SOLAR IRRADIANCE MONITORING SYSTEM SIMS

The Solar Irradiance Monitoring System (SIMS) is an advanced tool to be used by Photovoltaic (PV) and Concentration Photovoltaics (CPV) technologies users, developers and installers. SIMS makes use of an accurate geometric model, developed to estimate shadowing effects caused by orographic features and buildings, using Digital Terrain Models (DTM), and satellite data to retrieve irradiances information. The system can provide three services essential for PV and CPV technologies:

ENERGY PRODUCTION FROM PV SYSTEMS

ENERGY PRODUCTION FROM TRACKING PV SYSTEM

GLOBAL SOLAR IRRADIANCE AND DIRECT NORMAL IRRADIANCE

Energy Production from PV systems

Estimation of Energy production for PV systems requires information based on the Monthly Average Daily Global Solar Radiation (MADGSR) gathered from satellite data (EUMETSAT Down-welling Solar Shortwave radiation Flux, DSSF). To estimate the MADGSR all the images from the MSG database (from July 2008 to November 2011) are processed. Combining MADGSR and the input values, the system will provide the Total amount of energy that a PV plant can produce during an year.
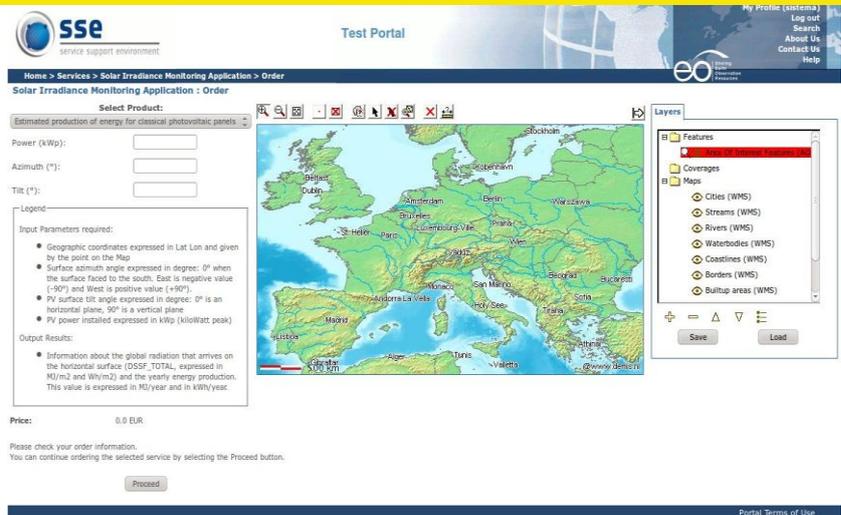
INPUT and OUTPUT

Input parameters are:

- Site position (expressed in Lat and Lon)
- The surface orientation (azimuth angle)
- Surface Tilt Angle (tilt of the panel)
- Power Installed

Output is a .txt file with stored:

- the input information
- the total yearly irradiance
- the yearly averaged production of energy

Energy Production from Tracking PV system

The tracking PV Systems are a great improvement in PV applications. The possibility to capture more irradiance on the surface permits to these systems to produce more Energy on daily and yearly basis. But one of the main problems related with the possibility of tracking the Sun is to know how much radiation reach the PV surface every moment during the day. With SIMS it is possible to know the exact position of the sun and the amount of radiation that reach the Tracking surface both on one and two axes systems, in order to be able to monitor the performance and provide promptly assistance.
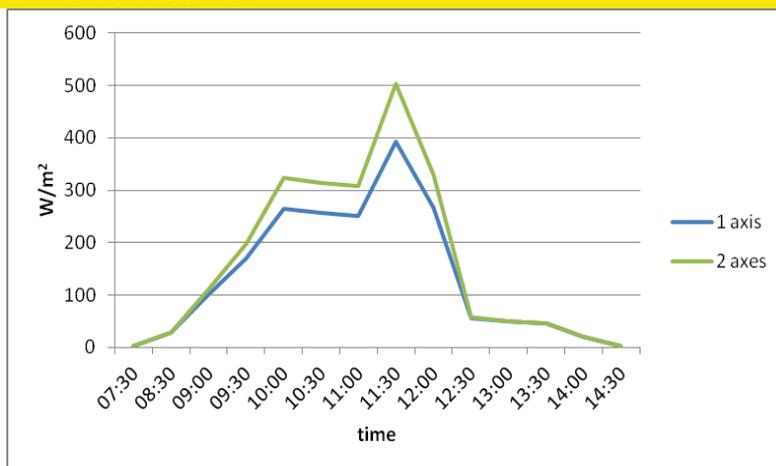
Input parameters are:

- Site position (expressed in Lat and Lon)
- The surface orientation (azimuth angle)
- Surface Tilt Angle (tilt of the panel)
- Power Installed

Output is a .txt file with stored:

- the input information
- the total yearly irradiance
- the yearly averaged production of energy
- Sun position and Irradiances values every 30 minutes

Comparison of 1axis and 2axes tracking PV incidence radiation

Global Solar Irradiance and Direct Normal Irradiance

Global Solar Irradiance (GSI) is the amount of solar irradiance that arrives on the Earth surface per surface unit considering the effects of Refraction, scattering and absorption. GSI is estimated by the Eumetsat's DSSF product, covering all Europe. The Direct Normal Irradiance is the amount of solar irradiance that arrives on the Earth surface per surface unit without having been scattered by the atmosphere, and falls within a capture angle of 5°. DNI values are computed every 30 minutes, based on the DSSF product, considering the fraction of radiation that reaches the Earth surface in the Normal direction. The results of this product are very important for monitoring the performances of CPV panels throughout the minutes/hour/day.
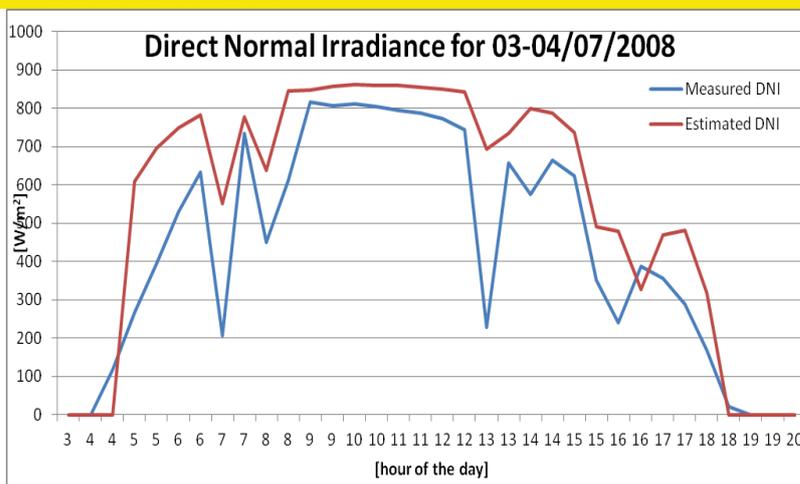
Input parameters are:

- Site position (lat and lon)
- Time range of investigation

Output is a .txt file with stored:

- the site position information
- the sun position (azimuth and zenith)
- the time
- the DNI values every half an hour
- the DSSF values expressed in Mj/m2 and Wh/m2

Comparison of estimated and measured DNI, cloudy day trend

VALIDATION RESULTS

The DSSF product gives GSI values that are in a very satisfactory agreement with the measured solar radiation: an **overall bias of -1.69%** and a **root mean square of 4.80%** say that the two data series are very close in both absolute and trend values.