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Inter-annual Variability of Mars Polar Processes as Observed by OMEGA/Mars Express

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Mars Express has now been operated successfully more than 6 earth years after orbit insertion in late 2003. Thanks to a much longer than expected lifetime of the cryocoolers, which still perform nominally, the coverage of polar regions by OMEGA now spans more than three full Mars years, from Ls 338°, M-year 26 to Ls 85°, M-year 30. Therefore, the South perennial cap (Ls 310° to Ls 0°), the South seasonal cap (Ls 0° to Ls 310°) and the North seasonal cap (Ls 170° to Ls 90°) have been observed over four successive Mars year while the North perennial cap (Ls 90° to Ls 170°) has been observed over three successive martian years.

Due to the precession of the pericenter and of the orbit plane of the elliptical orbit of the satellite, the OMEGA imaging spectrometer on board this mission obtained data on polar regions at resolutions ranging from 300 m to 10 km over a wide range of Ls and local times [1, 2, 3, 4, 5]. This provides an excellent data set for comparing the evolution of seasonal caps and the spectral characteristics of the perennial caps over different Martian years. For both the perennial cap and the seasonal cap, the CO2 ice signatures dominate in the South while H2O ice signatures dominate in the North. The lag by a few weeks of the retreat of the seasonal caps observed by OMEGA between different Martian years is consistent with that of the "Crocus lines" derived from TES temperature data in 1999 – 2001 [6], with a possible link with dust storm activity in 2007. The spectral component which is not dominant (H2O in the South, CO2 in the North) shows overall consistency but significant year to year variability. CRISM/MRO observations at a much higher spatial resolution support these conclusions. In late 2009, OMEGA observations of the South cap at the time of minimum extent (Ls 340°) showed a much larger extent of H2O ice signatures compared to what had been observed in early 2004 [1]. As these regions show only weak albedo contrast, the observed variegation is likely linked with subsurface characteristics such as the high thermal inertia of underlying water ice rich layers at very shallow depths. This will be investigated by linking OMEGA observations with radar sounding of the subsurface by MARSIS/Mex [6] and SHARAD depending on the availability of data on regions of interest.

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