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PVGIS
Photovoltaic Geographical Information System

Ana Gracia Amillo, Thomas Huld, Irene Pinedo Pascua, Ruben Urraca, Ewan Dunlop

European Commission, Joint Research Centre, Ispra
Overview of presentation

1. Introduction

2. PVGIS: features, calculations, data, output

3. PVGIS tools

4. Other EC tools and applications
1. Introduction
Ground measurements of solar radiation

• Best way to estimate the solar resource available at a given location.

• Requires **specific equipment** (pyranometers, pyrheliometers and solar trackers) which need proper **maintenance**.

• Long term datasets are rare (spatially and temporally), especially in the developing world.
1. Introduction
Satellite-based solar radiation estimates

- The level of **quality** reached in many areas come close to that of ground-based measurements.

- Solar radiation estimates are mainly from **geostationary** meteorological satellites.

- Spatial resolution is typically a few **km at continental scale**.

- Temporal resolution **15-30 minutes** depending on the satellite.
2. PVGIS online tool for PV yield estimation

The JRC has for more than 10 years developed and maintained the PVGIS online tool for making quick estimates of PV energy yield and solar irradiation. The tool is freely available to everybody.

The last version, **PVGIS-5**, was launched in 2017 with enhanced capabilities.

http://re.jrc.ec.europa.eu/pvgis.html

Online tools:

PVGIS features

- Calculation of **power output** of grid-connected PV systems for **different PV technologies**.
- **Fixed mounting, building integrated or tracking systems** can be studied.
- It is possible to calculate the **optimum inclination and orientation** for any location.
- **Off-grid PV system** calculator.
- Calculates **monthly** averages of solar radiation, as well as the average **daily profile** for fixed and sun-tracking systems.
- Possibility to download **hourly time series** and **Typical Meteorological Years**.
PVGIS calculations

- Calculations are now made using the full *hourly* time series of solar radiation data for improved accuracy.
- Calculation takes into account shadows from *local terrain* using a DEM with resolution 3” (~90m).
- The effect of the *spectral content, angle of incidence, temperature of the module* and *cooling by the wind* are accounted for in the estimation of the PV power output.
PVGIS output

- **Download** results and data via the tool: Screen output or download as CSV or PDF.
- **Web service interface** for download data.
- **Data and maps** for download:
  - Solar radiation and PV energy production data in raster format for GIS software
  - Maps in graphical format for printing or including in documents and presentations
  - Maps for all countries in Europe and Africa
PVGIS solar radiation data

- **Data coverage** was substantially extended in PVGIS-5.

- PVGIS data are mostly from the European **METEOSAT** satellites, covering Europe, Africa and most of Asia.
  
  (PVGIS-CMSAF, PVGIS-SARAH)

- Data for the Americas come from the **NSRDB** (National Renewable Energy Laboratory, NREL).
  
  (PVGIS-NSRDB)

- High latitude data come from **reanalysis** products.
  
  (PVGIS-COSMO, PVGIS-ERA5)
PVGIS solar radiation data

- The algorithms applied to Eurasia and Africa have been developed by the CM SAF collaboration (www.cmsaf.eu), especially Deutscher Wetterdienst (DWD).
- In a first step, a version of the Heliosat method is used to calculate the effective cloud albedo (CAL) which measures the reflectivity of clouds.
- The second step calculates the clear-sky irradiance using the SPECMAGIC algorithm (Müller et al. 2012) to calculate the transmissivity of the atmosphere, using as input:
  - Aerosols (long-term monthly climatology)
  - Water vapour (monthly averages)
  - Ozone (long-term monthly climatology)
- Finally the global and direct irradiance is calculated from the clear-sky radiation and cloud index.
PVGIS solar radiation data

METEOSAT raw image
Cloud index, CAL
Global horizontal irradiance
PVGIS data sources

- **Satellite-based spectral and broadband irradiance** data calculated by the CM SAF collaboration (www.cmsaf.eu) and JRC Ispra.
  - Hourly time resolution
  - Spatial resolution around 3-5km
  (PVGIS-CMSAF, PVGIS-SARAH)

- **Temperature and wind speed** data from ECMWF (www.ecmwf.int) operational forecast data.
  - 3-hourly time resolution, linear interpolation to hourly values
  - Spatial resolution 0.75° latitude/longitude (~81km)

- **Module power measurements** mainly by the ESTI Laboratory (JRC), some data from literature
3. PVGIS tools

Choose a location/horizon
Enter a few parameters (PV power, inclination etc.)
Click “Visualize”
3. PVGIS tools
3. PVGIS tools – PV performance

Grid connected
Tracking PV
Off-grid
3. PVGIS tools – Solar radiation data

Monthly data
Daily data
Hourly data
3. PVGIS tools – TMY
4. EC tools and applications

RE2nAF: Renewable Energy and Rural Electrification for Africa
4. EC tools and applications

Electrification options for Africa
4. EC tools and applications

PV rooftop potential for EU member states

European distribution in NUTS 2 level of solar rooftop potential resulted by geospatial modelling in high spatial resolution
4. IEC 61853 Standard Series

The IEC 61853 Standard Series "Photovoltaic (PV) module performance testing and energy rating" describes how to perform the PV module measurements and calculations required to produce an energy rating analysis for a specific PV module under consideration. The standard has four parts:

1. "Irradiance and temperature performance measurements and power rating" (2011)
2. "Spectral responsivity, incidence angle and module operating temperature measurements" (2016)
Thank you for your attention!

http://re.jrc.ec.europa.eu/pvgis.html
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