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No widespread dust in the upper atmosphere of Mars from Mars Climate Sounder observations

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The vertical distribution of dust in the Martian atmosphere has been a topic of discussion in the recent years. Measurements by limb sounding instruments like the Mars Climate Sounder (MCS) and the Thermal Emission Spectrometer (TES) indicate that atmospheric dust is not homogeneously distributed in the vertical but exhibits layering in the lower atmosphere. Recent retrievals from TES measurements also suggest a dust maximum higher in the atmosphere that predominantly occurs at 50-60 km altitude on the daytime hemisphere. We use new retrievals from MCS measurements to investigate this deduction.

MCS is a mid- and far-infrared thermal emission radiometer on board the Mars Reconnaissance Orbiter. It measures radiances in limb and on-planet viewing geometries. From these radiance measurements, profiles of atmospheric temperature, dust and water ice are retrieved from the surface to $\sim$80 km with a vertical resolution of $\sim$5 km. Updates to the retrieval algorithm yield improved representations of aerosols above $\sim$40 km altitude.

With a few notable exceptions, retrieved dust extinctions in the upper atmosphere do not exceed 1e-5 km-1 at mid-infrared wavelengths, which is close to the limit of the MCS sensitivity. The sensitivity of an MCS limb measurement to aerosols at these altitudes is typically not limited by signal-to-noise but rather by the uncertainties in the representation of the instrument's vertical field-of-view, the far wings of which can provide radiance contributions from the lower atmosphere and the surface. Sensitivity studies suggest that low radiances measured at high altitudes are not caused by widespread dust but can be explained by these radiance contributions. Thus MCS measurements do not support the existence of widespread dust in the upper atmosphere of Mars.