EMS Annual Meeting Abstracts
Vol. 21, EMS2024-853, 2024, updated on 16 Jan 2025
https://doi.org/10.5194/ems2024-853
EMS Annual Meeting 2024

A campaign re-analysis for 'Swabian MOSES 2023': how do high-resolution observations change the analysis of a convective-scale data assimilation system?

Julia Thomas[1], Gernot Geppert[2], Hendrik Reich[2], Thorsten Steinert[2], Harald Anlauf[2], Jan Keller[2], Peter Knippertz[1], and Annika Oertel[1]
[1]Karlsruhe Institute of Technology, Institute of Meteorology and Climate Research Troposphere Research (IMKTRO), Karlsruhe, Germany (julia.thomas@kit.edu)
[2]German Weather Service (DWD), Offenbach, Germany

Natural hazards associated with mesoscale processes such as summertime convective events pose a considerable threat to people and property. Yet, forecasting such events remains a challenge, even for the latest generation of high-resolution, convective-scale numerical weather prediction models. Their forecast quality in such cases will likely benefit from improved initial conditions in form of an improved data assimilation analysis. Thus, the assimilation of high-resolution measurements of the lower troposphere has a high potential to enhance the predictability of convective conditions. For example, recent studies by the German Weather Service (DWD) in Aachen and Lindenberg suggest a positive influence of additional Doppler wind lidars (DWLs) on the analysis. However, a thorough investigation of the impact of additional ground-based observations in complex terrain is still lacking.

The 'Swabian MOSES' campaign took place from June to August 2023 in the German Black Forest mountain range and deployed a spatially distributed network of instruments to observe the dynamic and thermodynamic characteristics of the lower troposphere. Among them was a network of 12 DWLs, which together have never been used for data assimilation experiments before. Here, we present a 3-months campaign re-analysis dataset that uses a wealth of remote sensing and in-situ campaign observations. These data are added to the regional forecasting system of the DWD, which employs the non-hydrostatic model ICON at 2 km resolution (ICON-D2) and the Kilometer Scale Ensemble Data Assimilation system (KENDA) with 40 ensemble members that uses a Local Ensemble Transform Kalman Filter. We assimilate additional vertical profiles of the horizontal wind retrieved from the DWLs, targeted radiosoundings released from two sites during intensive observation periods, ground based zenith path-delay observations from a (not yet operational) German-wide network of Global Navigation Satellite Systems receivers, and 2-meter temperature and relative humidity as well as surface pressure observations.

In this contribution, we present our experimental setup, address challenges associated with the assimilation of non-operational observations, and demonstrate how different observations influence the campaign re-analysis. Moreover, we compare the campaign re-analysis with a quasi-operational reference re-analysis without additional observations. Our main focus is on the representation of convective summertime conditions.