Geophysical Research Abstracts
Vol. 16, EGU2014-1860-1, 2014
EGU General Assembly 2014

Formation of highly porous aerosol particles by atmospheric freeze-drying in ice clouds

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In cold high altitude cirrus clouds and anvils of high convective clouds in the tropics and mid-latitudes, ice partciles that are exposed to subsaturation conditions with respect to ice can sublimate, leaving behind residual modified aerosols. This freeze-drying process can occur in various types of clouds. In this talk we will describe experiements that simulate the atmospheric freeze-drying cycle of aerosols. We find that aerosols with high organic content can form highly porous particles (HPA) with a larger diameter and a lower density than the initial homogenous aerosol following ice subliation. We attribute this morphology change to phase separation upon freezing followed by a glass transition of the organic material that can preserve a porous structure follwoing ice sublimation. We find that the highly porous aerosol scatter solar light less efficiently than non-porous aerosol particles. A porous structure may explain the previously observed enhancement in ice nucleation efficiency of glassy organic particles. These observations may have implications for subsequent cloud formation cycles and aerosol albedo near cloud edges.