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Surface Downwelling Solar Radiation as estimated from MSG/SEVIRI and predicted by RAMS model forecast: verification and improvements from analysis

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The importance of solar energy estimation and forecast is commonly recognized because it represents an important tool for grid integration and facilitates the energy trading.
In this work we verify the surface downwelling solar radiation estimated by the Spinning Enhanced Visible and InfraRed Imager (SEVIRI) on the Meteosat Second Generation (MSG), and the one-day forecast made by the Regional Atmospheric Modeling System (RAMS). The verification is made with the observations of eleven pyranometers, distributed over the Italian territory and representative of different climate and orographic conditions, which are part of the "Aeronautica Militare Italiana" (ITalian Air Force) network.
The SEVIRI surface downwelling solar radiation is estimated using the SICCS (Surface Insolation under Clear and Cloudy skies derived from SEVIRI imagery) algorithm developed at KNMI. The surface solar radiation is calculated with a full radiative transfer model from the SEVIRI retrieved cloud properties: cloud mask, cloud optical thickness, cloud phase, and cloud particle size. For cloud-free cases, the aerosol and water vapor data are taken from monthly climatologies. The product is available at spatial resolution of 3x3 km2 (subsatellite) with 15 min time step for the full SEVIRI disk.
The RAMS model is a fully compressible mesoscale model, which is operational in a version maintained at ISAC-CNR. For this experiment the model is run at 4 km horizontal resolution over Italy for the next day. Initial and dynamic boundary conditions are given by the ECMWF operational analysis/forecast cycle of 12:00 UTC to simulate the operational context.
The analysis is made for a whole year and statistics are computed for different seasons to take into account for the natural variability of the Mediterranean climate.
Results show an evident dependence of both MGS and RAMS performance on the sky conditions. For the RAMS model this is related both to the short-wave parameterization of the model as well as to the to the ability to correctly predict the spatiotemporal distribution of clouds.
The variability of the performance with the stations shows the best agreement for maritime stations. The worst statistics are found for mountainous stations. Variability of the statistics with the stations is substantial and is a consequence of the different climatic conditions found in different stations.
Finally, the ability of the MOS (Model Output Statistics) to improve the forecast is analysed for the different stations.