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Atmosphere-surface interactions in the Martian water cycle during MY 27-28 retreived from OMEGA data.

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Mapping spectrometer OMEGA began its scientific phase on Mars orbit since January 2005 and is still operational. Our study is based on data received by two OMEGA detectors in the visible(0.3-1μm) and near-infrared(1-2.6 μm) spectral ranges. Features, related to the global water cycle, such as redistribution of the different forms of water(ices,vapour,frost, bound water) and changes in the surface structure and composition due to water phase transitions, have been monitored during 2 first years of OMEGA operations (MY 27, 28). Atmospheric contribution to the observed spectra has been eliminated on the pixel-by-pixel basis using a combination of observations and GCM results. Then we analyzed corrected hyperspectral images and mapped water bearing minerals, ices and water vapour for different seasons.

Mapping of hydrated minerals using 1.93 μm feature shows significant seasonal trend, characterized by spring-to-summer overall migration of the bound water following the retreating boundary of the seasonal water ice cap. The microstructure of the polar caps ices has been studied by comparing 1.2, 1.5 and 2.0 μm features and tracking their seasonal evolution. The relationships of respective bands depths and comparison with synthetic ice spectra calculated using DDA technique has allowed us to evaluate typical ice grain size at the polar cap surface. Resulting microphysical structure of water ice, as well as frost and bound water distribution in the circumpolar regions reveal zonal variations that suggest the strong contribution of stationary and quasi-stationary atmospheric planetary waves with zonal wavenumbers 2 and 3. This interpretation is confirmed by high-resolution simulations of the Martian water cycle by means of GFDL MGCM. Observed wave structures reveal dramatic change at Ls=97° and 120°, associated with reconfiguration of the regional circumpolar circulation. Bound water distribution also suggests its involvement into the atmospheric water cycle, while showing more inertial and diffuse behavior, with distinct wave-1 feature within 70°-80° latitude range.

Based on comparison of OMEGA data with synthetic spectra of packed and rare scattering media, water ice clouds in the aphelion tropical belt and above the polar caps have been analyzed and distinguished from the surface water ice and frosts.

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