PV POTENTIAL
(also) using Geographical Information Systems

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OUTLOOK

• Terceira Island – radiation data and photovoltaic potential
• Graciosa – radiation data and modeling, a pathway for a solar atlas
• GIS for PV potential assessment
Photovoltaic potential in Terceira

DATA

- Angra Heroísmo, Terceira Island
- 2009 data
- Meteo data: global, direct and diffuse irradiation
- 5 seconds → 15 minutes
- From Paulo Fialho, Azores University, Group of Chemistry and Physics of the Atmosphere
Photovoltaic potential in Terceira

Measured irradiance ($W/m^2$)
Data: 2009 at Angra do Heroísmo, in Terceira
Photovoltaic potential in Terceira

Model results: comparing different PV configurations
Data: 2009 at Angra do Heroísmo, in Terceira
Photovoltaic potential in Terceira

Model results: comparing different PV configurations
Data: 2009 at Angra do Heroísmo, in Terceira

Energy produced by a 2-axes tracking system and CPV normalized to the energy produced by a flat-plate system.

Accumulated energy (kWh/kWp) produced by the flat-plate system, 2-axes tracking system and CPV system.
Photovoltaic potential in Terceira

**DATA**

- PV potential: **1209 kWh/year/m²**, with significant diffuse radiation (58%)
- Highest irradiation in the summer months when alternative energy sources (e.g. wind power) are less significant
- Solar tracking and/or concentration systems offer a measurable boost of generated electricity, particularly in the summer months
- However they enhance **short-term variability** thus making it less useful for grid integration, in particular if PV has a relevant slice of the local energy portfolio.
Solar Atlas for the Azores Islands

2004-2005

2006-2007

GLOBAL
Solar Atlas for the Azores Islands

2004-2005

2006-2007
Solar Atlas for the Azores Islands

2004-2005

2006-2007

DIFFUSE
Solar Atlas for the Azores Islands

Global ARM

Global WRF

ARM - Atmospheric Radiation Measurement, Climate Research Facility
WRF - Weather Research and Forecasting Model
Solar Atlas for the Azores Islands

Azores
6x6 km
Solar Atlas for the Azores Islands

Graciosa
2x2 km
Solar Atlas for the Azores Islands

Graciosa
2x2 km
**Solar Atlas for the Azores Islands**

**Further work**

- Long term radiation averages
- Model validation using IM data
- Diffuse radiation calculation
GIS for PV potential assessment

• PV potential using ARCGIS: Lisbon assessment (collaboration with UNL)
• PV potential including facades
GIS for PV potential assessment
GIS for PV potential assessment

![GIS for PV potential assessment](image)

- **MWh/m²/year**
- **% occupied area**

- 31%
- 1.64
GIS for PV potential assessment
GIS for PV potential assessment
GIS for PV potential assessment: including facades

Analysis of idealized case.
The two buildings under analysis.
Colour code refers to height of each cell. Location is Lisbon.
GIS for PV potential assessment: including facades

Analysis of idealized case.
Projected shade on the facade.
Model results for January 1\textsuperscript{st} at 9am.
GIS for PV potential assessment: including facades

Analysis of idealized case.
Insolation per unit area (kW/m²).
Model results for January 1st at 9am.
GIS for PV potential assessment: including facades

Analysis of idealized case.
Total insolation on the facades (kW).
Model results for January 1\textsuperscript{st} at 9am.
GIS for PV potential assessment: including facades

Case study: FCUL campus
Elevation (m).
GIS for PV potential assessment: including facades

Case study: FCUL campus
Elevation (m).

Insolation per unit area (kW/m²).
Model results for June 1st at 9am.
Case study: FCUL campus

Insolation per unit area (kW/m$^2$).

Model results for June 1$^{st}$ at 9am.
Summary

Solar Energy in the Azores - Green Islands

• Preliminary estimation of PV potential from real meteo data
• Developing Solar Atlas for the archipelago using meteo data + weather modeling
• GIS offers tools for local estimation of solar potential
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PV POTENTIAL & CLIMATE

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