

PVGIS: a free online solar photovoltaic calculator tool to optimise light harvesting in viticulture



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The screenshot displays the PVGIS web interface with several key components:

- Map View:** Shows a map of Europe with a red pin indicating the location of Fondazione Edmund Mach (marked with ①) and another pin for ARC Infruitec-Nietvoorbij (marked with ②).
- PV Estimation Panel:** Contains settings for radiation database (PVGIS-CMSAF), PV technology (Crystalline silicon), installed power (1 kWp), and estimated system losses (14%). It includes options for fixed mounting (Free-standing) and tracking (Vertical axis, Inclined axis, 2-axis).
- Output options:** Includes checkboxes for 'Show graphs', 'Show horizon', 'Web page', and 'Text file'.
- Graphs:** Two graphs show 'Astronomic and topographic sunpath on May 17, 2017'. The left graph is for Fondazione Edmund Mach, and the right is for ARC Infruitec-Nietvoorbij. Both show solar elevation and sunpath angles relative to azimuth.

The Photovoltaic Geographical Information System (PVGIS) ©European Communities, 2001–2017) had been developed from solar radiation data estimated from satellite using the Satellite Application Facility on Climate Monitoring (CM SAF) models, representing the period 1996-2011. In areas North of 58° N the data are derived from ground station measurements collected within the European Solar Radiation Atlas and interpolated spatially.

The PVGIS service allows to simulate the photovoltaic potential of a PV system, according to the site location and horizon mask, the PV technology, installed peak power, yield and energy losses, as well as mounting options like slope (0=horizontal 90=vertical) and azimuth (-90=oriented to the East, 0= to the South, 90 to the West, + or -180 to the North). Several web-tools, available from the PVGIS online service, can be used in viticulture. In particular, the “Show horizon” option allows the calculation of both the astronomic and topographic sunrise, sunset, maximum potential day length, on a sunny day with no cloud cover [1-2].

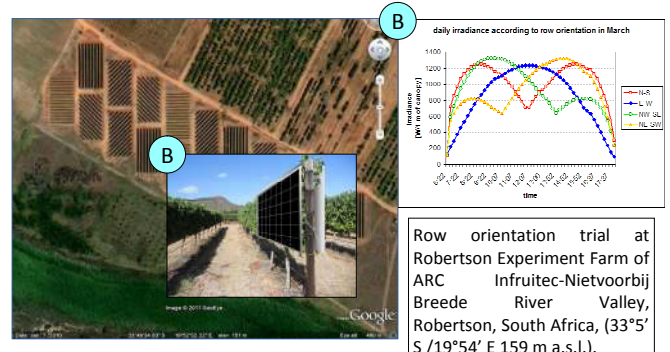
Moreover, the “Daily radiation” tool offers the possibility to calculate the monthly irradiance on the PV surface. Therefore, the PVGIS service can be used to simulate the monthly irradiance on the canopy surface using slope=90 (vertical) and the row orientation angle as azimuth value.

Finally, the “PV Estimation” service provides the estimation of the optimum inclination and orientation of the PV module (i.e. canopy) as affected by the horizon mask, to maximize the annual light interception.

PVGIS services and queries can also be embedded into new tools [2] (both local and online) to support the site selection and a proper vineyard design (row direction, row and vine spacing, trellis system, etc.).

References

- Hunter, J. J., Volschenk, C. G., & Zorer, R. (2016). Vineyard row orientation of *Vitis vinifera* L. cv. Shiraz/101-14 Mgt: Climatic profiles and vine physiological status. *Agricultural and Forest Meteorology*, 228, 104-119.
- Zorer, R., Volschenk, C. G., & Hunter, J. J. (2017). Integrating Geographic Information Systems and hemispherical photography in the assessment of canopy light profiles in a vineyard. *Agricultural and Forest Meteorology*, 232, 672-681.



Row orientation trial at Robertson Experiment Farm of ARC Infruitec-Nietvoorbij Breede River Valley, Robertson, South Africa, (33°51' S / 19°54' E 159 m a.s.l.).

PVGIS estimates of solar electricity generation
Location: 46°11'31" North, 11°8'18" East, Elevation: 259 m a.s.l.

Solar radiation database used: PVGIS-CMSAF

Nominal power of the PV system: 1.0 kW (crystalline silicon)
Estimated losses due to temperature and low irradiance: 10.8% (temperature)
Estimated loss due to angular reflector: 2.8%
Other losses (cables, inverter etc.): 1.4%
Combined PV system losses: 24.7%

Fixed system: inclination=32°, orientation=22° (optimum)

Month	E_p	E_m	H_p	H_m
Jan	1.83	56.8	2.31	71.7
Feb	2.36	80.0	3.60	103.
Mar	3.84	114.	4.66	144.

PVGIS estimates of solar electricity generation
Location: 33°54'54" South, 19°53'45" East, Elevation: 157 m a.s.l.

Solar radiation database used: PVGIS-helioclin

Nominal power of the PV system: 1.0 kW (crystalline silicon)
Estimated losses due to temperature and low irradiance: 10.8% (temperature)
Estimated loss due to angular reflector: 2.8%
Other losses (cables, inverter etc.): 1.4%
Combined PV system losses: 15.2%

Fixed system: inclination=32°, orientation=180° (optimum)

Month	E_p	E_m	H_p	H_m
Jan	5.11	158	7.08	
Feb	5.11	143	7.06	
Mar	4.80	149	6.90	

