Geophysical Research Abstracts,
Vol. 10, EGU2008-A-06103, 2008
SRef-ID: 1607-7962/gra/EGU2008-A-06103
EGU General Assembly 2008

Frontiers in radiative transfer for remote sensing and climate modeling of Venus and Mars

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Recent improvements in our understanding of the absorption, emission, and multiple scattering in the atmospheres of Venus and Mars have contributed to our ability to analyze remote sensing observations and to simulate the climates of these planets. However, some of the radiative processes in these atmospheres still pose substantial challenges. The absorption by CO_2 and other trace gases in the high-pressure, high-temperature conditions of the deep atmosphere of Venus is strongly influenced by quantum-mechanical line mixing and pressure-induced absorption, as well as other processes poorly represented in most models. These processes are contributing uncertainties as large as a factor of 2 in retrievals of trace gas abundances at altitudes between the cloud base and the surface. At higher altitudes on Venus, and throughout the atmosphere of Mars, the combined effects of line mixing and non-local thermodynamic equilibrium contribute uncertainties remote sensing retrievals and in radiative heating and cooling rate calculations, particularly at near-infrared wavelengths. Limitations in our ability to model multiple scattering by non-spherical dust particles in the Martian atmosphere compromise our ability to retrieve the thermal structure, trace gas, and dust distributions from available remote sensing observations. New laboratory measurements and new theoretical approaches to address these areas will be summarized (or solicited) in this presentation.