Geophysical Research Abstracts
Vol. 19, EGU2017-14370-1, 2017
EGU General Assembly 2017

Seasonal Transport in Mars' Mesosphere revealed by Nitric Oxide Nightglow vertical profiles and global images from IUVS/MAVEN

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Abstract:

We analyze the ultraviolet nightglow in the atmosphere of Mars through Nitric Oxide (NO) δ and γ bands emissions.

On the dayside thermosphere of Mars, solar extreme ultraviolet radiation partly dissociates CO_2 and N_2 molecules. O(^{3}P) and N(^{4}S) atoms are carried by the day-to-night hemispheric transport. They preferentially descend in the nightside mesosphere in the winter hemisphere, where they can radiatively recombine to form NO($C^2\Pi$). The excited molecules promptly relax by emitting photons in the UV δ bands and in the γ bands through cascades via the $A^2\Sigma$, v' = 0 state. These emissions are thus indicators of the N and O atom fluxes transported from the dayside to Mars' nightside and the winter descending circulation pattern from the nightside thermosphere to the mesosphere (e.g. Bertaux et al., 2005 ; Bougher et al., 1990 ; Cox et al., 2008 ; Gagné et al., 2013 ; Gérard et al., 2008 ; Stiepen et al., 2015).

Observations of these emissions have been accumulated on a large dataset of nightside disk images and vertical profiles obtained at the limb by the Imaging Ultraviolet Spectrograph (IUVS, McClintock et al., 2015) instrument when the *Mars Atmosphere and Volatile EvolutioN (MAVEN)* spacecraft is at its apoapsis and its periapsis phases along its orbit, respectively.

We present discussion on the variability in the brightness, altitude and topside scale height of the emission with season, geographical position and local time and possible interpretation for local and global changes in the mesosphere dynamics.

IUVS images and limb scans reveal unexpected complex structure of the emission. The brightest emission is observed close to the winter pole. The emission is also surprisingly more intense in some sectors located close to the equator : at 120° and 150° longitude. Observations also reveal spots and streaks, indicating irregularities in the wind circulation pattern and possible impact of waves and tides.

The disk images and limb profiles are compared to the LMD-MGCM model (Gonzàlez-Galindo et al., 2009 ; Lopez-Valverde et al., 2011) to focus on the seasonal, local time and geographical influences on the NO Nightglow emission. We will also provide a statistical study of the regions of enhanced brightness (i.e. splotches and streaks) and discuss possible interpretation from the comparison to the GCM.

Acknowledgements

A. Stiepen is supported the Fund for Scientific Research (F.R.S.-FNRS). The MAVEN mission is supported by NASA through the Mars Exploration Program in association with the University of Colorado and NASA's Goddard Space Flight Center. M. Stevens is supported by the NASA MAVEN Participating Scientist program.