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Satellite-Based Surface Solar Irradiance Nowcast in Alpine Areas

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The accurate knowledge of Surface Incoming Shortwave Radiation (SIS) is essential for climate monitoring and climate model evaluation. In addition, SIS data has substantial socio-economic value since it is used in many applications in the public and private sector. The demand for Photovoltaic (PV) power predictions, resulting from the increasing share of fluctuating PV power in the energy supply system, is rapidly growing. Forecasts on different time scales from a few hours to several days are required. The basis of PV power predictions are forecasts of global horizontal irradiance (GHI, equivalent to SIS), which can be derived from numerical weather prediction (NWP) models, satellite information, or ground measurements using empirical or statistical methods.
The objective of this study is SIS prediction for the time horizon of several hours ahead (1-6 h), using an algorithm to obtain Cloud Motion Vectors (CMV's). As a basis images produced by the Meteosat Second Generation (MSG) satellites and processed with the HelioMont algorithm by Stöckli (2013) are used. Particularly the clear-sky index (KI) with 15 minutes resolution was taken to derive a vector field out of two consecutive pictures with the flow motion algorithm from Sun (2010). With a stream-line method the 15 minutes forecasts were calculated up to 6 h ahead.
For the SIS predictions a calculation of clear sky irradiance with "Specmagic" (LibRadtran) algorithm was made. The forecasts were evaluated with SIS measurements from ground stations and compared with forecasts based on the assumption of persistence of clear-sky index. In addition a comparison of forecasted irradiance and satellite GHI values is made. A heuristic decision between persistence and cloud motion vector based forecasts could be made for operational purposes.
For forecasts with the CMV- algorithm the RMSE for the first two hours of forecast is in the range of persistence RMSE or slightly higher. RMSE of the persistence forecasts agree with literature values and increase with longer forecast horizon. Initial results show a worse performance for the CMV based forecast algorithm than for the persistence forecasts beyond 2 hours. As a surprising result RMSE of CMV forecasts is often decreasing for longer forecast times.