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Atmospheric water behavior from the observations by the PFS and OMEGA spectrometers onboard Mars Express

L. Maltagliati (1), M. Tschimmel (1), D.V. Titov (1,2), N.I. Ignatiev (2,5), T. Fouchet (3), E. Lellouch (3), J.-P. Bibring (4), Y. Langevin (4), V. Formisano (5), M. Giuranna (5)

(1) Max Planck Institute for Solar System Research, Katlenburg-Lindau, Germany, (2) Space Research Institute of Russian Academy of Sciences (IKI RAN), Moskow, Russia, (3) LESIA, Observatoire de Paris, Meudon, France, (4) Institut d'Astrophysique Spatiale, Univ. Paris-Sud, Orsay, France, (5) Istituto di Fisica dello Spazio Interplanetario (INAF-IFSI), Roma, Italy (maltagliati@mps.mpg.de / Phone: +49 5556-979429)

We present the results of water vapor retrievals in the atmosphere of Mars from the observations by PFS (Planetary Fourier Spectrometer) and OMEGA (Observatoire pour la Minéralogie, l'Eau, les Glaces, at l'Activité) onboard Mars Express. Complementary characteristics of the two instruments allow a comprehensive analysis of the Martian water cycle at an unprecedented detail. We retrieved the water vapor abundance using the 2.6 μm H_2O band in both cases. The use of similar retrieval procedures allows a direct comparison between the two datasets.

Water vapor shows a maximum of 65 pr. μm during the Northern summer, centered at $\sim 75^{\circ}$ latitude. After Ls = 130° the maximum quickly vanishes and a "tongue" of 15-20 pr. μm appears and progresses equatorward. However, in this process only a small amount of water is transported: the bulk is stored on the surface, mainly adsorbed by regoliths. A smaller maximum of 20-25 pr. μm is also present at high Southern latitudes during the local late spring – early summer.

This behavior is qualitatively in good agreement with the previous measurements, mainly those by Viking-MAWD and MGS-TES, implying the persistence of the annual cycle of atmospheric water. However, the values derived from the Mars Express

observations are significantly lower, especially compared with TES. The longitudinal distribution shows also some inhomogeneities, with a minimum in the polar area between 30° W and 10° E, and local maxima over Arabia Terra and the Tharsis highlands, most probably caused by atmosphere-surface coupling and atmospheric circulation.

Atmospheric water behavior above the Tharsis volcanoes was studied in detail by OMEGA. In about 75% of orbits the atmosphere over the volcanoes was found to be significantly enriched in water vapor, with an average factor of 3 between the mixing ratio on the summit and at the bottom of the volcanoes. The enrichment shows a clear seasonal trend, with a minimum during the early Northern summer and the maximum around the Northern spring equinox. This behavior can be explained by the influence of the local circulation generated by the extreme topography of the region.

We used OMEGA high spatial resolution and mapping capabilities to retrieve the atmospheric water above the Spirit and Opportunity sites and the Hellas basin. The results over the rovers' sites are in good agreement with the Mini-TES results for Spirit, but show significant discrepancies for Opportunity. There are indications that this difference is related to physical peculiarities of the two sites. The Hellas basin shows a pronounced seasonal behavior, which indicates peculiar vertical distribution of water vapor over the course of the year, and the presence of surface ice during local winter.