SURFACE DUST REDISTRIBUTION ON MARS AS OBSERVED BY THE MARS GLOBAL SURVEYOR.

A. R. Vasavada[1], M. A. Szwast[2], and M. I. Richardson[3], [1]Jet Propulsion Laboratory, California Institute of Technology, 321-220, 4800 Oak Grove Drive, Pasadena, CA 91109, ashwin@jpl.nasa.gov, [3]California Institute of Technology, 1200 E. California Blvd., Pasadena, CA 91125, [3]Ashima Research, 600 S. Lake Ave. Ste. 303, Pasadena, CA 91106.

Introduction: The global redistribution of dust by the atmosphere is both geologically and climatologically important [1,2,3]. Dust deposition and removal at the surface represents ongoing sedimentary geology: a modern version of aeolian processes responsible for the concentration of vast dustsheets and potentially for ancient layered units at various locations on Mars. The varying amount of dust on the surface also has been hypothesized as a factor in controlling whether regional or global dust storms occur in a given year. Indeed, the atmosphere has a very short, sub-seasonal time-scale (or memory) and as such, any interannual variability in the climate system that is not simply ascribable to stochastic processes must involve changing conditions on the surface.

An excellent, multi-year dataset is provided by the Mars Global Surveyor (MGS) Thermal Emission Spectrometer (TES) and the Mars Orbiter Camera Wide Angle imager (MOC-WA). This dataset allows investigation into the degree to which surface dust deposits on Mars change: over decadal time scales, over the course of the annual cycle, and as a result of global and regional dust storms. The MGS mapping orbit data set extends over 3 Martian years. These data sets include one global dust storm and smaller regional storms (one in the first TES mapping year and two in the third).

Data and Methods: We have used TES albedo measurements as a proxy for surface dust coverage, after validating this approach against the spectral Dust Cover Index [4]. We also use MOC-WA imagery to provide a qualitative verification of changes in surface dust coverage that we have inferred from changes in TES albedo. There are some limitations to our approach, including the masking of surface albedo by atmospheric scattering, and the inability to assess dust delivery or removal from a fully covered dusty surface (i.e., one that would not change in brightness).

Results and Discussion: We will present temporal profiles of surface albedo and atmospheric dust opacity for several study regions on Mars [1]. The collection of regions comprise both net sources and sinks of dust over the multiyear period of study. In addition, they illuminate some of the relationships between surface albedo and the occurrance of seasonal frost, atmospheric dust events, and global dust storms.

The MGS albedo data provide the ability to trace dust cover changes to specific atmospheric phenomena at a detailed level. These data show that the 2001 global dust storm caused widespread dust cover changes. Long-term responses to the 2001 storm varied. Areas that were darkened by the 2001 storm tend to show little or no recovery since, while areas that were brightened by the 2001 storm tend to recover over several years. This implies that dust redistribution may be cyclical, but with a multi-year time scale.

Other processes yielding significant albedo changes include seasonal cap-edge winds, seasonally varying regional winds, local/regional dust storms, and extratropical cyclones. Dust devils and ongoing, small-scale dust lifting do not appear to significantly modify the global patterns of dust cover. Finally, we argue that the apparent long-term darkening of the southern mid and high latitudes between the Viking and MGS eras is largely a consequence of the timing of image acquisition relative to global dust storms and surface dust "cleaning" by the seasonal ice cap and does not represent a decadal-scale, secular change. In fact, following the 2001 global dust storm, in late southern spring, the southern hemisphere was brighter in MGS than in Viking data.

References: [1] Szwast, M. A. et al. (2006) *JGR*, *111*, E1108. [2] Geissler, P. E. (2005) *JGR*, *110*, E02001. [3] Fenton, L. K. et al. (2007) *Nature*, *446*, 646. [4] Ruff S. W. and Christensen P. R. (2002) *JGR*, *107*, 5127.