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Inter-annual variability of H_2O ice deposits observed in late summer, at the time of minimum extent of the Southern polar cap of Mars

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Extended regions exhibiting water ice signatures have been observed by OMEGA on Mars Express at the boundary of the CO_2 perennial cap during the first months of operation of the mission [1]. This period in late summer (Ls 335°-340° corresponds to the minimum extent of the ice coverage around the South pole. The retreat of the South seasonal cap, spectrally dominated by CO_2 frost [2, 3] ends at Ls 310° - 315° for years which do not present a global dust storm [4], and the first signs of H_2O frost re-condensation are observed before the fall equinox (Ls 0°). A large outlier had been identified by OMEGA observations at longitudes from 290°E to 10°E. It was shown to extend over an area representing $\sim$ 25% of the surface of the perennial cap by Themis observations [5]. The H_2O covered regions at the boundary of the cap and within the outlier have an intermediate albedo (30-35%) between that of the perennial cap (> 60%) and that of surrounding terrains ($\sim$ 20%). It is interesting to note that these regions are those still covered by bright ice at Ls 310° [4] , which have been spectrally identified as CO_2 ice [2]. The retreat of the seasonal cap is therefore delayed by $\sim$ 1 month over H_2O ice deposits.

In late 2009, OMEGA observations of the South cap at the time of minimum extent (Ls 340°) showed a much larger extent of H_2O ice signatures compared to what had been observed in early 2004 [1]. H_2O ice covered regions appeared homogeneous at the km scales corresponding to OMEGA observations. A series of CRISM observations were planned for the next southern fall season (mid-2011), in order to further investigate the time variability of the southern H_2O ice deposits within the outlier. The FOV of CRISM does not make it possible to map large regions at full regions, and we focused on areas within or at the boundary of the outlier. The results demonstrate that the extent of the outlier in 2011 is more similar to 2004 than to 2009. Another important result is that within the boundaries of the H_2O ice covered regions, the spectral signatures exhibit only slow variations at the CRISM pixel scale (20 m). Coverage of these areas with HIRISE made it possible to investigate the characteristics of the deposits at even smaller scales. The perennial character of these deposits must therefore be linked to surface and sub-surface characteristics over areas several 10 km in scale. These southern deposits constitute a smaller source of atmospheric water than the northern perennial cap as they are much smaller in extent and they are exposed to sunlight for 2 months in late summer instead of 6 months in the North over the whole summer. This is in line with the highly asymmetric seasonal cycle of atmospheric water [6, 7].

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