EMS Annual Meeting Abstracts
Vol. 16, EMS2019-671, 2019

Uncertainty estimates of local global radiation measurements taking into account the mesoscale spatial and temporal variability

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The Lindenberg Meteorological Observatory – Richard-Aßmann-Observatory (MOL-RAO) of the German Meteorological Service (DWD) has been performing measurements of the radiation budget components for more than 20 years at its boundary layer field site (Grenzschichtmessfeld) GM Falkenberg. Data from Falkenberg are extensively used to monitor the performance of the operational NWP models in DWD.
Incoming radiation may exhibit strong temporal and spatial variations at scales of a few minutes and a few kilometers, respectively, in particular under conditions of changing cloudiness. In order to allow a fair comparison of local radiation measurements at a given site versus grid values forecasted by an NWP model, an uncertainty estimate of the measured data should be given that reflects the effect of rapidly changing cloud conditions.
We have developed a method to characterize the uncertainty of global radiation measurements at GM Falkenberg using an envelope method applied to the time series of 10-minutes averaged radiation data with a filter width of seven time steps. Before determining the envelope, the radiation data are normalized using the clear-sky radiation model proposed by Bird and Halstrom. Data from a regional scale network of eight radiation sensors distributed around Lindenberg, which was in operation between July 1999 and May 2015, were used for validation of the proposed method. We were able to show that the arithmetic mean from these stations (assumed to represent an estimate of the area-averaged radiation) falls within the uncertainty range derived from this method for more than 90 % of all cases. The method can, with some modifications, also be applied to data of the downward longwave radiation.