The PACA Atlas, overview

The 250 m resolution solar atlas in Provence-Alpes-Côtes-d'Azur (PACA)

Since February 2004, the Heliosat-2 algorithm [3] applied to Meteosat Second Generation (MSG) SEVIRI images has been used to update, on a daily basis, the solar resource database HelioClim-3. This database covers Europe, Africa, the Mediterranean Basin, the Atlantic Ocean and part of the Indian Ocean with a spatial resolution of approximately 5 km (see figure) and a temporal resolution up to 15 minutes. The MSG data are received from Eumetsat and processed in near real time, overnight.

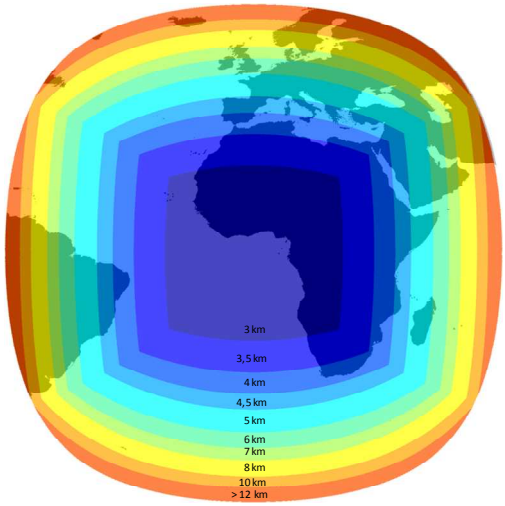

Figure: Spatial coverage and resolution of HelioClim-3 solar resource database.

Considering the HelioClim-3 spatial resolution, the geographic scale of solar mapping that can be derived is approx. 1 / 5 000 000. This geographic scale is suitable for continent or country solar mapping. Nevertheless, customers' feedback notably states that there is a need of spatial resolution improvement.

In this context of spatial resolution improvement of solar resource estimation, the solar atlas in PACA was launched in January 2009 and has been finalized in December 2010. It aims at increasing spatial resolution of HelioClim-3 to derive 250 m resolution solar maps. The atlas will account for the global, direct and diffuse on inclined plane or in normal incidence irradiations and their temporal variations intra and inter-annual, on a monthly basis.

The establishment of this atlas of the solar potential at the geographical scale of 1 / 250 000 from HelioClim-3 requires taking into account local phenomena such as:

- Meteorological phenomena related to the topography of the region,
- The effects of shadows of relief depending on the position of the sun,
- The diffusion's characteristics of the atmosphere for the evaluation of direct, isotropic and circumsolar diffuse radiations from the estimation of global horizontal radiation.

These phenomena are indeed the source of significant local spatial variations and potentially discriminating in choosing the location, the calculation of profitability or the sizing of photovoltaic or thermodynamic solar power systems. Solar mapping with a geographic scale of 1 / 3 000 000 or more does not represent properly these local phenomena.

The SRTM-V4 database is used to get topographic data with a spatial resolution of approximately 100 m and a localization accuracy of typically 10 m. This topographic data is used to estimate high resolution terrain effects on HelioClim-3 derived solar radiation fields, taking into account:

- Effects of optical path length variations;
- Shadow effects on direct and circumsolar diffuse radiation assessed from horizon computation as presented by the figure 2a;
- Horizon effects on isotropic diffuse radiation with the sky view factor estimation.

Moreover, in order to establish an accurate mapping to 1 / 250 000 with associated uncertainty using HelioClim-3 data, we have established procedures of calibration with meteorological ground stations. The global horizontal irradiation is calibrated thanks to the Météo France meteorological network comprising, in PACA, about 30 ground stations delivering at least daily global irradiation. The diffuse and direct irradiations are calibrated thanks to three specific ground stations dedicated to the project, delivering one year of concomitant 10-min global and diffuse irradiations on the horizontal plan and direct irradiation on normal incidence.

The solar atlas in PACA is available for free at www.atlas-solaire.fr.