TRANSPORT OF WATER FROM THE RESIDUAL NORTH POLAR CAP ON MARS; R.M. Haberle, NASA/Ames Research Center, M.S. 245-3, Moffett Field, CA 94035, and B.M. Jakosky, Laboratory for Atmospheric and Space Physics, University of Colorado, Boulder, CO 80309-0392.

There are several observations concerning the behavior of water vapor in the Martian atmosphere which indicate that (a) during summer the north remnant cap is a significant source for atmospheric water vapor, and (b) water sublimed from the polar cap at this season is carried equatorward to low northern latitudes by atmospheric motions. In support of the first point is the fact that column vapor abundances increase markedly when the seasonal carbon dioxide disappears and the residual water ice cap is exposed. Further support comes from sublimation calculations which show that the residual cap is capable of supplying the water that appears after the cap is exposed (1). Evidence in favor of the second point is that the time at which the maximum column abundance occurs steadily increases with distance from the pole. Based on the timing data, it appears that some of the water sublimed from the cap reaches the northern tropical regions and beyond by summers end.

To simulate this transport we have used a two-dimensional model of the Martian circulation (2). Winds are computed from the primitive-equations forced by diabatic heating alone. Large-scale eddy motions, which lander data indicate are nearly absent during northern summer, are ignored. We are therefore computing the so-called "diabatic circulation" which, under suitable conditions, is a good approximation to the actual motion of air parcels (3). Our diabatic heating algorithms account for dust as well as carbon dioxide. Winds computed by this model are then used to solve a water vapor continuity equation whose sources and sinks are sublimation from the residual north cap, and precipitation within the atmopshere, respectively. Sublimation from the cap is computed as in (1).

A variety of experiments have been carried out with this model to test the sensitivity of the simulated transport to such factors as vertical and horizontal sub-grid scale mixing, precipitation, dust loading, topography, and others. We find that in the absence of significant sub-grid scale horizontal mixing ($K_H > 10^9$ cm^2/sec), water sublimed from the north remnant cap during summer in this model remains at high latitudes (> 60° N) throughout the summer. The circulation in the vicinity of the cap lacks the required latitudinal extent to move in water out of the polar environs. The implication is that the observed increase water at the lower latitudes during late summer is not the result of transport from the residual cap. However, continued desorption from the regolith also appears to be incapable of supplying the required water (1).

Since the low latitude circulation at this season is capable of transporting water northward, its contribution to the observed behavior may be important. We are currently carrying out experiments to assess this possibility. These results, in addition to those mentioned above, will be presented and discussed.

REFERENCES

(1) Jakosky, B.M. (1987). Lunar and Planetary Science XVIII, this issue, Lunar and Planetary Institute, Houston.
(2) Haberle, R.M., Leovy, C.B., and Pollack, J.B. (1982). Icarus, 50, 322-267.
(3) Dunkerton, T. (1978). J. Atmos. Sci., 35, 2325-2333.