THE MARTIAN OZONE LAYER AS SEEN BY SPICAM: 2004-2011

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Introduction:

The SPICAM UV/IR spectrometer on board Mars Express has now been operational for more than ten years. In its nadir viewing mode, the instrument observes the reflected and scattered ultraviolet radiation between 110-320 nm, from which one can derive the ozone vertical column. We will present in this talk the results of a complete reprocessing of the SPICAM dataset with an improved version of the algorithm initially presented by Perrier et al. (2006). The SPICAM climatology covers continuously four Martian years (MY27-MY30) and constitutes the longest observational record of ozone on Mars.

New retrieval algorithm:

Perrier et al. (2006) presented the first ozone climatology from SPICAM observations obtained after about one Martian year of operation. That dataset resulted from an algorithm based on the ratio between the observed UV spectrum and a unique "reference" reflectance measured above Olympus Mons, assumed to be void of ozone, clouds, and dust. This was an elegant way of filtering out instrumental parameters (such as detector efficiency or point spread function) that were not precisely determined at that time. After ten years of operation and a series of dedicated technological observations, those parameters are now well characterized. This allows using a more accurate absolute calibration method that consists in deriving the ozone column directly from the UV reflectance, defined as the ratio between the observed and solar spectra. The approach reduces the risk of systematic error associated to the quality or to the environmental parameters of the so-called "reference" spectrum used in the previous algorithm. The new ozone algorithm also accounts for all the reading modes of the detector, for was not the case in the previous version since observations above Olympus Mons were not always available. In addition, the new code includes several improvements regarding the treatment of raw spectra, spectroscopic parameters, and temporal sampling of the data.

The 2004-2011 ozone climatology:

We will present an overview of the results obtained with our new ozone algorithm over four Martian years (MY27-MY30) between January 2004-September 2011. We will describe the main features of the ozone column distribution as seen by SPICAM as well as its variations at the diurnal, seasonal, and interannual scales. The well-known anticorrelation between the ozone and water vapour will be tested against the co-located water vapour measurements performed with the infrared channel of SPICAM (Fedorova et al., 2006a). This infrared channel also provides a complete coverage of the $O(^1\Delta_g)$ airglow at 1.27 µm produced by the photolysis of ozone (Fedorova et al., 2006b). We will show how this information can help to understand more precisely the seasonal variations of the total column. Finally, we will evaluate our quantitative understanding of the Martian ozone by comparing the SPICAM results to the latest version of the LMD general circulation model with photochemistry (Lefèvre et al., 2008).

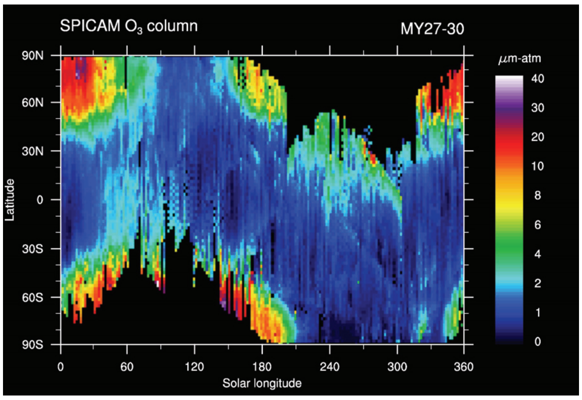

Figure 1. Seasonal evolution of the ozone total column (µm-atmosphere) derived from SPICAM observations, averaged over 2004-2011. No measurements are performed in the polar night regions.

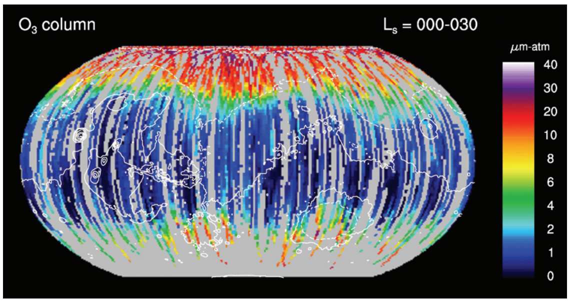

Figure 2. Ozone column distribution (µm-atmosphere) observed near northern hemisphere spring equinox (L_s = 0-30°), all orbits over 2004-2011.

Bibliography:

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