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Assimilation of 3D polarimetric microphysical retrievals using the operational ICON model framework of DWD

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The use of dual-polarization radar data for model evaluation and data assimilation (DA) has the potential to enhance the representation of microphysical processes in numerical weather prediction (NWP) models and short-term quantitative precipitation forecasts (QPFs). Reimann et al. (2023) evaluated in a first study but for only two stratiform and one convective rainfall events in the summers of 2017 and 2021 the benefits of radar-derived liquid water content (LWC) and ice water content (IWC) in data assimilation. These two quantities are derived from observations of the operational dual-polarimetric C-band radar network of the German national meteorological service (DWD, Deutscher Wetterdienst) and assimilated into the operational convective-scale NWP model ICON-D2 of DWD using the ensemble-based KENDA (Kilometer-Scale Ensemble Data Assimilation system) framework.
This study extends the work by Reimann et al. (2023). E.g. since spring 2021, the radial resolution of the radar volume scans has been increased from 1 km to 0.25 km, enabling also to increase the accuracy of the microphysical retrievals. We present our advanced setup, including e.g. Z_{DR} calibration, and will show our preliminary results on the performance of different assimilation configurations. The configurations are the assimilation of conventional observations (CONV), the additional assimilation of 3D reflectivities (Z_H), the assimilation of 3D LWC or IWC below or above the melting layer instead of Z_H where possible and the joint assimilation of all radar sets together with CONV. We demonstrate how the use of updated retrievals using both the new higher radial resolution only and revised optimized DA settings compares to previous assimilation results from Reimann et al. (2023). Since the accuracy of state-of-the-art polarimetric microphysical retrievals is still reduced in the presence of riming, we focus on stratiform events only, such as the precipitation event on 14 July 2021 in the Ahr valley and the recent event on 31 May 2024 in Bavaria and Baden-Württemberg. Both events led to devastating floods. Further investigations are underway to apply the double-moment bulk microphysics scheme in the data assimilation framework, which is potentially more suited to digest the polarimetric information content compared to the single-moment scheme.

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Session

Seamless Prediction: Data assimilation integrating nowcasting and new observations

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