QUICK GUIDE - GLARE MODULE

Purpose:

The purpose of this document is to help you set up a calculation of glare from Solar PV and 3D objects using GLARE module in windPRO.

Outline of Guide:

1. **Requirements**
2. **Adding Glare receptor**
3. **Adding Glare reflectors**
4. **Quick view of Glare**
5. **Create a Glare calculation**
6. **Results of Glare calculation**

1. REQUIREMENTS

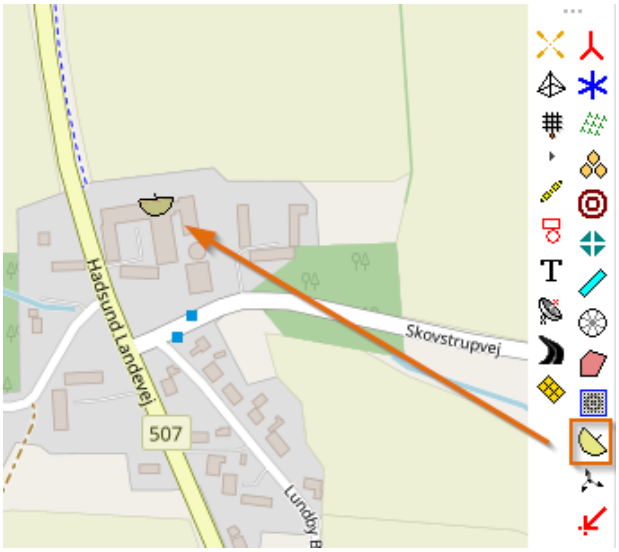
The steps in this quick guide require an installation of windPRO 3.6 with license to GLARE module. For calculation of glare from PV plants, a Solar PV license is required.

Before defining the glare receptors and reflectors you should establish a digital elevation model, either as height contours or as an elevation grid. Also, make sure you have a background map with satisfying resolution.

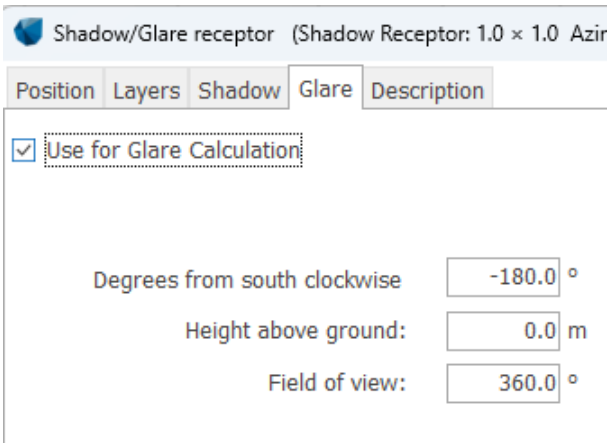
For more guidance on establishing background maps and a digital elevation model visit the Start using windPRO and the BASIS manual.

2. ADDING GLARE RECEPTOR

Start by inserting a  Shadow/Glare receptor in the location on the map for which you want to calculate glare:



A Shadow/Glare receptor can be used for calculation of flicker from wind turbines and glare from PVs and 3D objects. By default, the Shadow/Glare receptor is set to be used in SHADOW calculations. To use the object in a GLARE calculation, you need to select a checkbox in the Glare tab in the object setup and specify the needed inputs:



3. ADDING GLARE REFLECTORS

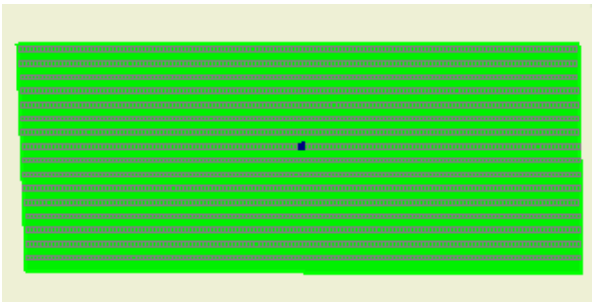
There are two types of glare reflectors, for which glare can be calculated:

- Solar PV areas – for calculation of glare from solar installations

- 3D objects – for calculation of glare from reflecting surfaces of buildings etc.

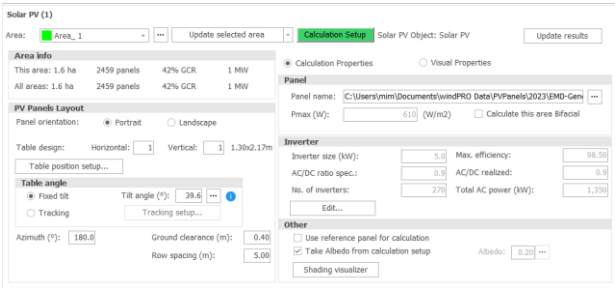
For Solar PV glare calculations:

Create layout with the Solar PV object:

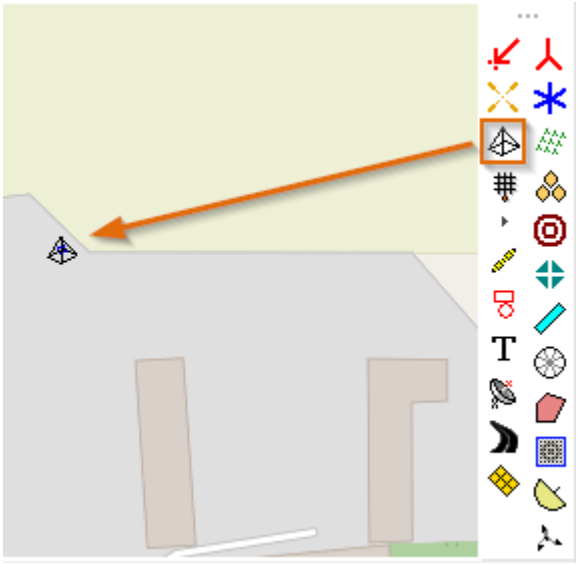


For guidance on creating a Solar PV area visit Solar PV: Energy calculation.

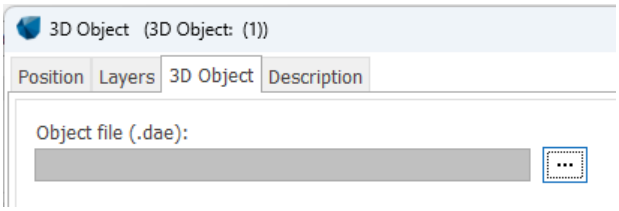
It is important that you specify the size of the PV panels and layout of the solar PV accurately. It will have influence on the results:



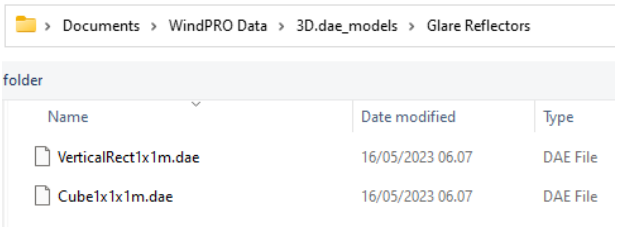
For general glare calculations of 3D objects:
Insert a Visual Element object:



Here, you can import the 3D object from a .dae file:

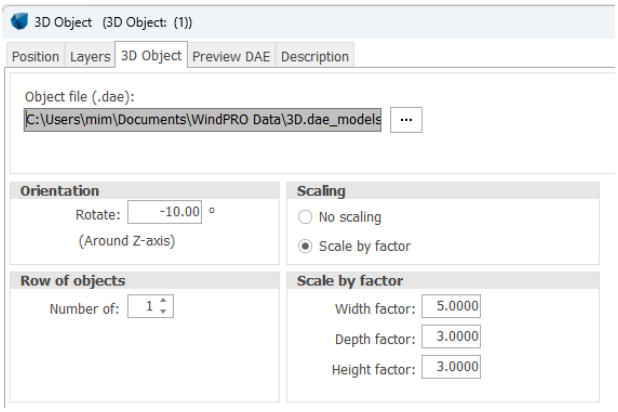


In the library available in windPRO, two predefined models are available:

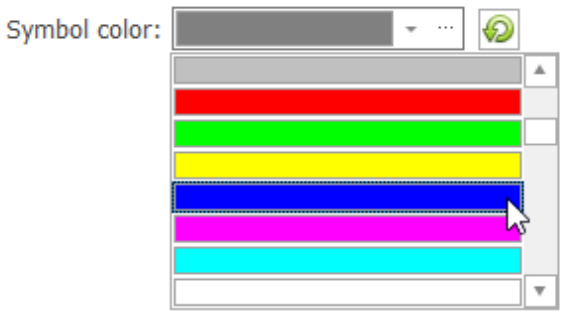


The first is a vertical rectangle, which can be used for modelling a façade of a building. The second one is a cube, which can be used for modelling of a rectangular building with all facades being reflecting. You can also use other .dae files in Glare calculation.

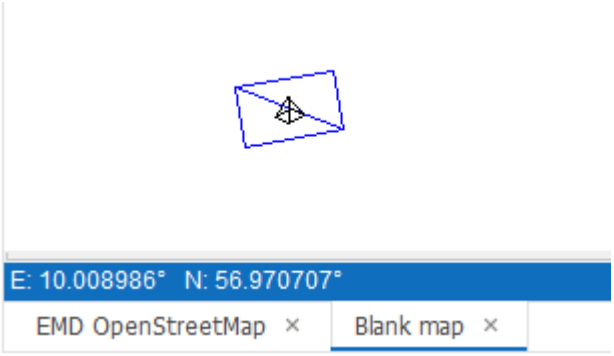
Select the cube to model a greenhouse. The default dimensions of the cube are 1x1x1m. Modify the size by specifying a scaling factor in the 3D object. Also, specify the rotation of the object around z-axis:



For graphical presentation of glare in the reports, select the symbol color for the 3D object in the Position tab:



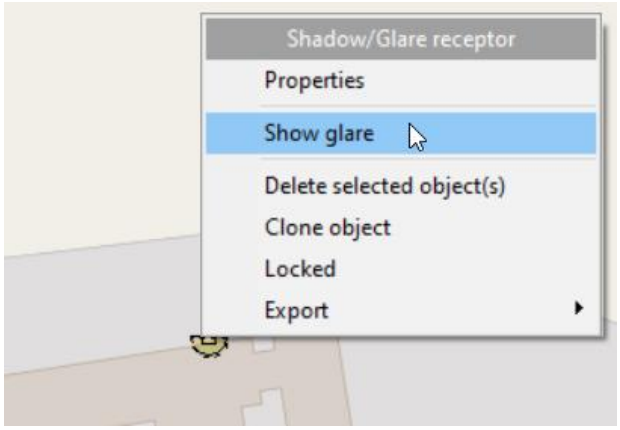
You can view the 3D object on the map. For small objects you will need to change to Blank map to view the object:



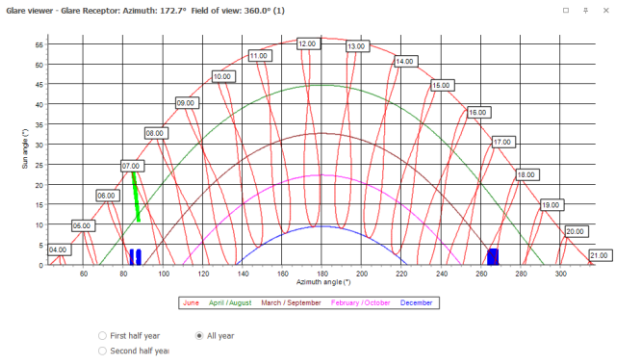
4. QUICK VIEW OF GLARE

For a receptor, you can quickly view glare coming from all reflectors defined in a project – Solar PV areas and 3D objects. It is a fast way to assess if there is any glare in the location of the receptor. Default calculation settings are used in the quick view.

Right click on a receptor and choose “Show glare”:

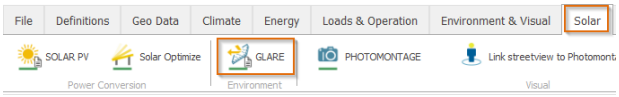


A glare viewer will open, where you can see the sun positions for which glare is visible at the receptor location. The colors marked in the graph correspond to the color of the Solar PV areas and 3D objects in the project:

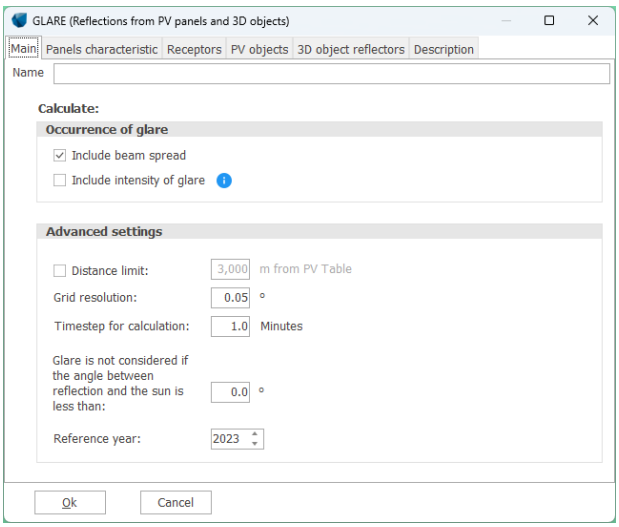


5. CREATING A GLARE CALCULATIONS

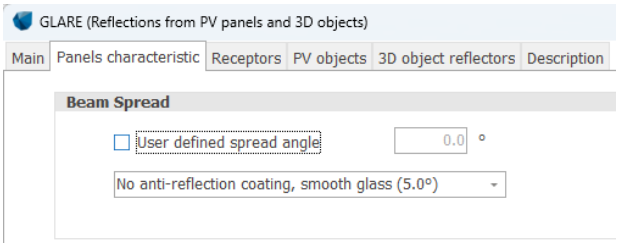
To create a new Glare calculation, select GLARE from the Solar tab:



A window with the Glare calculation setup will open. In the Main tab, you can specify what should be included in the calculation and the settings for the calculation. In this quick guide example, please keep the default settings and calculate the occurrence of glare including beam spread:



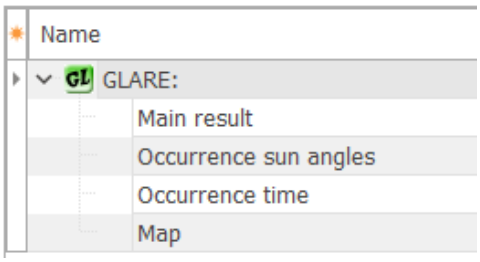
In the Panel characteristic tab, you can choose the type of coating of the glass used in PVs and the 3D object. In this calculation, use the default setting – smooth glass with no anti-reflection coating:



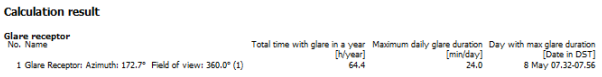
In the following tabs in the calculation setup, select the receptors, Solar PV objects and 3D objects to be used in the calculation. Once you have selected the objects you created previously to be used in the calculation, start it by pressing OK.

6. RESULTS OF GLARE CALCULATION

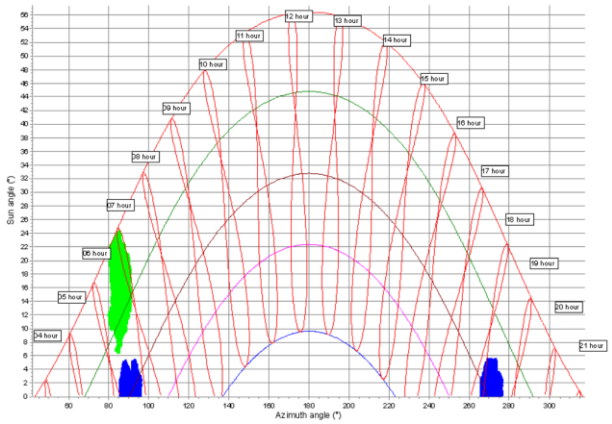
There are currently four reports available for the Glare calculation:



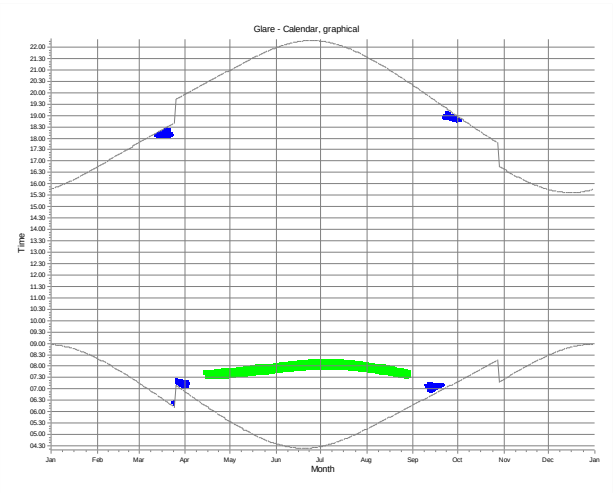
Main result will summarize the calculation setup and will provide the main result – total duration of glare during the year and maximum daily glare duration:



Occurrence sun angles is a graph representing sun positions for which glare can be observed. It is a graph similar to the one available in the Quick view:



Occurrence time translates the above graph to a more understandable form, where glare times are shown during a year. The graph is created considering the daylight-saving time:



Finally, the Map report presents the receptors and reflectors on the map. For Solar PV areas the PV panels causing glare are highlighted:

Result to file per receptor is available for the calculation. It contains a list of timesteps for which glare is visible at the receptor, together with details about incidence angle on the reflecting surface and sun position defined by sun altitude and sun azimuth:

Time	Glare table count	Incidence Angle	Sun Azimut	Sun Altitude	Irradiance
		°	°	°	W/m2
12/03/2023 18.06	1	0.68026	262.90304	0.2675	0
12/03/2023 18.07	1	1.6587	263.11269	0.13224	0
13/03/2023 18.04	1	0	262.75265	0.83213	0
13/03/2023 18.05	1	1.28658	262.96247	0.69692	0
13/03/2023 18.06	1	1.9863	263.17225	0.56165	0
13/03/2023 18.07	1	2.49703	263.38199	0.42632	0
13/03/2023 18.08	1	2.91971	263.59168	0.29093	0
13/03/2023 18.09	1	3.28846	263.80133	0.15548	0
13/03/2023 18.10	1	3.61981	264.01095	0.01998	0
14/03/2023 18.04	1	1.6927	263.02342	1.12611	0
14/03/2023 18.05	1	2.27087	263.23331	0.99082	0
14/03/2023 18.06	1	2.72913	263.44317	0.85547	0
14/03/2023 18.07	1	3.12075	263.65297	0.72007	0
14/03/2023 18.08	1	3.4684	263.86274	0.58461	0
14/03/2023 18.09	1	3.7842	264.07247	0.44909	0
14/03/2023 18.10	1	4.07559	264.28215	0.31353	0
14/03/2023 18.11	1	4.34746	264.49181	0.17791	0