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Atmos. Chem. Phys., 7, 3771-3781, 2007
www.atmos-chem-phys.net/7/3771/2007/
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Physical controls on orographic cirrus inhomogeneity

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Abstract. Optical depth distributions (P(σ)) are a useful measure of radiatively important cirrus (Ci) inhomogeneity. Yet, the relationship between P(σ) and underlying cloud physical processes remains unclear. In this study, we investigate the influence of homogeneous and heterogeneous freezing processes, ice particle growth and fallout, and mesoscale vertical velocity fluctuations on P(σ) shape during an orographic Ci event. We evaluate Lagrangian Ci evolution along kinematic trajectories from a mesoscale weather model (MM5) using an adiabatic parcel model with binned ice microphysics. Although the presence of ice nuclei increased model cloud cover, our results highlight the importance of homogeneous freezing and mesoscale vertical velocity variability in controlling Ci P(σ) shape along realistic upper tropospheric trajectories.

Final Revised Paper (PDF, 16405 KB) Discussion Paper (ACPD)

Citation: Kay, J. E., Baker, M., and Hegg, D.: Physical controls on orographic cirrus inhomogeneity, Atmos. Chem. Phys., 7, 3771-3781, 2007. Bibtex EndNote Reference Manager

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