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Assessment and validation of total surface solar irradiance and its direct and diffuse components derived from SEVIRI observations

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Within the frame work of the EU project EURO4M we produced and validated a data set of surface solar irradiance with high spatial resolution (typically 3x5 km2 over Europe) and temporal resolution (15 minutes). The most important input data are a cloud mask and cloud properties derived from METEOSAT/SEVIRI observations, which allows the radiation product to go back to the year 2004. Other input data were taken from the MACC re-analysis data set (aerosol properties) and MODIS (MCD43C3 surface albedo). Calculations of the surface irradiances were carried out with version 2 of the physics-based SICCS algorithm. This new version was improved relative to its previous version mainly by the calculation of direct and diffuse radiation instead of global radiation only, by adding aerosol variability into the scheme and by substituting the climatological snow-cleared surface albedo by an albedo with interannual variability including snow. The underlying radiative transfer calculations were performed with the Doubling Adding KNMI (DAK) model, which has recently been prepared for broadband calculations using the correlated-k method for gaseous absorption. We validated the new radiation product with surface observations from nine BSRN stations spread across Europe and the Mediterranean. For most of these stations we found biases in transmissivity between our calculations and the BSRN observations for clear skies and water clouds smaller than ± 0.02, which is in agreement with earlier closure studies but for ice clouds the station-mean bias in transmissivity was +0.036. We blame this to insufficient accuracy in the description of the single scattering properties of ice crystals. Maps of annual mean global irradiance based on the new product feature subtle and realistic details. An example is the map of the Netherlands which shows increases towards the coast and minima over slightly elevated and somewhat darker regions.

BSRN Baseline Surface Radiation Network
EURO4M European Reanalysis and Observations for Monitoring
MACC Monitoring Atmospheric Composition and Climate
MODIS Moderate Resolution Imaging Spectroradiometer
SEVIRI Spinning Enhanced Visible and Infrared Imager
SICCS Surface Insolation under Cloudy Conditions derived from SEVIRI Imagery