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Mixed-phase altocumulus clouds over Leipzig: Remote sensing measurements and spectral cloud microphysics simulations

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The present work combines remote sensing observations and detailed microphysics cloud modeling to investigate two altocumulus cloud cases observed over Leipzig, Germany. A suite of remote sensing instruments was able to detect primary ice at rather warm temperatures of -6°C. For comparison, a second mixed phase case at about -25°C is introduced. To further look into the details of cloud microphysical processes a simple dynamics model of the Asai-Kasahara type is combined with detailed spectral microphysics forming the model system AK-SPECS. Temperature and humidity profiles are taken either from observation (radiosonde) or GDAS reanalysis. Vertical velocities are prescribed to force the dynamics as well as main cloud features to be close to the observations. Subsequently, sensitivity studies with respect to dynamical as well as ice microphysical parameters are carried out with the aim to quantify the most important sensitivities for the cases investigated. For the cases selected, the liquid phase is mainly determined by the model dynamics (location and strength of vertical velocity) whereas the ice phase is much more sensitive to the microphysical parameters (ice nuclei (IN) number, ice particle shape). The choice of ice particle shape may induce large uncertainties which are in the same order as those for the temperature-dependent IN number distribution.