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Improving microphysics in a convective parameterization: possibilities and limitations

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The convective cloud field model (CCFM) is a convective parameterization implemented in the climate model ECHAM6.1-HAM2.2. It represents a population of clouds within each ECHAM-HAM model column, simulating up to 10 different convective cloud types with individual radius, vertical velocities and microphysical properties. Comparisons between CCFM and radar data at Darwin, Australia, show that in order to reproduce both the convective cloud top height distribution and the vertical velocity profile, the effect of aerodynamic drag on the rising parcel has to be considered, along with a reduced entrainment parameter.

A new double-moment microphysics (the Predicted Particle Properties scheme, P3) has been implemented in the latest version of CCFM and is compared to the standard single-moment microphysics and the radar retrievals at Darwin. The microphysical process rates (autoconversion, accretion, deposition, freezing, ...) and their response to changes in CDNC are investigated and compared to high resolution CRM WRF simulations over the Amazon region. The results shed light on the possibilities and limitations of microphysics improvements in the framework of CCFM and in convective parameterizations in general.