Viking orbiter measurements of the martian atmosphere suggest that the residual north polar water-ice cap is the primary source of atmospheric water vapor, which appears at successively lower northern latitudes as the summer season progresses [1]. Zonally symmetric studies of water vapor transport indicate that the zonal mean meridional circulation is incapable (due to its weakness at high latitudes) of transporting from north polar regions to low latitudes the quantity of water vapor observed [2]. This result has been interpreted as implying the presence of nonpolar sources of water, namely subsurface ice and adsorbed water, at northern middle and subtropical latitudes. Another possibility, which has not been explored, is the ability of atmospheric wave motions, which are not accounted for in a zonally symmetric framework, to efficiently accomplish the transport from a north polar source to the entirety of the northern hemisphere. The ability or inability of the full range of atmospheric motions to accomplish this transport has important implications regarding the questions of water sources and sinks on Mars: if the full spectrum of atmospheric motions proves to be incapable of accomplishing the transport, it strengthens arguments in favor of additional water sources.

Preliminary results from a three-dimensional atmospheric dynamical/water vapor transport numerical model will be presented. The model accounts for the physics of a subliming water-ice cap, but does not yet incorporate recondensation of this sublimed water. Transport of vapor away from this water-ice cap in this three-dimensional framework will be compared with previously obtained zonally symmetric (two-dimensional) results to quantify effects of water vapor transport by atmospheric eddies.

Numerical simulation of thermally induced near-surface flows over Martian terrain.

T. R. Parish¹ and A. D. Howard², ¹Department of Atmospheric Science, University of Wyoming, Laramie WY 82071, USA, ²Department of Environmental Sciences, University of Virginia, Charlottesville VA 22903, USA.

Introduction: The near-surface martian wind and temperature regimes display striking similarities to terrestrial desert counterparts [1,2]. The diurnal radiative cycle is responsible for establishment of a pronounced thermal circulation in which downslope (katabatic) flows prevail during the nighttime hours and weak upslope (anabatic) conditions prevail during the daytime. The low-level wind regime appears to play an important role in modifying the surface of the polar regions [3]. Viking imagery of the north polar cap shows evidence of eolian characteristics such as dunes, frost streaks, and wind-scour features. The direction of the prevailing wind can in cases be inferred from the orientation of surface features such as frost streaks and ice grooves.

For the past several years a numerical modeling study has been in progress to examine the sensitivity of thermally induced surface winds on Mars to the patterns of solar insolation and longwave radiative. The model used is a comprehensive atmospheric me-

IRTM 11-μm channel brightness temperatures to also decrease in regions where low 20-μm channel brightness temperatures are observed [7,8]. The maps also show new phenomena, the most striking of which is a clear tendency for the low-brightness temperature regions to occur at fixed geographic locations. During this season, the coldest low brightness temperatures appear to be concentrated in distinct regions, with spatial scales ranging from 50 to 300 km. There are approximately a dozen of these concentrations, with the largest centered near the location of the south residual polar cap. Other concentrations are located at Cavi Angusti, and close to the craters Main, South, Lau, and Dana. Broader, less-intense regions appear to be well correlated with the boundaries of the south polar layered deposits, and the Mountains of Mitchell. We have thus far detected no evidence for horizontal motion of any of these regions.

The fact that the low brightness temperature regions do not appear to move and are correlated with the locations of surface features suggests that they are not artifacts of the IRTM instrument or its viewing geometry, but the result of processes occurring on the surface or in the lower atmosphere. Presently, we do not know whether other low brightness temperature regions that have been observed during the southern winter or during the northern fall and winter exhibit similar spatial and temporal behavior. We intend to better understand the cause(s) and implications of these phenomena through modeling and further analysis of the Viking and Mariner 9 datasets.


Fig. 1. Time evolution of (a) wind speed and (b) wind direction at the lowest sigma level (20 m) after 24-hr integration of constant slope runs for terrain slopes of 0.0005, 0.001, 0.002, 0.004, and 0.008, corresponding to curves A, B, C, D, and E respectively.