DETERMINATION OF NET MARTIAN POLAR DUST FLUX FROM MGS-TES OBSERVATIONS. M. A. Blackmon[1,*] and J. R. Murphy[1], [1]Department of Astronomy, New Mexico State University, Las Cruces, NM 88003-8001, USA. [*]E-mail address: mablackm@nmsu.edu (M. A. Blackmon)

Introduction: Using atmospheric dust abundance and atmospheric temperature observation data from the Thermal Emission Spectrometer (TES) on board the Mars Global Surveyor (MGS), the net flux of dust into and out of the Martian polar regions will be examined. Mars' polar regions possess "layered terrain", believed to be comprised of a mixture of ice and dust, with the different layers possibly representing different past climate regimes [1-3]. These changes in climate may reflect changes in the deposition of dust and volatiles through impacts, volcanism, changes in resources of ice and dust [1], and response to Milankovitch type cycles (changes in eccentricity of orbit, obliquity and precession of axis) [9, 11-12]. Understanding how rapidly such layers can be generated is an important element to understanding Mars' climate history.

The TES instrument is an infrared spectrometer that observes a wavelength range of 6-50 µm. Vertical temperature profiles derived from TES spectral data will be ingested into a 1-dimensional radiative/convective transfer model of Mars' atmosphere in order to "diagnose" the atmospheric circulation (winds) that can transport dust vertically and in the North/South direction. An analysis method developed by Santee & Crisp [4] (for use with Mariner 9 IRIS data) will be used to derive the circulation and its ability to transport the suspended dust. The vertical distribution of the dust will itself be derived from the observed temperatures and the observed column dust abundance. Along with TES data analysis, the NASA Ames Mars General Circulation Model (GCM) will be used to give a self-consistent determination of the processes involved. These model results will be analyzed using the same methods as the TES data. The TES data and model results should give a reasonable assessment of the net flux of dust around the poles, and help to understand whether dust is currently being deposited in the polar regions or eroding from these areas. This analysis should provide clues as to the seasonal trends [1-3,9,11-12] of the polar-layered terrains that have been in the spotlight over the past few years thanks to high-resolution images from the Mars Orbiter Camera (MOC) onboard MGS.

MGS-TES: MGS has been in orbit around Mars since September 1997. It carries on-board the TES instrument which is a Michelson interferometer that has a spectral range of 6-50 µm and a spectral resolution of 5 and 10 cm^{-1} [5]. Vertical profiles of atmospheric temperature are derived from these spectra, at pressure levels ranging from the surface to ~40 km (0.02 mbars) at ~02:00 and ~14:00 local time [6].

Methodology: This study uses the observed vertical temperature data and dust content measurements from TES to analyze the sign (gain or loss) of dust at high latitudes. The MGS-TES vertical temperature data can be analyzed in the same method as Santee & Crisp [4] to derive a transport circulation. They derived 'transport' circulation information from Mariner 9 IRIS atmospheric temperature and dust distribution data in a diagnostic stream function model. The dust column abundance can be derived from opacity measurements in 9 µm silicate band from TES and then input into a 1-dimensional radiative/convective transfer model to acquire a crude vertical distribution of the dust. The calculated circulation and dust distribution will be combined to quantify the net dust flux.

A comparison with [4] over the same season will be made as a preliminary order of magnitude comparison. Santee & Crisp [4] examined L_S=343°-348°, and we have data for the same time period with MGS-TES for L_S=343.4°-348.48°. After the preliminary comparison of the circulation and dust distribution has been done and the results appear reasonable with [4], the analysis will then be applied over MGS years 1 and 2. We will look at interannual variability for these two years, as there was a global dust storm in year 2 at L_S=185° [6] and no global dust storm in year 1. This year-to-year analysis of how dust storms affect dust flow around the polar regions can lead to an analysis of how the flux into or out of the polar regions is affected by the strength and/or number of dust storms during the Martian year.

Along with TES data analysis, we will employ the NASA Ames Mars General Circulation Model (GCM) to give a self-consistent determination of the processes involved. Applying the same analysis technique to model results, which provides a comparison of quantified dust flux and derived dust flux, will allow for the identification of potential problems in the analysis. The TES data in conjunction with the model results should give a reasonable assessment of the net flux of dust around the poles.

Future Projects: A challenging and fruitful project beyond understanding the dust flux could be determining the age of the layers from the net flux. The flux of dust per year, which could give the annual deposition of dust per year, could be used in correlation with images from MOC (to get the thickness of the layers) and dust sizes measured using TES [8] in order to calculate the age of the layers that can be seen. To do this, we could calculate the mass load, which is the amount of particle mass in a vertical column of atmosphere with a cross section of unity [7]. This is given by the optical depth τ, particle density ρ, and mean particle radius <r>

$$m = \frac{2}{3}\langle r\rangle \rho\tau \qquad \left[\frac{g}{cm^2}\right] \qquad (1)$$

The time in years would be given by the flux F_{dust} [cm/yr] and the density of the layers ρ_{Layers}

$$Time = \frac{m}{F_{Dust} \bullet \rho_{Layers}} \qquad [years] \quad (2)$$

This technique would be an independent method from counting craters to determine ages of geologic areas on the surface and see how it compares with past determinations of the ages of the layers [7,9]. This method of age dating could help determine ages in the North polar region which has a lack of craters over 300 m for age dating [9]. This age dating can also be done in conjunction with changes in Martian orbital characteristics through the NASA Ames GCM to help constrain changes in flux throughout Martian geologic history [10].

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