Improving cloud and radiation forecasts by assimilating visible satellite images

Leonhard Scheck*[1,2], Stefan Geiss[1], Liselotte Bach[2], Alberto De Lozar[2], and Martin Weissmann[3]

[1]Hans Ertel Centre for Weather Research / LMU Munich – Theresienstr. 37, 80333 München, Germany
[2]Deutscher Wetterdienst [Offenbach] – Frankfurter Str.135, 63067 Offenbach, Germany
[3]Institute of Meteorology and Geophysics [Vienna] – Universitätsring 1, 1010 Vienna, Austria

Abstract

As the share of renewables in electricity generation is increasing, there is also a rising interest in improved radiation forecasts that allow for a better prediction of the uncontrollable and intermittent generation of photovoltaic power. Convective scale radiation forecasts can be improved by assimilating cloud-related observations. A promising type of observation for this purpose are satellite images in the visible spectral range, which contain high-resolution information on the location, water content and microphysical properties of clouds. Here we report on assimilation experiments using the ICON-D2 regional model and the local ensemble transformation Kalman filter implemented in the data assimilation system of the German Weather Service. A forward operator based on the Method for FAst Satellite Image Synthesis (MFASIS) and accounting for slant rays and 3D radative transfer effects is used to generate model equivalents for 0.6 micron Meteosat SEVIRI satellite images. Systematic difference between observed and systematic images and the benefits of using visible channels for model evaluation are discussed. Assimilation results for test periods of several weeks indicate that errors in the cloud distribution and the surface radiation can be significantly reduced by assimilating visible satellite images. Some beneficial impact is still present after 24 hours and also the agreement with most conventional observations is improved.

Keywords: satellite images, data assimilation, radiation, photovoltaics, convective scale

*Speaker