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Prognostic description of ice using a single category in the GCM ECHAM-HAM

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A new scheme for stratiform cloud microphysics has been implemented in a general circulation model. It features a widely used description of cloud water with the two categories for cloud droplets and rain. The unique aspect of the scheme is the break with the traditional approach to describe cloud ice analogously. Here we parametrize cloud ice with a single, prognostic category, as it has been done in recent regional models. The intrinsicly hard to parametrize processes of aggregation and accretion are replaced by the explicit computation of ice particle collection and fall speeds within the prognosed particle size distribution.

This work shows that a single category is a viable approach to describe cloud ice in climate models. Performance is evaluated in idealized single column model setups as well as global runs. We find that a nested approach for sub-stepping the microphysics scheme yields good results in terms of numerical stability and computational cost. The scheme is compared to an established description of cloud ice with two categories for in-cloud ice and snow. We find that especially in clouds where aggregation is weak but fall-speeds are not negligible due to strong depositional growth or riming, the new scheme produces much more reasonable results.