WATER ICE CLOUDS IN THE MARTIAN ATMOSPHERE: A VIEW FROM MGS TES. A.S. Hale[1], L.K. Tamppari[1], P. R. Christensen[2] , M. D. Smith[3,], Deborah Bass[1], Zheng Qu[1], and J. C. Pearl[3], [1]Jet Propulsion Laboratory/California Institute of Technology, M/S 264-235, 4800 Oak Grove Dr., Pasadena, CA 91109, amy.s.hale@jpl.nasa.gov, [2]Arizona State University, Dept. of Geology, Box 871404, Tempe, AZ 85287-1404, [3]NASA Goddard Space Flight Center, Mail Code 693, Greenbelt, MD 20771.

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Introduction: Over the past decade there has been an increased interest in water-ice clouds in the Martian atmosphere and the role they may play in the water cycle. Water-ice clouds in the Martian atmosphere have been inferred, historically, through observations of "blue" and "white" clouds [1], but the first positive confirmation of water-ice in the atmosphere came during the Mariner 9 mission, through the Infrared Interferometer Spectrometer experiment [2]. Despite these observations of water-ice clouds, they were not thought to be a significant player in the climate or water cycle. Even through the Viking era (mid-1970's), the true extent and ubiquity of water-ice clouds on Mars was not appreciated.

More recently, work has suggested that clouds forming in a low-latitude belt during the northern spring/summer time frame (the aphelion cloud belt) may be retaining water in and scavenging water to the northern hemisphere [3,4]. This cloud belt forms as a result of the cross-equatorial Hadley circulation, which has its upwelling branch in the northern hemisphere, during northern spring/summer. At the current epoch, Mars' northern spring/summer timeframe coincides with aphelion (L_s=71°), causing the atmospheric temperatures to be lower in this season, allowing water-ice clouds to form more readily than during the perihelion season.; thus this cloud belt is not seen in southern summer. Additionally, ice particles in the clouds may gravitationally settle, confining water to the northern hemisphere. This settling may also remove dust acting as cloud condensation nuclei, decreasing the radiative heating potential of the atmosphere further. This is a powerful mechanism to explain why Mars' northern hemisphere contains substantially more water than the southern hemisphere.

To date, the only three data sets offer the potential to examine year-to-year changes in cloud features over an entire Martian year: the Viking Infrared Thermal Mapper (IRTM) data set [5] and the Mars Global Surveyor (MGS) Thermal Emission Spectrometer (TES) data set [6-10], and Mars Odyssey THEMIS data set. We have examined the TES data in the same way in which we examined the Viking IRTM data [5; 9-10] This provides water-ice cloud information separated in time by 12 Martian years. Since the data are analyzed with the same method, we obtain a very accurate "apples to apples" comparison, and can generate a historical record of the subtleties of this annual event.

Method: We use the method of Tamppari et al. [5] to map water ice clouds in the Martian atmosphere. This technique was originally developed to analyze the broadband Viking IRTM channels and we have now applied it to the TES data. To do this, the TES spectra are convolved to the IRTM bandshapes and spatial resolutions, enabling use of the same processing techniques as were used in Tamppari *et al.* [5]. This retrieval technique relies on using the temperature difference recorded in the 20 micron and 11 micron IRTM bands (or IRTM convolved TES bands) to map cold water ice clouds above the warmer Martian surface. Careful removal of surface contributions to the observed radiance is therefore necessary, and we have used both older Viking-derived basemaps of the surface emissivity and albedo, and new MGS derived basemaps in order the explore any possible differences on cloud retrieval due to differences in surface contribution removal. These results will be presented in our poster.

Our previous work [11] has concentrated primarily on comparing MGS TES to Viking data; that work saw that large-scale cloud features, such as the aphelion cloud belt, are quite repeatable from year to year, though small scale behavior shows some variation. Comparison of Viking and MGS era cloud maps will be presented in our poster. In the current stage of our study, we have concentrated our efforts on close analysis of water ice cloud behavior in the northern summer of the three MGS mapping years on relatively small spatial scales, and present our results below.

Equatorial cloud belt: In all three MGS mapping years the equatorial cloud belt appears early in the northern summer, becoming complete and prominent by L_s = 110. The highest opacity clouds are seen over topographic highs, such as the Tharsis volcanoes, and Olympus Mons, though these are not strictly part of the aphelion belt itself. As the summer wears on, the low latitude cloud belt begins to dissipate, beginning at around longitude=170 West. By L_s = 140 the continuous cloud belt is gone, though remnants of it remain south of Olympus Mons and Tharsis. By L_s = 155, we can say that the cloud belt is truly gone, and hints of high latitude clouds are visible in the north. This behavior continues until L_s = 185, when a large cloud system becomes evident in the Tharsis region.

Topographically controlled clouds: In all three MGS mapping years, the most consistent cloud feature is the clouds over the topographically high regions of Tharsis and Olympus Mons. These clouds are of higher opacity than those in the aphelion cloud belt, and are of course far more spatially localized. Unlike the aphelion cloud belt, however, these clouds remain quite evident throughout the northern summer, and are clearly visible in all years from L_s = 110 until approximately L_s = 170. The Tharsis clouds remain visible up until approximately L_s = 185, though the Olympus Mons cloud disappears by L_s =170

Hellas Basin Clouds: Another consistent cloud feature is the cloud seen over the Hellas basin. This feature is very prominent each year in early northern summer, and slowly disappears as fall approaches. It is mostly gone by L_s = 155, and appears to be totally absent by L_s = 185. This is not unexpected, due to Hellas' southern location; by L_s = 185, the Hellas region is experiencing spring, with its warmer surface and atmospheric temperatures. Within longitudinally averaged TES data [e.g., Smith, 2004], this Hellas feature is not obvious; the reasons for this discrepancy are being explored.

Other water ice cloud features: Water ice clouds are also evident in early to mid northern summer in Vallis Marineris. These clouds disappear around L_s = 155. High latitude clouds become evident around L_s = 155 as well, and remain visible until approximately L_s = 185, when they disappear. Both of these features are evident in all three MGS years and have highly repeatable behaviors.

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