# Impact of mesoscale dynamics and aerosols on the life cycle of cirrus clouds

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The role of clouds is crucial for our understanding of the current and the changing climate (IPCC, 2007). Cirrus clouds modulate the Earth's radiation budget significantly. It is assumed that (thin) cirrus clouds contribute to a net warming of the Earth-Atmosphere system (see e.g. Chen et al., 2000) but the magnitude of this warming has not been quantified yet. Recently, the impact of thin cirrus clouds in the mid latitudes was estimated in idealised framework using vertical profiles from radiosondes (Fusina et al., 2007), but the global effect is still uncertain. The formation and evolution of cirrus clouds depends in a complex way on a variety of environmental conditions (temperature, relative humidity, wind fields) as well as on the impact of background aerosol acting as ice nuclei. The interaction of various processes and their non-linear dependence on ambient conditions renders the understanding of cirrus clouds in general a difficult task.

Although cirrus clouds appear quite homogeneous from a satellite perspective (e.g., a warm-front cirrus), even a casual glance from the ground reveals an inhomogeneous, patchy structure of cirrus, corroborated by in situ measurements: Inside cirrus clouds temperature and vertical velocity flucutations are substantial, thus causing inhomogeneities in ice crystal number concentrations and ice water content. Based on temperature and/or vertical velocity measurements in the upper troposphere (e.g. Gary, 2006; Gierens et al., 2007) an ``ubiquitous'' background of temperature fluctuations is often assumed and superimposed on trajectory calculations for large-scale updraft motion. However, these variations (in temperature and/or vertical velocity) have a deterministic physical origin. In particular, small-scale variations can be related to turbulence generated by breaking internal gravity waves. One main task in our cirrus cloud research is to identify physical sources of these variations inside cirrus clouds and their impact on the life cycle of cirrus clouds.

Using the EULAG model together with a newly developed and validated ice microphysics scheme (Spichtinger and Gierens, 2008) the impact of orographic waves and turbulence generated in critical layers is investigated. Additionally, the impact of heterogeneous ice nuclei competing against homogeneous freezing, the dominant pathway of ice crystal formation in the tropopause region, on the life cycle of cirrus clouds is investigated prescribing the same dynamical setup.