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Water vapor in the Martian atmosphere by SPICAM IR/Mars-Express

A.Y. Trokhimovskiy (1), A.A. Fedorova (1), O.I. Korablev (1), J.-L. Bertaux (2,3), E. Villard (2,3), A.V. Rodin (1)

(1) Space Research Institute (IKI), Moscow, Russia, (2) Service d'Aéronomie du CNRS/IPSL, Verrières-le-Buisson, France, (3) Institut Pierre Simon Laplace, Université de Versailles-Saint-Quentin, Saint-Quentin en Yvelines, France, (trokh@iki.rssi.ru / Fax: +7-495-3332102)

Introduction

SPICAM experiment along with PFS and OMEGA spectrometers on Mars Express has a capability to sound the water vapor in the atmosphere. The results of H_2O measurements have been intensively published during last years [1-6]. Here we present the new analysis of SPICAM IR water vapor measurements, covering two Martian years. The near-IR channel of SPICAM experiment on Mars Express spacecraft is a 800-g acousto-optic tunable filter (AOTF)-based spectrometer operating in the spectral range of 1-1.7 μm with resolving power of ~2000 [7, 8]. The nadir measurements of H_2O in the 1.37-μm spectral band is one of the main objectives of the experiment.

Data treatment

As compared with previous analysis of water vapor presented in [4] we used the spectroscopic database HITRAN2004 [9] instead of HITRAN 2000 and the most recent measurements of the water line-width broadening in CO_2 atmosphere. Latest version HITRAN2008 doesn't have any meaningful changes in water vapour lines.

The new version of the Martian Climate Database V4.2 [10] was adopted for modelling of synthetic spectra and a scenario based on TES MY24 was used.

The spare model of SPICAM IR instrument was recalibrated in June 2007 in Reims, to analyze specifically the sensitivity to the H_2O vapor band. According to laboratory measurements, a leakage from the AOTF is responsible up to 5% of signal in sharp absorption features, making the apparent depth of the H_2O band lower.

Radiative transfer modelling

Sensitivity of retrieval to aerosol scattering and different vertical distributions of aerosol and water vapor was analyzed for H_2O absorption band at 1.38 μm and 2.56 μm for different dust particles. Dependences of equivalent width of the H2O band on the water vapor abundance and aerosol optical depth for different vertical distribution of water vapor and aerosol optical depth are obtained. Calculations of Martian atmospheric dust optical properties are done as well. The aerosol scattering account for analysis of the bulk of SPICAM data is now in progress.

Results

Here we present the results from January 2004 (Ls= 330°, MY26) to January 2008 (Ls= 150°, MY29), i.e. two and a half Martian years, in the assumption of clear atmosphere. The seasonal trend of water vapor obtained by SPICAM IR is consistent with TES results and disagrees with MAWD South pole maximum measurements. The maximum abundance is 50-55 pr. μm at the North pole (during MY28 data are missing) and 13-16 pr.μm at the South pole. The northern tropical maximum amounts to 11-14 pr μm. The seasonal trend of water vapor obtained by SPICAM IR is consistent for MY27 with TES results [11]. The South Pole maximum for MY28 agrees well with the MAWD South Pole measurements in 1977 [12]. It assumes the same dust conditions and global dust storm happened at MY28 Ls 270° like during the MAWD observations. The maximum near 30-60S at L_s 260° relates to Hellas observations. Recent observations of water vapour distribution during the same period by CRISM spectrometer onboard Mars Reconnaissance Orbiter support these results [6]

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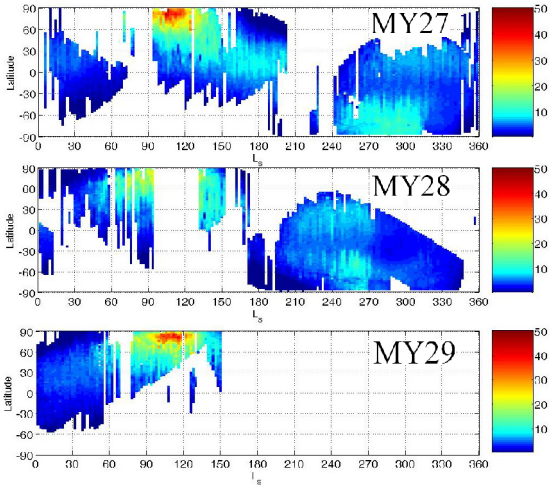

Figure 1: A seasonal map of the H_2O distribution by SPICAM for three Martian years

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