FORGESOLAR GLARE ANALYSIS

Project: **Fútaklettur EV**

Sólorka á smoltstøðina hjá Hiddenfjord á Fútakletti- eystur/vestur síður.

Site configuration: **Futaklettur-4**

Created 01 Dec, 2022
Updated 10 Jan, 2023
Time-step 1 minute
Timezone offset UTC0
Site ID 80388.14035
Category 500 kW to 1 MW
(1,000 kW / 32,400 m^2 limit)
DNI peaks at 1,000.0 W/m^2
Ocular transmission coefficient 0.5
Pupil diameter 0.002 m
Eye focal length 0.017 m
Sun subtended angle 9.3 mrad
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
D-sudur	15.0	202.0	1,683	28.1	1,109	18.5	-
EF-vestur	15.0	292.0	12,313	205.2	0	0.0	-
RV-sudur	15.0	202.0	2,434	40.6	0	0.0	-

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
Vegur 1	3,754	62.6	0	0.0
Vegur 2	6,533	108.9	0	0.0
Vegur 3	6,143	102.4	1,109	18.5
Vegur 4	0	0.0	0	0.0

Component Data

PV Arrays

Name: D-sudur
Axis tracking: Fixed (no rotation)
Tilt: 15.0°
Orientation: 202.0°
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	62.099207	-7.139743	70.00	9.00	79.00
2	62.098878	-7.138778	70.00	9.00	79.00
3	62.098817	-7.138869	70.00	7.00	77.00
4	62.099156	-7.139824	70.00	7.00	77.00

Name: EF-vestur
Axis tracking: Fixed (no rotation)
Tilt: 15.0°
Orientation: 292.0°
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	62.099537	-7.138330	55.00	6.00	61.00
2	62.099325	-7.138654	55.00	6.00	61.00
3	62.099358	-7.138762	55.00	5.00	60.00
4	62.099565	-7.138421	55.00	5.00	60.00

Name: RV-sudur
Axis tracking: Fixed (no rotation)
Tilt: 15.0°
Orientation: 202.0°
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	62.098807	-7.138489	70.00	9.00	79.00
2	62.098682	-7.137896	70.00	9.00	79.00
3	62.098604	-7.137971	70.00	7.00	77.00
4	62.098731	-7.138545	70.00	7.00	77.00

Route Receptors

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

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	62.100850	-7.140186	54.75	0.00	54.75
2	62.101171	-7.141773	63.58	0.00	63.58

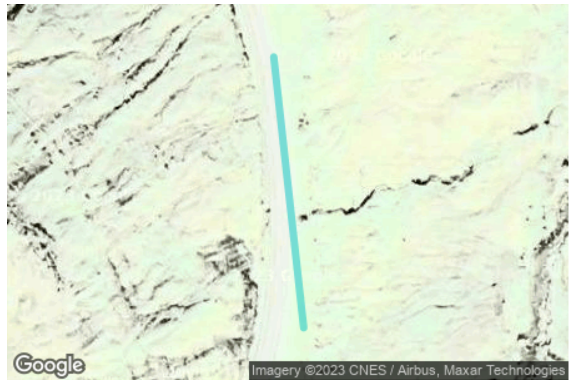
Name: Vegur 2
Path type: Two-way
Observer view angle: 50.0°

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	62.101257	-7.141913	64.83	0.00	64.83
2	62.102396	-7.143190	64.39	0.00	64.39
3	62.102135	-7.144295	82.45	0.00	82.45
4	62.101457	-7.143286	78.91	0.00	78.91
5	62.100157	-7.142664	85.38	0.00	85.38

Name: Vegur 3
Path type: Two-way
Observer view angle: 50.0°

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	62.099978	-7.142528	84.95	0.00	84.95
2	62.098863	-7.141326	90.05	0.00	90.05

Name: Vegur 4
Path type: Two-way
Observer view angle: 50.0°



Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	62.097734	-7.140155	82.40	0.00	82.40
2	62.096649	-7.139898	88.58	0.00	88.58

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
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RV-sudur	15.0	202.0	2,434	40.6	0	0.0	-

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
Vegur 1	3,754	62.6	0	0.0
Vegur 2	6,533	108.9	0	0.0
Vegur 3	6,143	102.4	1,109	18.5
Vegur 4	0	0.0	0	0.0

PV: D-sudur potential temporary after-image

Receptor results ordered by category of glare

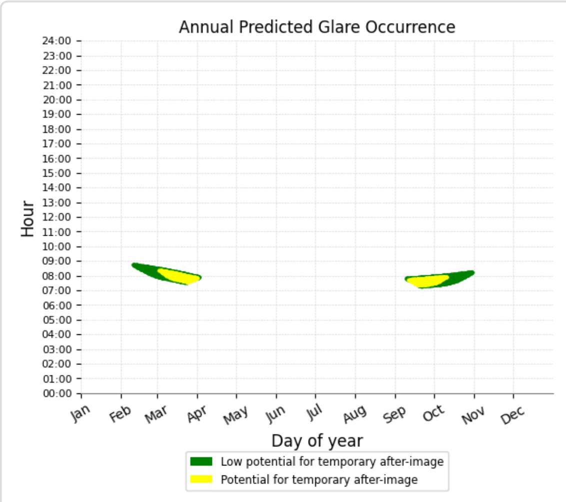
Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
Vegur 3	1,683	28.1	1,109	18.5
Vegur 1	0	0.0	0	0.0
Vegur 2	0	0.0	0	0.0
Vegur 4	0	0.0	0	0.0

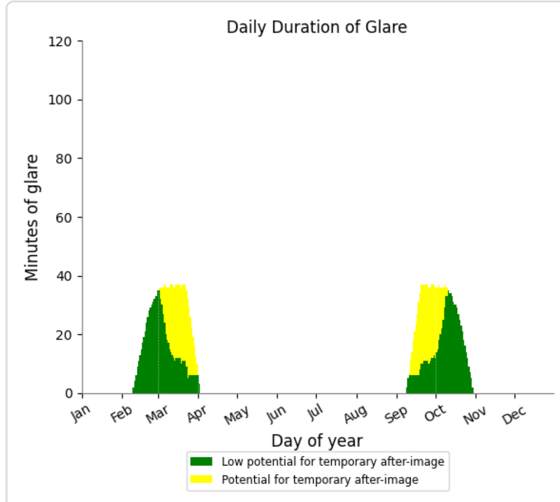
D-sudur and Vegur 3

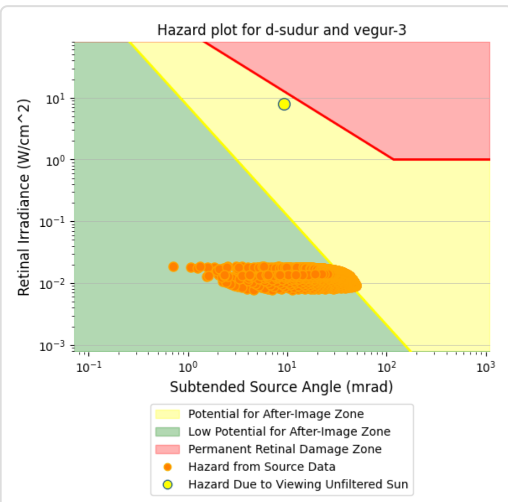
Receptor type: Route

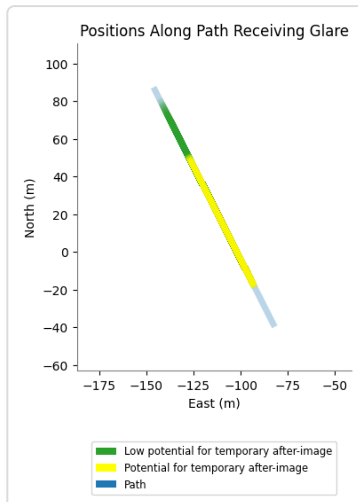
1,109 minutes of yellow glare

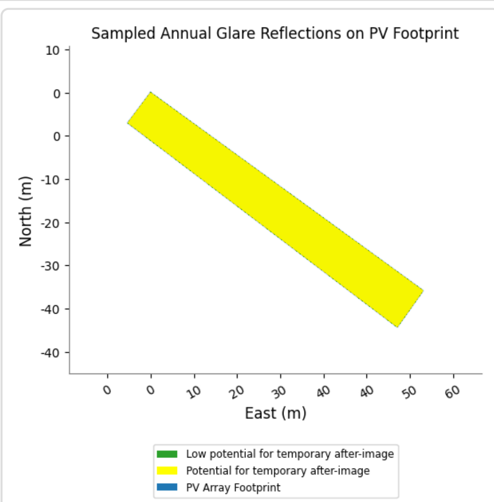
1,683 minutes of green glare











D-sudur and Vegur 1

Receptor type: Route

No glare found

D-sudur and Vegur 2

Receptor type: Route

No glare found

D-sudur and Vegur 4

Receptor type: Route

No glare found

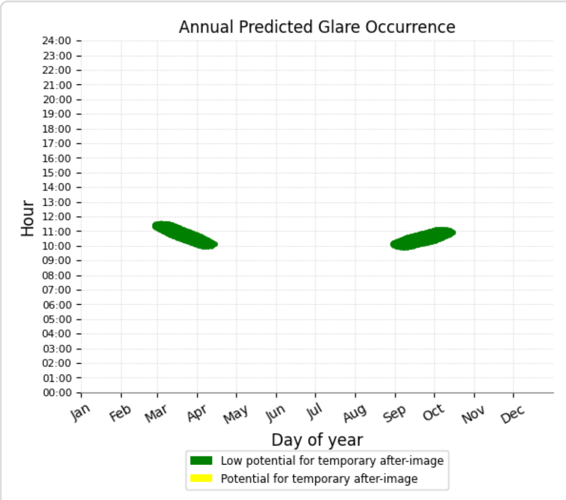
PV: EF-vestur low potential for temporary after-image

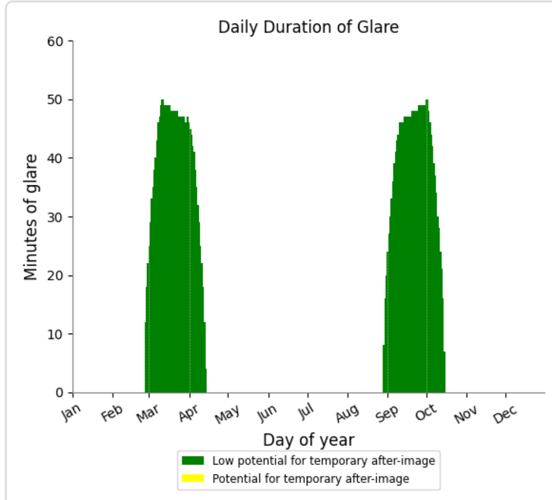
Receptor results ordered by category of glare

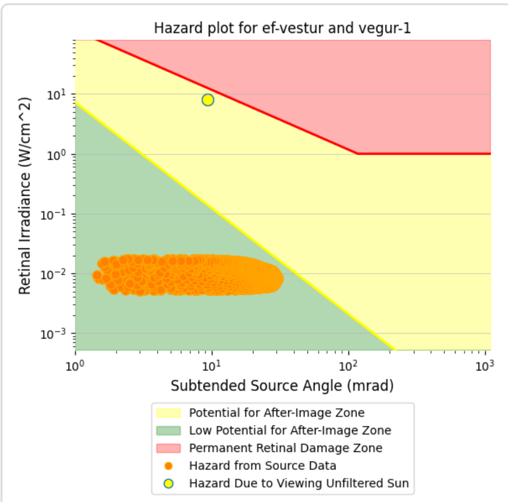
Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
Vegur 1	3,754	62.6	0	0.0
Vegur 2	6,533	108.9	0	0.0
Vegur 3	2,026	33.8	0	0.0
Vegur 4	0	0.0	0	0.0

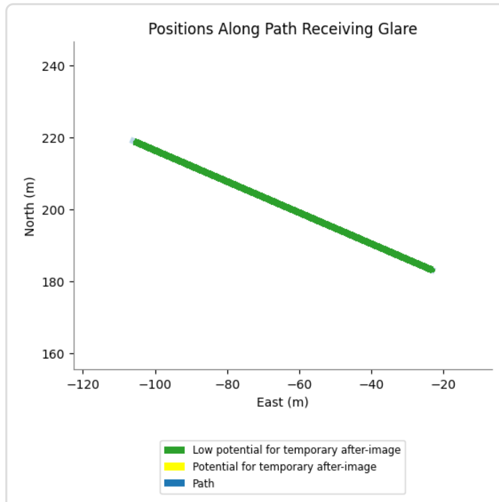
EF-vestur and Vegur 1

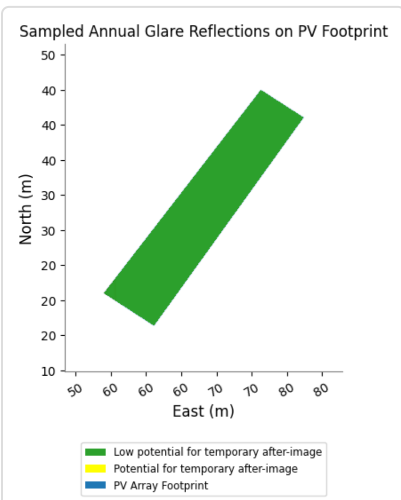
Receptor type: Route
0 minutes of yellow glare
3,754 minutes of green glare





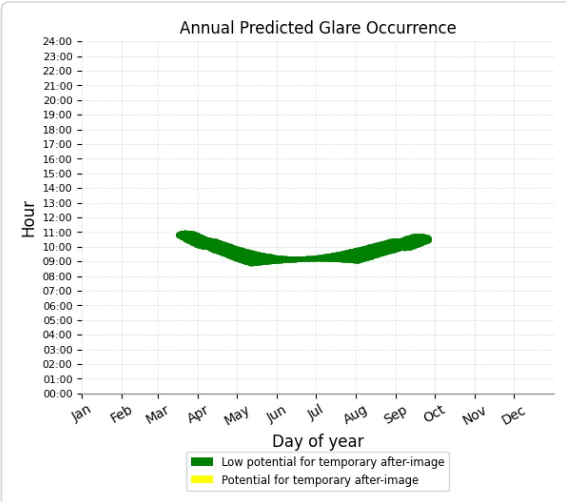


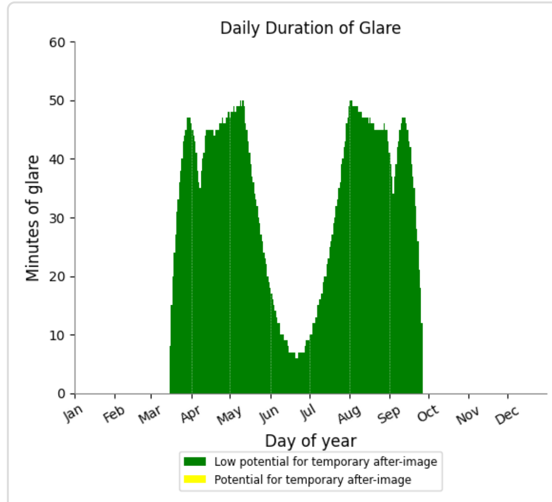


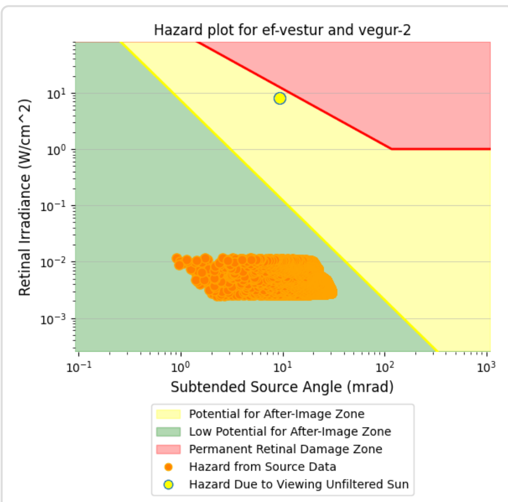


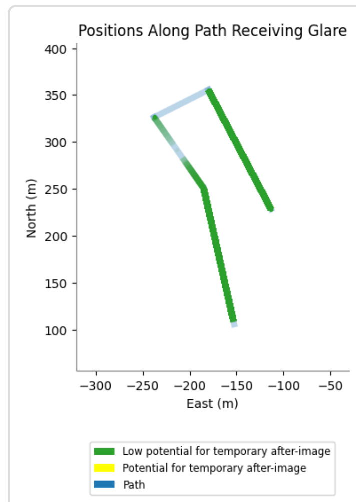
EF-vestur and Vegur 2

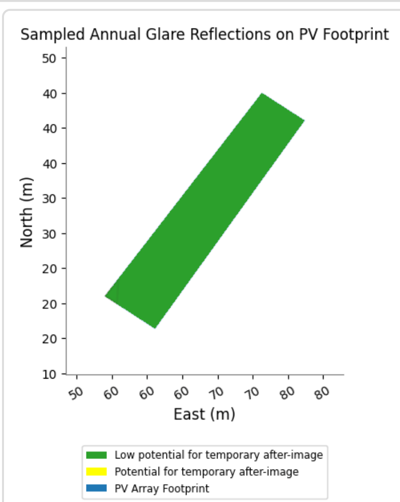
Receptor type: Route
0 minutes of yellow glare
6,533 minutes of green glare





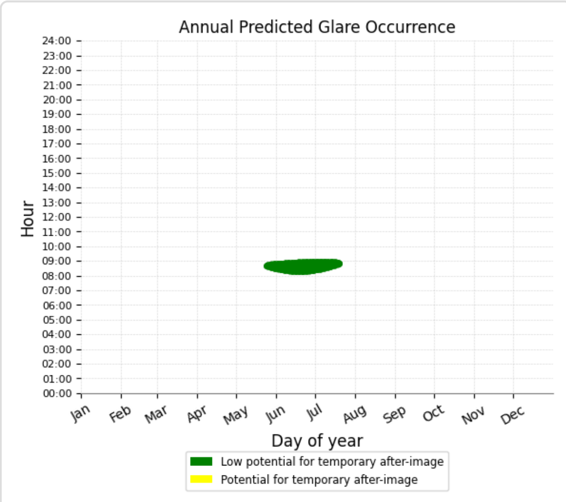


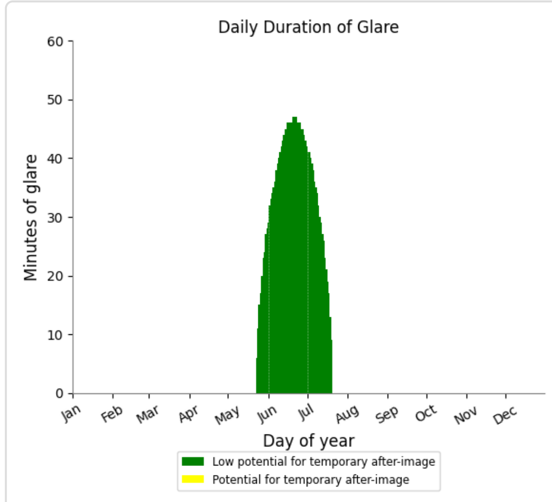


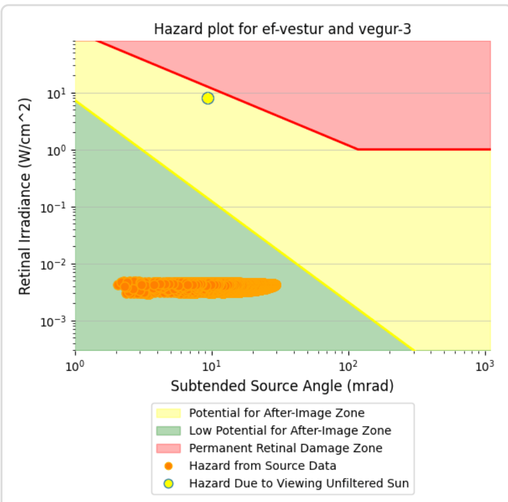


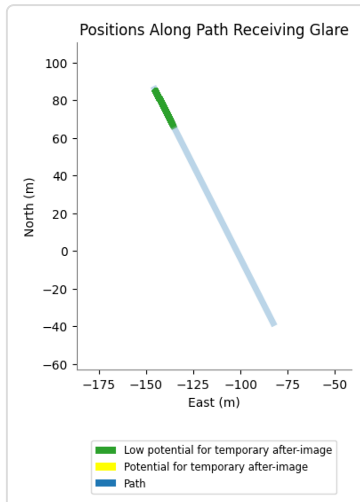
EF-vestur and Vegur 3

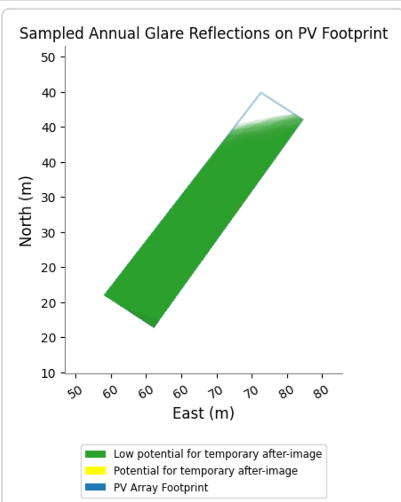
Receptor type: Route
0 minutes of yellow glare
2,026 minutes of green glare











EF-vestur and Vegur 4

Receptor type: Route

No glare found

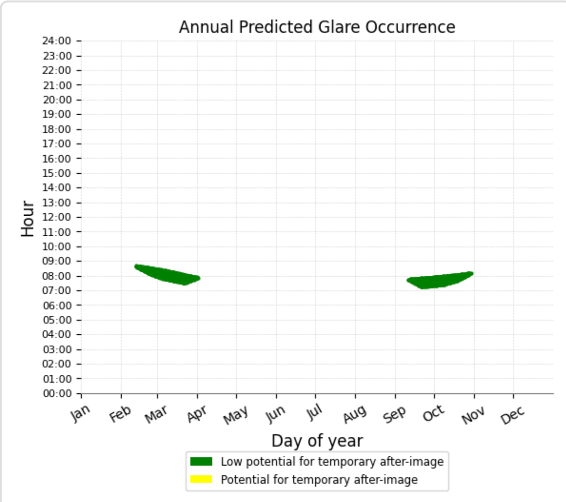
PV: RV-sudur low potential for temporary after-image

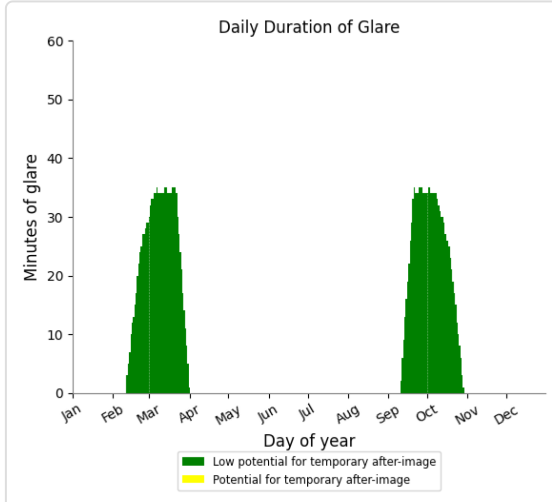
Receptor results ordered by category of glare

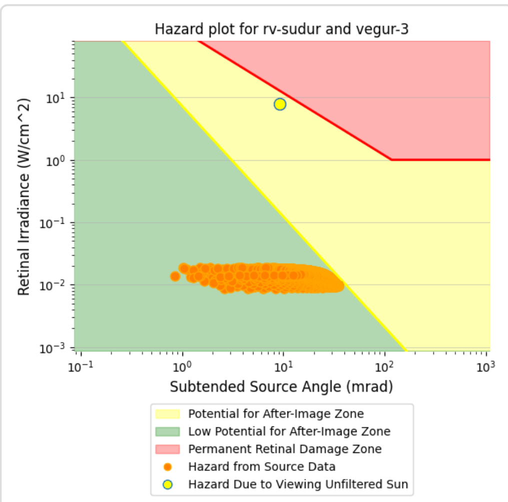
Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
Vegur 3	2,434	40.6	0	0.0
Vegur 1	0	0.0	0	0.0
Vegur 2	0	0.0	0	0.0
Vegur 4	0	0.0	0	0.0

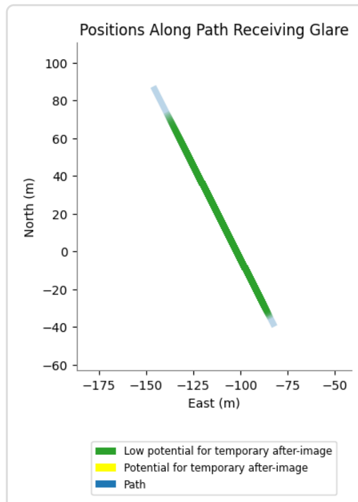
RV-sudur and Vegur 3

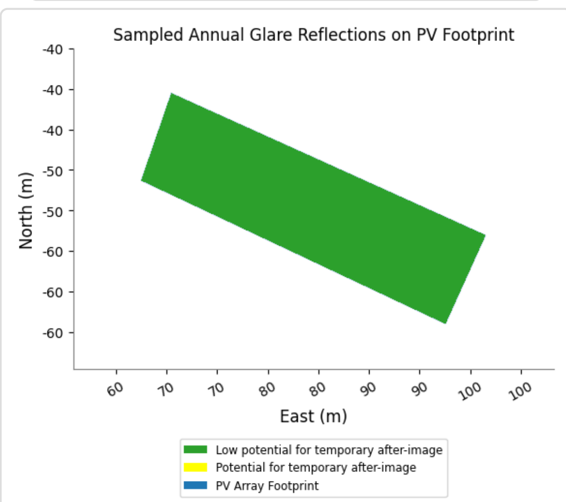
Receptor type: Route
0 minutes of yellow glare
2,434 minutes of green glare











RV-sudur and Vegur 1

Receptor type: Route

No glare found

RV-sudur and Vegur 2

Receptor type: Route

No glare found

RV-sudur and Vegur 4

Receptor type: Route

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