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CIRCUMPOLAR HOODS AND CLOUDS AND THEIR RELATION TO THE MARTIAN H_2O CYCLE; P. B. James, University of Missouri-St. Louis, St. Louis, MO 63121 and L. J. Martin, Lowell Observatory, Flagstaff, AZ. 86002

Water exists in both vapor and solid phases in the martian atmosphere. Ice particles are revealed in clouds when their concentration becomes on the order of 1 pr. μm. Cloud observations are therefore relevant to the distribution, sources and sinks, and transport of water on Mars as well as to the atmospheric dynamics on the planet. Earth based visible wavelength astronomy has been one of the most successful tools used to study the synoptic behavior of martian clouds. Most of our knowledge of the polar hoods, global duststorms, volcano clouds, etc. has come from terrestrial observations. We believe that these observations can continue to be of value, particularly when combined with other data bases.

The polar hoods are shrouds of condensate clouds which obscure both polar regions at times during their respective fall and winter seasons. They are dynamic atmospheric phenomena which are undoubtedly involved in both the CO_2 and H_2O cycles; but neither their exact origin nor their feedback effects in the cycles are well understood. Most information on the seasonal and spatial extents of the hoods has come from earth based astronomy although relevant observations were made by both Mariner 9 and Viking. The hoods are quite variable seasonally and spatially, and there seem to be distinct differences between the behaviors in the north and the south. In the martian antarctic the hood seems to form at about $L_s = 140^\circ$, when models predict that conditions at the edge of the south polar surface cap are changing from net CO_2 condensation to net sublimation. Water trapped near the edge of the cap near the solstice would, as it sublimes, be transported poleward by the CO_2 mass flux, which is still directed to the south; it could condense into clouds or haze upon encountering the much colder atmosphere nearer the pole and ultimately be trapped on the surface cap, where it could account for the bright annulus observed in the cap's recession.(1) In the north, the hood is a much more permanent fixture during fall, winter, and early spring suggesting sustained transport of water from outside sources into the arctic region, more efficient atmospheric condensation processes, significant differences in atmospheric dynamics in the hemispheres, or a combination of such processes.

Careful study of telescopic data can, despite limited resolution, also provide more detailed insights into the hydrologic cycle on Mars. Comparisons of images acquired using short wavelength filters, which provide maximum cloud contrast, and long wavelength filters, which are sensitive to surface features including the surface cap, provide correlations between cloud formation and large scale planetary dynamics. An example is provided by the 1978 north polar cap recession which was observed by the International Planetary Patrol as well as by Viking orbiters. The following figure shows regression curves determined from red/green filter pictures compared to those using a blue filter. Between Ls=20 and Ls=40 the curves both show a stationary surface cap, quite consistent with Viking results.(2) The two curves diverge between Ls=40 and Ls=50; the receding cap edge in red/green is consistent with the observed surface cap regression, while the cap appears to grow in blue. These results suggest that clouds are formed in an annulus surrounding the edge of the surface cap as the CO2 cover begins to disappear around latitude 65 N.

This correlates with an increase in water vapor observed by MAWD at the same space-time point in 1978.[3] Taken together, these results indicate that significant amounts of water ice are incorporated in the portion of the north polar cap between 65 and 70 N.

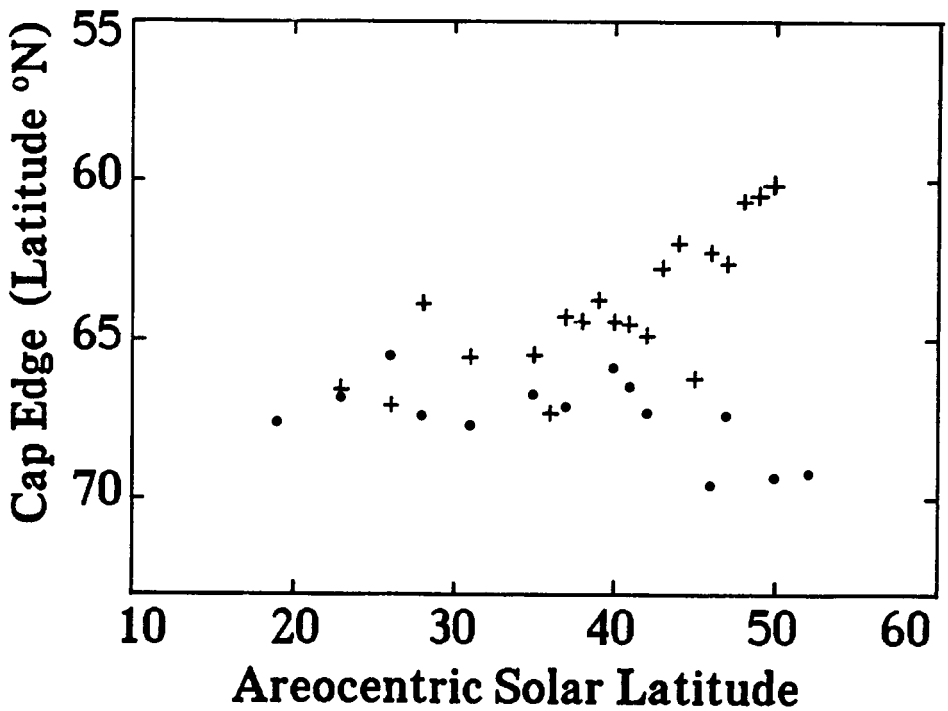

Figure 1. 1978 north polar regression curves are shown for red and green (dots) and blue (crosses) filter data. Generally, the cap edge was measured for seven longitudes for each picture; each data point represents the average of several pictures.

This result supports the usefulness and accuracy of earth based observations in the study of Mars dynamical phenomena, particularly when they can be studied in concert with less synoptic snapshots of phenomena from spacecract and observations in other spectral regions.

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