

AN INVESTIGATION OF THE CORRELATION OF WATER-ICE AND DUST RETRIEVALS VIA THE MGS TES DATA SET. Z. Qu¹, L.K. Tamppari¹, M. D. Smith², Deborah Bass¹ and A.S. Hale¹, ¹Jet Propulsion Laboratory/California Institute of Technology, M/S 301-250H, 4800 Oak Grove Dr., Pasadena, CA 91109, Zheng.qu@jpl.nasa.gov, ²NASA Goddard Space Flight Center, Mail Code 693, Greenbelt, MD 20771.

Introduction: Water-ice in the Martian atmosphere was first identified in the Mariner 9 Infrared Interferometer Spectrometer (IRIS) spectra [1]. The Viking Imaging Subsystem (VIS) instruments aboard the Viking orbiter also observed water-ice clouds and hazes in the Martian atmosphere. The MGS TES instrument is an infrared interferometer/spectrometer which covers the spectral range 6-50 μm with a selectable sampling resolution of either 5 or 10 cm^{-1} [2]. Using the relatively independent and distinct spectral signatures for dust and water-ice, these two retrieved quantities have been retrieved simultaneously [3-4]. Although the interrelations among the two quantities have been analyzed by Smith et al. [5] and the retrievals are thought to be robust, understanding the impact of each quantity on the other during their retrievals as well as the impact from the surface for retrievals is important for correctly interpreting the science, and therefore requires close examination. An understanding of the correlation or a-correlation between dust and water-ice would aid in understanding the physical processes responsible for the transport of aerosols in the Martian atmosphere. In this presentation, we present an investigation of the correlation between water-ice and dust in the MGS TES data set.

Background: With more and more observations for Martian water-ice clouds, the community starts to recognize that the water-ice clouds may play an important role in the Martian climate system. Clancy et al. [6] suggested that water-ice clouds transport water from southern to northern hemisphere, yielding an unclosed planetary-scale water cycle. Furthermore, annual water retention in the north polar region, possibly by water-ice cloud precipitation, is likely involved. In addition, water-ice cloud data aids the development of Mars Global Circulation Models (MGCM), which provide us a method for understanding the Martian atmosphere and the surface-atmosphere interactions. Current MGCMs have started to incorporate cloud microphysics, and the water-ice cloud data can support these efforts by providing a validation method.

Our research effort is centered around examining water-ice in the north polar region and its implications for water transport on a seasonal and annual basis.

In summary, water-ice cloud data set is important in aiding our understanding of Martian water cycling. One of the first few steps for us to use these data is to evaluate the quality of these data.

Method: In order to maximize the data set, we examine both the nadir and limb MGS TES data sets. The retrieval of water-ice clouds in the Martian atmosphere has been carried out using the TES data and by applying the technique by Smith et al. [3]. Both the nadir- and limb-geometry TES data are used to retrieve water-ice clouds. The nadir-geometry data have relatively higher horizontal spatial resolution, but retrieval of water-ice clouds is limited to day time regions and away from the relatively cold polar cap. The limb-geometry data can be used to retrieve water-ice cloud with no geographic and time restrictions, but have limited horizontal resolution.

Comparison between cloud data derived from limb- and nadir-geometry observations. In order to assess the quality of water-ice cloud data retrieved from TES limb-geometry observation, 9.45 million lines of water-ice cloud optical depth data for the two plus Martian years are mapped into more than 600 images and representative images are selected. Comparisons are made for water-ice cloud derived from nadir- and limb-geometry. The limb-geometry observations account for only part of the total column water-ice abundance (clouds higher than about one scale height). Therefore the cloud optical depth data is normalized before comparison such that the variation of the two data sets are compared, instead of absolute values. This comparison provides us an indication of the consistence among the two data sets, and helps us to determine whether or not the limb-geometry data can actually be a supplementary data set to extend the coverage beyond the nadir-geometry data.

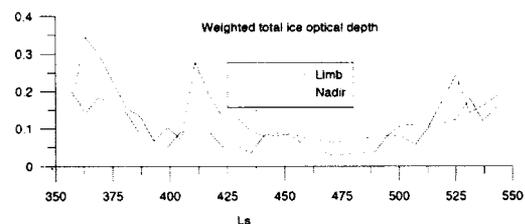


Fig. 1 Comparison of water-ice optical depth derived limb- and nadir- geometry for the total water-ice abundance in the region between 60°N and 80°N. Ls

larger than 365 denotes the second Martian mapping year.

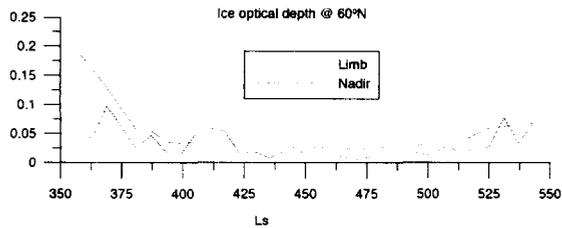


Fig. 2 Comparison of water-ice optical depth derived limb- and nadir- geometry for the 60°N latitude band (subset of Figure 1). Ls larger than 365 denotes the second Martian mapping year.

As seen in Fig.1 and 2, preliminary comparisons show the two data sets are in broad agreement, although there are some differences. These differences will be explored.

Quality assessment of water-ice data. Since the atmospheric dust and water-ice are retrieved together, it is possible that the errors of one quantity during retrieval affect the other. Correlations between dust and water-ice cloud optical depth are examined on pixel-by-pixel basis in order to see if there appear to be any false correlations (due to retrieval) between dust and water-ice when deriving water-ice cloud. In order to exclude topographic impact, the optical depth for both quantities are scaled to a surface pressure of 6.1 mb before further processing.

Correlations between water-ice clouds and dust. As the dust can serve as nuclei in the cloud condensation process. It is also possible that there exist physical correlations between water-ice clouds and the dust. These correlations are expected to exist, if any, on regional scale rather than on a pixel-by-pixel basis.

Results: This work is still in progress. This presentation is a status report for current analysis. We will present the current results on the nadir vs limb data sets as well as the results of the correlation of dust and water-ice retrievals with current understanding as to our understanding of the results.

References: [1] Curran. R. J. et al. (1973) *Sicence*, 183, 381-383. [2] Christensen R. R. et al. (1992) *J. Geophys. Res.*, 97(E5), 7719-7734. [3] Smith M. D. et al. (2000) *J. Geophys. Res.*, 105, 9539 - 9552. [4] Smith M. D. et al. (2000) *J. Geophys. Res.*, 105, 9589-9608. [5] Smith M. D. (2001) *Geophys. Res. Let.*, 28, 4263 - 4266. [6] Clancy R. T. et al. (1996) *Icarus*, 122, 36-62.

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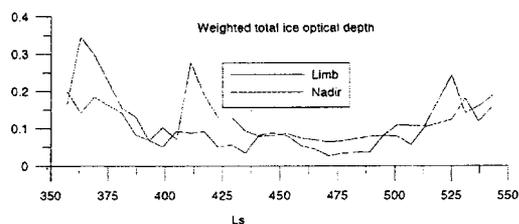


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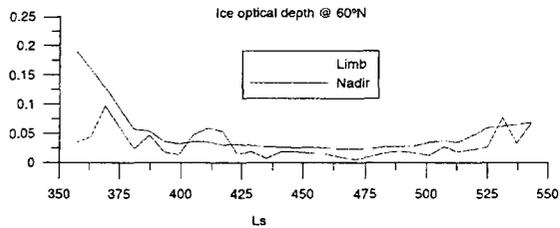


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