EMS Annual Meeting Abstracts
Vol. 9, EMS2012-154, 2012
12th EMS / 9th ECAC

Improving satellite-derived estimates of surface solar irradiance using a clear-sky model exploiting recent data sets on aerosol properties

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The solar radiation reaching the ground level on horizontal surfaces is of interest to many domains: agriculture, climate, energy, human health, meteorology... Images from geostationary meteorological satellite are currently expoited to produce estimates of the solar radiation at surface. The Heliosat-2 method is one of the most used methods and has been exploited by MINES ParisTech to process Meteosat images since 1985. This method calls upon the clear-sky model proposed in the European Solar Radiation Atlas (ESRA) The only input to this model that describes the atmospheric optical properties is the Linke turbidity factor. This factor summarizes in one quantity the effects of the aerosols and water vapour. Values of the Linke turbidity factor are available on a climatotological basis. As a consequence, the clear-sky irradiations proposed by the ESRA+Linke model do not vary from daya to day as they should do.
We have investigated the possibility of exploiting advanced data sets on aerosol properties together with a recent model for clear-sky to correct existing databases containing solar surface irradiation computed by the ESRA+Linke model. These aerosol data sets originate from the MACC project as well as the McClear clear-sky model. A series of ground measurements was asembled in order to serve as a reference in the comparison of the original and corrected satellite-derived irradiations. Comparison was performed for 15-min, 1-h and daily irradiation. For all summarizations, and almost all stations, the performances of the corrected irradiations are better than those obtained with the ESRA+Linke model. Correlation is larger and large irradiations are better reproduced. These results may be further used to perform a systematic correction of the existing databases of surface irradiation computed with ESRA+Linke.