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Optimizing observation impact on data assimilation for the short-term forecast with the use of Forecast Sensitivity to Observations (FSO)

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This study applies the concept of Forecast Sensitivity to Observations (FSO) to optimize an observation network dedicated to improve data assimilation for short-term energy forecasts over Europe. The poor representation of cloud fields in Numerical Weather Prediction (NWP) models is setting the limitations to accurate prediction. These limitations are approached by examining the observation network configuration in the frame of data assimilation. The variety of available observation types implies different information values for the assimilation and it is of importance to identify the most valuable observations. FSO is able to provide quantitatively the impact of different types of observations on the forecast error with the use of NWP model and its data assimilation as well as adjoint components.
Firstly, the assimilation of temperature, wind speed and pressure at locations of interest is performed by the Three-Dimensional Variational Data Assimilation (3D-VAR) system of the NWP model WRF (Weather and Research Forecasting Model). A cost function based on the dry energy norm is then defined and serves as an input information for the adjoint model (WRFPLUS), which then transports this information back to the time of assimilation. This information is used by the FSO system to estimate the observation impact. The impact of the monitoring network on short-term forecasts is investigated and the configuration of the ground based monitoring network with the use of artificial data is examined. The quantitative observation impact of the monitoring network provides an understanding of the quality of the observational data used in the data assimilation systems, leading to an optimized observation network configuration.