to observe through the increasing effective optical depths as one goes poleward.

By using a photochemical model that included multiple scattering of solar radiation, Lindner [3] showed that the absorption and scattering of solar radiation by clouds and dust should actually increase $O_3$ abundances at winter polar latitudes. Hence, regions with high dust and cloud abundance could contain high $O_3$ abundances (heterogeneous chemistry effects have yet to be fully understood [2,9]). It is quite possible that the maximum $O_3$ column abundance observed by Mariner 9 at 60 $\mu$-m atm is common. In fact, larger quantities may exist in some of the coldest areas with optically thick clouds and dust. As the Viking period often had more atmospheric dust loading than did that of Mariner 9, the reflectance spectroscopy technique may even have been incapable of detecting the entire $O_3$ column abundance during much of the Mars year that Viking observed, particularly at high latitudes. The behavior of $O_3$ is virtually unknown during global dust storms, in polar night, and within the polar hood, leaving large gaps in our understanding.

Acknowledgments: I thank K. Stamnes for providing the radiative transfer program, and NASA’s MSATT Program for support.


Fig. 3. Synthetic spectra as would be observed by spacecraft for atmospheres with no cloud or dust and 30 $\mu$-m-atm $O_3$ (solid line), vertical opacities of dust and cloud of 0.3 and 1.0, respectively, and 30 $\mu$-m-atm of $O_3$ (dashed line), and vertical opacities of dust and cloud of 0.3 and 1.0, respectively, and 100 $\mu$-m-atm of $O_3$ (dotted line). All cases assume a solar zenith angle of 75° (typical for winter polar observations), and a polar cap albedo of 0.6.

\[ d\psi/dt = 3 \times 10^{-10} M(t)/M(0) \text{ degrees/Earth year} \]