Geophysical Research Abstracts
Vol. 15, EGU2013-11851, 2013
EGU General Assembly 2013

Evaluation of the performance of a meso-scale NWP model to forecast solar irradiance on Reunion Island for photovoltaic power applications

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Solar photovoltaic power is a predominant source of electrical power on Reunion Island, regularly providing near 30% of electrical power demand for a few hours per day. However solar power on Reunion Island is strongly modulated by clouds in small temporal and spatial scales. Today regional regulations require that new solar photovoltaic plants be combined with storage systems to reduce electrical power fluctuations on the grid. Hence cloud and solar irradiance forecasting becomes an important tool to help optimize the operation of new solar photovoltaic plants on Reunion Island.

Reunion Island, located in the South West of the Indian Ocean, is exposed to persistent trade winds, most of all in winter. In summer, the southward motion of the ITCZ brings atmospheric instabilities on the island and weakens trade winds. This context together with the complex topography of Reunion Island, which is about 60 km wide, with two high summits (3070 and 2512 m) connected by a 1500 m plateau, makes cloudiness very heterogeneous. High cloudiness variability is found between mountain and coastal areas and between the windward, leeward and lateral regions defined with respect to the synoptic wind direction. A detailed study of local dynamics variability is necessary to better understand cloud life cycles around the island.

In the presented work, our approach to explore the short-term solar irradiance forecast at local scales is to use the deterministic output from a meso-scale numerical weather prediction (NWP) model, AROME, developed by Meteo France.

To start we evaluate the performance of the deterministic forecast from AROME by using meteorological measurements from 21 meteorological ground stations widely spread around the island (and with altitudes from 8 to 2245 m). Ground measurements include solar irradiation, wind speed and direction, relative humidity, air temperature, precipitation and pressure. Secondly we study in the model the local dynamics and thermodynamics that control cloud development and solar irradiance in order to define new predictors to improve probabilistic forecast of solar irradiance.