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Impact of cloud microphysics on cloud feedback and climate sensitivity

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Clouds are important for climate and climate change by interacting with radiation and being part of the hydrological cycle. They constitute a large uncertainty in global climate modeling and climate change projections as cloud processes occur on the subgrid-scale and need to be parameterized. In order to investigate the importance of cloud microphysics on cloud feedback and climate sensitivity, we will use different versions of the ECHAM6 general circulation model. The standard version ECHAM6-std only has a one-moment cloud microphysics scheme, which solves prognostic equations for the liquid and ice water mass mixing ratios. In ECHAM6-CCN, a two-moment cloud microphysics scheme (Lohmann and Ferrachat, 2010) is used. In order to obtain the number of activated cloud droplets, ECHAM6 is coupled to a CCN climatology that has been derived from observations and a suite of climate models (Kinne, pers. comm.). In ECHAM6-HAM, the two-moment cloud microphysics scheme is coupled to the Hamburg Aerosol Model HAM (Stier et al., 2005). In this version the chemical composition of the aerosols for acting as cloud condensation and ice nuclei is taken into account. By coupling these different ECHAM versions to a mixed-layer model, we will investigate how the different degrees of complexity in cloud microphysics impact cloud feedback and climate sensitivity.