6.075 Airborne Measurements of Mineral Dust Abundance, Mixing State, and Ice Nucleating Properties.

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Abstract:

Mineral dust aerosol particles impact the Earth's radiative balance via direct scattering and absorption of light and by promoting ice cloud formation. Modelling studies suggest that mineral dust is a leading contributor to aerosol optical depth throughout much of the globe. Lab and field studies indicate that dust particles are efficient ice nuclei, and recent airborne measurements confirm the dominant role of mineral dust on cirrus cloud formation in the Northern Hemisphere. However, our ability to simulate the net climate impact of mineral dust is limited by a lack of validating measurements of dust abundance and mixing state above the Earth's surface. We present a summary of mineral dust measurements in the free troposphere from more than 10 years of airborne sampling, highlighting vertical distributions, hemispheric dissimilarities, chemical transformation, and dust's role in cirrus formation. Clear sky aerosol measurements show that mineral dust is ubiquitous in the background upper troposphere at levels from ~1 to 1000's per liter and frequently accounts for 5-40% of particulate mass. Principal sources of upper tropospheric mineral dust include deep convection, strong biomass burning events, and long range isentropic transport. Over time mineral dust becomes coated with secondary sulfate, nitrate, and organic material that can deactivate ice nucleation sites on particle surfaces. This reduction in cirrus-forming potential depends on co-emissions, transport mechanisms, and particle age.