seasonal cap begins about this same time, and we begin to observe its recession. During the recession of the north cap we also observe cirrumpolar clouds that are believed to be formed by water vapor from the subliming cap [2]. Some observations suggest that at least part of the sublimed water and/or CO$_2$ reforms as surface ice toward the cap’s interior. This “new” ice is probably the bright component of the polar caps that is seen on Earth-based observations. This would explain the south cap’s appearance as that of a shrinking donut during its recession [3]. Near the edge of the shrinking cap, dust activity is also evident on the Viking images [4]. This may result from off-cap winds generated from sublimation and/or dust that might be released from within or beneath the ice. It has been found that all of Mars’ major dust storms that have been observed to date occurred during the broad seasons when either the north or south polar cap was receding [5]. There are short seasonal periods around the beginning and ending of cap recessions when no major dust
storms have been observed. Variable recession rates for the polar caps were suspected from Earth-based data and proven by Mariner 9 and Viking observations. The cycles for water, CO$_2$, and dust are thought to vary with the cap recessions, although the nature of the variations is not yet known. The possible relationship between variable recession rates and dust storm activity has been investigated by James et al. [6]. Iwasaki et al. [7] proposed a correlation between retarded cap recessions and the occurrence of major storms that seems plausible, although more data are needed. Certainly, the polar cap recession rates are at least one phenomenon that needs to be monitored in conjunction with dust storm activity. Since there is evidence that cap recessions may accelerate prior to the onset of encircling storms [5], this monitoring might even lead to predicting these storms. The possible advent of a planet-encircling storm during the Mars Observer (MO) Mission will provide a detailed correlation with a cap recession for that one martian year. We will then need to compare that cap recession with other storm and nonstorm years observed by other spacecraft and from Earth. MO data will also provide a stronger link between cap recessions and the water and CO$_2$ cycles. Cap recession variability might also be used to determine the variability of these cycles.

**Observations—Present, Past, and Future:** After nearly a century of valiant attempts at measuring polar cap recessions [8], including using Mariner 9 and Viking data [9-11], MO will provide the first comprehensive dataset. In contrast to MO, the older data are much less detailed and precise and could easily be forgotten, except that it will still be the only information on interannual variability. Since the MO mission will map just one martian year, it will provide a singular set of seasonal data. Standing alone it will not be possible to be certain which MO data are "seasonal" or whether an "average" or "abnormal" year is portrayed. Of course, even if MO could continue its work indefinitely, it might take a very long time to accumulate enough data to have a representative sample of Mars years. Therefore, we are obliged to retain and refer back to the still-viable historical records, including spacecraft data. These records will be easier to interpret and evaluate based upon new insights from MO data: By obtaining simultaneous Earth-based observations (including those from Hubble Space Telescope) during the MO mission, we will be able to make direct comparisons between the datasets. This will be very helpful in interpreting and measuring the Earth-based data taken during other periods. Continued Earth-based observations will be needed after MO to monitor the martian climate and extend the time line of the data. Improved techniques will allow us to monitor longer seasonal segments of martian years and to better interpret and measure the data. Eventually we may be able to establish limits on the degrees of variability of the polar cap recessions and, consequently, variations in the H$_2$O, CO$_2$, and dust cycles. Many of the questions presented by MO data and its upgraded portrayal of Mars can be addressed to longer-term, albeit cruder, Earth-based observations.


**DUST TRANSPORT INTO MARTIAN POLAR LATITUDES.** J. R. Murphy$^1$,2 and J. B. Pollack$^2$, National Research Council Associate, NASA Ames Research Center, Moffett Field CA 94035.

The presence of suspended dust in the martian atmosphere, and its ultimate return to the planet’s surface, is implicated in the formation of the polar layered terrain and the dichotomy in perennial CO$_2$ polar cap retention in the two hemispheres. We have been employing a three-dimensional numerical model to study martian global dust storms. The model accounts for the interactive feedbacks between the atmospheric thermal and dynamical states and an evolving radiatively active suspended dust load. Results from dust storm experiments, as well as from simulations in which we are interested in identifying the conditions under which surface dust lifting occurs at various locations and times, indicate that dust transport due to atmospheric eddy motions is likely to be important in the arrival of suspended dust at polar latitudes.

The layered terrain in both the northern and southern polar regions of Mars is interpreted as the manifestation of cyclical episodes of volatile (CO$_2$, H$_2$O) and dust deposition. The cyclical nature of this deposition is assumed to be driven by long-period variations that arise from orbital and axial tilt variations and influence the climatic conditions. The dust is assumed to be provided primarily by the occurrence of global-scale dust storms that fill the atmosphere with large quantities of suspended dust, some of which settles back to the surface in the polar regions. The dust settles onto the cap either independently due to gravitational sedimentation or incorporated into CO$_2$ snow [1], possibly serving as condensation nuclei for such a process. The dust storms develop at southern subtropical latitudes, and barring any other sources (which is probably a poor assumption), the dust that appears in suspension at polar latitudes is transported over long distances. It has been a common belief that an intensified Hadley-type circulation is responsible for transporting the dust to high northern latitudes. However, two-dimensional