

The seasonal behavior of water ice clouds in the Tharsis and Valles Marineris regions of Mars: Mars Orbiter Camera Observations

Jennifer L. Benson,^a Boncho P. Bonev,^a Philip B. James,^a Kathy J. Shan,^a
Bruce A. Cantor,^c and Michael A. Caplinger^c

^a Ritter Astrophysical Research Center, Department of Physics and Astronomy, University of Toledo, Toledo, OH 43606, USA

^b Department of Physics and Astronomy, Bowling Green State University, Bowling Green, OH 43403, USA

^c Malin Space Science Systems, Inc., PO Box 910148, San Diego, CA 92191, USA

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Observations of the Tharsis and Valles Marineris regions on Mars were performed by the Global Surveyor Mars Orbital Camera (MOC) between the dates of March 15, 1999 and July 31, 2001. MOC obtained surface maps in two wavelength ranges: blue (400-450nm) and red (575-625nm). This study used these observations to describe the area, height, location, optical depth, diurnal variation, and seasonal variation of clouds containing water ice. Ice clouds were discerned from other cloud types by visual inspection of the Daily Global Maps (DGMs) and matched with the blue images taken by the MOC. Dust and ice clouds often appear of similar brightness in the red wavelength range, yet in the blue wavelengths, the water clouds are bright and the dust clouds are dark.

Over the course of the observations, it was determined that the three Tharsis volcanoes, Olympus Mons, and Alba Patera have established seasonal trends in their cloud activity. One of the three Tharsis peaks' variation is similar to Olympus Mons which suggests that latitude is an important factor in seasonal cloud activity. It was also noted that cloud activity ended earlier in the second Martian year than the first, which is attributed to the global Martian dust storm of 2001. Dust storms raise the temperature of its occupied area and therefore promote the dissipation of water ice clouds. Clouds over Alba Patera vary in anti-correlation with the variability of Olympus and Ascræus Mons. The Valles Marineris and other small surface features have clouds mainly confined during the northern spring and summer seasons.

For all regions, the clouds varied daily by increasing in both size and thickness as the day progressed, reaching maximum in the mid to late afternoon. Cloud heights varied per location as 19.0-21.0 km for Olympus Mons, 15.0-18.0 km for Ascræus Mons, 12.0-14.0 km for Pavonis Mons, 16.0-17.4 km for Arsia Mons and 5.5 – 6.5 km for Alba Patera. The clouds at all locations tended to be higher later in the afternoon. Optical depth varied per location and the water ice content ranges from 0.5 to over 2.0 μm .

Results were compared, and found to agree, with previous studies performed using data from ground observations, Mariner 9, Hubble Space Telescope, and Viking I. This study had great advantage over the other studies, however, as it collected data on a daily basis. Overall, this study confirmed past observations and contributed a great amount of knowledge about the ice cloud characteristics of the Martian atmosphere. Possibly, one day this information may prove invaluable for human colonies requiring water for survival.