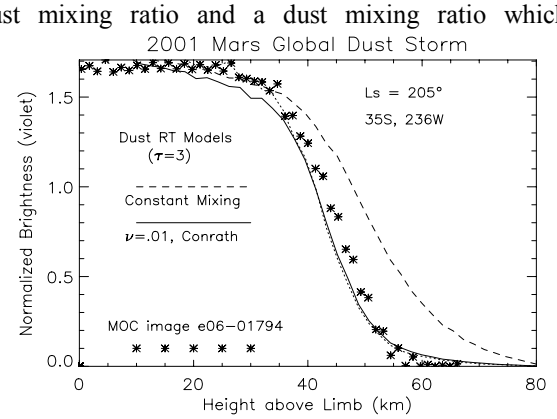
VERTICAL DISTRIBUTIONS OF DUST OPTICAL DEPTH DURING THE 2001 PLANET ENCIRCLING STORM FROM A SPHERICAL RADIATIVE TRANSFER ANALYSIS OF MOC LIMB IMAGES. R. T. Clancy[1], M. J. Wolff[1], B. A. Whitney[1], and B. A. Cantor[2], [1]Space Science Institute (P.O. Box 3075, Bald Head Island, NC 28461, clancyr@colorado.edu) for first author, [2]Malin Space Science Systems.

Introduction: The Mariner 9 IRIS thermal profile analysis of Conrath [1] and Viking limb analysis of Jaquin et al. [2] form the basis for our current understanding of dust vertical profiles during major (planet-encircling) Mars dust storms. The June-Sept 2001 major dust storm provides the opportunity for a much more comprehensive study, based upon MGS MOC (Mars Orbital Camera [3]) limb imaging and TES (Thermal Emission Spectrometer [4]) limb scan observations of dust vertical profiles in a globally extended dust storm. The current analysis pertains to MOC blue wide angle (WA) images returned in late July during the peak phase of the 2001 dust storm (L_s=200-205°), and in September during the early clearing phase of the storm (L_s=236°). A broader study under development will incorporate coarser vertical resolution TES limb observations (15 km versus the 2 km MOC resolution) with thermal IR (7-45 μm) and solar band (λ_{eff} = 0.7 μm) spectral coverage. This will eventually allow us to derive specific information on the vertical distribution of aerosol particle sizes. Here, we limit analysis to the retrieval of dust optical depth versus altitude for the purpose of defining the vertical extension of dust lifting during a planet-encircling dust storm.

MOC Limb Images: We have analysed a subset of MOC WA blue (400-450 nm) images that obtained atmospheric limb coverage with optimum vertical (i.e., unbinned, ~1.3 km/pixel) resolution during the July-Sept period of the 2001 Mars dust storm. The calibration and flat fielding for the MOC blue WA remain preliminary, especially at the margins of the CCD where the atmospheric limb is imaged in these data. Consequently, we compare radiative transfer (RT) models and MOC limb brightnesses in a relative sense. In this presentation we emphasize an unusually extended MOC limb image, characterized by continuous coverage from 48S to 45N latitudes, centered on 240W longitude, for L_s=205°. Additional, much less extended (in latitude) MOC limb images are modeled for L_s of 199°, 202°, and 236°.

Monte Carlo RT Model: We employ the full spherical, multiple scattering Monte Carlo RT code developed by Barbara Whitney for astrophysical studies, which she has recently reconfigured for Mars RT applications [5]. This model currently provides both emission and scattering source functions which may be specified with full three dimensional distributions, altough we employ purely scattering calculations with one dimensional dust distributions in the vertical for this study. Dust scattering properties (single scattering phase function and albedo) are represented by simple Henyey Greenstein expressions as well as full T-matrix ellipsoidal expansions, based upon analysis of multi-color HST images observed during 2001 dust storm [6].

Model-Data Comparisons: Figure 1 presents a typical limb brightness profile from the L_s=205° MOC image (asterisk sysmbols), at a latitude of 35S as indicated on the figure. Two model profiles are presented as solid and dashed lines, corresponding to a constant dust mixing ratio and a dust mixing ratio which



decreaes above 30 km according to the Conrath parameterization with ν=0.01, respectively. A dust vertical distribution in which particle settling velocities become significant relative to vertical lifting and mixing for altitudes above 30 km is implied by the observed MOC limb brightness. In general, this behavior typifies the vertical distribution of dust among the range of MOC limb profiles so far analyzed. However, the latitude range 5N to 20S for this particular image displays distinctly shallower dust vertical mixing. Furthermore, there are significant variations within the 30-50 km region and distinct "plateaus" of limb brightness at altitudes of 50-70 km which appear common during this dust storm. We will present these range of dust mixing profiles for a broader crossection of MOC imaging data, as well as preliminary TES solar band and thermal IR limb profiles.

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