EMS Annual Meeting Abstracts
Vol. 14, EMS2017-689, 2017

Improving short-term irradiance forecasts in the tropics with ensemble data assimilation in limited-area models using Meteosat-8 IODC observations

Frederik Kurzrock (1), Sylvain Cros (1), Fabrice Chane-Ming (2), Laurent Linguet (3), Roland Potthast (4), and Gilles Lajoie (3)

(1) Reuniwatt SAS, R&D, Sainte-Clotilde, France (sylvain.cros@reuniwatt.com), (2) Université de La Réunion, Saint-Denis, France, (3) Université de Guyane, Cayenne, France, (4) Deutscher Wetterdienst, Offenbach, Germany

More accurate short-term solar irradiance forecasts are required to enable an increased feed-in of photovoltaic power to non-interconnected electricity grids. Achieving higher forecast accuracy is particularly challenging in the case of Tropical Islands due to the lack of distinct large-scale horizontal gradients of thermodynamic fields as in mid-latitudes, pronounced convection and local thermal circulations. Limited-area models are used to forecast cloud processes and solar irradiance at high spatio-temporal resolutions of several kilometres and minutes. Nevertheless, they fail to accurately predict cloudiness evolution and thus tend to overpredict solar irradiance. Refining the initial conditions of limited-area models in terms of the cloud analysis is an efficient means for improving short-term cloudiness and irradiance forecasts.
The assimilation of satellite observations can achieve this improvement. Radiances observations from geostationary satellites cover large parts of the globe and are the primary source of cloud cover observations in data sparse regions like a tropical island's environment. Information about the model background error is beneficial for the determination of a precise analysis. Ensemble data assimilation allows to estimate the model background error, which makes it the favourable method as compared to variational data assimilation methods.
For the first time the COSMO (COnsortium for Small-scale MOdelling) model and its local ensemble transform Kalman filter (LETKF) data assimilation system KENDA (Kilometre-scale ensemble data assimilation for the COSMO model) which have been developed by the German meteorological service (Deutscher Wetterdienst, DWD) are applied for several sites on Reunion Island - tropical Island located in the Indian Ocean - with a grid-spacing of approximately 7 km. The boundary conditions are provided by the ICON (ICOsahedral Nonhydrostatic) global ensemble model which is operated by DWD. Enhanced MSG-1 IODC (Indian Ocean Data Coverage) radiance observations are available since February 2017 and assimilated with COSMO-KENDA. Conventional observations of ground stations, ships, buoys and airplanes are used to assess the general impact of the satellite data assimilation on the regional analysis. Moreover, ground-based irradiance measurements at different locations on the island allow an assessment of the irradiance forecasts. In the performed case studies the assimilation of radiance observations with COSMO-KENDA leads to improved shortest-term (up to 24 hours) irradiance forecasts. The focus is set on situations in which the appearance or disappearance of clouds in different altitudes is governed by advection.
The performed experiments provide a first assessment of the impact of ensemble-based satellite data assimilation on short-term tropical solar irradiance forecasts using limited-area models. Extensive evaluations and refinements of this method will contribute to a more accurate weather model forecast accuracy in tropical areas and especially for a better PV power integration in these regions.