Global Mapping of Martian Seasonal Caps with HEND Instrument during 2002-2007 Years.

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Introduction: We present a summary of continuous observations of Martian seasonal caps with High Energy Neutron Detector (HEND) during five years of orbital operations onboard Mars Odyssey. In this work we performed estimation of CO_2 deposit column density and mass for different latitude belts as a function of time using numerical model deconvolution of HEND data. We also used comparative analysis with other observational data and estimations such as Gamma Ray Spectrometer (GRS), orbital tracking data, Mars Orbiter Laser Altimeter (MOLA) and General Circulation Model (GCM) [1-4].

Data Analysis: Analysis of seasonal variations of Martian neutron albedo is one of direct ways for observation of seasonal redistribution of atmospheric mass between Martian poles[5,6]. The CO_2 frost changes the structure of subsurface and distribution of water ice in upper layers of regolith causing significant changes of neutron flux. This effect was used for estimation of column density of CO_2 deposit and reconstruction of multidimensional model of CO_2 deposit showing how snow depth varies as a function of latitude, longitude and time.

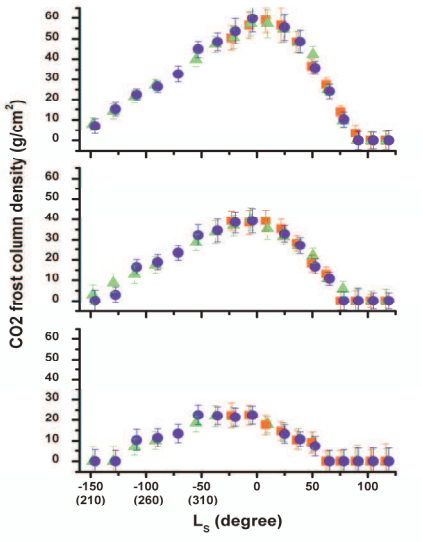

Fig.1. Seasonal curves of CO_2 deposit column density (HEND data) for different northern latitudes (80N-90N, 70N-80N, 60N-70N). Red color corresponds to the First Martian year of HEND observations, green – Second Martian year and blue – Third Martian year.

In this study we have used numerical modeling of HEND data gathered at different latitude belts on northern and southern hemispheres of Mars in order to find best fit correspondence between model predictions (with column density of CO_2 frost as free parameter) and counting rates in HEND detectors [6].

Results: The evolution of snow depth at different latitudes and total mass of seasonal caps trough the Martian year is shown on figures 1-3. The maximal thickness of CO_2 frost and mass of Martian seasonal caps estimated as ~ 65 g/cm^2 , 3.1 x 10^{15} kg (north) and ~ 110 g/cm^2 , 6.6 x 10^{15} kg (south) correspondingly. The comparison with latest MOLA data [7] shows that volume density of CO_2 deposit may vary from 300 kg/m^3 up to 1000 kg/m^3 at different locations within seasonal caps.

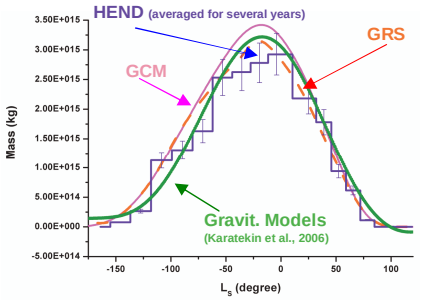

Fig.2. Mass estimations of northern seasonal cap from HEND data, GRS data, gravitational model and GCM.

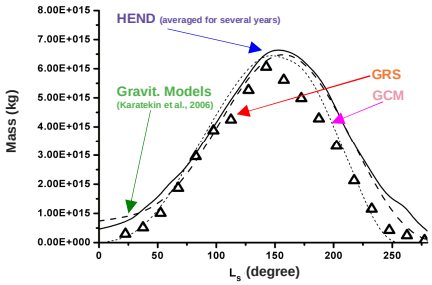

Fig.3. Mass estimations of southern seasonal cap from HEND data, GRS data, gravitational model and GCM.

At figures 2-3 to evaluate deviations among different approaches we have also presented comparison between seasonal caps mass estimations

taken from HEND, GRS, Gravitational models and GCM.

The long term continuous HEND observations are a promising base to search for inter-annual variations of CO_2 cycle. On figure 1 we have illustrated it by showing seasonal curves of CO_2 frost column density measured for three successive Martian years.

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