Evaluation of Solar Energy Potential and its Variability in the Azores

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Evaluation of Solar Energy Potential and its Variability in the Azores

- Instruments and stations
- Data processing
- Results
Instruments & Data Acquisition

- **Pyranometers** instruments are specially designed for regular and continuous measurement of global radiation between 0.3 \( \mu \text{m} \) and 3.0 \( \mu \text{m} \).

- IM network have installed Kipp & Zonen CM11 thermoelectric pyranometers ("high quality" - Guide to Meteorological Instruments and Methods of Observation, VI ed.).

- **AWS MILUS 500** (Vaisala):
  - Sampling Interval: < 30 seg
  - Integration Time: 10 min
  - Time Of Observation: TST
Stations

- Flores
- Corvo
- Horta
- Pico
- Graciosa
- A. do Heroísmo
- P. Delgada
- Nordeste
- S. Maria
Calibration & Data Processing & Archiving

- Much attention is being given to the calibration of the radiation sensors - ISO 9846:1993(E);
  **Last calibration of sensors were done on Oct-Nov/2009.**

- Measurements are carefully analysed applying Quality Control /Quality Assessment (QC/QA) procedures;

- Once the control procedures are completed, the final data are centralised in a database system.
Data processing for row and 10’ data:

- **[TSV]** contains the all information collected at all stations;
- Extract and set by time (10 minutes average) raw-data recorded:
- **[RAD]** station/monthly data files with 10’ data.

10’ data values control:

\[
\begin{align*}
\text{iflag} = 0 &: \text{(good)} \\
\text{iflag} = 1 &: > 0.9 \times x0 \text{ (bad)} \\
\text{iflag} = 2 &: 0.8 \times x0 = <x> 0.9 \times x0 \text{ (suspect)}
\end{align*}
\]

\(x0: \text{Extraterrestrial irradiance}\)
Data processing for hourly data (1):

- Building [*.hor] files:

  - To each hour H is assigned an integrated value between H-1 and H.
  - For example, the total value at 5:00 TST is obtained by integrating of the 4:10, 4:20,..., 4:50 and 5:00.

- Zero hourly values are considered wrong and set to missing (-1).
Data processing for hourly data (2):

- Building [*_.ho1*] files:

  Hourly data outside of the sunrise-sunset period are set to zero.

```c
  c
  if(za.gt.90..or.za.lt.-90.)then
    x(k)=0.
    else if(x(k).eq.0.)then
      x(k)=-1.
  endif
  c```
Pyrnometers network performance (2000-2009)

Flores (05010)
1998 - 2000

Flores (05010)
2006 - 2009
Horta (05060) 1998 - 2000

Horta (05060) 2006 - 2009

Pico (09220) 2006 - 2009

Graciosa (09120) 2006 - 2009
Flores - Global Radiation (10 minutes)

Relative deviation of measurements from model MESTRad
Results (I)
(from 1999-2000 data)

Hourly irradiation (kJ/m²)
### Results (II)
(from 1999-2000 data)

#### Daily global irradiation values tables (Wh/m²)

Daily Global Irradiation values (Wh/m²)
Average, maximum, minimum and number of years
Station ID: 501
Year range: 1999 - 2009

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Results (II)
(from 1999-2000 data)

Daily global irradiation (kJ/m²)
Irradiação Global Diária (kJ/m²)
Valores médios (2000-2009)
Valores máximos (2000-2009)
MESTrad2009
Results (III)
(from 1999-2000 data)

Monthly Global Radiation Tables (Wh/m2)

Station: (085060) FAIAL ISL
Global Radiation G in WH.M-2 (WRR)
Latitude: 38 31 N   Longitude: 28 38 W   Altitude: 60 m

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Results (III)
(from 1999-2000 data)

Diagrams of the mean annual course of global radiation (kWh/m²)
Diagrams of the mean annual course of global radiation (kWh/m²)
Results (IV)
(from 1999-2000 data)

Mean annual monthly number of days with daily radiation given thresholds (Wh/m²)

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Thanks for your attention