DUST-DYNAMIC FEEDBACKS IN THE MARTIAN ATMOSPHERE: SURFACE DUST LIFTING;

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The emplacement of dust into the martian atmosphere requires a dynamical interaction between the overlying atmosphere and particles upon the surface. This is the case for both localized lifting events and planetary scale storms. The identification of which specific components of the atmospheric circulation are responsible for dust raising at particular seasons and locations is a fundamental question in regard to understanding the genesis of lifting events and possible feedbacks between lifted dust and continuation or cessation of lifting. We have been developing numerical models [1,2] with which to study a wide range of questions related to suspended dust in the martian atmosphere. Our present model is comprised of interactively coupled 3-D dynamical [3] and aerosol transport/microphysical [4] models. With this model we are investigating the nature of possible feedbacks between surface dust lifting and the amplification/damping of near-surface wind and thermal fields and their implications for additional lifting. These studies allow us to identify preferred locations for dust lifting (*e.g.*, large scale topographic slopes) and the particular circulation component(s) (*e.g.*, overturning circulation, thermal tides, baroclinic waves) responsible for the lifting.

Surface dust lifting is calculated employing model [3] generated surface stress values, which are a measure of the momentum transfer between the atmosphere and ground. Based upon theoretical considerations and wind tunnel studies [5], the static threshold value of the surface stress for the initiation of particle motion under martian surface conditions is ~0.035 N m^{-2}. More appropriately, under conditions of pre-existing particle motion, the threshold value is 80% of the static value, or ~0.028 N m^{-2}. For terrestrial applications, the relationship between surface stress and dust raising has been empirically determined to be proportional to the square of the surface stress [6,7]. We employ this type of prescription to calculate surface dust raising in our model.

Via a sequence of experiments (all carried out at a seasonal date of southern summer solstice, ~L_S=270) we have investigated the impact of the large scale martian topography upon the ability of the atmospheric circulation to lift dust from the surface. This is acconplished by running our model with observed topography (and surface thermal inertia and albedo fields) smoothed to our model resolution (7.5^{o} latitude-by-9.0^{o} longitude) and also with a flat lower boundary (and spatially invariant thermal inertia and albdeo values). Analogous experiments in which the lifted dust is radiatively inactive (passive tracer) have been conducted to act as a control against which feedbacks are defined.

These simulations, taken in total, indicate the following:

1) the inclusion of topography enhances the amount of dust lifted at northern middle latitudes, apparently via interactions with baroclinic waves present there, though dust-dynamic feedback effects are minimal,

2) the inclusion of topography apparently inhibits (at southern subtropical and middle latitudes) dust-dynamic feedbacks which in the case of a flat lower boundary act to produce a 'dust storm' like occurrence in which minimal dust lifting occurs for several sols after which lifting rapidly increases and then subsequently declines,

3) a dusty-atmosphere (and thus more energetic) initial state results in enhanced dust raising ability and greater positive feedbacks than is the case for an initially dust free atmosphere.

Results from these simulations will be presented including analyses of the various dynamical components to illustrate the nature of the feedbacks and the various circulation components of importance at various locations and times.

[1] Murphy et al. (1990) *JGR*, *95*, 14,629; [2] Murphy et al. (1993), *JGR*, accepted; [3] Pollack et al. (1990) *JGR*, *95*, 1447; [4] Toon et al. (1988) *JAS*, *45*, 2123; [5] Greeley and Iversen (1985) 'Wind as a Geological Process', Cambridge Univ. Press; [6] Gillette, D. (1981) *Spec. Pap. Geol. Soc. Am.*, 186, 11; [7] Westphal et al. (1987) *JGR*, *92*, 3027.