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Aerosols that form subvisible cirrus at the tropical tropopause

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Abstract. The composition of residual particles from evaporated cirrus ice crystals near the tropical tropopause as well as unfrozen aerosols were measured with a single particle mass spectrometer. Subvisible cirrus residuals were predominantly composed of internal mixtures of neutralized sulfate with organic material and were chemically indistinguishable from unfrozen sulfate-organic aerosols. Ice residuals were also similar in size to unfrozen aerosol. Heterogeneous ice nuclei such as mineral dust were not enhanced in these subvisible cirrus residuals. Biomass burning particles were depleted in the residuals. Cloud probe measurements showing low cirrus ice crystal number concentrations were inconsistent with conventional homogeneous freezing. Recent laboratory studies provide heterogeneous nucleation scenarios that may explain tropopause level subvisible cirrus formation.

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