Geophysical Research Abstracts
Vol. 13, EGU2011-4881, 2011
EGU General Assembly 2011

Evidences of the inter-years and seasonal variations of the water ice content within the surficial layer of the Martian soil revealed based on the TES, the HEND and the OMEGA data analysis

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The global mapping of the inter-years and seasonal variations of the water ice content within the surficial layer of the Martian soil has been realized based on the TES, the HEND and the OMEGA data analysis. The water ice contents within the surficial soil layer (with thickness 2-10 cm) outside of the Northern seasonal polar cap edge have been estimated and mapped for the winter-spring seasons (with time step ΔLs=20°) based on the comparison of the summer-time values of the soil's thermal inertia with its values during the winter-spring period for each of the three Martian years of the TES observations. The inter-years and the seasonal variations of the water equivalent content in the thicker surface layer of the Martian soil (up to depth $\sim$20 cm) we analyzed and mapped for different seasons based on the HEND fast neutrons flux mapping data, collected during the four Martian years of the observations. The results of both mapping approaches convincingly show manifestation of both essential seasonal fluctuations of the water ice contents in the surficial soil and its notable changes between different years of the observations. The mapping of the spatial variations of the water ice spectral index (on the band 1.5 μm) within a water ice annulus surrounding the CO2-rich ice deposits of the Northern seasonal polar cap has been conducted based on the OMEGA data for the winter season and for a different stages of its spring regression. The CO2 ice band depth at 1.43 μm was used for mapping of the seasonal CO2 ice cover. The joint analysis of the TES, the HEND and the OMEGA data let us to reveal the dynamics trend of the external boundary of the seasonal permafrost on Mars and to make quantitative estimations of the water ice content variability in the surface soil layer around the edge of the Northern seasonal polar cap during both the winter and different stages of its spring regression.

The contribution of Russian co-authors has been supported by RFFI grant № 10-2-00464-a)