EGU22-11528
https://doi.org/10.5194/egusphere-egu22-11528
EGU General Assembly 2022

Evaluation of convective cloud microphysics in numerical weather prediction models with dual-wavelength polarimetric radar observations

Gregor Köcher[1], Florian Ewald[2], Martin Hagen[2], Christoph Knote[1,3], Eleni Tetoni[2], and Tobias Zinner[1]

[1]Ludwig-Maximilians-Universität, Meteorologisches Institut, München, Germany
[2]Deutsches Zentrum für Luft- und Raumfahrt (DLR), Institut für Physik der Atmosphäre, Oberpfaffenhofen, Germany
[3]Universität Augsburg, Medizinische Fakultät, Augsburg, Germany

The representation of microphysical processes in numerical weather prediction models remains a main source of uncertainty until today. To evaluate the influence of cloud microphysics parameterizations on numerical weather prediction, a convection permitting regional weather model setup has been established using 5 different microphysics schemes of varying complexity (double-moment, spectral bin, particle property prediction (P3)). A polarimetric radar forward operator (CR-SIM) has been applied to simulate radar signals consistent with the simulated particles. The performance of the microphysics schemes is analyzed through a statistical comparison of the simulated radar signals to radar measurements on a dataset of 30 convection days.

The observational data basis is provided by two polarimetric research radar systems in the area of Munich, Germany, at C- and Ka-band frequencies and a complementary polarimetric C-band radar operated by the German Meteorological Service. By measuring at two different frequencies, the dual-wavelength ratio that facilitates the investigation of the particle size evolution is derived. Polarimetric radars provide in-cloud information about hydrometeor type and asphericity by measuring, e.g., the differential reflectivity ZDR.

Within the DFG Priority Programme 2115 PROM, we compare the simulated polarimetric and dual-wavelength radar signals with radar observations of convective clouds. Deviations are found between the schemes and observations in ice and liquid phase, related to the treatment of particle size distributions. Apart from the P3 scheme, simulated reflectivities in the ice phase are too high. Statistical distributions of simulated and observed polarimetric and dual-wavelength radar signals demonstrate the challenge to correctly represent ice and rain particle size distributions. The polarimetric information is further exploited by applying a classification algorithm to obtain dominant hydrometeor classes. By comparing the simulated and observed distribution of hydrometeors, as well as the frequency, intensity and area of high impact weather situations (e.g., hail or heavy convective precipitation), the influence of cloud microphysics on the ability to correctly predict high impact weather situations is examined.