EMS Annual Meeting Abstracts
Vol. 14, EMS2017-365-1, 2017

Validation of Direct Normal Irradiance from Meteosat Second Generation

Angela Meyer (1), Laurent Vuilleumier (1), Reto Stöckli (1), Stefan Wilbert (2), and Luis F. Zarzalejo (3)

(1) Federal Office of Meteorology and Climatology, MeteoSwiss, Measurement and Data, Payerne, Switzerland (laurent.vuilleumier@meteoswiss.ch), (2) German Aerospace Centre, Institute of Solar Research, Plataforma Solar de Almeria, Ctra de Senes s/n km 4, 04200 Tabernas, Almeria, Spain, (3) Centre for Energy, Environment and Technological Research CIEMAT, Avda. Complutense, 40, 28040 Madrid, Spain

Direct normal irradiance (DNI) estimates from the HelioMont algorithm using MSG/SEVIRI data are validated with ground-based data collected at two sites during year 2015. One site is the Plataforma Solar de Almeria (PSA), a 1km x 1km solar power research facility in Southern Spain hosting a half-dozen pyrheliometers. These provide high-quality DNI measurements at a site of the scale of the MSG/SEVIRI pixel resolution. The PSA DNI measurements are thus particularly well suited for satellite validation purposes. The other site is the Swiss Payerne BSRN station. At PSA, the availability of circumsolar ratio measurements allows correcting the measured DNI for circumsolar irradiance included in the pyrheliometer opening angle. The availability of several pyrheliometers at PSA allows checking the influence of spatial averaging, and the 1 minute resolution allows similar verification with temporal averaging.

The HelioMont algorithm (Stöckli, 2013) belongs to the Heliosat algorithm family. It first estimates the clear-sky irradiance using look-up tables derived from a radiative transfer model (RTM), then it applies a cloud modification factor (CMF) accounting for the effect of cloudiness using an empirical algorithm and the satellite imagery data. Clear-sky data allow verifying the RTM. Its most important uncertainty source is the aerosol optical depth (AOD) used as input. With locally-measured AOD, an expanded uncertainty of about $\pm$5-6% with a negative bias of 1-2% is found. Using AOD estimates by the Copernicus Atmosphere Monitoring Service (CAMS), the uncertainty is increased to about $\pm$15% with a negative bias of $\sim$1-3%. An aerosol climatology by Kinne (2008) was also tested, resulting in a significant negative bias of $\sim$15% and a dispersion of $\pm$18% around it. The CMF estimated by HelioMont was compared with one deduced by dividing the ground-based DNI measurements by the HelioMont clear-sky estimates. The satellite derived CMF is found to be in good agreement with the one deduced from DNI measurements for clear-sky situations. On the other hand, the satellite-derived CMF is found to be generally overestimated for cloudy situations, i.e. there are too few very low CMF. An important scatter is found when comparing the satellite and ground-based CMF, but 1-hour temporal averaging or spatial averaging using the multiple pyrheliometer measurements at PSA allows a significant reduction of the scatter.

Stöckli, R. (2013), The HelioMont Surface Solar Radiation Processing, Scientific Report MeteoSwiss, 93.

Kinne, S. (2008), Clouds in the perturbed climate system, Chap. Climatologies of cloud related aerosols: Particle number and size, ISBN: 978-0-262-01287-4.