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Improving the representation of mixed-phase cloud microphysics in the ICON-LEM

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The representation of ice-phase cloud microphysics in ICON-LEM (the Large-Eddy Model configuration of the ICOsahedral Nonhydrostatic model) is improved by implementing the recently published Predicted Particle Properties (P3) scheme into the model. In the typical two-moment microphysical schemes, such as that previously used in ICON-LEM, ice-phase particles must be partitioned into several prescribed categories. It is inherently difficult to distinguish between categories such as graupel and hail based on just the particle size, yet this partitioning may significantly affect the simulation of convective clouds. The P3 scheme avoids the problems associated with predefined ice-phase categories that are inherent in traditional microphysics schemes by introducing the concept of "free" ice-phase categories, whereby the prognostic variables enable the prediction of a wide range of smoothly varying physical properties and hence particle types. To our knowledge, this is the first application of the P3 scheme in a large-eddy model with horizontal grid spacings on the order of 100 m.

We will present results from ICON-LEM simulations with the new P3 scheme comprising idealized stratiform and convective cloud cases. We will also present real-case limited-area simulations focusing on the HOPE ($\mathrm{HD(CP)^2}$ Observational Prototype Experiment) intensive observation campaign. The results are compared with a matching set of simulations employing the two-moment scheme and the performance of the model is also evaluated against observations in the context of the HOPE simulations, comprising data from ground based remote sensing instruments.