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Cirrus cloud dynamics - a source for supersaturation inside cirrus

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The occurrence of cirrus clouds and their potential formation regions, i.e. ice-supersaturated regions in the extra tropics is strongly correlated to large-scale dynamics, i.e. weather systems along their storm tracks (e.g. Wylie and Menzel, 1999; Gierens et al., 2000). The vertical velocities produces by these systems in the upper troposphere are moderate ($w < 10$ cm/s) but could last for hours. This large-scale feature should form quite homogeneous layer of ice clouds, as sometimes observed. On the other hand, we know from several measurements that these clouds layers often are not homogeneous in terms of ice crystal number density and relative humidity. This points to dynamics on small scale or mesoscale inside cirrus clouds, producing an internal structure. Dynamics on smaller scales depends strongly on the environmental conditions (thermal stratification, wind speed and shear).

In this contribution I investigate the dynamics inside cirrus clouds during large-scale ascents using different environmental conditions. For this purpose the anelastic non-hydrostatic model EULAG (Smolarkiewicz and Margolin, 1997) together with a recently developed and validated ice microphysics scheme (Spichtinger and Gierens, 2008) is used.

It turns out that dynamics on smaller scales inside cirrus clouds originally triggered by large-scale updrafts also affects the relative humidity distribution inside the clouds. In some cases, high supersaturations inside thick clouds (i.e. cirrus with high ice crystal number densities) could exist as a transition phenomenon. However, these findings maybe partly could explain the high supersaturation puzzle (Peter et al., 2006).

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