

Heckington Fen Solar Park

EN010123

Environmental Statement | Volume 3: Technical Appendices Appendix 17.4: Forge Solar Model (Fixed Panels: 20 degrees) Glint Report

Applicant: Ecotricity (Heck Fen Solar) Limited

Document Reference: 6.3.17.4

Pursuant to: APFP Regulation 5(2)(a)

February 2023



APPENDIX 17.4 - FORGE SOLAR MODEL (FIXED PANELS - 20 DEGREES)

Document Properties		
Regulation Reference	Regulation 5(2)(a)	
Planning Inspectorate Scheme Reference	EN010123	
Application Document Reference	6.3.17.4	
Title	Appendix 17.4 - Forge Solar Model (Fixed Panels - 20 degrees)	
Prepared By	Heckington Fen Energy Park Project Team (Wardell Armstrong)	
Version History		
Version	Date	Version Status
Rev 1	February 2023	Application Version

FORGESOLAR GLARE ANALYSIS

Project: **BR10116 Heckington Fen**

Site configuration: **Heckington Fen - Panel Angle 20deg**

Client: Ecotricity

Created 09 Jan, 2023

Updated 20 Jan, 2023

Time-step 1 minute

Timezone offset UTC0

Site ID 82077.12176

Category 100 MW to 1 GW

DNI peaks at 1,000.0 W/m²

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 potential for temporary after-image predicted

PV Array	Tilt	Orient	Annual Green Glare		Annual Yellow Glare		Energy
	°	°	min	hr	min	hr	kWh
PV array 1	20.0	180.0	291	4.8	32,270	537.8	-

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

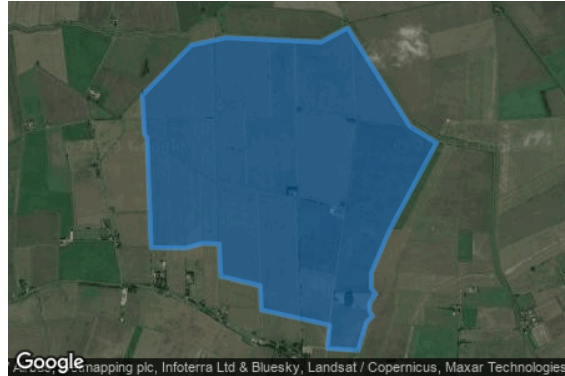
Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
A1121	0	0.0	36	0.6
A17	0	0.0	5,135	85.6
B1395	0	0.0	984	16.4
Browns Drove	0	0.0	0	0.0
Claydike Bank	0	0.0	1,062	17.7
Harrisons Drove	0	0.0	35	0.6
Littleworth Drove	1	0.0	2,771	46.2
Rail 1	250	4.2	950	15.8
Rail 2	40	0.7	2,836	47.3
FP 1	0	0.0	0	0.0
FP 2	0	0.0	0	0.0
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	2,064	34.4

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
OP 7	0	0.0	633	10.6
OP 8	0	0.0	1,508	25.1
OP 9	0	0.0	1,341	22.4
OP 10	0	0.0	1,009	16.8
OP 11	0	0.0	335	5.6
OP 12	0	0.0	174	2.9
OP 13	0	0.0	1,698	28.3
OP 14	0	0.0	1,013	16.9
OP 15	0	0.0	21	0.3
OP 16	0	0.0	1,908	31.8
OP 17	0	0.0	39	0.7
OP 18	0	0.0	24	0.4
OP 19	0	0.0	8	0.1
OP 20	0	0.0	0	0.0
OP 21	0	0.0	0	0.0
OP 22	0	0.0	0	0.0
OP 23	0	0.0	0	0.0
OP 24	0	0.0	0	0.0
OP 25	0	0.0	0	0.0
OP 26	0	0.0	0	0.0
OP 27	0	0.0	0	0.0
OP 28	0	0.0	0	0.0
OP 29	0	0.0	21	0.3
OP 30	0	0.0	31	0.5
OP 31	0	0.0	1,449	24.1
OP 32	0	0.0	854	14.2
OP 33	0	0.0	282	4.7
OP 34	0	0.0	23	0.4
OP 35	0	0.0	1,939	32.3
OP 36	0	0.0	2,053	34.2
OP 37	0	0.0	26	0.4
OP 38	0	0.0	8	0.1
OP 39	0	0.0	0	0.0
OP 40	0	0.0	0	0.0

Component Data

PV Arrays

Name: PV array 1
Axis tracking: Fixed (no rotation)
Tilt: 20.0°
Orientation: 180.0°
Rated power: -
Panel material: Light textured 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	53.000037	-0.230570	2.11	3.50	5.61
2	53.004169	-0.223833	1.02	3.50	4.52
3	53.004789	-0.219026	1.00	3.50	4.50
4	53.004427	-0.206023	2.00	3.50	5.50
5	53.005589	-0.202289	2.00	3.50	5.50
6	52.997454	-0.193706	2.77	3.50	6.27
7	52.996130	-0.190058	2.21	3.50	5.71
8	52.988749	-0.196667	4.00	3.50	7.50
9	52.985416	-0.199027	2.94	3.50	6.44
10	52.984150	-0.199027	3.35	3.50	6.85
11	52.983633	-0.198470	4.00	3.50	7.50
12	52.982884	-0.199285	2.91	3.50	6.41
13	52.982238	-0.199285	2.02	3.50	5.52
14	52.981825	-0.198899	2.54	3.50	6.04
15	52.981308	-0.199714	3.00	3.50	6.50
16	52.979008	-0.200873	3.00	3.50	6.50
17	52.979163	-0.205121	2.51	3.50	6.01
18	52.981075	-0.204778	2.71	3.50	6.21
19	52.982342	-0.214177	3.93	3.50	7.43
20	52.984331	-0.214305	2.02	3.50	5.52
21	52.985106	-0.219756	2.15	3.50	5.65
22	52.987767	-0.219970	2.97	3.50	6.47
23	52.987819	-0.222245	2.30	3.50	5.80
24	52.987431	-0.224605	2.58	3.50	6.08
25	52.987483	-0.229326	2.62	3.50	6.12
26	52.996550	-0.229884	2.00	3.50	5.50
27	52.996782	-0.230227	1.64	3.50	5.14

Route Receptors

Name: A1121

Path type: Two-way

Observer view angle: 50.0°



Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	52.970471	-0.188959	4.87	2.00	6.87
2	52.970807	-0.187725	4.00	2.00	6.00
3	52.970775	-0.186170	3.75	2.00	5.75
4	52.970659	-0.183037	2.89	2.00	4.89
5	52.970652	-0.180569	3.00	2.00	5.00
6	52.971964	-0.170023	3.00	2.00	5.00
7	52.972481	-0.165785	2.00	2.00	4.00
8	52.974238	-0.151634	2.00	2.00	4.00
9	52.975621	-0.141001	2.34	2.00	4.34
10	52.975924	-0.138641	2.22	2.00	4.22
11	52.976609	-0.133491	4.37	2.00	6.37
12	52.976771	-0.131839	3.99	2.00	5.99
13	52.976667	-0.128974	2.98	2.00	4.98
14	52.975588	-0.110553	3.71	2.00	5.71
15	52.973274	-0.072808	3.00	2.00	5.00

Name: A17
Path type: Two-way
Observer view angle: 50.0°



Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	52.987442	-0.321437	7.00	2.00	9.00
2	52.987571	-0.319463	4.82	2.00	6.82
3	52.987778	-0.316953	6.41	2.00	8.41
4	52.988114	-0.315150	6.00	2.00	8.00
5	52.988669	-0.312661	5.00	2.00	7.00
6	52.989173	-0.310065	4.93	2.00	6.93
7	52.989431	-0.308048	5.55	2.00	7.55
8	52.989689	-0.304550	6.00	2.00	8.00
9	52.989664	-0.302576	5.86	2.00	7.86
10	52.989405	-0.299486	6.23	2.00	8.23
11	52.989147	-0.297684	7.93	2.00	9.93
12	52.988553	-0.295066	7.66	2.00	9.66
13	52.987570	-0.292167	7.63	2.00	9.63
14	52.986979	-0.290510	8.12	2.00	10.12
15	52.983316	-0.280109	8.00	2.00	10.00
16	52.982580	-0.277406	8.00	2.00	10.00
17	52.982205	-0.275614	7.94	2.00	9.94
18	52.981792	-0.272760	7.68	2.00	9.68
19	52.981462	-0.268125	7.00	2.00	9.00
20	52.981171	-0.265153	6.15	2.00	8.15
21	52.980855	-0.262696	6.56	2.00	8.56
22	52.980777	-0.261259	5.00	2.00	7.00
23	52.980939	-0.259327	5.09	2.00	7.09
24	52.981327	-0.257128	5.65	2.00	7.65
25	52.981908	-0.253920	5.10	2.00	7.10
26	52.982263	-0.251807	5.00	2.00	7.00
27	52.983071	-0.248009	5.34	2.00	7.34
28	52.983561	-0.246120	4.90	2.00	6.90
29	52.984169	-0.244211	3.14	2.00	5.14
30	52.984556	-0.242537	3.00	2.00	5.00
31	52.984692	-0.241249	3.00	2.00	5.00
32	52.984737	-0.239704	3.00	2.00	5.00
33	52.984498	-0.236357	2.73	2.00	4.73
34	52.984415	-0.235012	2.22	2.00	4.22
35	52.984388	-0.233156	2.11	2.00	4.11
36	52.984372	-0.232185	2.08	2.00	4.08
37	52.984249	-0.230289	1.71	2.00	3.71
38	52.983997	-0.228712	3.92	2.00	5.92
39	52.983706	-0.227220	4.11	2.00	6.11
40	52.983390	-0.225869	4.00	2.00	6.00
41	52.982511	-0.222725	3.37	2.00	5.37
42	52.981833	-0.220730	3.51	2.00	5.51
43	52.980276	-0.215944	3.13	2.00	5.13
44	52.979759	-0.213992	3.24	2.00	5.24
45	52.979204	-0.212136	4.05	2.00	6.05
46	52.977770	-0.208745	4.00	2.00	6.00
47	52.977214	-0.207190	3.92	2.00	5.92
48	52.976620	-0.204609	4.00	2.00	6.00
49	52.975199	-0.199030	4.14	2.00	6.14
50	52.974536	-0.196616	4.77	2.00	6.77
51	52.974065	-0.195399	3.97	2.00	5.97
52	52.972986	-0.193285	3.49	2.00	5.49
53	52.971558	-0.190775	4.10	2.00	6.10
54	52.970628	-0.189332	5.00	2.00	7.00
55	52.969087	-0.187561	4.17	2.00	6.17
56	52.966431	-0.184943	3.00	2.00	5.00
57	52.964169	-0.182626	4.00	2.00	6.00
58	52.961435	-0.180110	2.10	2.00	4.10
59	52.955076	-0.176419	3.00	2.00	5.00



Name: B1395
Path type: Two-way
Observer view angle: 50.0°



Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	52.984572	-0.233157	2.37	2.00	4.37
2	52.985046	-0.233253	3.00	2.00	5.00
3	52.987249	-0.234004	2.49	2.00	4.49
4	52.990258	-0.234991	2.49	2.00	4.49
5	52.994676	-0.236515	3.00	2.00	5.00
6	52.999150	-0.237984	2.65	2.00	4.65
7	52.999551	-0.238167	2.11	2.00	4.11
8	52.999874	-0.238274	2.00	2.00	4.00
9	53.000196	-0.238167	2.14	2.00	4.14
10	53.001010	-0.237480	2.63	2.00	4.63
11	53.002598	-0.236085	2.00	2.00	4.00
12	53.003799	-0.235023	1.72	2.00	3.72
13	53.004845	-0.234144	2.81	2.00	4.81
14	53.005361	-0.233983	2.76	2.00	4.76
15	53.005859	-0.233800	2.69	2.00	4.69
16	53.006478	-0.234004	3.00	2.00	5.00
17	53.006917	-0.234465	3.00	2.00	5.00
18	53.007331	-0.234605	2.48	2.00	4.48
19	53.008764	-0.234304	1.60	2.00	3.60
20	53.008996	-0.234304	1.95	2.00	3.95
21	53.012766	-0.235254	1.83	2.00	3.83
22	53.013366	-0.235415	1.84	2.00	3.84
23	53.016077	-0.236134	2.00	2.00	4.00
24	53.016903	-0.236472	2.67	2.00	4.67
25	53.019607	-0.237614	2.55	2.00	4.55
26	53.022037	-0.238689	3.58	2.00	5.58
27	53.029576	-0.242773	1.92	2.00	3.92
28	53.031636	-0.243970	3.92	2.00	5.92

Name: Browns Drove
Path type: Two-way
Observer view angle: 50.0°



Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	52.969897	-0.187814	4.00	2.00	6.00
2	52.973399	-0.187482	3.00	2.00	5.00
3	52.979023	-0.186994	3.68	2.00	5.68
4	52.983761	-0.186591	3.00	2.00	5.00

Name: Claydike Bank
Path type: Two-way
Observer view angle: 50.0°



Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	52.975607	-0.141579	2.45	2.00	4.45
2	52.977364	-0.143768	2.87	2.00	4.87
3	52.981961	-0.149524	2.00	2.00	4.00
4	52.987677	-0.156670	2.98	2.00	4.98
5	52.988962	-0.158300	2.00	2.00	4.00
6	52.993832	-0.164416	3.00	2.00	5.00
7	52.995452	-0.166454	2.00	2.00	4.00
8	52.998907	-0.170757	1.49	2.00	3.49
9	53.010024	-0.184629	3.00	2.00	5.00
10	53.011727	-0.186737	1.07	2.00	3.07
11	53.014733	-0.190461	1.73	2.00	3.73
12	53.017680	-0.194133	2.71	2.00	4.71
13	53.021423	-0.198762	1.47	2.00	3.47
14	53.025329	-0.203680	2.27	2.00	4.27
15	53.027123	-0.205904	2.66	2.00	4.66

Name: Harrisons Drove
Path type: Two-way
Observer view angle: 50.0°



Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	52.981482	-0.148984	2.00	2.00	4.00
2	52.980267	-0.154965	2.00	2.00	4.00
3	52.978908	-0.161548	1.04	2.00	3.04
4	52.977777	-0.167051	2.15	2.00	4.15
5	52.977510	-0.168298	2.92	2.00	4.92

Name: Littleworth Drove
Path type: Two-way
Observer view angle: 50.0°



Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	52.997946	-0.237644	3.00	2.00	5.00
2	52.997419	-0.242257	3.17	2.00	5.17
3	52.996980	-0.246171	3.55	2.00	5.55
4	52.996875	-0.246713	4.01	2.00	6.01
5	52.995988	-0.249562	4.00	2.00	6.00
6	52.995470	-0.251351	3.29	2.00	5.29
7	52.995063	-0.253091	4.00	2.00	6.00
8	52.994970	-0.253647	3.79	2.00	5.79
9	52.994849	-0.254650	3.09	2.00	5.09
10	52.994821	-0.255146	3.59	2.00	5.59
11	52.995028	-0.256090	4.38	2.00	6.38
12	52.995204	-0.256825	4.14	2.00	6.14
13	52.995186	-0.257093	4.09	2.00	6.09
14	52.994892	-0.259185	5.19	2.00	7.19
15	52.994547	-0.261028	5.00	2.00	7.00
16	52.994188	-0.262908	4.00	2.00	6.00
17	52.993062	-0.269185	5.26	2.00	7.26
18	52.992396	-0.272959	5.78	2.00	7.78
19	52.991661	-0.277175	5.20	2.00	7.20
20	52.991008	-0.281015	6.27	2.00	8.27
21	52.989829	-0.287968	5.00	2.00	7.00
22	52.989380	-0.290580	6.24	2.00	8.24
23	52.989051	-0.291594	7.10	2.00	9.10
24	52.988695	-0.292173	7.73	2.00	9.73
25	52.987904	-0.293102	8.89	2.00	10.89
26	52.986267	-0.294400	10.05	2.00	12.05
27	52.985980	-0.294421	10.93	2.00	12.93
28	52.984817	-0.293976	13.26	2.00	15.26
29	52.984701	-0.294105	13.44	2.00	15.44
30	52.984462	-0.295060	13.79	2.00	15.79
31	52.983964	-0.297001	14.78	2.00	16.78

Name: Rail 1
Path type: Two-way
Observer view angle: 50.0°



Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	53.041317	-0.380502	10.40	2.75	13.15
2	53.039221	-0.380739	9.01	2.75	11.76
3	53.037040	-0.380481	9.67	2.75	12.42
4	53.030930	-0.379548	10.34	2.75	13.09
5	53.028801	-0.379204	9.30	2.75	12.05
6	53.027065	-0.379247	9.38	2.75	12.13
7	53.025278	-0.379666	12.26	2.75	15.01
8	53.024071	-0.380127	10.06	2.75	12.81
9	53.022774	-0.380878	8.71	2.75	11.46
10	53.019031	-0.383539	9.57	2.75	12.32
11	53.013958	-0.387165	9.58	2.75	12.33
12	53.009575	-0.390298	12.07	2.75	14.82
13	53.008586	-0.390996	12.59	2.75	15.34
14	53.007637	-0.391629	12.89	2.75	15.64
15	53.006714	-0.392112	13.41	2.75	16.16
16	53.005820	-0.392476	12.21	2.75	14.96
17	53.004616	-0.392825	13.49	2.75	16.24
18	53.003173	-0.393007	13.04	2.75	15.79
19	53.002588	-0.392997	13.55	2.75	16.30
20	53.000757	-0.392814	13.80	2.75	16.55
21	52.998908	-0.392428	14.04	2.75	16.79
22	52.997409	-0.391752	15.59	2.75	18.34
23	52.995827	-0.390599	16.38	2.75	19.13
24	52.994387	-0.388984	15.42	2.75	18.17
25	52.993225	-0.387273	14.70	2.75	17.45
26	52.992421	-0.385717	14.69	2.75	17.44
27	52.990277	-0.380959	12.13	2.75	14.88
28	52.989818	-0.379956	11.29	2.75	14.04
29	52.987571	-0.374978	11.60	2.75	14.35
30	52.985649	-0.370724	11.66	2.75	14.41
31	52.982861	-0.364545	10.51	2.75	13.26
32	52.981546	-0.361997	11.80	2.75	14.55
33	52.980235	-0.359786	13.61	2.75	16.36
34	52.965705	-0.339808	16.09	2.75	18.84
35	52.960723	-0.333056	9.59	2.75	12.34
36	52.959302	-0.330824	9.43	2.75	12.18
37	52.955837	-0.324001	14.46	2.75	17.21
38	52.948727	-0.310440	9.09	2.75	11.84
39	52.940245	-0.294218	5.42	2.75	8.17
40	52.930364	-0.274348	4.42	2.75	7.17
41	52.918554	-0.250337	4.58	2.75	7.33

Name: Rail 2
Path type: Two-way
Observer view angle: 50.0°



Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	52.995674	-0.412337	16.90	2.75	19.65
2	52.995377	-0.408780	16.99	2.75	19.74
3	52.994934	-0.404108	15.39	2.75	18.14
4	52.994321	-0.398368	14.04	2.75	16.79
5	52.993972	-0.392564	12.73	2.75	15.48
6	52.993888	-0.386974	11.63	2.75	14.38
7	52.993798	-0.384538	10.53	2.75	13.28
8	52.993585	-0.381449	10.98	2.75	13.73
9	52.993294	-0.378852	10.54	2.75	13.29
10	52.992545	-0.373885	9.31	2.75	12.06
11	52.990537	-0.363177	8.88	2.75	11.63
12	52.989329	-0.356686	9.18	2.75	11.93
13	52.986926	-0.344048	8.00	2.75	10.75
14	52.984123	-0.329081	14.02	2.75	16.77
15	52.981481	-0.316174	14.87	2.75	17.62
16	52.979485	-0.306937	15.96	2.75	18.71
17	52.978749	-0.303504	13.90	2.75	16.65
18	52.978206	-0.300564	15.03	2.75	17.78
19	52.977431	-0.295178	13.97	2.75	16.72
20	52.976985	-0.292324	12.33	2.75	15.08
21	52.976462	-0.289427	9.56	2.75	12.31
22	52.973755	-0.274600	6.23	2.75	8.98
23	52.970621	-0.257327	2.28	2.75	5.03
24	52.967074	-0.237929	2.89	2.75	5.64
25	52.966570	-0.234131	2.82	2.75	5.57
26	52.966460	-0.232393	2.00	2.75	4.75
27	52.966525	-0.224196	2.91	2.75	5.66
28	52.966699	-0.211150	1.32	2.75	4.07
29	52.967714	-0.203135	2.00	2.75	4.75
30	52.969730	-0.186945	4.56	2.75	7.31
31	52.971939	-0.169297	3.00	2.75	5.75
32	52.973710	-0.155102	2.56	2.75	5.31
33	52.975357	-0.142206	3.00	2.75	5.75
34	52.976636	-0.132195	4.42	2.75	7.17
35	52.976669	-0.131529	4.00	2.75	6.75
36	52.976643	-0.130542	3.27	2.75	6.02
37	52.976501	-0.128193	2.62	2.75	5.37
38	52.975609	-0.113687	5.00	2.75	7.75
39	52.974647	-0.097605	3.00	2.75	5.75
40	52.973141	-0.072800	3.00	2.75	5.75
41	52.972418	-0.060856	3.64	2.75	6.39

Flight Path Receptors

Name: FP 1
Description:
Threshold height: 15 m
Direction: 71.7°
Glide slope: 3.0°
Pilot view restricted? Yes
Vertical view: 30.0°
Azimuthal view: 50.0°



Point	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
Threshold	53.089408	-0.185319	5.06	15.24	20.30
Two-mile	53.080325	-0.231078	2.18	186.81	188.99

Name: FP 2
Description:
Threshold height: 15 m
Direction: 252.2°
Glide slope: 3.0°
Pilot view restricted? Yes
Vertical view: 30.0°
Azimuthal view: 50.0°



Point	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
Threshold	53.096940	-0.146902	5.11	15.24	20.35
Two-mile	53.105760	-0.100992	5.13	183.90	189.03

Discrete Observation Point Receptors

Name	ID	Latitude (°)	Longitude (°)	Elevation (m)	Height (m)
OP 1	1	52.977735	-0.201889	3.01	2.00
OP 2	2	52.977073	-0.205349	4.01	2.00
OP 3	3	52.975377	-0.197667	5.87	2.00
OP 4	4	52.975842	-0.202130	3.66	2.00
OP 5	5	52.976808	-0.207752	4.00	2.00
OP 6	6	52.979072	-0.209114	4.83	2.00
OP 7	7	52.977774	-0.208133	4.42	2.00
OP 8	8	52.979560	-0.211684	4.66	2.00
OP 9	9	52.979602	-0.214608	3.13	2.00
OP 10	10	52.980306	-0.215300	3.54	2.00
OP 11	11	52.981572	-0.219023	4.00	2.00
OP 12	12	52.982987	-0.222145	3.93	2.00
OP 13	13	52.984240	-0.224167	3.11	2.00
OP 14	14	52.983904	-0.226871	4.16	2.00
OP 15	15	52.987989	-0.233952	3.18	2.00
OP 16	16	52.990360	-0.234681	2.19	2.00
OP 17	17	52.993330	-0.236376	4.00	2.00
OP 18	18	52.995003	-0.236816	3.00	2.00
OP 19	19	52.997263	-0.237519	3.22	2.00
OP 20	20	53.006190	-0.234167	3.00	2.00
OP 21	21	53.019272	-0.235442	4.02	2.00
OP 22	22	53.009911	-0.214000	3.91	2.00
OP 23	23	53.017743	-0.194546	2.68	2.00
OP 24	24	53.024946	-0.203482	2.12	2.00
OP 25	25	53.014965	-0.191120	1.65	2.00
OP 26	26	53.009536	-0.184807	2.63	2.00
OP 27	27	53.006789	-0.181154	2.00	2.00
OP 28	28	53.005849	-0.163798	3.65	2.00
OP 29	29	52.996303	-0.168205	2.00	2.00
OP 30	30	52.994997	-0.165377	2.00	2.00
OP 31	31	52.983734	-0.185971	3.00	2.00
OP 32	32	52.980263	-0.186983	3.69	2.00
OP 33	33	52.974498	-0.187710	3.11	2.00
OP 34	34	52.983700	-0.171560	2.89	2.00
OP 35	35	52.983570	-0.269921	7.90	2.00
OP 36	36	52.992628	-0.255962	6.00	2.00
OP 37	37	52.995777	-0.250944	3.86	2.00
OP 38	38	53.001205	-0.260427	3.57	2.00
OP 39	39	53.010959	-0.258772	2.81	2.00
OP 40	40	53.011987	-0.234766	2.72	2.00

Glare Analysis Results

Summary of Results Glare with potential for temporary after-image predicted

PV Array	Tilt	Orient	Annual Green Glare		Annual Yellow Glare		Energy
	°	°	min	hr	min	hr	kWh
PV array 1	20.0	180.0	291	4.8	32,270	537.8	-

Total annual 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
A1121	0	0.0	36	0.6
A17	0	0.0	5,135	85.6
B1395	0	0.0	984	16.4
Browns Drove	0	0.0	0	0.0
Claydike Bank	0	0.0	1,062	17.7
Harrisons Drove	0	0.0	35	0.6
Littleworth Drove	1	0.0	2,771	46.2
Rail 1	250	4.2	950	15.8
Rail 2	40	0.7	2,836	47.3
FP 1	0	0.0	0	0.0
FP 2	0	0.0	0	0.0
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	2,064	34.4
OP 7	0	0.0	633	10.6
OP 8	0	0.0	1,508	25.1
OP 9	0	0.0	1,341	22.4
OP 10	0	0.0	1,009	16.8
OP 11	0	0.0	335	5.6
OP 12	0	0.0	174	2.9
OP 13	0	0.0	1,698	28.3
OP 14	0	0.0	1,013	16.9
OP 15	0	0.0	21	0.3
OP 16	0	0.0	1,908	31.8
OP 17	0	0.0	39	0.7
OP 18	0	0.0	24	0.4
OP 19	0	0.0	8	0.1
OP 20	0	0.0	0	0.0
OP 21	0	0.0	0	0.0

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
OP 22	0	0.0	0	0.0
OP 23	0	0.0	0	0.0
OP 24	0	0.0	0	0.0
OP 25	0	0.0	0	0.0
OP 26	0	0.0	0	0.0
OP 27	0	0.0	0	0.0
OP 28	0	0.0	0	0.0
OP 29	0	0.0	21	0.3
OP 30	0	0.0	31	0.5
OP 31	0	0.0	1,449	24.1
OP 32	0	0.0	854	14.2
OP 33	0	0.0	282	4.7
OP 34	0	0.0	23	0.4
OP 35	0	0.0	1,939	32.3
OP 36	0	0.0	2,053	34.2
OP 37	0	0.0	26	0.4
OP 38	0	0.0	8	0.1
OP 39	0	0.0	0	0.0
OP 40	0	0.0	0	0.0

PV: PV array 1 potential temporary after-image

Receptor results ordered by category of glare

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
A1121	0	0.0	36	0.6
A17	0	0.0	5,135	85.6
B1395	0	0.0	984	16.4
Claydike Bank	0	0.0	1,062	17.7
Harrisons Drove	0	0.0	35	0.6
Littleworth Drove	1	0.0	2,771	46.2
Rail 1	250	4.2	950	15.8
Rail 2	40	0.7	2,836	47.3
Browns Drove	0	0.0	0	0.0
FP 1	0	0.0	0	0.0
FP 2	0	0.0	0	0.0
OP 6	0	0.0	2,064	34.4
OP 7	0	0.0	633	10.6
OP 8	0	0.0	1,508	25.1
OP 9	0	0.0	1,341	22.4
OP 10	0	0.0	1,009	16.8
OP 11	0	0.0	335	5.6
OP 12	0	0.0	174	2.9
OP 13	0	0.0	1,698	28.3
OP 14	0	0.0	1,013	16.9
OP 15	0	0.0	21	0.3
OP 16	0	0.0	1,908	31.8
OP 17	0	0.0	39	0.7
OP 18	0	0.0	24	0.4
OP 19	0	0.0	8	0.1
OP 29	0	0.0	21	0.3
OP 30	0	0.0	31	0.5
OP 31	0	0.0	1,449	24.1
OP 32	0	0.0	854	14.2
OP 33	0	0.0	282	4.7
OP 34	0	0.0	23	0.4
OP 35	0	0.0	1,939	32.3
OP 36	0	0.0	2,053	34.2
OP 37	0	0.0	26	0.4

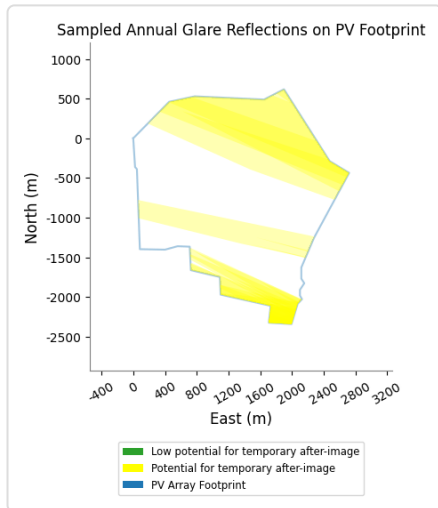
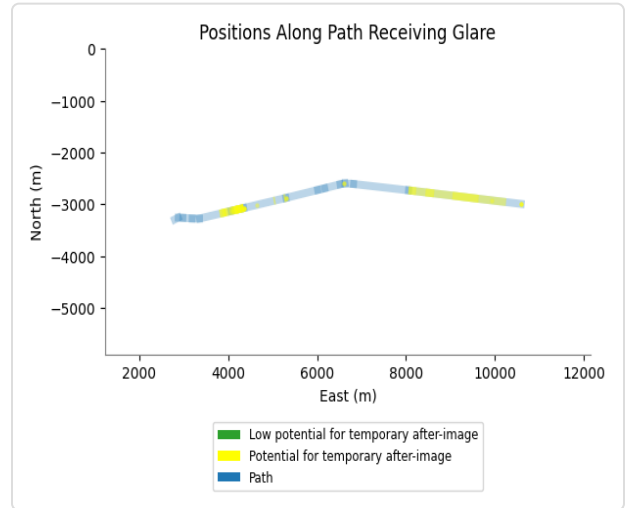
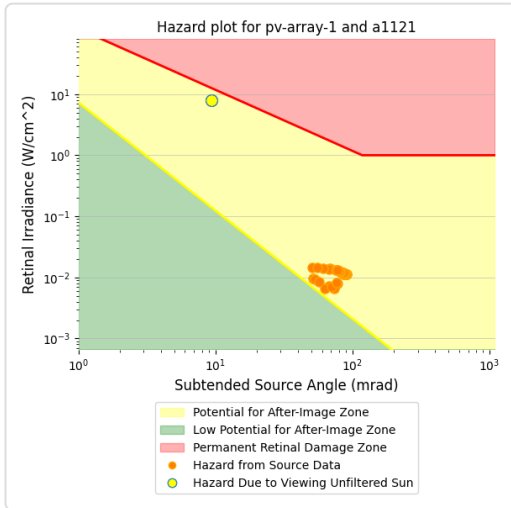
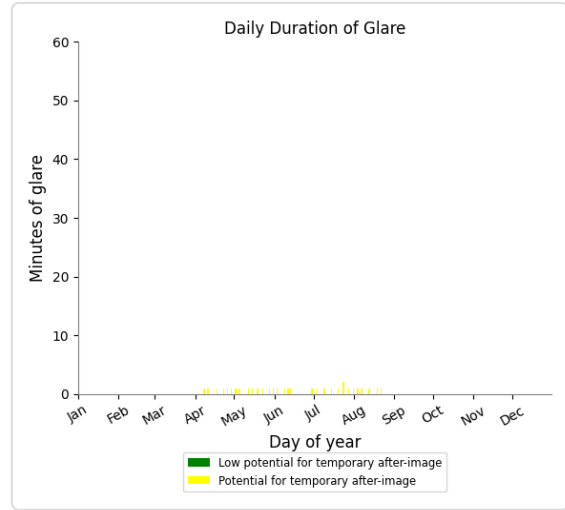
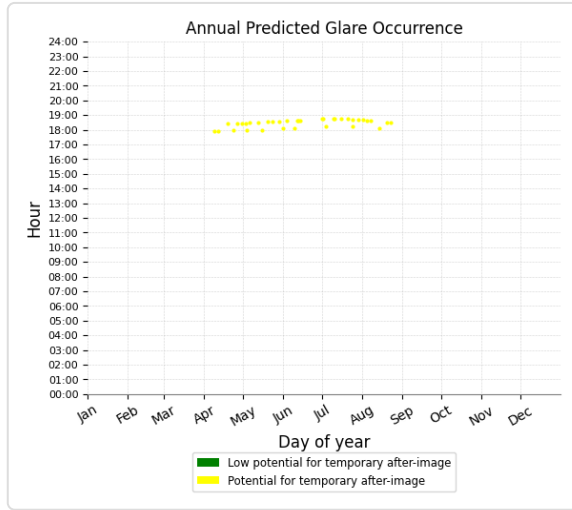
Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
OP 38	0	0.0	8	0.1
OP 1	0	0.0	0	0.0
OP 2	0	0.0	0	0.0
OP 3	0	0.0	0	0.0
OP 4	0	0.0	0	0.0
OP 5	0	0.0	0	0.0
OP 20	0	0.0	0	0.0
OP 21	0	0.0	0	0.0
OP 22	0	0.0	0	0.0
OP 23	0	0.0	0	0.0
OP 24	0	0.0	0	0.0
OP 25	0	0.0	0	0.0
OP 26	0	0.0	0	0.0
OP 27	0	0.0	0	0.0
OP 28	0	0.0	0	0.0
OP 39	0	0.0	0	0.0
OP 40	0	0.0	0	0.0

PV array 1 and A1121

Receptor type: Route

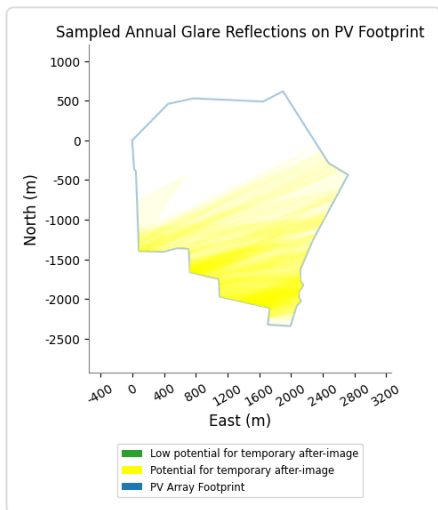
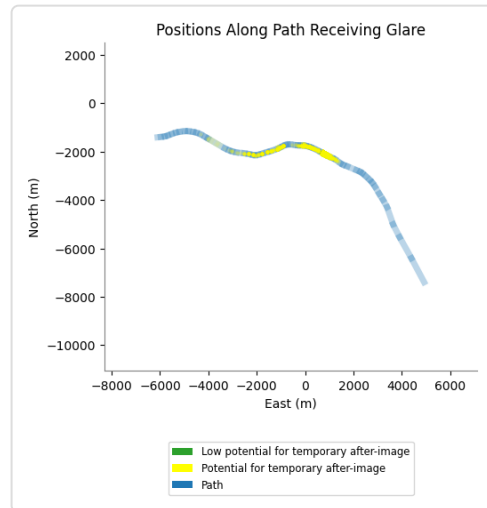
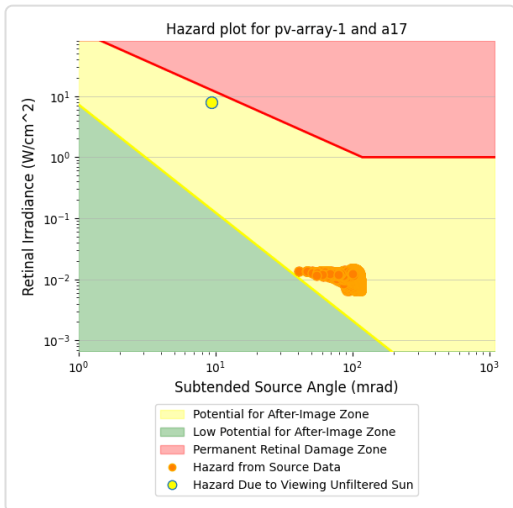
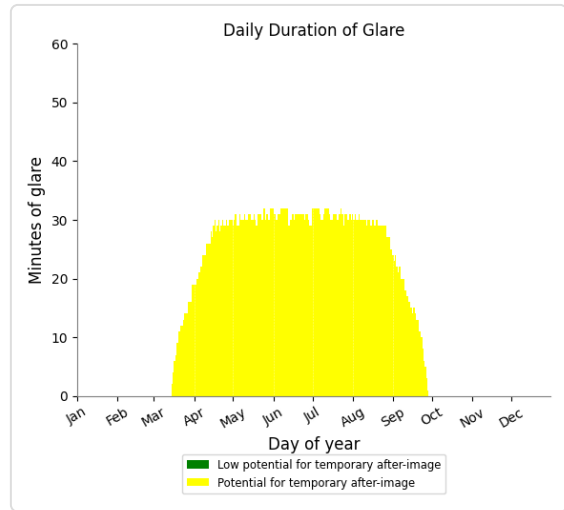
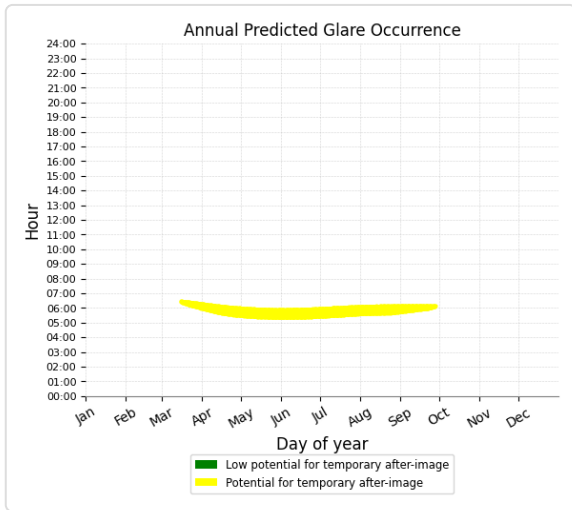
36 minutes of yellow glare

0 minutes of green glare



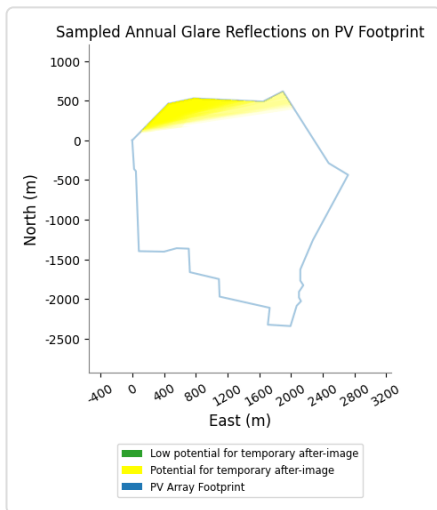
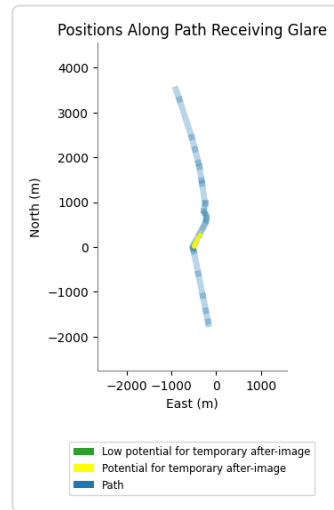
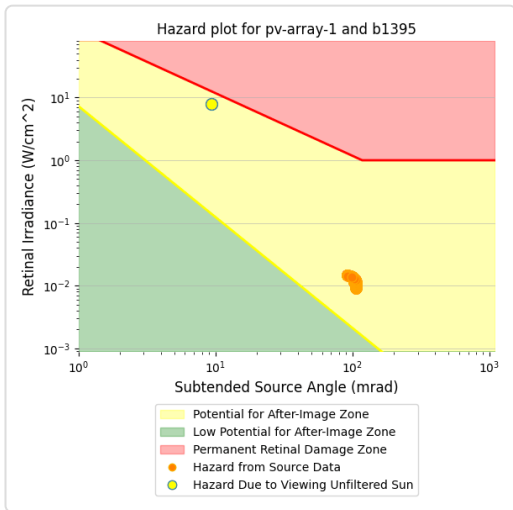
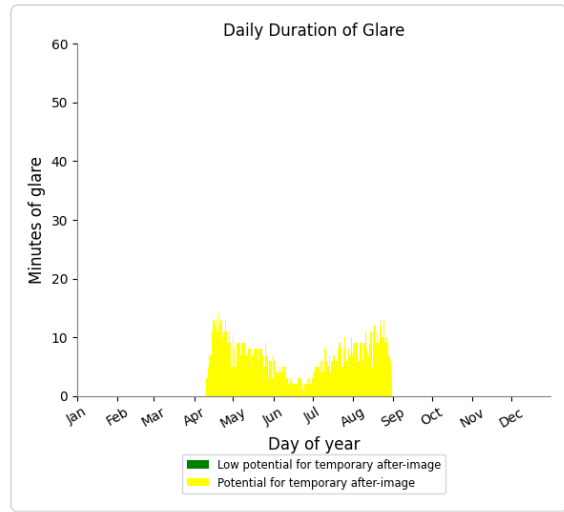
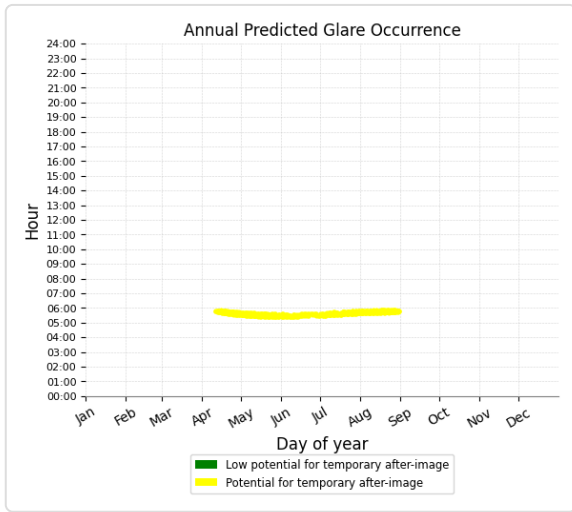
PV array 1 and A17

Receptor type: Route
 5,135 minutes of yellow glare
 0 minutes of green glare



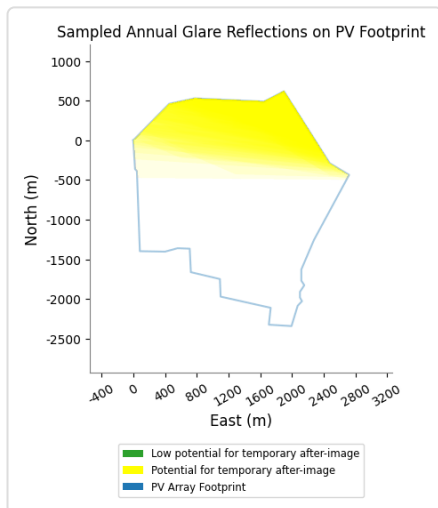
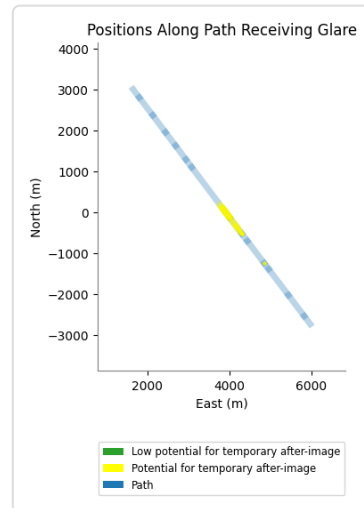
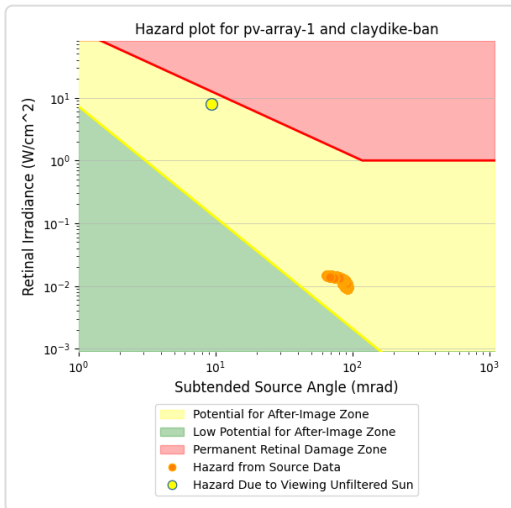
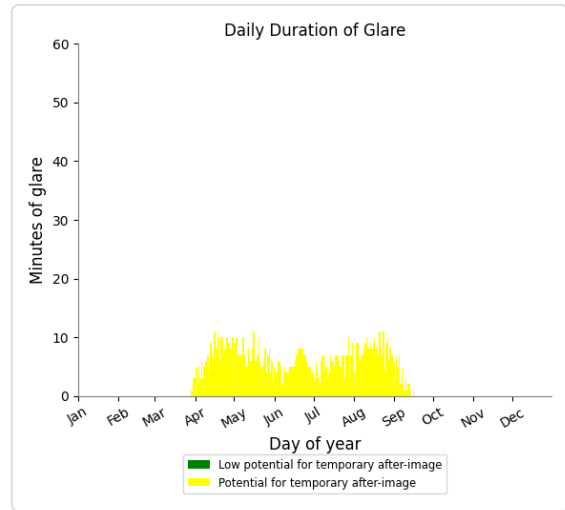
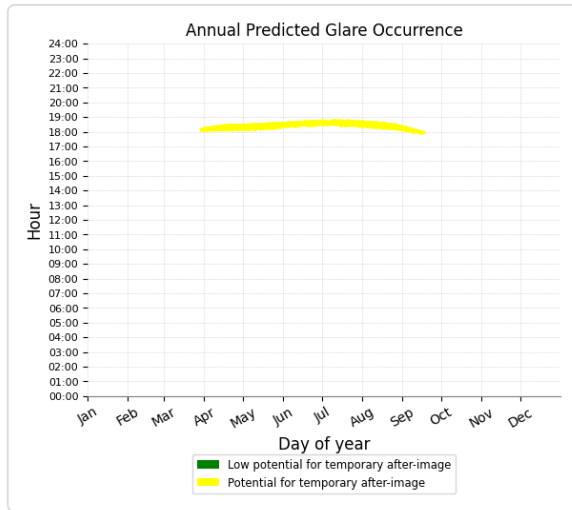
PV array 1 and B1395

Receptor type: Route
 984 minutes of yellow glare
 0 minutes of green glare



PV array 1 and Claydike Bank

Receptor type: Route
 1,062 minutes of yellow glare
 0 minutes of green glare

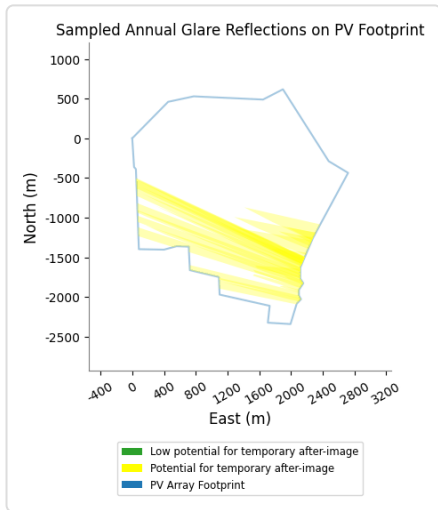
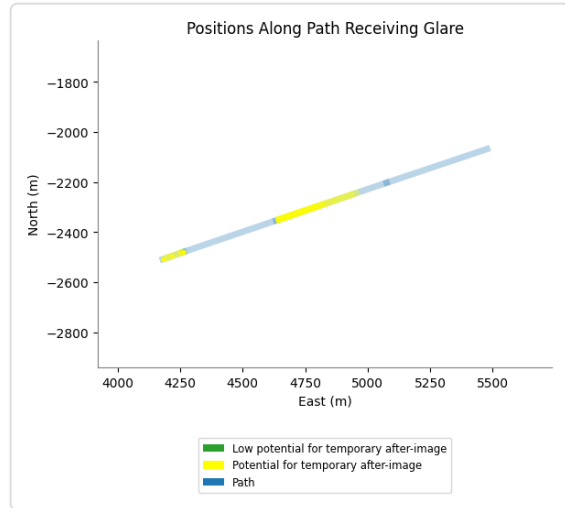
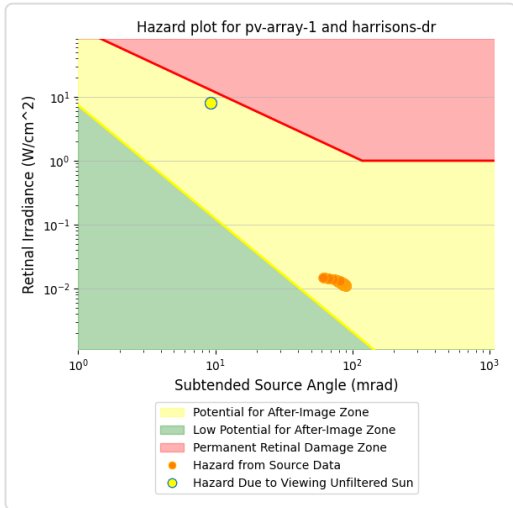
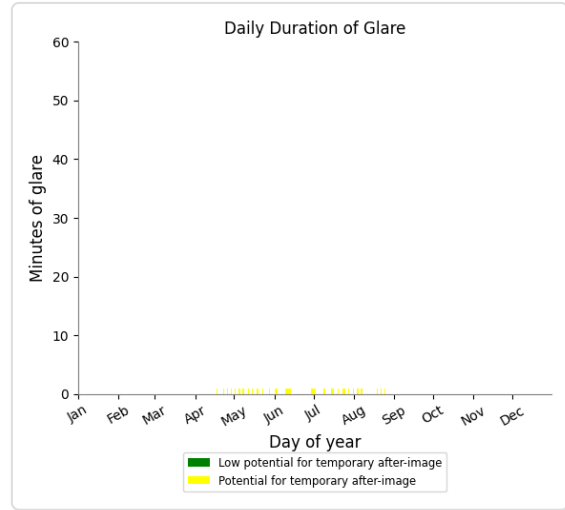
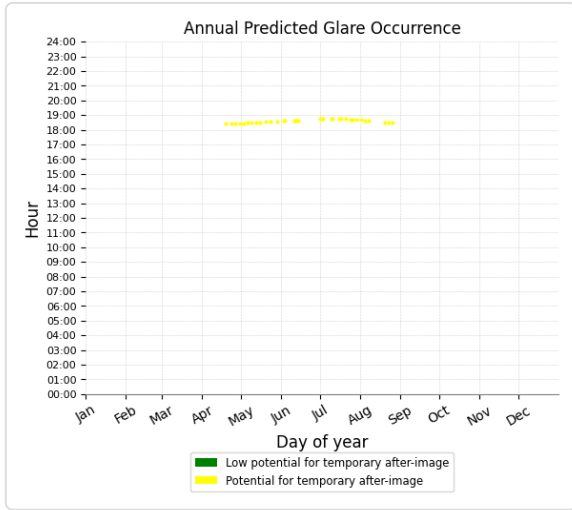


PV array 1 and Harrisons Drove

Receptor type: Route

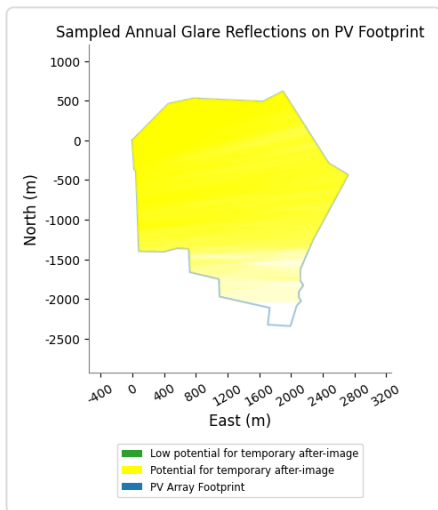
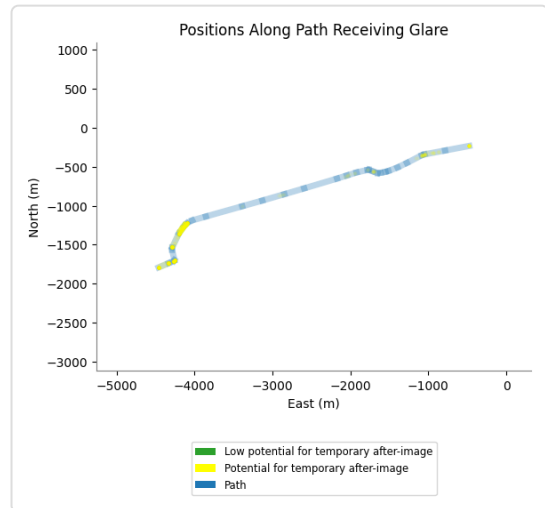
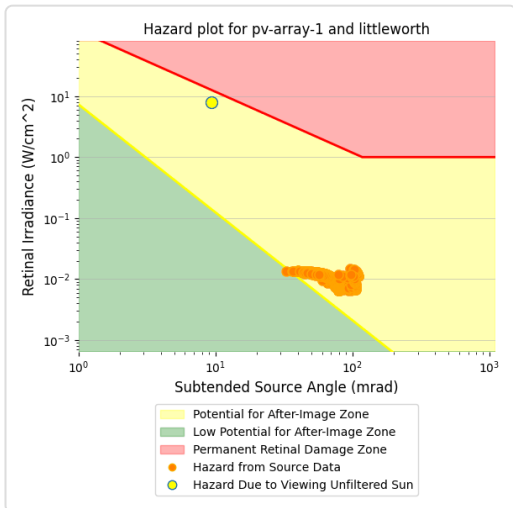
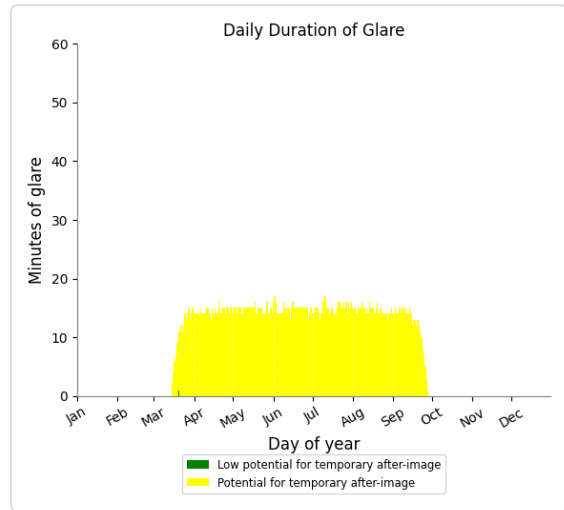
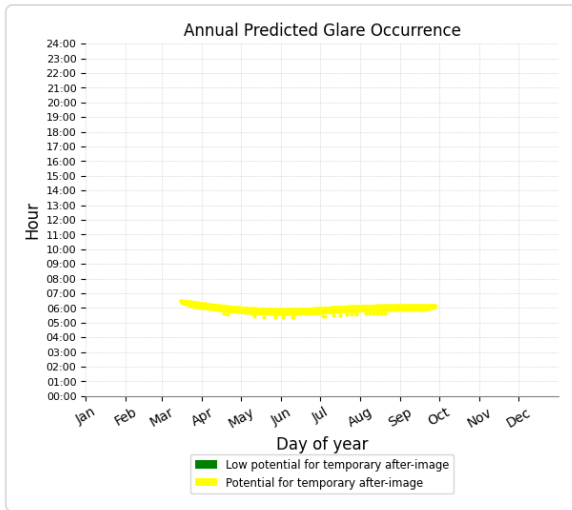
35 minutes of yellow glare

0 minutes of green glare



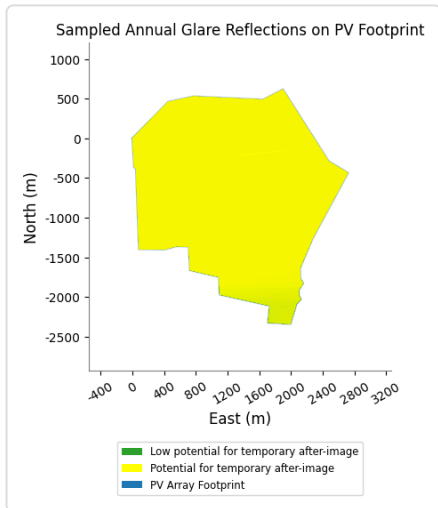
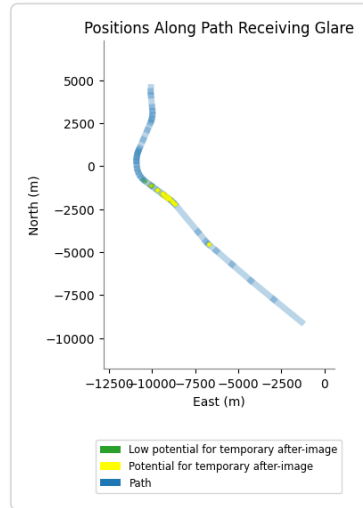
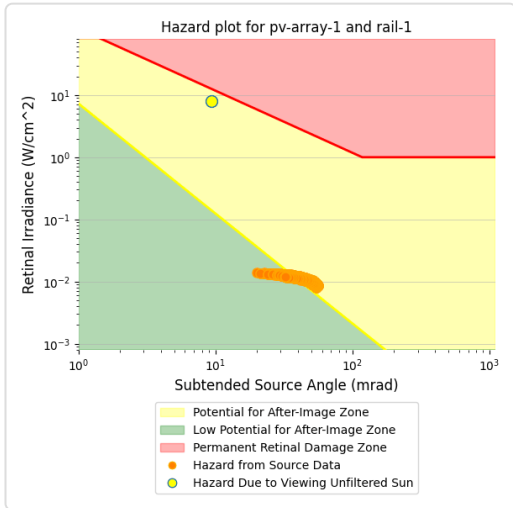
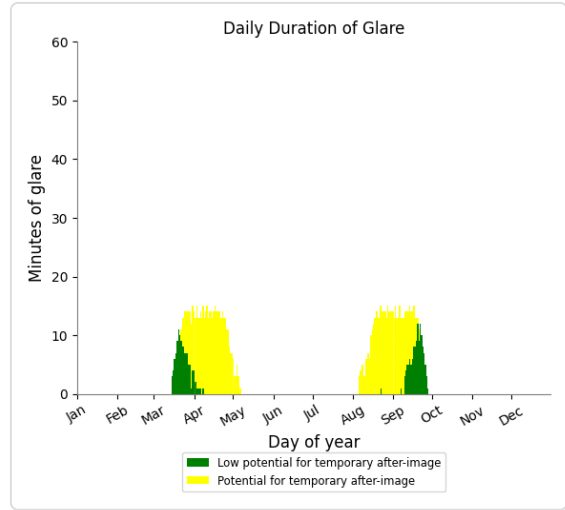
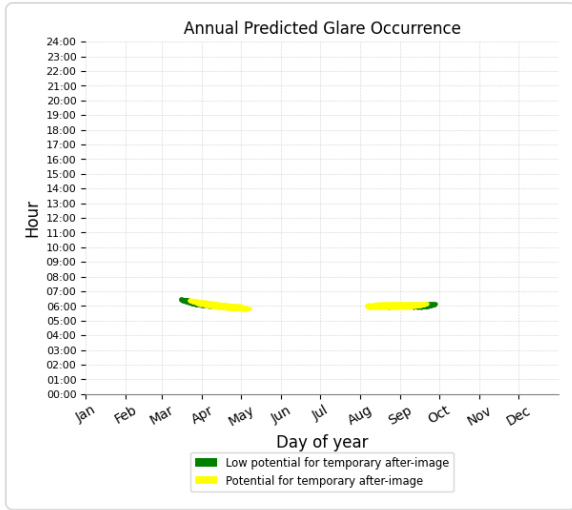
PV array 1 and Littleworth Drove

Receptor type: Route
 2,771 minutes of yellow glare
 1 minutes of green glare



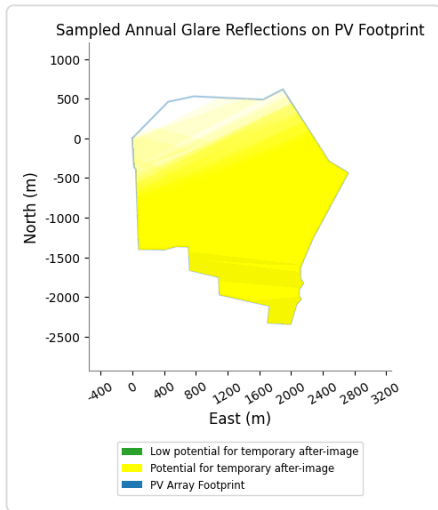
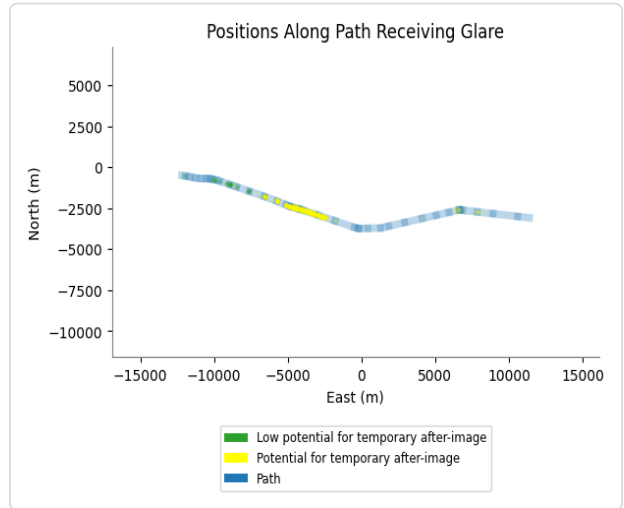
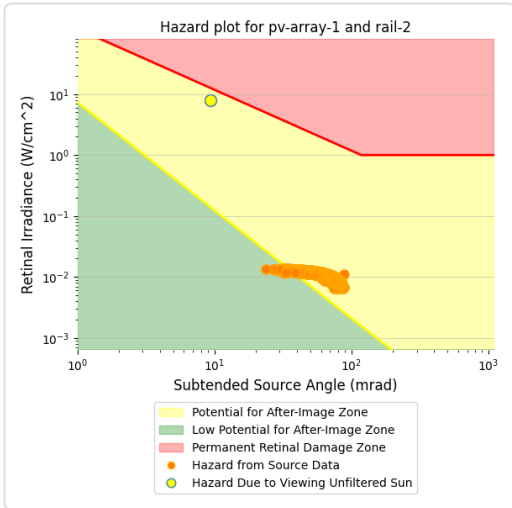
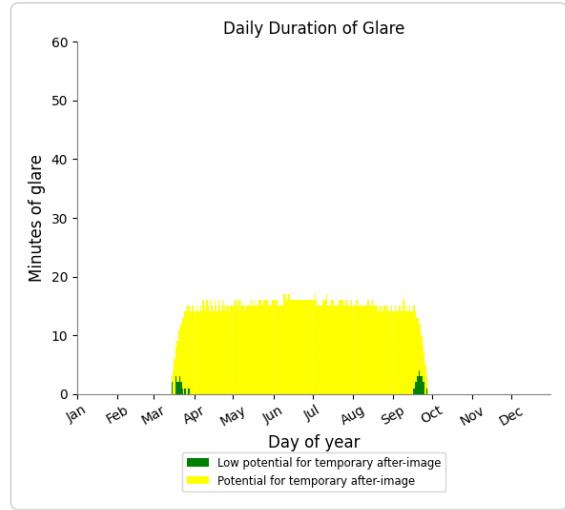
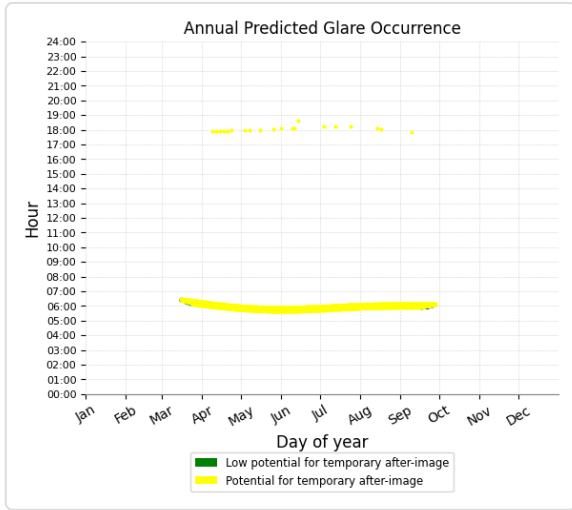
PV array 1 and Rail 1

Receptor type: Route
 950 minutes of yellow glare
 250 minutes of green glare



PV array 1 and Rail 2

Receptor type: Route
 2,836 minutes of yellow glare
 40 minutes of green glare



PV array 1 and Browns Drove

Receptor type: Route

No glare found

PV array 1 and FP 1

Receptor type: 2-mile Flight Path

No glare found

PV array 1 and FP 2

Receptor type: 2-mile Flight Path

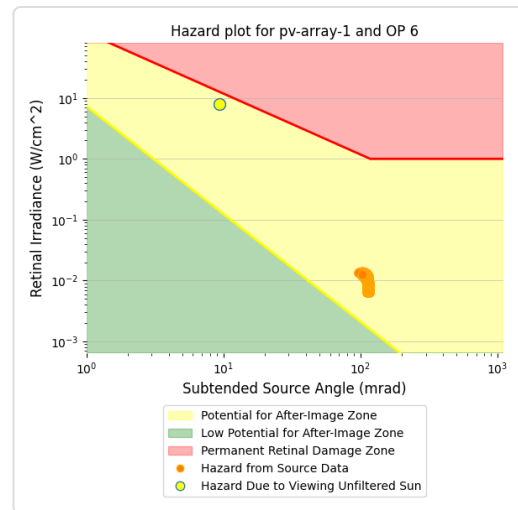
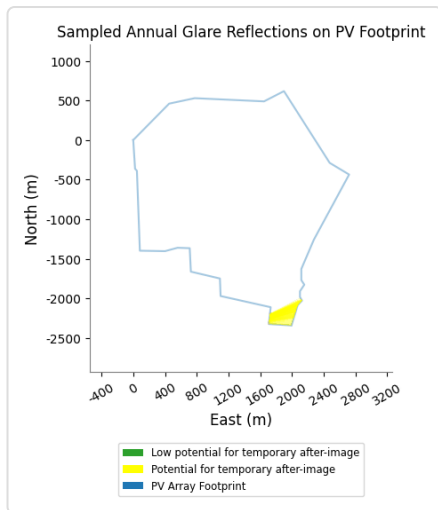
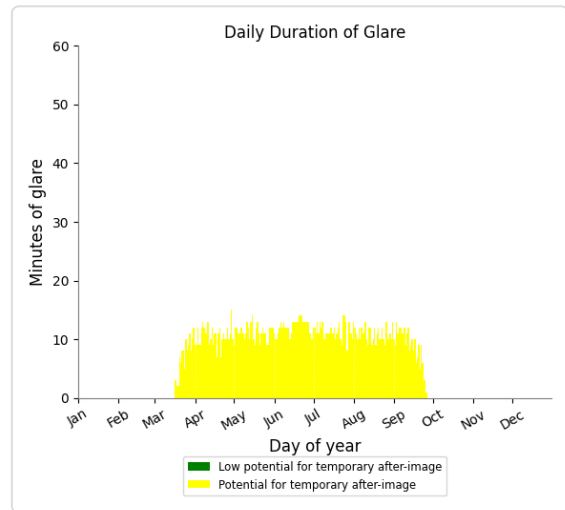
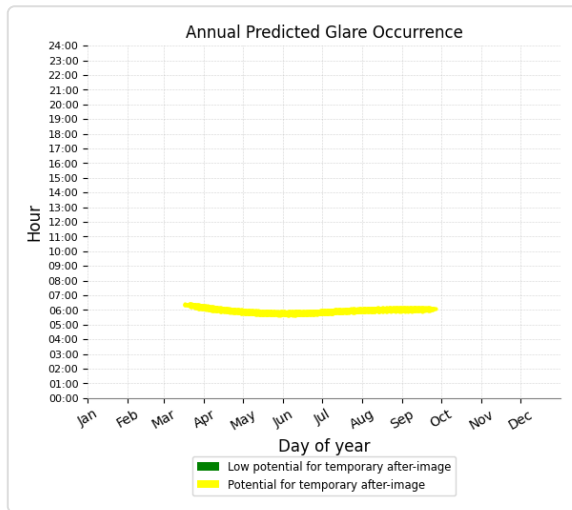
No glare found

PV array 1 and OP 6

Receptor type: Observation Point

2,064 minutes of yellow glare

0 minutes of green glare

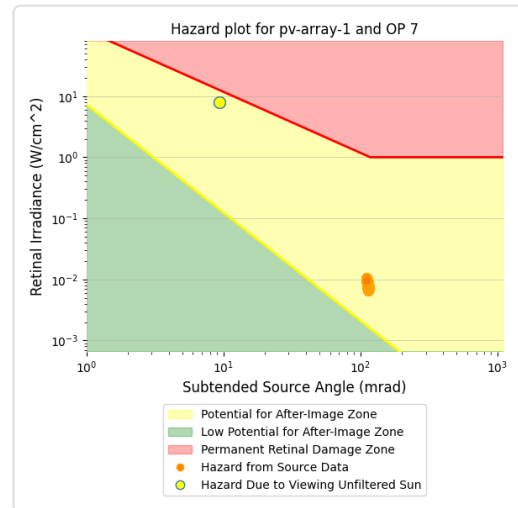
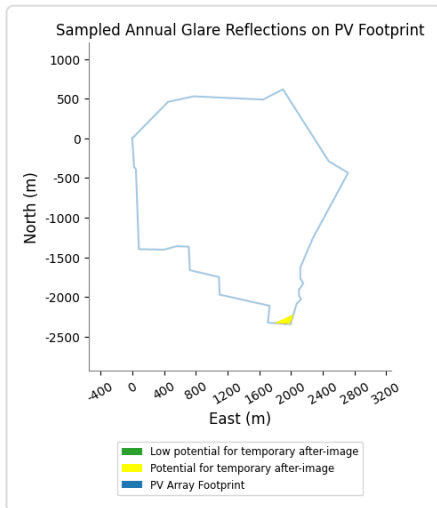
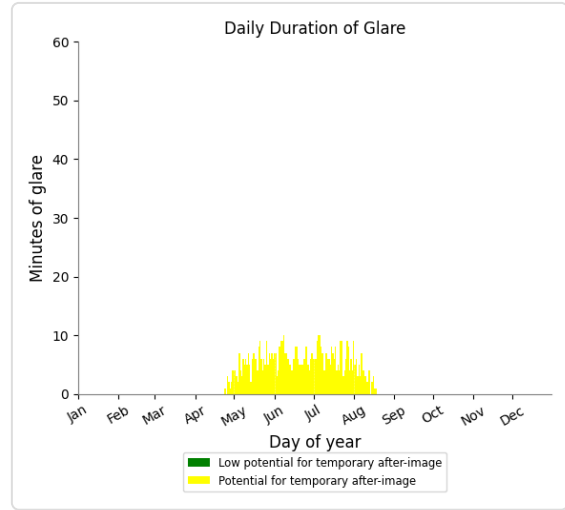
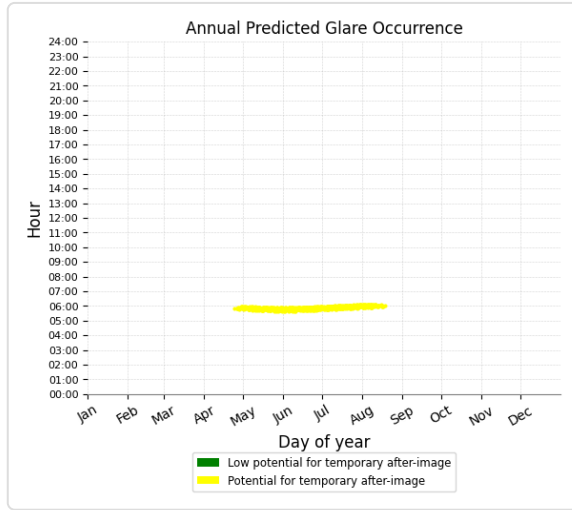


PV array 1 and OP 7

Receptor type: Observation Point

633 minutes of yellow glare

0 minutes of green glare

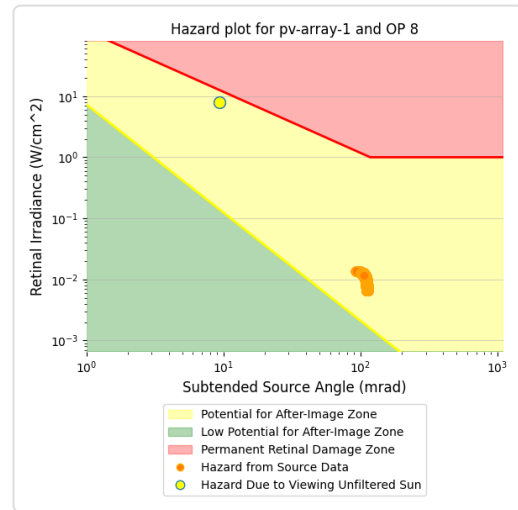
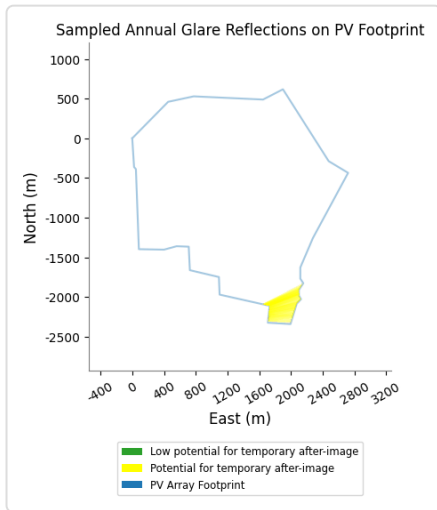
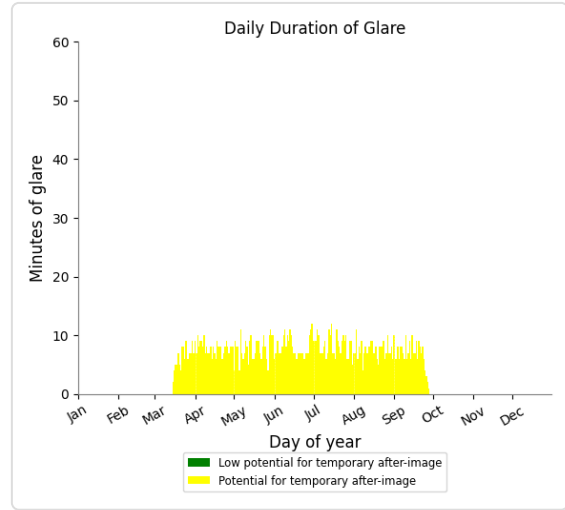
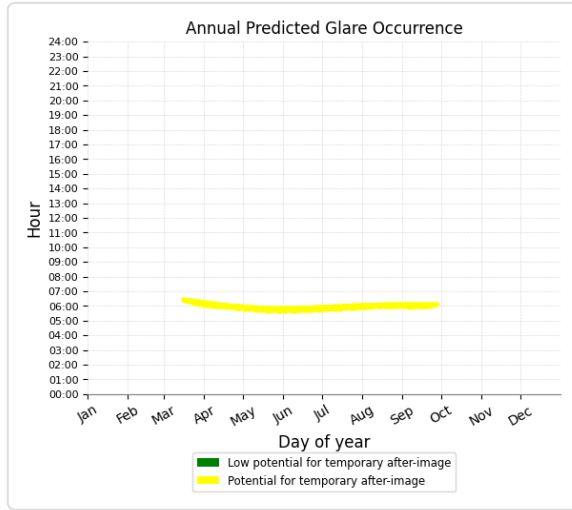


PV array 1 and OP 8

Receptor type: Observation Point

1,508 minutes of yellow glare

0 minutes of green glare

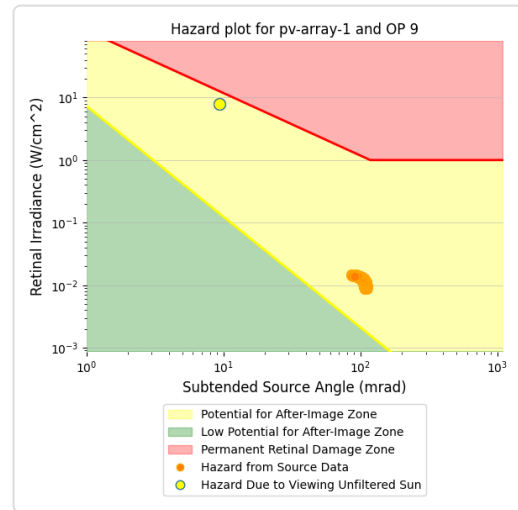
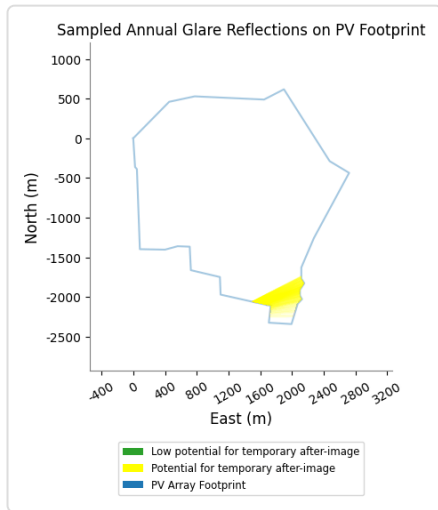
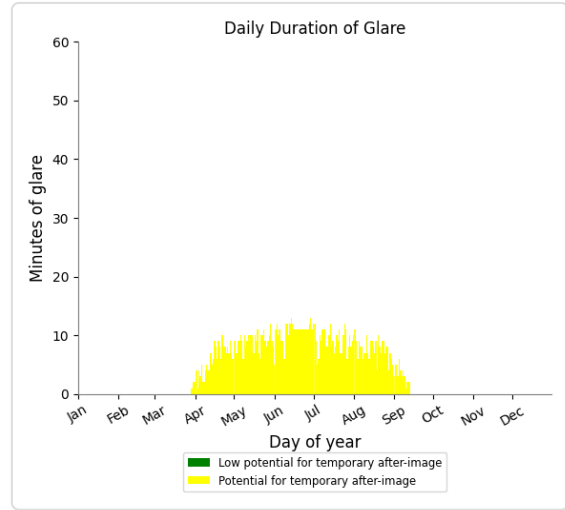
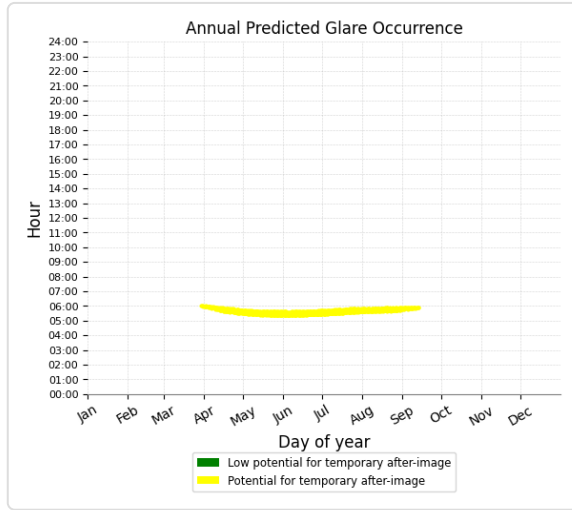


PV array 1 and OP 9

Receptor type: Observation Point

1,341 minutes of yellow glare

0 minutes of green glare

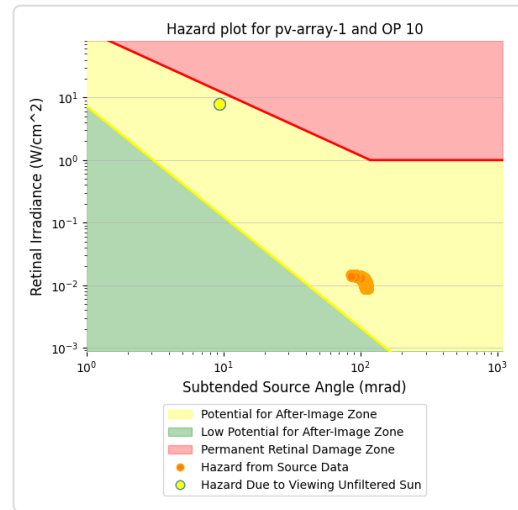
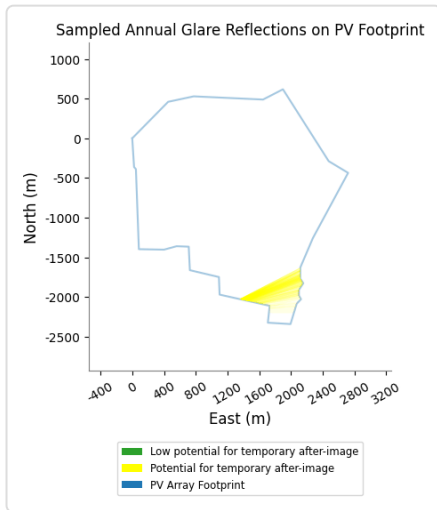
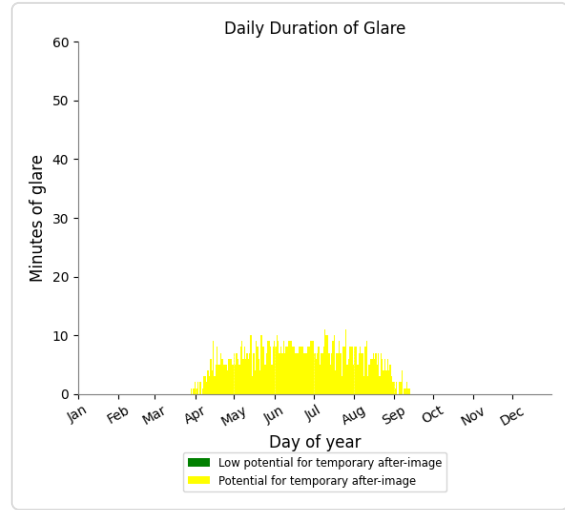
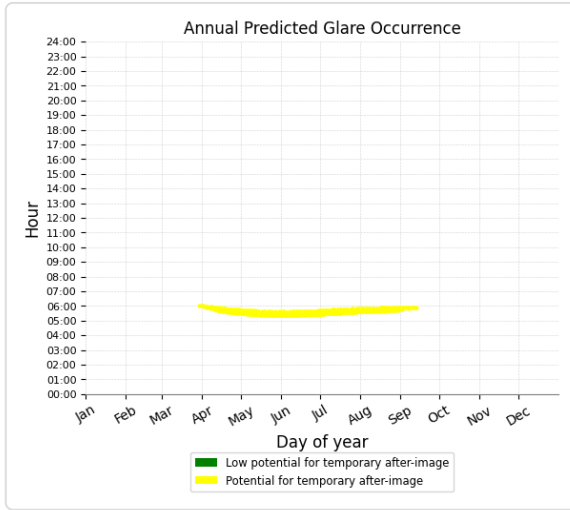


PV array 1 and OP 10

Receptor type: Observation Point

1,009 minutes of yellow glare

0 minutes of green glare

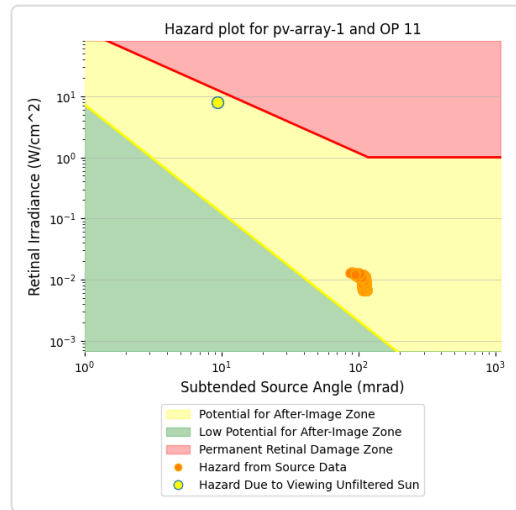
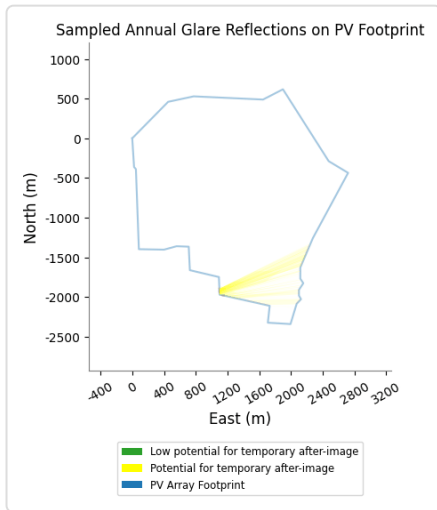
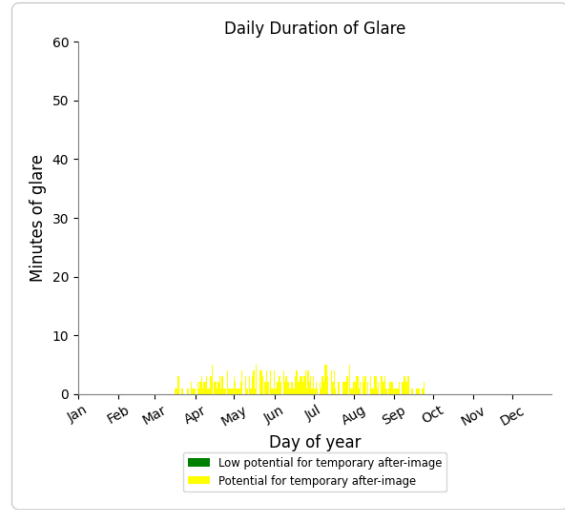
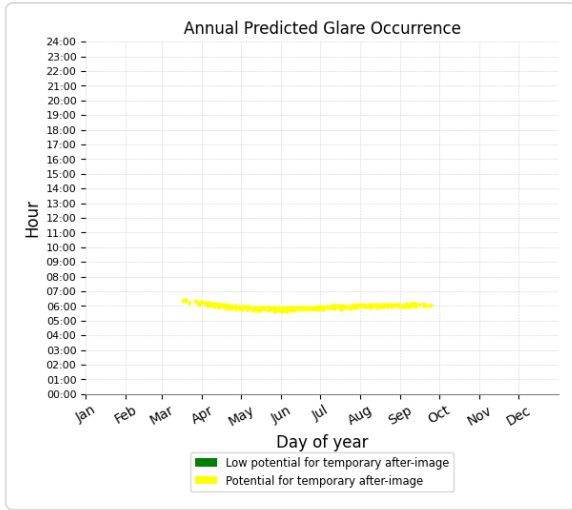


PV array 1 and OP 11

Receptor type: Observation Point

335 minutes of yellow glare

0 minutes of green glare

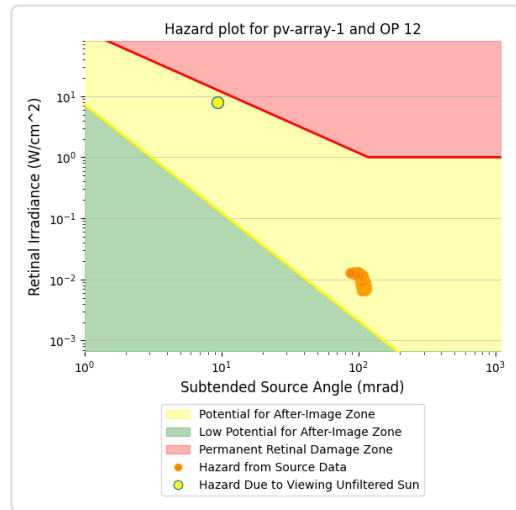
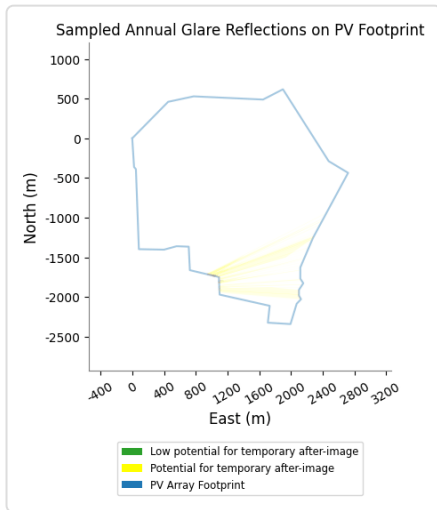
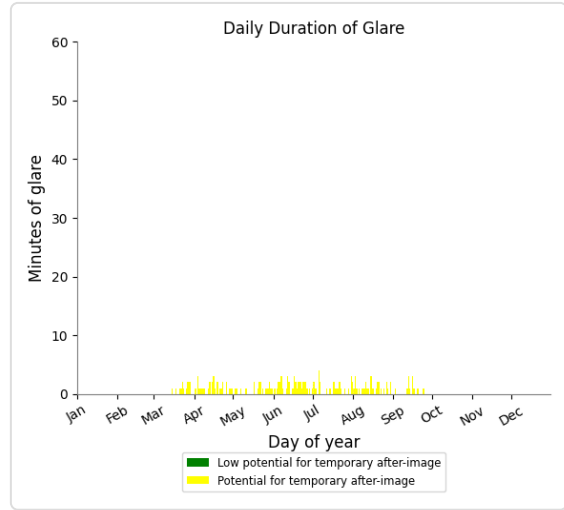
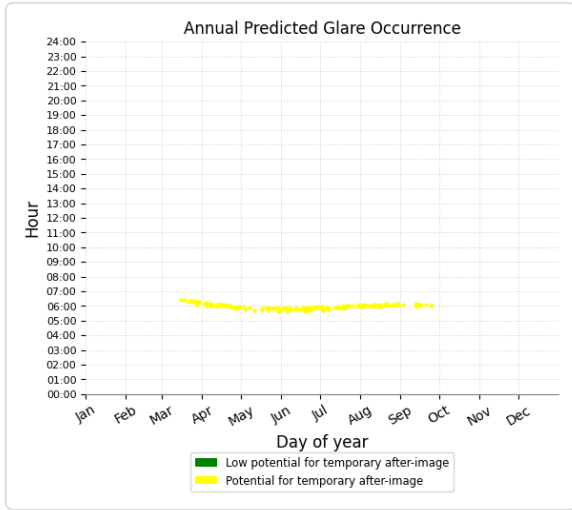


PV array 1 and OP 12

Receptor type: Observation Point

174 minutes of yellow glare

0 minutes of green glare

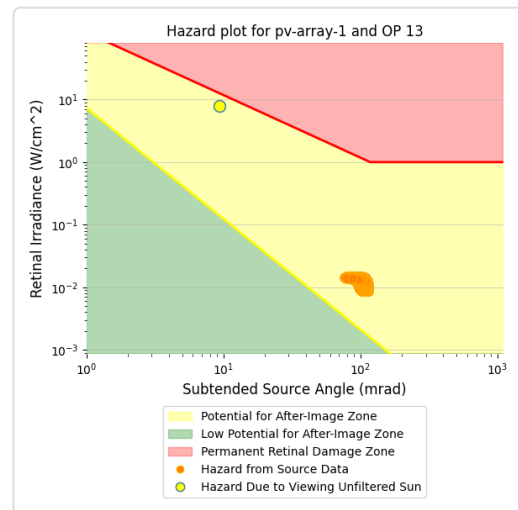
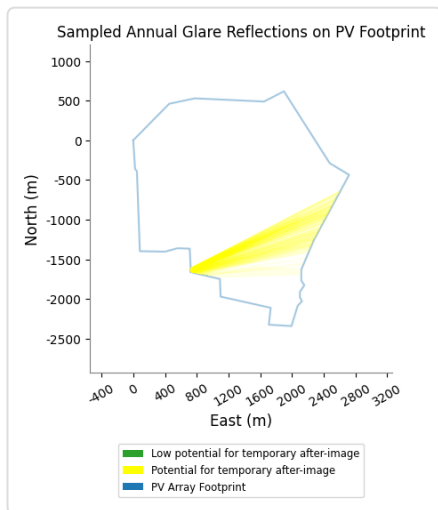
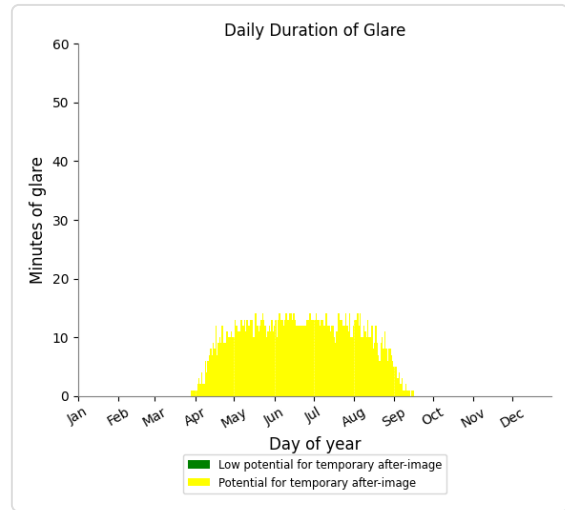
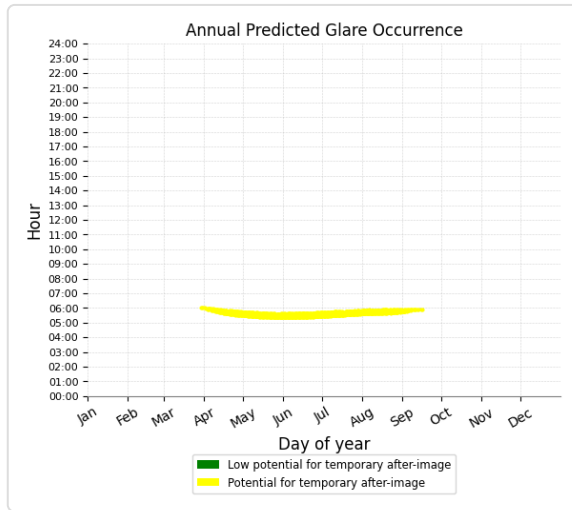


PV array 1 and OP 13

Receptor type: Observation Point

1,698 minutes of yellow glare

0 minutes of green glare

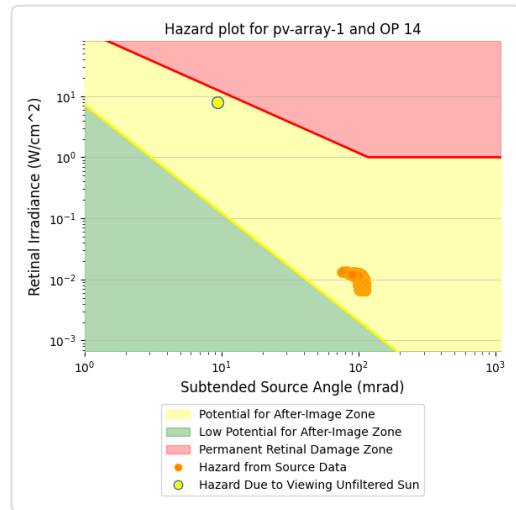
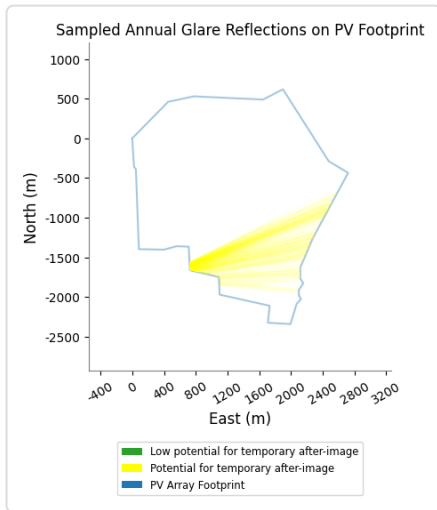
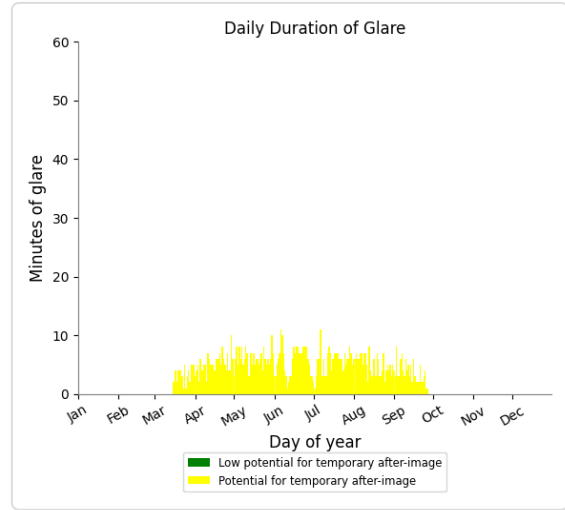
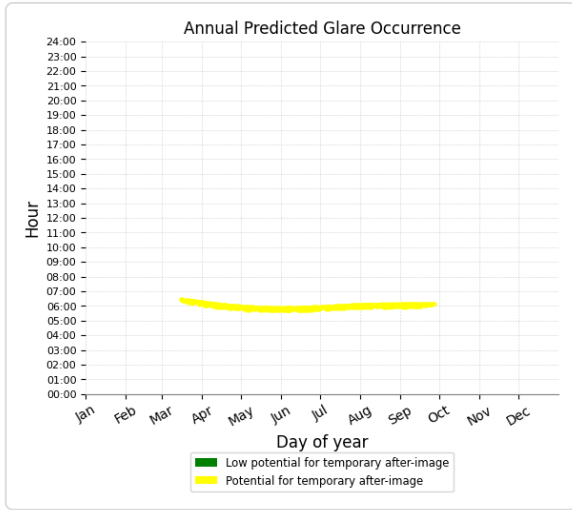


PV array 1 and OP 14

Receptor type: Observation Point

1,013 minutes of yellow glare

0 minutes of green glare

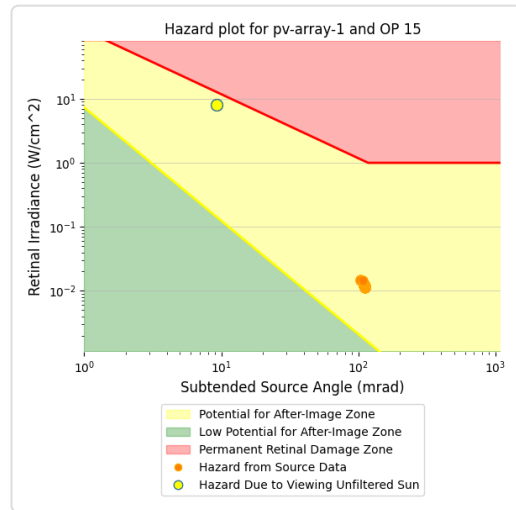
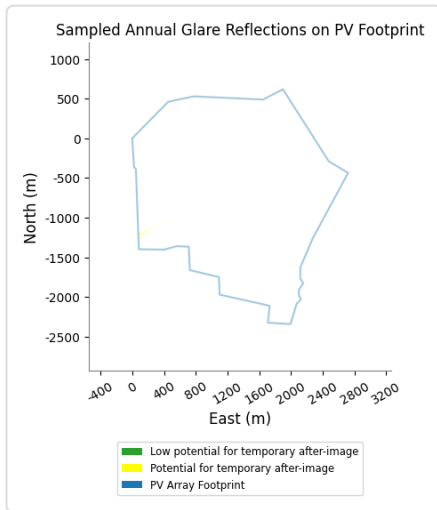
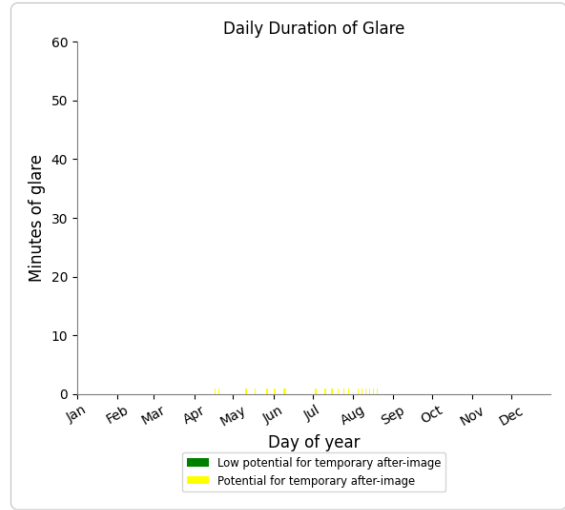
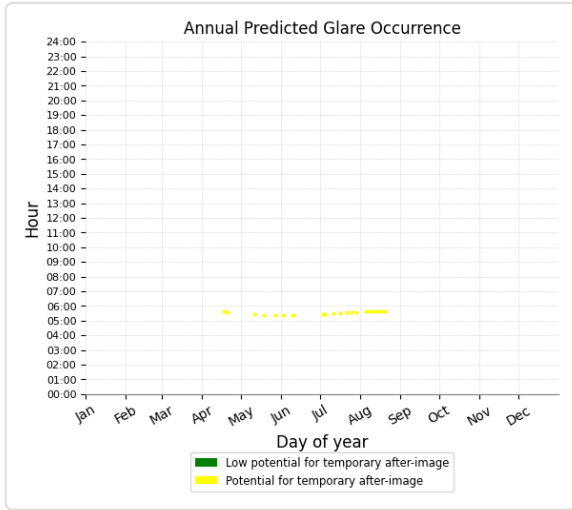


PV array 1 and OP 15

Receptor type: Observation Point

21 minutes of yellow glare

0 minutes of green glare

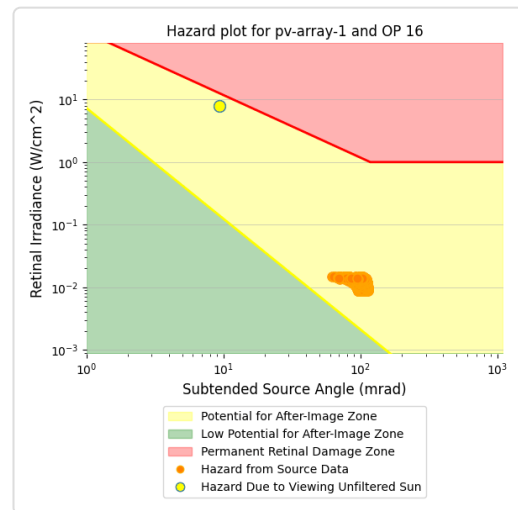
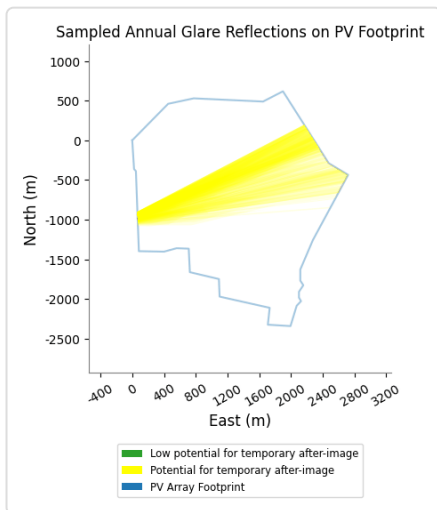
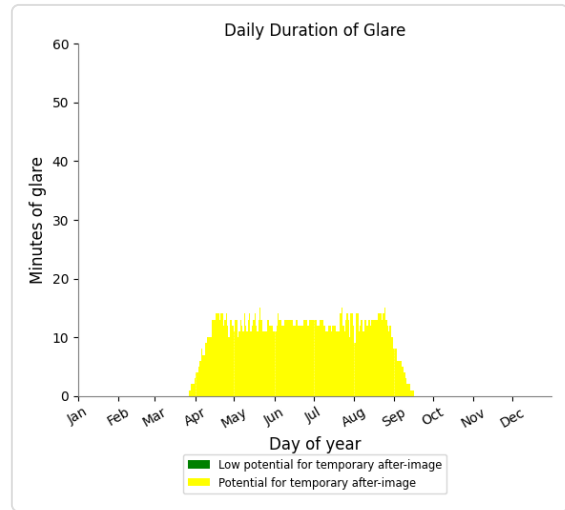
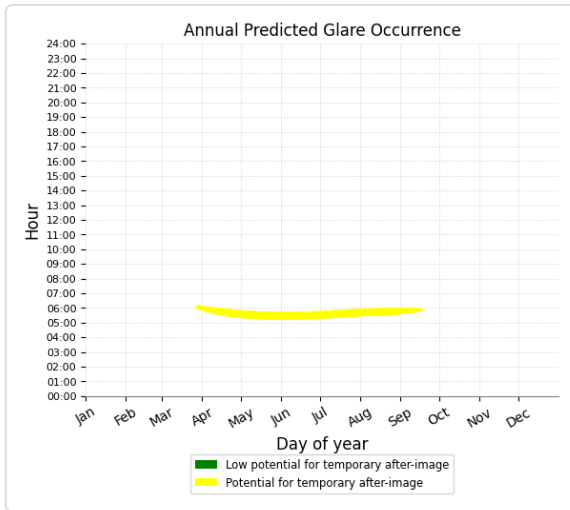


PV array 1 and OP 16

Receptor type: Observation Point

1,908 minutes of yellow glare

0 minutes of green glare

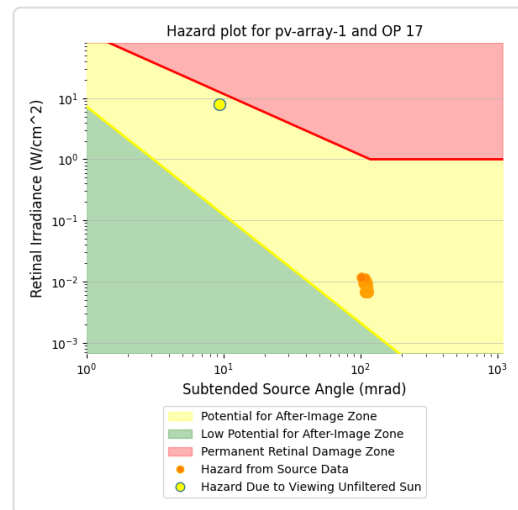
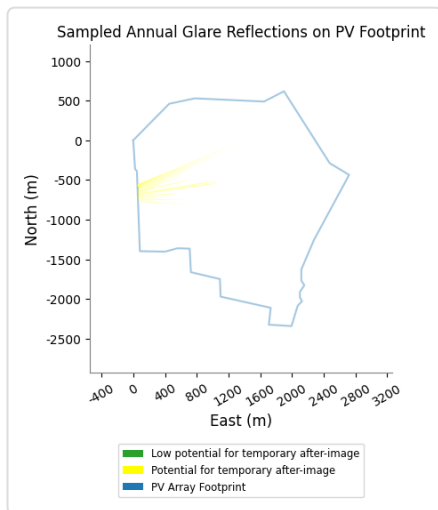
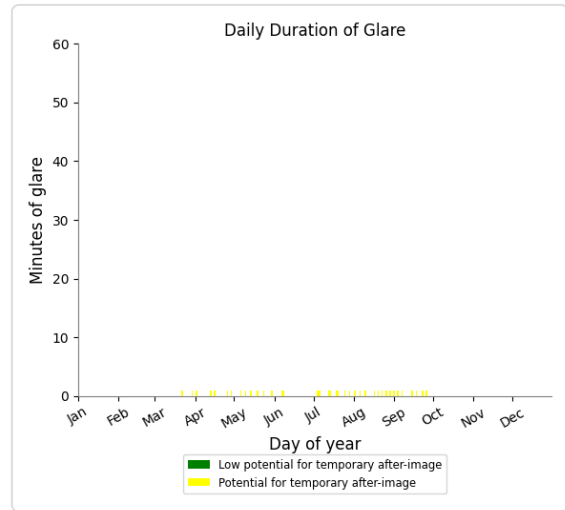
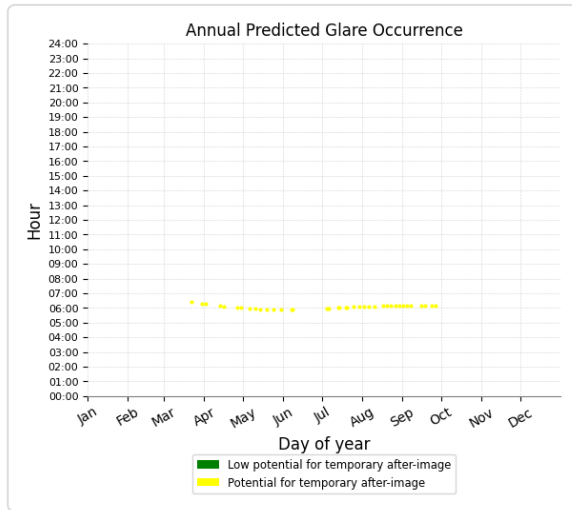


PV array 1 and OP 17

Receptor type: Observation Point

39 minutes of yellow glare

0 minutes of green glare

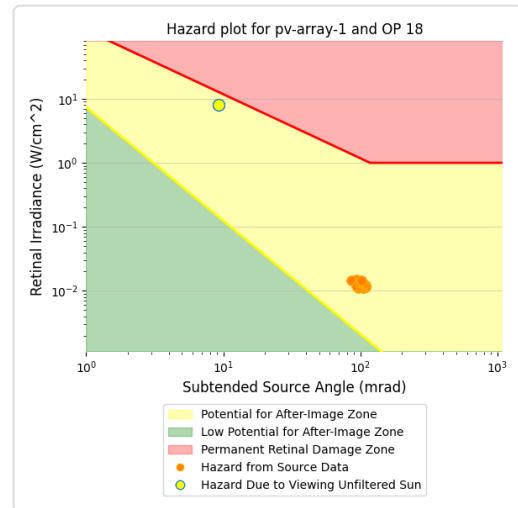
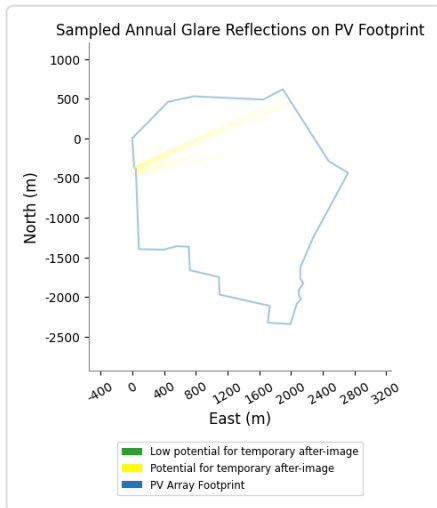
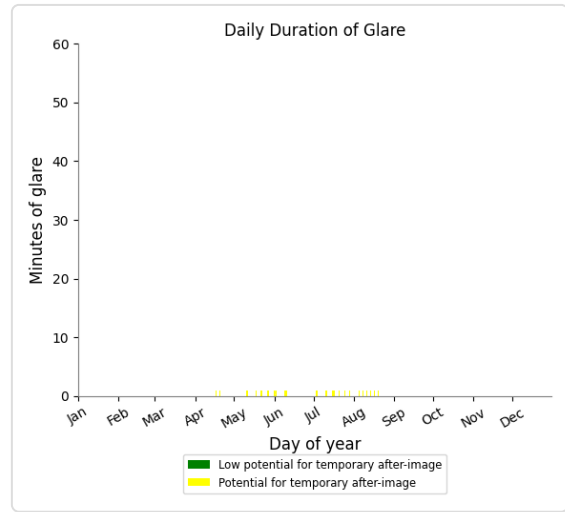
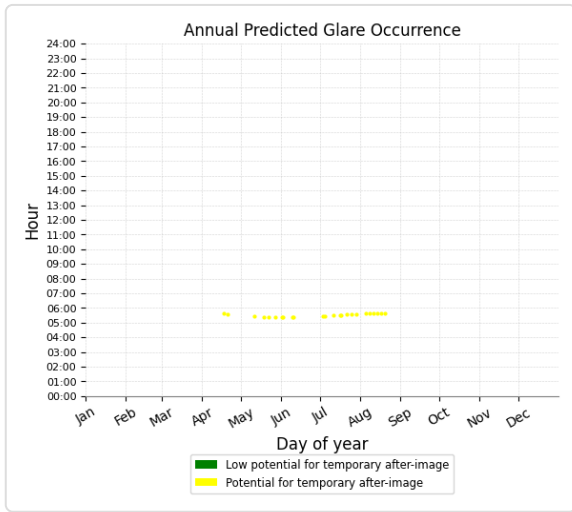


PV array 1 and OP 18

Receptor type: Observation Point

24 minutes of yellow glare

0 minutes of green glare

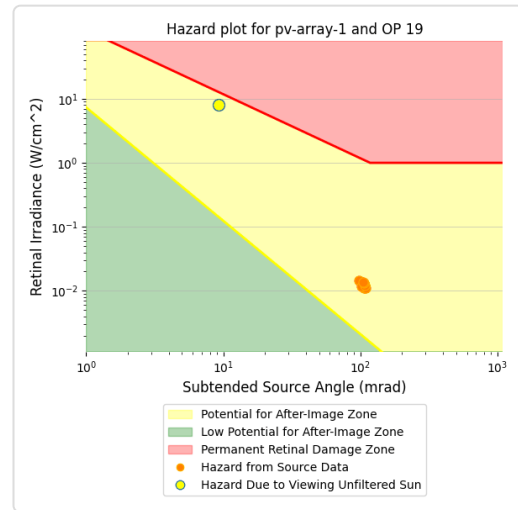
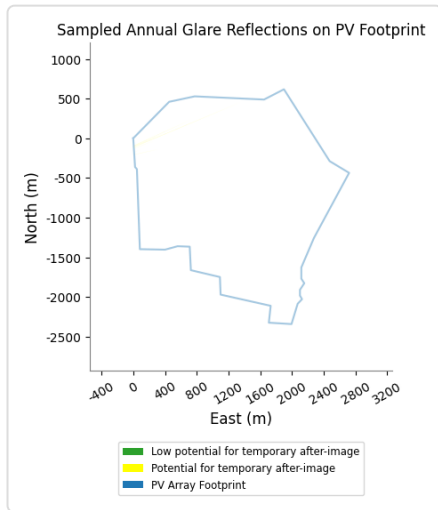
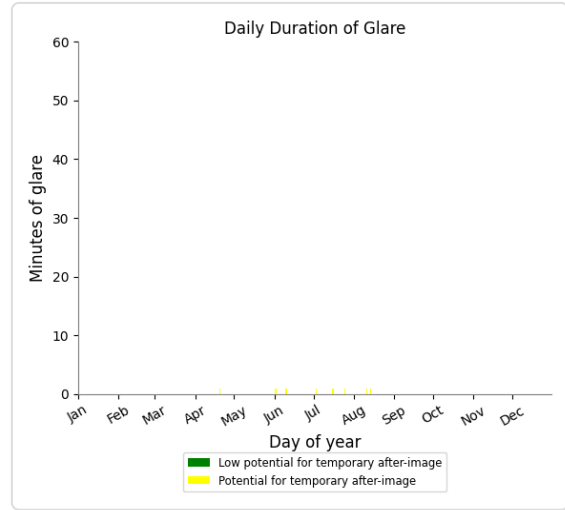
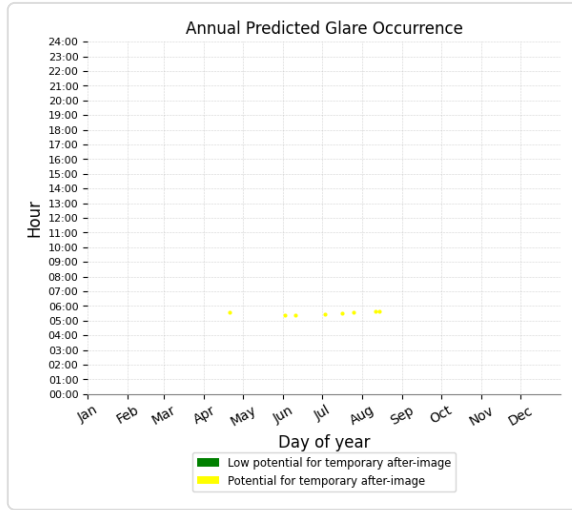


PV array 1 and OP 19

Receptor type: Observation Point

8 minutes of yellow glare

0 minutes of green glare

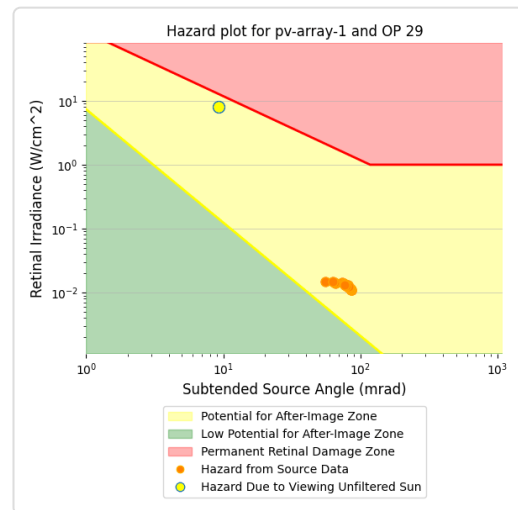
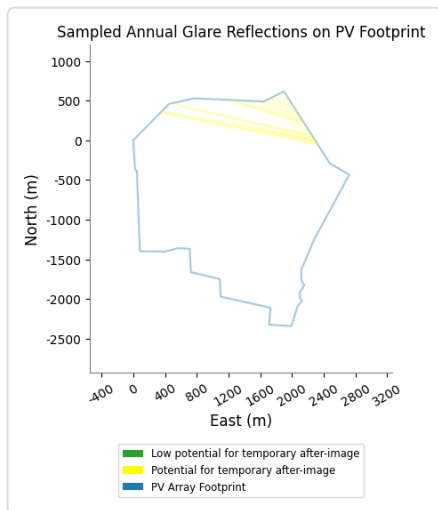
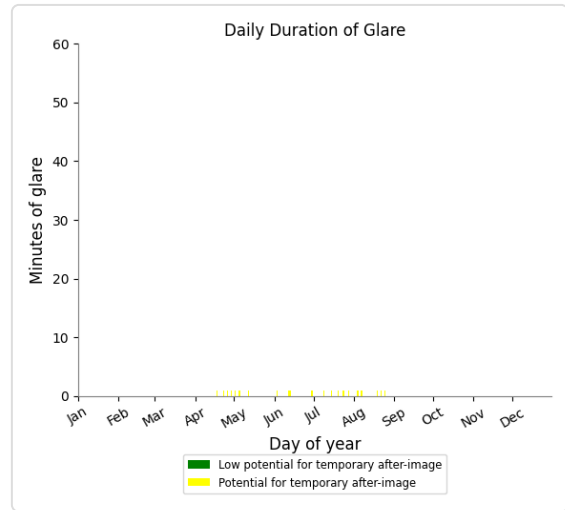
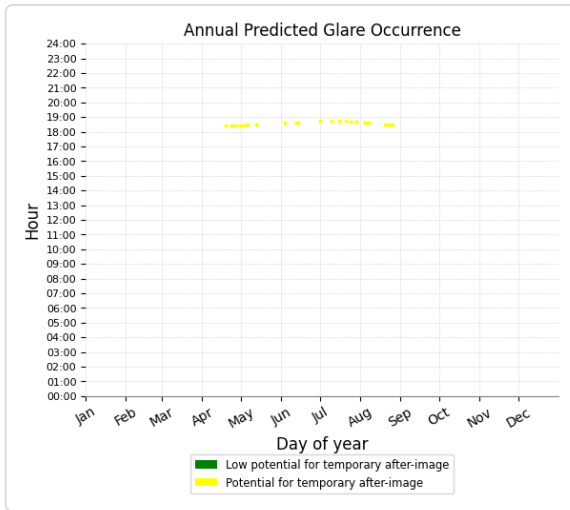


PV array 1 and OP 29

Receptor type: Observation Point

21 minutes of yellow glare

0 minutes of green glare

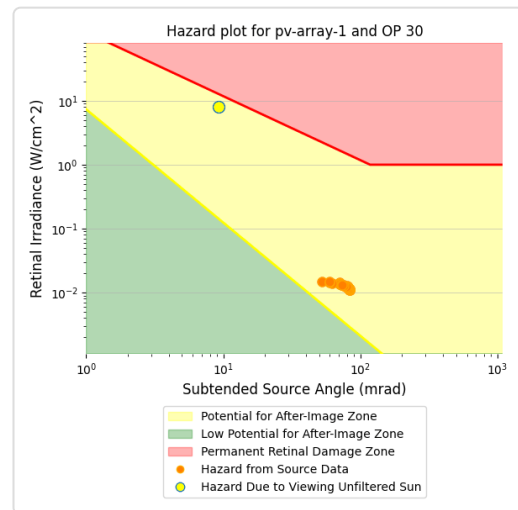
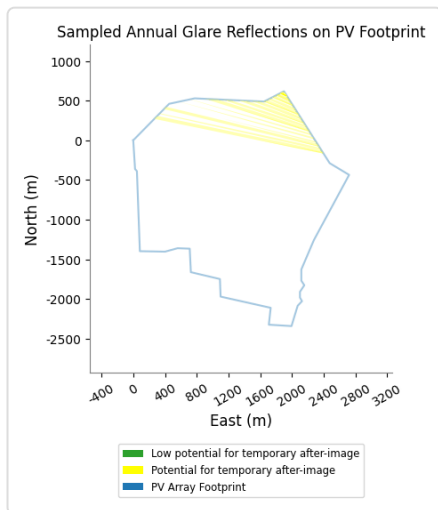
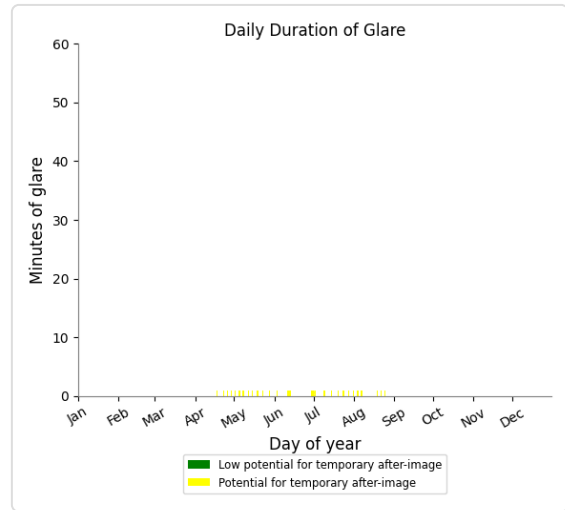
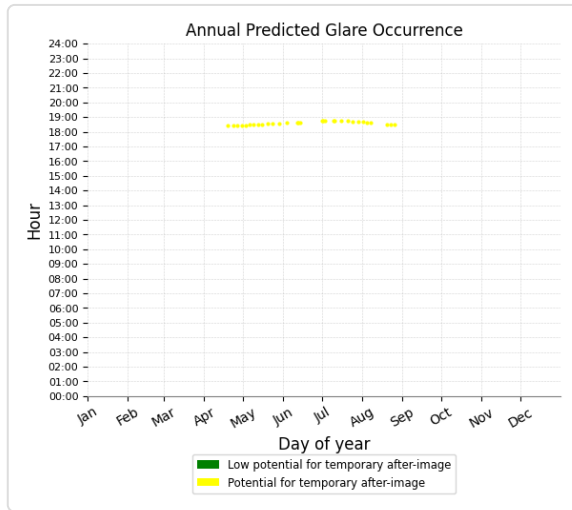


PV array 1 and OP 30

Receptor type: Observation Point

31 minutes of yellow glare

0 minutes of green glare

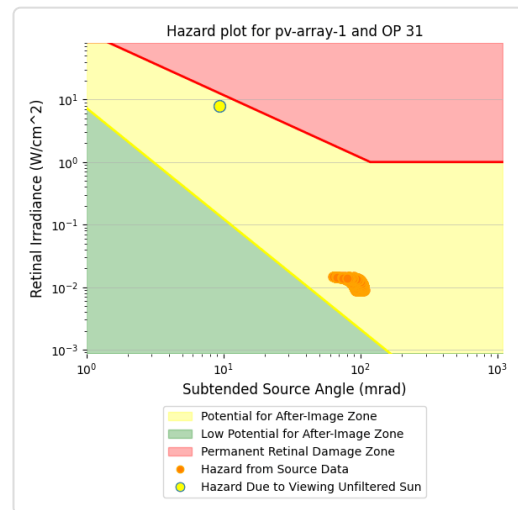
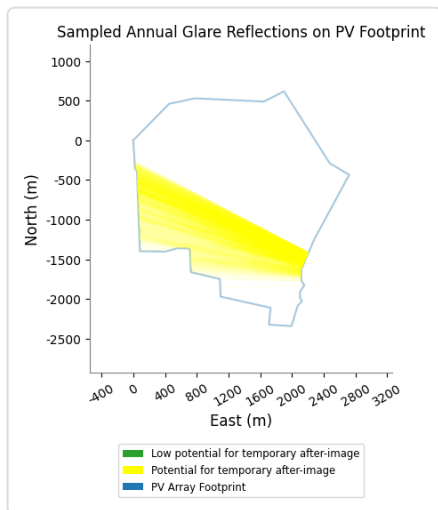
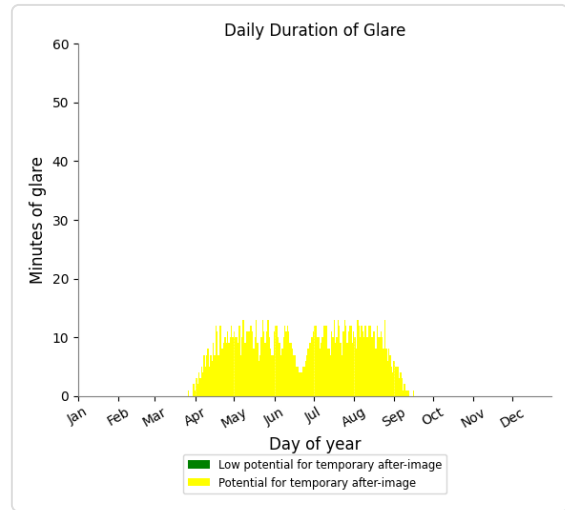
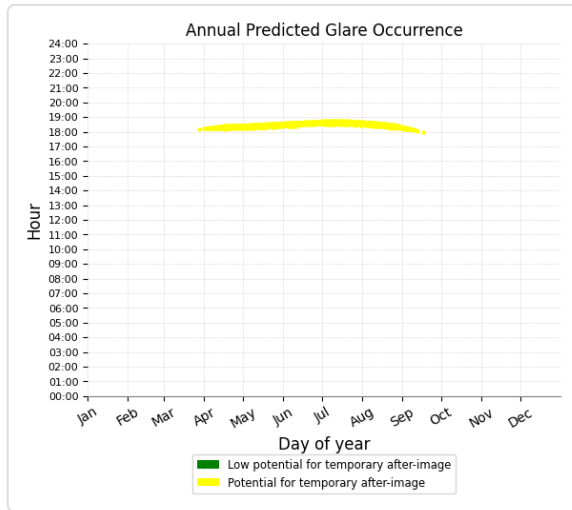


PV array 1 and OP 31

Receptor type: Observation Point

1,449 minutes of yellow glare

0 minutes of green glare

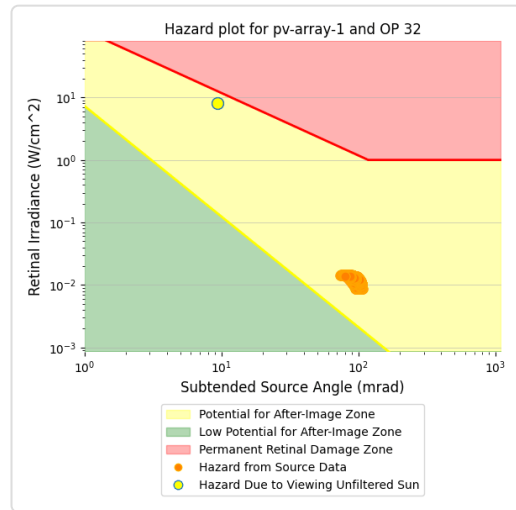
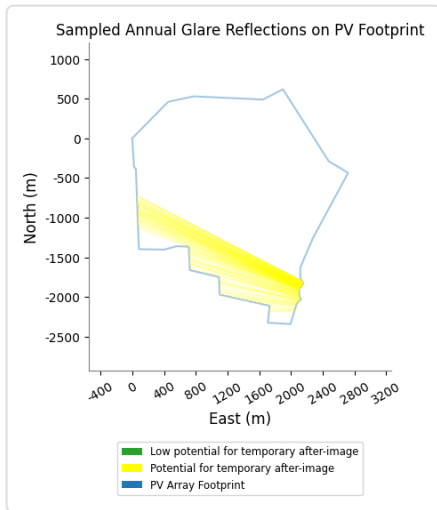
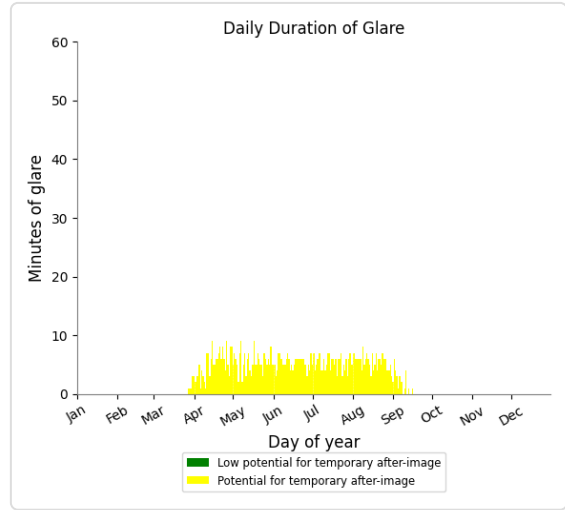
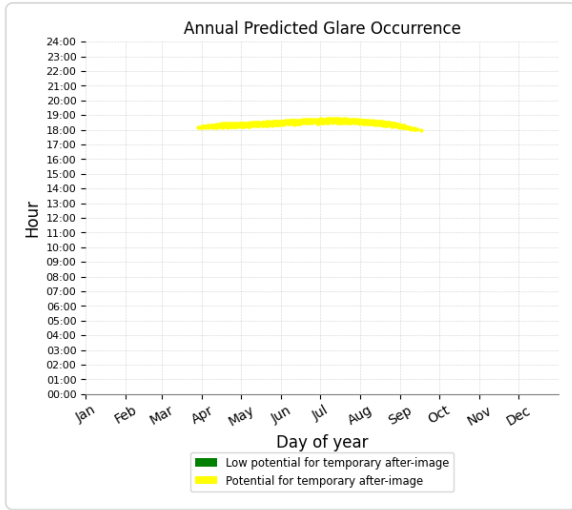


PV array 1 and OP 32

Receptor type: Observation Point

854 minutes of yellow glare

0 minutes of green glare

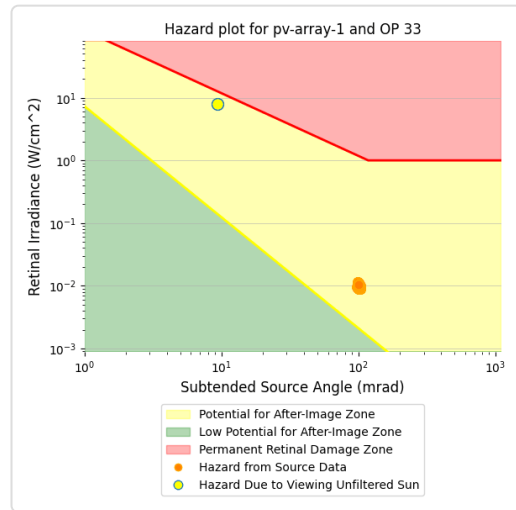
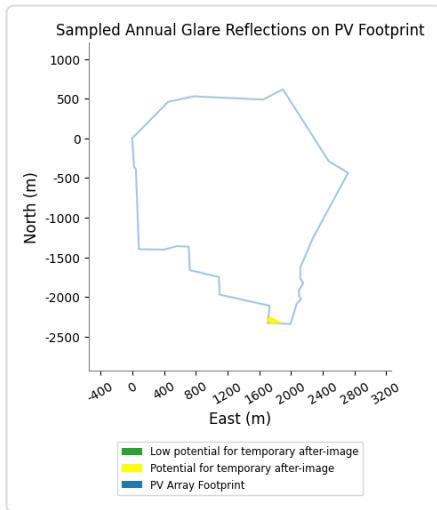
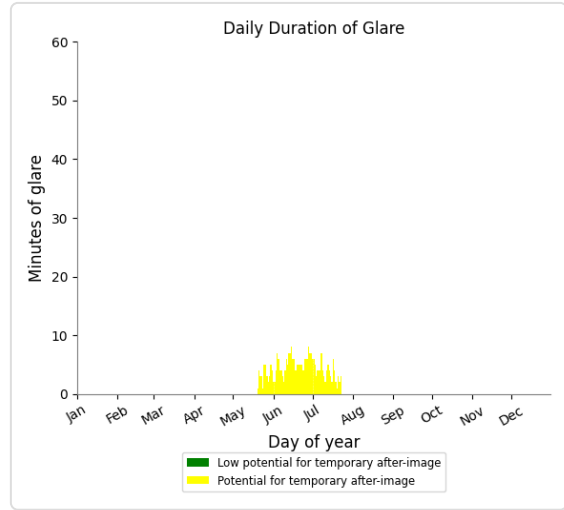
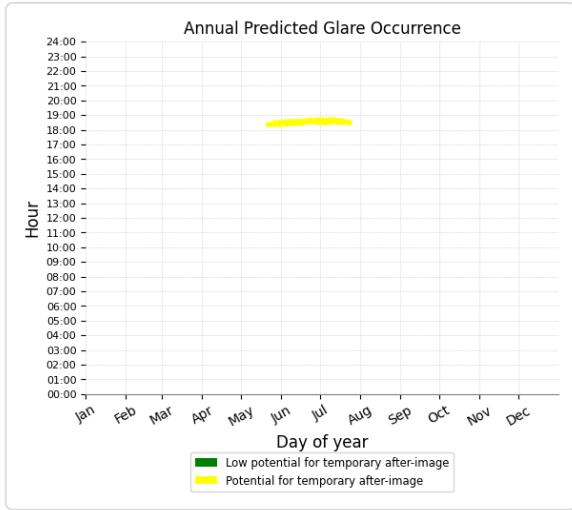


PV array 1 and OP 33

Receptor type: Observation Point

282 minutes of yellow glare

0 minutes of green glare

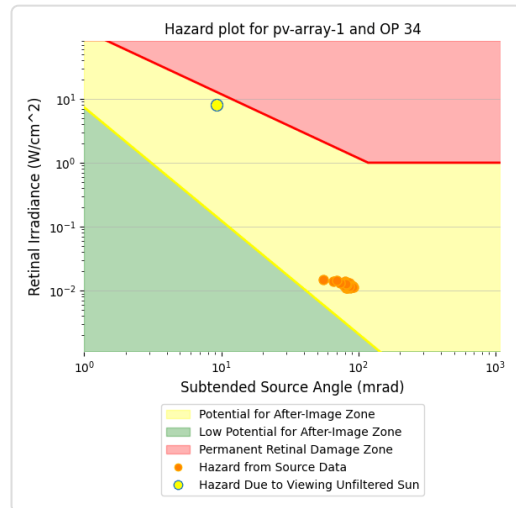
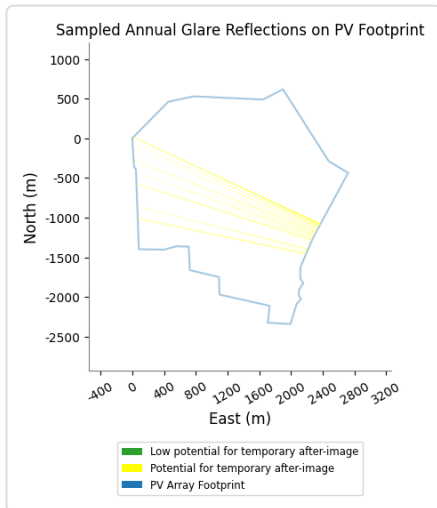
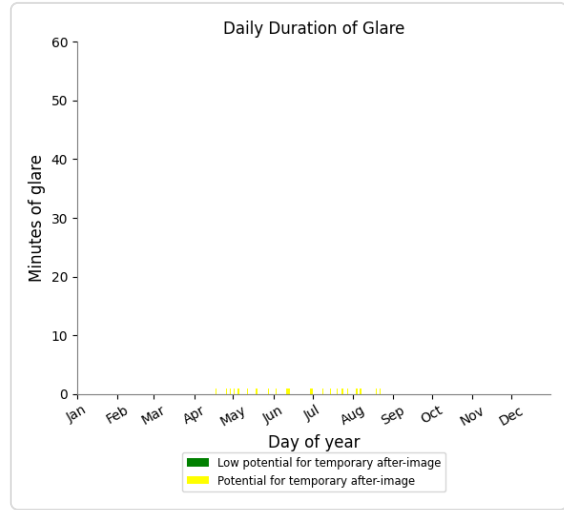
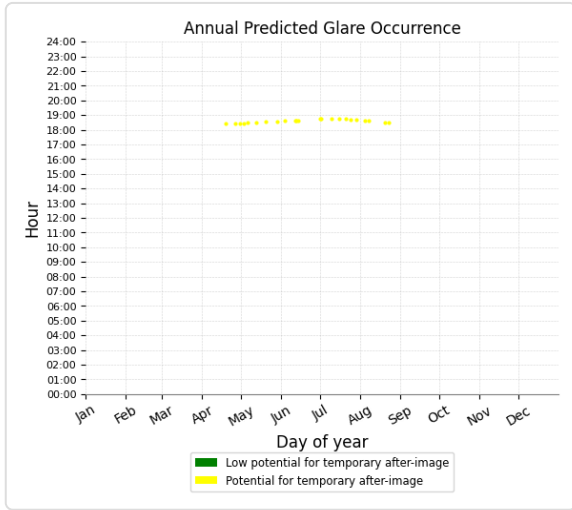


PV array 1 and OP 34

Receptor type: Observation Point

23 minutes of yellow glare

0 minutes of green glare

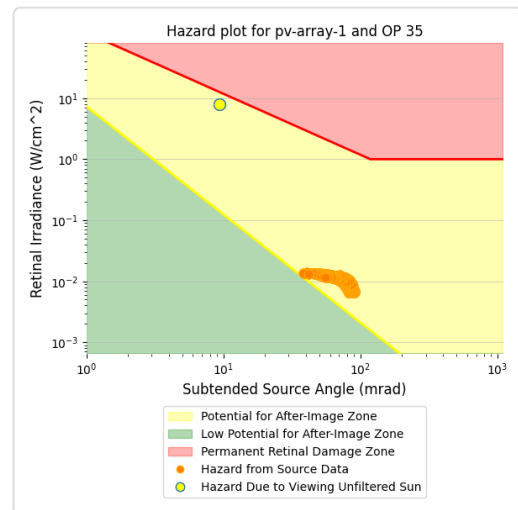
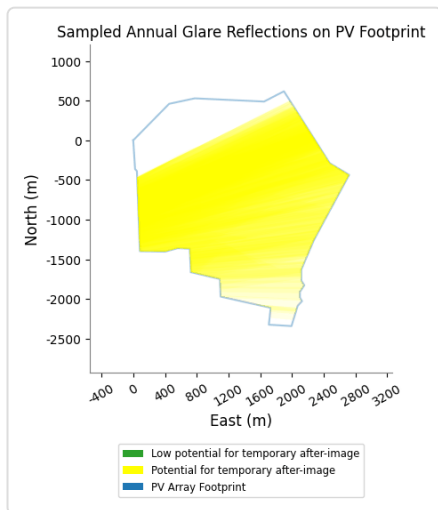
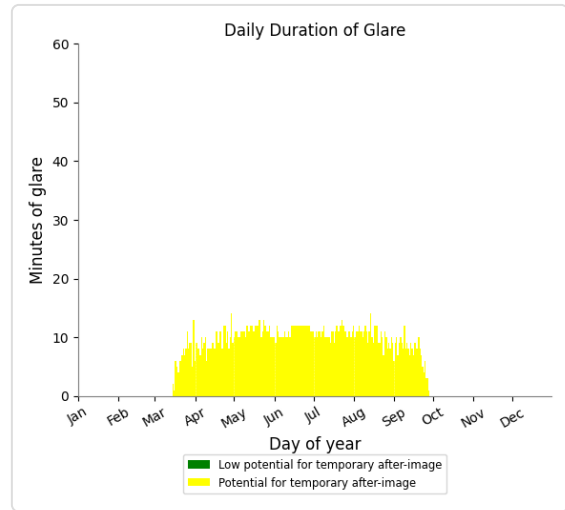
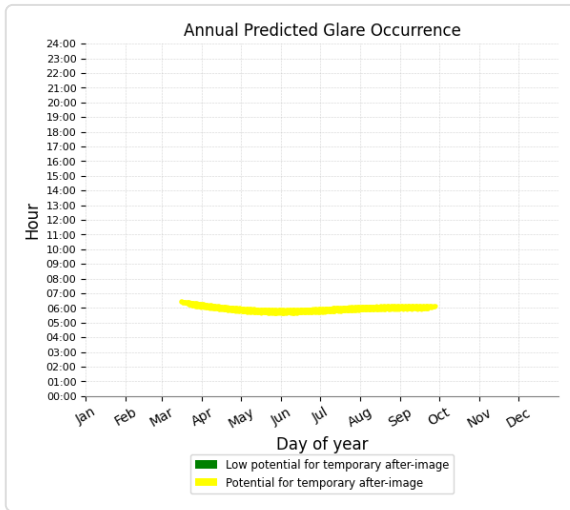


PV array 1 and OP 35

Receptor type: Observation Point

1,939 minutes of yellow glare

0 minutes of green glare

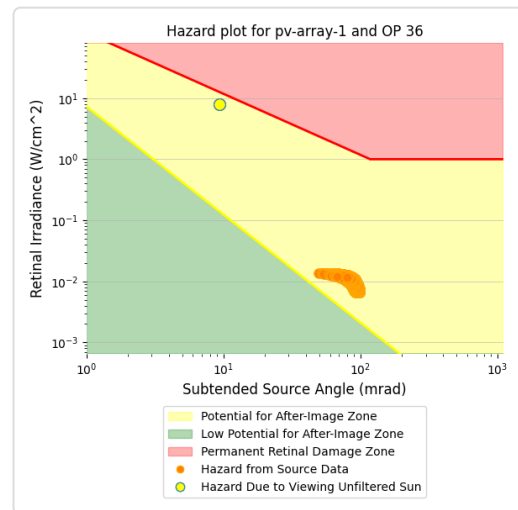
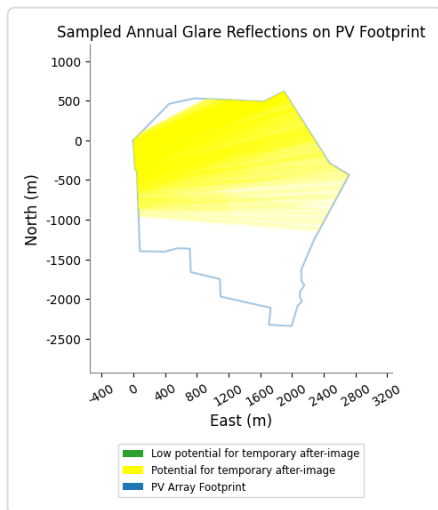
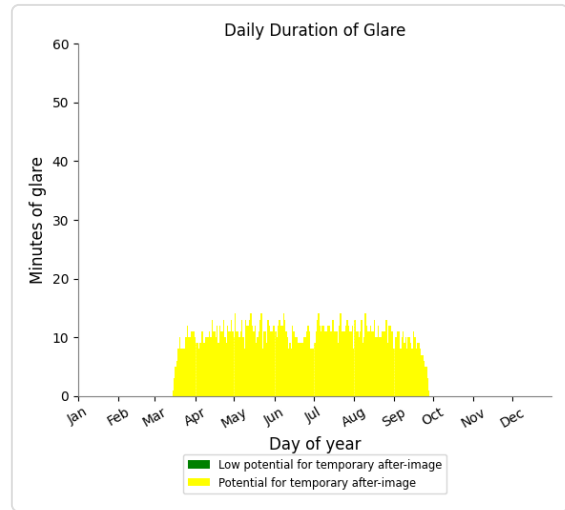
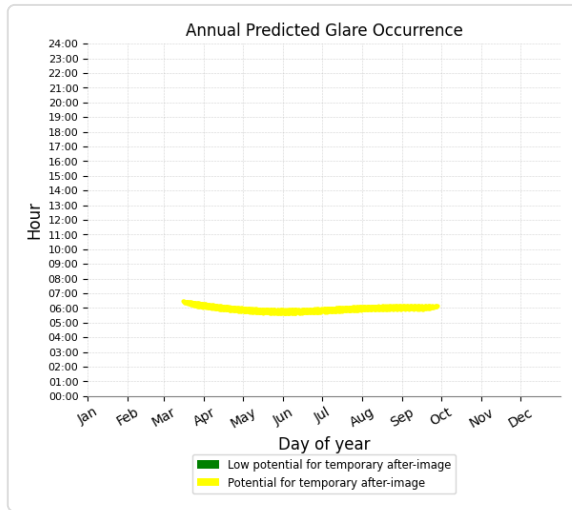


PV array 1 and OP 36

Receptor type: Observation Point

2,053 minutes of yellow glare

0 minutes of green glare

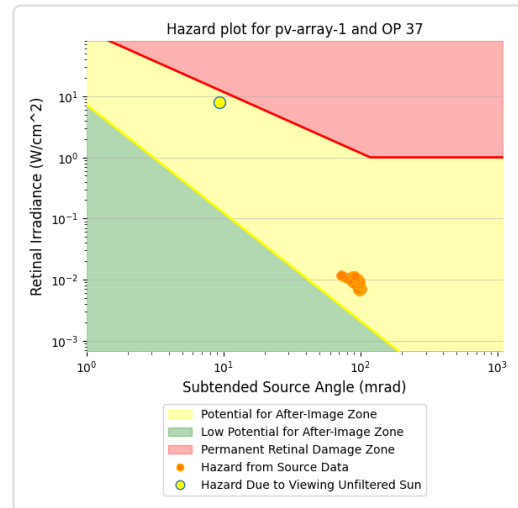
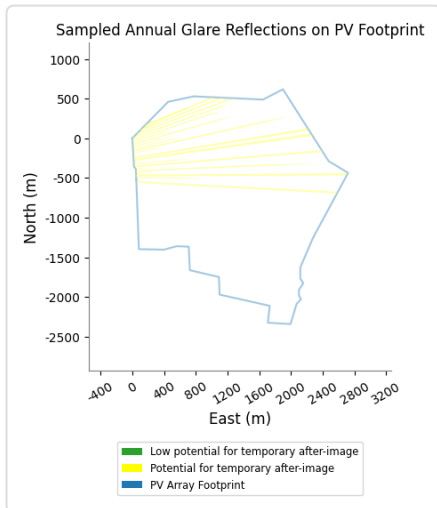
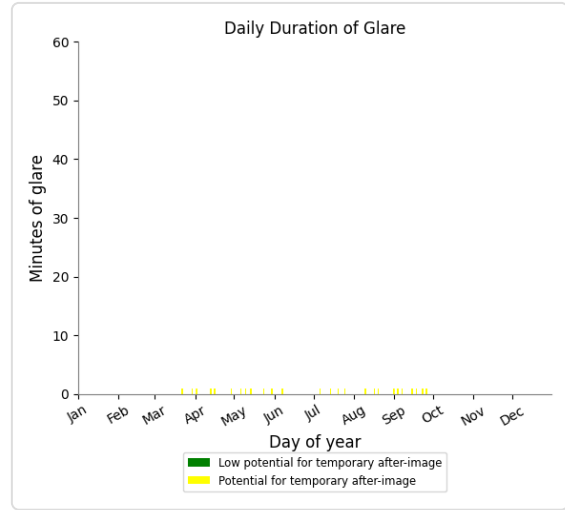
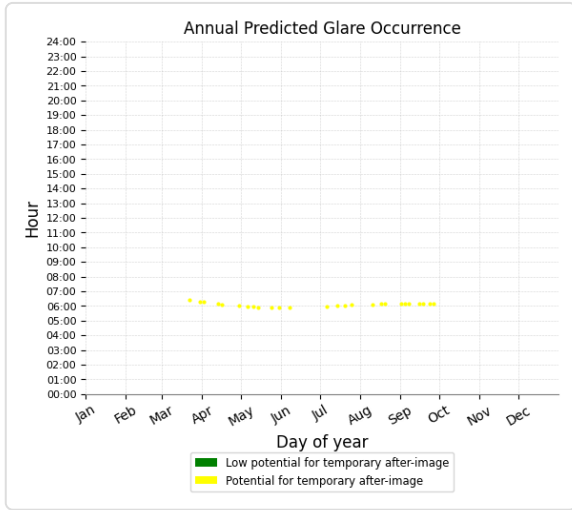


PV array 1 and OP 37

Receptor type: Observation Point

26 minutes of yellow glare

0 minutes of green glare

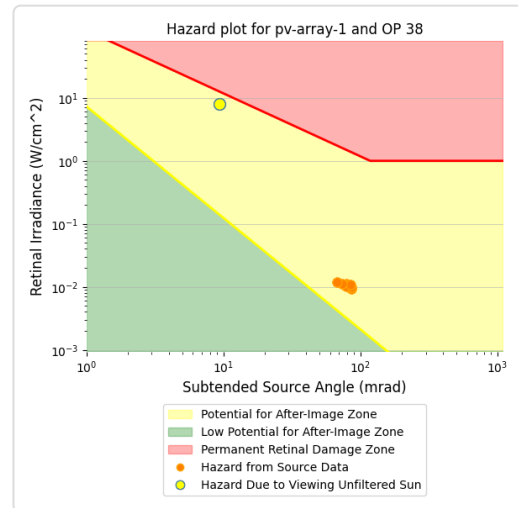
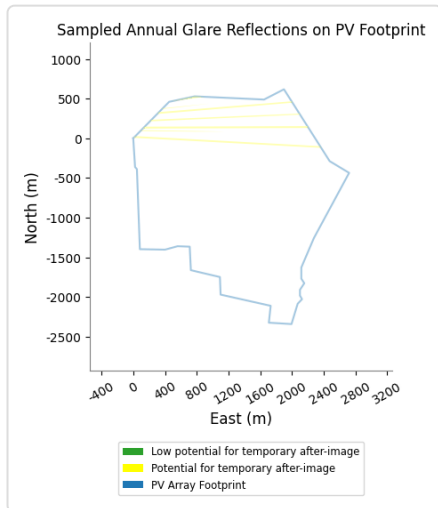
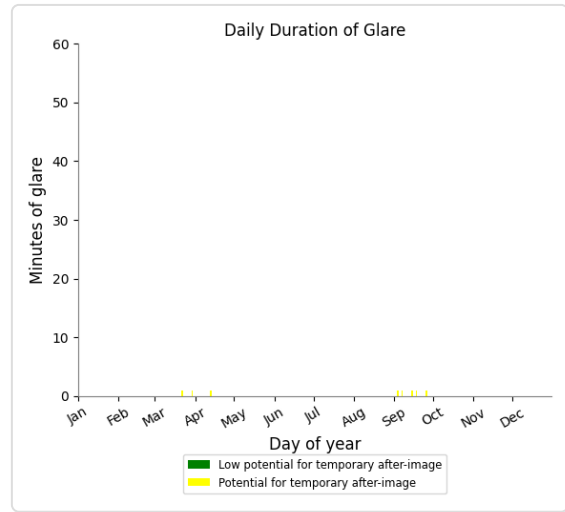
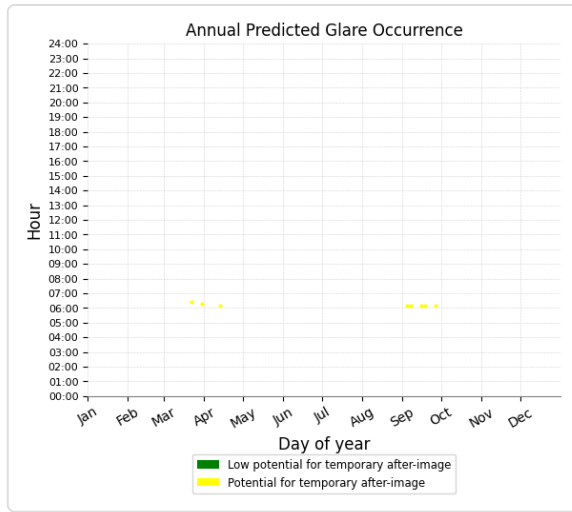


PV array 1 and OP 38

Receptor type: Observation Point

8 minutes of yellow glare

0 minutes of green glare



PV array 1 and OP 1

Receptor type: Observation Point

No glare found

PV array 1 and OP 2

Receptor type: Observation Point

No glare found

PV array 1 and OP 3

Receptor type: Observation Point

No glare found

PV array 1 and OP 4

Receptor type: Observation Point

No glare found

PV array 1 and OP 5

Receptor type: Observation Point

No glare found

PV array 1 and OP 20

Receptor type: Observation Point

No glare found

PV array 1 and OP 21

Receptor type: Observation Point
No glare found

PV array 1 and OP 22

Receptor type: Observation Point
No glare found

PV array 1 and OP 23

Receptor type: Observation Point
No glare found

PV array 1 and OP 24

Receptor type: Observation Point
No glare found

PV array 1 and OP 25

Receptor type: Observation Point
No glare found

PV array 1 and OP 26

Receptor type: Observation Point
No glare found

PV array 1 and OP 27

Receptor type: Observation Point
No glare found

PV array 1 and OP 28

Receptor type: Observation Point
No glare found

PV array 1 and OP 39

Receptor type: Observation Point
No glare found

PV array 1 and OP 40

Receptor type: Observation Point
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 [\[REDACTED\]](#) 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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