Geophysical Research Abstracts
Vol. 16, EGU2014-13812, 2014
EGU General Assembly 2014

Impact of Atmospheric Attenuations Time Resolutions in Solar Radiation Derived from Satellite Imagery

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Accurate knowledge of solar irradiance components at the earth surface is of highly interest in many scientific and technology branches concerning meteorology, climate, agriculture and solar energy applications. In the specific case of solar energy systems the solar resource analysis with accuracy is a first step in every project since it is a required data for design, power output estimations, systems simulations and risk assessments. Solar radiation measurement availability is increasing both in spatial density and in historical archiving. However, it is still quite limited and most of the situations cannot make use of a long term ground database of high quality since solar irradiance is not generally measured where users need data.

Satellite-derived solar radiation estimations are a powerful and valuable tool for solar resource assessment studies that have achieved a relatively high maturity due to years of developments and improvements. However, several sources of uncertainty are still present in satellite-derived methods. In particular, the strong influence of atmospheric attenuation information as input to the method is one of the main topics of improvement. Since solar radiation attenuation by atmospheric aerosols, and water vapor in a second place, is, after clouds, the second most important factor determining solar radiation, and particularly direct normal irradiance, the accurate knowledge of aerosol optical depth and water vapor content is relevant in the final output of satellite-derived methods.

This present work, two different datasets we are used for extract atmospheric attenuation information. On the one hand the monthly mean values of the Linke turbidity factor from Meteotest database, which are twelve unique values of the Linke turbidity worldwide with a spatial resolution of 1/12º. On the other hand, daily values of AOD (Aerosol Optical Depth) at 550 nm, Angstrom alpha exponent and water vapor column were taken from a gridded database that combines MODIS Terra satellite and Aqua, C005 data collection. The AOD at 550 nm in the C005 collection data of MODIS have been proven to be more accurate than the previous version in assessment studies using AERONET data. The need of daily information of aerosol attenuation parameters has been clearly observed in places where aerosol optical depth variability is high (as the case of India). In addition, the sensitivity to the clear sky model used in the methodology has been also briefly analyzed, but a deeper analysis would require more extensive ground measurement.

The sensitivity results show that, as expected, DNI estimations are much more sensible to the atmospheric attenuation input than GHI. The GHI response to the atmospheric aerosol loading is modulated by the positive feedback of the diffuse component and by the angular projection. When comparing the sensitivity of satellite estimations in Spain and India, it is pointed out than the higher aerosol loading and dynamics that normally occurs over India cause higher variability of both GHI and DNI satellite calculations.