Assimilation of ground-based microwave radiometer observations into the convection resolving ICON model using an observing system simulation experiment

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State-of-the-art high resolution, convection resolving NWP models and reanalysis typically operate on a horizontal resolution of 1-5 km. These models require specific data assimilation schemes with frequent analysis (every 1-6 h) and corresponding dense and frequent observations to define the detailed initial conditions. Key variables needed for convection-resolving data assimilation are, among others, the 3-dimensional fields of temperature and humidity. Both variables are not adequately (vertically, horizontally and temporally) measured by current observing systems, which mostly comprise radiosondes, aircraft observations, and polar orbiting satellite sensors. The vertical resolution of atmospheric profiles provided by satellite sensors is poor, especially in the atmospheric boundary layer, where convection resolving models have many layers close to the surface to better describe the surface-atmosphere exchange processes. To the necessary information, a new generation of observations through the lowest few kilometers of the atmosphere is required. A network of ground-based remote sensing sensors (e.g., microwave radiometer, MWR, or water vapor DIAL) has the potential to provide real time profile observations to forecasting centers. Maintaining an operational observing network is a difficult and expensive task. Therefore, it is essential to evaluate the impact of different components of the current observing system and to assess the potential contribution of a new observing components to the analysis of the atmospheric state.
In our study we perform an Observing System Simulation Experiment (OSSE) to show the potential benefit of ground-based MWR for improving the initial thermodynamic state of the atmosphere. The Nature Run (NR), representing the “true” atmosphere, is performed using the ICON-LES model for a 150x150 km domain in the western part of Germany with 500 m horizontal resolution for summertime convective cases. The MWR observations, consisting of temperature and humidity profile dependent brightness temperatures, are simulated with the radiative transfer model RTTOV-gb and assimilated into the convection resolving ICON model (2km horizontal resolution). We will present first impact studies of assimilating synthetic observations of single MWR instruments on the initial temperature and humidity fields and consider the approach for evaluating the effect of a network of instruments with respect to other variables of interest, such as precipitation and solar radiation, i.e. relevance for solar power applications.