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Inhomogeneities in cirrus clouds

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Spatial inhomogeneities in cirrus clouds have a great impact on their radiative properties and therefore on Earth's energy budget. The formation of inhomogeneities depends strongly on the environmental conditions and the dynamical situation.

In this study idealized numerical simulations with a 2D cloud resolving version of the EULAG model are carried out in order to identify the key processes that lead to inhomogeneities. The model includes a two moment bulk microphysical scheme for cold clouds. Nucleation, deposition and sedimentation are the microphysical processes represented by the scheme.

Different environmental conditions are tested, which give rise to two kinds of dynamic instabilities. Namely convective instability caused by lifting of a potentially unstable layer and Kelvin-Helmholtz instability due to strong wind shear in a stably stratified environment. The relative importance of dynamic and thermodynamic processes is investigated. The different length scales involved in the formation of the inhomogeneities are identified by spectral analysis. The temporal evolution of spectra is used to distinguish between different formation processes. It turns out that the two instabilities occur on different length scales in the early stage of the evolution. In a later stage the length scale of inhomogeneities depends mostly on background wind speed and Brunt-Vaisala frequency.