP 16	0	0.0	0	0.0	0
OP 17	0	0.0	0	0.0	0
OP 18	0	0.0	0	0.0	0
OP 19	0	0.0	0	0.0	0
OP 20	0	0.0	0	0.0	0
OP 21	0	0.0	0	0.0	0

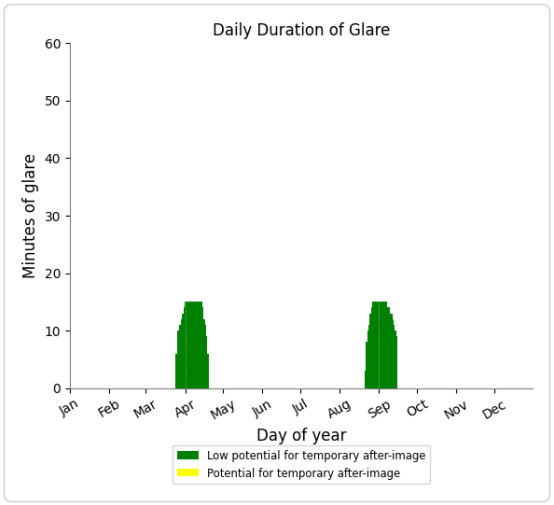


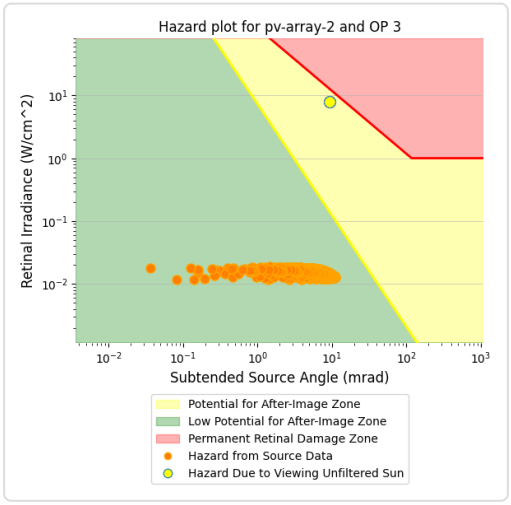
PV array 2 and OP 3

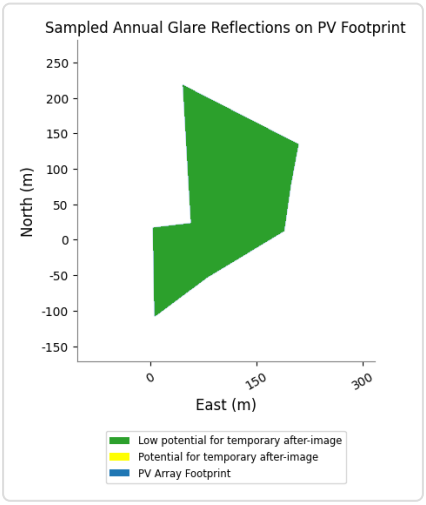
Yellow glare: none

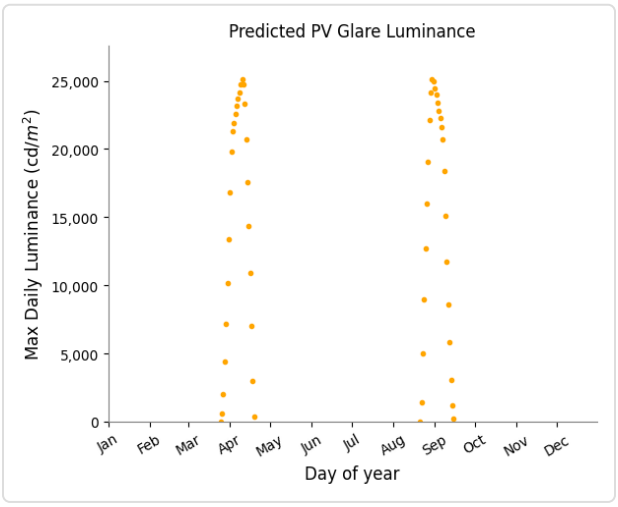
Green glare: 673 min.







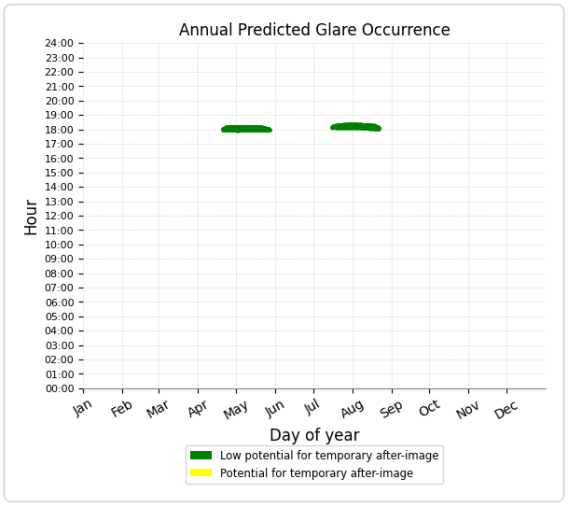


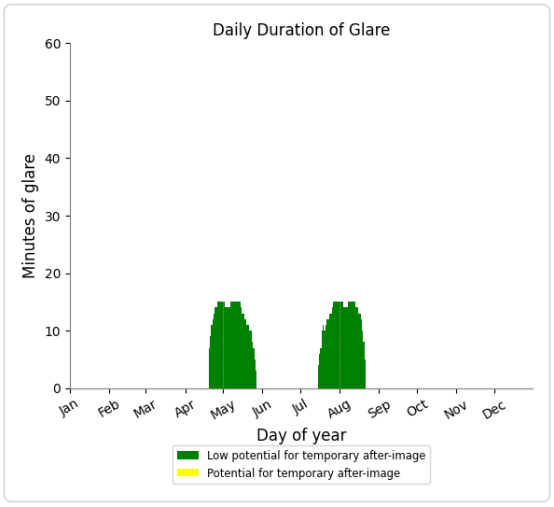


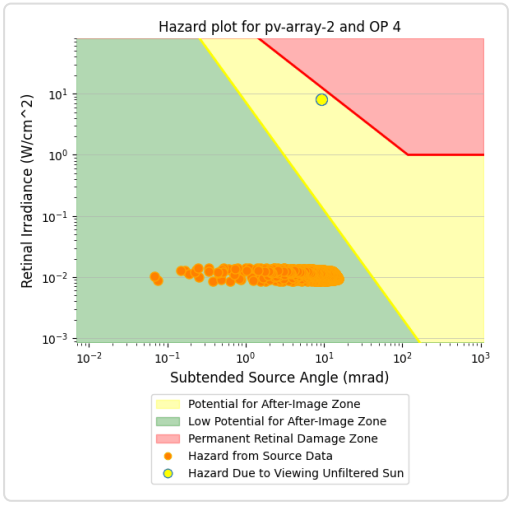
PV array 2 and OP 4

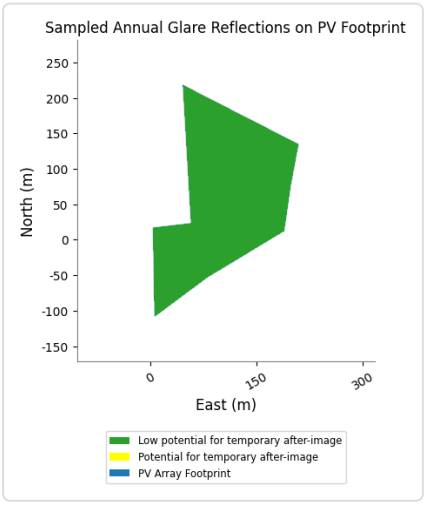
Yellow glare: none

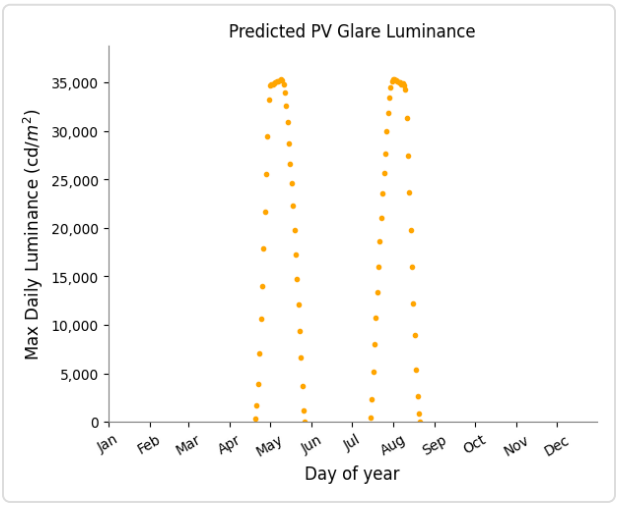
Green glare: 953 min.







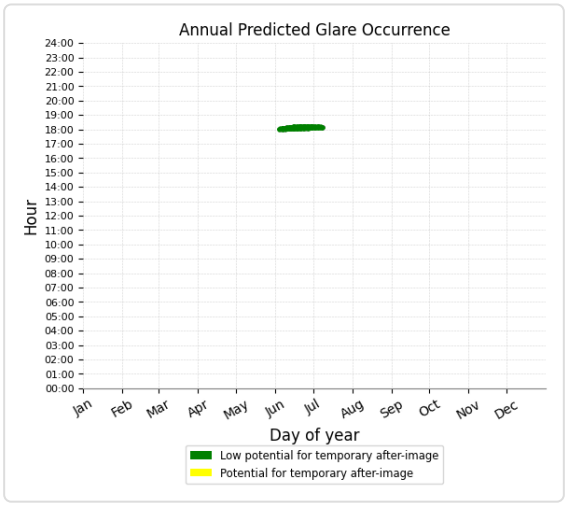


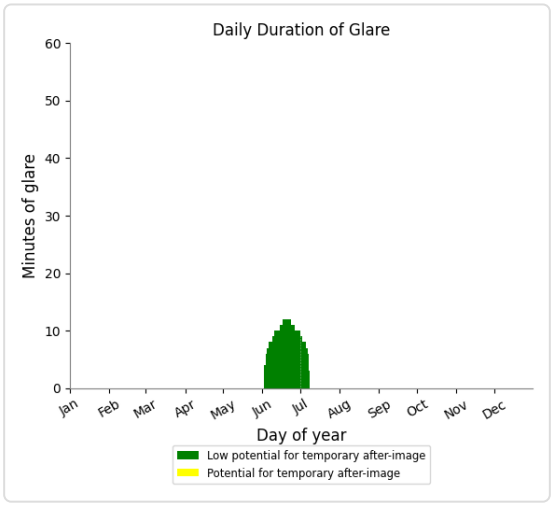


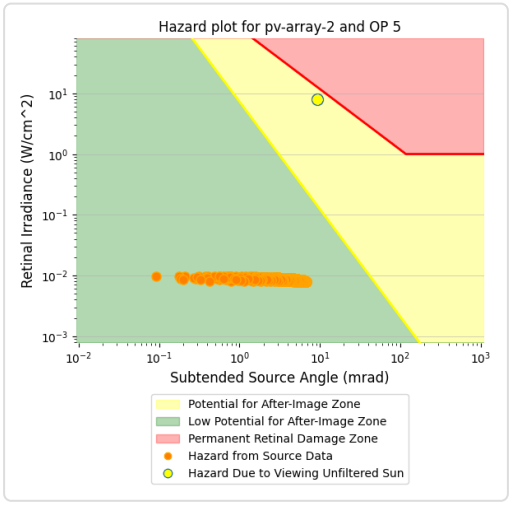
PV array 2 and OP 5

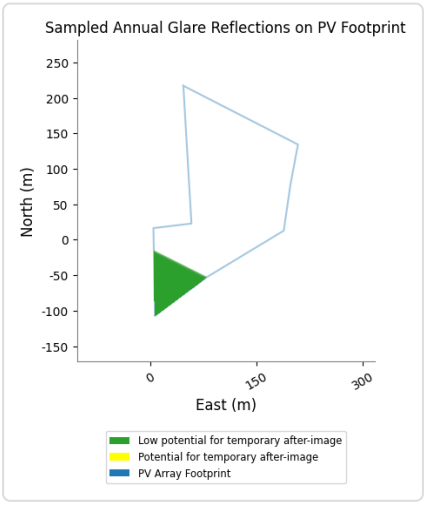
Yellow glare: none

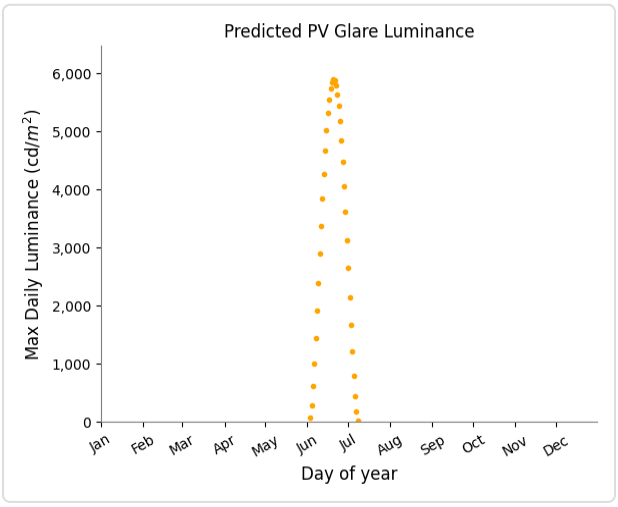
Green glare: 336 min.







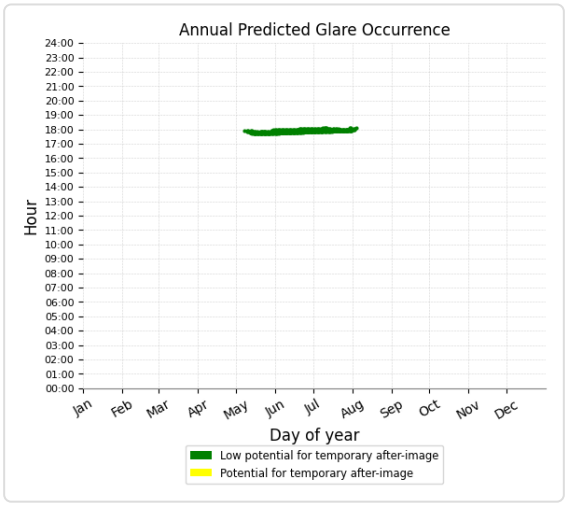


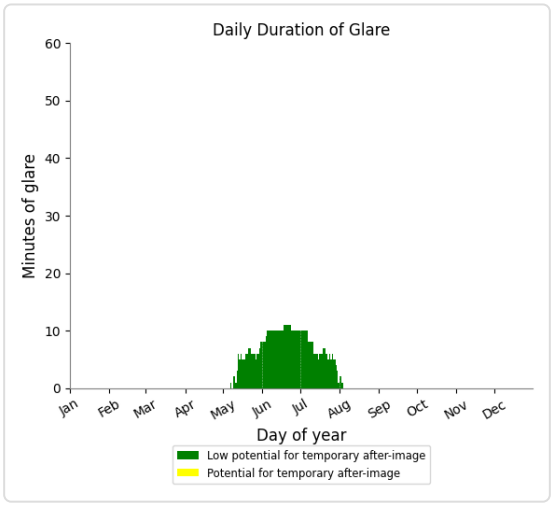


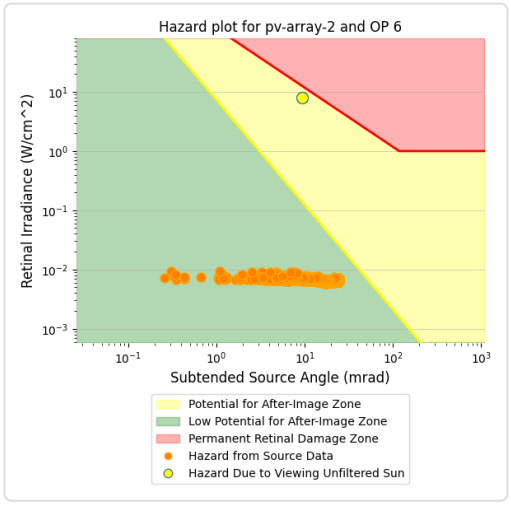
PV array 2 and OP 6

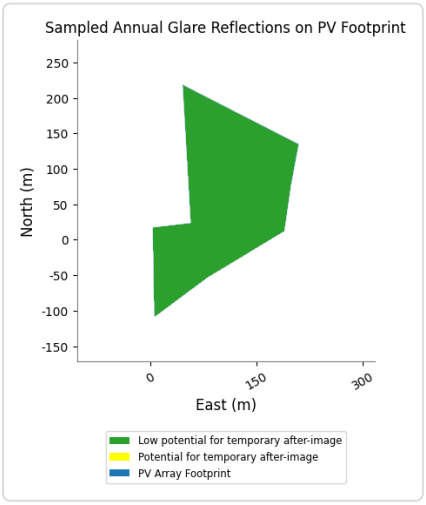
Yellow glare: none

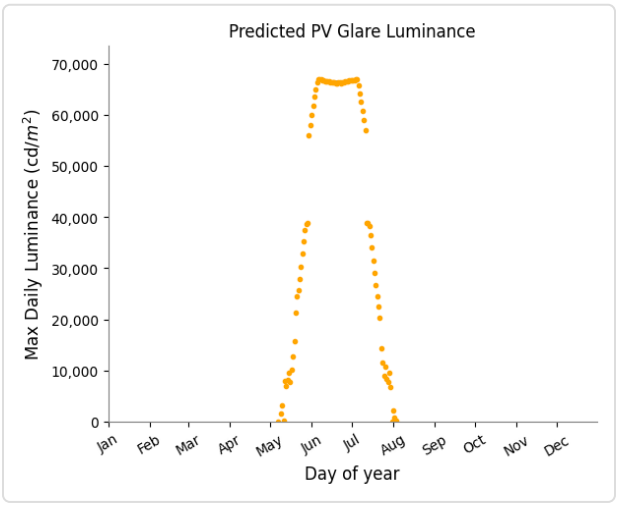
Green glare: 634 min.







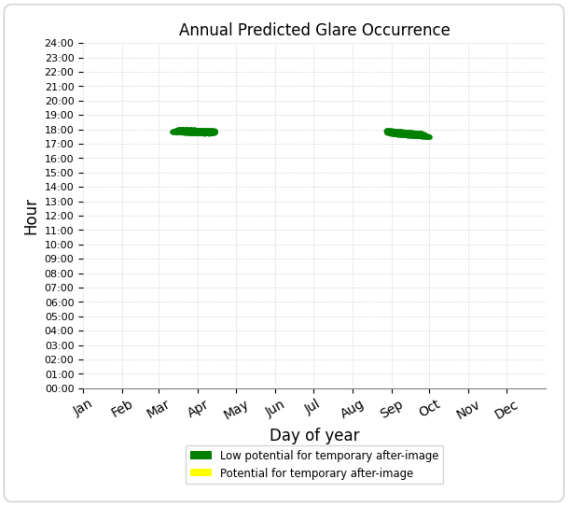


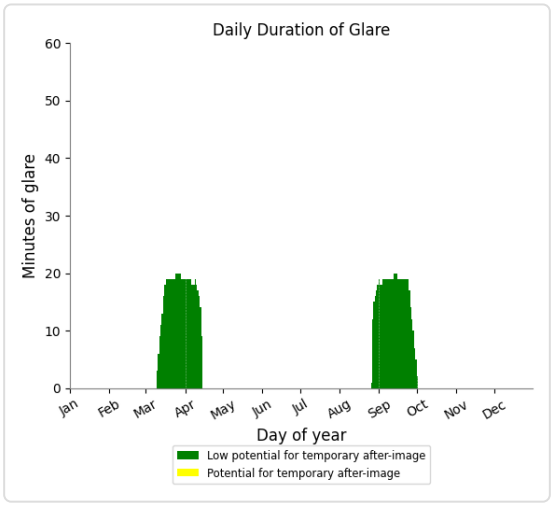


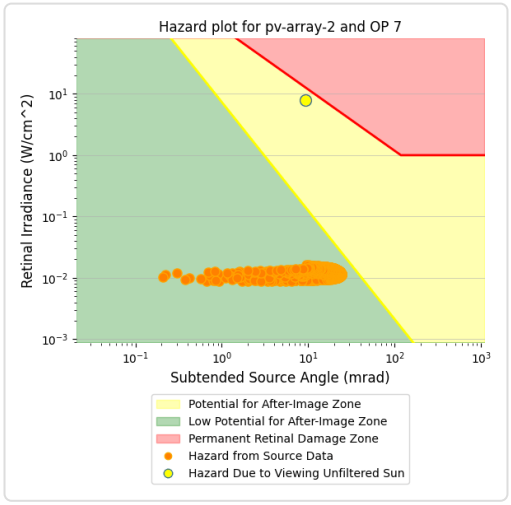
PV array 2 and OP 7

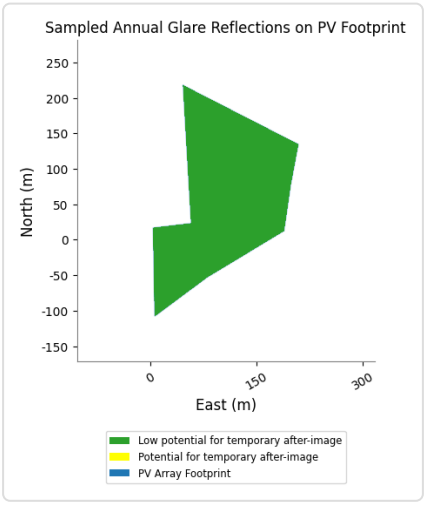
Yellow glare: none

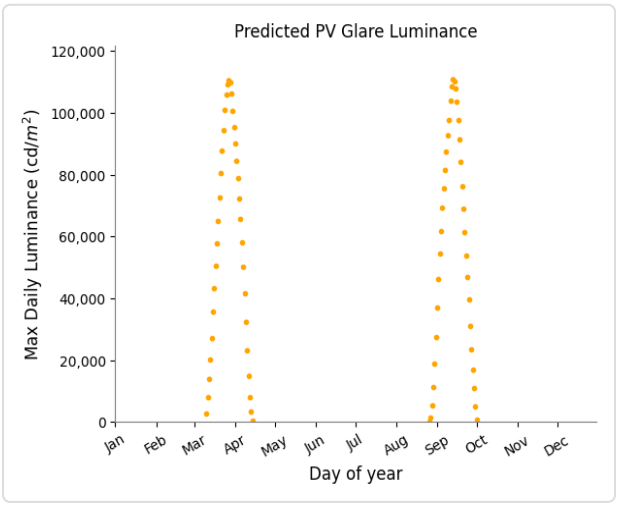
Green glare: 1,210 min.







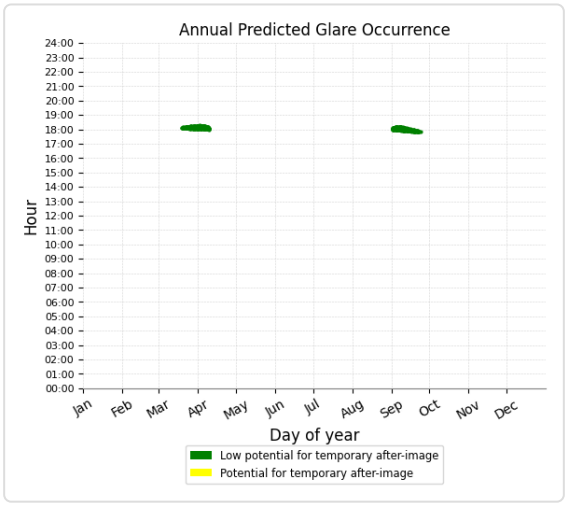


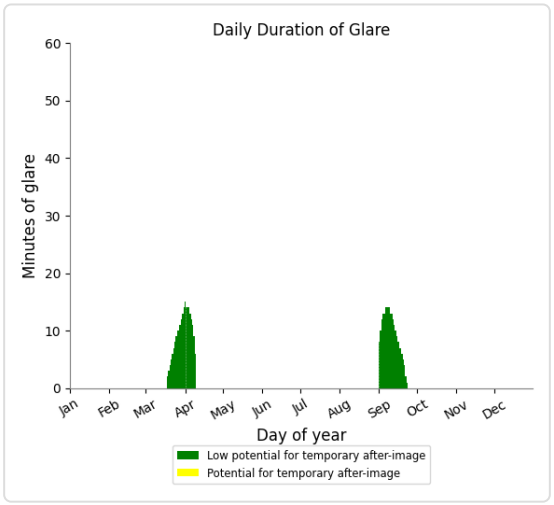


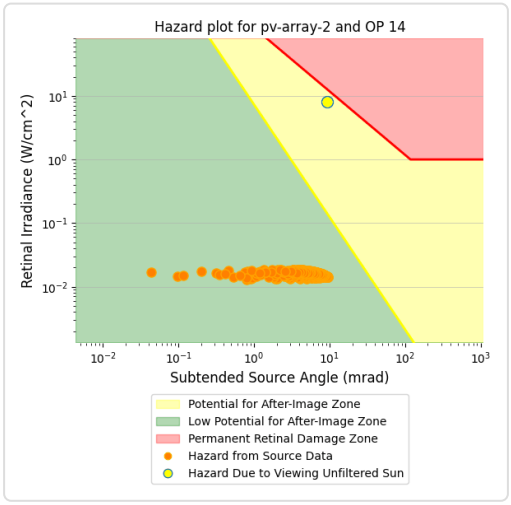
PV array 2 and OP 14

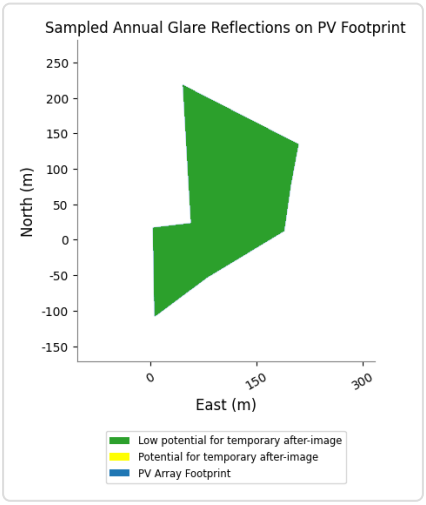
Yellow glare: none

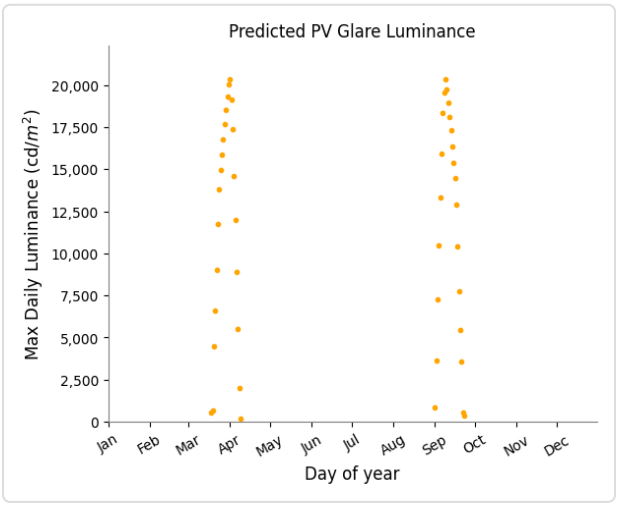
Green glare: 442 min.







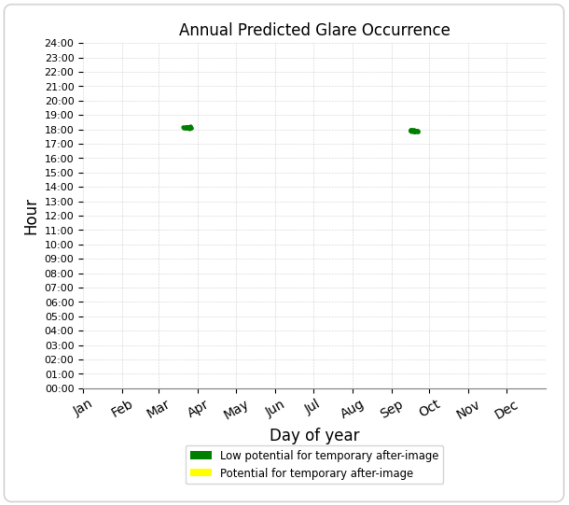


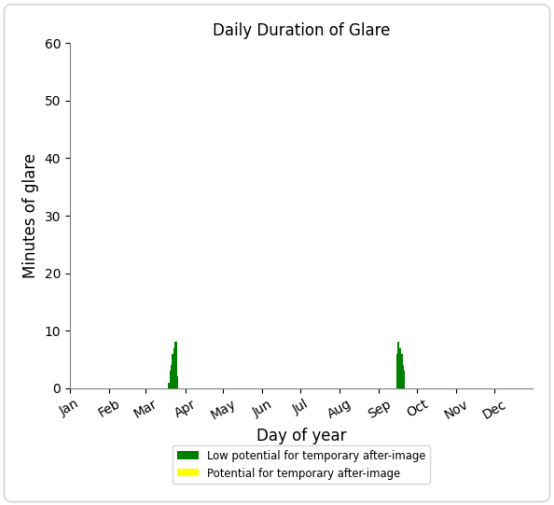


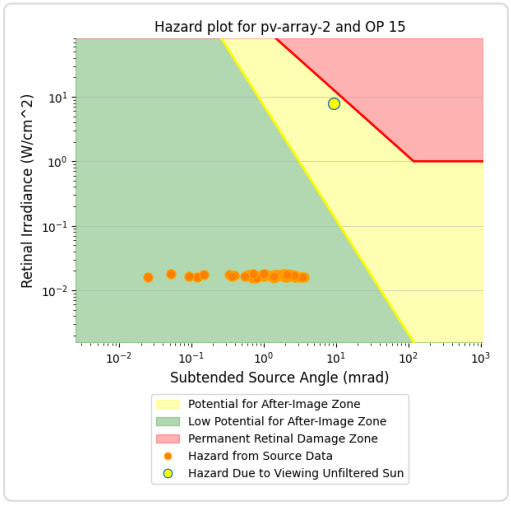
PV array 2 and OP 15

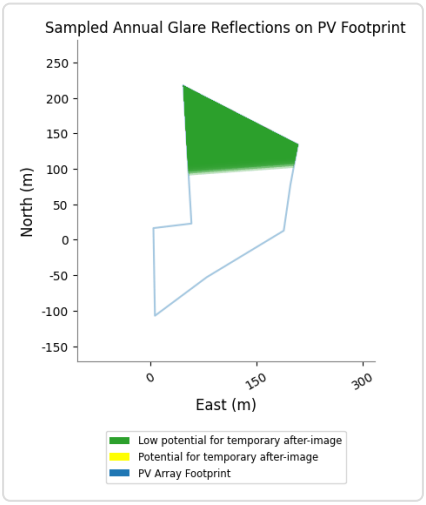
Yellow glare: none

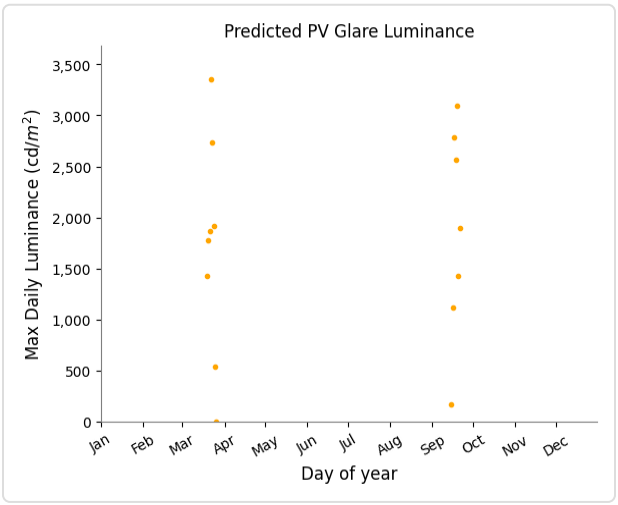
Green glare: 80 min.











PV array 2 and OP 1

No glare found

PV array 2 and OP 2

No glare found

PV array 2 and OP 8

No glare found

PV array 2 and OP 9

No glare found

PV array 2 and OP 10

No glare found

PV array 2 and OP 11

No glare found

PV array 2 and OP 12

No glare found

PV array 2 and OP 13

No glare found

PV array 2 and OP 16

No glare found

PV array 2 and OP 17

No glare found

PV array 2 and OP 18

No glare found

PV array 2 and OP 19

No glare found

PV array 2 and OP 20

No glare found

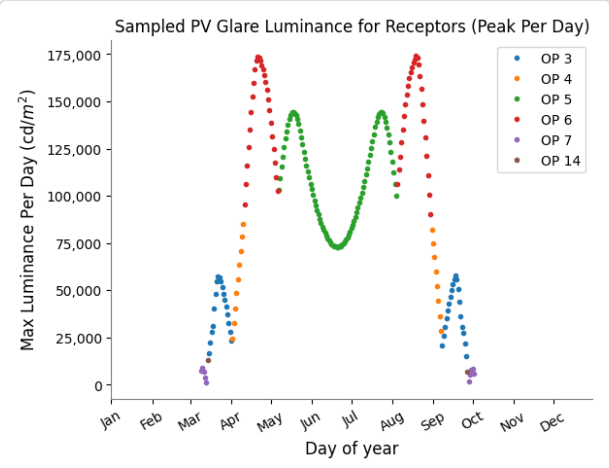
PV array 2 and OP 21

No glare found

PV: PV array 3 low potential for temporary after-image

Receptor results ordered by category of glare

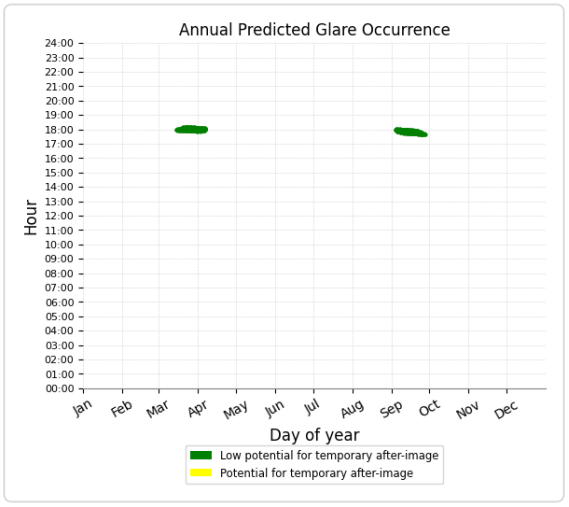
Receptor	Annual Green Glare		Annual Yellow Glare		Peak Luminance
	min	hr	min	hr	cd/m^2
OP 3	631	10.5	0	0.0	57,669
OP 4	1,111	18.5	0	0.0	107,277
OP 5	1,870	31.2	0	0.0	144,595
OP 6	1,916	31.9	0	0.0	174,039
OP 7	42	0.7	0	0.0	8,648
OP 14	312	5.2	0	0.0	21,305
OP 1	0	0.0	0	0.0	0
OP 2	0	0.0	0	0.0	0
OP 8	0	0.0	0	0.0	0
OP 9	0	0.0	0	0.0	0
OP 10	0	0.0	0	0.0	0
OP 11	0	0.0	0	0.0	0
OP 12	0	0.0	0	0.0	0
OP 13	0	0.0	0	0.0	0
OP 15	0	0.0	0	0.0	0
OP 16	0	0.0	0	0.0	0
OP 17	0	0.0	0	0.0	0
OP 18	0	0.0	0	0.0	0
OP 19	0	0.0	0	0.0	0
OP 20	0	0.0	0	0.0	0
OP 21	0	0.0	0	0.0	0

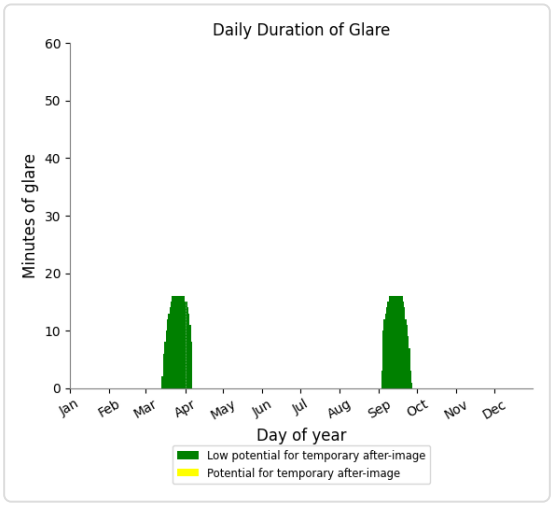


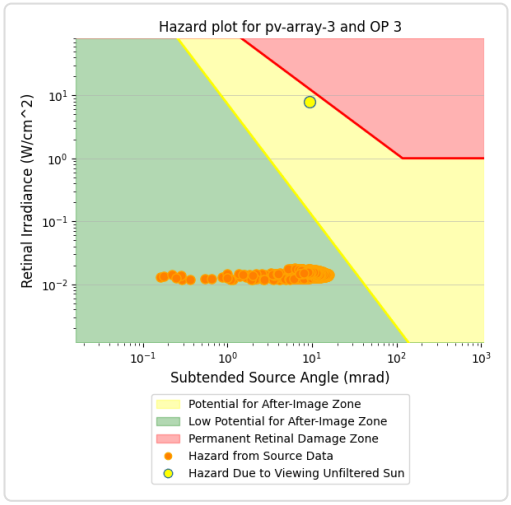
PV array 3 and OP 3

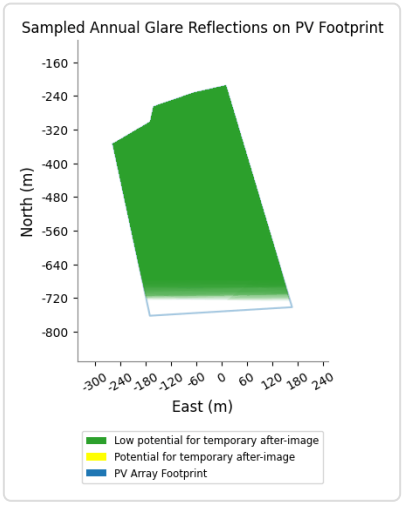
Yellow glare: none

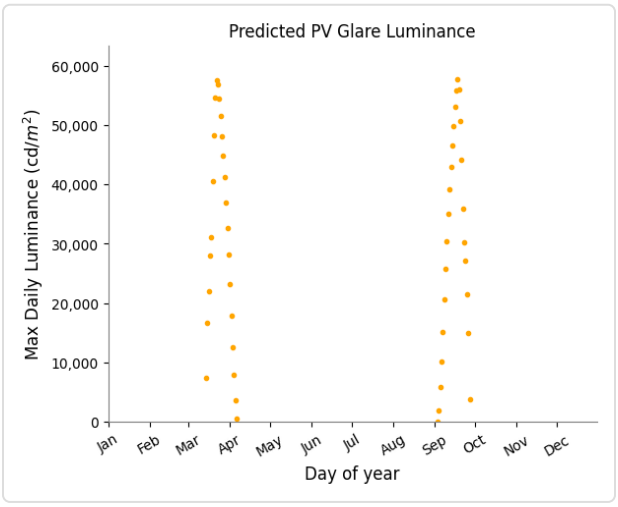
Green glare: 631 min.







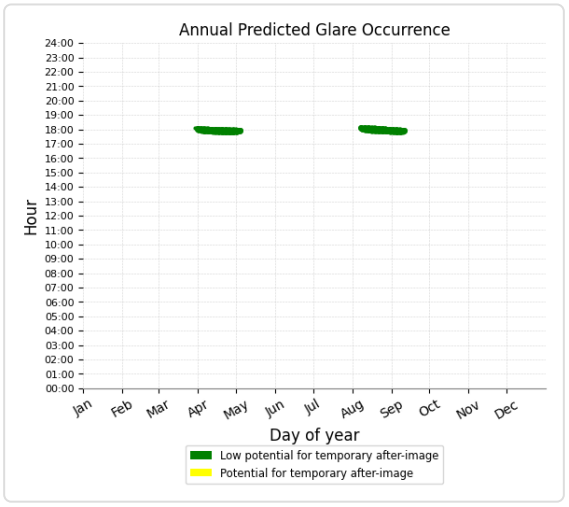


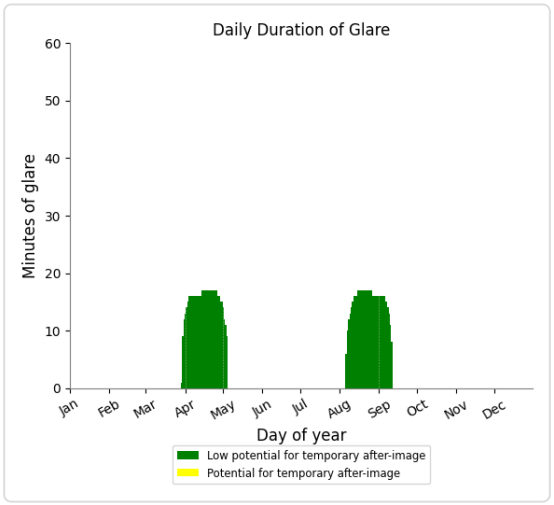


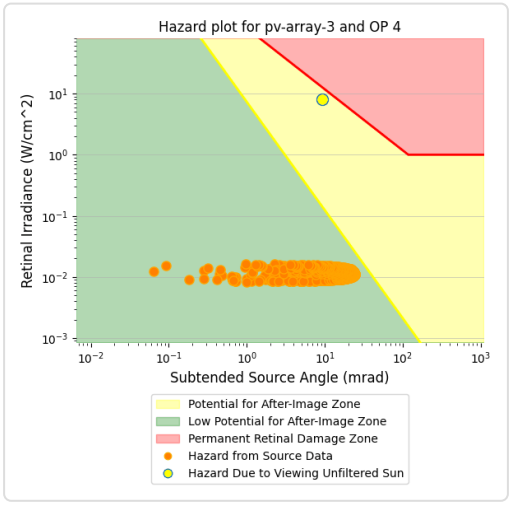
PV array 3 and OP 4

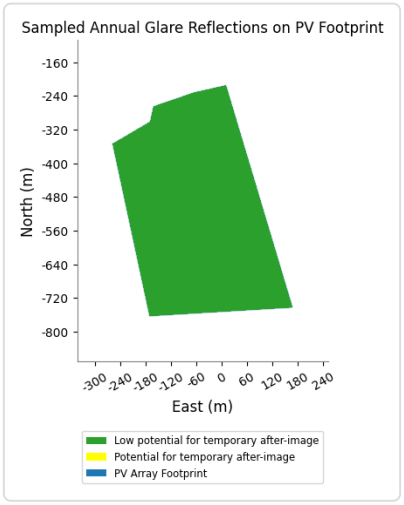
Yellow glare: none

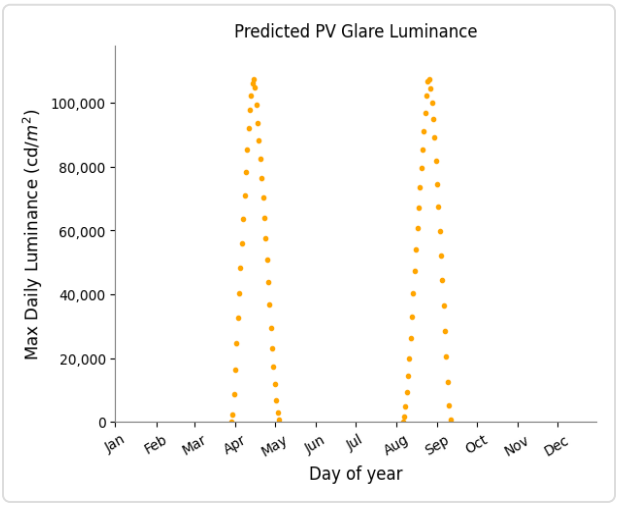
Green glare: 1,111 min.







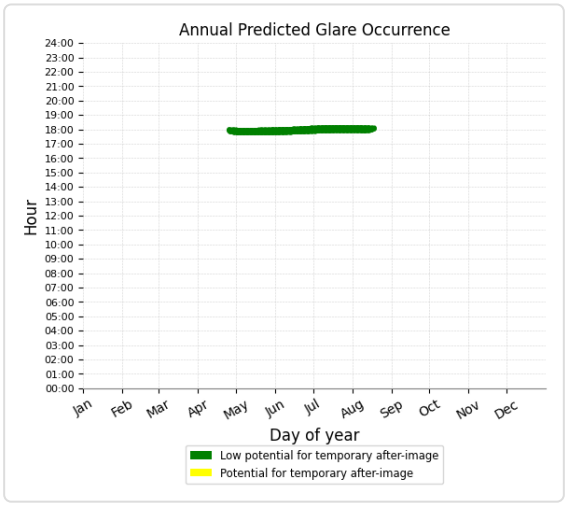


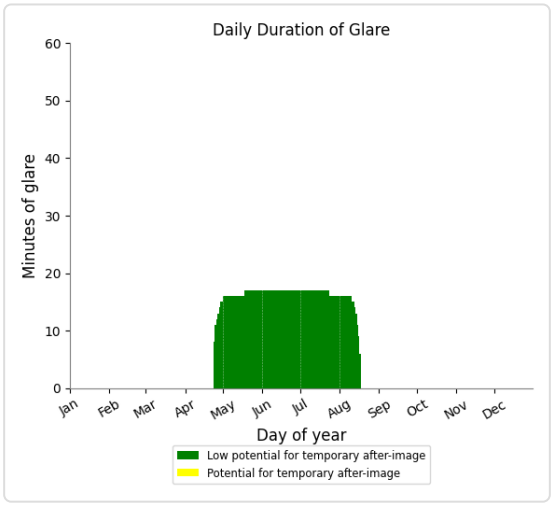


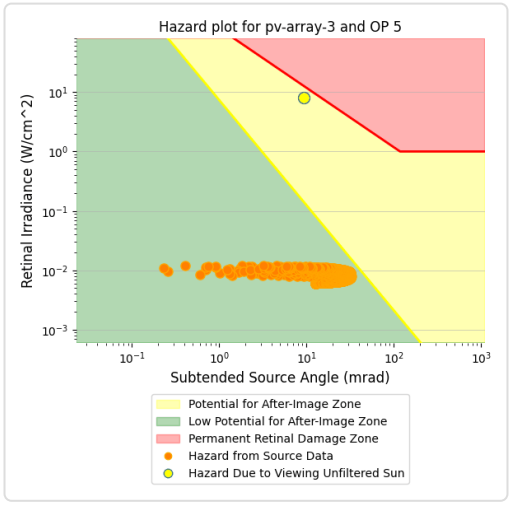
PV array 3 and OP 5

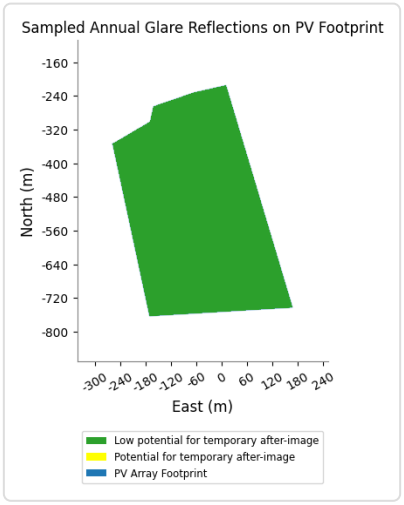
Yellow glare: none

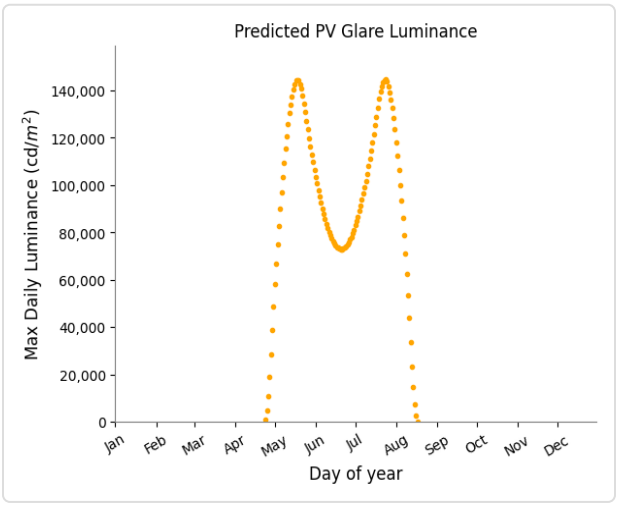
Green glare: 1,870 min.







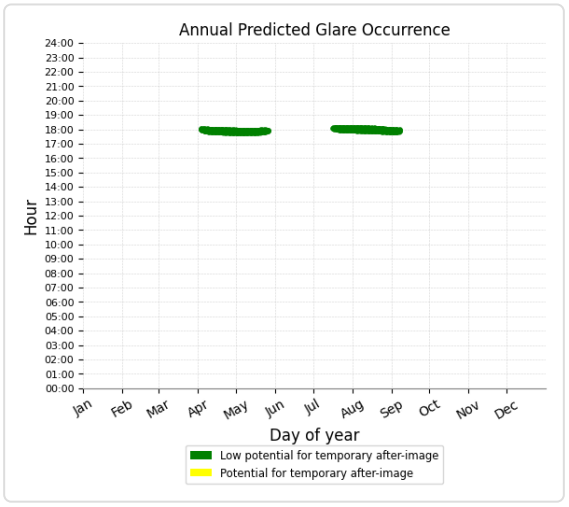


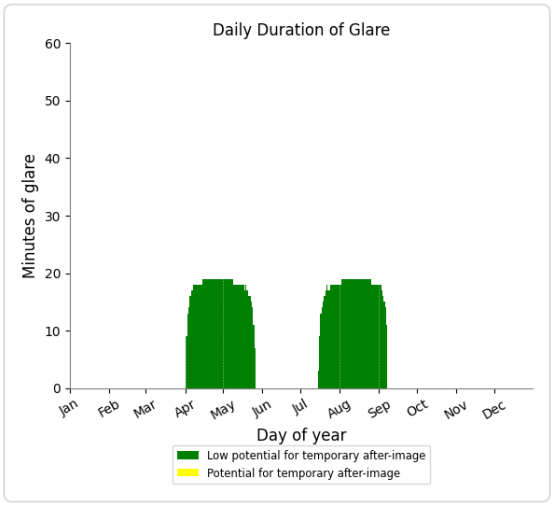


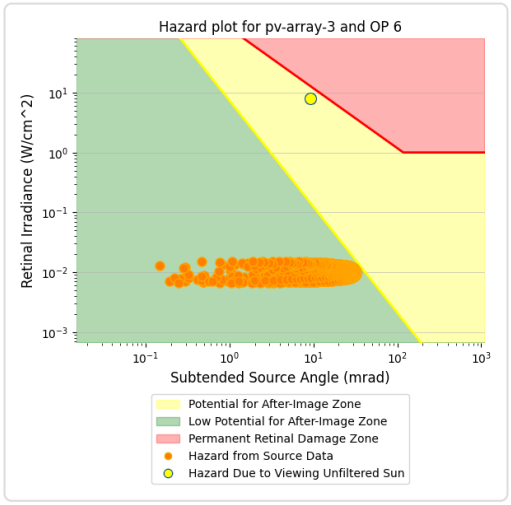
PV array 3 and OP 6

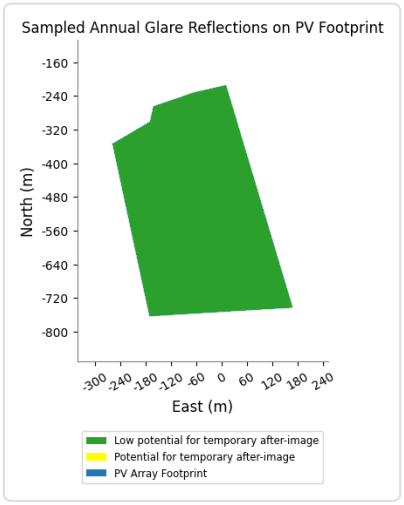
Yellow glare: none

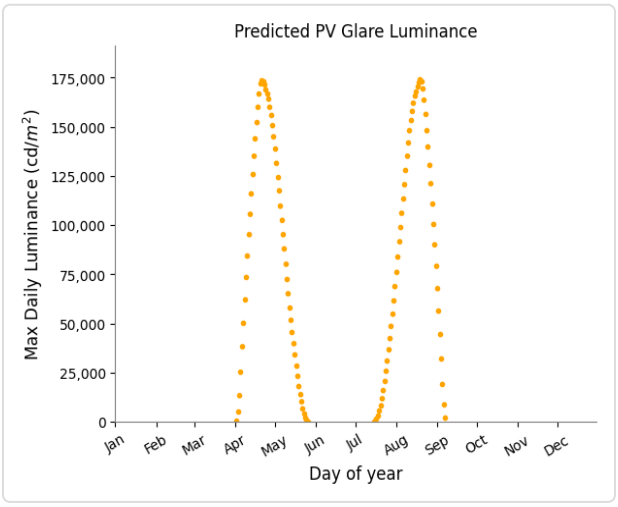
Green glare: 1,916 min.







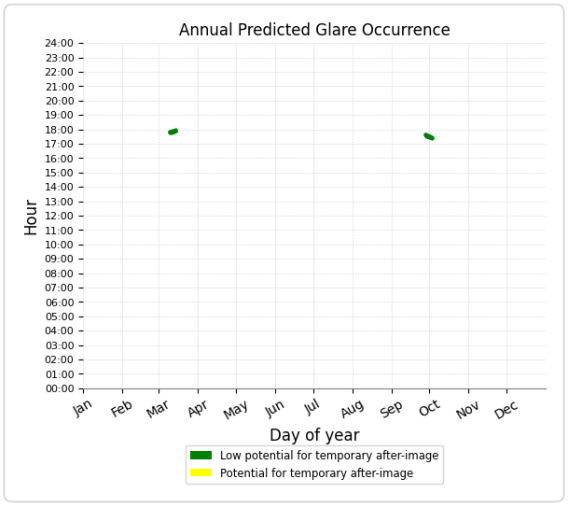


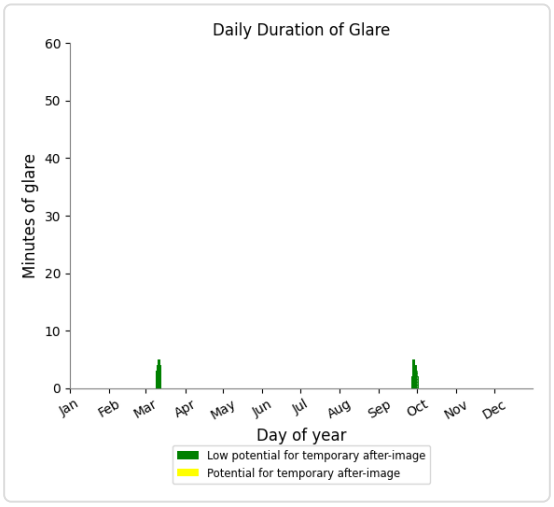


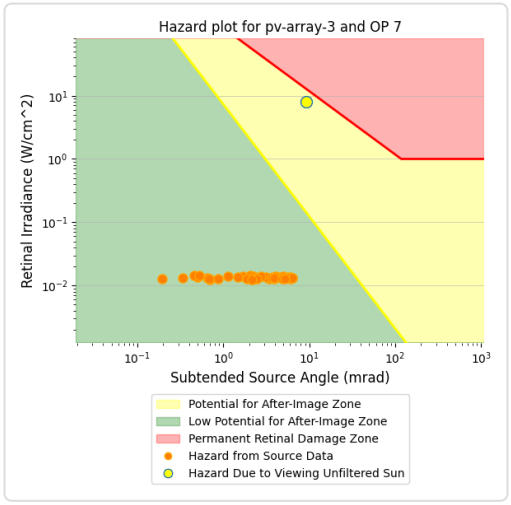
PV array 3 and OP 7

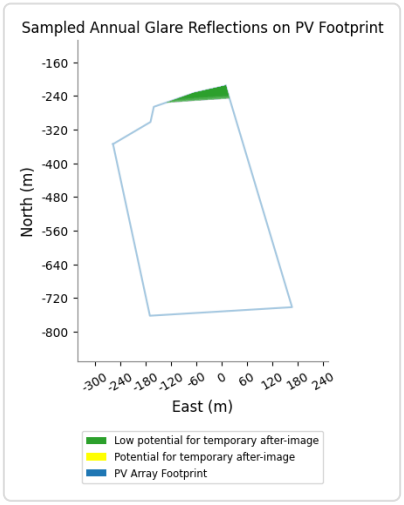
Yellow glare: none

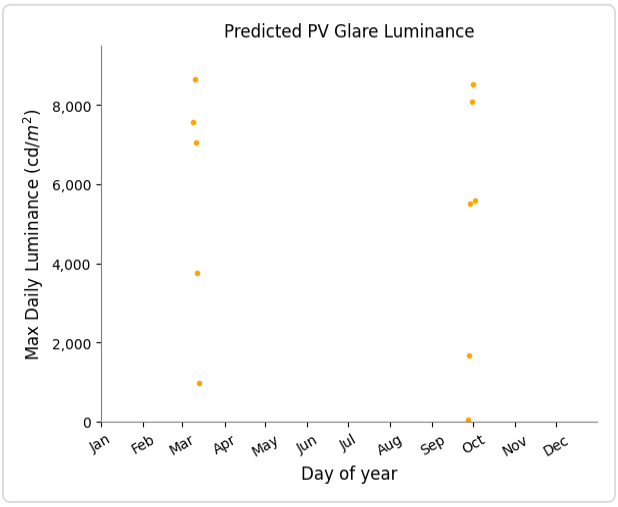
Green glare: 42 min.







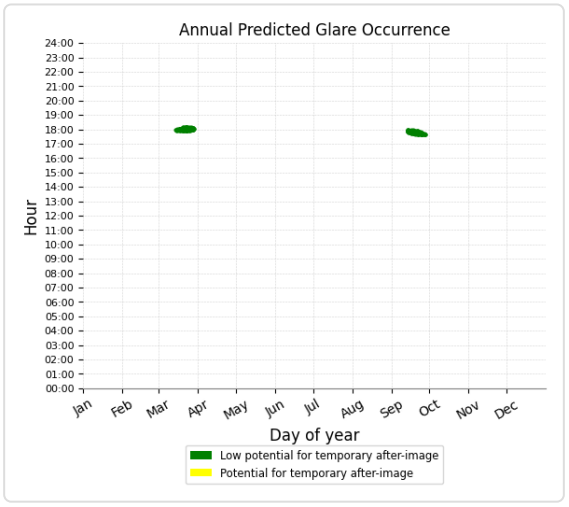


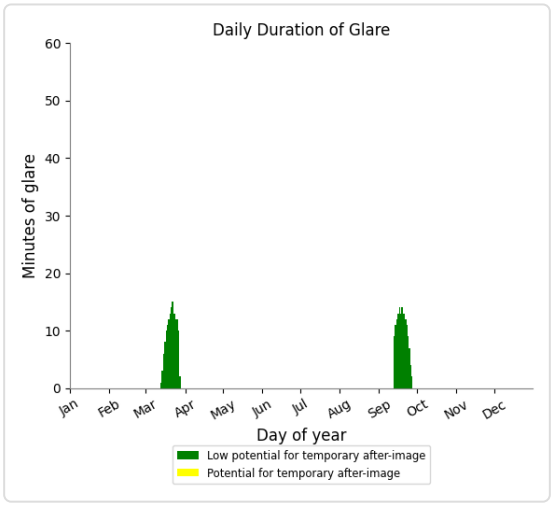


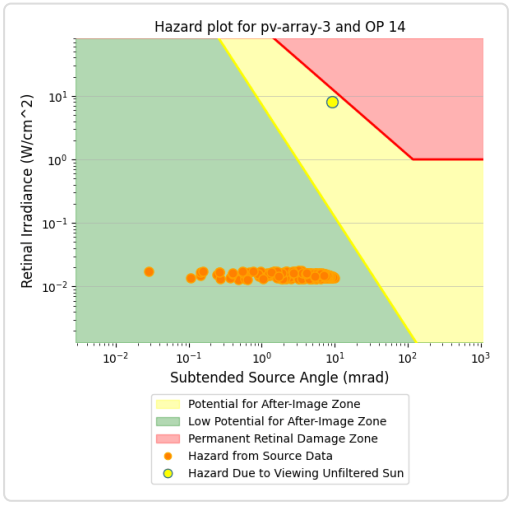
PV array 3 and OP 14

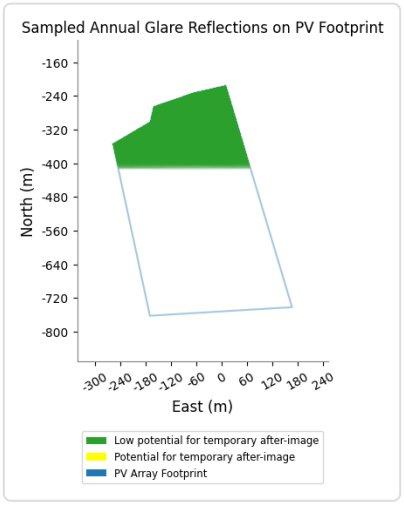
Yellow glare: none

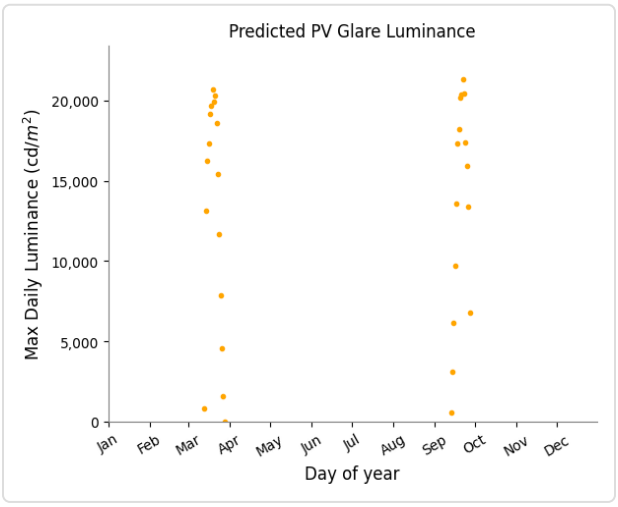
Green glare: 312 min.











PV array 3 and OP 1

No glare found

PV array 3 and OP 2

No glare found

PV array 3 and OP 8

No glare found

PV array 3 and OP 9

No glare found

PV array 3 and OP 10

No glare found

PV array 3 and OP 11

No glare found

PV array 3 and OP 12

No glare found

PV array 3 and OP 13

No glare found

PV array 3 and OP 15

No glare found

PV array 3 and OP 16

No glare found

PV array 3 and OP 17

No glare found

PV array 3 and OP 18

No glare found

PV array 3 and OP 19

No glare found

PV array 3 and OP 20

No glare found

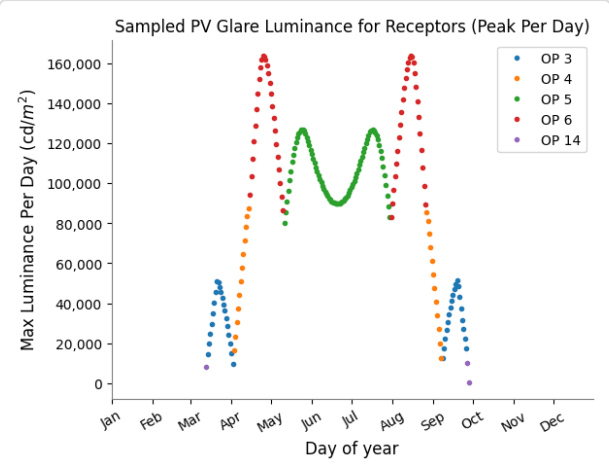
PV array 3 and OP 21

No glare found

PV: PV array 4 low potential for temporary after-image

Receptor results ordered by category of glare

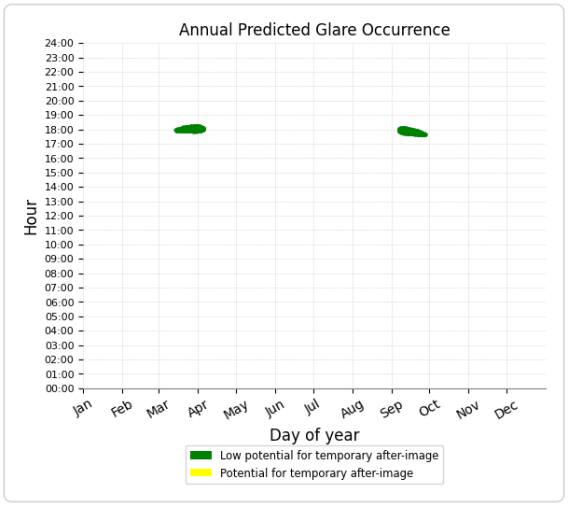
Receptor	Annual Green Glare		Annual Yellow Glare		Peak Luminance
	min	hr	min	hr	cd/m^2
OP 3	716	11.9	0	0.0	51,209
OP 4	1,557	25.9	0	0.0	91,653
OP 5	2,801	46.7	0	0.0	126,920
OP 6	2,552	42.5	0	0.0	163,630
OP 14	283	4.7	0	0.0	15,341
OP 1	0	0.0	0	0.0	0
OP 2	0	0.0	0	0.0	0
OP 7	0	0.0	0	0.0	0
OP 8	0	0.0	0	0.0	0
OP 9	0	0.0	0	0.0	0
OP 10	0	0.0	0	0.0	0
OP 11	0	0.0	0	0.0	0
OP 12	0	0.0	0	0.0	0
OP 13	0	0.0	0	0.0	0
OP 15	0	0.0	0	0.0	0
OP 16	0	0.0	0	0.0	0
OP 17	0	0.0	0	0.0	0
OP 18	0	0.0	0	0.0	0
OP 19	0	0.0	0	0.0	0
OP 20	0	0.0	0	0.0	0
OP 21	0	0.0	0	0.0	0

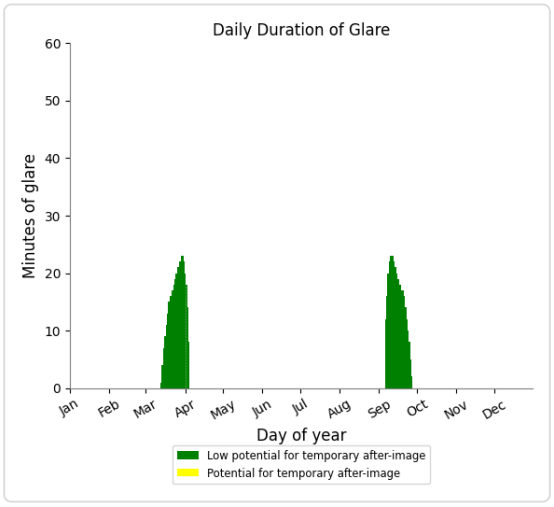


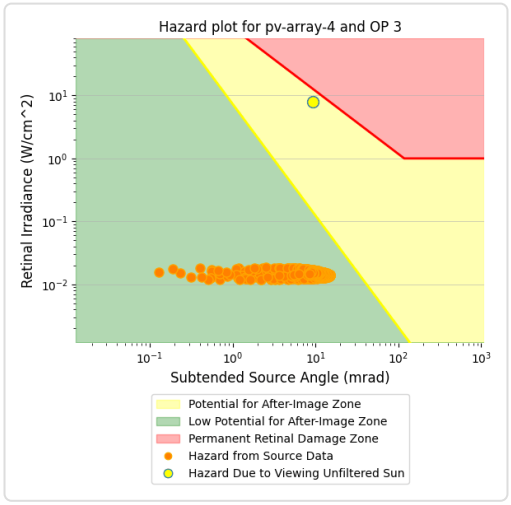
PV array 4 and OP 3

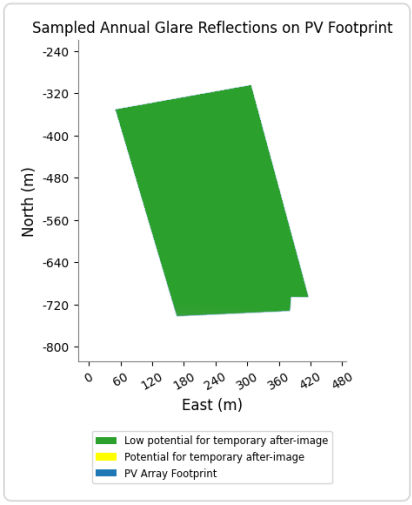
Yellow glare: none

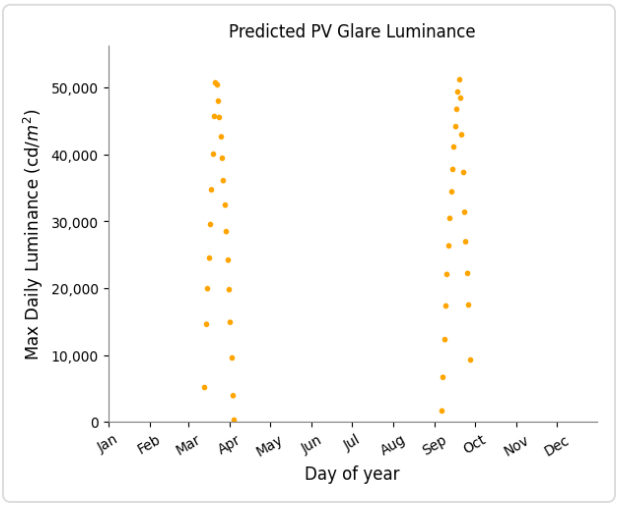
Green glare: 716 min.







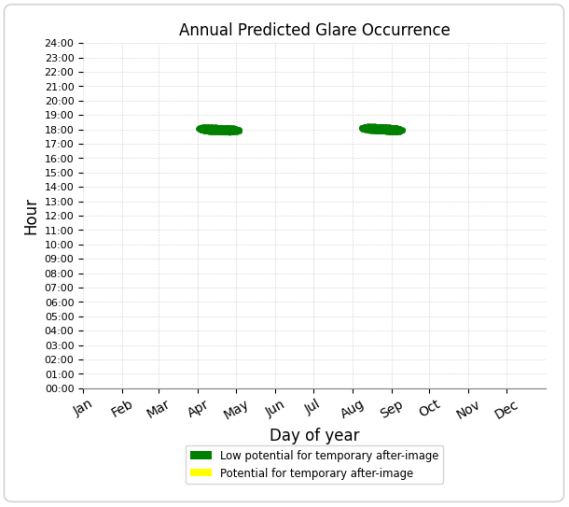


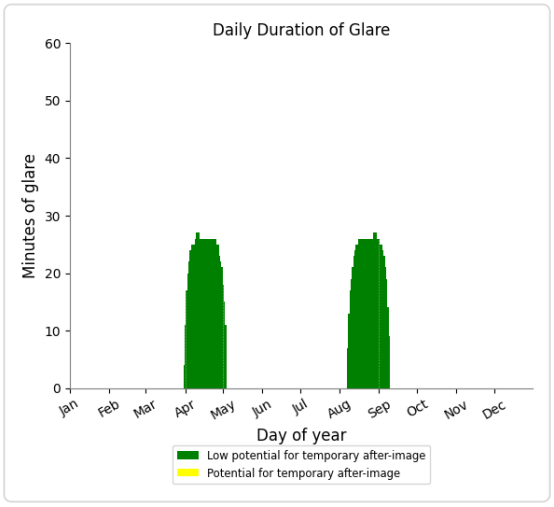


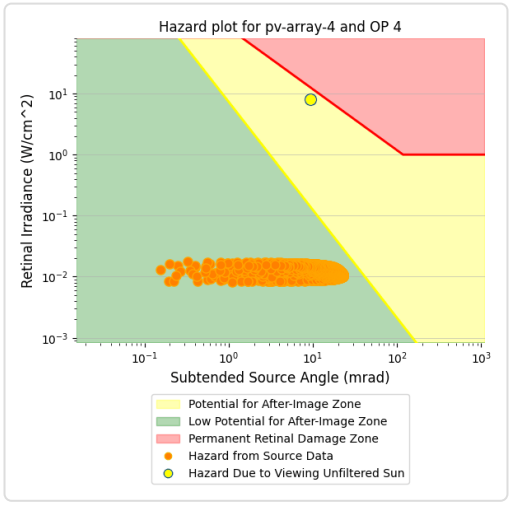
PV array 4 and OP 4

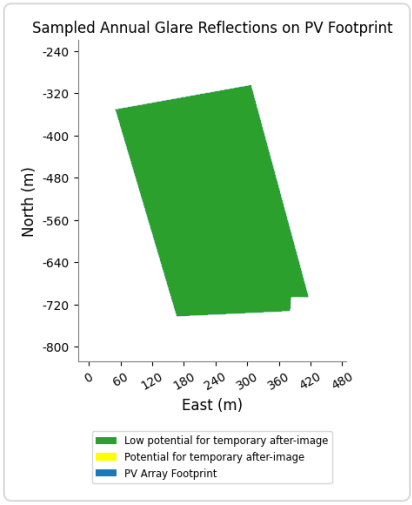
Yellow glare: none

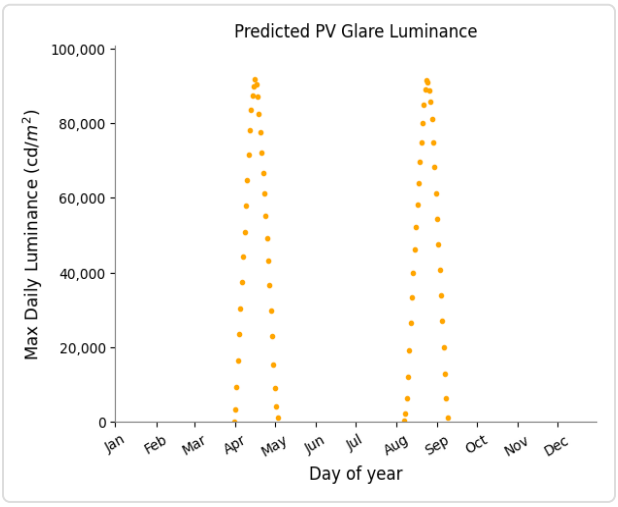
Green glare: 1,557 min.







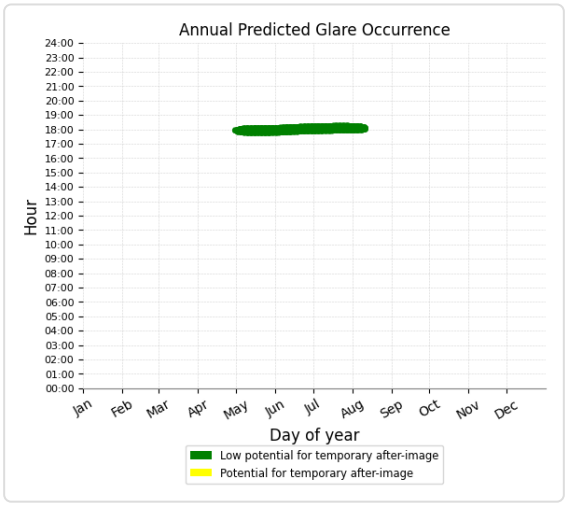


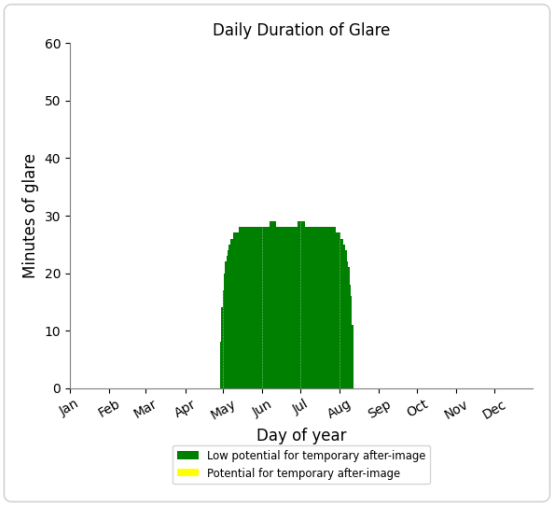


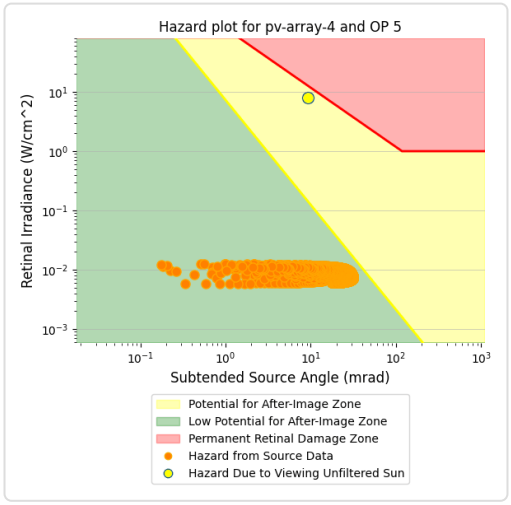
PV array 4 and OP 5

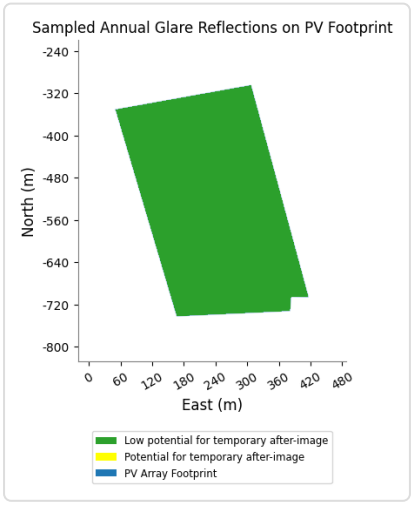
Yellow glare: none

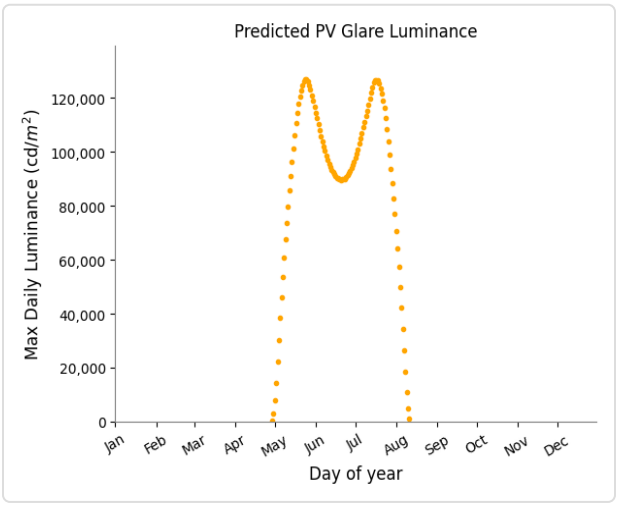
Green glare: 2,801 min.







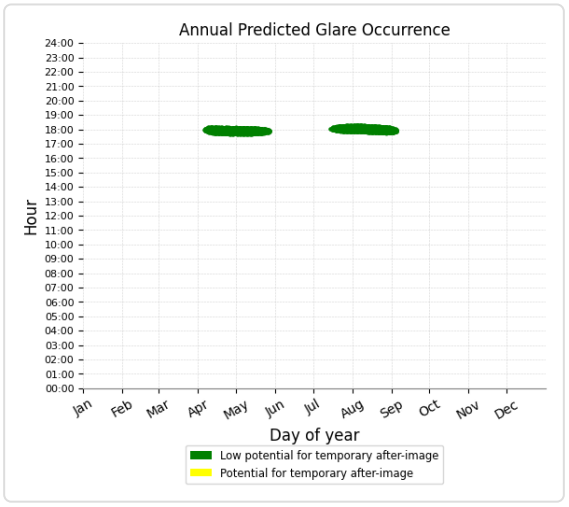


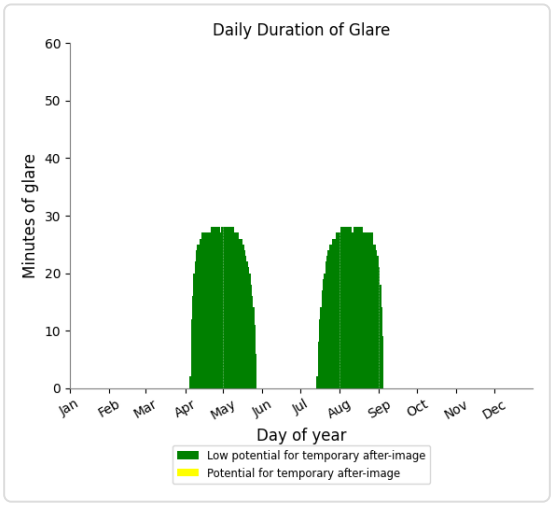


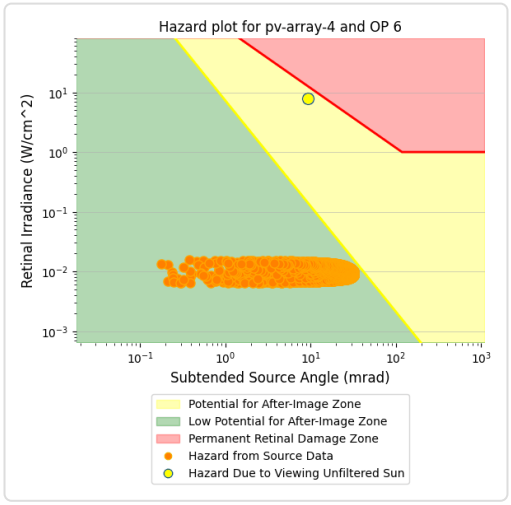
PV array 4 and OP 6

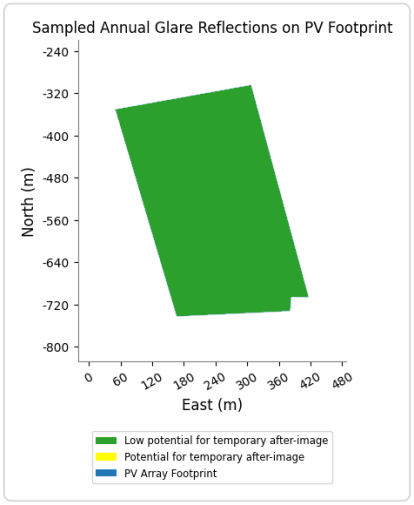
Yellow glare: none

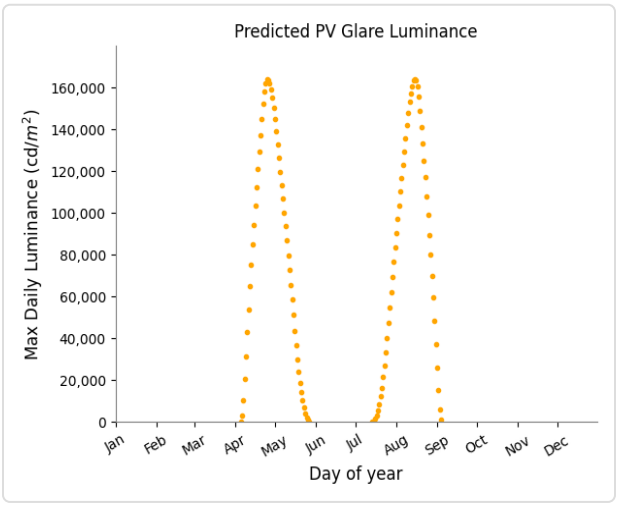
Green glare: 2,552 min.







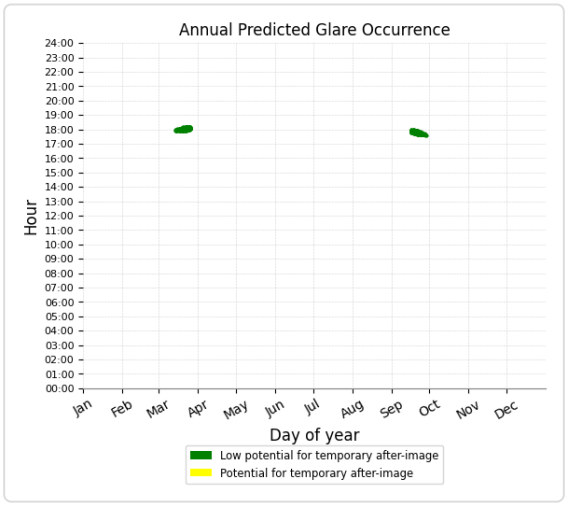


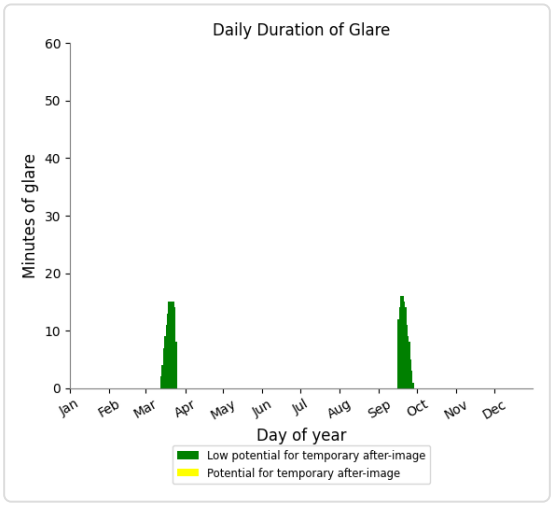


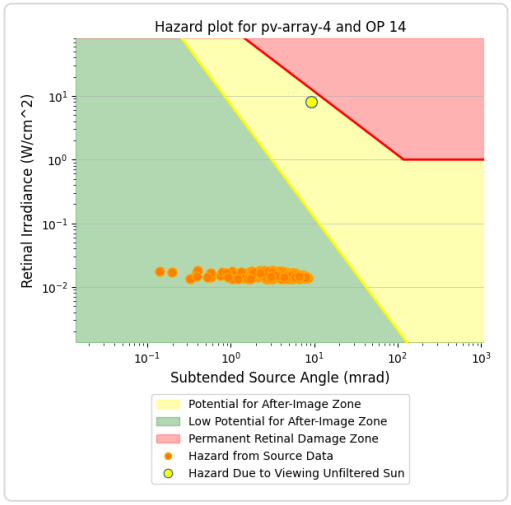
PV array 4 and OP 14

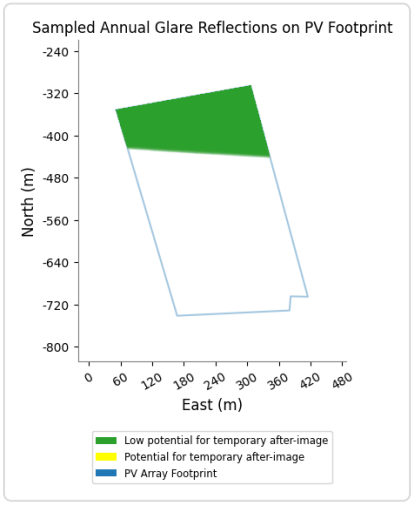
Yellow glare: none

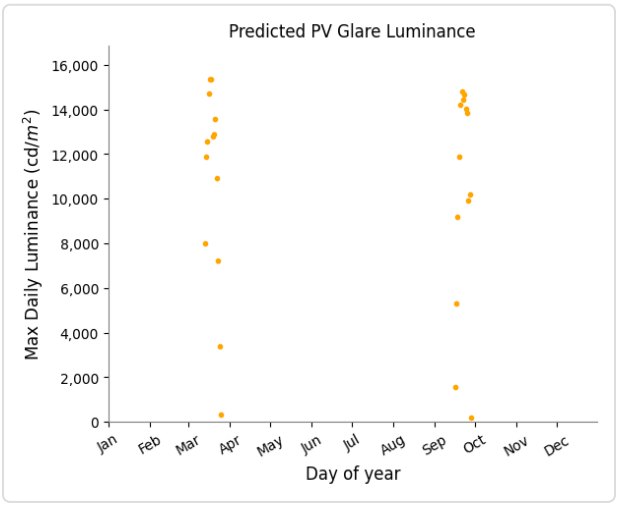
Green glare: 283 min.











PV array 4 and OP 1

No glare found

PV array 4 and OP 2

No glare found

PV array 4 and OP 7

No glare found

PV array 4 and OP 8

No glare found

PV array 4 and OP 9

No glare found

PV array 4 and OP 10

No glare found

PV array 4 and OP 11

No glare found

PV array 4 and OP 12

No glare found

PV array 4 and OP 13

No glare found

PV array 4 and OP 15

No glare found

PV array 4 and OP 16

No glare found

PV array 4 and OP 17

No glare found

PV array 4 and OP 18

No glare found

PV array 4 and OP 19

No glare found

PV array 4 and OP 20

No glare found

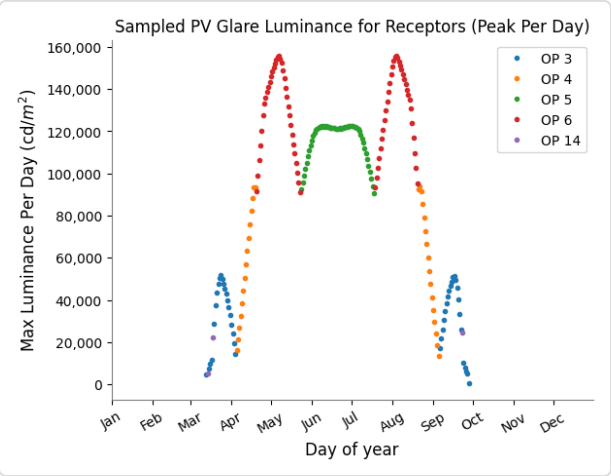
PV array 4 and OP 21

No glare found

PV: PV array 5 low potential for temporary after-image

Receptor results ordered by category of glare

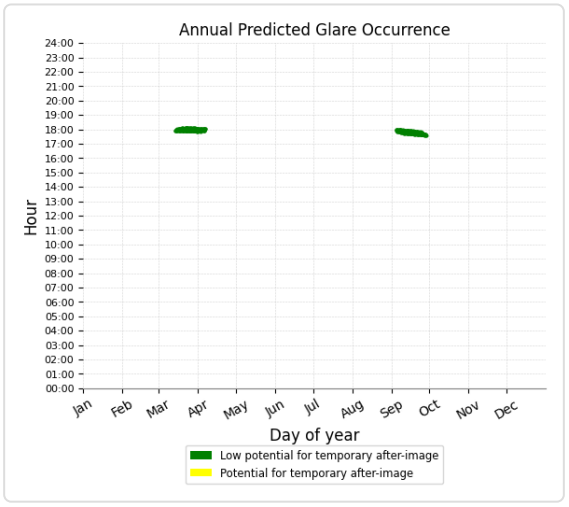
Receptor	Annual Green Glare		Annual Yellow Glare		Peak Luminance
	min	hr	min	hr	cd/m^2
OP 3	401	6.7	0	0.0	51,597
OP 4	1,084	18.1	0	0.0	93,934
OP 5	1,756	29.3	0	0.0	122,443
OP 6	2,895	48.2	0	0.0	155,496
OP 14	88	1.5	0	0.0	24,519
OP 1	0	0.0	0	0.0	0
OP 2	0	0.0	0	0.0	0
OP 7	0	0.0	0	0.0	0
OP 8	0	0.0	0	0.0	0
OP 9	0	0.0	0	0.0	0
OP 10	0	0.0	0	0.0	0
OP 11	0	0.0	0	0.0	0
OP 12	0	0.0	0	0.0	0
OP 13	0	0.0	0	0.0	0
OP 15	0	0.0	0	0.0	0
OP 16	0	0.0	0	0.0	0
OP 17	0	0.0	0	0.0	0
OP 18	0	0.0	0	0.0	0
OP 19	0	0.0	0	0.0	0
OP 20	0	0.0	0	0.0	0
OP 21	0	0.0	0	0.0	0

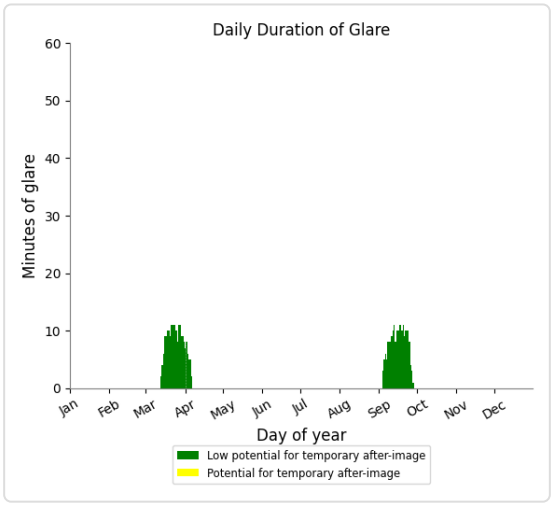


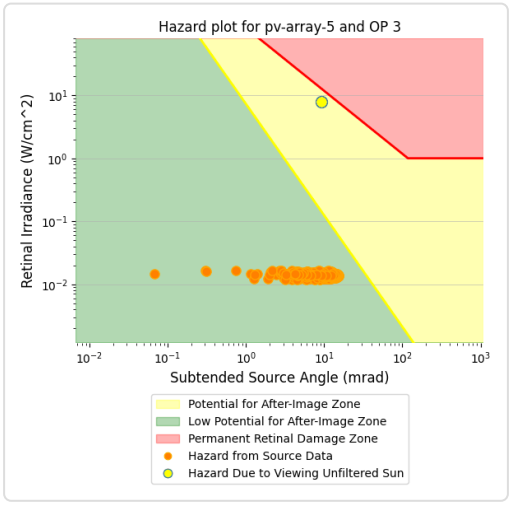
PV array 5 and OP 3

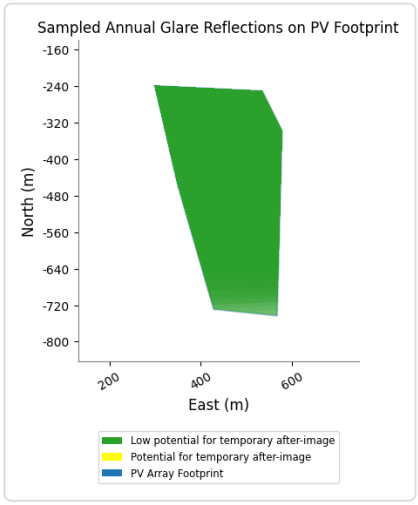
Yellow glare: none

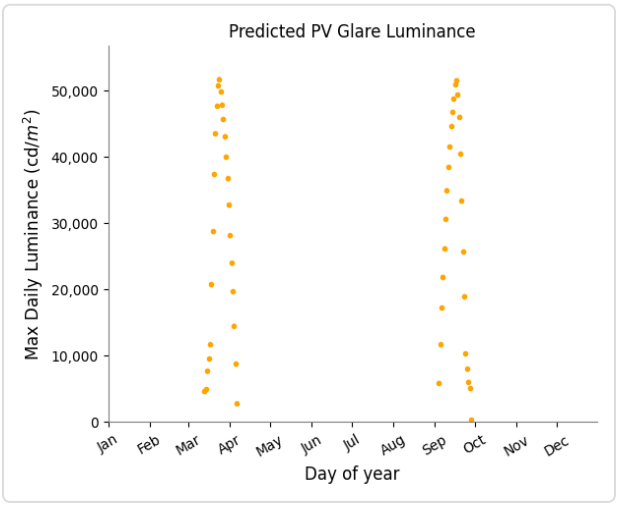
Green glare: 401 min.







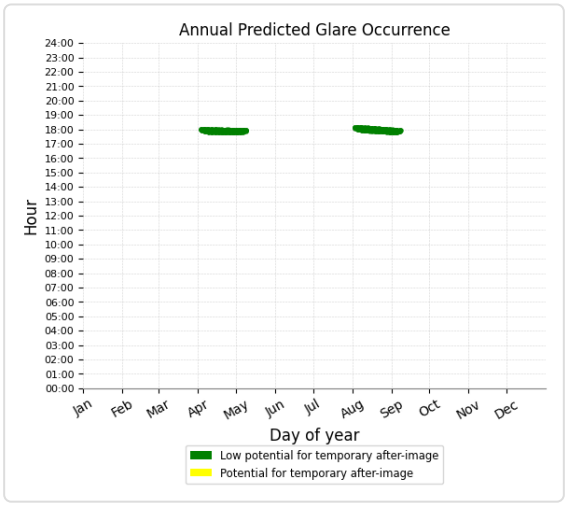


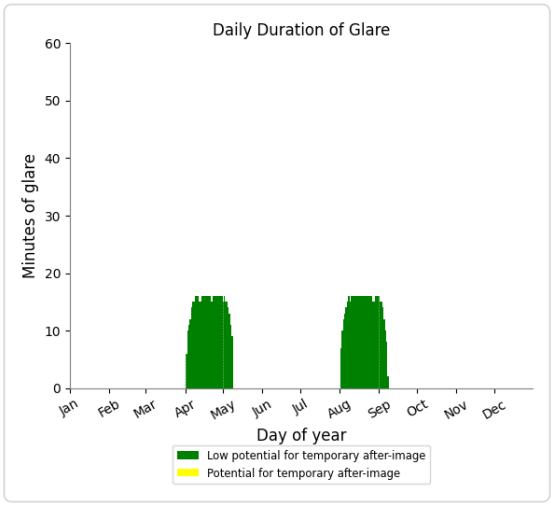


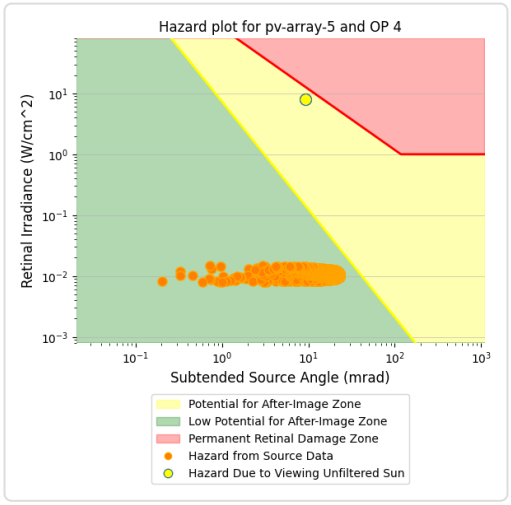
PV array 5 and OP 4

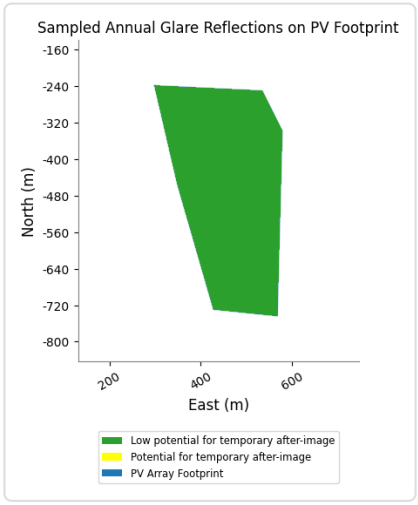
Yellow glare: none

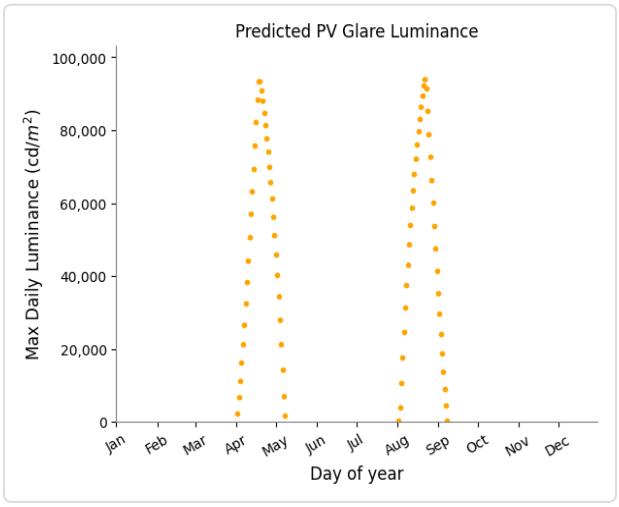
Green glare: 1,084 min.







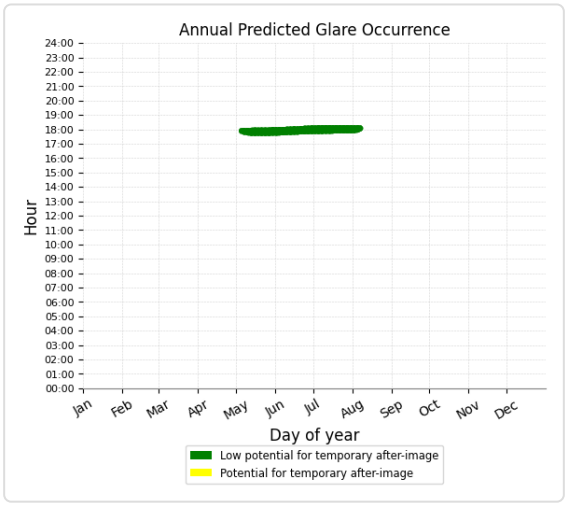


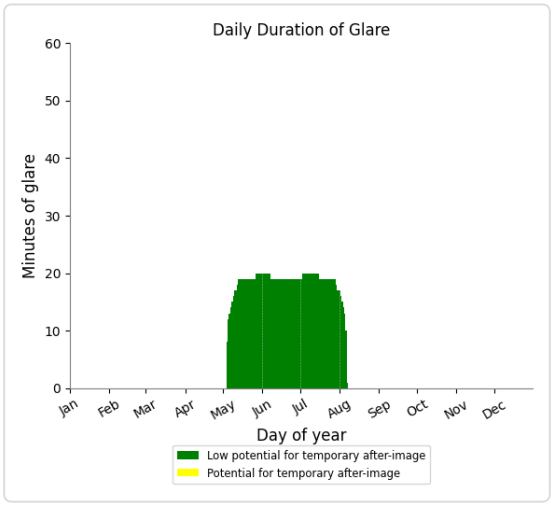


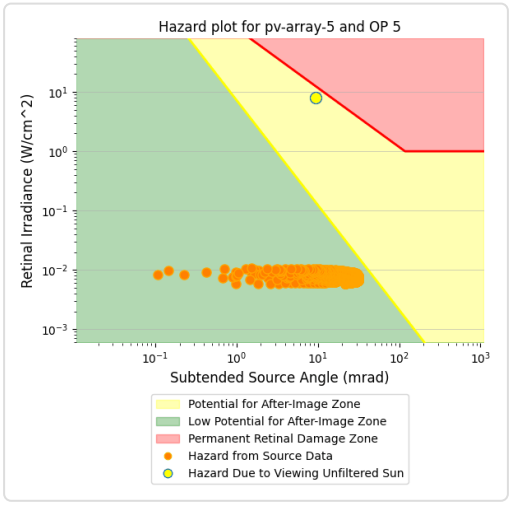
PV array 5 and OP 5

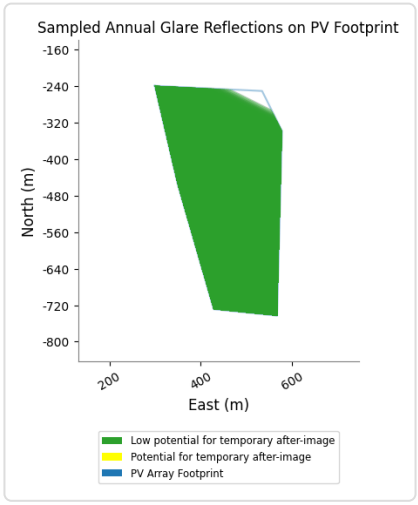
Yellow glare: none

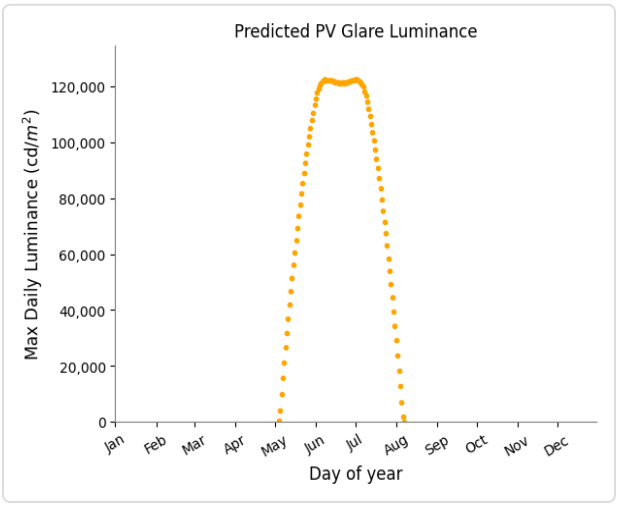
Green glare: 1,756 min.







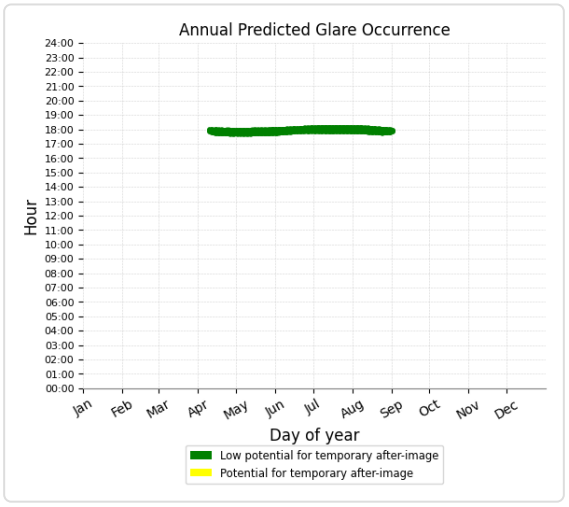


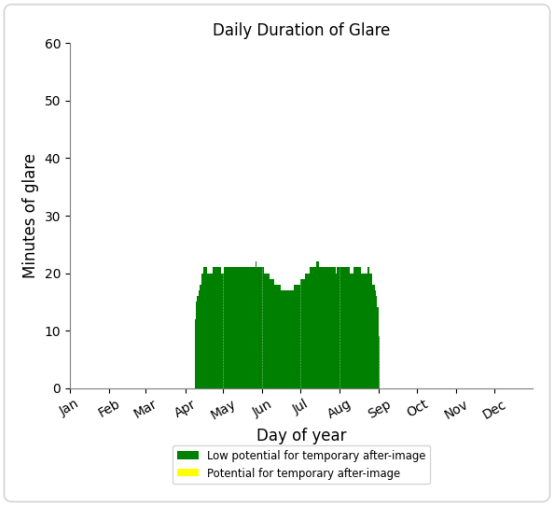


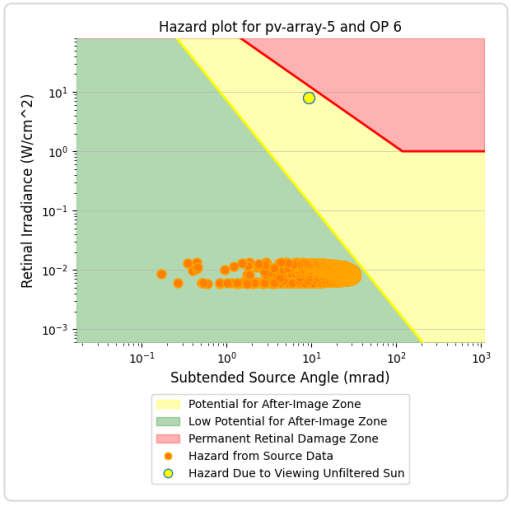
PV array 5 and OP 6

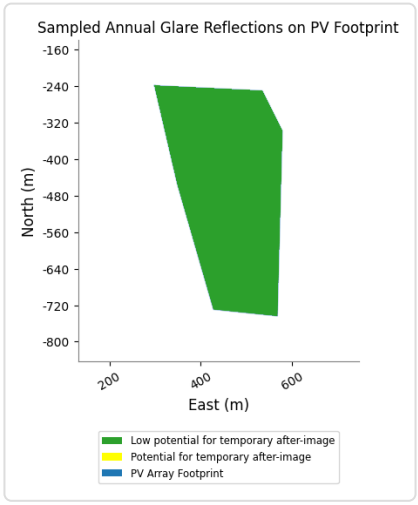
Yellow glare: none

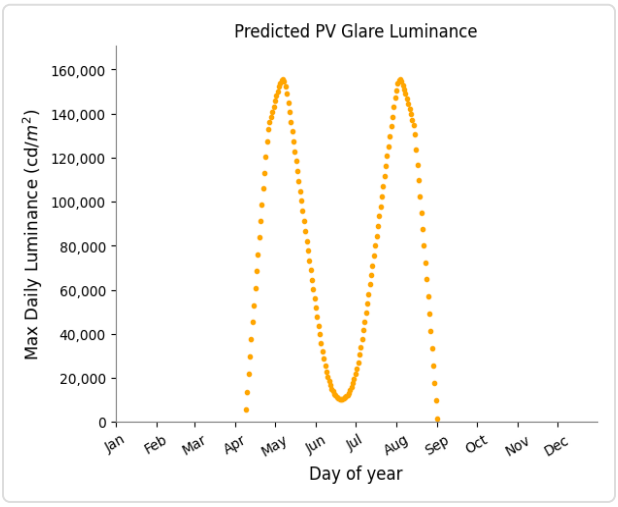
Green glare: 2,895 min.







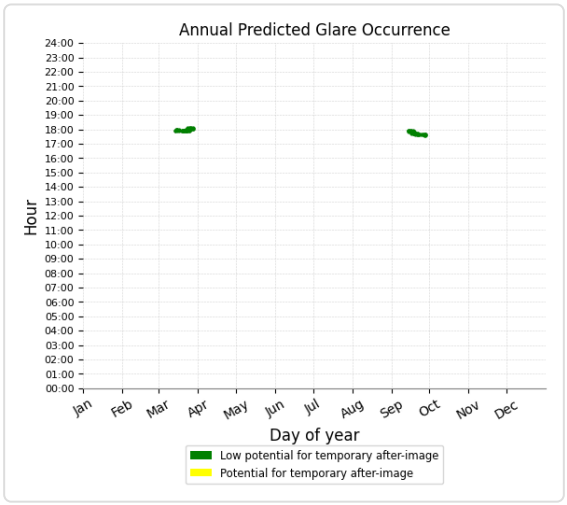


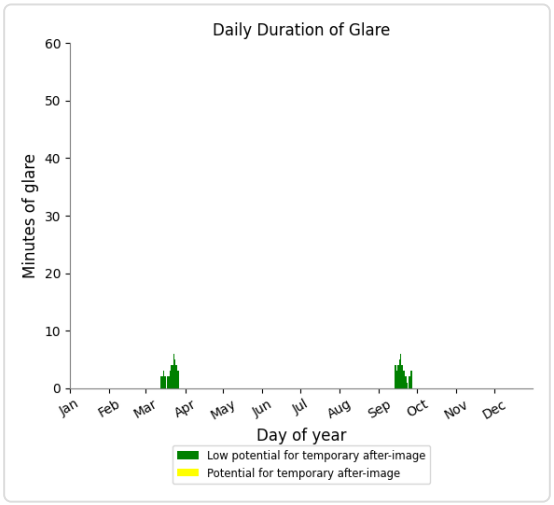


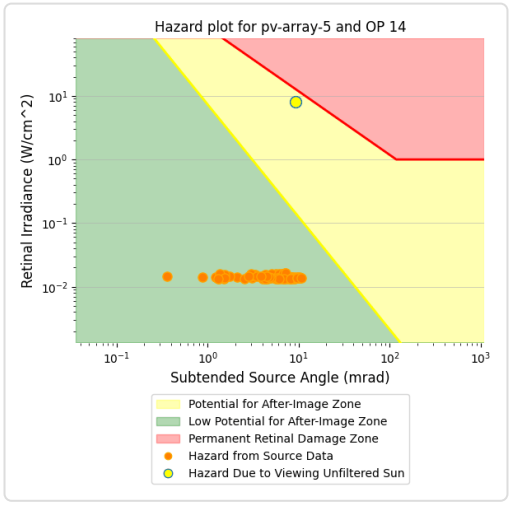
PV array 5 and OP 14

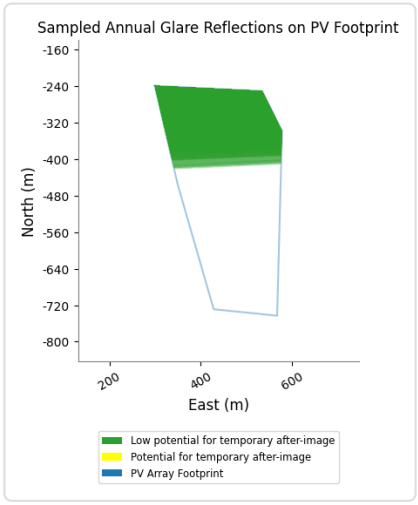
Yellow glare: none

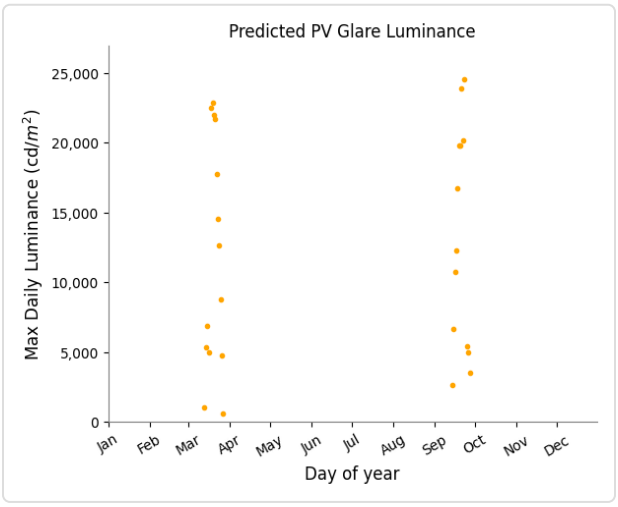
Green glare: 88 min.











PV array 5 and OP 1

No glare found

PV array 5 and OP 2

No glare found

PV array 5 and OP 7

No glare found

PV array 5 and OP 8

No glare found

PV array 5 and OP 9

No glare found

PV array 5 and OP 10

No glare found

PV array 5 and OP 11

No glare found

PV array 5 and OP 12

No glare found

PV array 5 and OP 13

No glare found

PV array 5 and OP 15

No glare found

PV array 5 and OP 16

No glare found

PV array 5 and OP 17

No glare found

PV array 5 and OP 18

No glare found

PV array 5 and OP 19

No glare found

PV array 5 and OP 20

No glare found

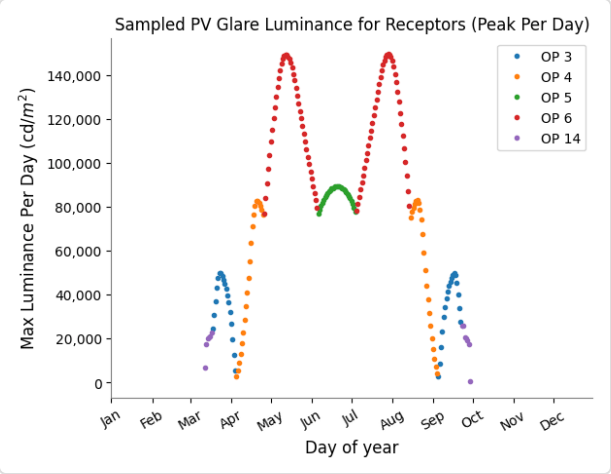
PV array 5 and OP 21

No glare found

PV: PV array 6 low potential for temporary after-image

Receptor results ordered by category of glare

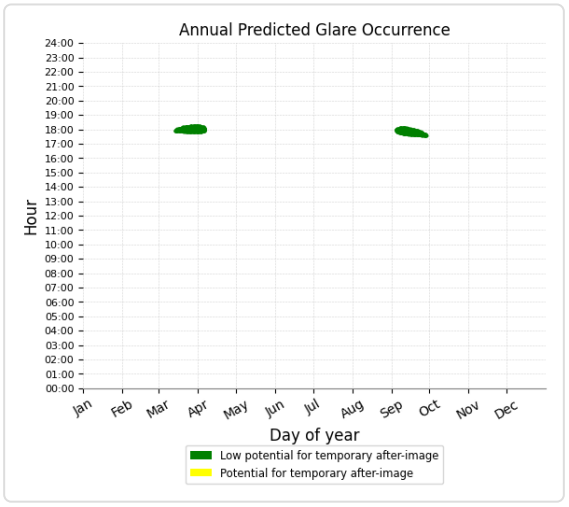
Receptor	Annual Green Glare		Annual Yellow Glare		Peak Luminance
	min	hr	min	hr	cd/m^2
OP 3	832	13.9	0	0.0	49,877
OP 4	1,840	30.7	0	0.0	82,961
OP 5	2,350	39.2	0	0.0	89,175
OP 6	3,885	64.8	0	0.0	149,436
OP 14	314	5.2	0	0.0	25,812
OP 1	0	0.0	0	0.0	0
OP 2	0	0.0	0	0.0	0
OP 7	0	0.0	0	0.0	0
OP 8	0	0.0	0	0.0	0
OP 9	0	0.0	0	0.0	0
OP 10	0	0.0	0	0.0	0
OP 11	0	0.0	0	0.0	0
OP 12	0	0.0	0	0.0	0
OP 13	0	0.0	0	0.0	0
OP 15	0	0.0	0	0.0	0
OP 16	0	0.0	0	0.0	0
OP 17	0	0.0	0	0.0	0
OP 18	0	0.0	0	0.0	0
OP 19	0	0.0	0	0.0	0
OP 20	0	0.0	0	0.0	0
OP 21	0	0.0	0	0.0	0

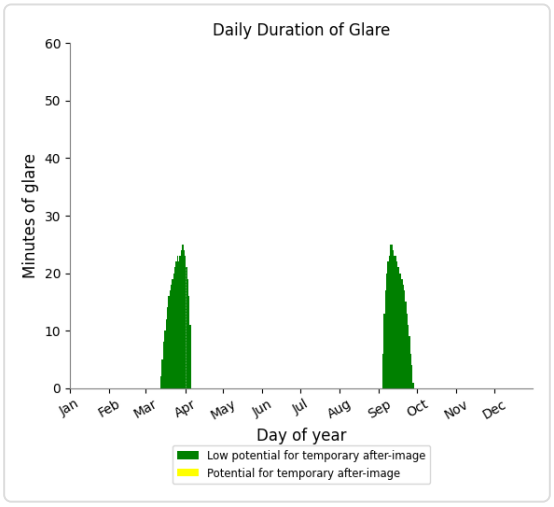


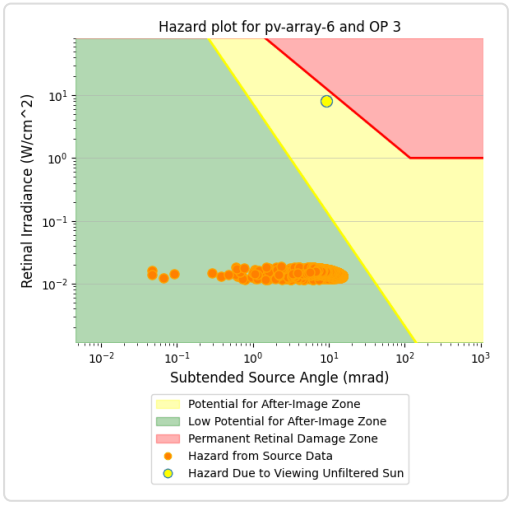
PV array 6 and OP 3

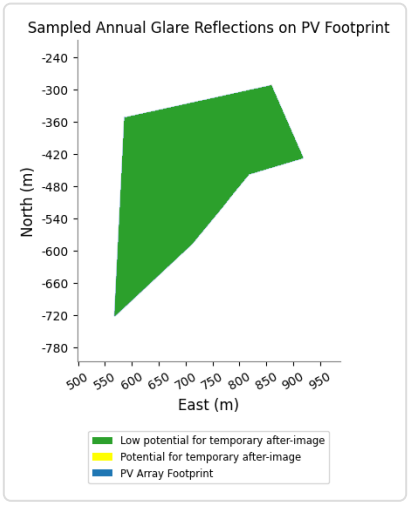
Yellow glare: none

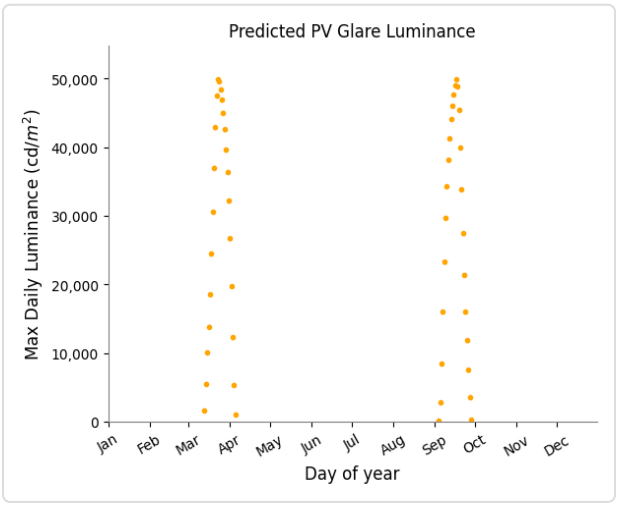
Green glare: 832 min.







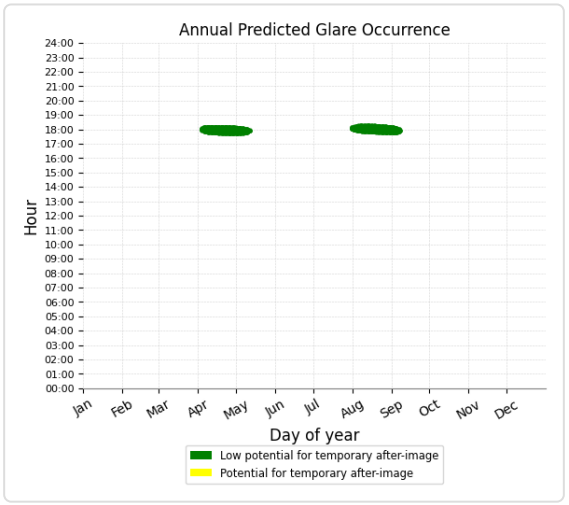


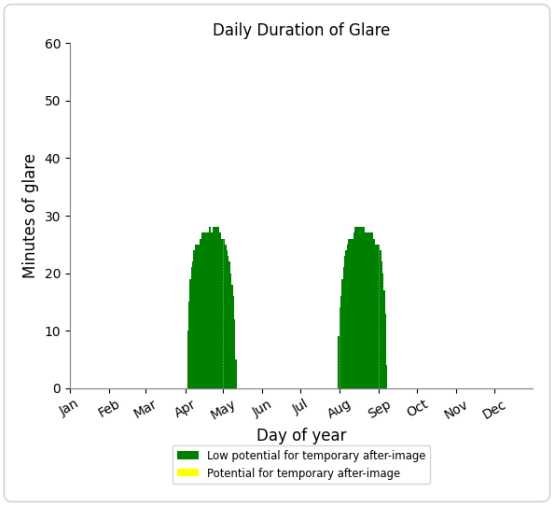


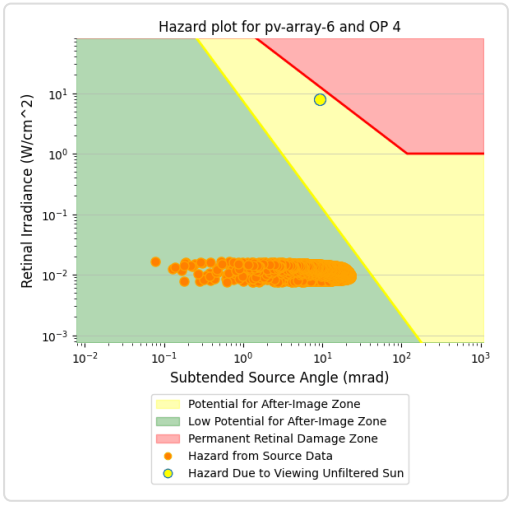
PV array 6 and OP 4

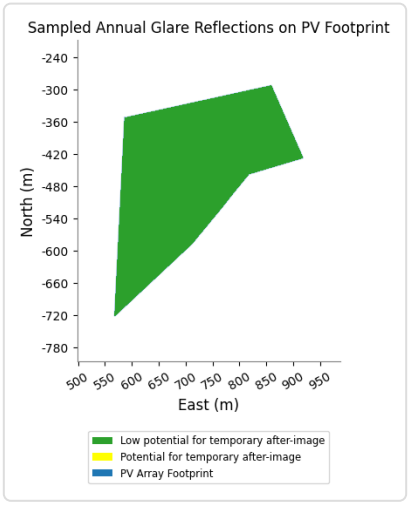
Yellow glare: none

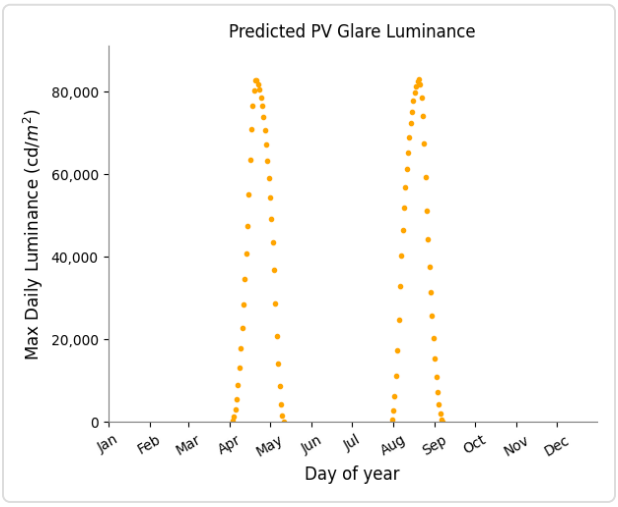
Green glare: 1,840 min.







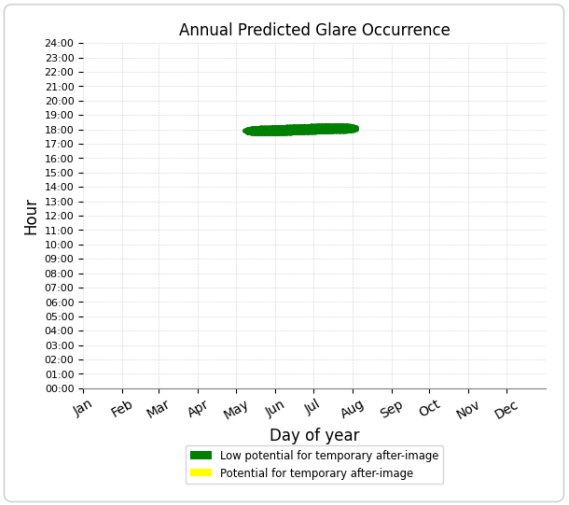


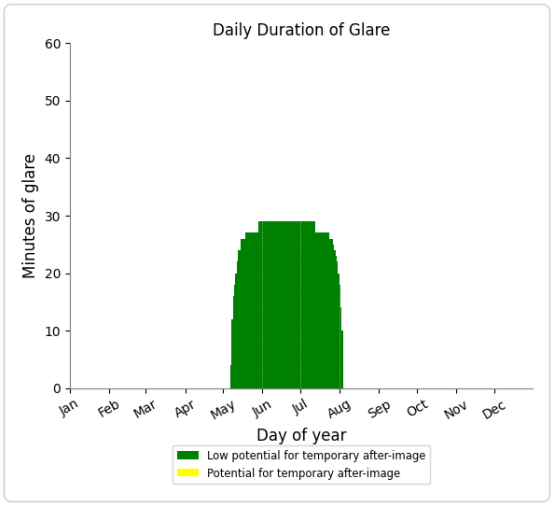


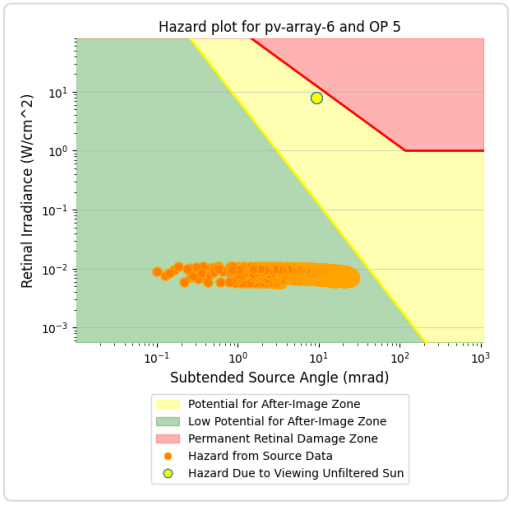
PV array 6 and OP 5

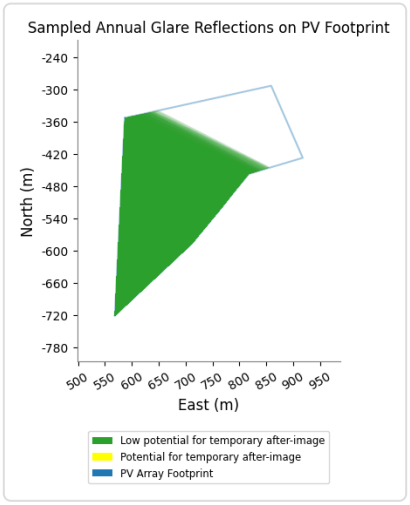
Yellow glare: none

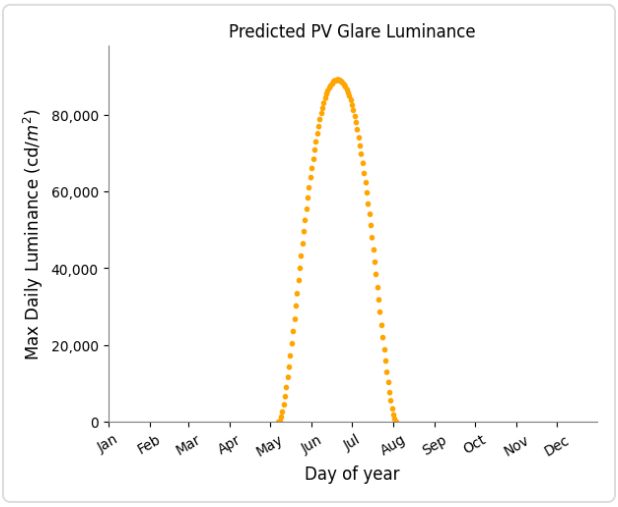
Green glare: 2,350 min.







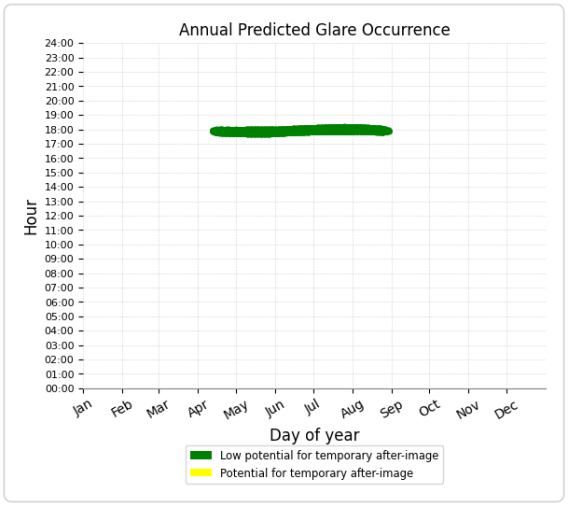


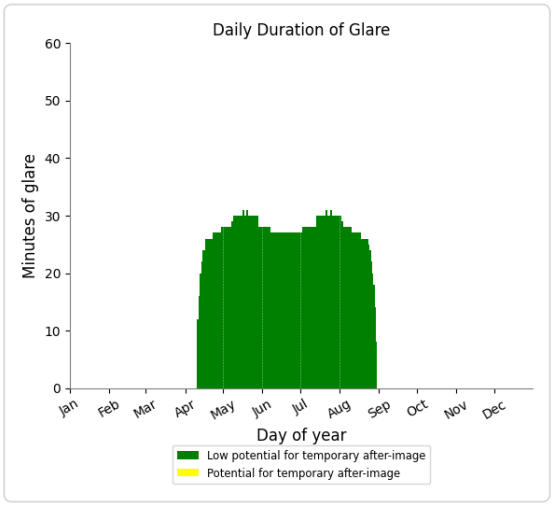


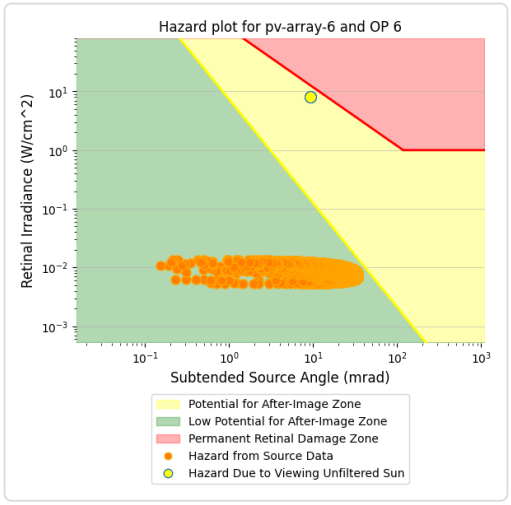
PV array 6 and OP 6

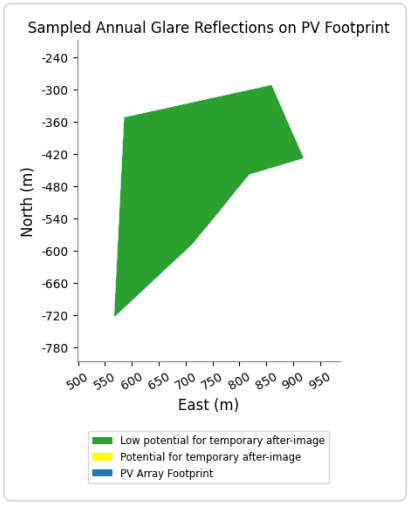
Yellow glare: none

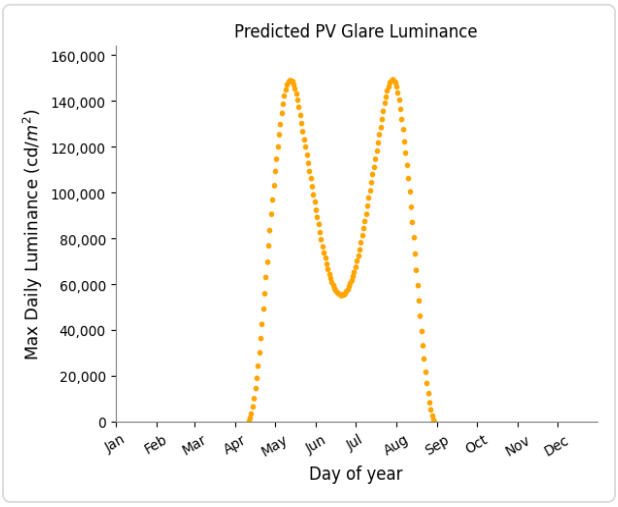
Green glare: 3,885 min.







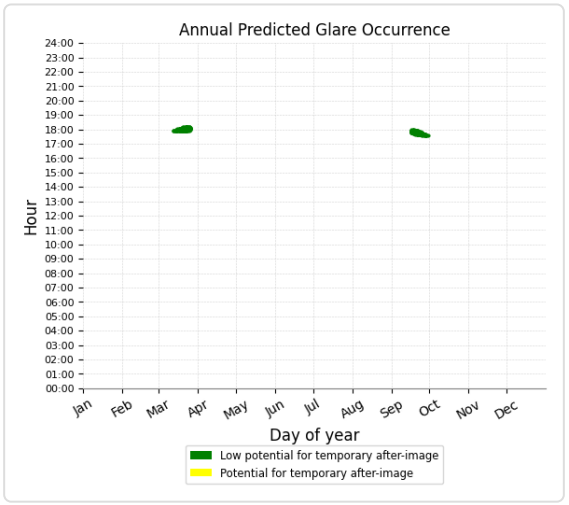


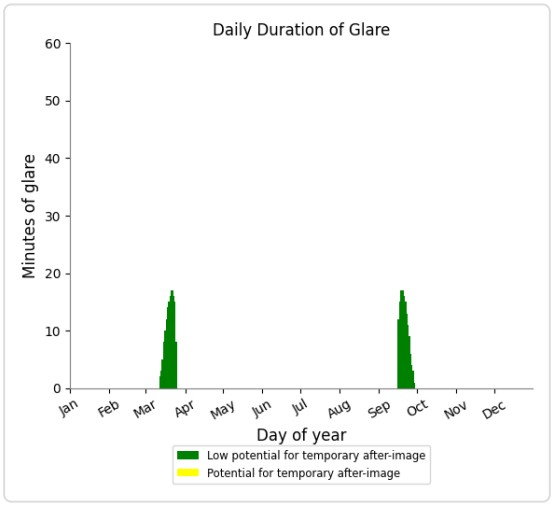


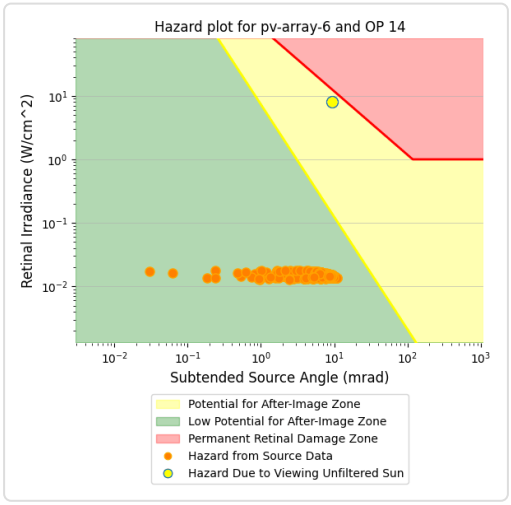
PV array 6 and OP 14

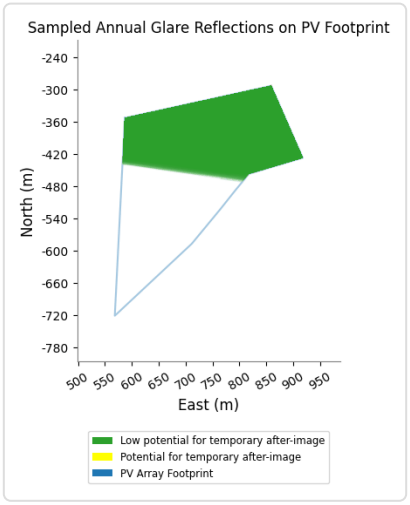
Yellow glare: none

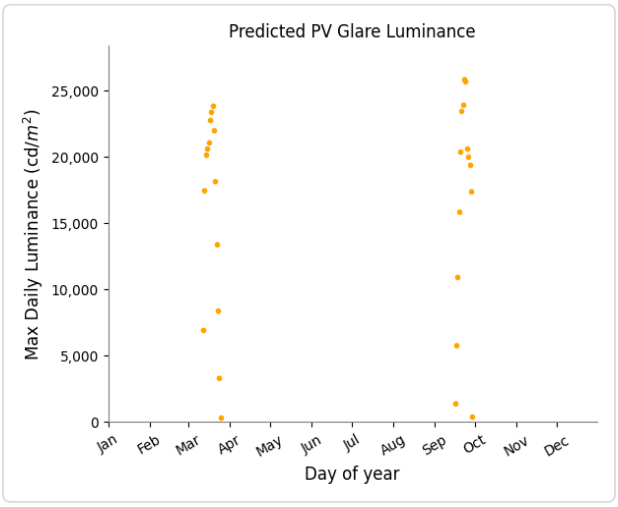
Green glare: 314 min.











PV array 6 and OP 1

No glare found

PV array 6 and OP 2

No glare found

PV array 6 and OP 7

No glare found

PV array 6 and OP 8

No glare found

PV array 6 and OP 9

No glare found

PV array 6 and OP 10

No glare found

PV array 6 and OP 11

No glare found

PV array 6 and OP 12

No glare found

PV array 6 and OP 13

No glare found

PV array 6 and OP 15

No glare found

PV array 6 and OP 16

No glare found

PV array 6 and OP 17

No glare found

PV array 6 and OP 18

No glare found

PV array 6 and OP 19

No glare found

PV array 6 and OP 20

No glare found

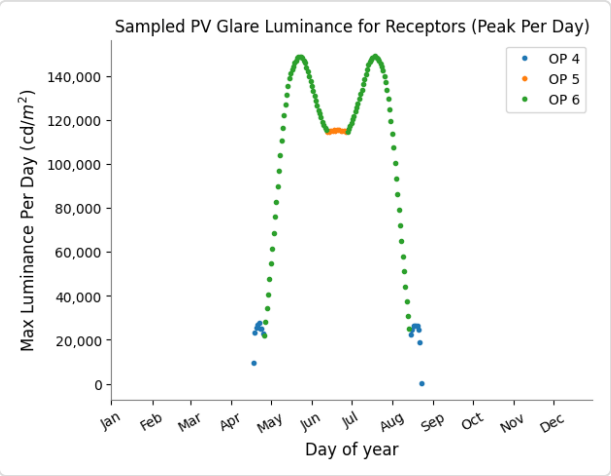
PV array 6 and OP 21

No glare found

PV: PV array 7 low potential for temporary after-image

Receptor results ordered by category of glare

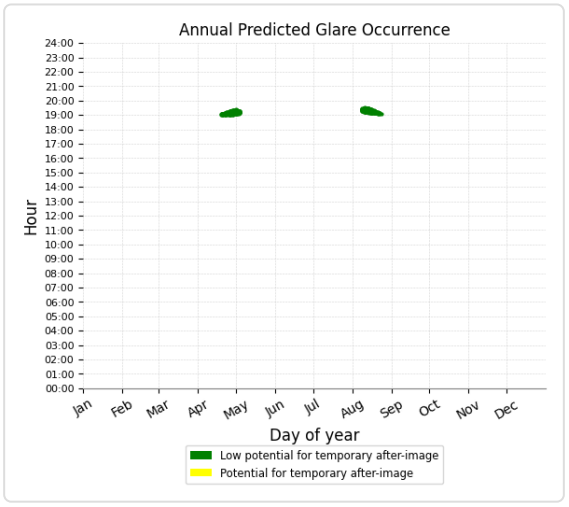
Receptor	Annual Green Glare		Annual Yellow Glare		Peak Luminance
	min	hr	min	hr	cd/m^2
OP 4	389	6.5	0	0.0	27,843
OP 5	2,510	41.8	0	0.0	115,382
OP 6	3,260	54.3	0	0.0	148,928
OP 1	0	0.0	0	0.0	0
OP 2	0	0.0	0	0.0	0
OP 3	0	0.0	0	0.0	0
OP 7	0	0.0	0	0.0	0
OP 8	0	0.0	0	0.0	0
OP 9	0	0.0	0	0.0	0
OP 10	0	0.0	0	0.0	0
OP 11	0	0.0	0	0.0	0
OP 12	0	0.0	0	0.0	0
OP 13	0	0.0	0	0.0	0
OP 14	0	0.0	0	0.0	0
OP 15	0	0.0	0	0.0	0
OP 16	0	0.0	0	0.0	0
OP 17	0	0.0	0	0.0	0
OP 18	0	0.0	0	0.0	0
OP 19	0	0.0	0	0.0	0
OP 20	0	0.0	0	0.0	0
OP 21	0	0.0	0	0.0	0

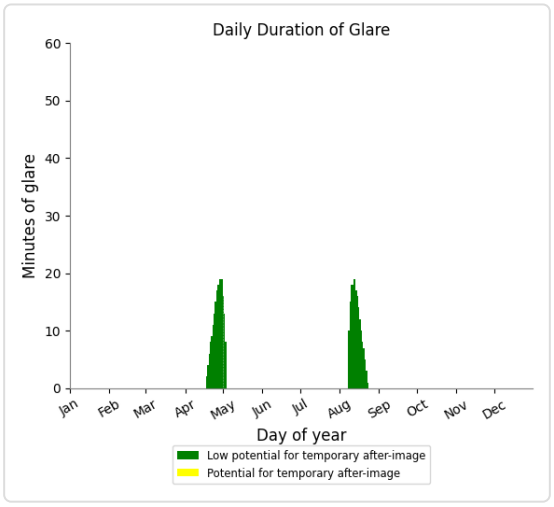


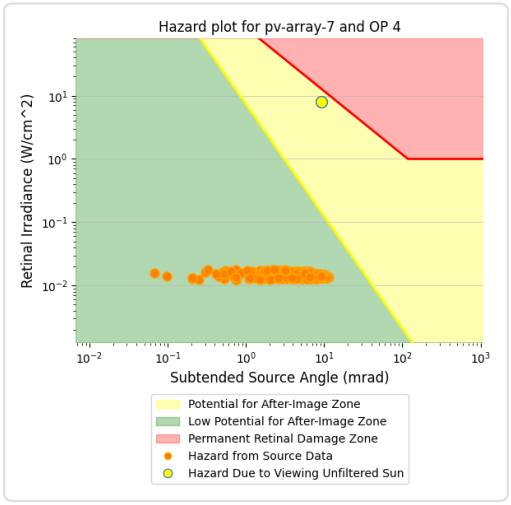
PV array 7 and OP 4

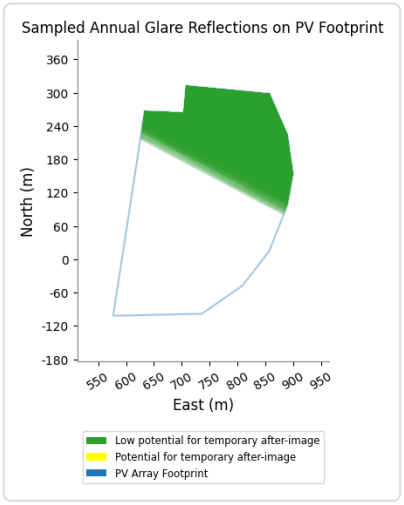
Yellow glare: none

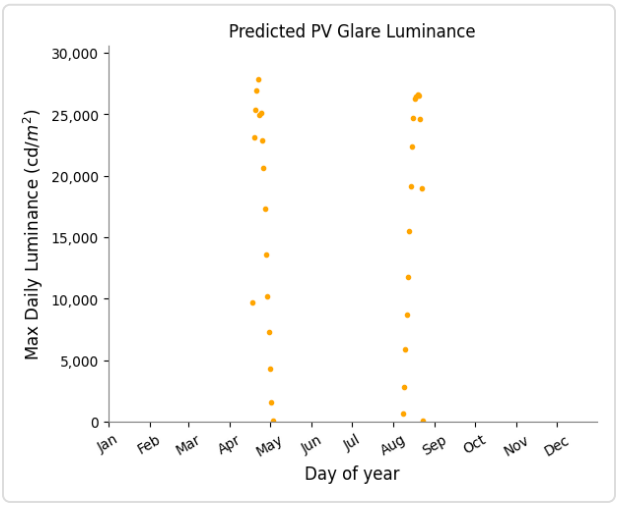
Green glare: 389 min.







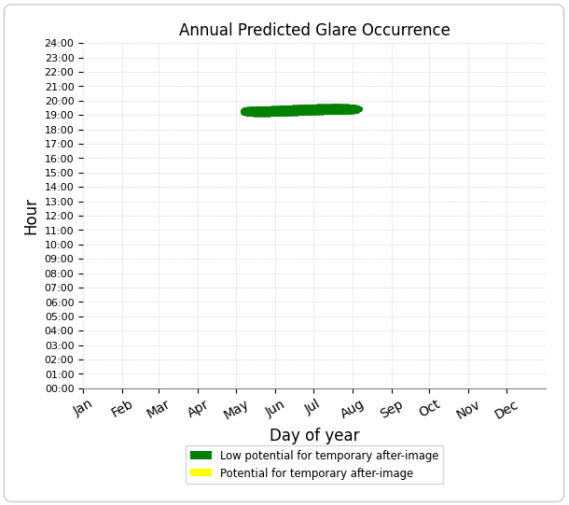


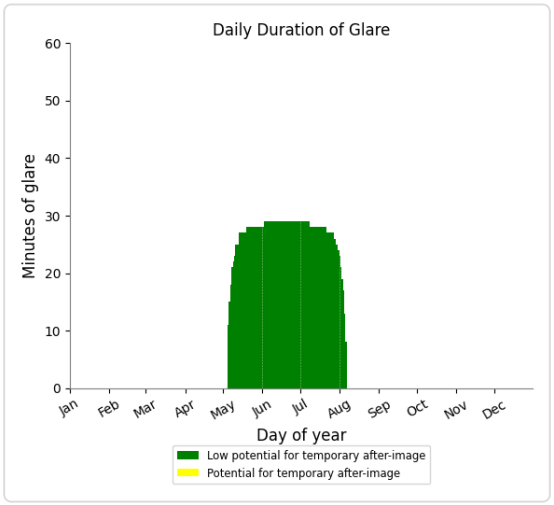


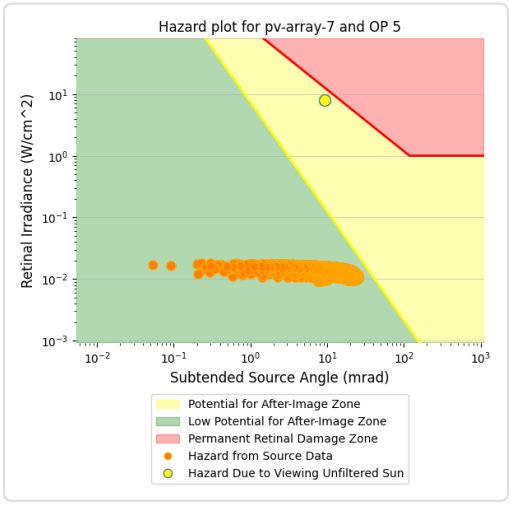
PV array 7 and OP 5

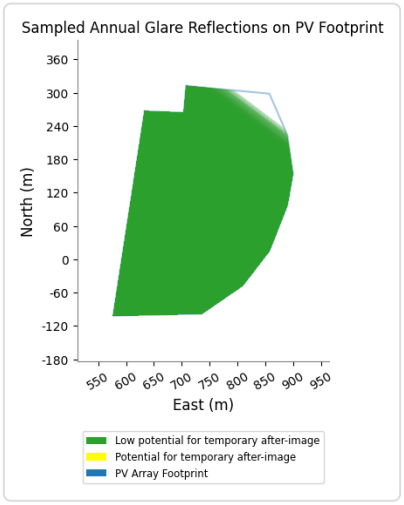
Yellow glare: none

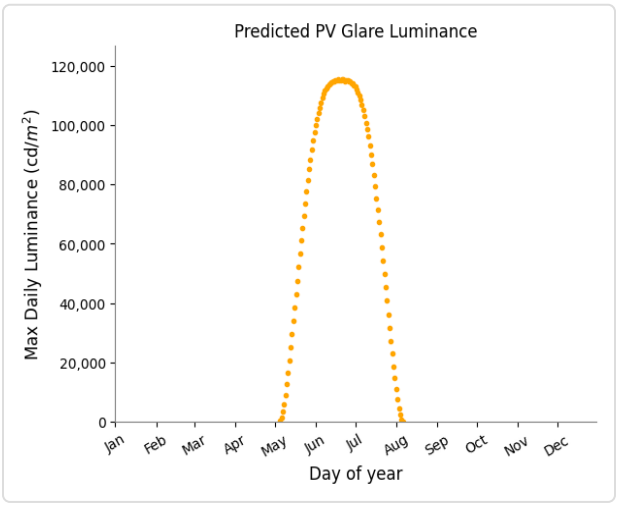
Green glare: 2,510 min.







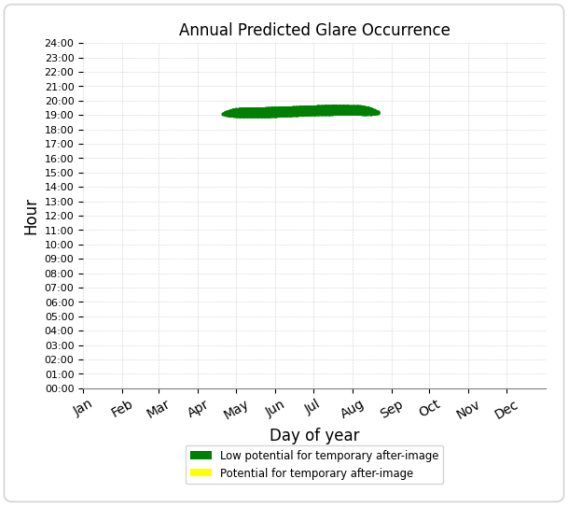


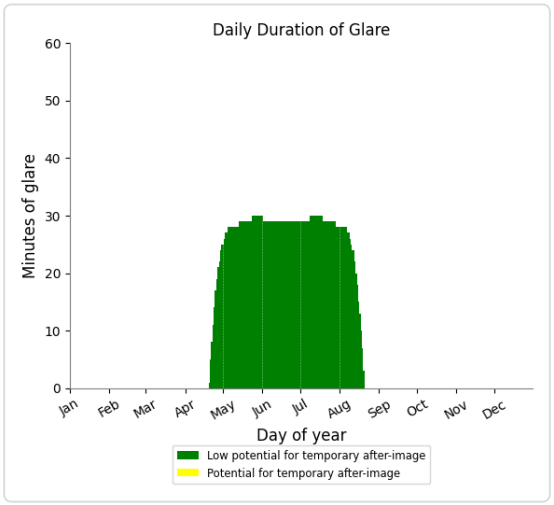


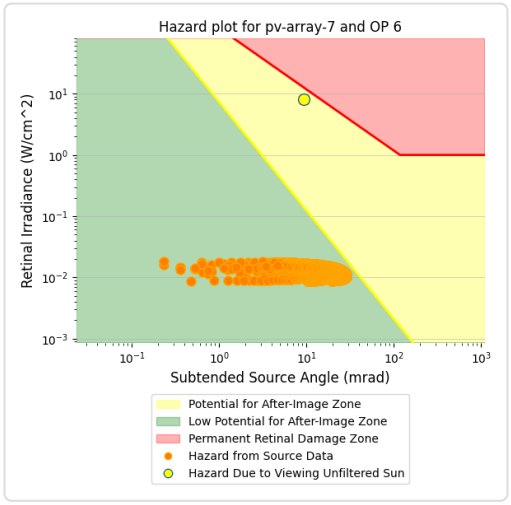
PV array 7 and OP 6

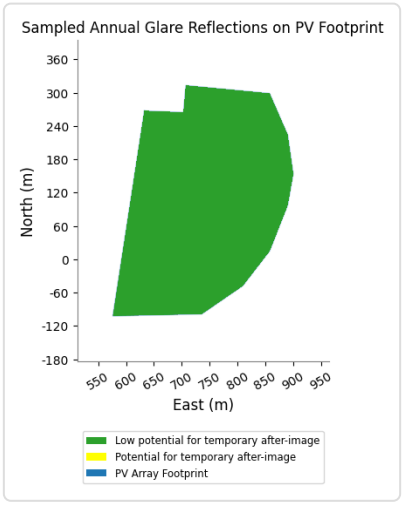
Yellow glare: none

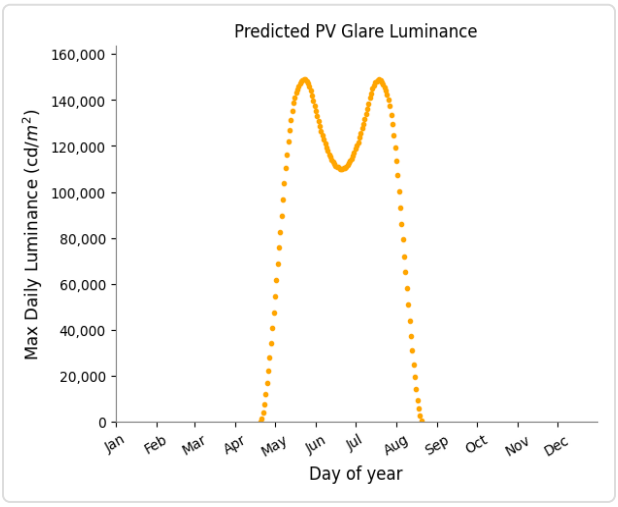
Green glare: 3,260 min.











PV array 7 and OP 1

No glare found

PV array 7 and OP 2

No glare found

PV array 7 and OP 3

No glare found

PV array 7 and OP 7

No glare found

PV array 7 and OP 8

No glare found

PV array 7 and OP 9

No glare found

PV array 7 and OP 10

No glare found

PV array 7 and OP 11

No glare found

PV array 7 and OP 12

No glare found

PV array 7 and OP 13

No glare found

PV array 7 and OP 14

No glare found

PV array 7 and OP 15

No glare found

PV array 7 and OP 16

No glare found

PV array 7 and OP 17

No glare found

PV array 7 and OP 18

No glare found

PV array 7 and OP 19

No glare found

PV array 7 and OP 20

No glare found

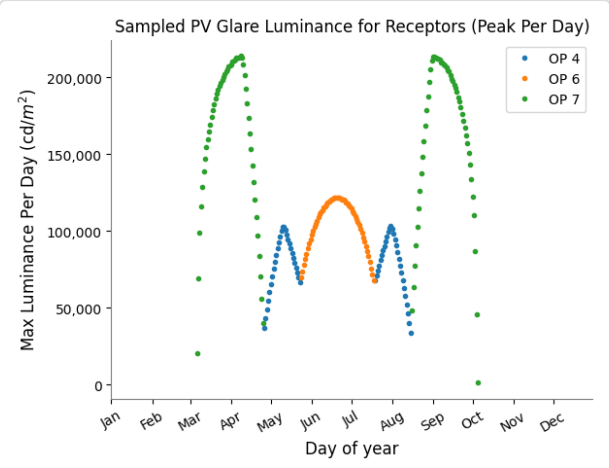
PV array 7 and OP 21

No glare found

PV: PV array 8 low potential for temporary after-image

Receptor results ordered by category of glare

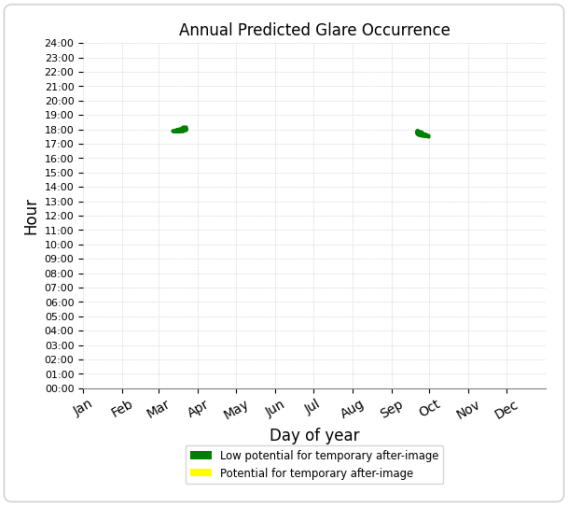
Receptor	Annual Green Glare		Annual Yellow Glare		Peak Luminance
	min	hr	min	hr	cd/m^2
OP 2	152	2.5	0	0.0	9,755
OP 3	1,345	22.4	0	0.0	80,048
OP 4	2,861	47.7	0	0.0	103,345
OP 5	23	0.4	0	0.0	39
OP 6	2,119	35.3	0	0.0	121,659
OP 7	2,690	44.8	0	0.0	213,947
OP 14	1,083	18.1	0	0.0	66,985
OP 15	360	6.0	0	0.0	21,590
OP 1	0	0.0	0	0.0	0
OP 8	0	0.0	0	0.0	0
OP 9	0	0.0	0	0.0	0
OP 10	0	0.0	0	0.0	0
OP 11	0	0.0	0	0.0	0
OP 12	0	0.0	0	0.0	0
OP 13	0	0.0	0	0.0	0
OP 16	0	0.0	0	0.0	0
OP 17	0	0.0	0	0.0	0
OP 18	0	0.0	0	0.0	0
OP 19	0	0.0	0	0.0	0
OP 20	0	0.0	0	0.0	0
OP 21	0	0.0	0	0.0	0

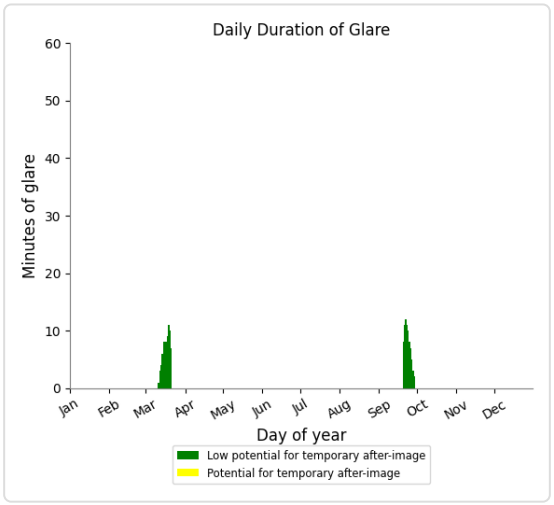


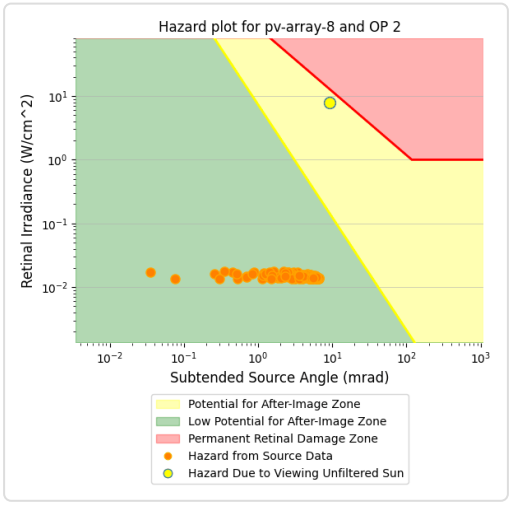
PV array 8 and OP 2

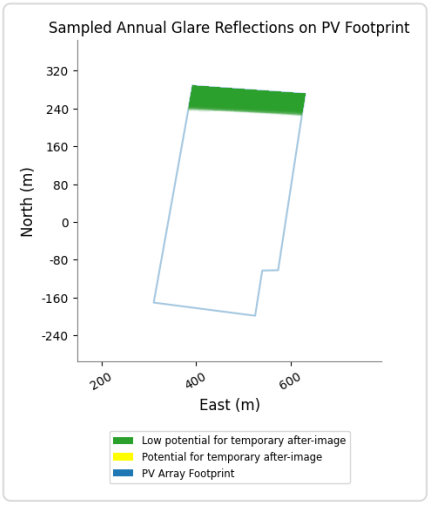
Yellow glare: none

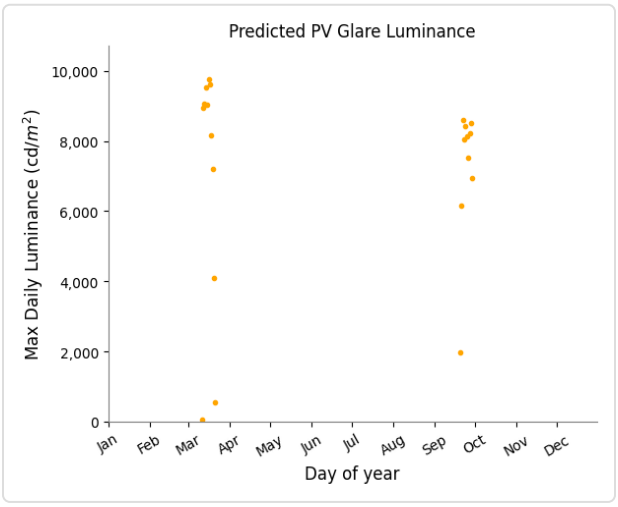
Green glare: 152 min.







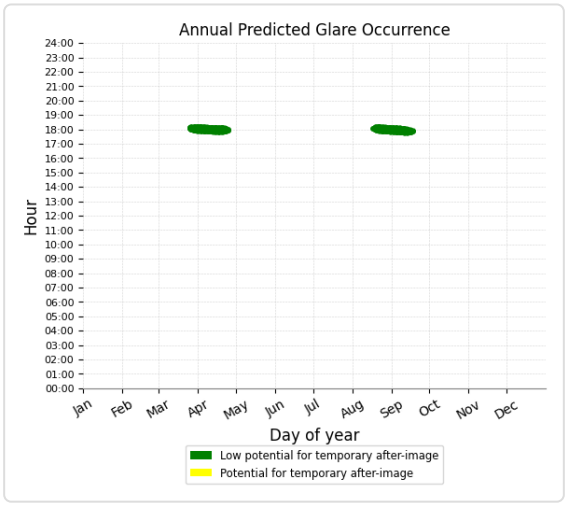


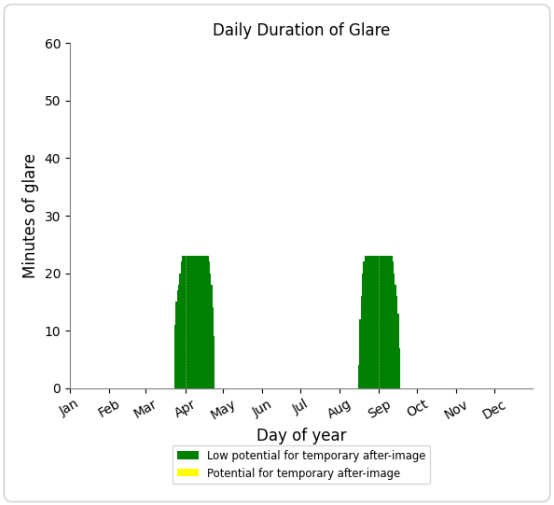


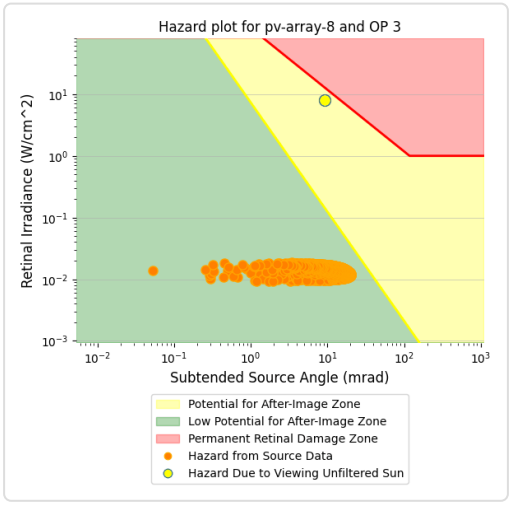
PV array 8 and OP 3

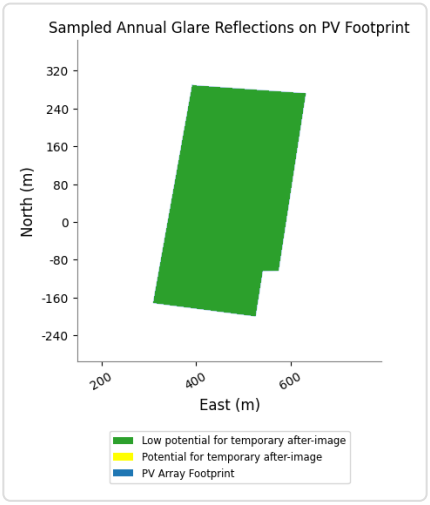
Yellow glare: none

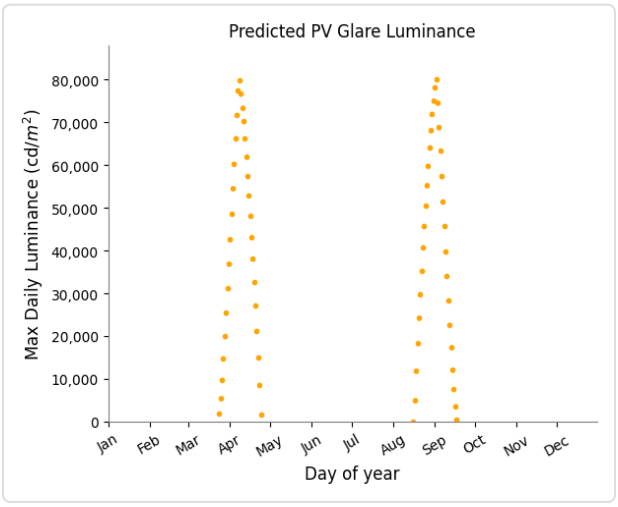
Green glare: 1,345 min.







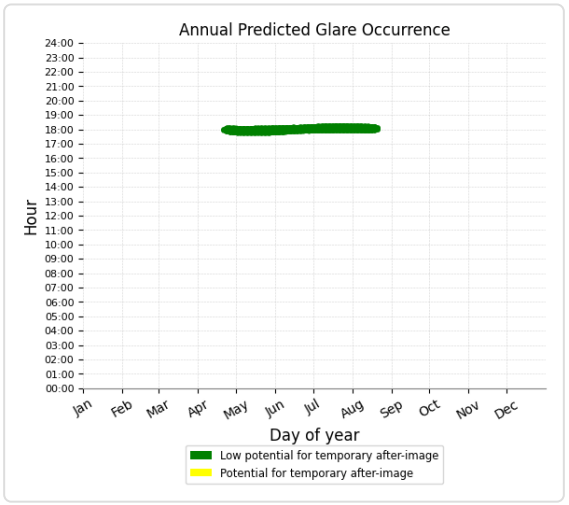


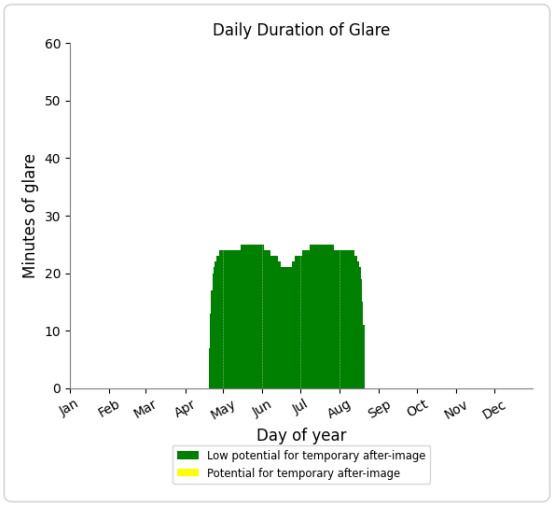


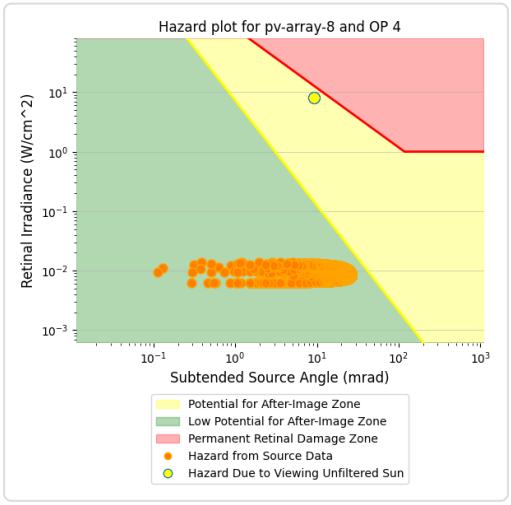
PV array 8 and OP 4

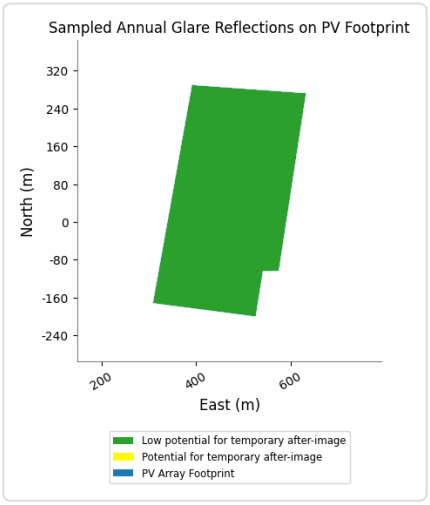
Yellow glare: none

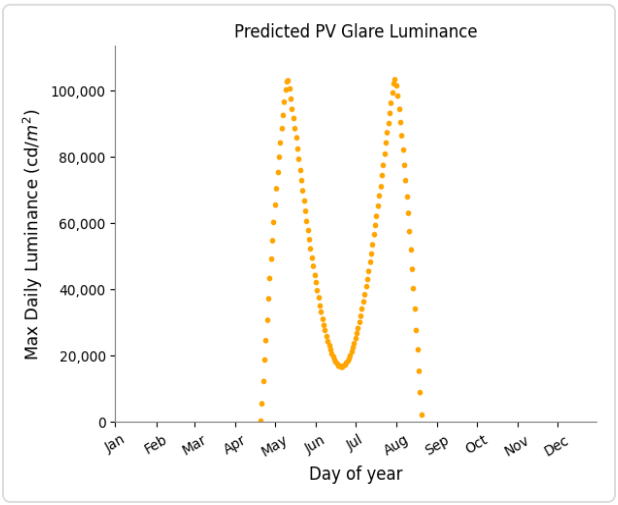
Green glare: 2,861 min.







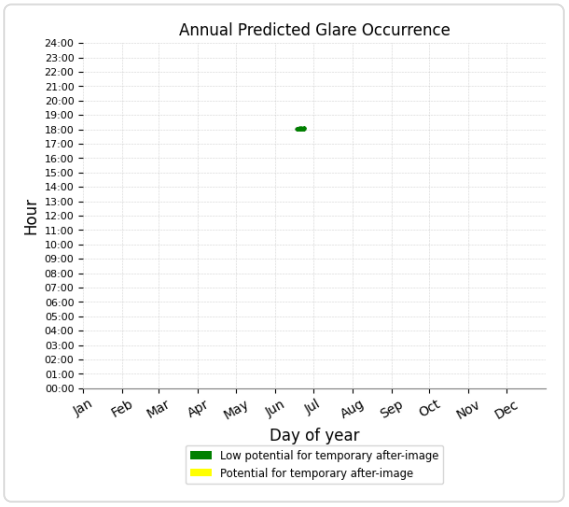


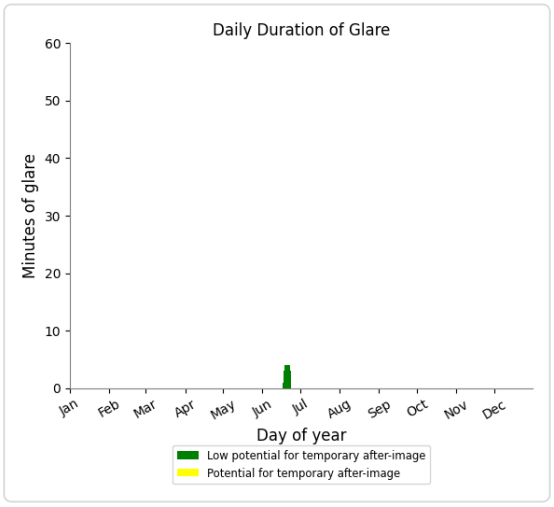


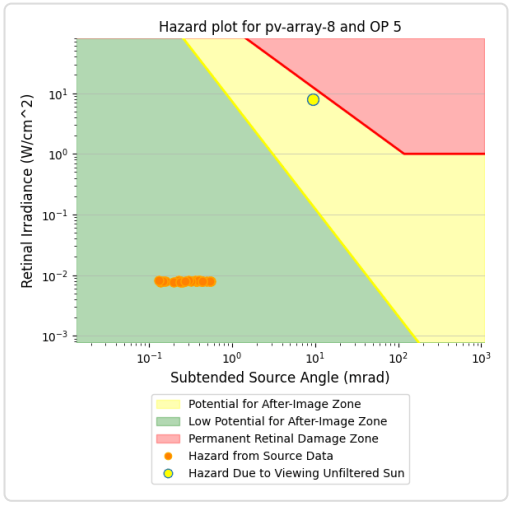
PV array 8 and OP 5

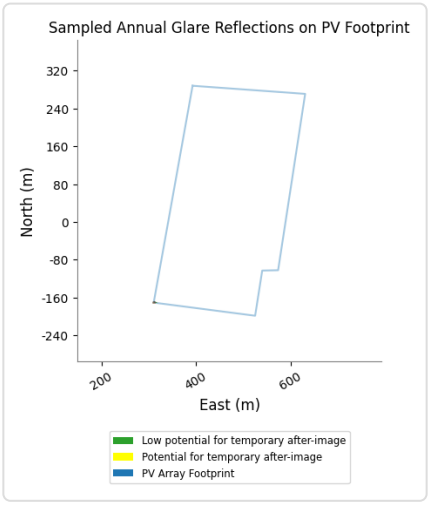
Yellow glare: none

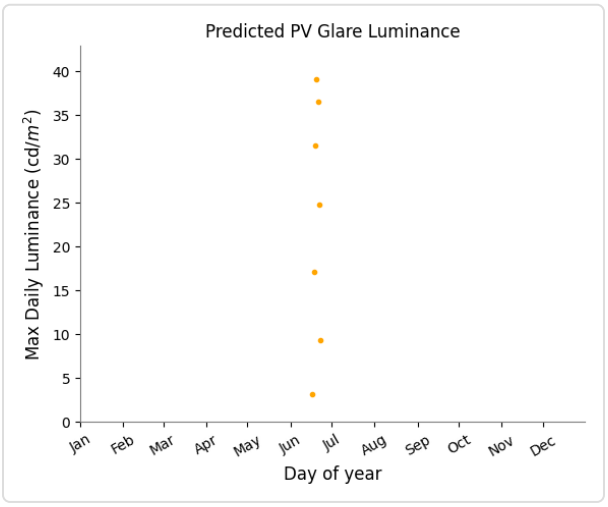
Green glare: 23 min.







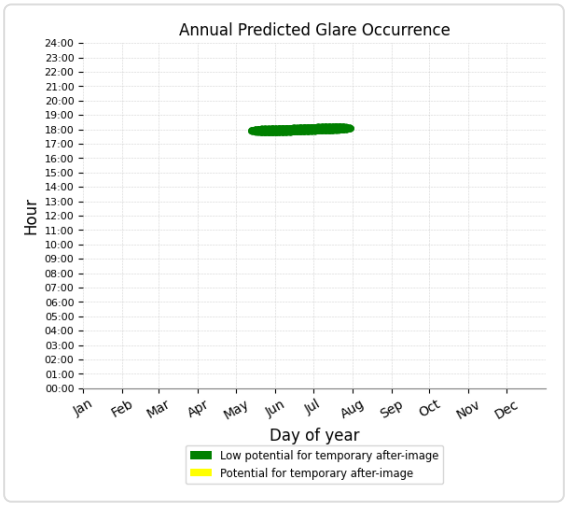


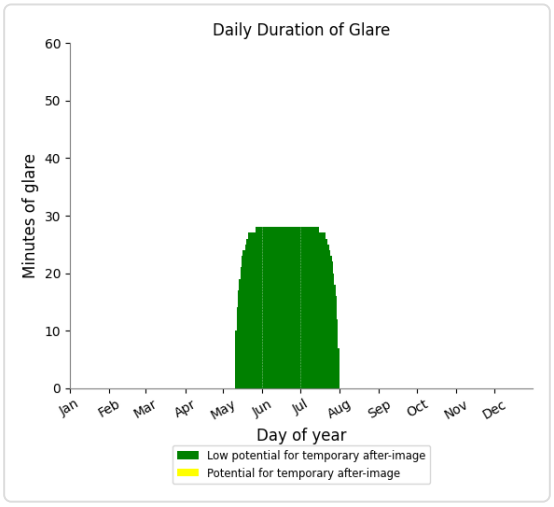


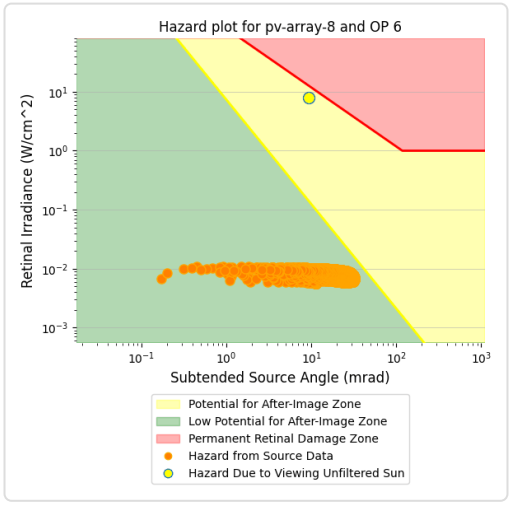
PV array 8 and OP 6

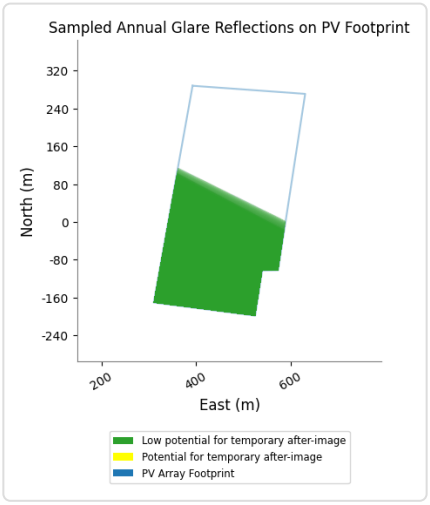
Yellow glare: none

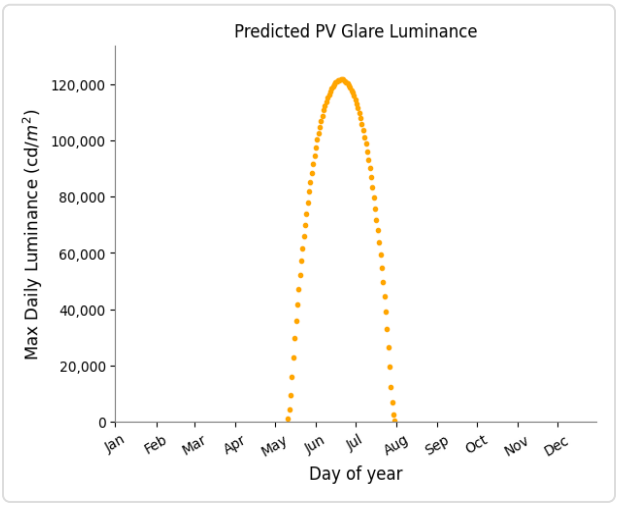
Green glare: 2,119 min.







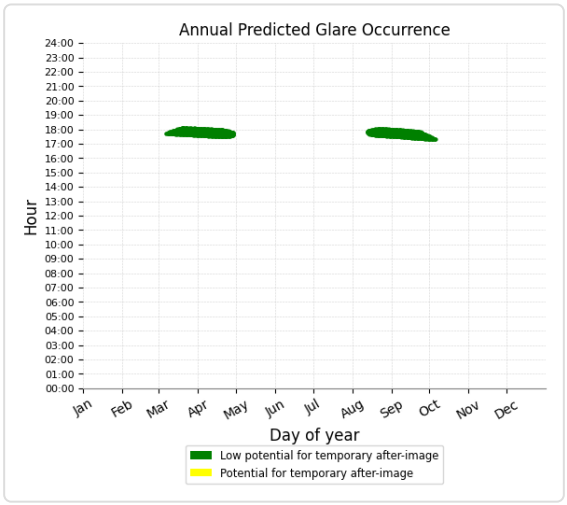


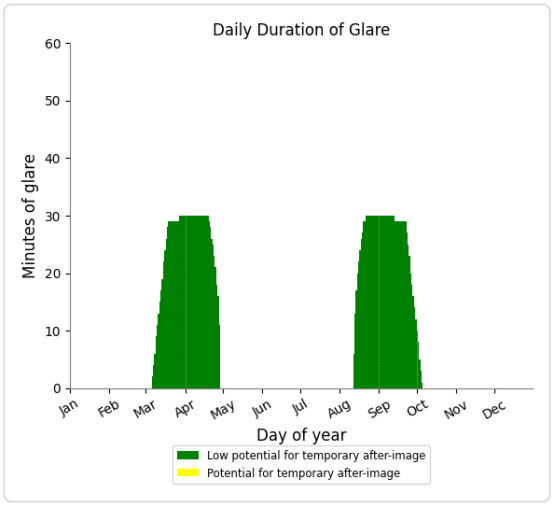


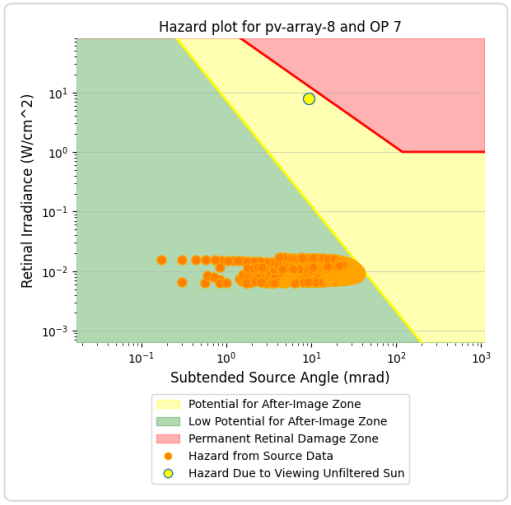
PV array 8 and OP 7

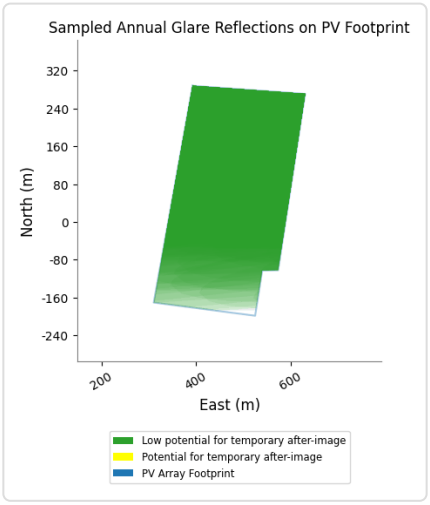
Yellow glare: none

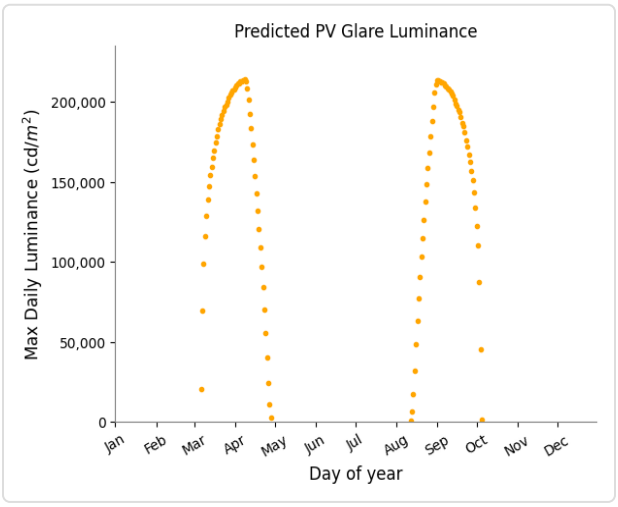
Green glare: 2,690 min.







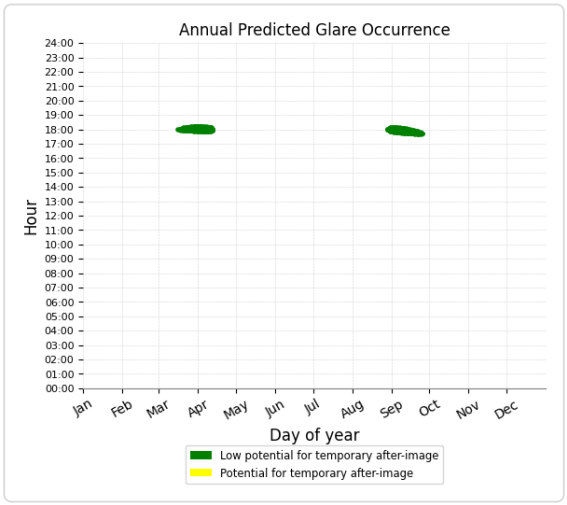


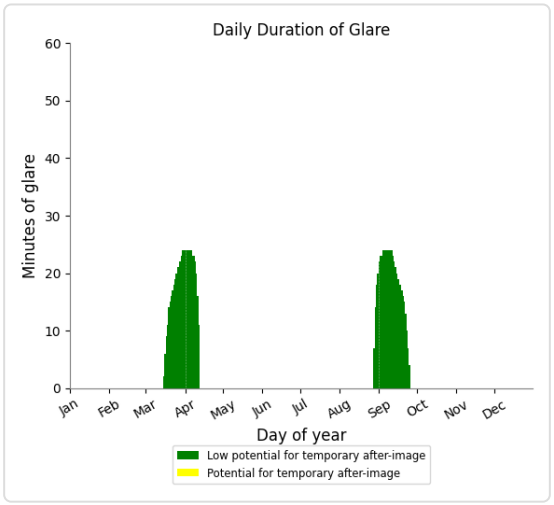


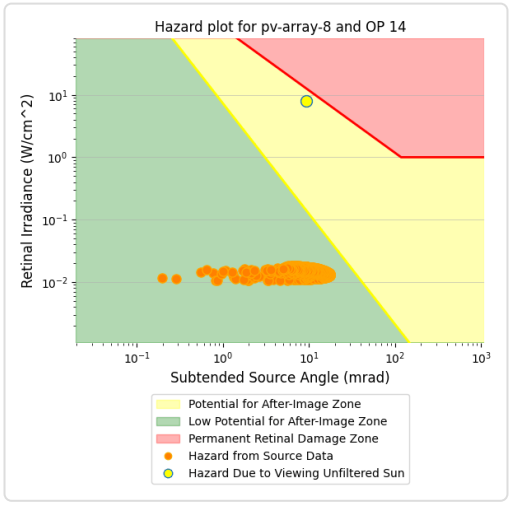
PV array 8 and OP 14

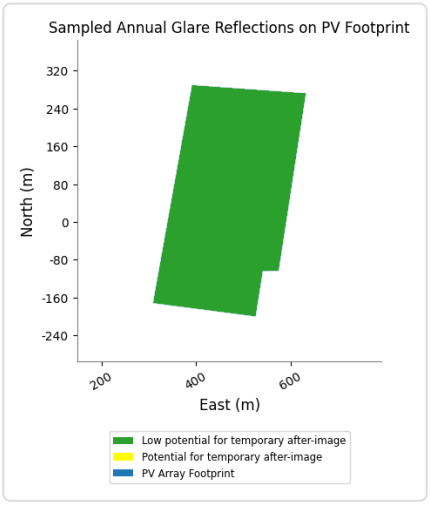
Yellow glare: none

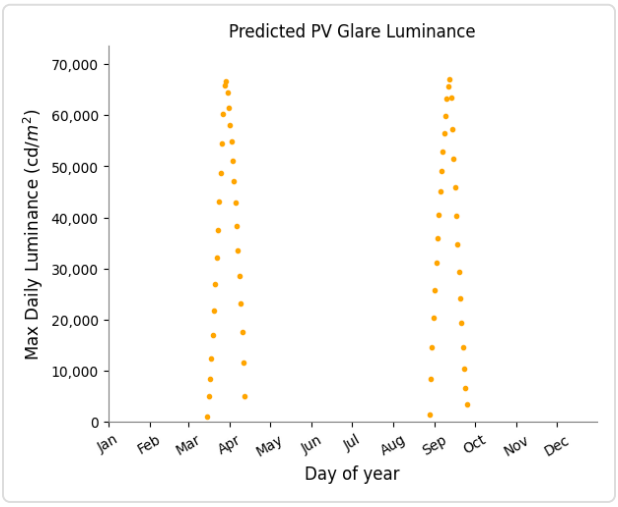
Green glare: 1,083 min.







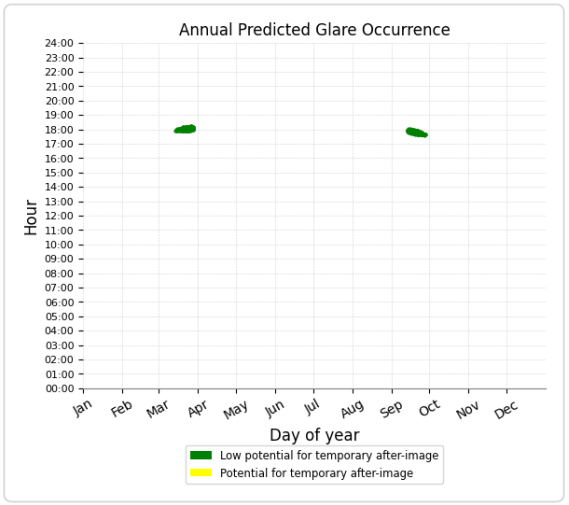


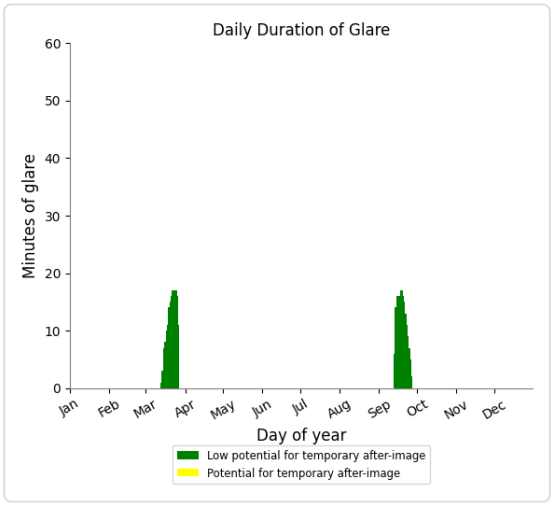


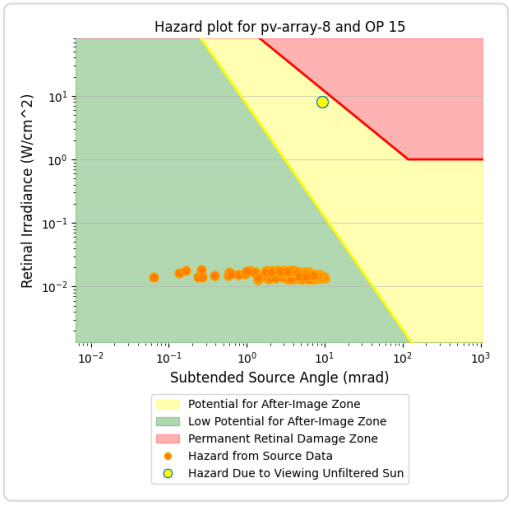
PV array 8 and OP 15

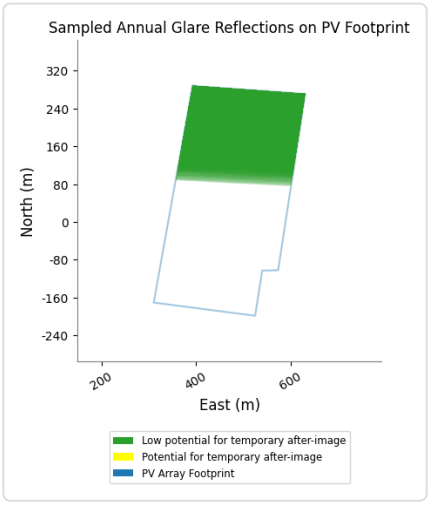
Yellow glare: none

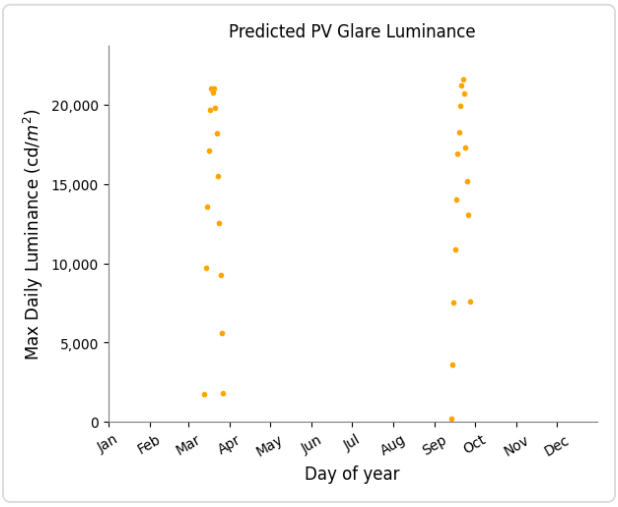
Green glare: 360 min.











PV array 8 and OP 1

No glare found

PV array 8 and OP 8

No glare found

PV array 8 and OP 9

No glare found

PV array 8 and OP 10

No glare found

PV array 8 and OP 11

No glare found

PV array 8 and OP 12

No glare found

PV array 8 and OP 13

No glare found

PV array 8 and OP 16

No glare found

PV array 8 and OP 17

No glare found

PV array 8 and OP 18

No glare found

PV array 8 and OP 19

No glare found

PV array 8 and OP 20

No glare found

PV array 8 and OP 21

No glare found

Assumptions

"Green" glare is glare with low potential to cause an after-image (flash blindness) when observed prior to a typical blink response time.
"Yellow" glare is glare with potential to cause an after-image (flash blindness) when observed prior to a typical blink response time.
Times associated with glare are denoted in Standard time. For Daylight Savings, add one hour.
The algorithm does not rigorously represent the detailed geometry of a system; detailed features such as gaps between modules, variable height of the PV array, and support structures may impact actual glare results. However, we have validated our models against several systems, including a PV array causing glare to the air-traffic control tower at Manchester-Boston Regional Airport and several sites in Albuquerque, and the tool accurately predicted the occurrence and intensity of glare at different times and days of the year.
Several V1 calculations utilize the PV array centroid, rather than the actual glare spot location, due to algorithm limitations. This may affect results for large PV footprints. Additional analyses of array sub-sections can provide additional information on expected glare. This primarily affects V1 analyses of path receptors.
Random number computations are utilized by various steps of the annual hazard analysis algorithm. Predicted minutes of glare can vary between runs as a result. This limitation primarily affects analyses of Observation Point receptors, including ATCTs. Note that the SGHAT/ ForgeSolar methodology has always relied on an analytical, qualitative approach to accurately determine the overall hazard (i.e. green vs. yellow) of expected glare on an annual basis.
The analysis does not automatically consider obstacles (either man-made or natural) between the observation points and the prescribed solar installation that may obstruct observed glare, such as trees, hills, buildings, etc.
The subtended source angle (glare spot size) is constrained by the PV array footprint size. Partitioning large arrays into smaller sections will reduce the maximum potential subtended angle, potentially impacting results if actual glare spots are larger than the sub-array size. Additional analyses of the combined area of adjacent sub-arrays can provide more information on potential glare hazards. (See previous point on related limitations.)
The variable direct normal irradiance (DNI) feature (if selected) scales the user-prescribed peak DNI using a typical clear-day irradiance profile. This profile has a lower DNI in the mornings and evenings and a maximum at solar noon. The scaling uses a clear-day irradiance profile based on a normalized time relative to sunrise, solar noon, and sunset, which are prescribed by a sun-position algorithm and the latitude and longitude obtained from Google maps. The actual DNI on any given day can be affected by cloud cover, atmospheric attenuation, and other environmental factors.
The ocular hazard predicted by the tool depends on a number of environmental, optical, and human factors, which can be uncertain. We provide input fields and typical ranges of values for these factors so that the user can vary these parameters to see if they have an impact on the results. The speed of SGHAT allows expedited sensitivity and parametric analyses.
The system output calculation is a DNI-based approximation that assumes clear, sunny skies year-round. It should not be used in place of more rigorous modeling methods.
Hazard zone boundaries shown in the Glare Hazard plot are an approximation and visual aid based on aggregated research data. Actual ocular impact outcomes encompass a continuous, not discrete, spectrum.
Glare locations displayed on receptor plots are approximate. Actual glare-spot locations may differ.
Refer to the Help page at **www.forgesolar.com/help/** for assumptions and limitations not listed here.

Default glare analysis parameters and observer eye characteristics (for reference only):

- Analysis time interval: 1 minute
- Ocular transmission coefficient: 0.5
- Pupil diameter: 0.002 meters
- Eye focal length: 0.017 meters
- Sun subtended angle: 9.3 milliradians

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FORGESOLAR GLARE ANALYSIS

Project: **BR10356 Normanton Larches Solar**
Site configuration: **Aviation 500ft 180 and 205 OPs 1-20**

Created 08 Mar, 2024
Updated 21 Mar, 2024
Time-step 1 minute
Timezone offset UTC0
Minimum sun altitude 0.0 deg
DNI peaks at 1,000.0 W/m^2
Category 10 MW to 100 MW
Site ID 113974.19448

Ocular transmission coefficient 0.5
Pupil diameter 0.002 m
Eye focal length 0.017 m
Sun subtended angle 9.3 mrad
PV analysis methodology V2

Summary of Results

Glare with low potential for temporary after-image predicted

PV Array	Tilt	Orient	Annual Green Glare		Annual Yellow Glare		Energy	Peak Luminance
	°	°	min	hr	min	hr	kWh	cd/m^2
PV array 1	25.0	180.0	5,503	91.7	0	0.0	-	191,343
PV array 2	25.0	180.0	5,116	85.3	0	0.0	-	144,104
PV array 3	25.0	180.0	4,921	82.0	0	0.0	-	157,694
PV array 4	25.0	180.0	5,375	89.6	0	0.0	-	157,881
PV array 5	25.0	180.0	5,180	86.3	0	0.0	-	180,420
PV array 6	25.0	180.0	7,132	118.9	0	0.0	-	215,619
PV array 7	25.0	205.0	7,098	118.3	0	0.0	-	260,662
PV array 8	25.0	180.0	16,692	278.2	0	0.0	-	244,634

Total glare received by each receptor; may include duplicate times of glare from multiple reflective surfaces.

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
OP 1	232	3.9	0	0.0
OP 2	0	0.0	0	0.0
OP 3	0	0.0	0	0.0
OP 4	0	0.0	0	0.0
OP 5	0	0.0	0	0.0
OP 6	0	0.0	0	0.0
OP 7	1,452	24.2	0	0.0
OP 8	7,056	117.6	0	0.0

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
OP 9	0	0.0	0	0.0
OP 10	0	0.0	0	0.0
OP 11	0	0.0	0	0.0
OP 12	0	0.0	0	0.0
OP 13	0	0.0	0	0.0
OP 14	16,000	266.7	0	0.0
OP 15	16,995	283.2	0	0.0
OP 16	13,184	219.7	0	0.0
OP 17	2,098	35.0	0	0.0
OP 18	0	0.0	0	0.0
OP 19	0	0.0	0	0.0
OP 20	0	0.0	0	0.0

Component Data

PV Arrays

Name: PV array 1
Axis tracking: Fixed (no rotation)
Tilt: 25.0°
Orientation: 180.0°
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	53.270453	-1.023592	44.16	3.58	47.74
2	53.270382	-1.026510	38.69	3.58	42.27
3	53.270337	-1.028001	42.19	3.58	45.77
4	53.268374	-1.027819	47.55	3.58	51.13
5	53.267835	-1.027411	47.97	3.58	51.55
6	53.268194	-1.025823	42.76	3.58	46.34
7	53.268605	-1.023538	48.05	3.58	51.63

Name: PV array 2
Axis tracking: Fixed (no rotation)
Tilt: 25.0°
Orientation: 180.0°
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	53.272403	-1.022893	44.98	3.58	48.56
2	53.271659	-1.020468	49.10	3.58	52.68
3	53.271146	-1.020629	49.06	3.58	52.64
4	53.270568	-1.020768	49.76	3.58	53.34
5	53.269978	-1.022399	48.94	3.58	52.52
6	53.269490	-1.023494	46.53	3.58	50.11
7	53.270600	-1.023526	44.05	3.58	47.63
8	53.270658	-1.022721	44.52	3.58	48.10

Name: PV array 3
Axis tracking: Fixed (no rotation)
Tilt: 25.0°
Orientation: 180.0°
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	53.267270	-1.027453	49.52	3.58	53.10
2	53.267742	-1.026122	44.46	3.58	48.04
3	53.268066	-1.026004	43.25	3.58	46.83
4	53.268361	-1.024577	44.74	3.58	48.32
5	53.268515	-1.023451	48.43	3.58	52.01
6	53.263789	-1.021096	44.95	3.58	48.53
7	53.263606	-1.026144	50.81	3.58	54.39

Name: PV array 4
Axis tracking: Fixed (no rotation)
Tilt: 25.0°
Orientation: 180.0°
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	53.267296	-1.022818	47.72	3.58	51.30
2	53.267707	-1.018998	49.22	3.58	52.80
3	53.264120	-1.017373	43.17	3.58	46.75
4	53.264126	-1.017861	43.81	3.58	47.39
5	53.263885	-1.017893	45.60	3.58	49.18
6	53.263795	-1.021085	44.91	3.58	48.49

Name: PV array 5
Axis tracking: Fixed (no rotation)
Tilt: 25.0°
Orientation: 180.0°
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	53.268300	-1.019106	51.65	3.58	55.23
2	53.268197	-1.015587	47.94	3.58	51.52
3	53.267411	-1.014932	45.87	3.58	49.45
4	53.263776	-1.015093	42.99	3.58	46.57
5	53.263904	-1.017175	44.48	3.58	48.06
6	53.266359	-1.018355	43.98	3.58	47.56

Name: PV array 6
Axis tracking: Fixed (no rotation)
Tilt: 25.0°
Orientation: 180.0°
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	53.267286	-1.014793	45.26	3.58	48.84
2	53.263975	-1.015072	41.69	3.58	45.27
3	53.265181	-1.012926	37.52	3.58	41.10
4	53.265759	-1.012132	35.68	3.58	39.26
5	53.266067	-1.011724	35.43	3.58	39.01
6	53.266349	-1.011338	34.83	3.58	38.41
7	53.266619	-1.009836	34.68	3.58	38.26
8	53.267825	-1.010716	42.25	3.58	45.83

Name: PV array 7
Axis tracking: Fixed (no rotation)
Tilt: 25.0°
Orientation: 205.0°
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	53.272905	-1.013964	31.12	3.58	34.70
2	53.269568	-1.014790	42.80	3.58	46.38
3	53.269645	-1.012452	41.27	3.58	44.85
4	53.270081	-1.011636	34.85	3.58	38.43
5	53.270774	-1.010553	29.54	3.58	33.12
6	53.271339	-1.010188	28.20	3.58	31.78
7	53.271929	-1.010075	28.04	3.58	31.62
8	53.272622	-1.010220	28.03	3.58	31.61
9	53.273142	-1.010896	28.00	3.58	31.58
10	53.273245	-1.012661	29.01	3.58	32.59
11	53.272872	-1.012832	29.79	3.58	33.37

Name: PV array 8
Axis tracking: Fixed (no rotation)
Tilt: 25.0°
Orientation: 180.0°
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	53.273036	-1.017714	40.54	3.58	44.12
2	53.268875	-1.018985	51.61	3.58	55.19
3	53.268647	-1.015617	47.61	3.58	51.19
4	53.269515	-1.015413	43.77	3.58	47.35
4	53.269515	-1.015413	43.77	3.58	47.35
5	53.269567	-1.014796	42.80	3.58	46.38
5	53.269567	-1.014796	42.80	3.58	46.38
6	53.272898	-1.013964	31.12	3.58	34.70

Discrete Observation Point Receptors

Name	ID	Latitude (°)	Longitude (°)	Elevation (m)	Height (m)
OP 1	1	53.274658	-0.956085	26.85	152.40
OP 2	2	53.280560	-0.951536	27.44	152.40
OP 3	3	53.287000	-0.946429	23.00	152.40
OP 4	4	53.298511	-0.952811	33.00	152.40
OP 5	5	53.299640	-0.964398	28.38	152.40
OP 6	6	53.287225	-0.974011	23.92	152.40
OP 7	7	53.272753	-0.986371	37.57	152.40
OP 8	8	53.265874	-0.967488	33.88	152.40
OP 9	9	53.299127	-0.939421	18.00	152.40
OP 10	10	53.306154	-0.950150	29.17	152.40
OP 11	11	53.308462	-0.963540	37.62	152.40
OP 12	12	53.296511	-0.979762	23.67	152.40
OP 13	13	53.283581	-0.992722	40.63	152.40
OP 14	14	53.268595	-0.997529	38.41	152.40
OP 15	15	53.264437	-0.984998	29.15	152.40
OP 16	16	53.260330	-0.969119	37.98	152.40
OP 17	17	53.269570	-0.934272	22.21	152.40
OP 18	18	53.275422	-0.930581	24.95	152.40
OP 19	19	53.281734	-0.928263	23.00	152.40
OP 20	20	53.283581	-0.968861	22.00	152.40

Glare Analysis Results

Summary of Results

Glare with low potential for temporary after-image predicted

PV Array	Tilt	Orient	Annual Green Glare		Annual Yellow Glare		Energy	Peak Luminance
	°	°	min	hr	min	hr	kWh	cd/m^2
PV array 1	25.0	180.0	5,503	91.7	0	0.0	-	191,343
PV array 2	25.0	180.0	5,116	85.3	0	0.0	-	144,104
PV array 3	25.0	180.0	4,921	82.0	0	0.0	-	157,694
PV array 4	25.0	180.0	5,375	89.6	0	0.0	-	157,881
PV array 5	25.0	180.0	5,180	86.3	0	0.0	-	180,420
PV array 6	25.0	180.0	7,132	118.9	0	0.0	-	215,619
PV array 7	25.0	205.0	7,098	118.3	0	0.0	-	260,662
PV array 8	25.0	180.0	16,692	278.2	0	0.0	-	244,634

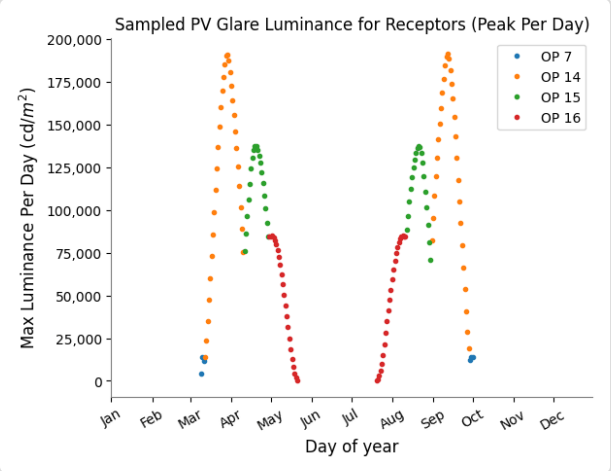
Total glare received by each receptor; may include duplicate times of glare from multiple reflective surfaces.

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
OP 1	232	3.9	0	0.0
OP 2	0	0.0	0	0.0
OP 3	0	0.0	0	0.0
OP 4	0	0.0	0	0.0
OP 5	0	0.0	0	0.0
OP 6	0	0.0	0	0.0
OP 7	1,452	24.2	0	0.0
OP 8	7,056	117.6	0	0.0
OP 9	0	0.0	0	0.0
OP 10	0	0.0	0	0.0
OP 11	0	0.0	0	0.0
OP 12	0	0.0	0	0.0
OP 13	0	0.0	0	0.0
OP 14	16,000	266.7	0	0.0
OP 15	16,995	283.2	0	0.0
OP 16	13,184	219.7	0	0.0
OP 17	2,098	35.0	0	0.0
OP 18	0	0.0	0	0.0
OP 19	0	0.0	0	0.0
OP 20	0	0.0	0	0.0

PV: PV array 1 low potential for temporary after-image

Receptor results ordered by category of glare

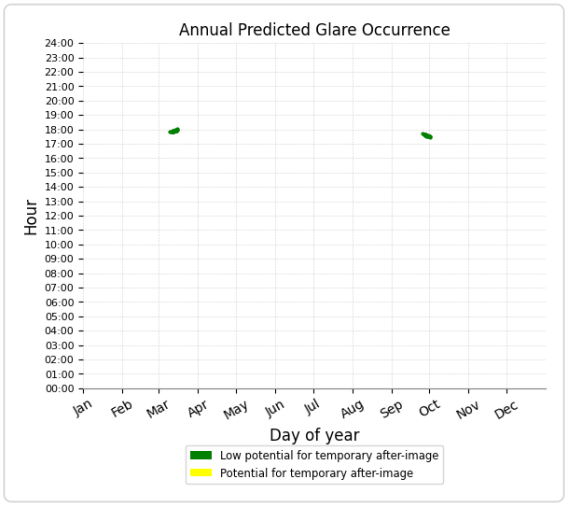
Receptor	Annual Green Glare		Annual Yellow Glare		Peak Luminance
	min	hr	min	hr	cd/m^2
OP 7	50	0.8	0	0.0	14,088
OP 8	906	15.1	0	0.0	75,293
OP 14	1,632	27.2	0	0.0	191,343
OP 15	1,407	23.4	0	0.0	137,698
OP 16	1,122	18.7	0	0.0	84,835
OP 17	386	6.4	0	0.0	25,526
OP 1	0	0.0	0	0.0	0
OP 2	0	0.0	0	0.0	0
OP 3	0	0.0	0	0.0	0
OP 4	0	0.0	0	0.0	0
OP 5	0	0.0	0	0.0	0
OP 6	0	0.0	0	0.0	0
OP 9	0	0.0	0	0.0	0
OP 10	0	0.0	0	0.0	0
OP 11	0	0.0	0	0.0	0
OP 12	0	0.0	0	0.0	0
OP 13	0	0.0	0	0.0	0
OP 18	0	0.0	0	0.0	0
OP 19	0	0.0	0	0.0	0
OP 20	0	0.0	0	0.0	0

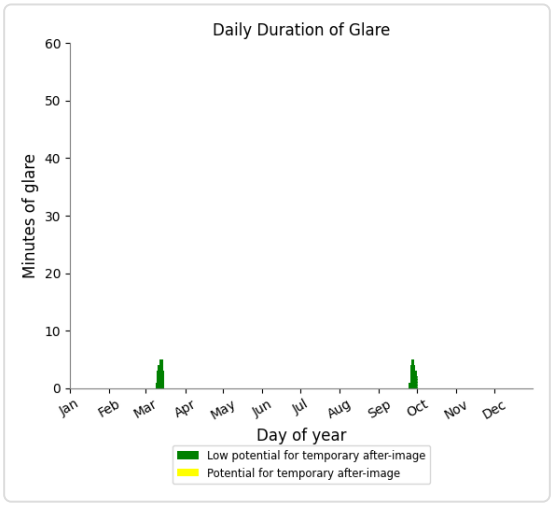


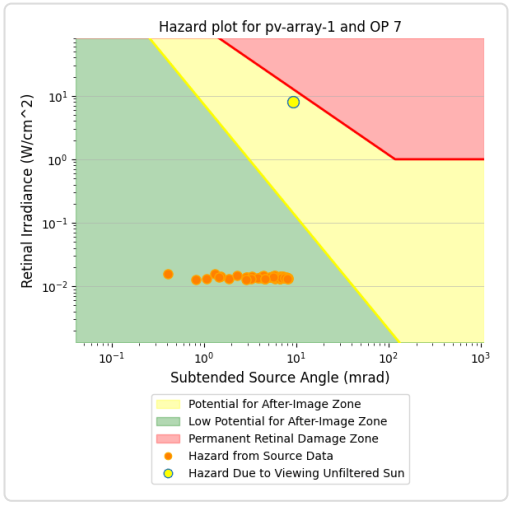
PV array 1 and OP 7

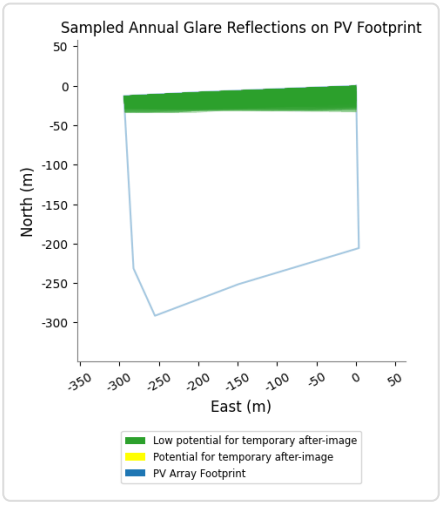
Yellow glare: none

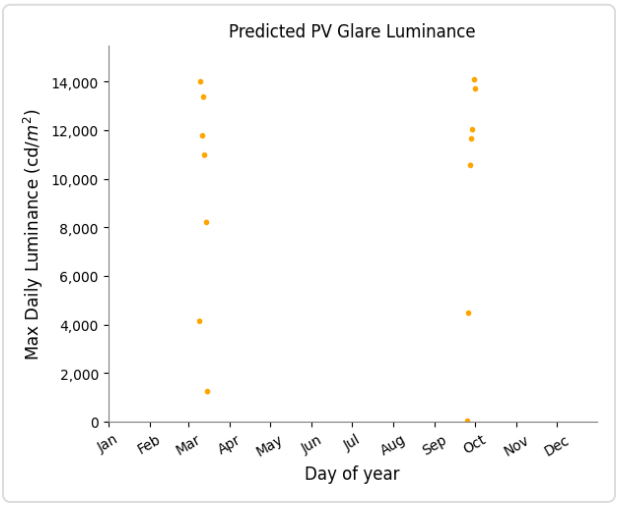
Green glare: 50 min.







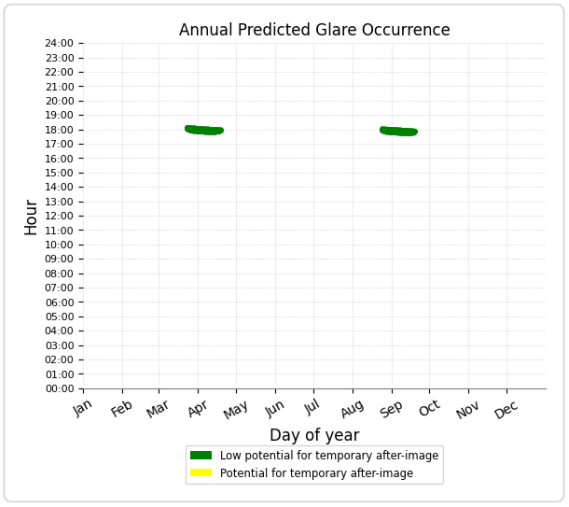


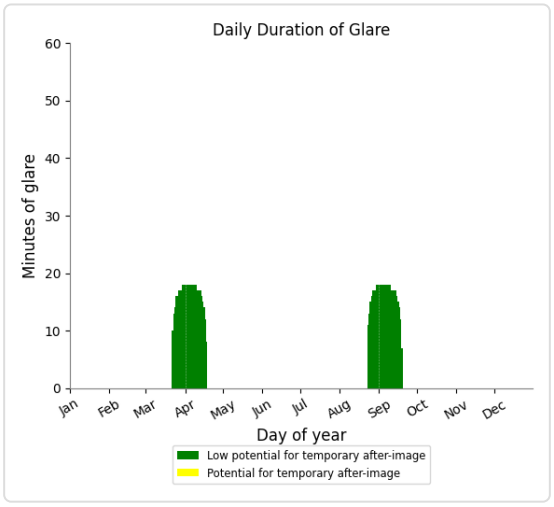


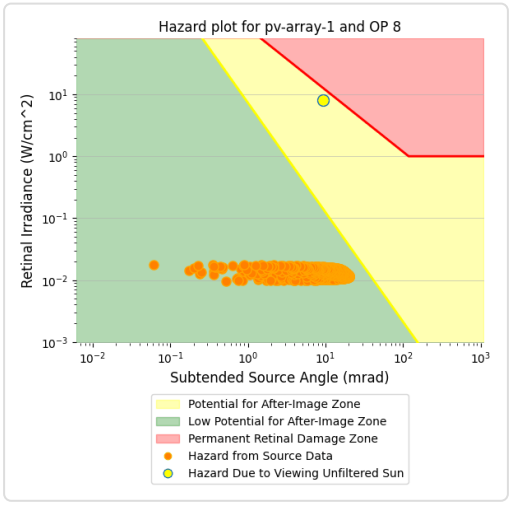
PV array 1 and OP 8

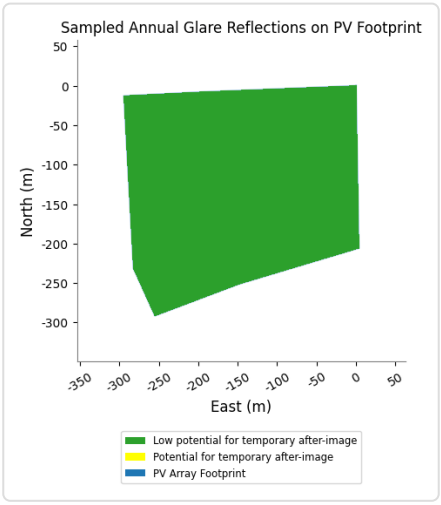
Yellow glare: none

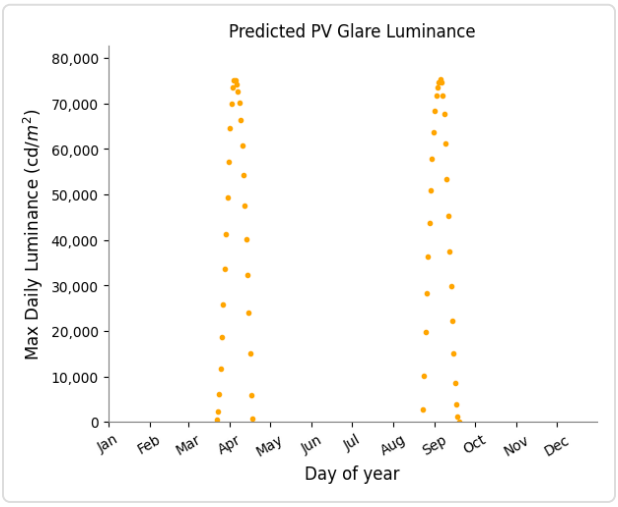
Green glare: 906 min.







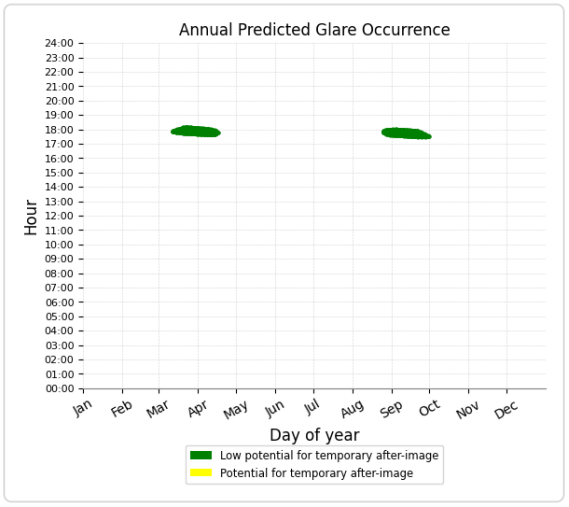


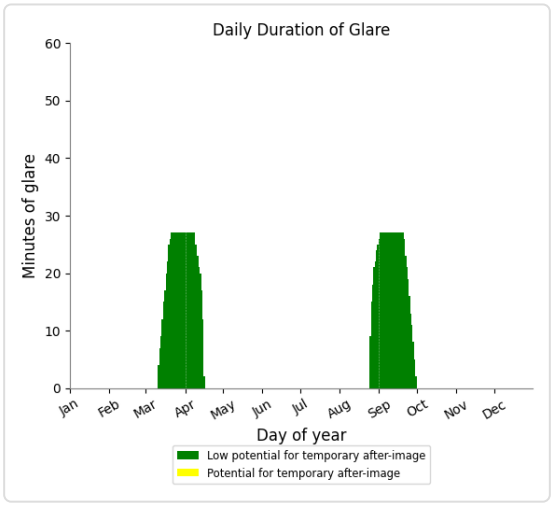


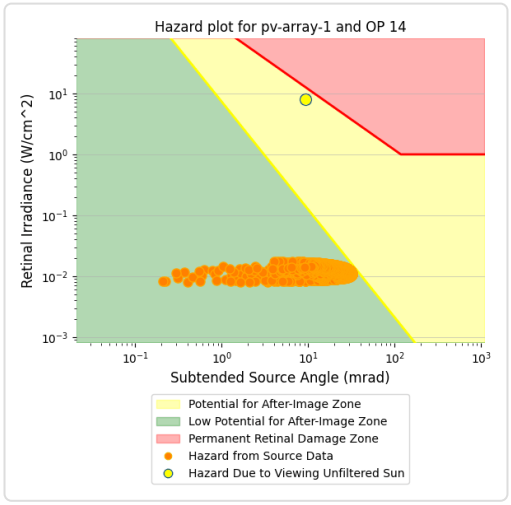
PV array 1 and OP 14

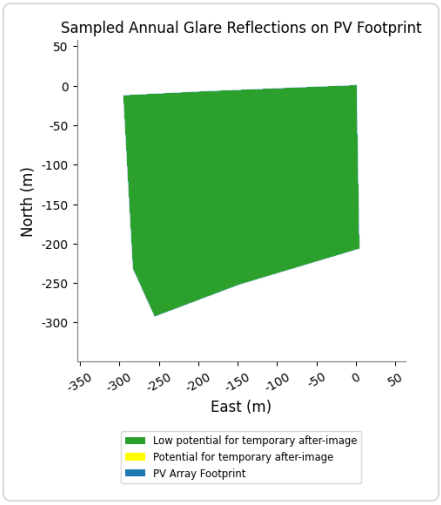
Yellow glare: none

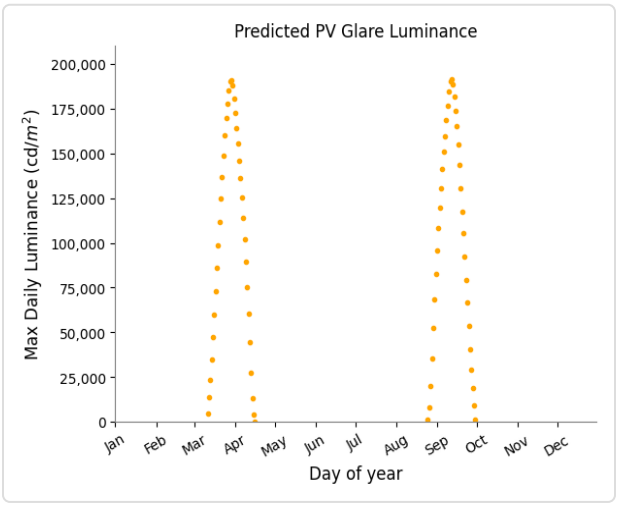
Green glare: 1,632 min.







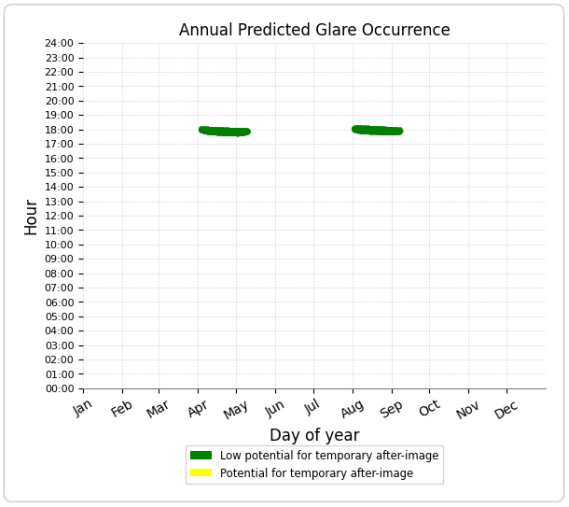


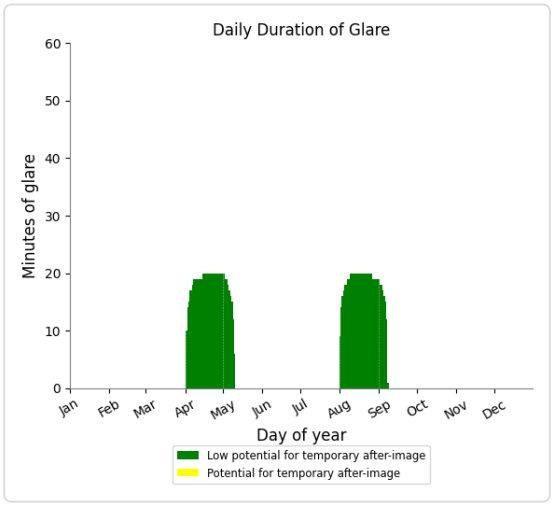


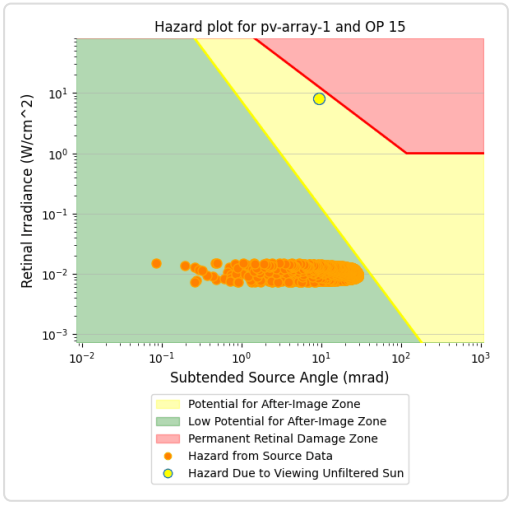
PV array 1 and OP 15

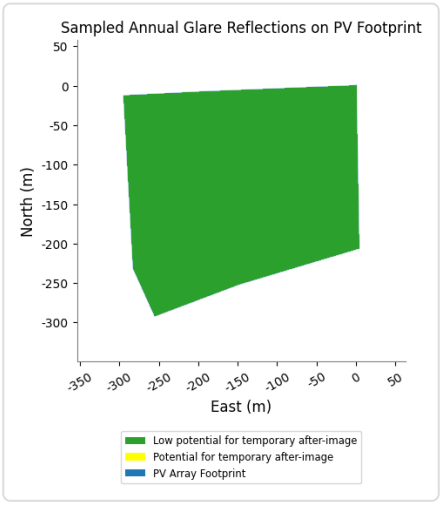
Yellow glare: none

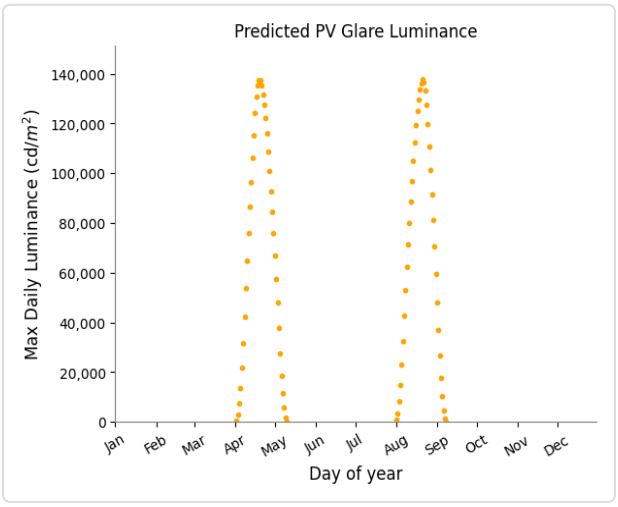
Green glare: 1,407 min.







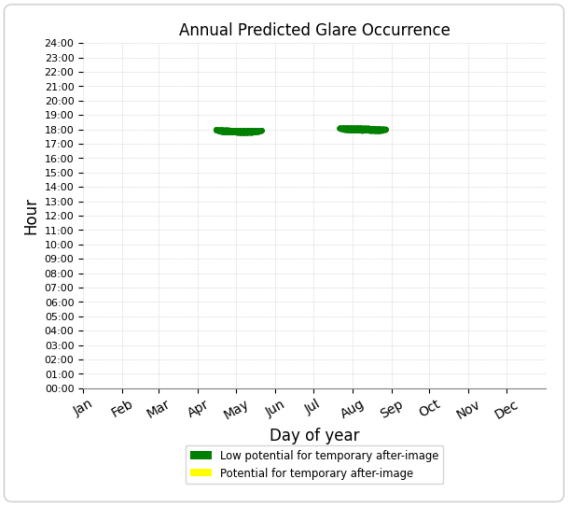


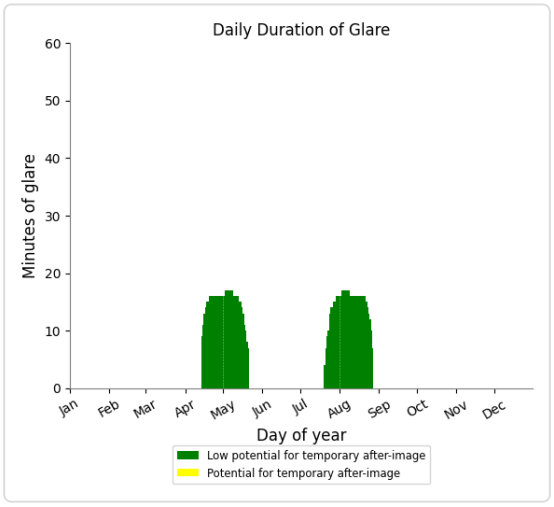


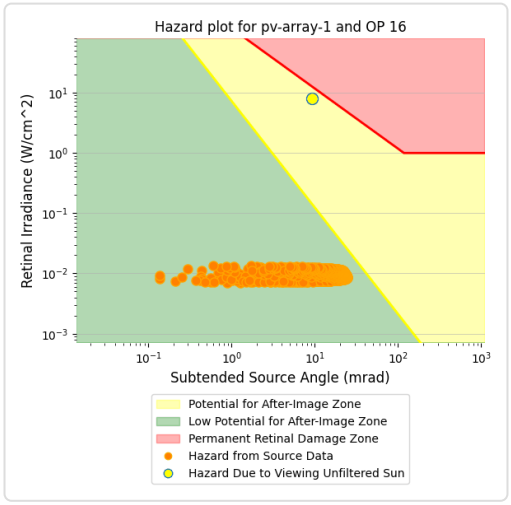
PV array 1 and OP 16

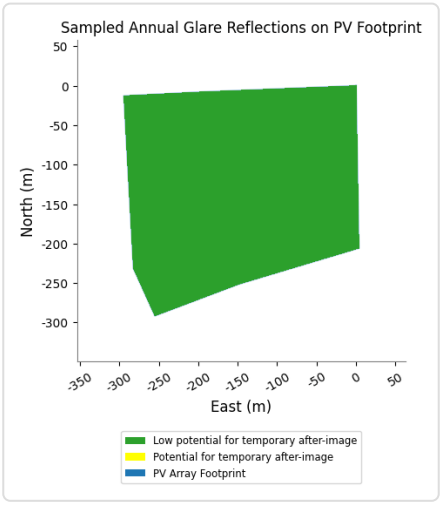
Yellow glare: none

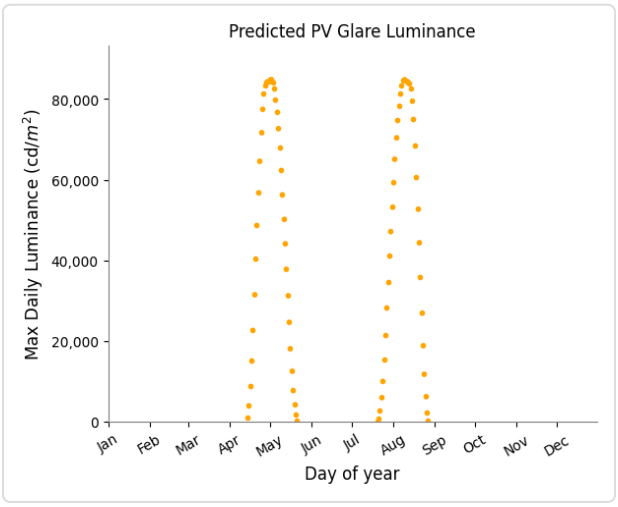
Green glare: 1,122 min.







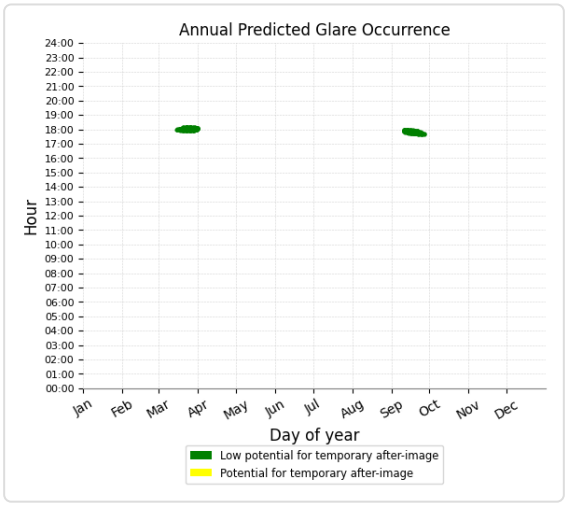


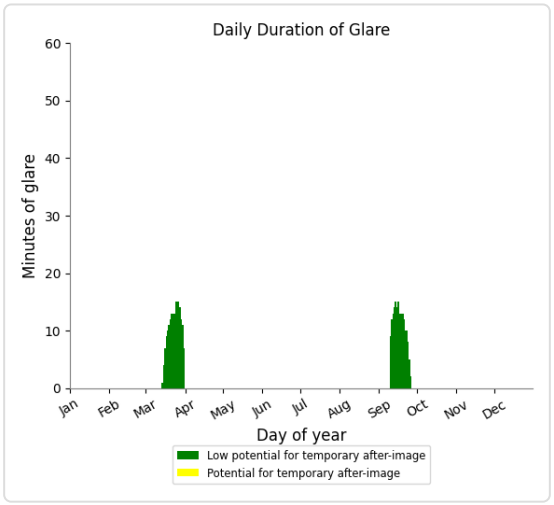


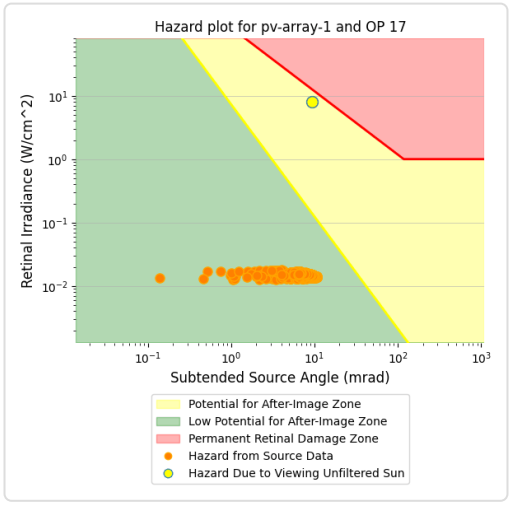
PV array 1 and OP 17

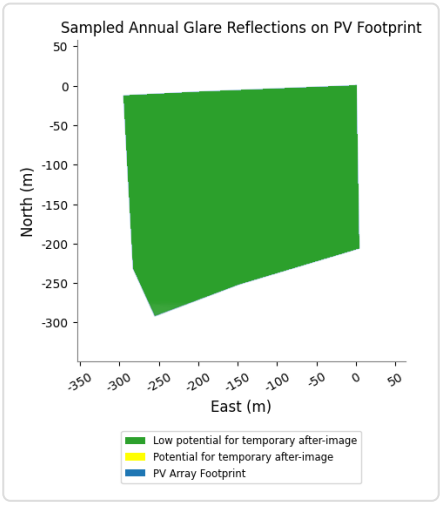
Yellow glare: none

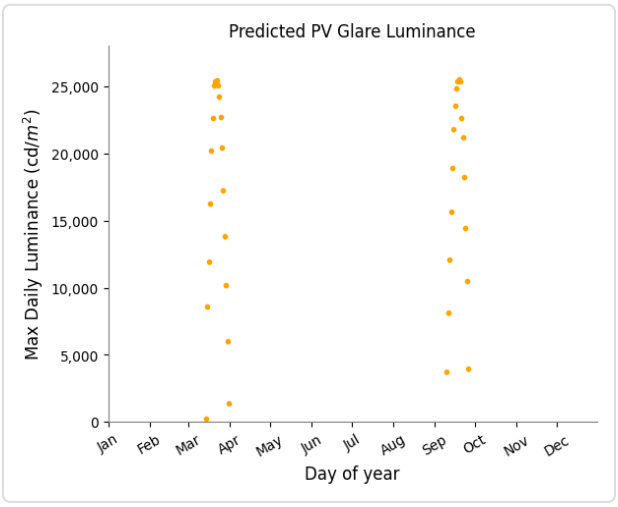
Green glare: 386 min.











PV array 1 and OP 1

No glare found

PV array 1 and OP 2

No glare found

PV array 1 and OP 3

No glare found

PV array 1 and OP 4

No glare found

PV array 1 and OP 5

No glare found

PV array 1 and OP 6

No glare found

PV array 1 and OP 9

No glare found

PV array 1 and OP 10

No glare found

PV array 1 and OP 11

No glare found

PV array 1 and OP 12

No glare found

PV array 1 and OP 13

No glare found

PV array 1 and OP 18

No glare found

PV array 1 and OP 19

No glare found

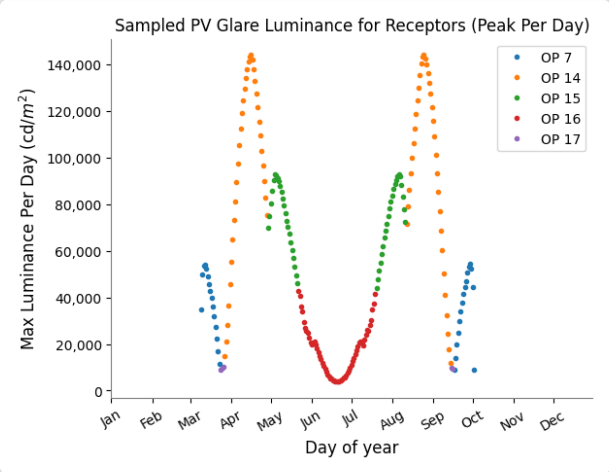
PV array 1 and OP 20

No glare found

PV: PV array 2 low potential for temporary after-image

Receptor results ordered by category of glare

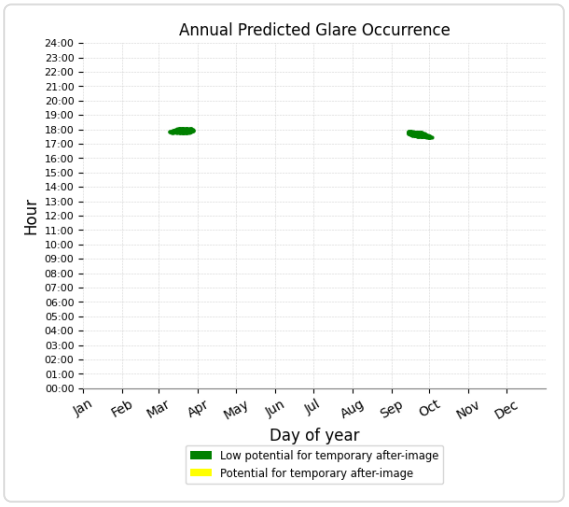
Receptor	Annual Green Glare		Annual Yellow Glare		Peak Luminance
	min	hr	min	hr	cd/m^2
OP 7	457	7.6	0	0.0	54,409
OP 8	273	4.5	0	0.0	46,416
OP 14	1,992	33.2	0	0.0	144,104
OP 15	1,315	21.9	0	0.0	93,036
OP 16	742	12.4	0	0.0	52,771
OP 17	337	5.6	0	0.0	14,111
OP 1	0	0.0	0	0.0	0
OP 2	0	0.0	0	0.0	0
OP 3	0	0.0	0	0.0	0
OP 4	0	0.0	0	0.0	0
OP 5	0	0.0	0	0.0	0
OP 6	0	0.0	0	0.0	0
OP 9	0	0.0	0	0.0	0
OP 10	0	0.0	0	0.0	0
OP 11	0	0.0	0	0.0	0
OP 12	0	0.0	0	0.0	0
OP 13	0	0.0	0	0.0	0
OP 18	0	0.0	0	0.0	0
OP 19	0	0.0	0	0.0	0
OP 20	0	0.0	0	0.0	0

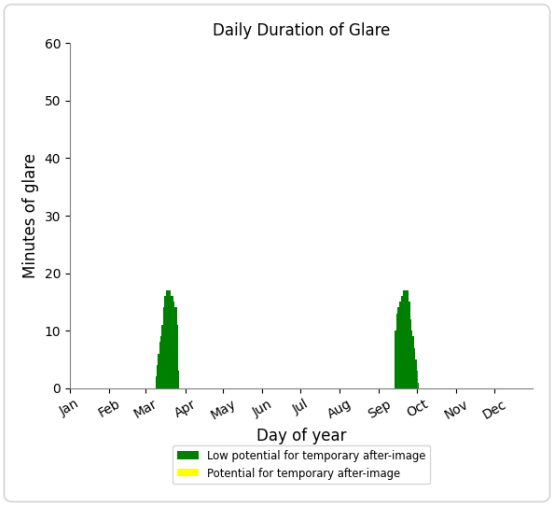


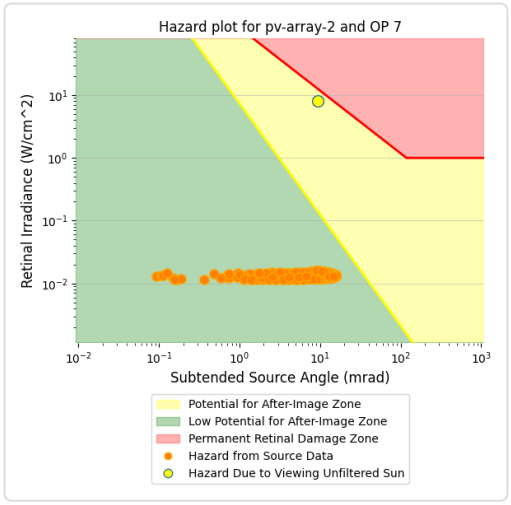
PV array 2 and OP 7

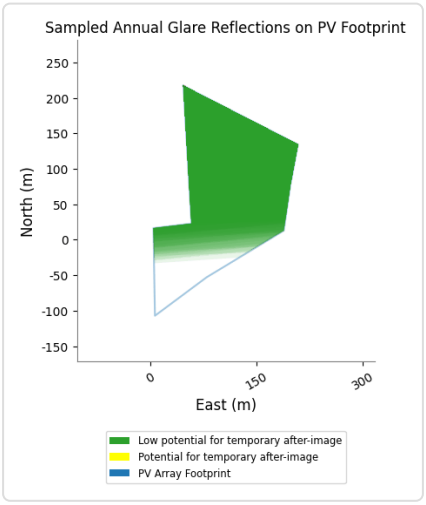
Yellow glare: none

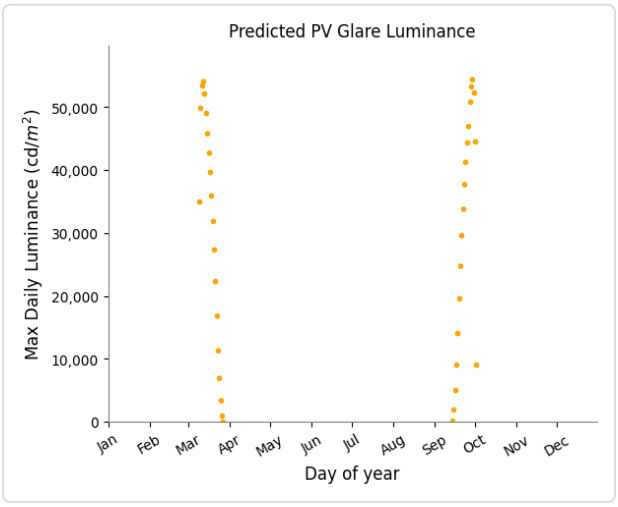
Green glare: 457 min.







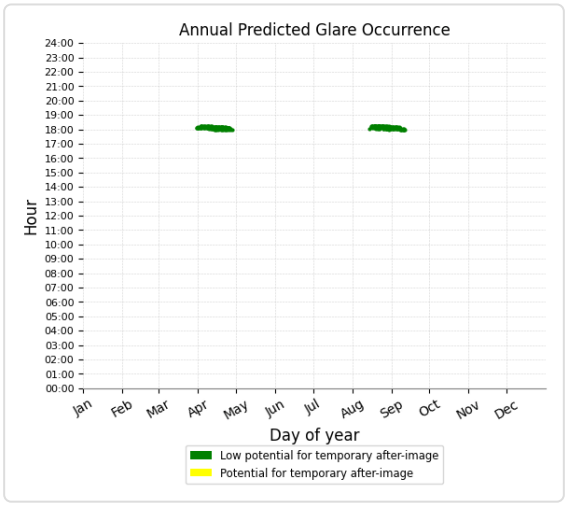


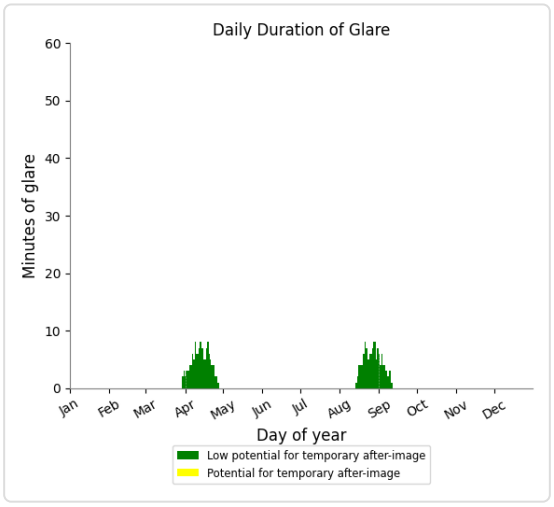


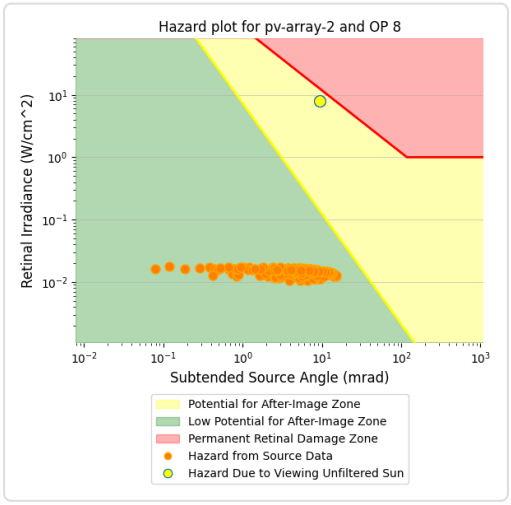
PV array 2 and OP 8

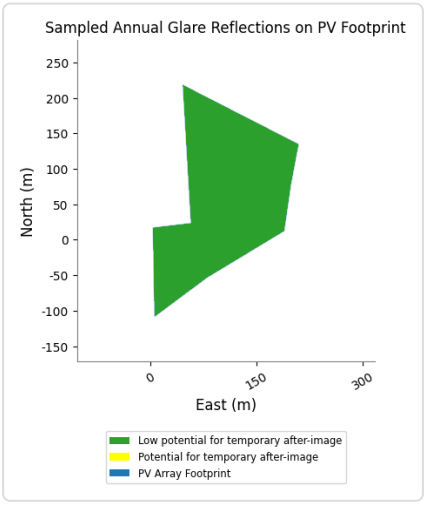
Yellow glare: none

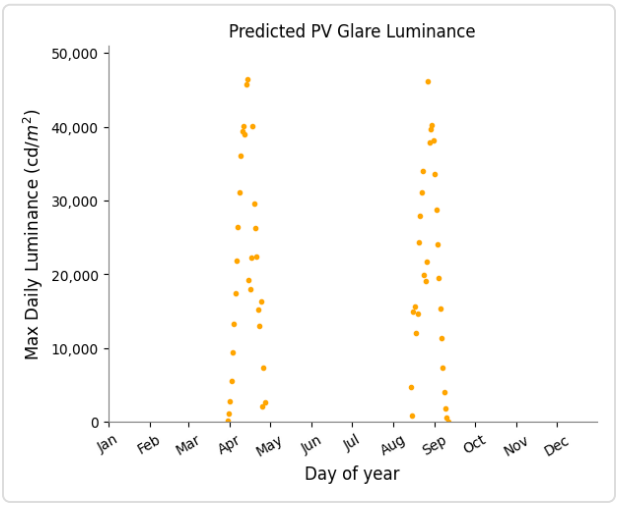
Green glare: 273 min.







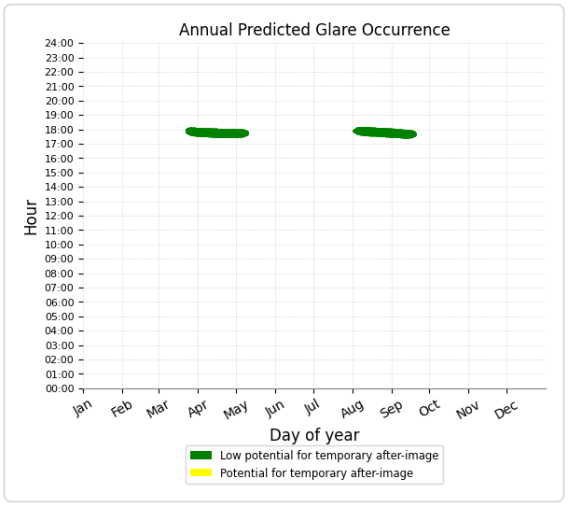


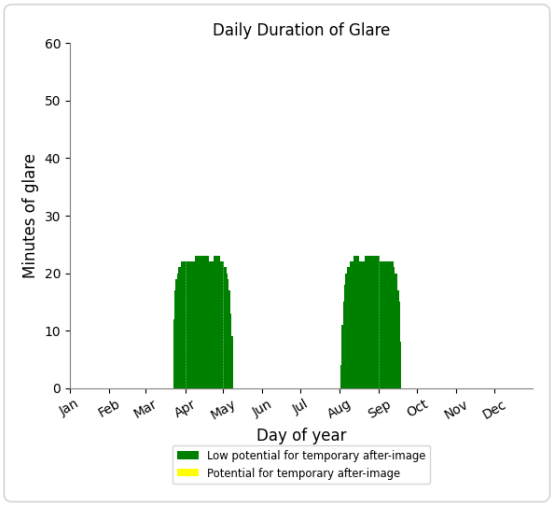


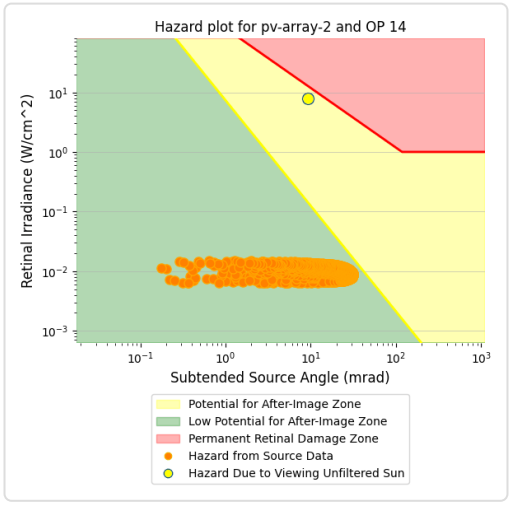
PV array 2 and OP 14

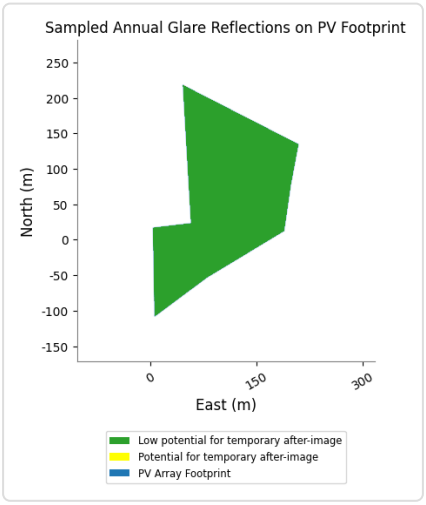
Yellow glare: none

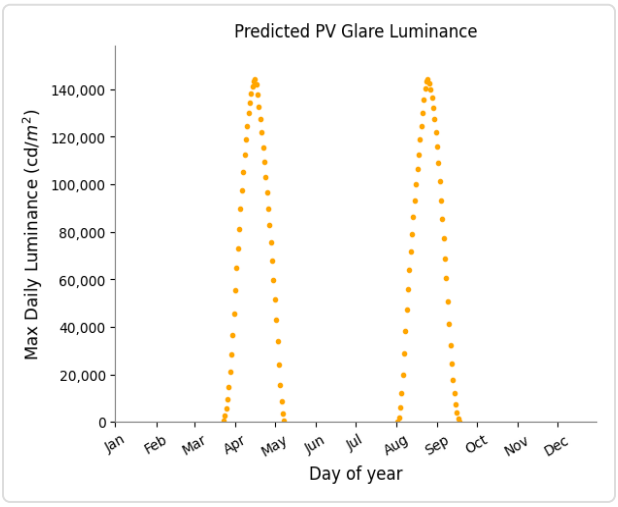
Green glare: 1,992 min.







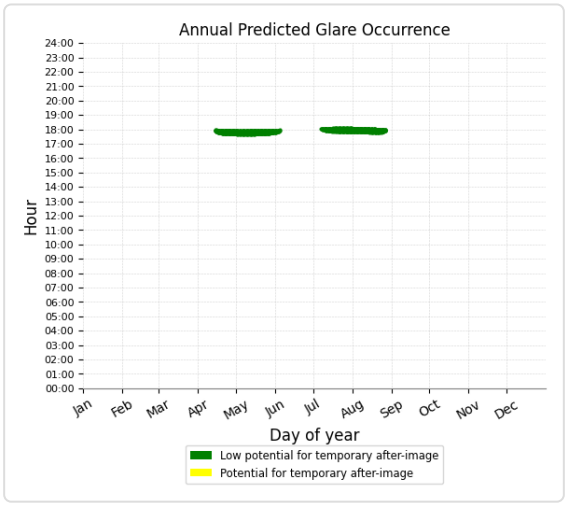


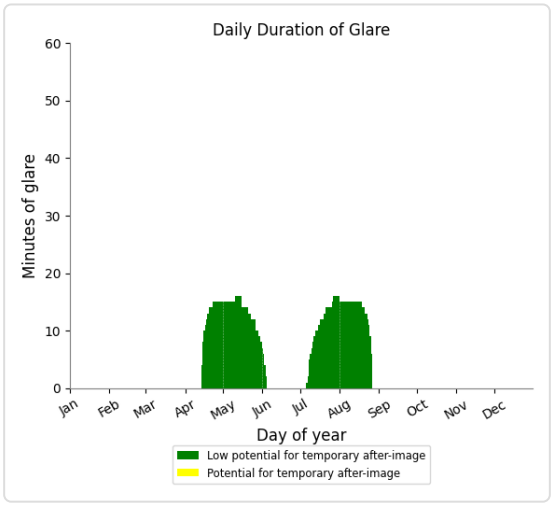


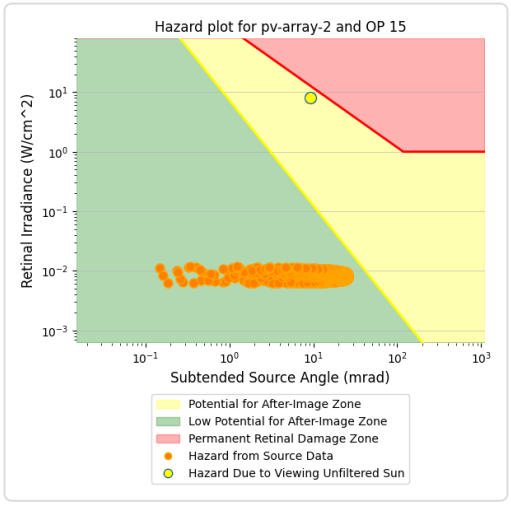
PV array 2 and OP 15

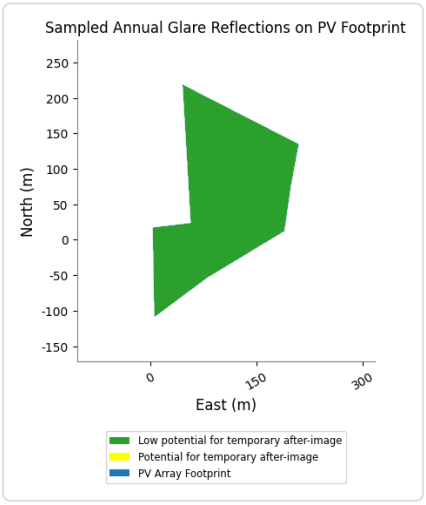
Yellow glare: none

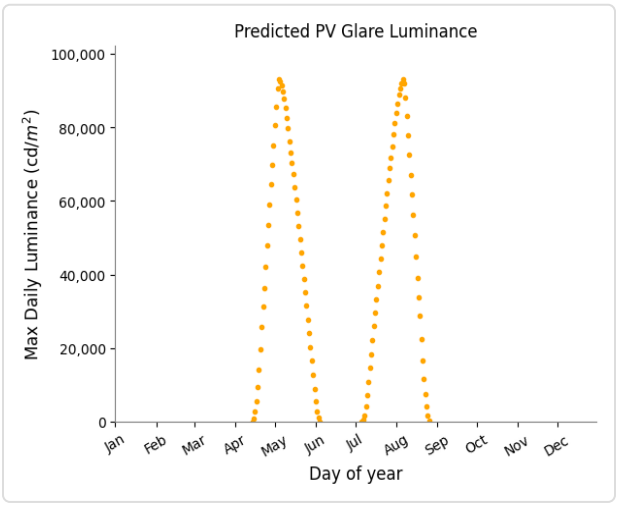
Green glare: 1,315 min.







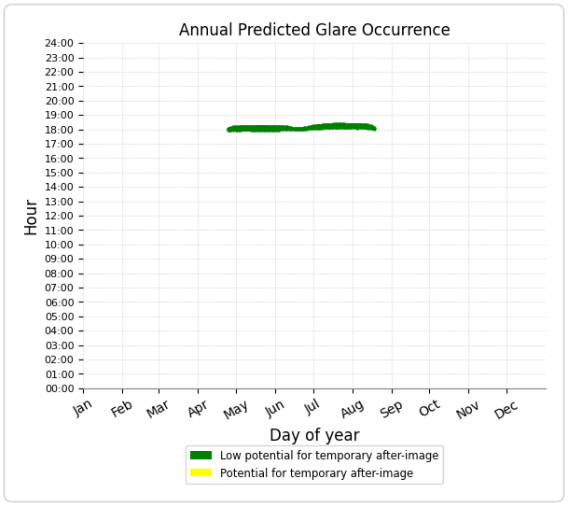


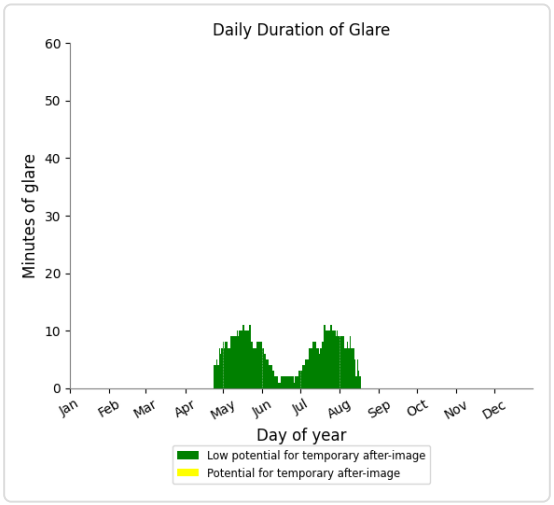


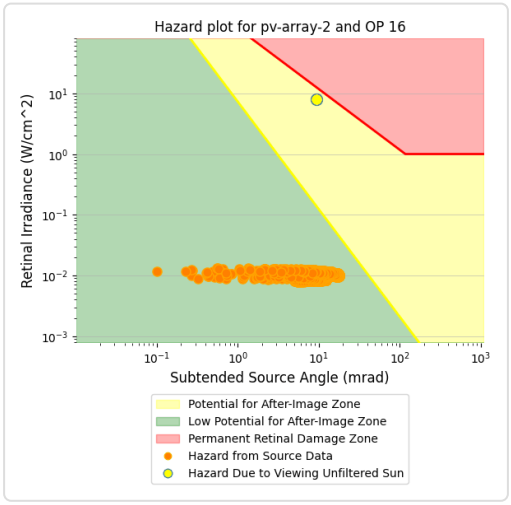
PV array 2 and OP 16

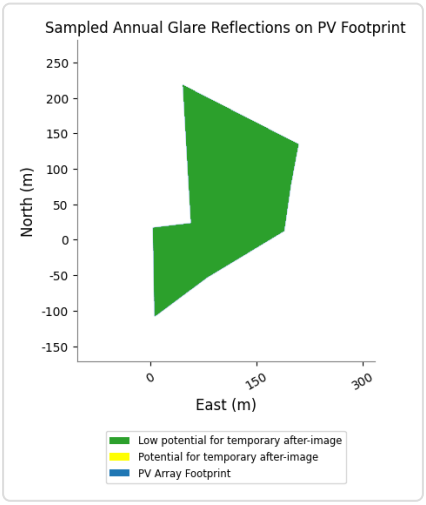
Yellow glare: none

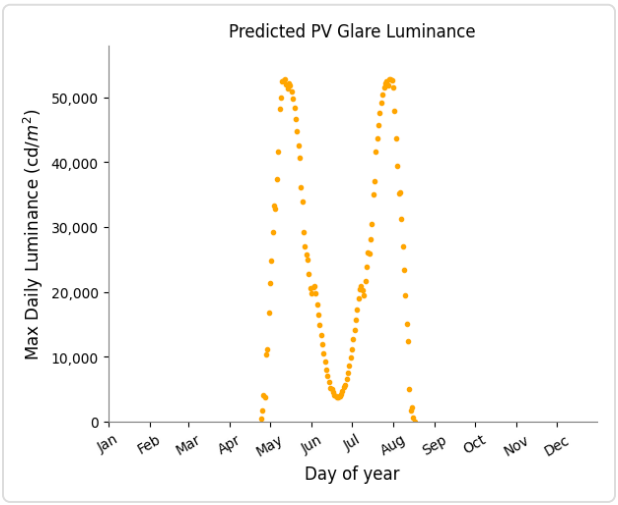
Green glare: 742 min.







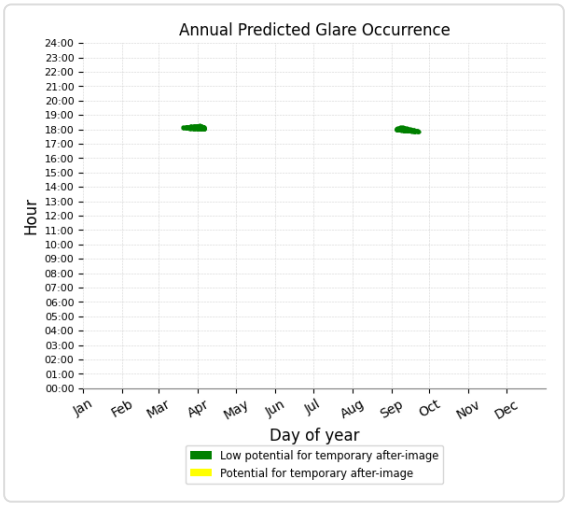


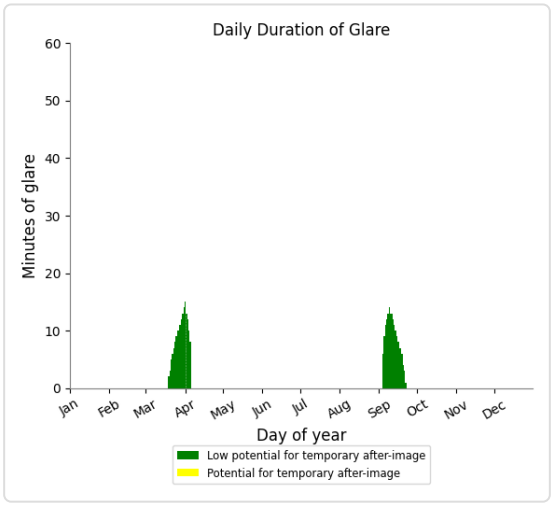


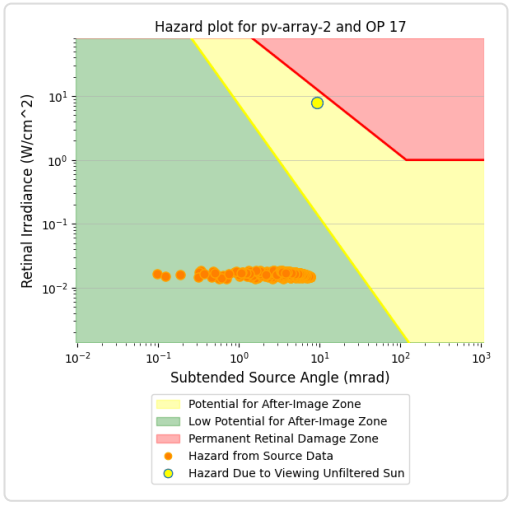
PV array 2 and OP 17

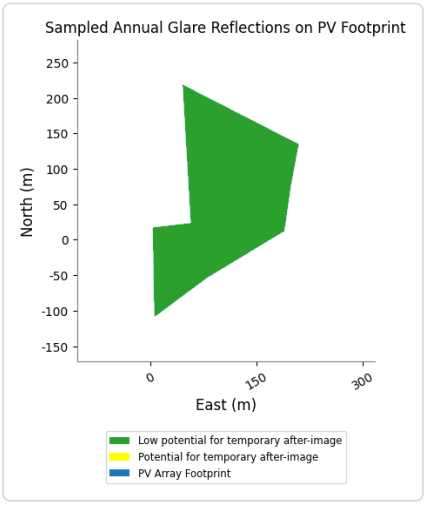
Yellow glare: none

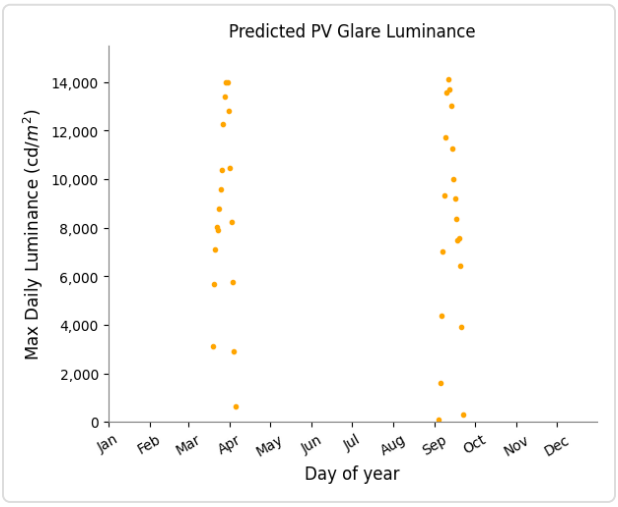
Green glare: 337 min.











PV array 2 and OP 1

No glare found

PV array 2 and OP 2

No glare found

PV array 2 and OP 3

No glare found

PV array 2 and OP 4

No glare found

PV array 2 and OP 5

No glare found

PV array 2 and OP 6

No glare found

PV array 2 and OP 9

No glare found

PV array 2 and OP 10

No glare found

PV array 2 and OP 11

No glare found

PV array 2 and OP 12

No glare found

PV array 2 and OP 13

No glare found

PV array 2 and OP 18

No glare found

PV array 2 and OP 19

No glare found

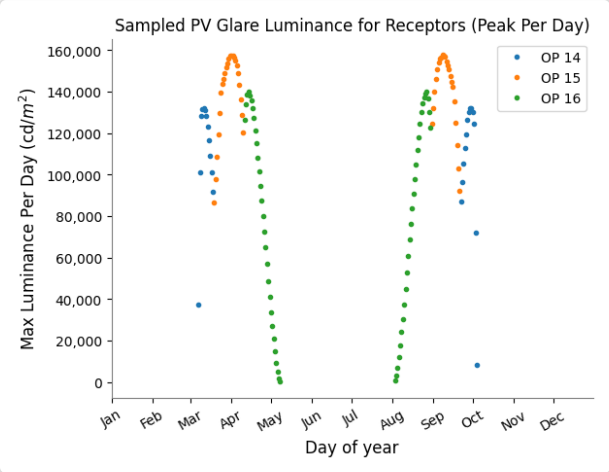
PV array 2 and OP 20

No glare found

PV: PV array 3 low potential for temporary after-image

Receptor results ordered by category of glare

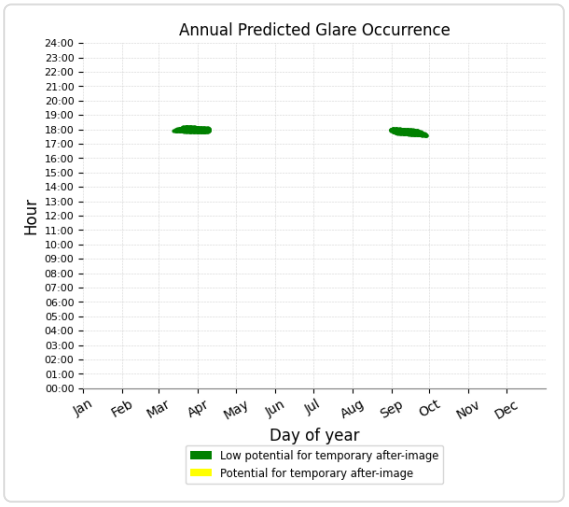
Receptor	Annual Green Glare		Annual Yellow Glare		Peak Luminance
	min	hr	min	hr	cd/m^2
OP 8	868	14.5	0	0.0	87,495
OP 14	768	12.8	0	0.0	132,281
OP 15	1,682	28.0	0	0.0	157,694
OP 16	1,412	23.5	0	0.0	139,907
OP 17	191	3.2	0	0.0	8,140
OP 1	0	0.0	0	0.0	0
OP 2	0	0.0	0	0.0	0
OP 3	0	0.0	0	0.0	0
OP 4	0	0.0	0	0.0	0
OP 5	0	0.0	0	0.0	0
OP 6	0	0.0	0	0.0	0
OP 7	0	0.0	0	0.0	0
OP 9	0	0.0	0	0.0	0
OP 10	0	0.0	0	0.0	0
OP 11	0	0.0	0	0.0	0
OP 12	0	0.0	0	0.0	0
OP 13	0	0.0	0	0.0	0
OP 18	0	0.0	0	0.0	0
OP 19	0	0.0	0	0.0	0
OP 20	0	0.0	0	0.0	0

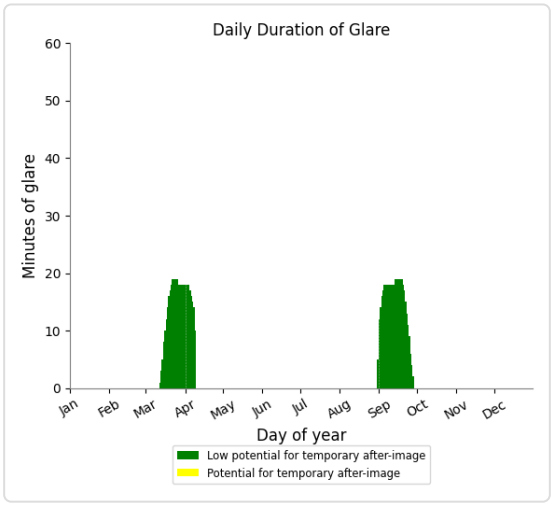


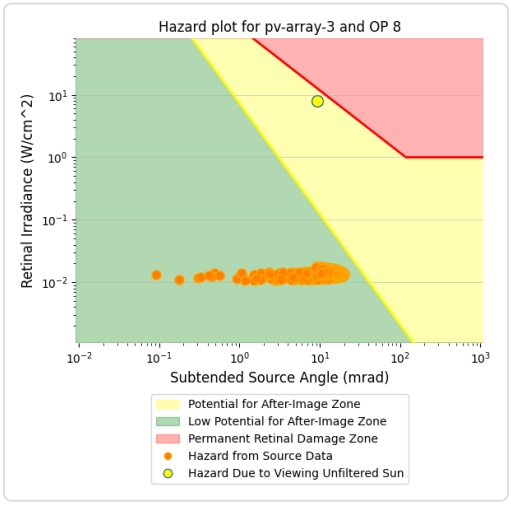
PV array 3 and OP 8

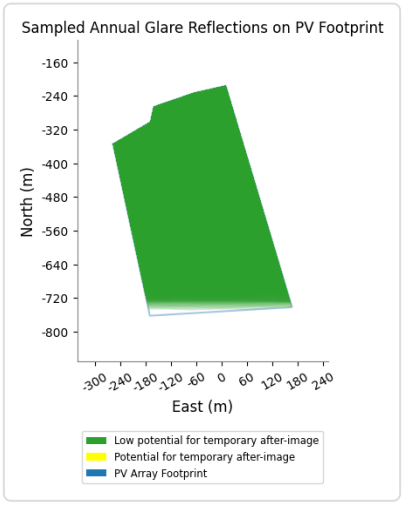
Yellow glare: none

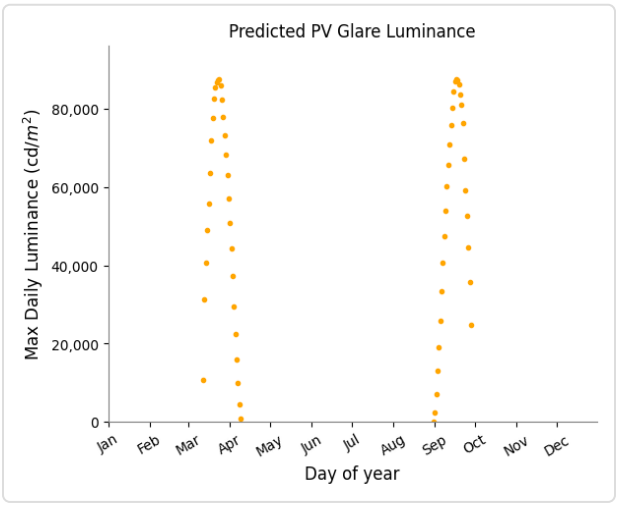
Green glare: 868 min.







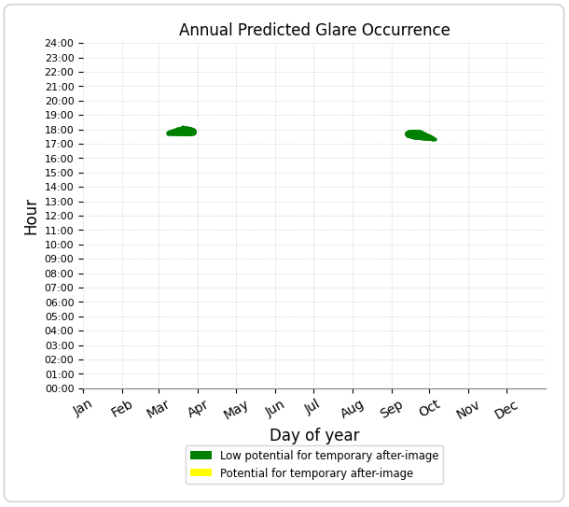


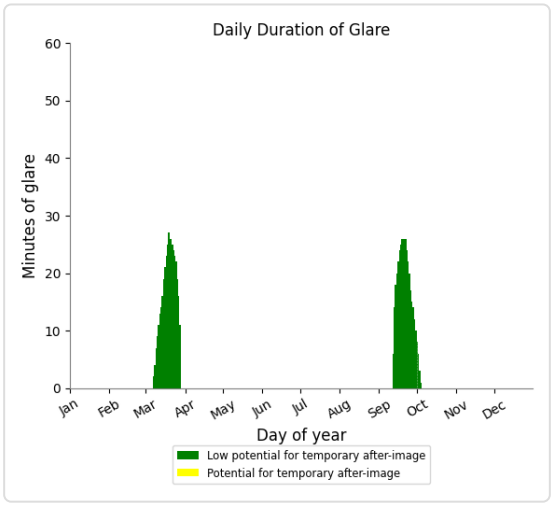


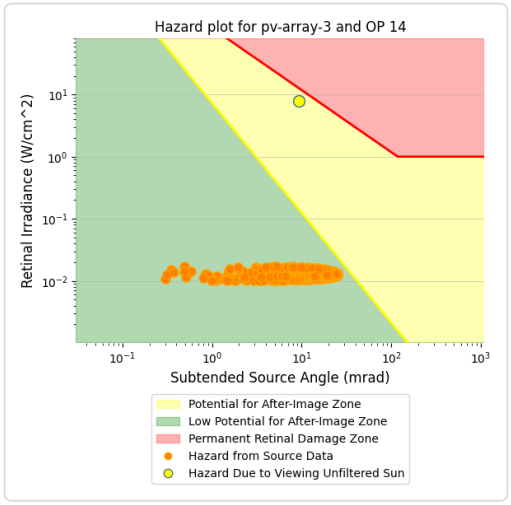
PV array 3 and OP 14

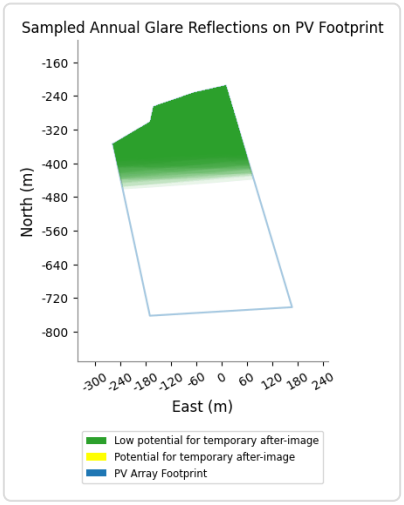
Yellow glare: none

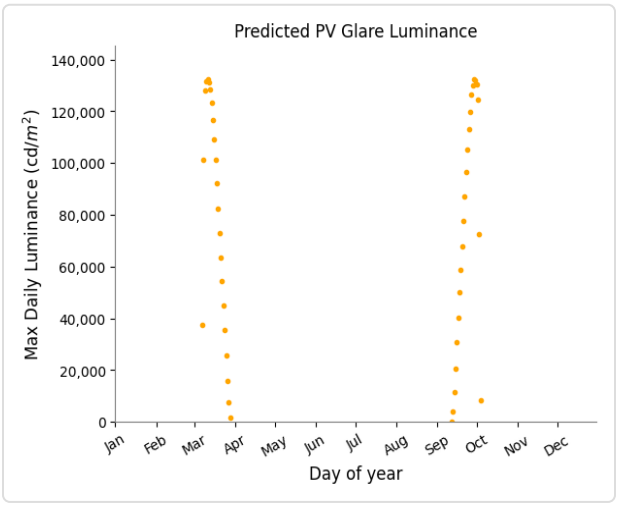
Green glare: 768 min.







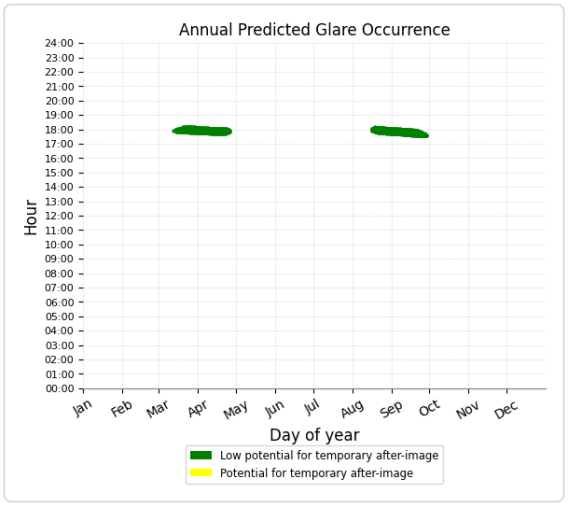


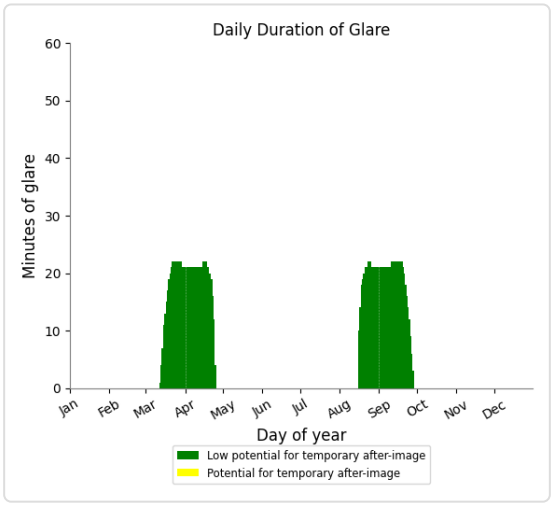


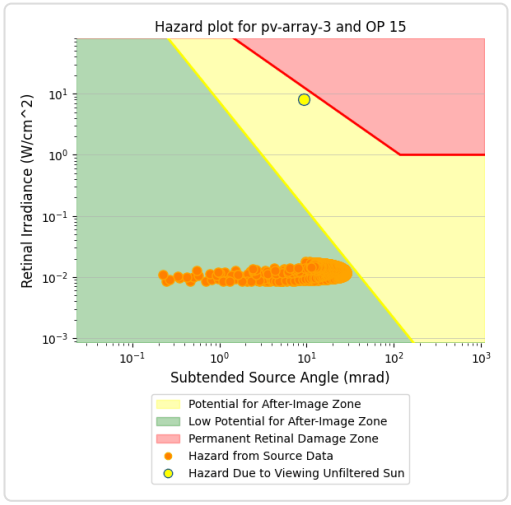
PV array 3 and OP 15

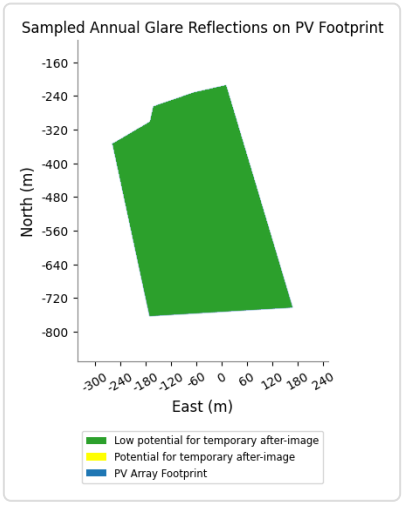
Yellow glare: none

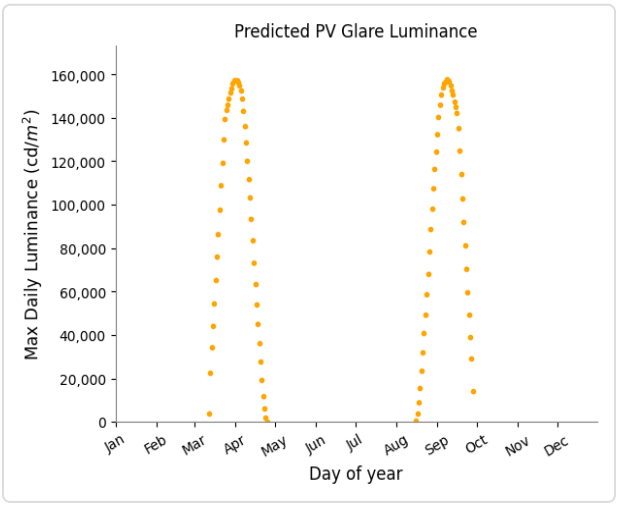
Green glare: 1,682 min.







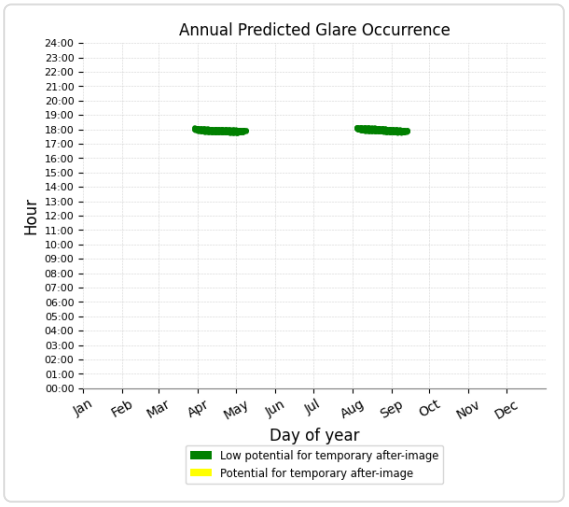


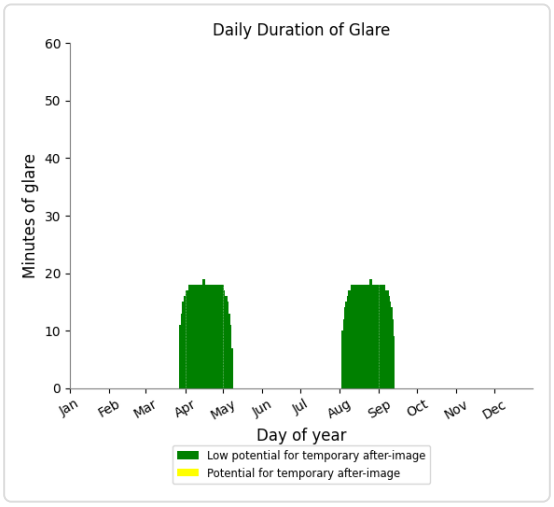


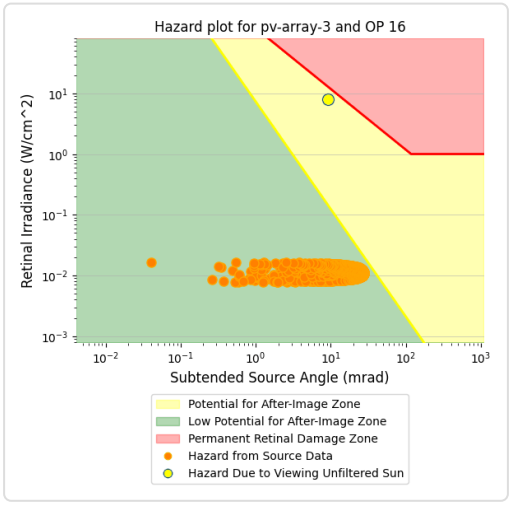
PV array 3 and OP 16

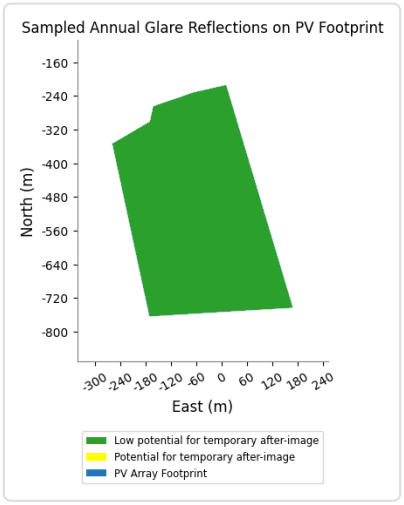
Yellow glare: none

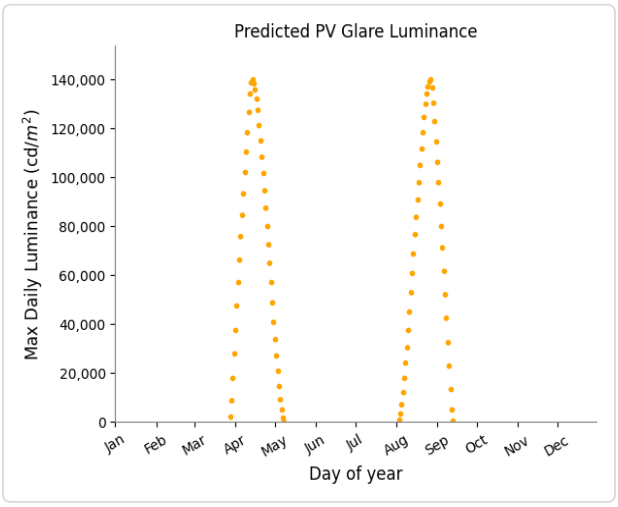
Green glare: 1,412 min.







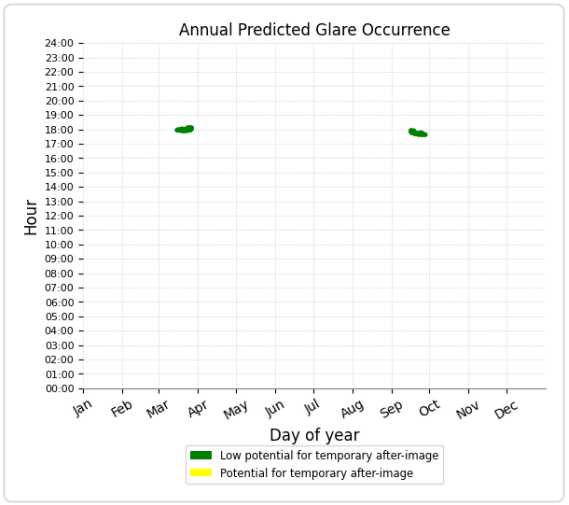


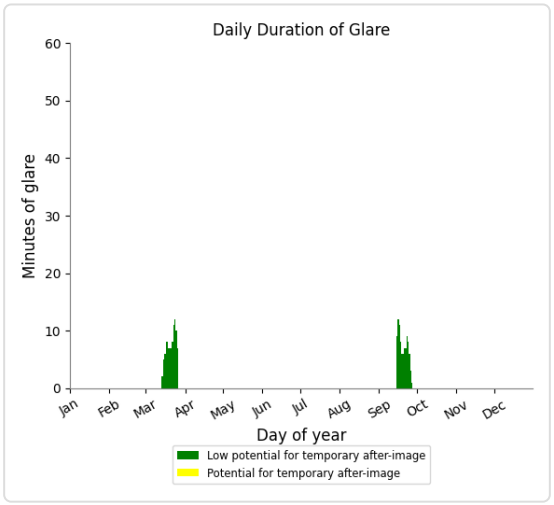


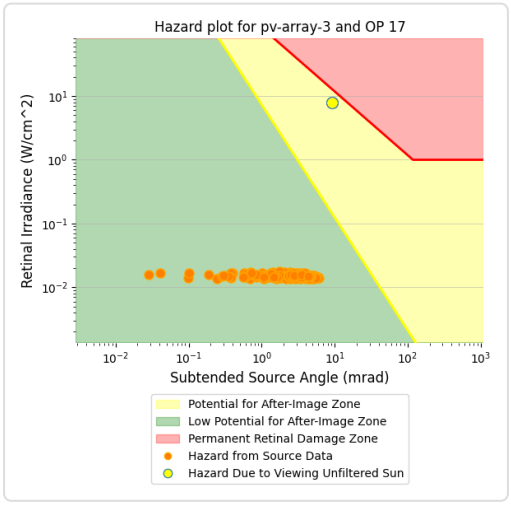
PV array 3 and OP 17

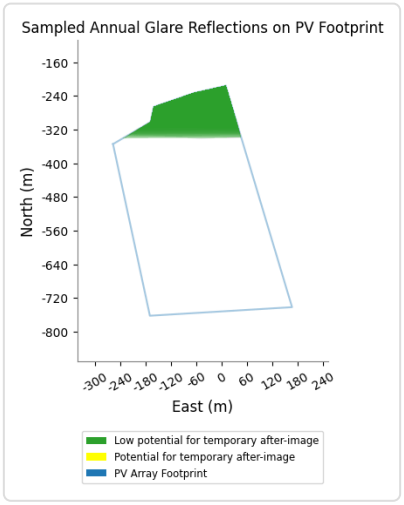
Yellow glare: none

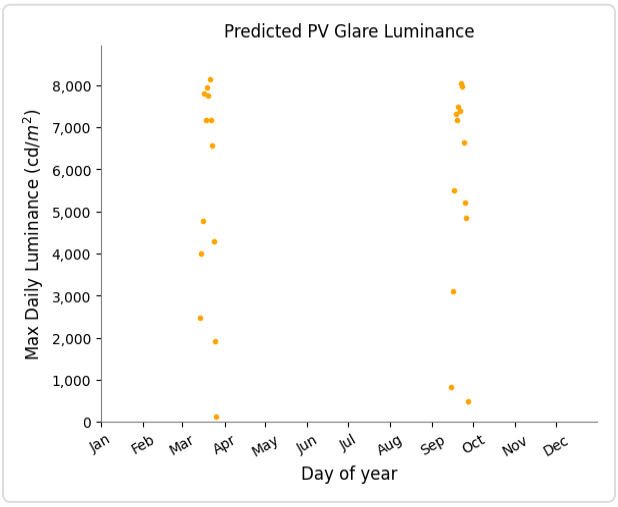
Green glare: 191 min.











PV array 3 and OP 1

No glare found

PV array 3 and OP 2

No glare found

PV array 3 and OP 3

No glare found

PV array 3 and OP 4

No glare found

PV array 3 and OP 5

No glare found

PV array 3 and OP 6

No glare found

PV array 3 and OP 7

No glare found

PV array 3 and OP 9

No glare found

PV array 3 and OP 10

No glare found

PV array 3 and OP 11

No glare found

PV array 3 and OP 12

No glare found

PV array 3 and OP 13

No glare found

PV array 3 and OP 18

No glare found

PV array 3 and OP 19

No glare found

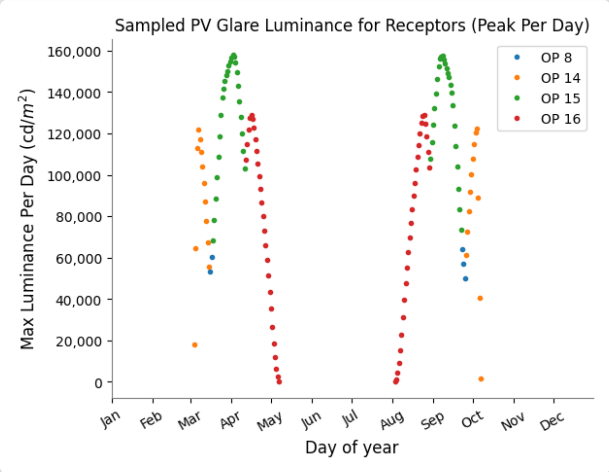
PV array 3 and OP 20

No glare found

PV: PV array 4 low potential for temporary after-image

Receptor results ordered by category of glare

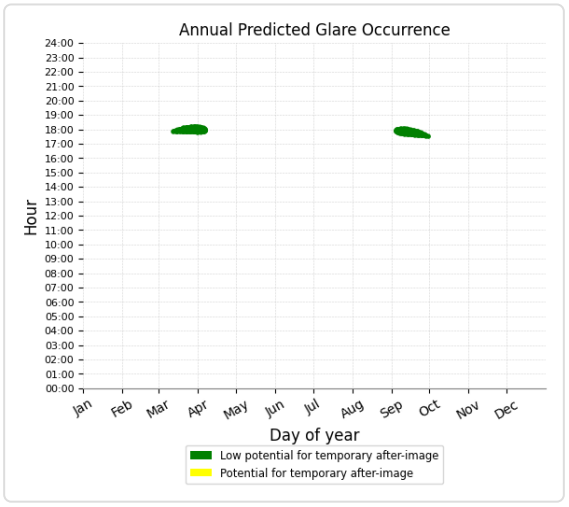
Receptor	Annual Green Glare		Annual Yellow Glare		Peak Luminance
	min	hr	min	hr	cd/m^2
OP 8	972	16.2	0	0.0	83,063
OP 14	446	7.4	0	0.0	122,436
OP 15	1,945	32.4	0	0.0	157,881
OP 16	1,859	31.0	0	0.0	129,104
OP 17	153	2.5	0	0.0	2,975
OP 1	0	0.0	0	0.0	0
OP 2	0	0.0	0	0.0	0
OP 3	0	0.0	0	0.0	0
OP 4	0	0.0	0	0.0	0
OP 5	0	0.0	0	0.0	0
OP 6	0	0.0	0	0.0	0
OP 7	0	0.0	0	0.0	0
OP 9	0	0.0	0	0.0	0
OP 10	0	0.0	0	0.0	0
OP 11	0	0.0	0	0.0	0
OP 12	0	0.0	0	0.0	0
OP 13	0	0.0	0	0.0	0
OP 18	0	0.0	0	0.0	0
OP 19	0	0.0	0	0.0	0
OP 20	0	0.0	0	0.0	0

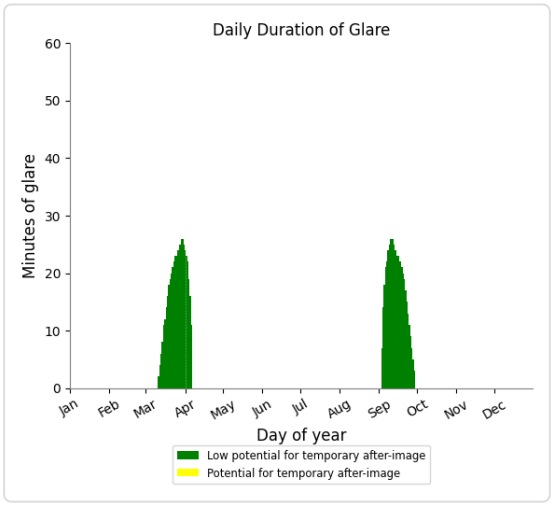


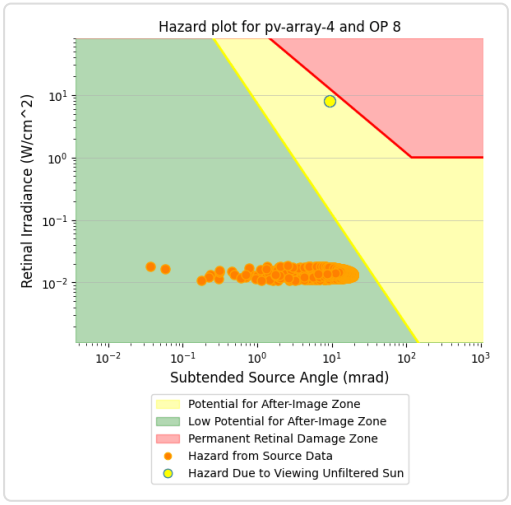
PV array 4 and OP 8

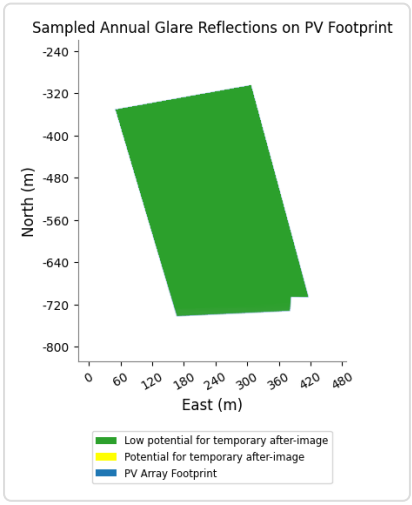
Yellow glare: none

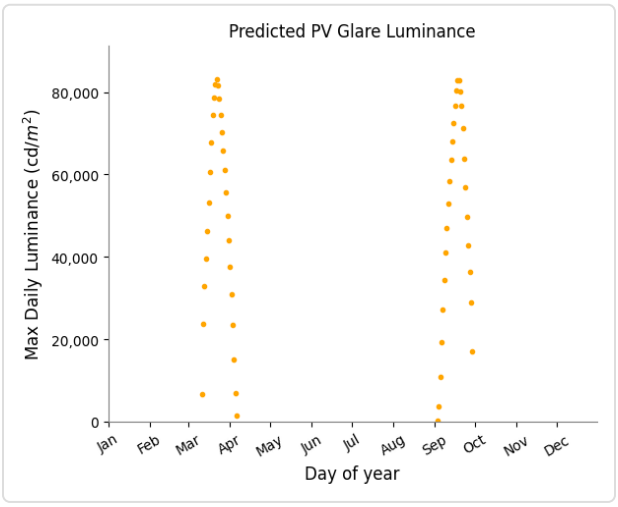
Green glare: 972 min.







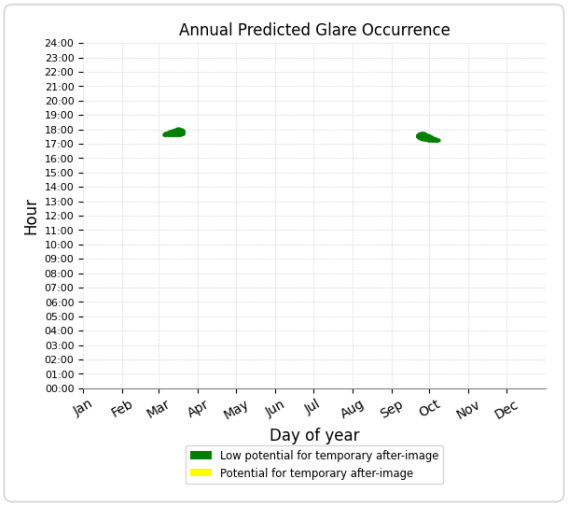


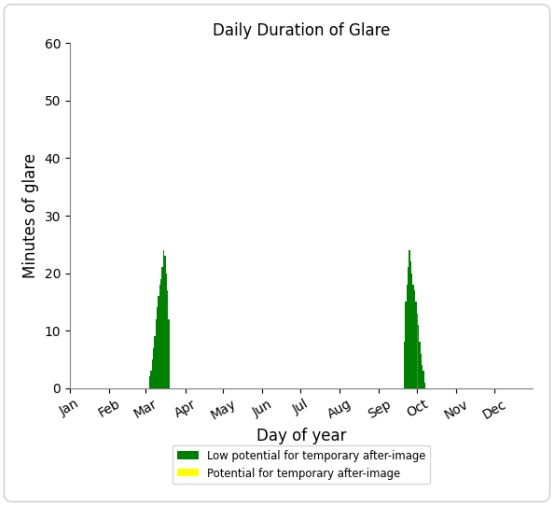


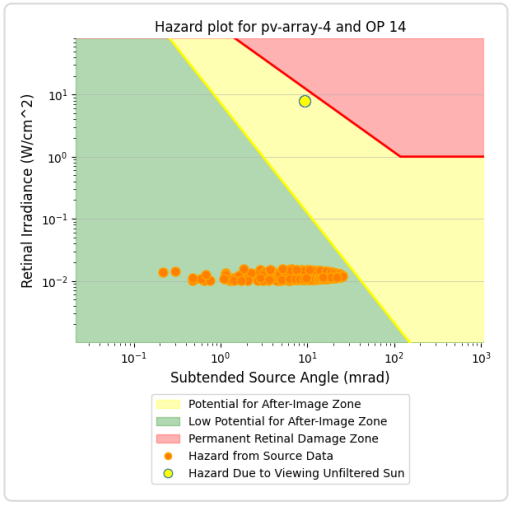
PV array 4 and OP 14

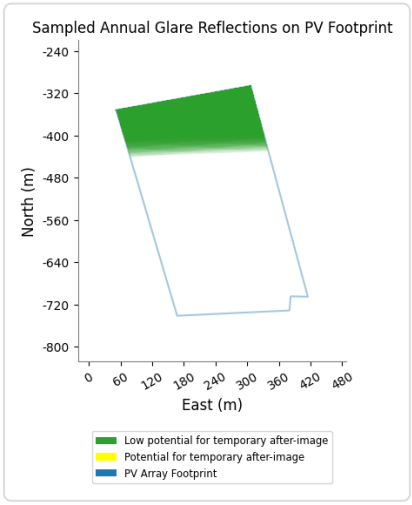
Yellow glare: none

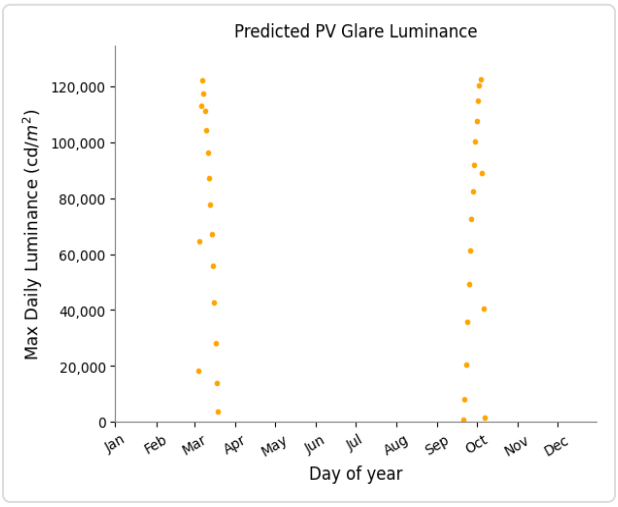
Green glare: 446 min.







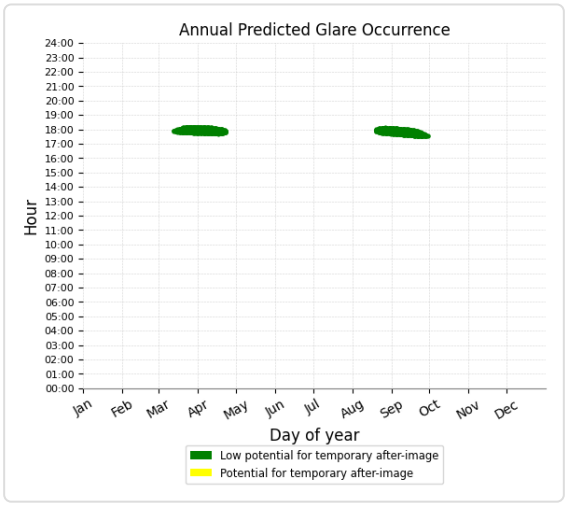


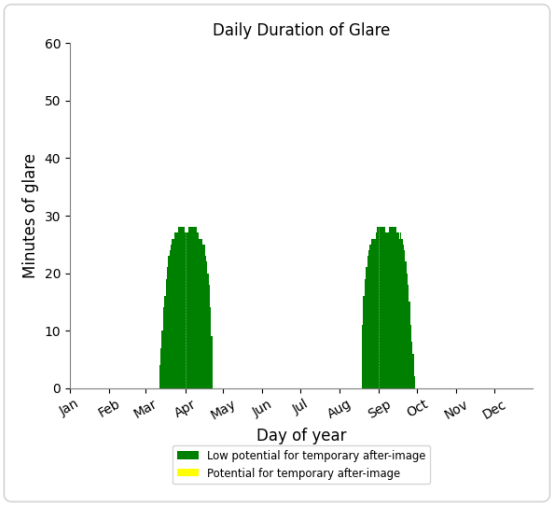


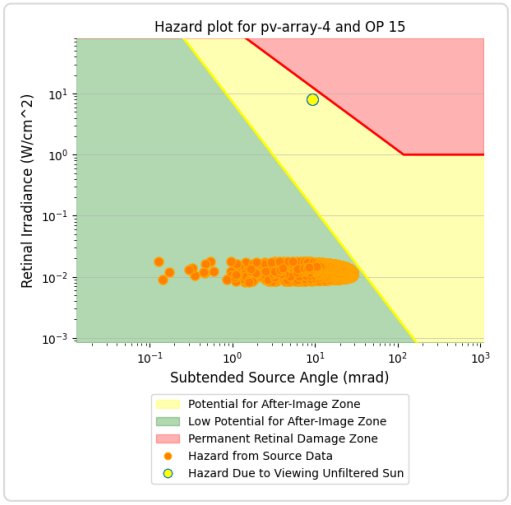
PV array 4 and OP 15

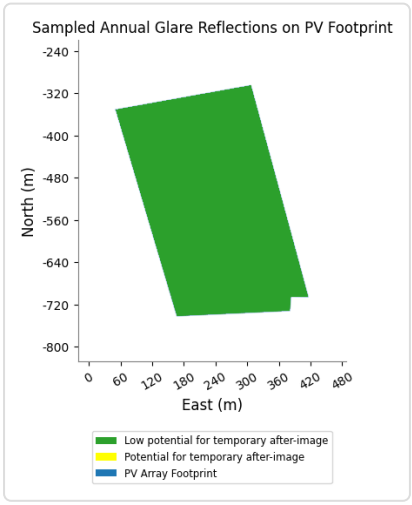
Yellow glare: none

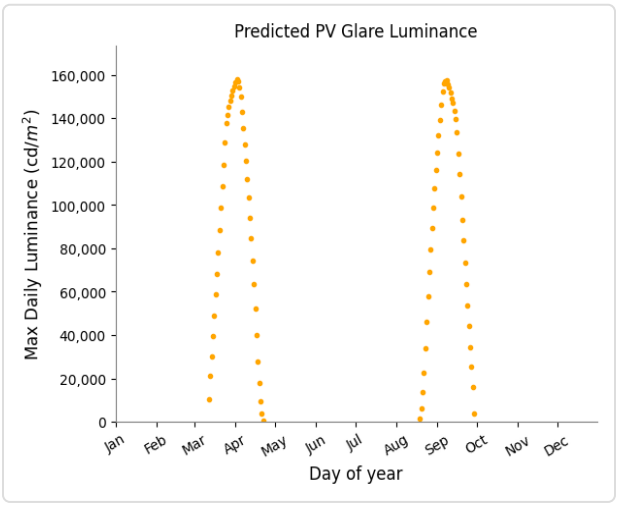
Green glare: 1,945 min.







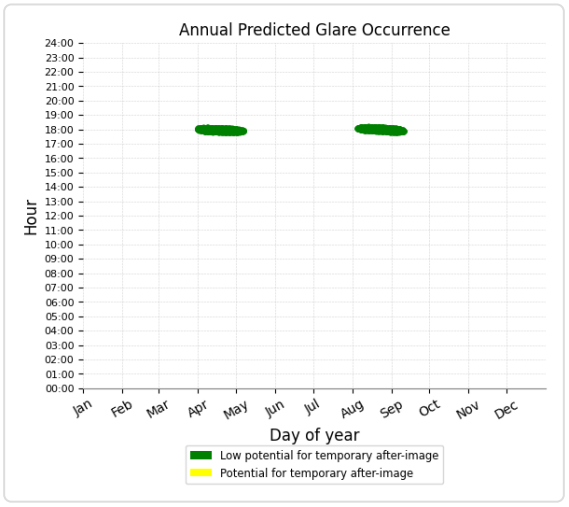


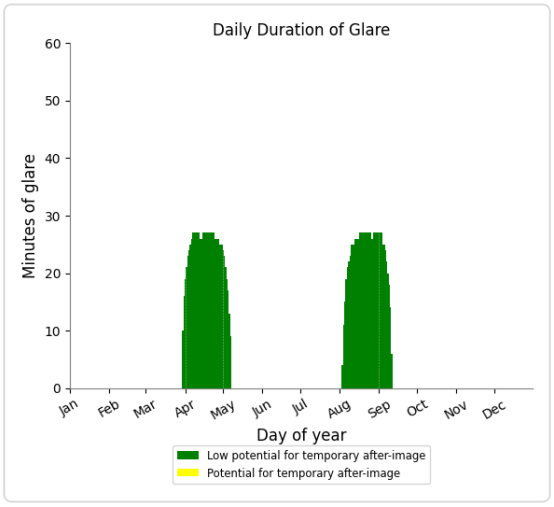


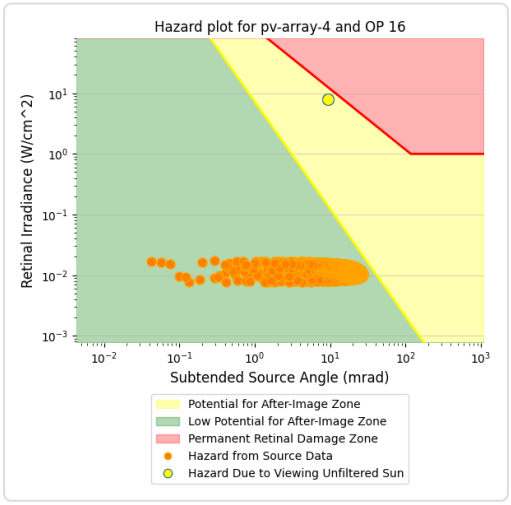
PV array 4 and OP 16

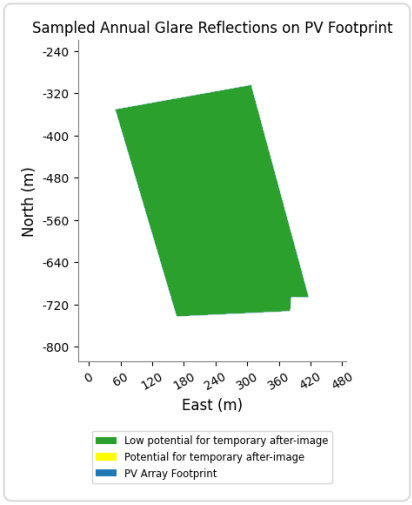
Yellow glare: none

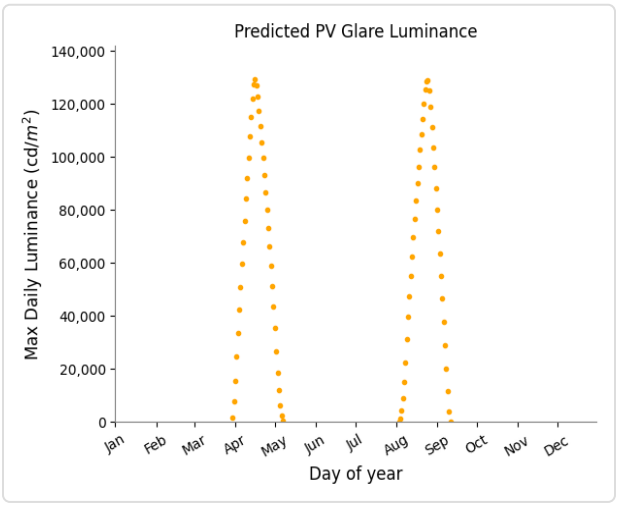
Green glare: 1,859 min.







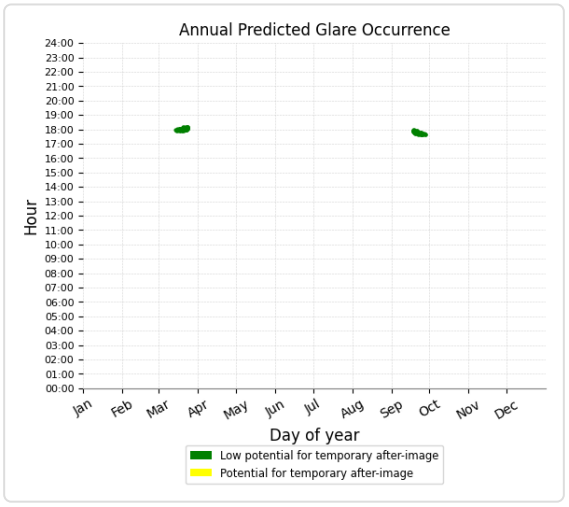


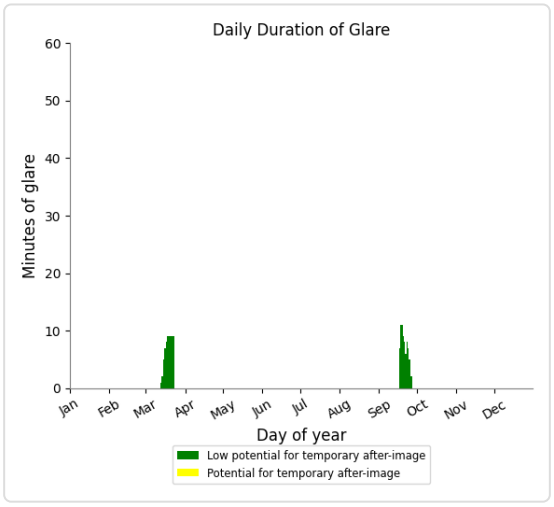


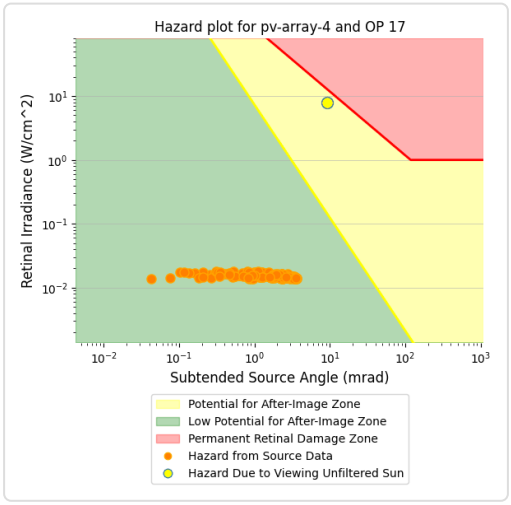
PV array 4 and OP 17

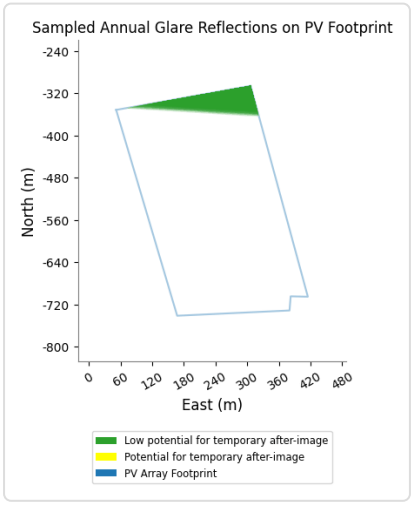
Yellow glare: none

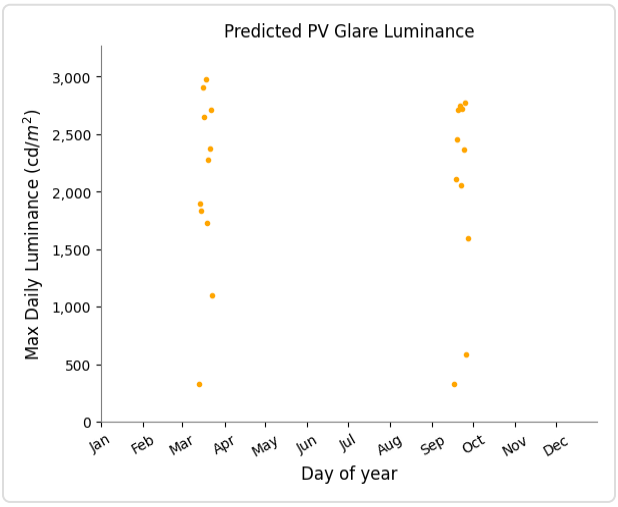
Green glare: 153 min.











PV array 4 and OP 1

No glare found

PV array 4 and OP 2

No glare found

PV array 4 and OP 3

No glare found

PV array 4 and OP 4

No glare found

PV array 4 and OP 5

No glare found

PV array 4 and OP 6

No glare found

PV array 4 and OP 7

No glare found

PV array 4 and OP 9

No glare found

PV array 4 and OP 10

No glare found

PV array 4 and OP 11

No glare found

PV array 4 and OP 12

No glare found

PV array 4 and OP 13

No glare found

PV array 4 and OP 18

No glare found

PV array 4 and OP 19

No glare found

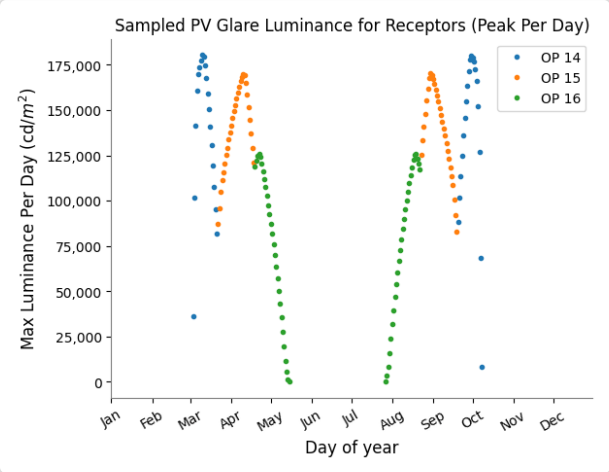
PV array 4 and OP 20

No glare found

PV: PV array 5 low potential for temporary after-image

Receptor results ordered by category of glare

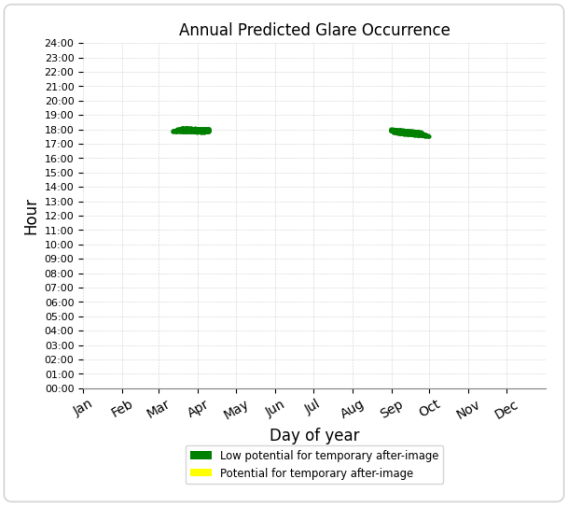
Receptor	Annual Green Glare		Annual Yellow Glare		Peak Luminance
	min	hr	min	hr	cd/m^2
OP 8	839	14.0	0	0.0	88,464
OP 14	849	14.2	0	0.0	180,420
OP 15	1,977	33.0	0	0.0	170,674
OP 16	1,515	25.2	0	0.0	125,617
OP 1	0	0.0	0	0.0	0
OP 2	0	0.0	0	0.0	0
OP 3	0	0.0	0	0.0	0
OP 4	0	0.0	0	0.0	0
OP 5	0	0.0	0	0.0	0
OP 6	0	0.0	0	0.0	0
OP 7	0	0.0	0	0.0	0
OP 9	0	0.0	0	0.0	0
OP 10	0	0.0	0	0.0	0
OP 11	0	0.0	0	0.0	0
OP 12	0	0.0	0	0.0	0
OP 13	0	0.0	0	0.0	0
OP 17	0	0.0	0	0.0	0
OP 18	0	0.0	0	0.0	0
OP 19	0	0.0	0	0.0	0
OP 20	0	0.0	0	0.0	0

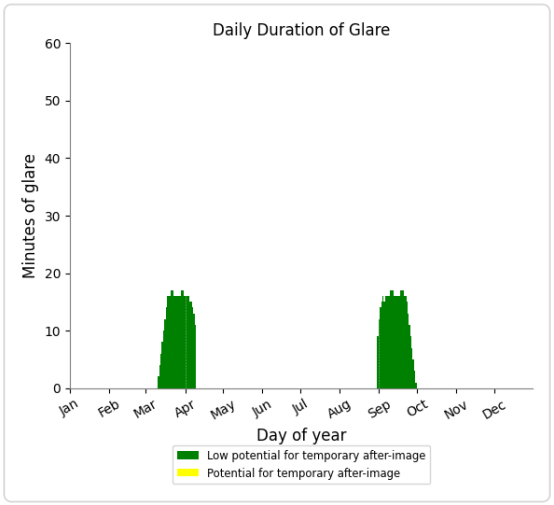


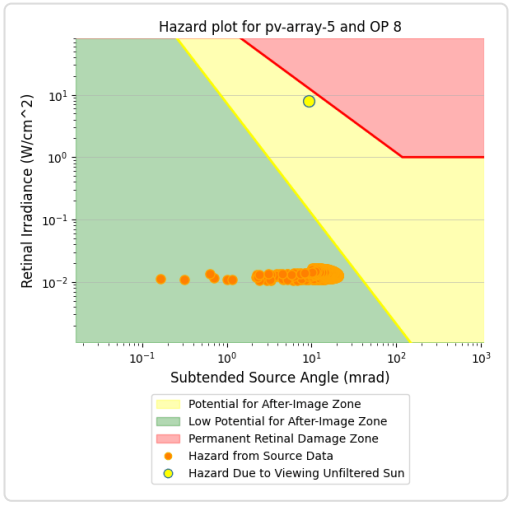
PV array 5 and OP 8

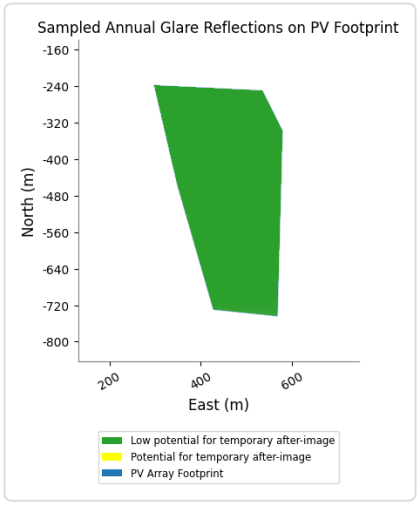
Yellow glare: none

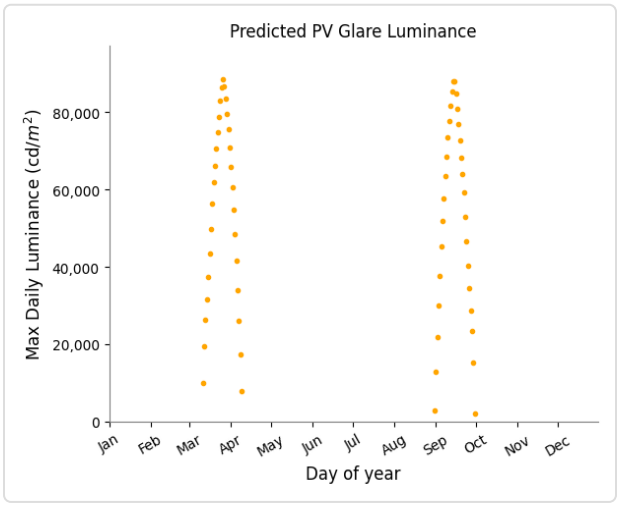
Green glare: 839 min.







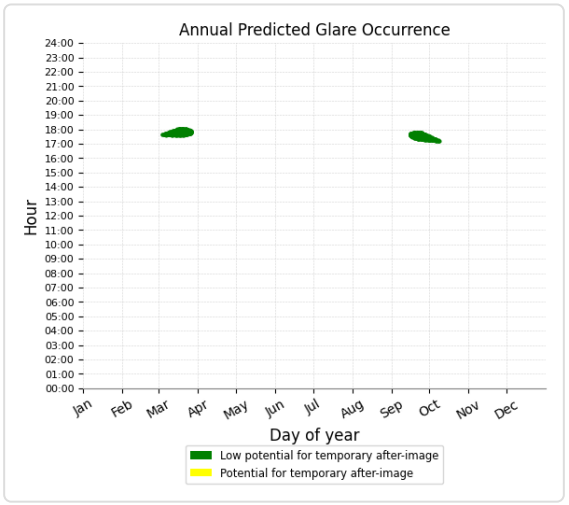


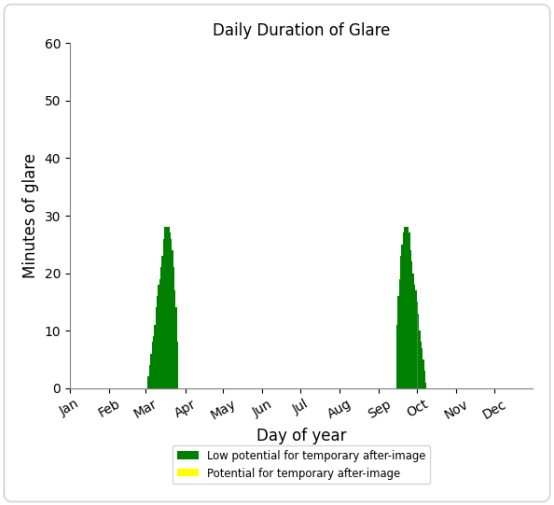


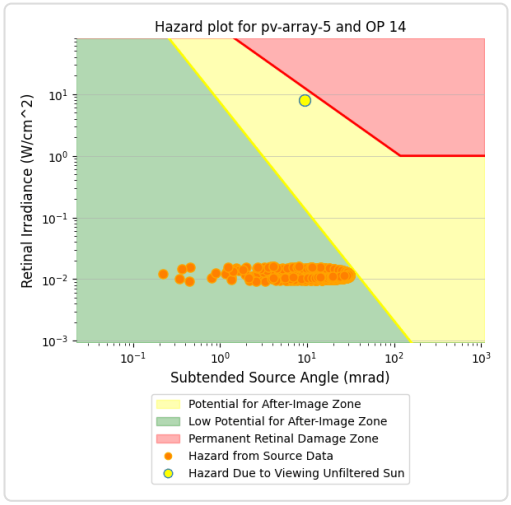
PV array 5 and OP 14

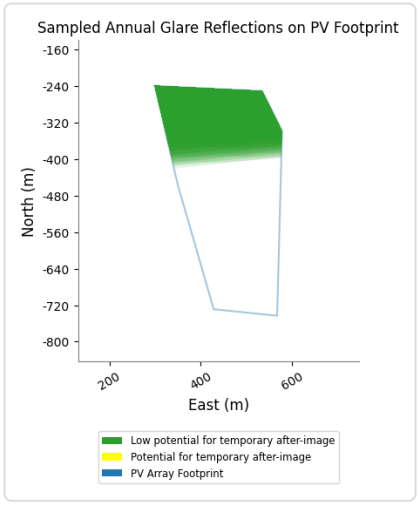
Yellow glare: none

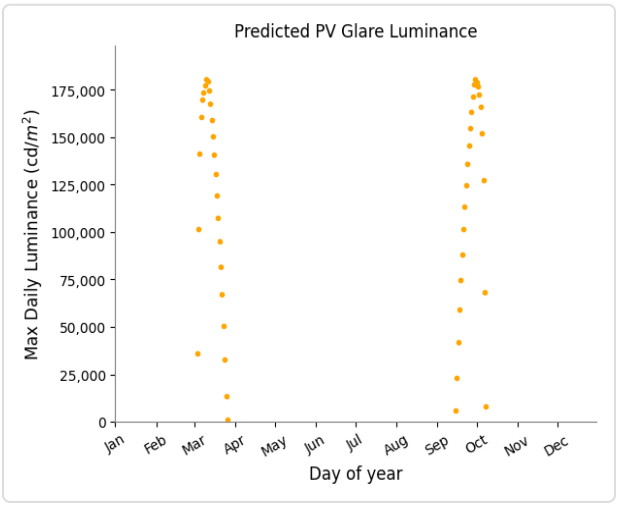
Green glare: 849 min.







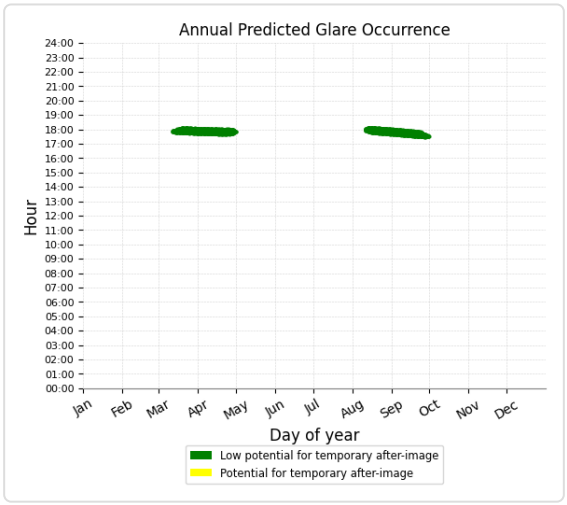


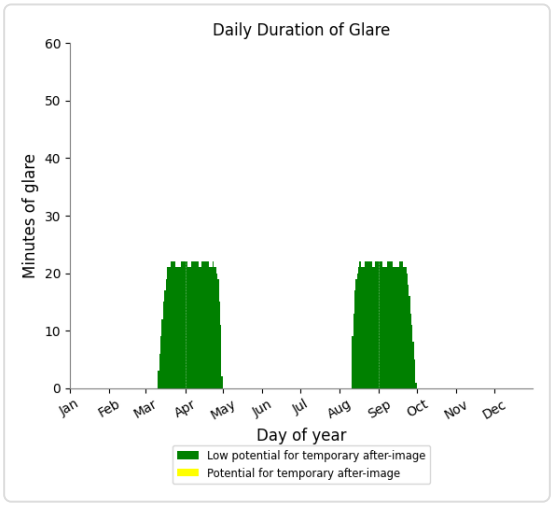


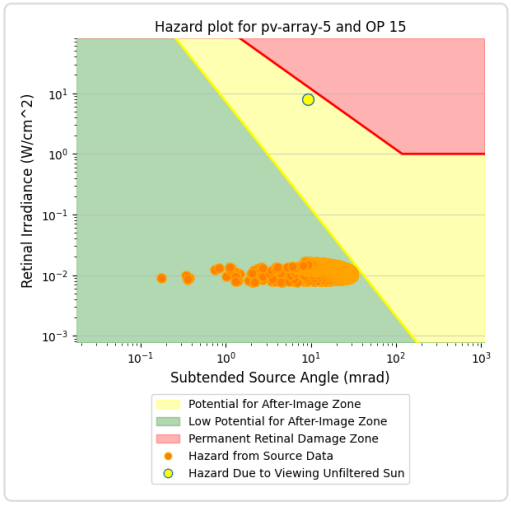
PV array 5 and OP 15

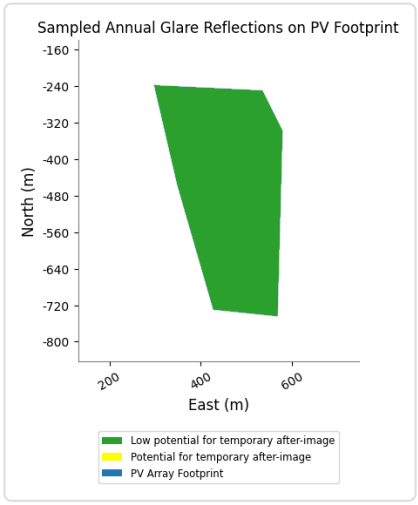
Yellow glare: none

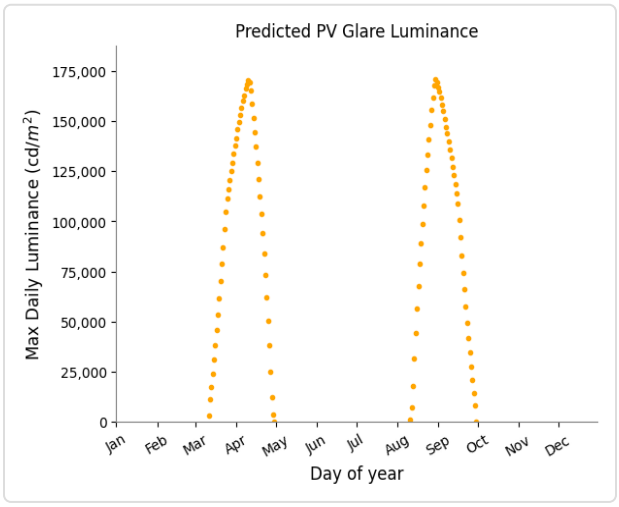
Green glare: 1,977 min.







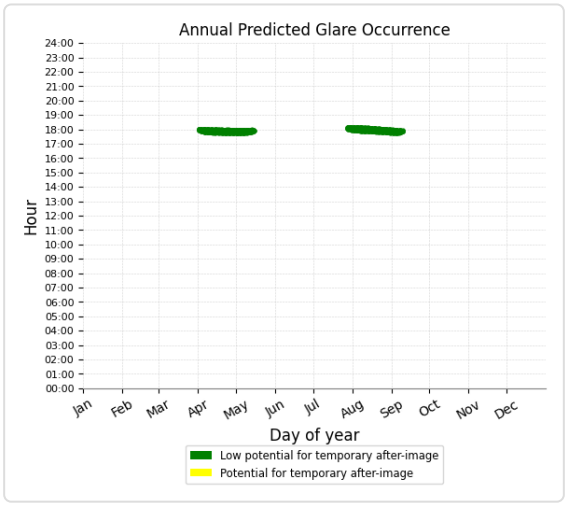


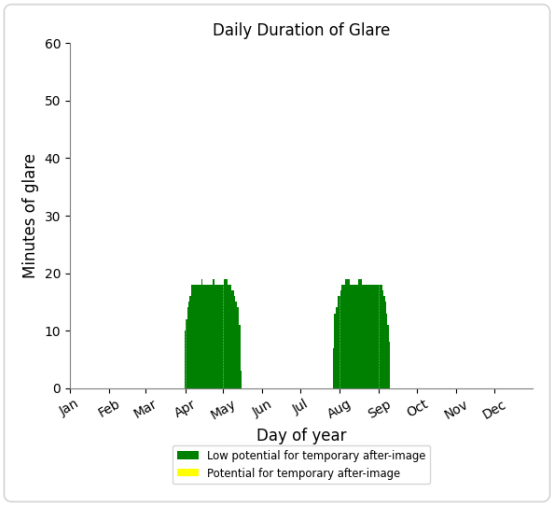


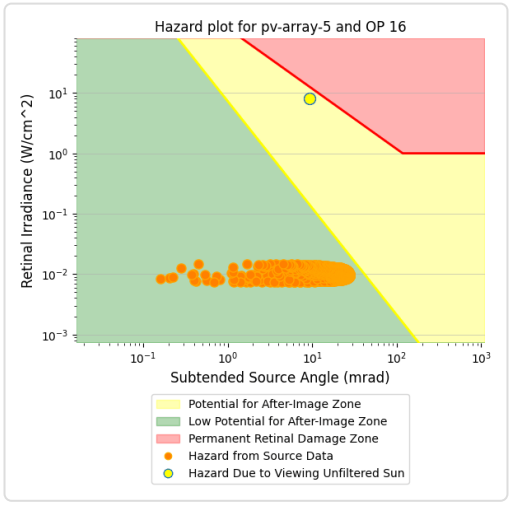
PV array 5 and OP 16

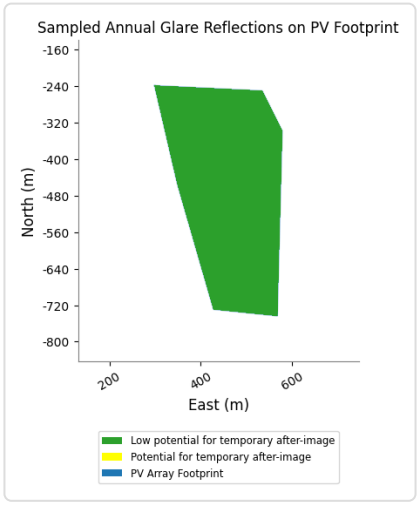
Yellow glare: none

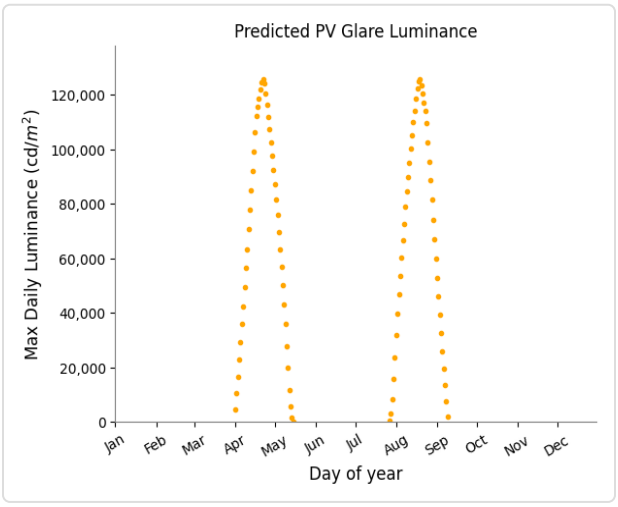
Green glare: 1,515 min.











PV array 5 and OP 1

No glare found

PV array 5 and OP 2

No glare found

PV array 5 and OP 3

No glare found

PV array 5 and OP 4

No glare found

PV array 5 and OP 5

No glare found

PV array 5 and OP 6

No glare found

PV array 5 and OP 7

No glare found

PV array 5 and OP 9

No glare found

PV array 5 and OP 10

No glare found

PV array 5 and OP 11

No glare found

PV array 5 and OP 12

No glare found

PV array 5 and OP 13

No glare found

PV array 5 and OP 17

No glare found

PV array 5 and OP 18

No glare found

PV array 5 and OP 19

No glare found

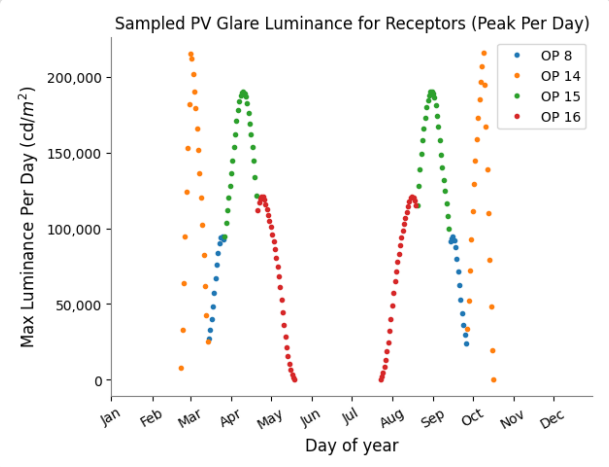
PV array 5 and OP 20

No glare found

PV: PV array 6 low potential for temporary after-image

Receptor results ordered by category of glare

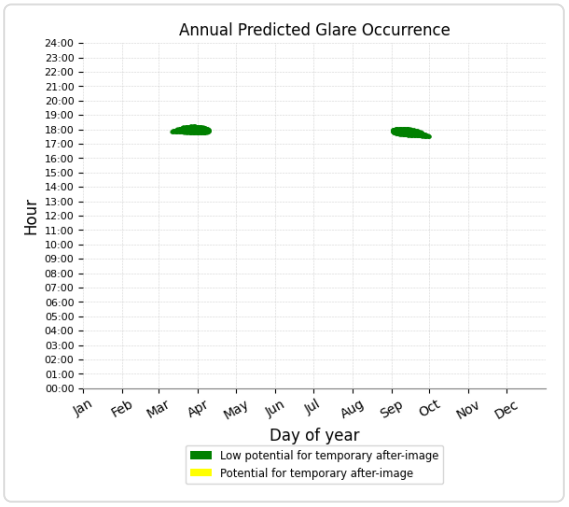
Receptor	Annual Green Glare		Annual Yellow Glare		Peak Luminance
	min	hr	min	hr	cd/m^2
OP 8	1,183	19.7	0	0.0	94,333
OP 14	784	13.1	0	0.0	215,619
OP 15	2,640	44.0	0	0.0	190,194
OP 16	2,335	38.9	0	0.0	121,125
OP 17	190	3.2	0	0.0	7,635
OP 1	0	0.0	0	0.0	0
OP 2	0	0.0	0	0.0	0
OP 3	0	0.0	0	0.0	0
OP 4	0	0.0	0	0.0	0
OP 5	0	0.0	0	0.0	0
OP 6	0	0.0	0	0.0	0
OP 7	0	0.0	0	0.0	0
OP 9	0	0.0	0	0.0	0
OP 10	0	0.0	0	0.0	0
OP 11	0	0.0	0	0.0	0
OP 12	0	0.0	0	0.0	0
OP 13	0	0.0	0	0.0	0
OP 18	0	0.0	0	0.0	0
OP 19	0	0.0	0	0.0	0
OP 20	0	0.0	0	0.0	0

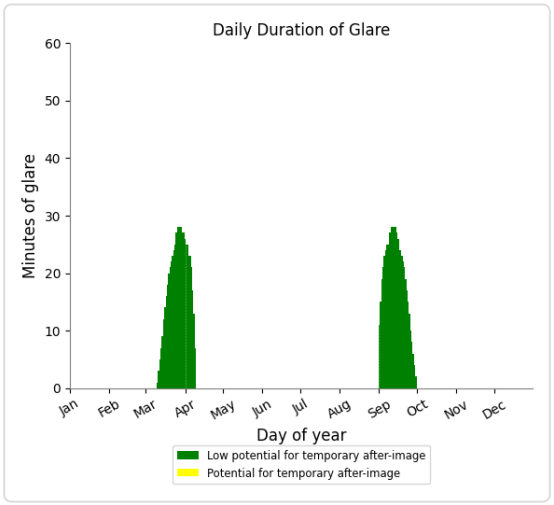


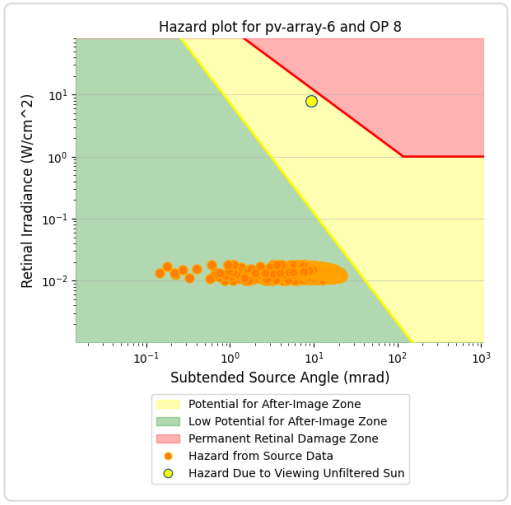
PV array 6 and OP 8

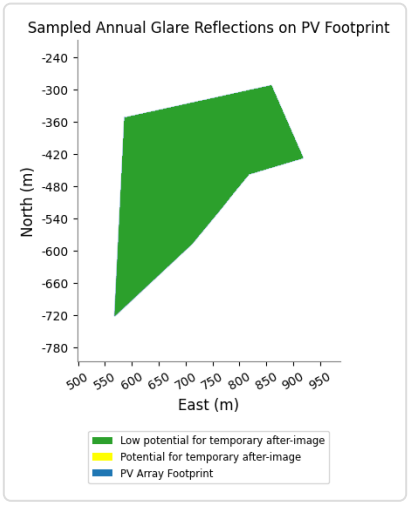
Yellow glare: none

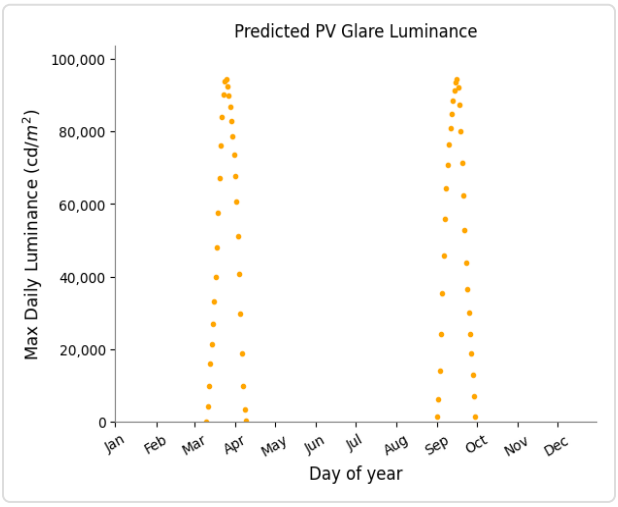
Green glare: 1,183 min.







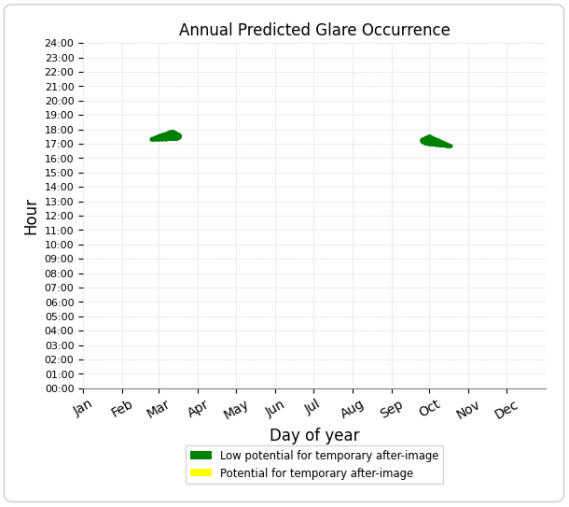


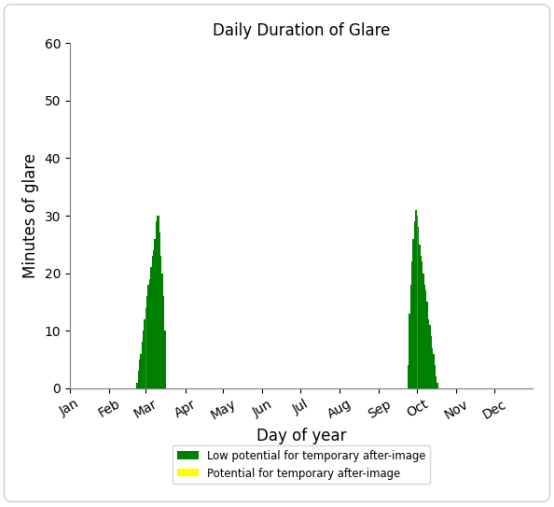


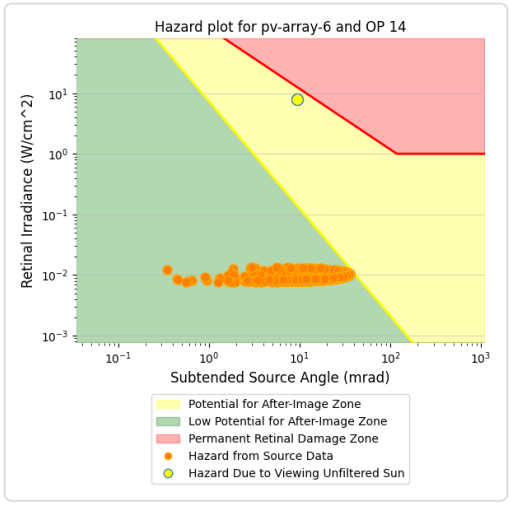
PV array 6 and OP 14

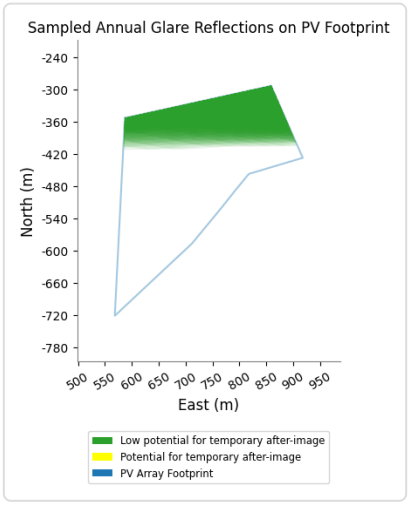
Yellow glare: none

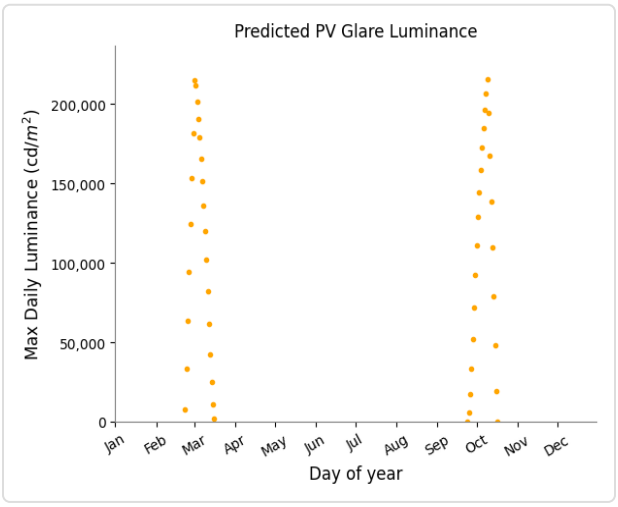
Green glare: 784 min.







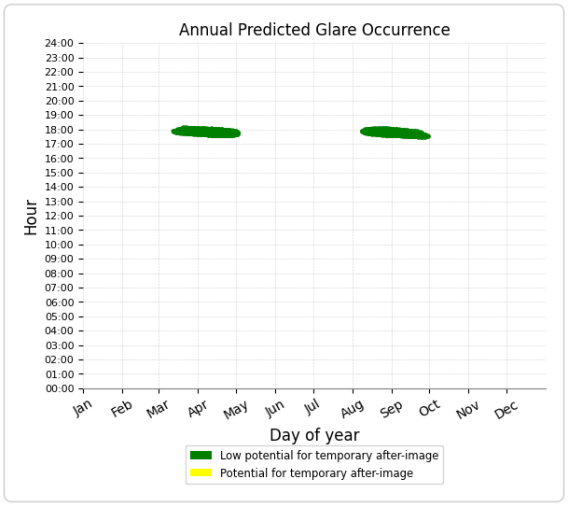


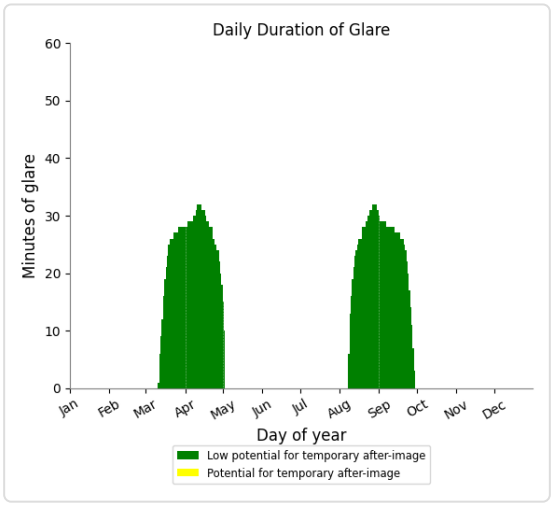


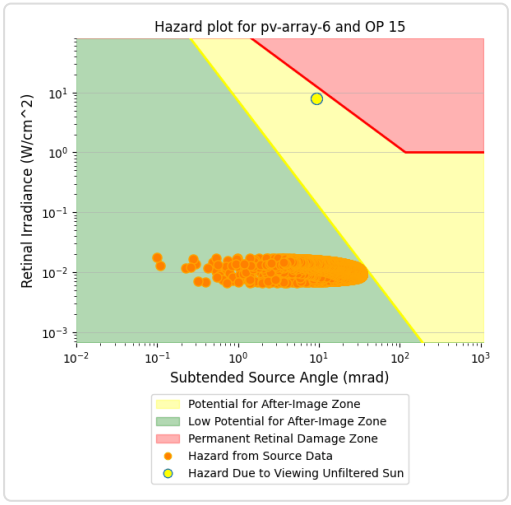
PV array 6 and OP 15

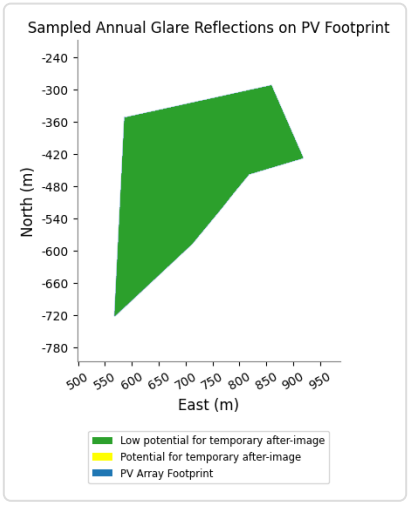
Yellow glare: none

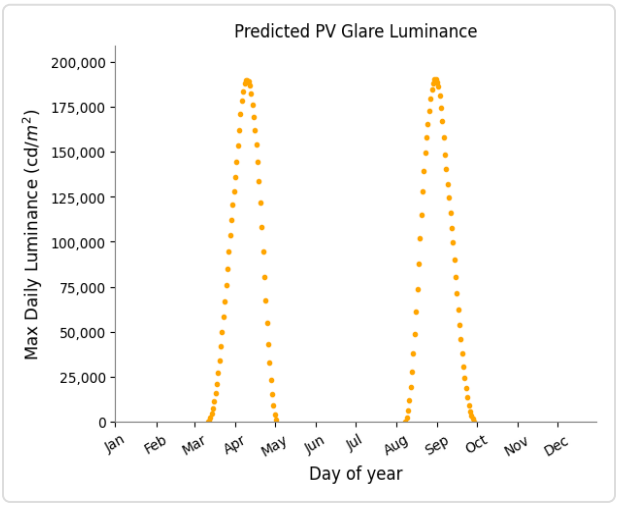
Green glare: 2,640 min.







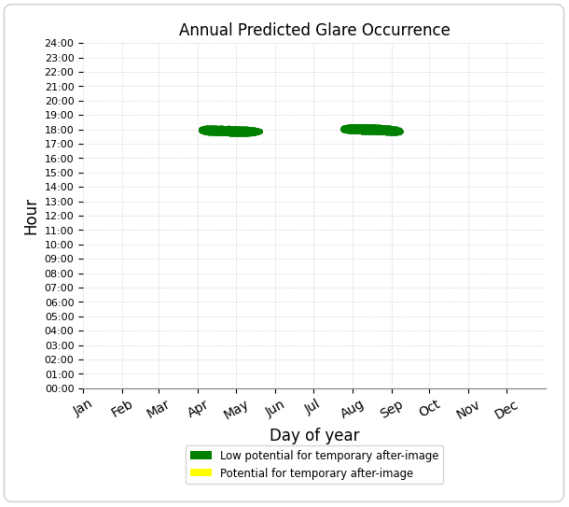


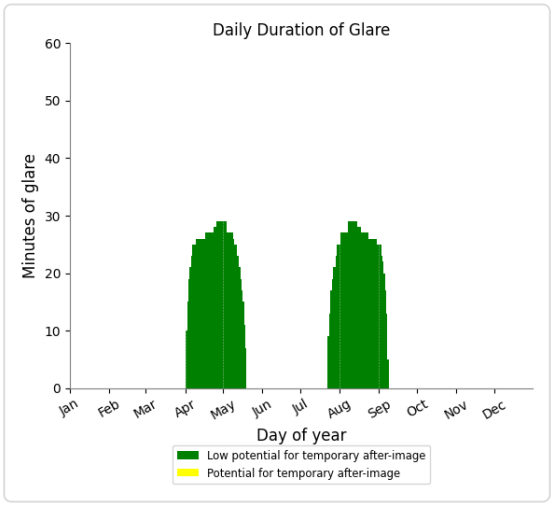


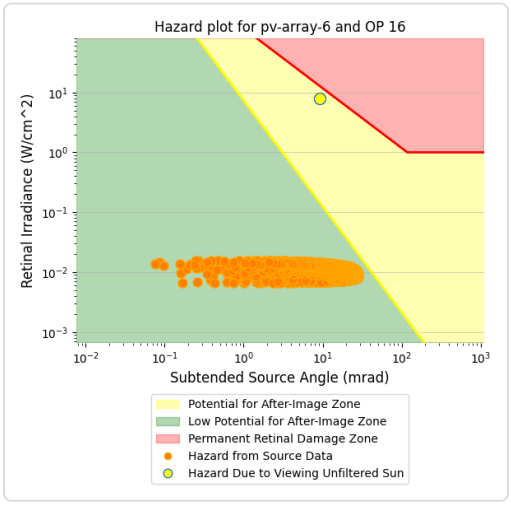
PV array 6 and OP 16

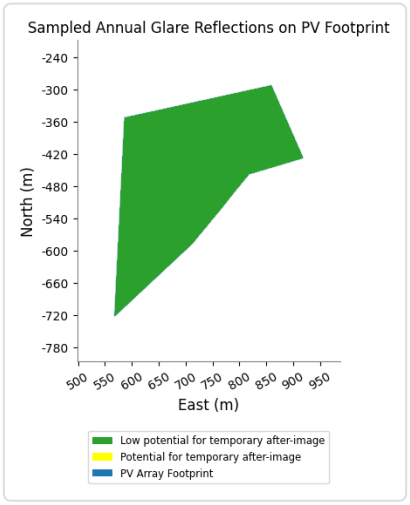
Yellow glare: none

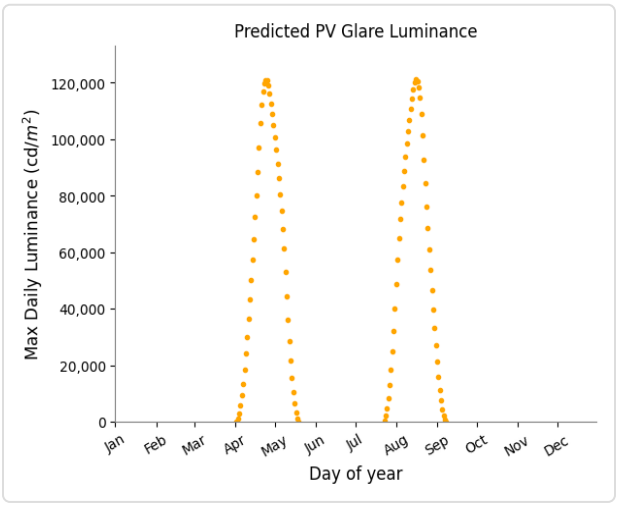
Green glare: 2,335 min.







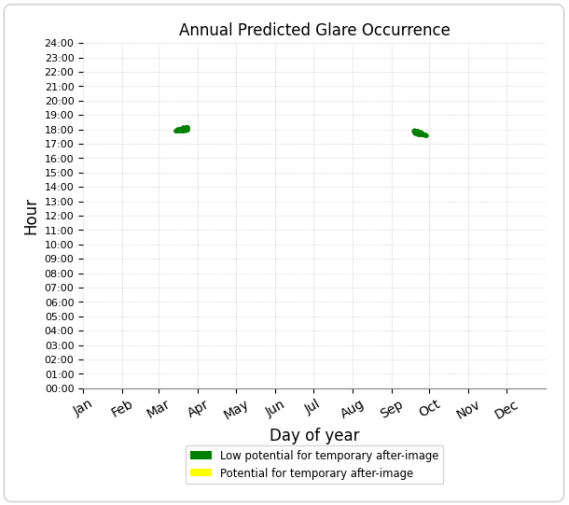


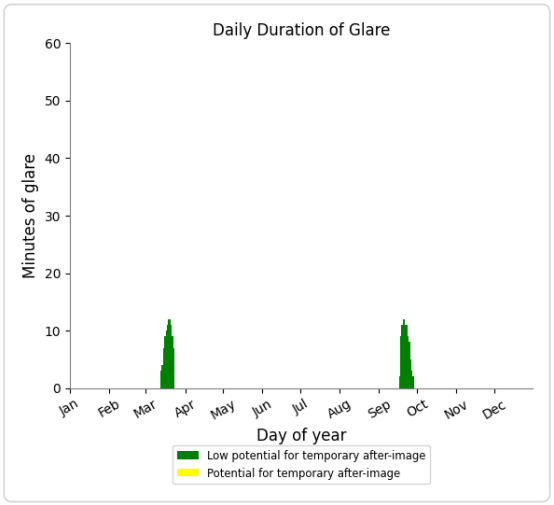


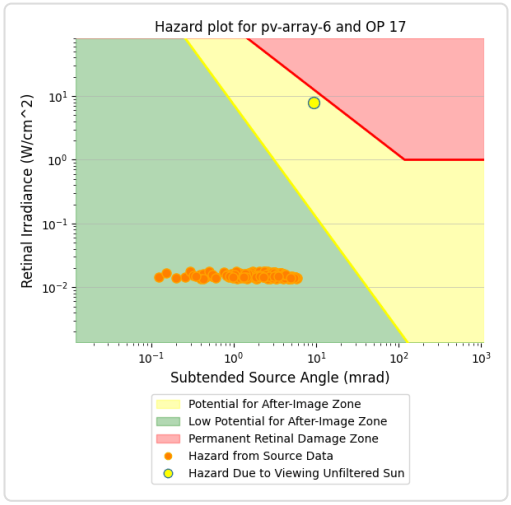
PV array 6 and OP 17

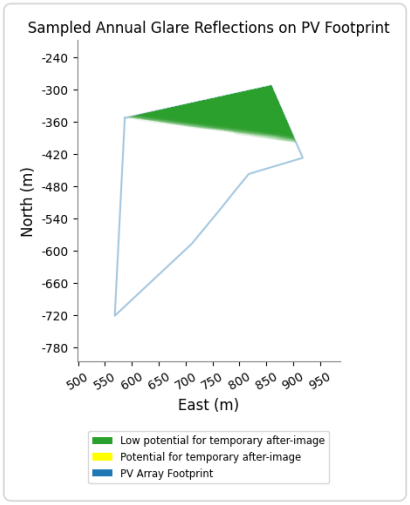
Yellow glare: none

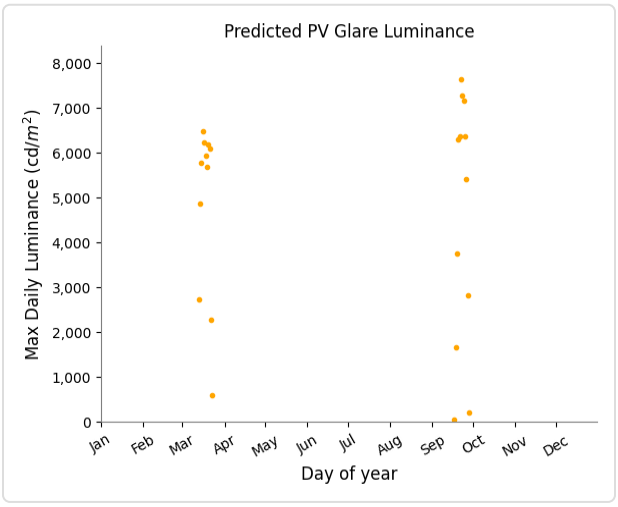
Green glare: 190 min.











PV array 6 and OP 1

No glare found

PV array 6 and OP 2

No glare found

PV array 6 and OP 3

No glare found

PV array 6 and OP 4

No glare found

PV array 6 and OP 5

No glare found

PV array 6 and OP 6

No glare found

PV array 6 and OP 7

No glare found

PV array 6 and OP 9

No glare found

PV array 6 and OP 10

No glare found

PV array 6 and OP 11

No glare found

PV array 6 and OP 12

No glare found

PV array 6 and OP 13

No glare found

PV array 6 and OP 18

No glare found

PV array 6 and OP 19

No glare found

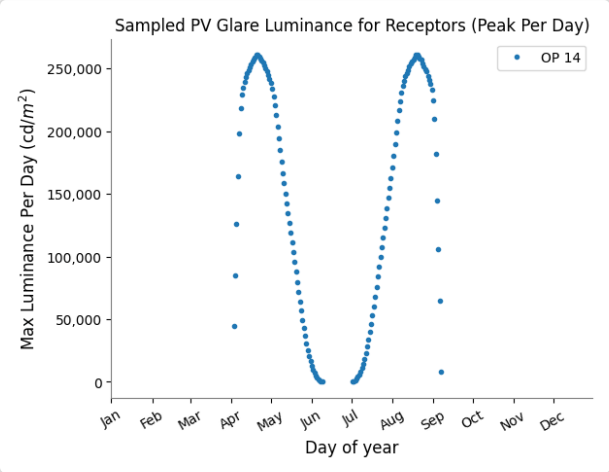
PV array 6 and OP 20

No glare found

PV: PV array 7 low potential for temporary after-image

Receptor results ordered by category of glare

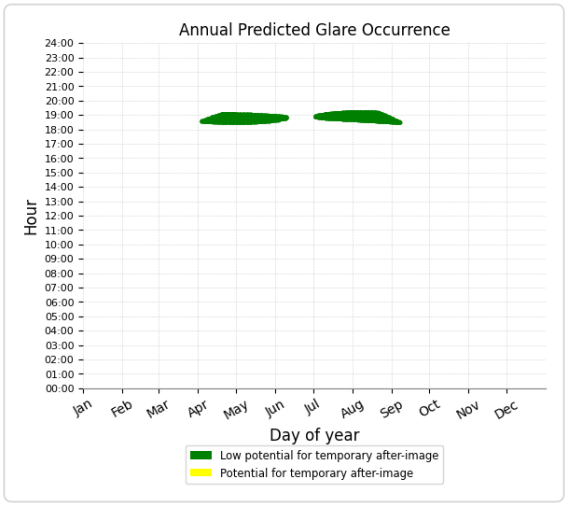
Receptor	Annual Green Glare		Annual Yellow Glare		Peak Luminance
	min	hr	min	hr	cd/m^2
OP 14	3,550	59.2	0	0.0	260,662
OP 15	2,262	37.7	0	0.0	155,238
OP 16	1,286	21.4	0	0.0	85,277
OP 1	0	0.0	0	0.0	0
OP 2	0	0.0	0	0.0	0
OP 3	0	0.0	0	0.0	0
OP 4	0	0.0	0	0.0	0
OP 5	0	0.0	0	0.0	0
OP 6	0	0.0	0	0.0	0
OP 7	0	0.0	0	0.0	0
OP 8	0	0.0	0	0.0	0
OP 9	0	0.0	0	0.0	0
OP 10	0	0.0	0	0.0	0
OP 11	0	0.0	0	0.0	0
OP 12	0	0.0	0	0.0	0
OP 13	0	0.0	0	0.0	0
OP 17	0	0.0	0	0.0	0
OP 18	0	0.0	0	0.0	0
OP 19	0	0.0	0	0.0	0
OP 20	0	0.0	0	0.0	0

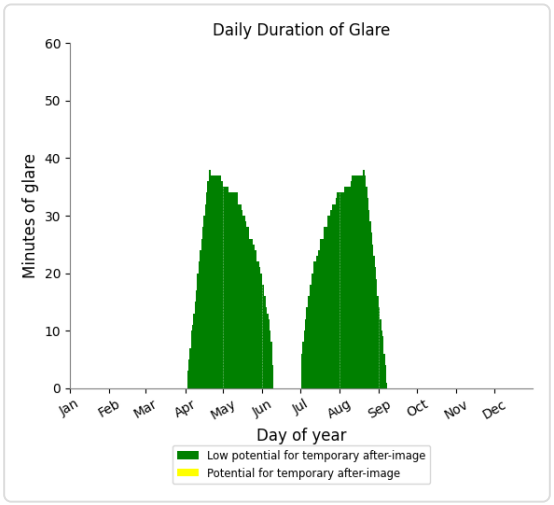


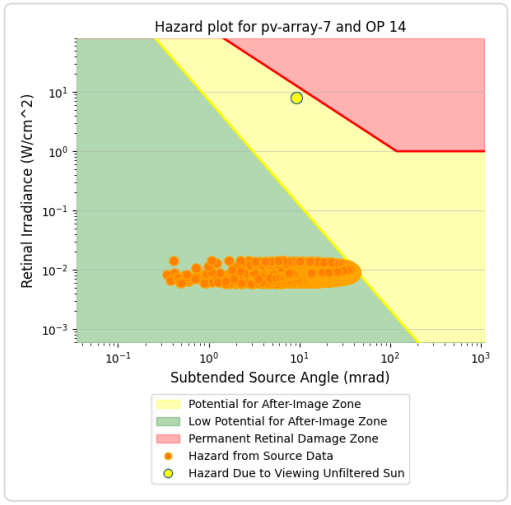
PV array 7 and OP 14

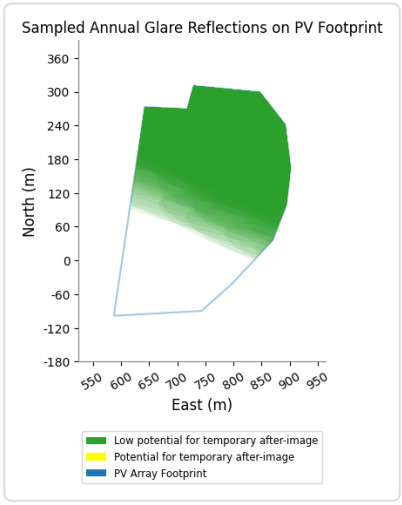
Yellow glare: none

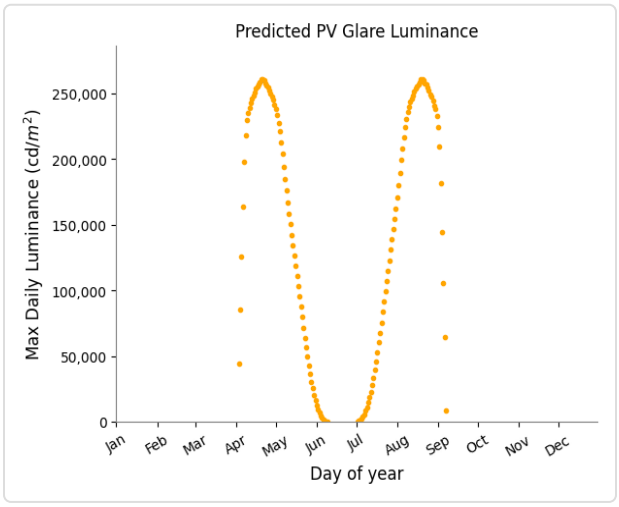
Green glare: 3,550 min.







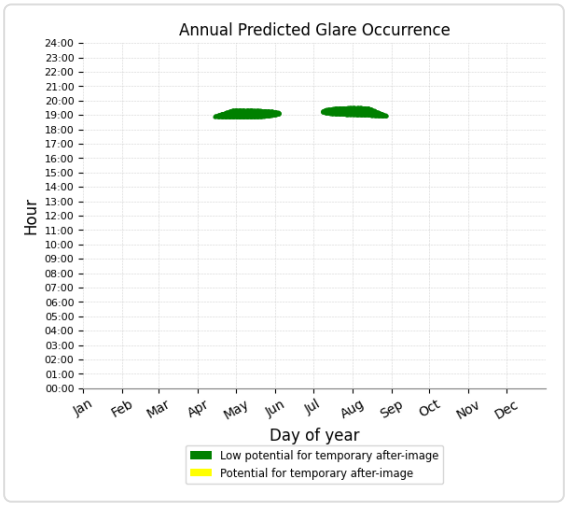


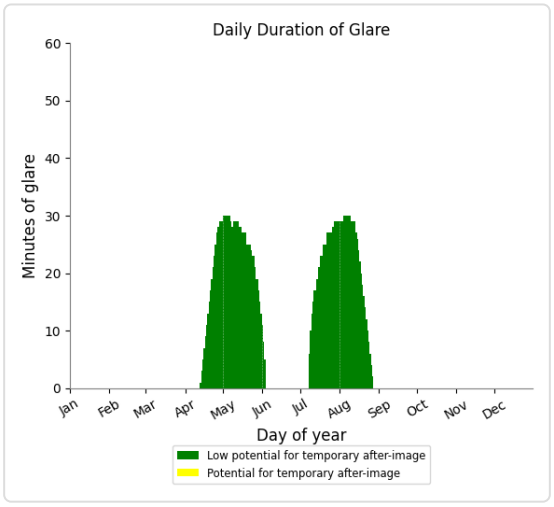


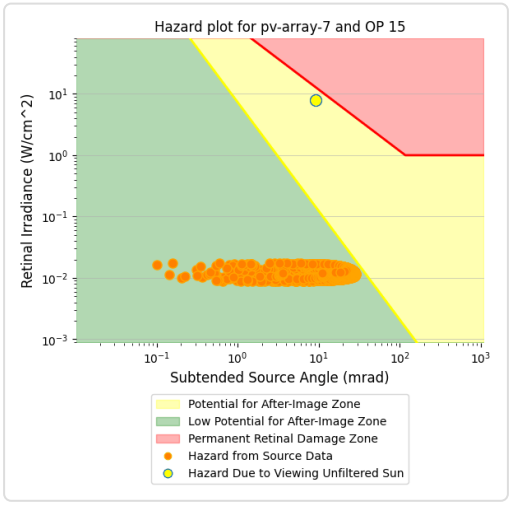
PV array 7 and OP 15

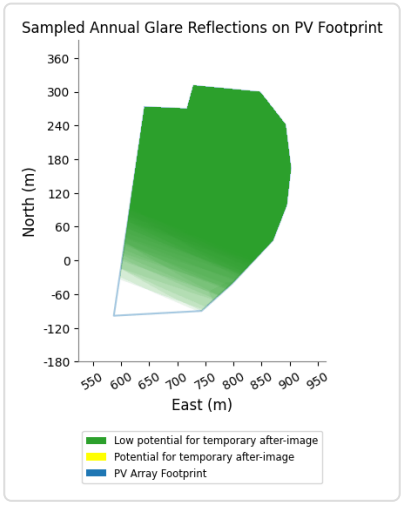
Yellow glare: none

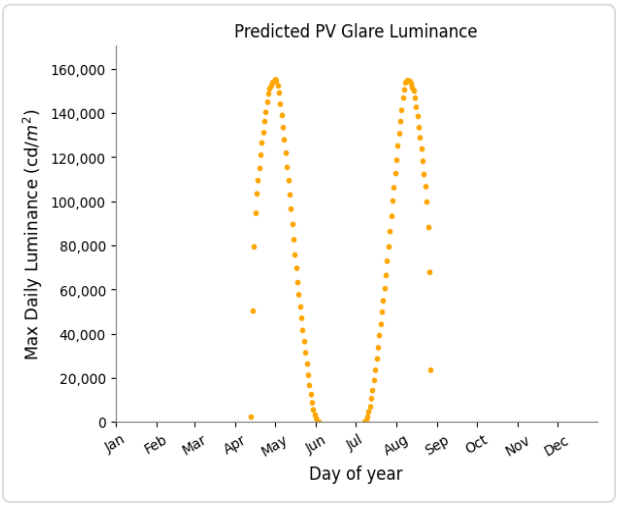
Green glare: 2,262 min.







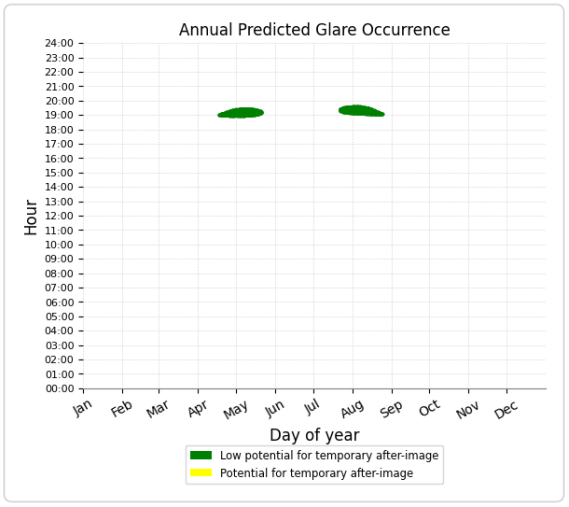


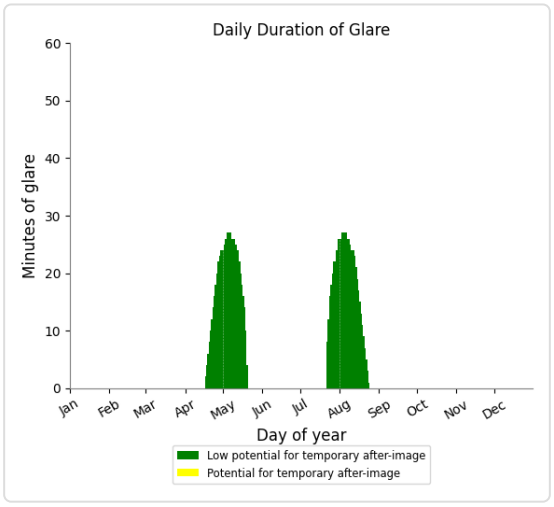


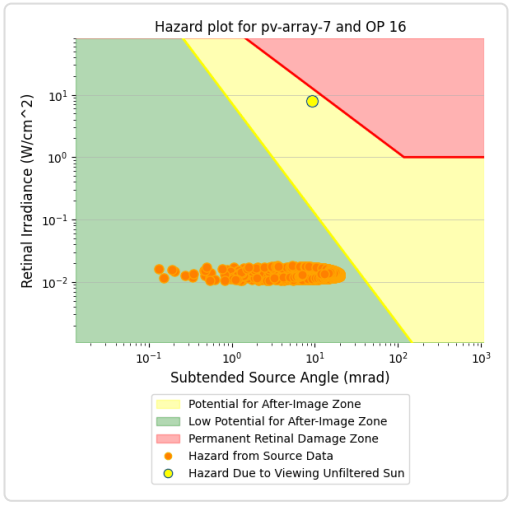
PV array 7 and OP 16

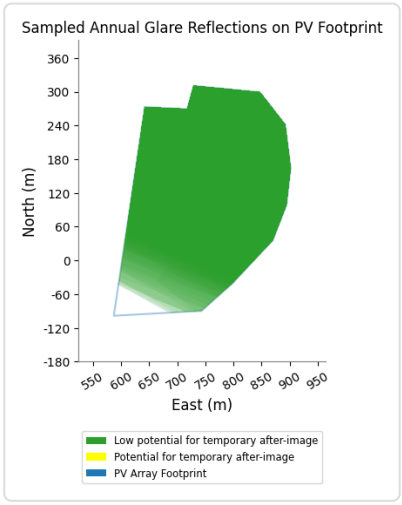
Yellow glare: none

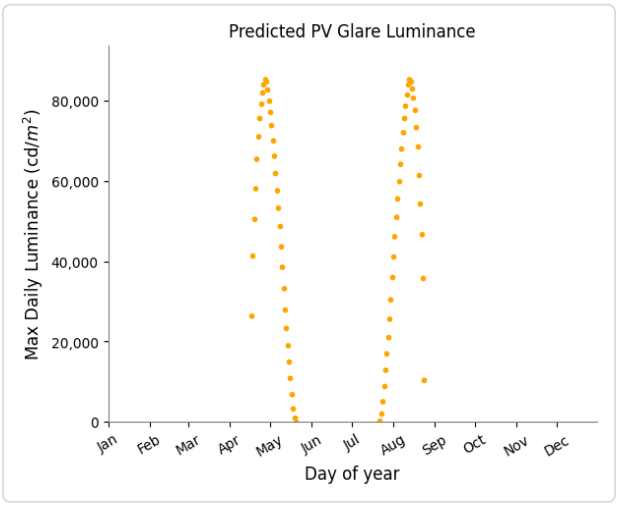
Green glare: 1,286 min.











PV array 7 and OP 1

No glare found

PV array 7 and OP 2

No glare found

PV array 7 and OP 3

No glare found

PV array 7 and OP 4

No glare found

PV array 7 and OP 5

No glare found

PV array 7 and OP 6

No glare found

PV array 7 and OP 7

No glare found

PV array 7 and OP 8

No glare found

PV array 7 and OP 9

No glare found

PV array 7 and OP 10

No glare found

PV array 7 and OP 11

No glare found

PV array 7 and OP 12

No glare found

PV array 7 and OP 13

No glare found

PV array 7 and OP 17

No glare found

PV array 7 and OP 18

No glare found

PV array 7 and OP 19

No glare found

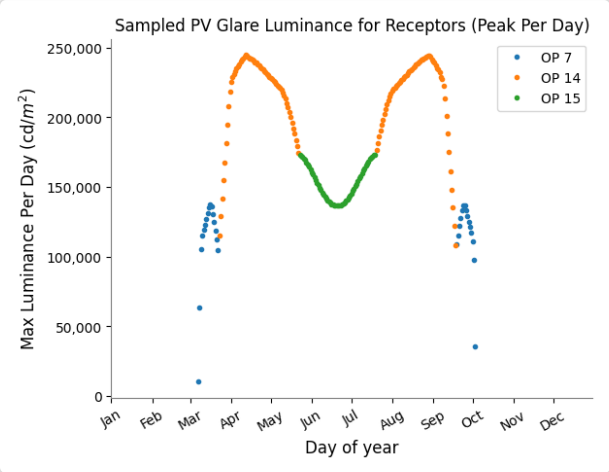
PV array 7 and OP 20

No glare found

PV: PV array 8 low potential for temporary after-image

Receptor results ordered by category of glare

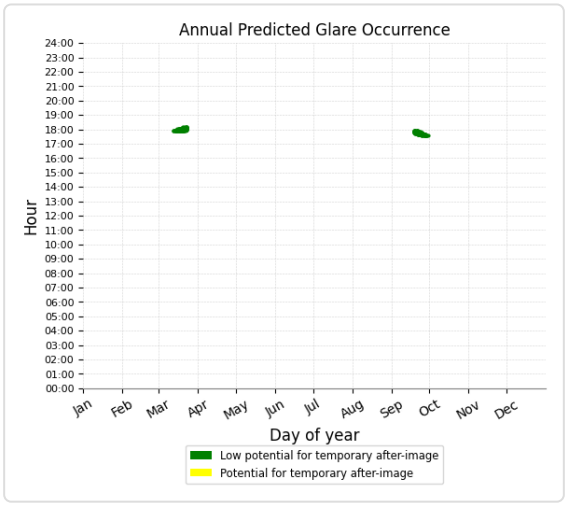
Receptor	Annual Green Glare		Annual Yellow Glare		Peak Luminance
	min	hr	min	hr	cd/m^2
OP 1	232	3.9	0	0.0	18,637
OP 7	945	15.8	0	0.0	137,283
OP 8	2,015	33.6	0	0.0	130,050
OP 14	5,979	99.7	0	0.0	244,634
OP 15	3,767	62.8	0	0.0	176,924
OP 16	2,913	48.5	0	0.0	132,589
OP 17	841	14.0	0	0.0	51,243
OP 2	0	0.0	0	0.0	0
OP 3	0	0.0	0	0.0	0
OP 4	0	0.0	0	0.0	0
OP 5	0	0.0	0	0.0	0
OP 6	0	0.0	0	0.0	0
OP 9	0	0.0	0	0.0	0
OP 10	0	0.0	0	0.0	0
OP 11	0	0.0	0	0.0	0
OP 12	0	0.0	0	0.0	0
OP 13	0	0.0	0	0.0	0
OP 18	0	0.0	0	0.0	0
OP 19	0	0.0	0	0.0	0
OP 20	0	0.0	0	0.0	0

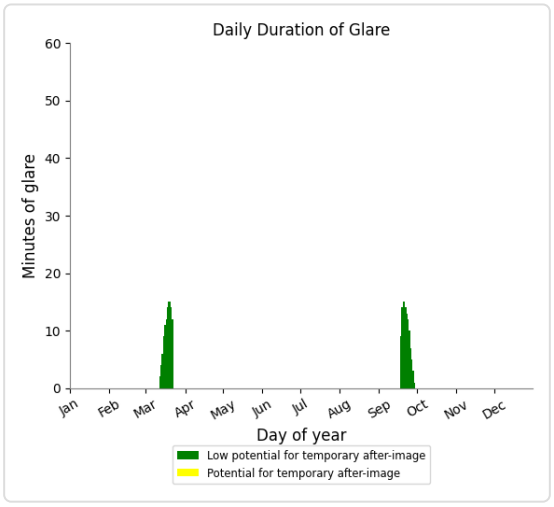


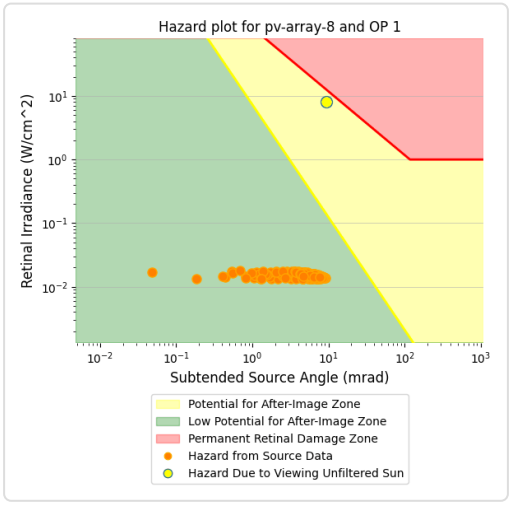
PV array 8 and OP 1

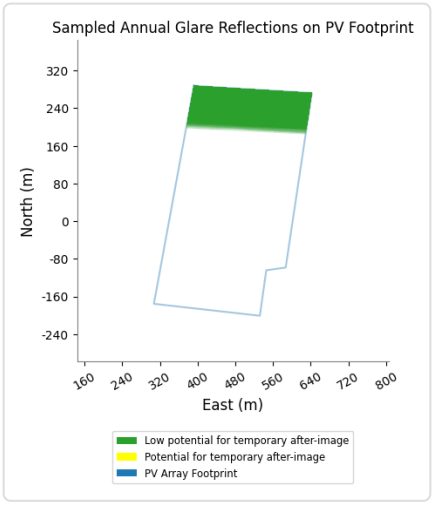
Yellow glare: none

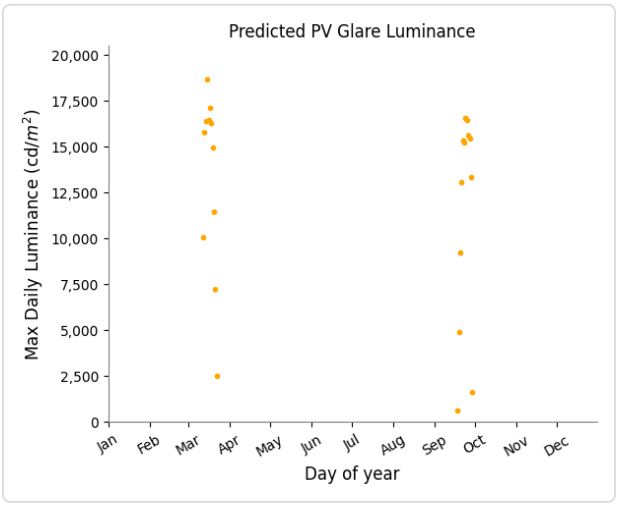
Green glare: 232 min.







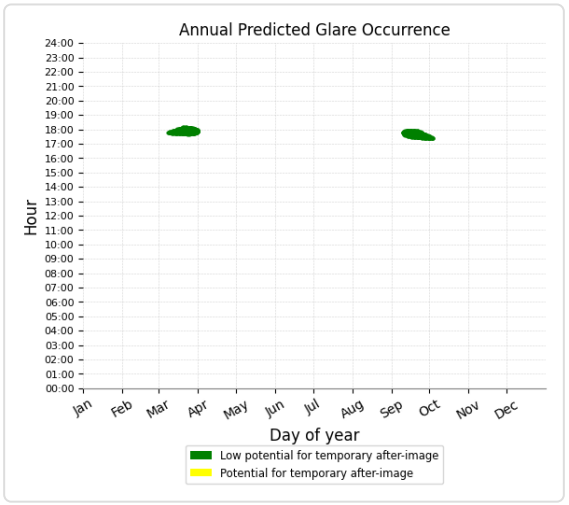


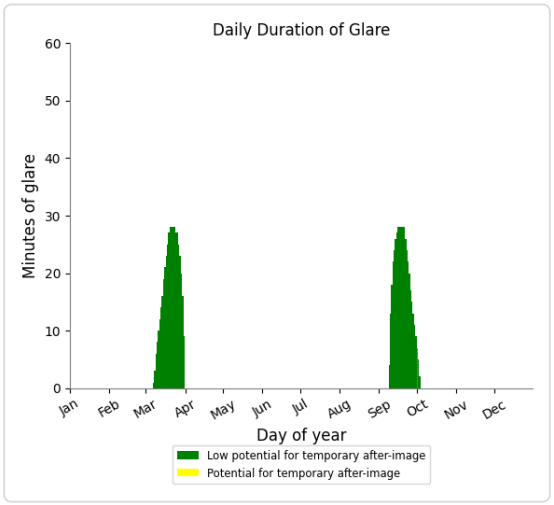


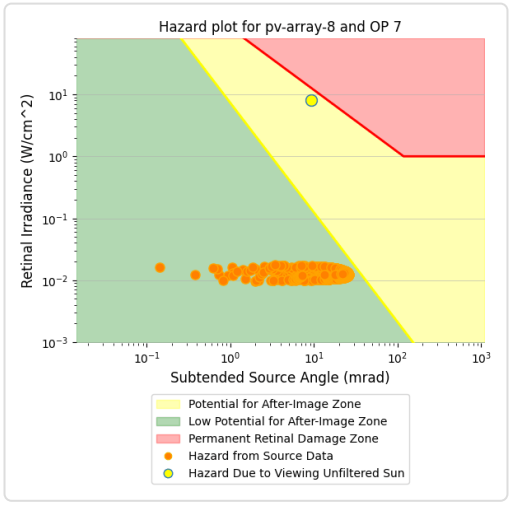
PV array 8 and OP 7

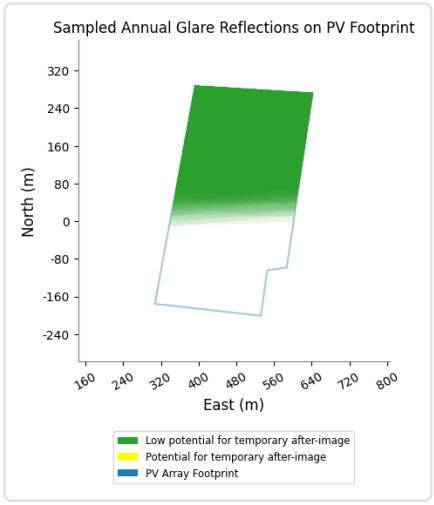
Yellow glare: none

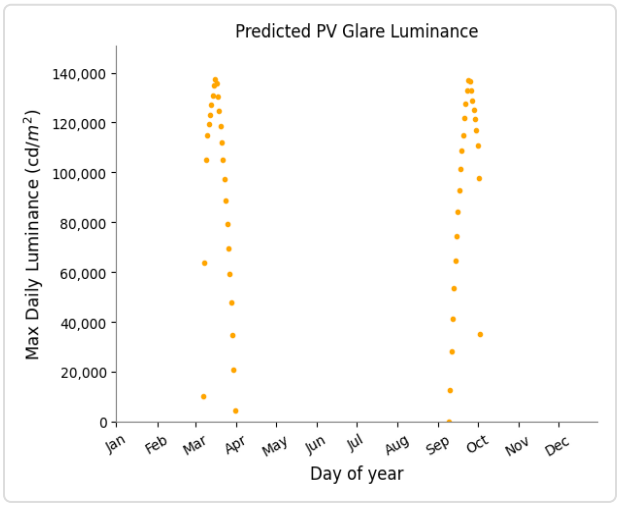
Green glare: 945 min.







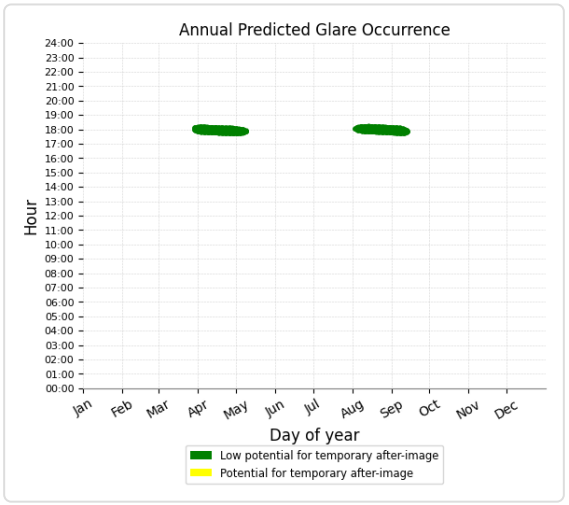


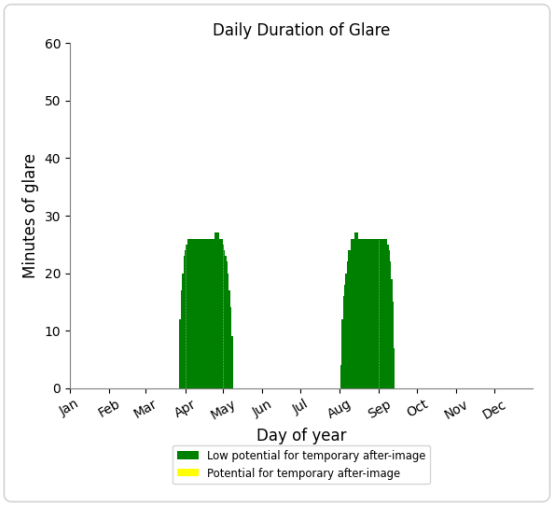


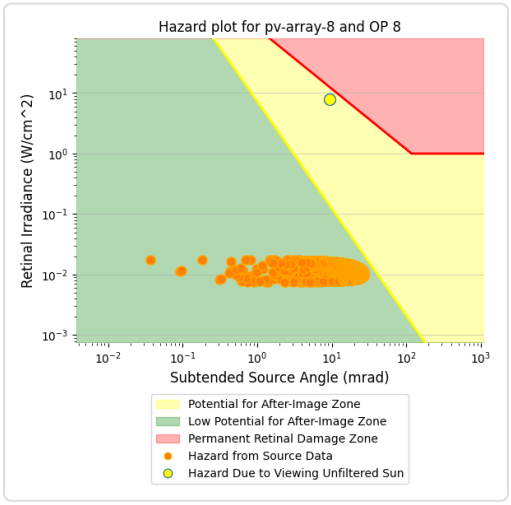
PV array 8 and OP 8

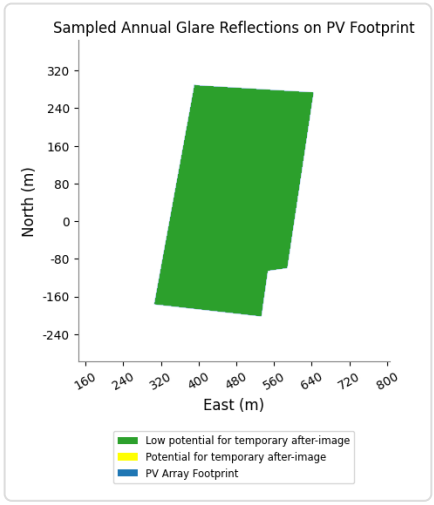
Yellow glare: none

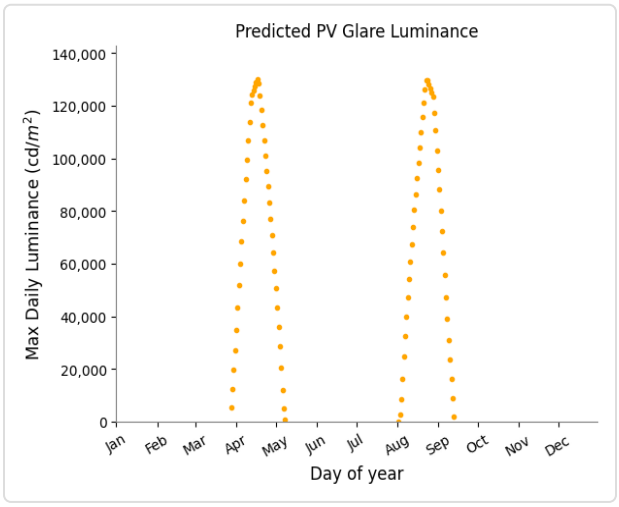
Green glare: 2,015 min.







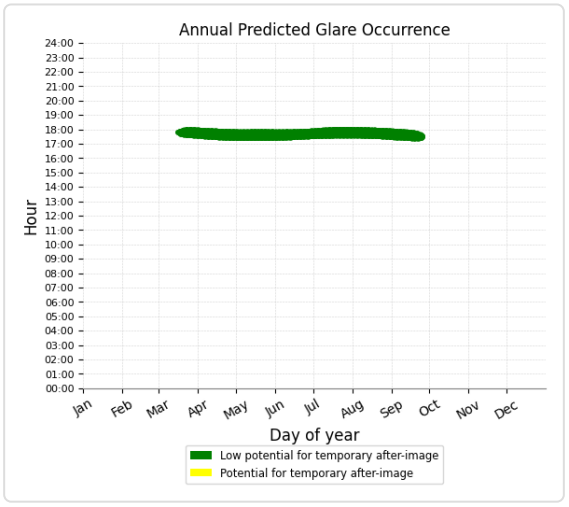


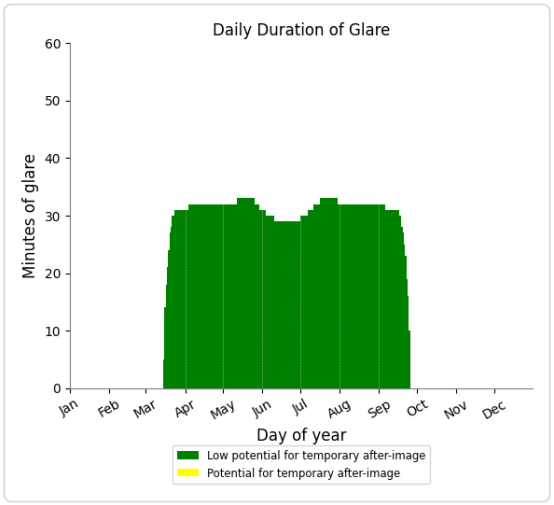


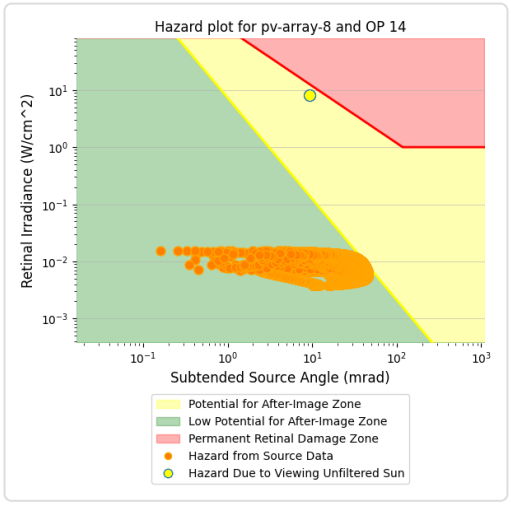
PV array 8 and OP 14

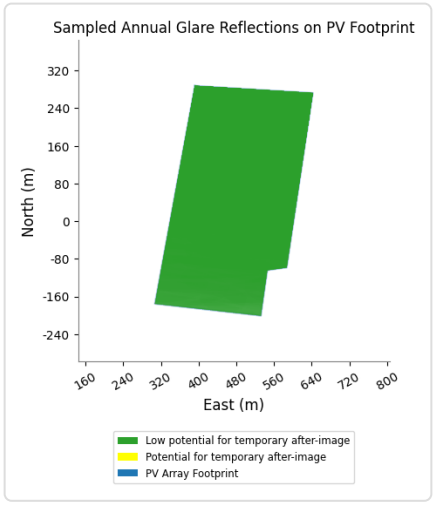
Yellow glare: none

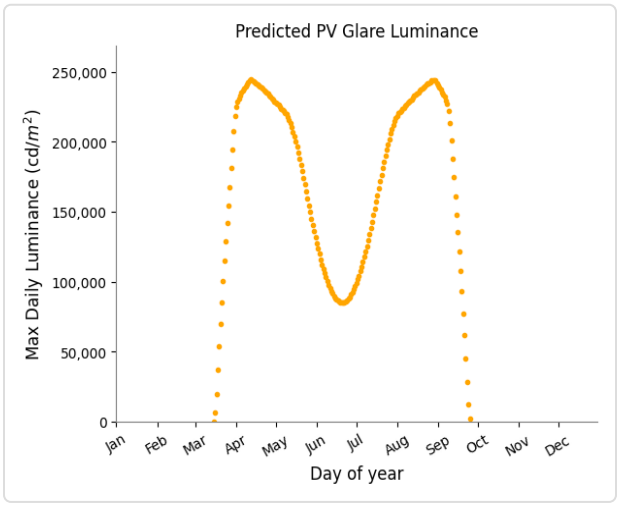
Green glare: 5,979 min.







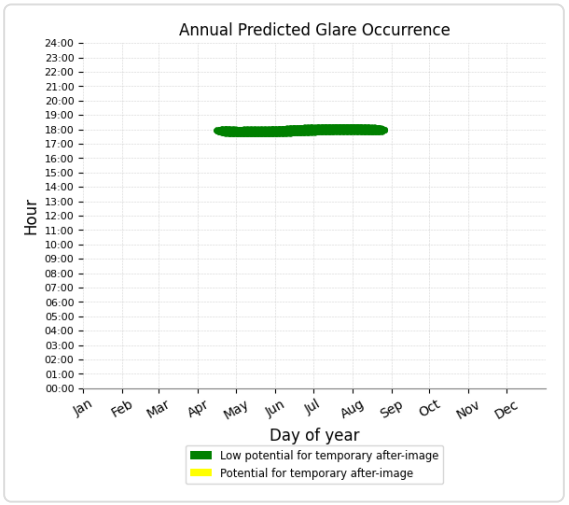


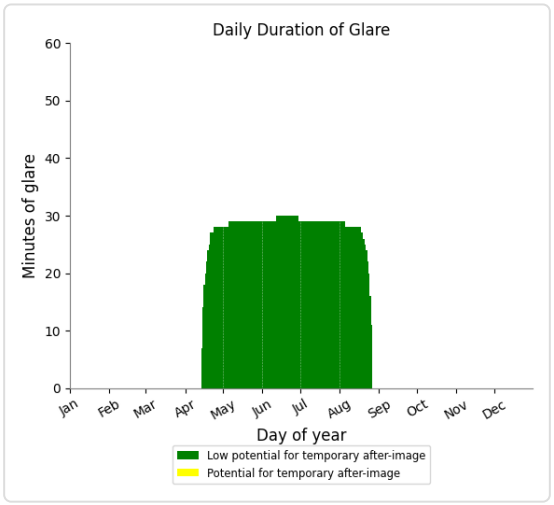


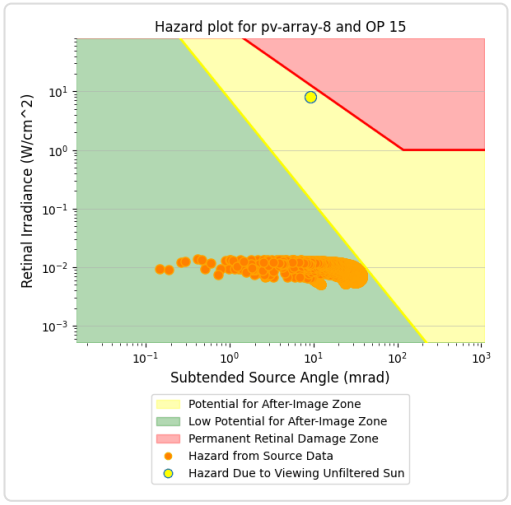
PV array 8 and OP 15

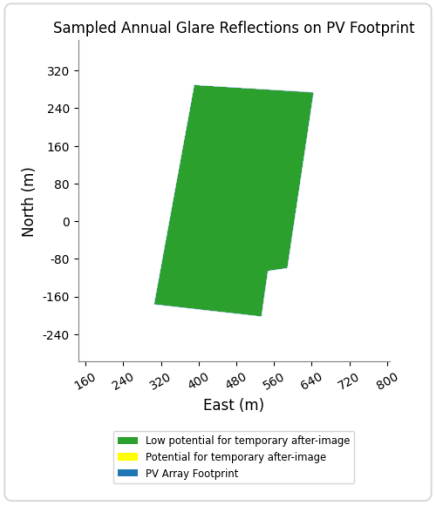
Yellow glare: none

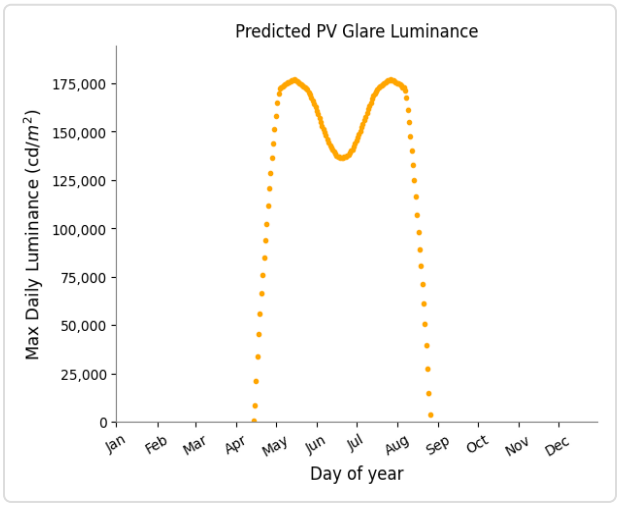
Green glare: 3,767 min.







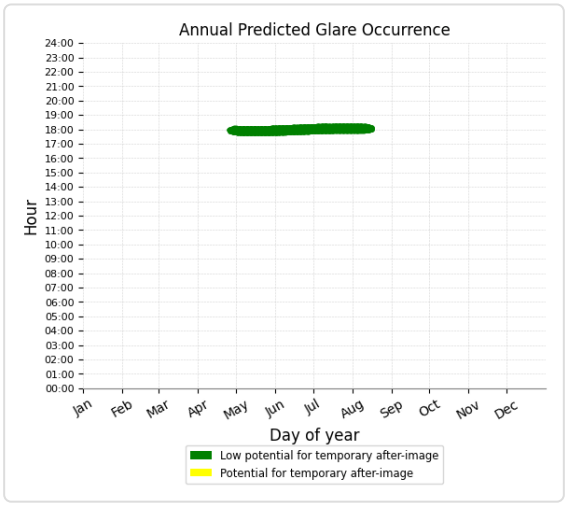


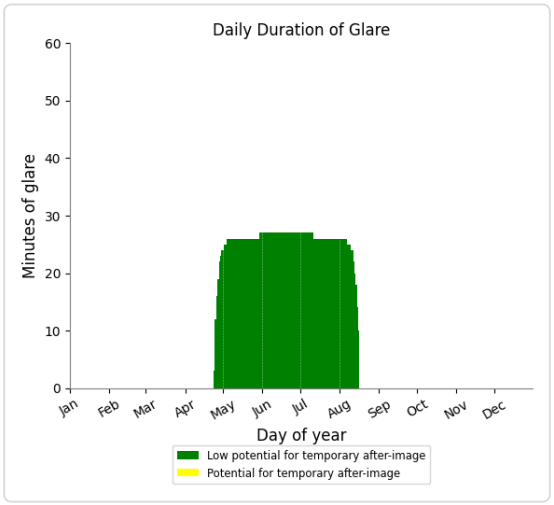


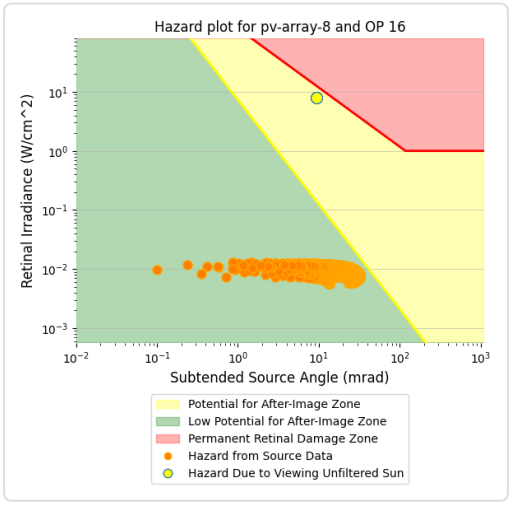
PV array 8 and OP 16

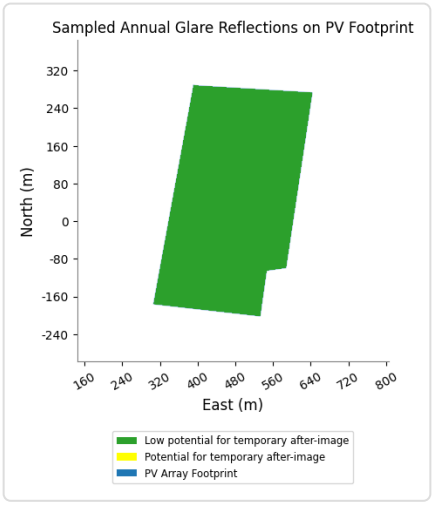
Yellow glare: none

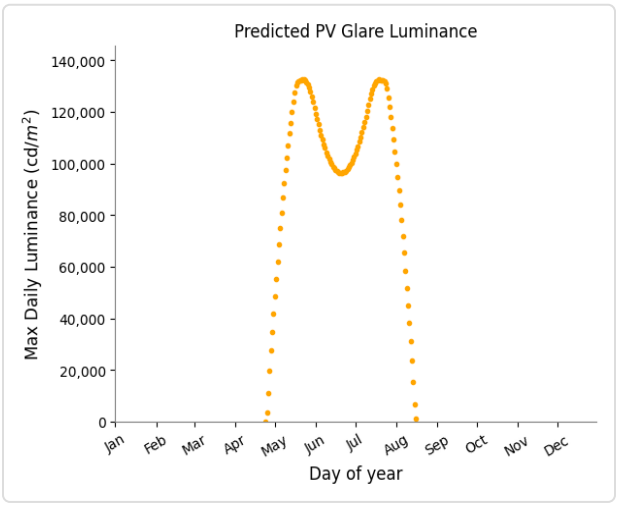
Green glare: 2,913 min.







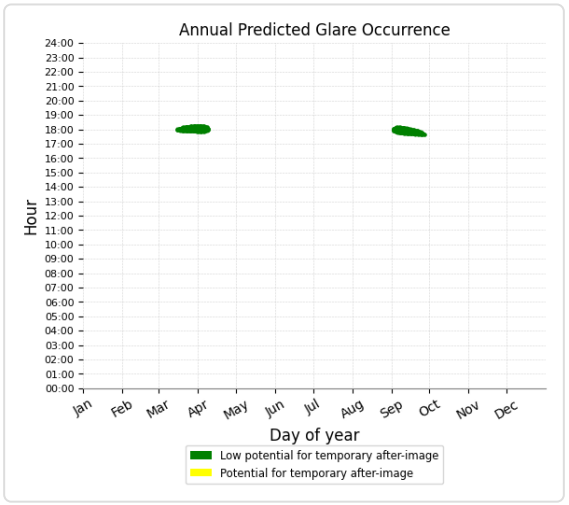


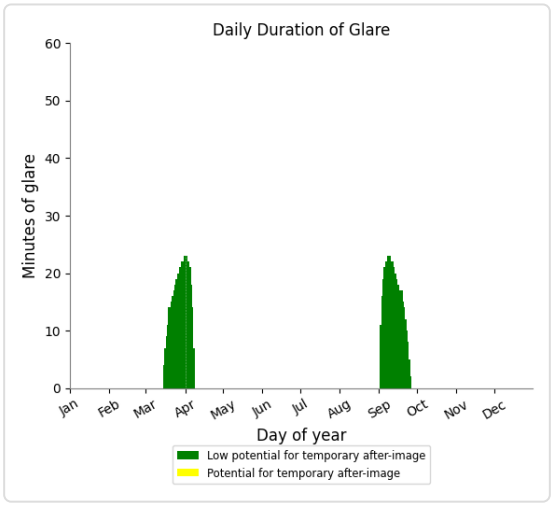


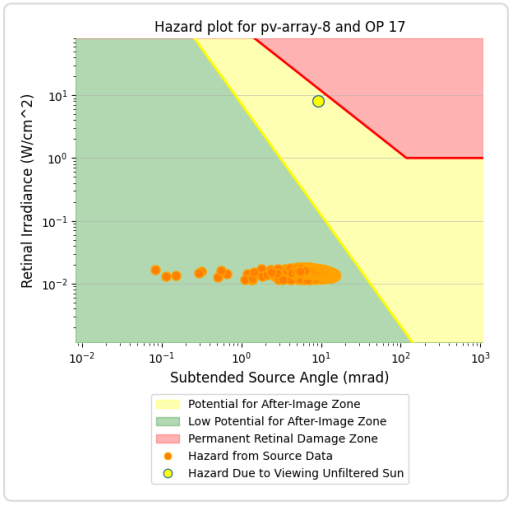
PV array 8 and OP 17

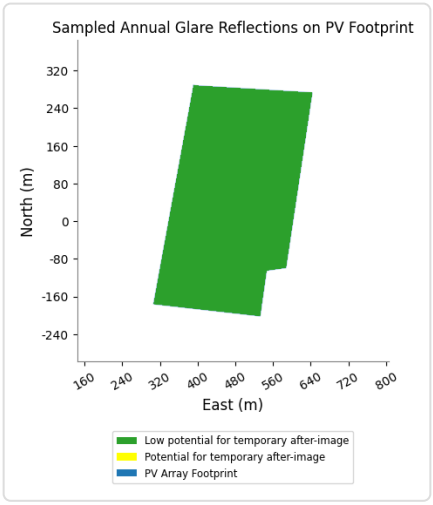
Yellow glare: none

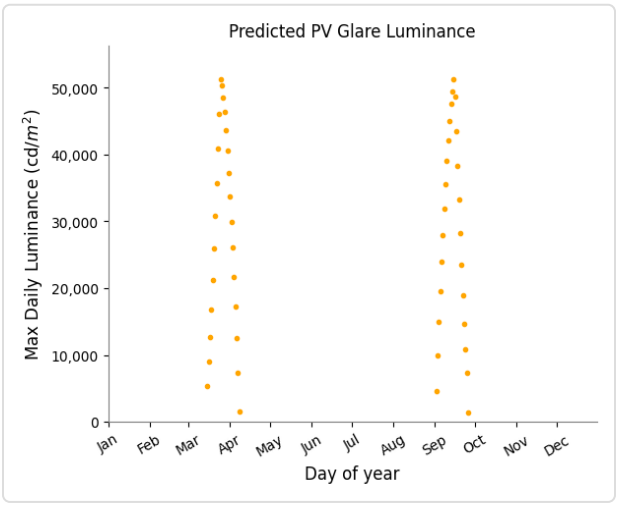
Green glare: 841 min.











PV array 8 and OP 2

No glare found

PV array 8 and OP 3

No glare found

PV array 8 and OP 4

No glare found

PV array 8 and OP 5

No glare found

PV array 8 and OP 6

No glare found

PV array 8 and OP 9

No glare found

PV array 8 and OP 10

No glare found

PV array 8 and OP 11

No glare found

PV array 8 and OP 12

No glare found

PV array 8 and OP 13

No glare found

PV array 8 and OP 18

No glare found

PV array 8 and OP 19

No glare found

PV array 8 and OP 20

No glare found

Assumptions

"Green" glare is glare with low potential to cause an after-image (flash blindness) when observed prior to a typical blink response time.
"Yellow" glare is glare with potential to cause an after-image (flash blindness) when observed prior to a typical blink response time.
Times associated with glare are denoted in Standard time. For Daylight Savings, add one hour.
The algorithm does not rigorously represent the detailed geometry of a system; detailed features such as gaps between modules, variable height of the PV array, and support structures may impact actual glare results. However, we have validated our models against several systems, including a PV array causing glare to the air-traffic control tower at Manchester-Boston Regional Airport and several sites in Albuquerque, and the tool accurately predicted the occurrence and intensity of glare at different times and days of the year.
Several V1 calculations utilize the PV array centroid, rather than the actual glare spot location, due to algorithm limitations. This may affect results for large PV footprints. Additional analyses of array sub-sections can provide additional information on expected glare. This primarily affects V1 analyses of path receptors.
Random number computations are utilized by various steps of the annual hazard analysis algorithm. Predicted minutes of glare can vary between runs as a result. This limitation primarily affects analyses of Observation Point receptors, including ATCTs. Note that the SGHAT/ ForgeSolar methodology has always relied on an analytical, qualitative approach to accurately determine the overall hazard (i.e. green vs. yellow) of expected glare on an annual basis.
The analysis does not automatically consider obstacles (either man-made or natural) between the observation points and the prescribed solar installation that may obstruct observed glare, such as trees, hills, buildings, etc.
The subtended source angle (glare spot size) is constrained by the PV array footprint size. Partitioning large arrays into smaller sections will reduce the maximum potential subtended angle, potentially impacting results if actual glare spots are larger than the sub-array size. Additional analyses of the combined area of adjacent sub-arrays can provide more information on potential glare hazards. (See previous point on related limitations.)
The variable direct normal irradiance (DNI) feature (if selected) scales the user-prescribed peak DNI using a typical clear-day irradiance profile. This profile has a lower DNI in the mornings and evenings and a maximum at solar noon. The scaling uses a clear-day irradiance profile based on a normalized time relative to sunrise, solar noon, and sunset, which are prescribed by a sun-position algorithm and the latitude and longitude obtained from Google maps. The actual DNI on any given day can be affected by cloud cover, atmospheric attenuation, and other environmental factors.
The ocular hazard predicted by the tool depends on a number of environmental, optical, and human factors, which can be uncertain. We provide input fields and typical ranges of values for these factors so that the user can vary these parameters to see if they have an impact on the results. The speed of SGHAT allows expedited sensitivity and parametric analyses.
The system output calculation is a DNI-based approximation that assumes clear, sunny skies year-round. It should not be used in place of more rigorous modeling methods.
Hazard zone boundaries shown in the Glare Hazard plot are an approximation and visual aid based on aggregated research data. Actual ocular impact outcomes encompass a continuous, not discrete, spectrum.
Glare locations displayed on receptor plots are approximate. Actual glare-spot locations may differ.
Refer to the Help page at **www.forgesolar.com/help/** for assumptions and limitations not listed here.

Default glare analysis parameters and observer eye characteristics (for reference only):

- Analysis time interval: 1 minute
- Ocular transmission coefficient: 0.5
- Pupil diameter: 0.002 meters
- Eye focal length: 0.017 meters
- Sun subtended angle: 9.3 milliradians

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Glint Aviation Report

CLIENT:	One Planet
PROJECT:	Normanton Larches
SUBJECT:	Glint Assessment – Green Glare at Aviation Circuits at Retford (Gamston) Airport
JOB NO:	BR10356
DATE:	25/03/2024
PREPARED BY:	Andi Sihota
CHECKED BY:	Simon Allen

This Technical Note summarises the findings of the glint assessment at Normanton Larches and the modelled effects along the aviation circuits at Retford (Gamston) Airport 2.7km to the northeast of the Proposed Development.

1 INTRODUCTION

1.1.1 The glint assessment was carried out at the Normanton Larches Solar Site southeast of Worksop, Nottinghamshire, UK as seen by the red line boundary in Figure 1.1. The National Grid reference for the site is 465422, 374895 (Easting, Northing). Retford (Gamston) Airport is situated 2.7km to the northeast of the Site and was assessed for potential glint effects. As illustrated, the Airport lies 9km to the east of the Proposed Site.

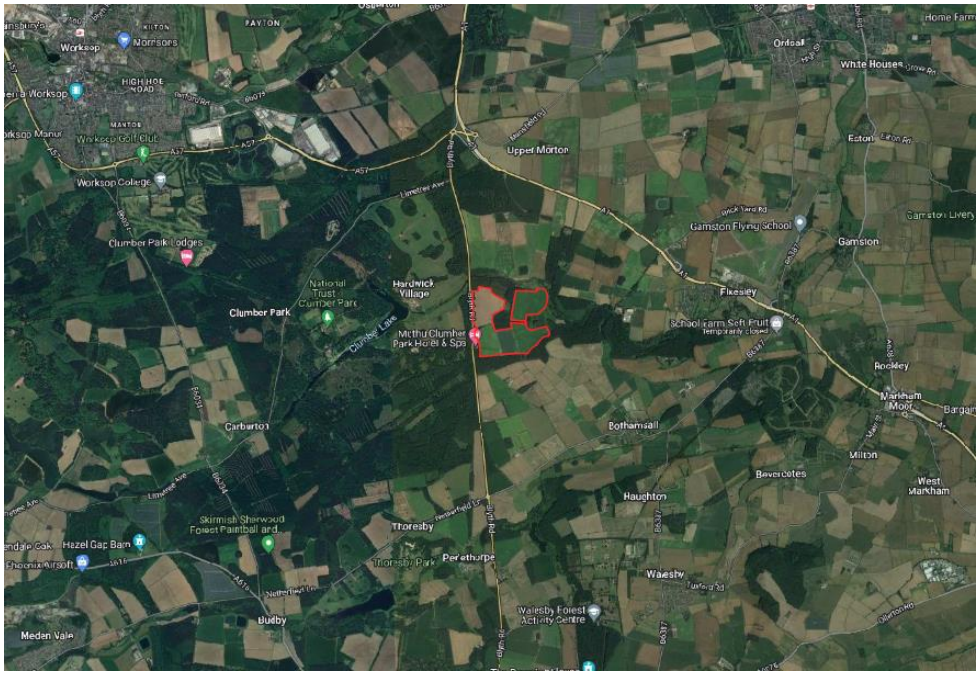


Figure 1.1 – Satellite photography of Site and surroundings

(Google 2024; Image © Airbus; Image © Maxar Technologies; Image © 2024 Infoterra Ltd & Bluesky)

1.1.2 The fixed panels at the Proposed Site will be set at an angle to the horizontal of 25 degrees and at a maximum height above ground level (agl) of 3.58m.

1.1.3 The glint assessment considered the potential effects of glint caused by the proposed PV development on ground-based receptors and aircraft operations in the surrounding area.

1.1.4 During consultation with Gamston Airport, concern was expressed around aviation safety at the airport. In response to Gamston's specific requests, additional aviation routes and overhead circuits were assessed. This section summaries that modelling.

1.1.5 The additional Retford (Gamston) Airport aviation receptors assessed include:

- Fixed Wing circuits for both runways as well as the 'dead side' at varying heights: 200ft, 500 ft, 1000ft, 1500ft, 2000ft
- Rotary circuits for both runways as well as the 'dead side' at varying heights: 200ft, 500 ft, 1000ft, 1500ft, 2000ft

1.1.6 The computer model (Forge Solar's GlareGauge) is industry standard and approved and recommended by the FAA in the United States and aviation authorities around the world. The model is regularly upgraded to account for technological progression and to improve accuracy.

2 GUIDANCE

2.1.1 Federal Aviation Administration (FAA) guidance[1], which is widely used as the default guidance in the absence of any specific glint guidance from the Civil Aviation Authority (CAA), suggests that:

"Initially, FAA believed that solar energy systems could introduce a novel glint and glare effect to pilots on final approach. FAA has subsequently concluded that in most cases, the glint and glare from solar energy systems to pilots on final approach is similar to glint and glare pilots routinely experience from water bodies, glass-façade buildings, parking lots, and similar features. However, FAA has continued to receive reports of potential glint and glare from on-airport solar energy systems on personnel working in ATCT cabs. Therefore, FAA has determined the scope of agency policy should

[1] FAA, '*Federal Aviation Administration Policy: Review of Solar Energy System Projects on Federally-Obligated Airports'* 05/11/2021, https://www.federalregister.gov/documents/2021/05/11/2021-09862/federal-aviation-administration-policy-review-of-solar-energy-system-projects-on-federally-obligated

be focused on the impact of on-airport solar energy systems to federally-obligated towered airports, specifically the airport's ATCT cab."

2.1.2 The FAA does not consider it to be necessary to prevent pilots from experiencing yellow glint, suggesting this is something they routinely encounter and are capable of overcoming.

2.1.3 The Government has also recently (November 2023) produced its National Policy Statement for Renewable Energy Infrastructure (NPS EN-3) which came into force on 17th January 2024. Whilst this is aimed at larger developments, it does reveal the Government position on glint. It says:

"Glint and glare

3.10.149 Solar PV panels are designed to absorb, not reflect, irradiation. However, the Secretary of State should assess the potential impact of glint and glare on nearby homes, motorists, public rights of way, and aviation infrastructure (including aircraft departure and arrival flight paths).

3.10.150 Whilst there is some evidence that glint and glare from solar farms can be experienced by pilots and air traffic controllers in certain conditions, there is no evidence that glint and glare from solar farms results in significant impairment on aircraft safety. Therefore, unless a significant impairment can be demonstrated, the Secretary of State is unlikely to give any more than limited weight to claims of aviation interference because of glint and glare from solar farms."

3 CIRCUIT MODELLING

3.1.1 The Airport supplied coordinates of the points that needed to be assessed along the circuits and are included in Table 3.1 and Appendix 1.

Table 3.1: Observation Points along circuits at Runways 02, 14 and 32 at Retford (Gamston) Airport

Runway Designator	Position	Coordinate	OP Number	OP Number in Forge
02	Approach	53.274658, -0.956085	OP1	OP1
02	Midpoint	53.280560, -0.951536	OP2	OP2
02	Departure	53.287000, -0.946429	OP3	OP3
02 Rotary	Crosswind	53.298511, -0.952811	OP4	OP4

02 Rotary	Downwind turn	53.299640, -0.964398	OP5	OP5
02 Rotary	Downwind midpoint	53.287225, -0.974011	OP6	OP6
02 Rotary	Base leg turn	53.272753, -0.986371	OP7	OP7
02 Rotary	Base to final turn	53.265874, -0.967488	OP8	OP8
02 Fixed	Crosswind turn	53.299127, -0.939421	OP9	OP9
02 Fixed	Crosswind	53.306154, -0.950150	OP10	OP10
02 Fixed	Downwind turn	53.308462, -0.963540	OP11	OP11
02 Fixed	Downwind abeam '20'	53.296511, -0.979762	OP12	OP12
02 Fixed	Downwind abeam over A1	53.283581, -0.992722	OP13	OP13
02 Fixed	Base leg turn	53.268595, -0.997529	OP14	OP14
02 Fixed	Base leg	53.264437, -0.984998	OP15	OP15
02 Fixed	Base to final turn	53.260330, -0.969119	OP16	OP16
02	Dead side abeam '02'	53.269570, -0.934272	OP17	OP17
02	Dead side midpoint	53.275422, -0.930581	OP18	OP18
02	Dead side abeam '20'	53.281734, -0.928263	OP19	OP19
14	Approach	53.283581, -0.968861	OP20	OP20
14	Midpoint	53.279168, -0.962682	OP21	OP1
14	Departure	53.275011, -0.957188	OP22	OP2
14 Fixed	Crosswind turn	53.265823, -0.946545	OP23	OP3
14 Fixed	Crosswind	53.258892, -0.954442	OP24	OP4
14 Fixed	Downwind turn	53.253860, -0.968518	OP25	OP5
14 Fixed	Downwind (early)	53.259816, -0.979075	OP26	OP6
14 Fixed	Downwind (late)	53.270494, -0.993838	OP27	OP7
14 Fixed	Base leg turn	53.282145, -1.005425	OP28	OP8
14 Fixed	Base leg	53.287327, -0.996241	OP29	OP9
14 Fixed	Base to final turn	53.291175, -0.981221	OP30	OP10
32 Fixed	Crosswind turn	53.286506, -0.974955	OP31	OP11
32 Fixed	Crosswind	53.281991, -0.989976	OP32	OP12
32 Fixed	Downwind turn	53.277526, -0.995040	OP33	OP13
14 Rotary	Crosswind turn	53.268852, -0.946545	OP34	OP14
14 Rotary	Crosswind	53.273523, -0.934529	OP35	OP15
14 Rotary	Downwind turn	53.279168, -0.926461	OP36	OP16
14 Rotary	Downwind (early)	53.284095, -0.934872	OP37	OP17

14 Rotary	Downwind (late)	53.291278, -0.946460	OP38	OP18
14 Rotary	Base leg turn	53.296049, -0.954528	OP39	OP19
14 Rotary	Base leg	53.293535, -0.965342	OP40	OP20
14 Rotary	Base to final turn	53.288918, -0.971350	OP41	OP21

	Denotes Configuration 1		*Denotes Configuration 2*

3.1.2 These points were plotted in ForgeSolar and analysed for glint. Each point was represented by the 'Observation Point' feature and provide a 360° view.

3.1.3 Due to the number of points present, they had to be split over two configurations within ForgeSolar. For each height there are two reports that are produced, as seen Appendix 5. Due to the nature of the software, the Observation Point numbers cannot start at a fixed number and default back to OP1 so there are two sets of numbers that are numbered the same but represent different locations as illustrated in Table 3.1 above.

3.1.4 Figure 3.1 and Figure 3.2, below illustrate the points drawn in ForgeSolar for both configurations per height and represent all the coordinate locations of points shown in Table 3.1.

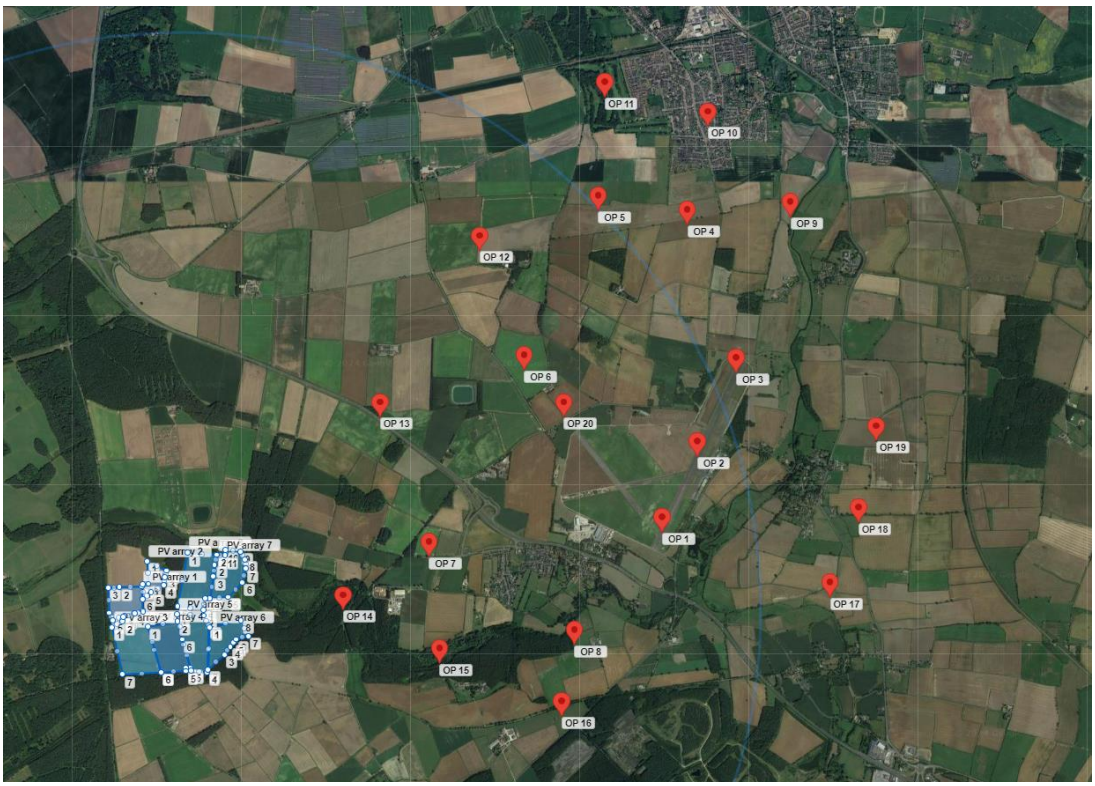


Figure 3.1: Configuration 1 Observation Points (OPs)

(ForgeSolar 2024; Google Earth © Google Image © 2024 Airbus)

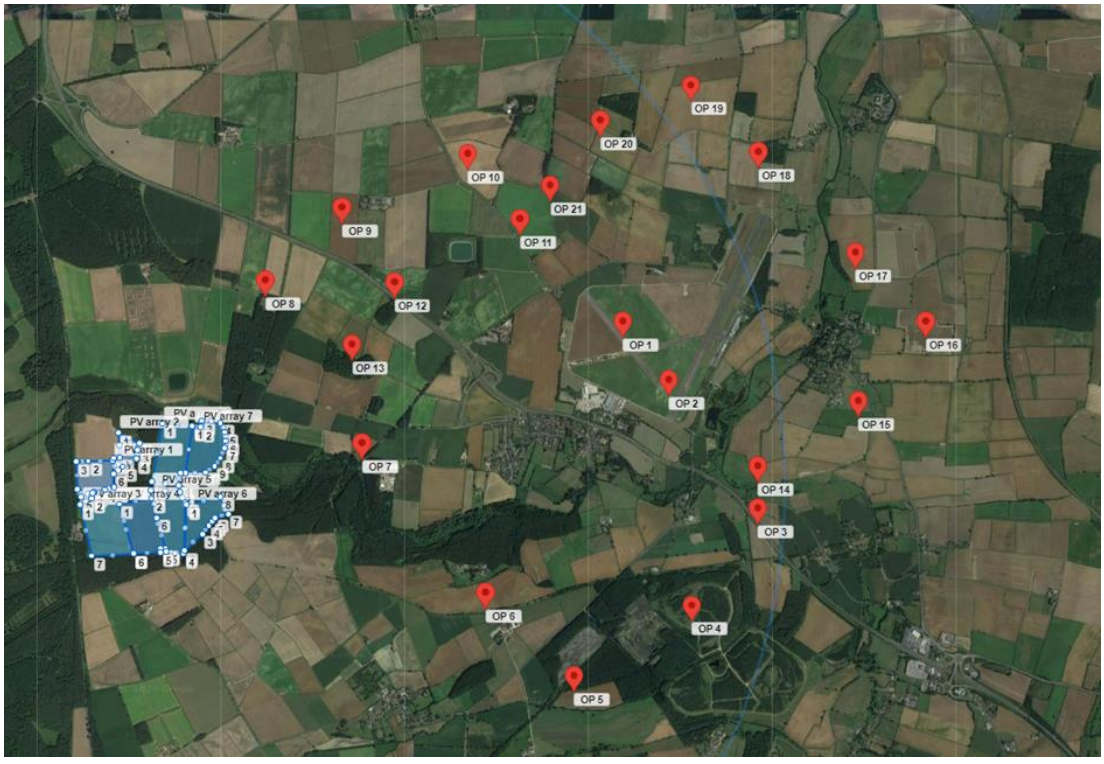


Figure 3.2: Configuration 2 Observation Points (OPs)

(ForgeSolar 2024; Google Earth © Google Image © 2024 Airbus)

Aviation Receptors At 200ft

3.1.5 For fixed panels orientated to the south with an angle of 25° and a height of 3.58m, when the OPs were set to a height of 200ft, some yellow glint was predicted. It is anticipated that this would be a reason for the Airport to object to the solar farm. As a result, a decision has been made to reorientate the panels in PV Array 7 so that they face a bearing of 200° relative to true north.

3.1.6 Further modelling has confirmed that once this adjustment has been made to the panels in PV Array 7, only green glint is predicted at all the aviation OPs identified above.

3.1.7 The results below discuss the combined predicted glint from the south-facing PVs 1-6 and 8, and then separately the reorientated PV Array 7.

3.1.8 It should be noted that when assessing multiple arrays, the raw output from ForgeSolar (see Appendix 4), does not account for any duplication of timings at the same receptor (i.e. predicted durations of glint from multiple arrays should not necessary be considered sequential and treated as additive, some of it may occur simultaneously from several arrays). However, the results discussed in this Chapter for Arrays 1-6 & 8, have been post-processed to correct this and remove any duplicated duration.

3.1.9 Table 3.2 shows that from PV Arrays 1-6 and 8 only green glint is predicted along the circuits at a height of 200ft with all the glint contained in the early evening between 17:35 and 18:27. This slightly overlaps with Retford (Gamston) Airport operating hours which normally extend until 18:00 local time[2].

3.1.10 PV Array 7 also only predicts green glint. Glint is predicted to occur only between 18:56 and 19:39 which is outside the airport's normal operating hours.

3.1.11 Green glint is low intensity glint with low potential for temporary after image.

3.1.12 Green glint does not exceed the tolerable thresholds for pilots on final approach within the FAA's most recent guidance. Therefore, glint is not expected to have a material impact on aircraft landing at this airfield, nor the safe flight operations of pilots performing circuits following the procedures the airport have asked to be modelled.

[2] Fly-In – Retford Gamston Airport (retfordairport.co.uk)

3.1.13 Any effects would be less intense than may be observed from reflections arising from large bodies of water or car windscreens in the airport carpark.

Table 3.2: Modelling Results for OPs along aviation circuits at a height of 200ft

OP Number	Runway Designator Position	Max Annual Duration (minutes)	Start Time	End Time	Start Date	End Date
PV Arrays 1-6 & 8						
OP7	02 Rotary Base leg turn	573	17:35	18:13	13/03/2024	28/09/2024
OP8	02 Rotary Base to final turn	2,318	17:38	18:20	14/03/2024	26/09/2024
OP14	02 Fixed Base leg turn	5,380	17:23	18:19	07/03/2024	03/10/2024
OP15	02 Fixed Base leg	4,870	17:37	18:25	14/03/202	27/09/2024
OP16	02 Fixed Base to final turn	4,278	17:46	18:26	30/03/2024	11/09/2024
OP17	02 Dead side abeam '02'	684	17:44	18:16	16/03/2024	24/09/2024
OP23	14 Fixed Crosswind turn	1,520	17:42	18:20	15/03/2024	25/09/2024
OP24	14 Fixed Crosswind	3,791	17:48	18:25	31/03/2024	09/09/2024
OP25	14 Fixed Downwind turn	3,140	17:48	18:27	23/04/2024	17/08/2024
OP26	14 Fixed Downwind (early)	4,443	17:46	18:26	03/04/2024	07/09/2024
OP27	14 Fixed Downwind (late)	2,053	17:35	18:17	12/03/2024	28/09/2024
OP34	14 Rotary Crosswind turn	905	17:43	18:17	16/03/2024	24/09/2024
OP35	14 Rotary Crosswind	59	17:43	18:12	16/03/2024	24/09/2024
PV Array 7						
OP14	02 Fixed Base leg turn	2,500	18:52	19:32	14/04/2024	27/08/2024
OP15	02 Fixed Base leg	1,692	19:03	19:39	19/04/2024	21/08/2024
OP16	02 Fixed Base to final turn	957	19:05	19:38	21/04/2024	19/08/2024
OP25	14 Fixed Downwind turn	1,520	19:09	19:35	04/05/2024	06/08/2024
OP26	14 Fixed Downwind (early)	2,045	19:09	19:35	23/04/2024	18/08/2024

Aviation Receptors At 500ft

3.1.14 With the adjustment to the orientation of the Panels within PV Array 7, when all the coordinate locations were set to a height of 500ft, only green glint was predicted at all the OPs.

3.1.15 Table 3.3 shows that from PV Arrays 1-6 and 8 only green glint is predicted along the circuits at a height of 500ft with all the glint contained in the early evening between 17:23 and 18:27, again slightly overlapping with the airport's operational hours, which extend to 18:00 local time.

3.1.16 PV Array 7 also only predicts green glint. Glint is predicted to occur only between 18:51 and 19:39 which is outside the airport's operating hours.

3.1.17 Green glint is low intensity glint with low potential for temporary after image.

3.1.18 Green glint does not exceed the tolerable thresholds for pilots on final approach within the FAA's most recent guidance. Therefore, glint is not expected to have a material impact on aircraft landing at this airfield. Any effects would be comparable or less than reflections from large bodies of still water or cars in the airport carparks.

Table 3.3: Modelling Results for OPs along aviation circuits at a height of 500ft

OP Number	Runway Designator Position	Max Annual Duration (minutes)	Start Time	End Time	Start Date	End Date
PV Arrays 1-6 & 8						
OP1	02 Approach	232	17:33	18:09	12/03/2024	29/09/2024
OP7	02 Rotary Base leg turn	947	17:2	18:08	07/03/2024	03/10/2024
OP8	02 Rotary Base to final turn	2,761	17:30	18:16	10/03/2024	30/09/2024
OP14	02 Fixed Base leg turn	7,206	16:51	18:09	23/02/2024	17/10/2024
OP15	02 Fixed Base leg	5,919	17:27	18:15	11/03/2024	30/09/2024
OP16	02 Fixed Base to final turn	4,652	17:38	18:20	28/03/2024	13/09/2024
OP17	02 Dead side abeam '02'	884	17:35	18:16	13/03/2024	28/09/2024
OP22	14 Departure	152	17:32	18:08	11/03/2024	29/09/2024
OP23	14 Fixed Crosswind turn	1,788	17:35	18:16	13/03/2024	28/09/2024
OP24	14 Fixed Crosswind	4,193	17:42	18:21	29/03/2024	11/09/2024

OP25	14 Fixed Downwind turn	3,094	17:42	18:20	24/04/2024	17/08/2024
OP26	14 Fixed Downwind (early)	4,667	17:35	18:18	02/04/2024	07/09/2024
OP27	14 Fixed Downwind (late)	2,735	17:19	18:10	06/03/2024	05/10/2024
OP34	14 Rotary Crosswind turn	1,164	17:33	18:16	12/03/2024	29/09/2024
OP35	14 Rotary Crosswind	361	17:36	18:13	13/03/2024	27/09/2024
PV Array 7						
OP14	02 Fixed Base leg turn	3,550	18:29	19:13	03/04/2024	07/09/2024
OP15	02 Fixed Base leg	2,262	18:51	19:30	13/04/2024	27/08/2024
OP16	02 Fixed Base to final turn	1,286	18:58	19:34	17/04/2024	24/08/2024
OP24	14 Fixed Crosswind	389	19:01	19:30	18/04/2024	23/08/2024
OP25	14 Fixed Downwind turn	2,510	19:02	19:39	05/05/2024	06/08/2024
OP26	14 Fixed Downwind (early)	3,260	18:57	19:36	20/04/2024	20/08/2024

Aviation Receptors At 1000ft

3.1.19 When all the coordinate locations were set to a height of 1000ft, only green glint was predicted at all the OPs.

3.1.20 Table 3.4 shows that from PV Arrays 1-6 and 8 only green glint is predicted along the circuits at a height of 1000ft with all the glint contained in the early evening between 16:09 and 18:12, overlapping the operational hours as the normal operating hours are until 18:00 local time.

3.1.21 PV Array 7 also only predicts green glint. Glint is predicted to occur only between 17:51 and 19:28 which ever so slightly overlaps with the airport's operating hours.

3.1.22 Green glint is low intensity glint with low potential for temporary after image.

3.1.23 Green glint does not exceed the tolerable thresholds for pilots on final approach within the FAA's most recent guidance. Therefore, glint is not expected to have a material impact on aircraft landing at this airfield. Any effects would be comparable or less than reflections from large bodies of still water or cars in the airport carparks.

Table 3.4: Modelling Results for OPs along aviation circuits at a height of 1000ft						
OP Number	**Runway Designator Position**	**Max Annual Duration (minutes)**	**Start Time**	**End Time**	**Start Date**	**End Date**
PV Arrays 1-6 & 8						
OP1	02 Approach	466	17:23	18:07	08/03/2024	03/10/2024
OP7	02 Rotary Base leg turn	1,667	17:01	17:58	27/02/2024	12/10/2024
OP8	02 Rotary Base to final turn	3,328	17:19	18:08	07/03/2024	03/10/2024
OP14	02 Fixed Base leg turn	11,399	16:09	17:54	07/02/2024	01/11/2024
OP15	02 Fixed Base leg	7,401	17:10	18:03	10/03/2024	01/10/2024
OP16	02 Fixed Base to final turn	5,113	17:25	18:09	28/03/2024	13/09/2024
OP17	02 Dead side abeam '02'	1,186	17:27	18:12	09/03/2024	01/10/2024
OP18	02 Dead side midpoint	325	17:29	18:08	10/03/2024	01/10/2024
OP22	14 Departure	395	17:22	18:06	07/03/2024	03/10/2024
OP23	14 Fixed Crosswind turn	2,130	17:28	18:11	10/03/2024	30/09/2024
OP24	14 Fixed Crosswind	4,418	17:33	18:12	30/03/2024	11/09/2024
OP25	14 Fixed Downwind turn	3,348	17:30	18:11	24/04/2024	16/08/2024
OP26	14 Fixed Downwind (early)	5,591	17:19	18:08	02/04/2024	07/09/2024
OP27	14 Fixed Downwind (late)	4390	16:33	17:58	15/02/2024	25/10/2024
OP34	14 Rotary Crosswind turn	1519	17:25	18:11	09/03/2024	02/10/2024
OP35	14 Rotary Crosswind	566	17:29	18:10	10/03/2024	01/10/2024
PV Array 7						
OP14	02 Fixed Base leg turn	5,718	17:51	18:45	19/03/2024	22/09/2024
OP15	02 Fixed Base leg	3,074	18:32	19:13	06/04/2024	04/09/2024
OP16	02 Fixed Base to final turn	1,744	18:46	19:23	12/04/2024	29/08/2024
OP24	14 Fixed Crosswind	655	18:52	19:24	13/04/2024	27/08/2024
OP25	14 Fixed Downwind turn	2,476	18:51	19:28	06/05/2024	05/08/2024
OP26	14 Fixed Downwind (early)	3,516	18:42	19:22	21/04/2024	20/08/2024
OP27	14 Fixed Downwind (late)	704	17:59	18:41	22/03/2024	19/09/2024

Aviation Receptors At 1500ft

3.1.24 When all the coordinate locations were set to a height of 1500ft, only green glint was predicted at all the OPs.

3.1.25 Green glint is low intensity glint with low potential for temporary after image.

3.1.26 Table 3.5 shows that from PV Arrays 1-6 and 8 only green glint is predicted along the circuits at a height of 1000ft with all the glint contained in the early evening between 16:07 and 18:07, overlapping the operational hours as the normal operating hours are until 18:00 local time.

3.1.27 PV Array 7 also only predicts green glint. Glint is predicted to occur only between 16:50 and 19:18 which overlaps with the airport's operating hours.

3.1.28 Green glint does not exceed the tolerable thresholds for pilots on final approach within the FAA's most recent guidance. Therefore, glint is not expected to have a material impact on aircraft landing at this airfield. Any effects would be comparable or less than reflections from large bodies of still water or cars in the airport carpark.

Table 3.5: Modelling Results for OPs along aviation circuits at a height of 1500ft from PV Arrays 1-6 and 8

OP Number	Runway Designator Position	Max Annual Duration (minutes)	Start Time	End Time	Start Date	End Date
PV Arrays 1-6 & 8						
OP1	02 Approach	994	17:03	17:56	28/02/2024	11/10/2024
OP7	02 Rotary Base leg turn	3,733	16:07	17:39	01/02/2024	08/11/2024
OP8	02 Rotary Base to final turn	4,273	16:58	17:53	05/03/2024	06/10/2024
OP14	02 Fixed Base leg turn	18,816	15:07	17:21	15/01/2024	24/11/2024
OP15	02 Fixed Base leg	9,193	16:33	17:38	11/03/2024	30/09/2024
OP16	02 Fixed Base to final turn	5,869	17:00	17:53	28/03/2024	12/09/2024
OP17	02 Dead side abeam '02'	1,675	17:13	18:04	04/03/2024	07/10/2024
OP18	02 Dead side midpoint	640	17:14	18:03	03/03/2024	07/10/2024
OP22	14 Departure	650	17:12	18:01	03/03/2024	08/10/2024
OP23	14 Fixed Crosswind turn	2,402	17:20	18:07	09/03/2024	02/10/2024
OP24	14 Fixed Crosswind	4,651	17:23	18:05	30/03/2024	11/09/2024
OP25	14 Fixed Downwind turn	3,782	17:19	18:04	24/04/2024	16/08/2024
OP26	14 Fixed Downwind (early)	6,313	17:02	17:58	03/04/2024	07/09/2024
OP27	14 Fixed Downwind (late)	6,928	15:59	17:45	27/01/2024	13/11/2024
OP33	32 Fixed Downwind turn	30	16:21	17:03	09/02/2024	31/10/2024
OP34	14 Rotary Crosswind turn	1,794	17:16	18:07	05/03/2024	06/10/2024

OP35	14 Rotary Crosswind	767	17:18	18:07	06/03/2024	05/10/2024
OP36	14 Rotary Downwind turn	64	17:23	17:56	07/03/2024	03/10/2024
PV Array 7						
OP8	02 Rotary Base to final turn	456	18:18	18:48	29/03/2024	11/09/2024
OP14	02 Fixed Base leg turn	7,608	16:50	17:53	09/03/2024	01/10/2024
OP15	02 Fixed Base leg	4,168	17:55	18:41	31/03/2024	09/09/2024
OP16	02 Fixed Base to final turn	2,413	18:22	19:02	06/04/2024	04/09/2024
OP24	14 Fixed Crosswind	945	18:43	19:16	09/04/2024	31/08/2024
OP25	14 Fixed Downwind turn	2,489	18:40	19:18	06/05/2024	04/08/2024
OP26	14 Fixed Downwind (early)	3,639	18:27	19:08	21/04/2024	20/08/2024
OP27	14 Fixed Downwind (late)	1,956	17:24	18:26	08/03/2024	02/10/2024

Aviation Receptors At 2000ft

3.1.29 When all the coordinate locations were set to a height of 2000ft, only green glint was predicted at all the OPs.

3.1.30 Green glint is low intensity glint with low potential for temporary after image.

3.1.31 Table 3.6 shows that only green glint is predicted along the circuits at a height of 1000ft with all the glint contained in the early evening between 15:07 and 18:04, overlapping the operational hours as the normal operating hours are until 18:00 local time.

3.1.32 PV Array 7 also only predicts green glint. Glint is predicted to occur only between 16:50 and 19:08 which overlaps with the airport's operating hours.

3.1.33 Green glint does not exceed the tolerable thresholds for pilots on final approach within the FAA's most recent guidance. Therefore, glint is not expected to have a material impact on aircraft landing at this airfield or performing circuits as indicated by the airport. Any effects would be of lower intensity than might be expected to be reflected from large waterbodies or car windscreens in the airport carpark.

Table 3.6: Modelling Results for OPs along aviation circuits at a height of 2000ft from PV Arrays 1-6 and 8						
OP Number	**Runway Designator Position**	**Max Annual Duration (minutes)**	**Start Time**	**End Time**	**Start Date**	**End Date**
PV Arrays 1-6 & 8						
OP1	02 Approach	994	17:03	17:56	28/02/2024	11/10/2024
OP7	02 Rotary Base leg turn	3,733	16:07	17:39	01/02/2024	08/11/2024
OP8	02 Rotary Base to final turn	4,273	16:58	17:53	05/03/2024	06/10/2024
OP14	02 Fixed Base leg turn	18,816	15:07	17:21	15/01/2024	24/11/2024
OP15	02 Fixed Base leg	9,193	16:33	17:38	11/03/2024	30/09/2024
OP16	02 Fixed Base to final turn	5,869	17:00	17:53	28/03/2024	12/09/2024
OP17	02 Dead side abeam '02'	1,675	17:13	18:04	04/03/2024	07/10/2024
OP18	02 Dead side midpoint	640	17:14	18:03	03/03/2024	07/10/2024
OP21	14 Midpoint	80	16:57	17:40	25/02/2024	14/10/2024
OP22	14 Departure	930	17:02	17:56	28/02/2024	12/10/2024
OP23	14 Fixed Crosswind turn	2,682	17:13	18:01	08/03/2024	03/10/2024
OP24	14 Fixed Crosswind	4,840	17:14	17:58	30/03/2024	10/09/2024
OP25	14 Fixed Downwind turn	3,989	17:08	17:55	24/04/2024	16/08/2024
OP26	14 Fixed Downwind (early)	6,909	16:46	17:47	03/04/2024	07/09/2024
OP27	14 Fixed Downwind (late)	9,814	15:32	17:31	18/01/2024	21/11/2024
OP33	32 Fixed Downwind turn	1,187	15:47	17:09	18/01/2024	21/11/2024
OP34	14 Rotary Crosswind turn	2,128	17:08	18:01	02/03/2024	09/10/2024
OP35	14 Rotary Crosswind	977	17:09	18:03	02/03/2024	09/10/2024
OP36	14 Rotary Downwind turn	169	17:15	17:56	04/03/2024	06/10/2024
PV Array 7						
OP8	02 Rotary Base to final turn	456	18:18	18:48	29/03/2024	11/09/2024
OP14	02 Fixed Base leg turn	7,608	16:50	17:53	09/03/2024	01/10/2024
OP15	02 Fixed Base leg	4,168	17:55	18:41	31/03/2024	09/09/2024
OP16	02 Fixed Base to final turn	2,413	18:22	19:02	06/04/2024	04/09/2024

OP24	14 Fixed Crosswind	1,197	18:34	19:08	06/04/2024	04/09/2024
OP25	14 Fixed Downwind turn	2,509	18:29	19:08	07/05/2024	04/08/2024
OP26	14 Fixed Downwind (early)	3,754	18:12	18:55	21/04/2024	19/08/2024
OP27	14 Fixed Downwind (late)	3,184	16:59	18:06	27/02/2024	12/10/2024

4 CONCLUSION

4.1 Following the realignment of the panels in PV Array 7, all point receptors along the circuits, only green glint was predicted. Most of the glint was predicted in the early evening towards the end of the airport's normal opening hours, although there were a few instances when there was some glint predicted earlier, from about 15:00.

4.2 Pilots are regularly exposed to the sun's rays directly and are used to flying over large bodies of water and cities that produce glint. With the prediction of green glint only, we see no risk to pilot health and safety.

4.3 It is relevant to note that the Government's position, as set out in its latest 'National Policy Statement for Renewable Energy Infrastructure' (NPS EN-3, published Nov 2023, and enacted Jan 2024) states in Para 2.10.159:

"Whilst there is some evidence that glint and glare from solar farms can be experienced by pilots and air traffic controllers in certain conditions, there is no evidence that glint and glare from solar farms results in significant impairment on aircraft safety. Therefore, unless a significant impairment can be demonstrated, the Secretary of State is unlikely to give any more than limited weight to claims of aviation interference because of glint and glare from solar farms."

4.4 It is considered that, given the low intensity of glint predicted, there should be no reason for Retford (Gamston) Airport to object to the Proposed Development in its current form. The Developer is open to further discussion with the Airport to ensure that any outstanding concerns are addressed but is hopeful that this mitigated design now being put forward will allay any concerns and allow the Airport to support the Proposed Development.

A0

NORMANTON LARCHES SOLAR FARM

LANDSCAPE SPECIFICATION

PREPARATION

On completion of the construction of the solar farm infrastructure all deleterious construction materials and waste products shall be removed from site. Liaise with the main contractor operator on health and safety requirements, particularly in relation to any excavations near buried electrical cables.

Make good any damaged/disturbed areas by infilling with topsoil previously stripped from hardstanding areas within the site, grading out and cultivating to marry in with existing levels. Areas to be planted shall have a minimum depth of 350 mm topsoil. If less than this, make up the deficit with topsoil from the site. By mechanical means, relieve any compaction or areas of poor drainage arising from the construction works.

PROPOSED PLANTING

Planting to be supplied in accordance with BS 3936-1:1992 Nursery Stock. specification for trees and shrubs, BS 3936-4:2007 Nursery Stock, BS 8545:2014 Trees: from nursery to independence in the landscape. All landscaping works to be in accordance with BS4428:1989 "General Landscaping Works." All planting should be UK grown and, where possible, sourced from local provenance certified stock. Planting to take place during the months of November to March, preferably before January and at a time when the soil is not frozen or waterlogged.

WOODLAND SCREEN PLANTING CLOSE TO THE HOTEL AND ALONGSIDE THE BATTERY STORAGE AND SUBSTATION COMPOUND

(Identified as W1 and W2 on the planting plan)

The plants are to be planted in a random mix in rows at 1.75m centres, with the plants within the rows at 1.75m staggered centres. Planting shall be a minimum of 15m away from the nearest battery container and the measurement must be checked on site once the containers are in place, but before planting takes place.

7%	Acer campestre	Field Maple	60 – 80cm high bare root transplant or cell grown
3%	Acer campestre	Field Maple	8 – 10cm girth bare root standard trees
7%	Acer platanoides	Norway Maple	60 – 80cm high bare root transplant or cell grown
3%	Acer platanoides	Norway Maple	60 – 80cm high bare root transplant or cell grown
7%	Betula pendula	Birch	60 – 80cm high bare root transplant or cell grown
3%	Betula pendula	Birch	8 – 10cm girth container standard trees
15%	Crataegus monogyna	Hawthorn	60 – 80cm high bare root transplant or cell grown
15%	Corylus avellana	Hazel	60 – 80cm bare root transplant or cell grown
7%	Fagus sylvatica	Beech	60 – 80cm bare root transplant or cell grown
3%	Fagus sylvatica	Beech	8 – 10cm girth bare root standard trees
5%	Ilex aquifolium	Holly	45 – 60cm high cell or pot grown
15%	Pinus sylvatica	Scots Pine	0.5 – 0.75m high bushy container plant
7%	Quercus robur	Common Oak	45 – 60cm high bare root transplant or cell grown
3%	Quercus robur	Common Oak	8 – 10cm girth container standard trees.

NATIVE SCRUB PLANTING TO SCREEN VIEWS FROM THE A614 AND ROBIN HOODS WAY

(Identified as S1, S2, S3, S4 and S5 on the planting plan).

These areas shall be planted with a random mix of the following, in rows at 1.75m centres, with the plants within the rows at 1.75m staggered centres (equates to 8 rows deep):

5%	Acer campestre	Field Maple	60 – 80cm high bare root transplant or cell grown
5%	Cornus sanquinea	Dogwood	45 – 60cm high bare root transplant or cell grown
15%	Corylus avellana	Hazel	60 – 80cm bare root transplant or cell grown
30%	Crataegus monogyna	Hawthorn	60 – 80cm high bare root transplant or cell grown
3%	Ilex aquifolium	Holly	45 – 60cm high cell or pot grown
3%	Ligustrum vulgare	Privet	45 – 60cm high bare root transplant or cell grown
10%	Prunus spinosa	Blackthorn	45 – 60cm high cell or pot grown bare root transplant
10%	Rosa canina	Dog Rose	60 – 80cm high bare root transplant or cell grown
2%	Rhamnus catharticа	Buckthorn	45 – 60cm high cell or pot grown transplant
7%	Sorbus aucuparia	Rowan	60 – 80cm high bare root transplant or cell grown
5%	Ulex europaea	Gorse	20 - 30cm high container grown
5%	Sorbus aucuparia	Rowan	60 – 80cm high bare root transplant or cell grown

RIPARIAN EDGE TO THE RIVER POULTER
(Identified as R1 on the planting plan)

To be planted as a random mix at loose spacing of 3 – 5m, averaging 1 plant per 16m2.

25%	Sorbus aucuparia	Rowan	60 – 80cm high bare root transplant
20%	Cornus sanquinea	Dogwood	45 -60cm high bare root transplant
10%	Rosa canina	Dog Rose	60 – 80cm high bare root transplant
5%	Rhamnus catharica	Purging Buckthorn	45 – 60cm high bare root transplant
25%	Salix caprea	Goat willow	45 -60cm high bare root transplant
15%	Salix viminalis	Osier Willow	60 – 80cm high bare root transplant

PLANTING NOTES

The transplants are to be notch planted into the existing topsoil and protected with a clear plastic or light green, biodegradable tree shelter, 750mm high such as a Tubex Combitube or similar (typically as a 73- 105mm dia. nested set). The shelter to be secured to a softwood stake (supplier to be FSC® Certified). A 50 -75mm square biodegradable mulch mat is to be fixed around the base of each tree/transplant shelter and pegged down in accordance with the suppliers' recommendations.

Holly, roses and pines to be protected with a shrub shelter.

The standard trees are to be pit planted in the positions shown and secured with a single 50mm softwood stake driven in until firm and trimmed to 1.4m above ground level and secured with a single tree tie at 1.2m height. A 50 -75mm square biodegradable mulch mat is to be fixed around the base of each tree and pegged down in accordance with the suppliers' recommendations.

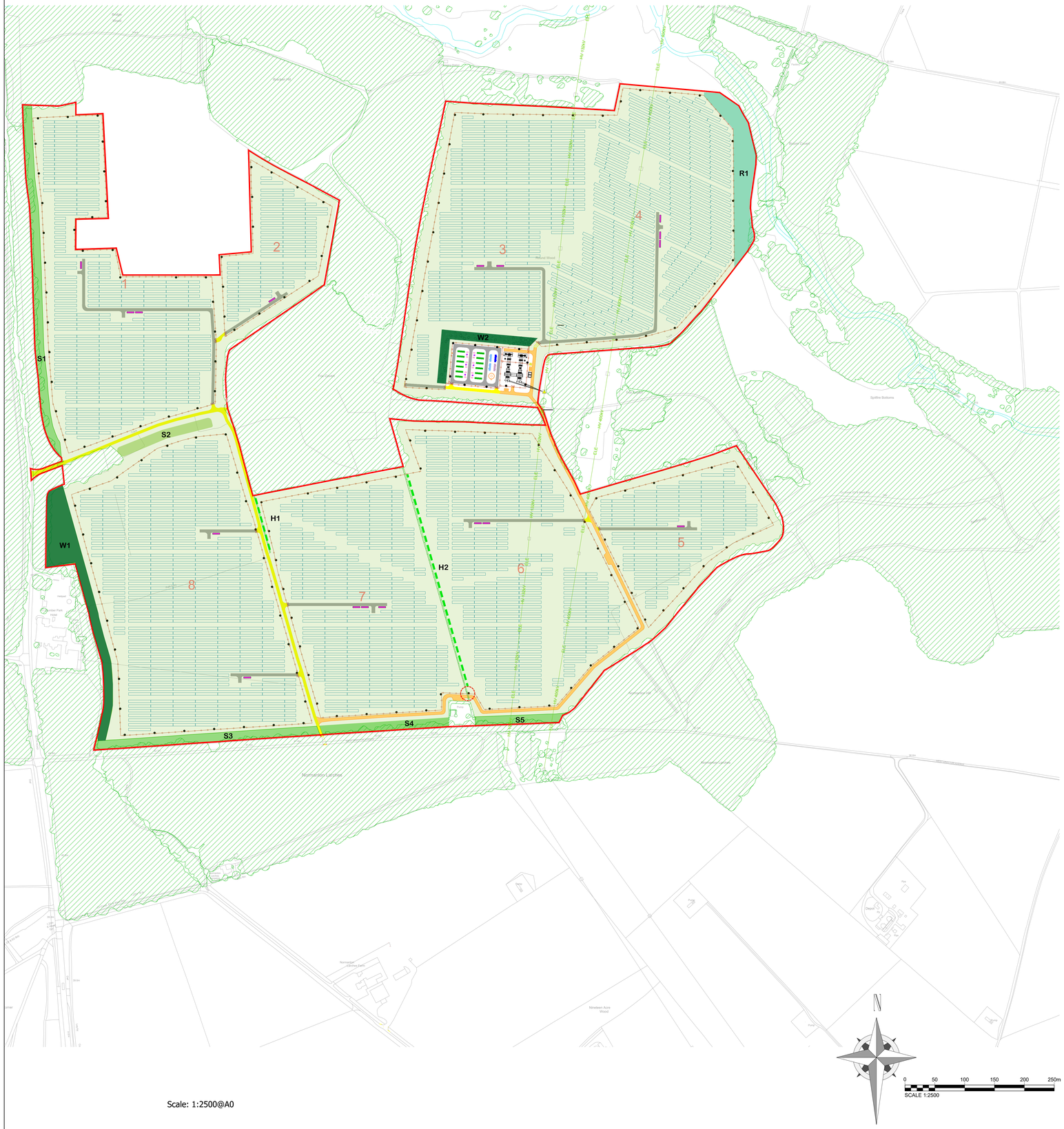
ENHANCHMENT OF EXISTING HEDGES
There are 490 metres length of existing low-cut hedges within the Site which will be retained. The following plants are to be planted in a random mix and spacing along eitherside of the hedge to enhance diversity. No plant protection required.

50 No	Cornus sanquinea	Dogwood	45 -60cm high bare root transplant
50 No	Prunus spinosa	Blackthorn	45 -60cm high bare root transplant
50No	Rosa canina	Dog rose	60 – 80cm high bare root transplant
25 No	Rhamnus catharticа	Buckthorn	45 – 60cm high bare root transplant
25 No	Sambucus nigra	Elder	60 – 80cm high bare root transplant
75No	Ulex europaea	Gorse	20 – 30cm high container grown
100 No	Vaccinium myrtillus	Bilberry	15cm high, container grown
75 No	Digitalis purpurea	Foxglove	1 litre container grown

GRASSLAND
Allow the fields to lie fallow to allow the seed bank to germinate, recultivation and repeating the process until there is little regrowth of pernicious weeds. As a last resort use chemical control. If time allows the preference is to seed the bare soil with the seed mixes, allow to germinate and keep mown to a height of 100mm to provide a firm grass sward on which to build out the panels. Any subsequent damage arising due to the construction works shall be made good by relieving compaction, spreading the soil to an even grade, cultivating to an even tilth and reseeding.
If not practical to pre-seed due to program or seasons, then the ground around the panels and margins is to be cultivated to a fine tilth and sown with the following seed mixes available from wildseed.co.uk (or other supplier of a similar product to approval).

Tussocky grassland within the riparian scrub planting
Area to be sown with Emorsgate Tussock Mix EM10 at a rate of 4g/m2 or similar to approval.

Area within the fenced array and between the array and either the site boundary or proposed woodland and scrub areas and among the woodland and scrub planting
To be sown with Landlife wildflower seed mix for Dry, Sandy and Loam Soils Wildflower Seeds LW3M https://www.wildflower.co.uk/products/wildflower-seed-mixtures/80-20-wildflower-meadows-seed-mixtures/lw3-dry-sandy-and-loam-soils-80-20.html. To be sown at a rate of 4g/m2 or similar to approval.



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Revisions:

Revision	Date	Revision Notes	Drawn	Inspected

LEGEND:

- PLANNING APPLICATION BOUNDARY
- DNO ACCESS
- EXISTING SITE ACCESS
- NEW INTERNAL ACCESS
- WATER COURSE
- PERIMETER FENCELINE
- O/H 400kV CABLE
- O/H 132kV CABLE

SITE INFRASTRUCTURE:

- SECURITY GATE
- CCTV CAMERA
- POINT OF CONNECTION
- SOLAR ARRAY
- 132kV SUBSTATION
- WATER TANK
- LATTICE TOWER
- MV POWER STATION
- CUSTOMER SWITCHGEAR
- SPARE PARTS CONTAINER
- WELFARE CABIN
- BESS CONTAINER
- POWER CONVERSION SYSTEM
- TRANSFORMER
- HYDRANT

ENVIRONMENT:

- EXISTING WOODLAND RETAINED
- W1, W2 — PROPOSED WOODLAND PLANTING
- S1, S2, S3, S4, S5 — PROPOSED SCRUB PLANTING
- PROPOSED SPECIES RICH MEADOW FOR SANDY SOIL
- R1 — PROPOSED RIPARIAN SCRUB WITH TUSSOCKY SPECIES RICH MEADOW
- H1, H2 — EXISTING HEDGE TO BE ENHANCED

Project:

Land Adjacent to the A614, Worksop, S80 3PA

Consultant:

ONE PLANET

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Drawn by:

sightline LANDSCAPE

Status:

PLANNING

Drawing Title:

PLANTING PLAN

Drawn:	Checked:	First Issued:
CM	CAM	28.03.24

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571_PP_01

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