Solar irradiance modelling over Belgium using Regional models within the frame of a day-ahead photovoltaic production forecasting system

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Global solar irradiances are modelled over Belgium using the regional climate WRF-ARW v3.4 model at a resolution of 5 kilometres over 2013 and 2014. Different WRF settings are tested and results are compared every 15 minutes with solar irradiance measurements performed at Sart-Tilman (Liège) and Daussoulx in the Walloon Region. A 2D representation of modelled cloudiness is also compared with in-situ observations at Sart-Tilman. The use of a large number of vertical layers in the low troposphere are needed to successfully model low stratiform clouds. However, issues are generally still encountered with stratocumulus and cumulus modelling with a systematic dry bias in the WRF-ARW outputs. Global irradiances are also modelled using the regional climate MAR model and the results are compared together with WRF outputs and in-situ observations. First tests suggest that the MAR model may perform significantly better than WRF-ARW for the modelling of this variable. Once the modelling of global irradiance is done, it is decomposed into direct and diffuse irradiances using the sigmoid model proposed by Ruiz-Arias et al., (2010). Diffuse irradiances fractions obtained using the global adjustment compare well with observations when modelling of global irradiances is successfully performed. Modelled global and diffuse irradiances are then used to develop a physical model of photovoltaic production which is afterwards compared with the historical data of photovoltaic panels productions.