Geophysical Research Abstracts
Vol. 14, EGU2012-12495, 2012
EGU General Assembly 2012

Oxygen dayglow observations on Mars by SPICAM IR

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Ozone is one of the most chemically reactive species of the Martian atmosphere. Study of temporal and space ozone variability along with water vapor variability is necessary to improve photochemical models. In the Martian atmosphere ozone can photodissociate under solar ultraviolet radiation in the Hartley continuum:
O_3+hν→O(1D)+O_2(a1Δg)
O_3+hν→ O(3P)+O_2(x3Σg)
Excited O_2 molecule can be deactivated through emission:
O_2(a1Δg)→O_2(x3Σg)+hν
or collision:
and O_2(a1Δg)+CO_2→O_2(x3Σg)+CO_2.
So, the O_2(a1Δg) can provide us an information about ozone distribution in the Martian atmosphere.
The SPICAM IR spectrometer onboard Mars Express mission, launched in 2003, is capable to measure the O_2 emission at 1.27 μm in the Martian atmosphere. It covers the spectral range of 1-1.7 μm with spectral resolution of 0.5-1.2nm. The field of view of the spectrometer in the nadir-limb mode is 1° that corresponds to 15-100 km for limb observations depending on the distance to limb and ∼5 km near the pericenter in nadir. In this work we present results of limb and nadir observations of the O_2 emission based on SPICAM IR data. From January 2004 to April 2010 there were made about 600 limb observations in IR range, but only 105 of them were successfully processed.
We have compared O_2 dayglow slant radiance profiles with theoretical data from LMD Mars general circulation model for different seasons and latitudes. The best statistics were obtained for high northern latitudes in spring season. The comparison has revealed that in the beginning of the spring observed dayglow values are 2-3 times larger than modeled one, while in the end of the spring theoretical and observational data coincide. A comparison for other seasons also will be presented.
From January 2004 (MY26) to January 2012 (MY31) there were carried out O_2 dayglow nadir observations. We present the O_2 emission map for 4 Martian years. The O_2 emission can be expressed through O_3 concentration, O_2 radiative lifetime and rate constant k of deactivation through collision with CO_2. The latter is known with great uncertainty but it is significant for photochemical study. To constrain this constant we have calculated a theoretical O_2 emission map for the same latitudes, longitudes, local times and solar longitudes based on LMD GCM model as at those SPICAM observations were made. A detailed comparison of these two maps can give us a restriction on the value of the rate constant of deactivation.