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Exploiting polarimetric radar observations to improve the ICON-D2 2-moment microphyiscs

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Polarimetric radar operators such as EMVORADO (Efficient Modular VOlume scan RADar Operator) enable the direct comparison of numerical weather simulations with radar observations in the polarimetric observation space. Additionally, microphysical retrievals are the appropriate way to conduct a synergistic comparison in model space. Our objective is an in-depth evalutation of the 3-dimensional representation of hydrometeors in ICON-D2 employing both strategies.

ICON-D2 with the two-moment microphysical scheme from Seifert-Beheng shows, similar to other numerical weather models, a tendency towards excessive riming and an overproduction of graupel. As a consequence, also oversized drops are simulated below the melting layer. In order to converge ICON simulations and according synthetic radar variables simulated with the EMVORADO to the actual radar observations, model evaluation and model parameter adjustment has been applied in an iterative procedure. This implies several experiments with adjusted microphysical parameters of ICON (e.g. sticking efficiencies, riming efficiencies, terminal velocities, shedding parameters) together with improvements in the melting scheme of EMVORADO. Among the challenges is the development of one universal melting scheme for both large-scale stratiform precipitation and convective thunderstorms. This study investigates the representation of hydrometeors in ICON-D2 and the performance of EMVORADO in different weather situations, in different seasons and for the whole German C-band radar network.

Until now, significant improvements have been achieved, e.g. reduced graupel production and mean droplet sizes that are more consistent with the radar measurements. In convective situations, we are able to identify synthetic/simulated columns of enhanced differential reflectivity, ZDR columns, although with smaller ZDR values compared to observations. First results show too much graupel above the melting layer dominating the ZDR signal but only small raindrops are transported upwards. The opposite is true for the areas below the cores of convective storms, where the formation of too large raindrops is apparent.

Presenting Author

Julian Steinheuer

Email Address of Presenting Author

J.Steinheuer@uni-bonn.de

Affiliation of Presenting Author

Institute of Geosciences, Meteorology Section, University of Bonn, Germany

Address of Presenting Author

Institut für Geowissenschaften, Auf dem Hügel 20, 53121 Bonn

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DE 122119125

Author: STEINHEUER, Julian (Institute of Geosciences, Meteorology Section, University of Bonn, Germany)

Co-authors: DE LOZAR, Alberto (Deutscher Wetterdienst); MENDROK, Jana (Deutscher Wetterdienst, Offenbach, Germany); TRÖMEL, Silke (University of Bonn, Institute for Geosciences - Section Meteorology); BLAHAK, Ulrich (Deutscher Wetterdienst); PEJCIC, Velibor (Institute of Geosciences, Meteorology Section, University of Bonn, Germany)

Presenter: STEINHEUER, Julian (Institute of Geosciences, Meteorology Section, University of Bonn, Germany)