THE MARTIAN OZONE LAYER AS SEEN BY MARS EXPRESS AND BY MAVEN

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Introduction: Ozone (O_3) on Mars is a product of the CO_2 photolysis by ultraviolet radiation. It is destroyed with a timescale of less than ~1h during the day by the H, OH, and HO_2 radicals. This tight coupling between O_3 and HO_x species makes ozone a sensitive tracer of the odd hydrogen chemistry that stabilizes the CO_2 atmosphere of Mars, and ozone measurements offer a powerful constraint for photochemical models. Ozone is also expected to be anticorrelated to water vapour, the source of hydrogen radicals HO_x. At high latitudes in winter, the absence of H_2O prevents the production of HO_x and the chemical lifetime of ozone may increase up to several days. In these conditions, the ozone column abundance usually reaches its largest values of the Martian year and ozone turns into a measurable tracer of the polar vortex dynamics. In recent years there has been much progress in the knowledge of the ozone climatology on Mars, thanks in particular to the data collected from two different ultraviolet spectrometers: SPICAM on Mars Express and IUVS on MAVEN. We will present an overview of key results obtained from both datasets. We will also discuss the potential for collaborative studies between MAVEN and TGO, with the prospect of the O_3 measurements by the NOMAD spectrometer on board ExoMars [1].

MEx/SPICAM ozone data: The UV channel of the SPICAM spectrometer on board Mars Express was operational for eight years years between 2004-2011. In its nadir viewing mode, the instrument observes the reflected and scattered ultraviolet radiation between 110-320 nm, from which is derived the ozone vertical column. The SPICAM climatology covers continuously four Martian years (MY27-MY30, Figure 1) and still constitutes the longest observational record of ozone on Mars. We will present the results of a complete reprocessing of the SPICAM dataset with an improved version of the algorithm initially presented by Perrier et al. [2]. The anticorrelation between the ozone and water vapour will also be tested against the co-located water vapour measurements performed with the infrared channel of SPICAM [3].

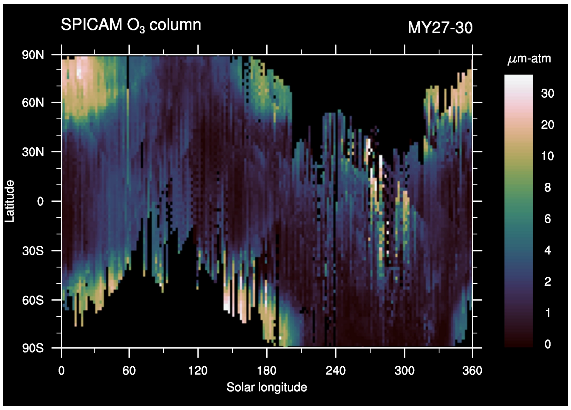

Figure 1: Seasonal evolution of the Mars ozone column (μm-atm) as measured by SPICAM on Mars Express between 2004-2011 (Martian Years 27-30).

MAVEN/IUVS ozone data: IUVS is one of nine science instruments aboard the MAVEN spacecraft. In the apoapse imaging phase, the spacecraft motion carries the IUVS lines-of-sight across the Martian disk while the scan mirror is used to make transverse swaths. This observation mode allows semi-global synoptic views of the planet at an apoapse of 6200 km altitude [4]. The ozone vertically-integrated column is derived by a multicomponent retrieval algorithm directly inherited from the SPICAM algorithm. In the same time as ozone is retrieved the dust UV optical depth as well as the surface albedo averaged over the mid-UV channel of IUVS (180-340 nm).

We will discuss the evolution of O_3 as seen by IUVS since the beginning of the mission in October 2014. We will show the fast day-to-day changes in the O_3 field observed in northern spring (Figure 2) when large ozone columns allow at that season to map the dry polar vortex and to characterize its dynamical perturbations by planetary waves. We will also show results obtained around equinox (L_s = 180-190°, summer 2016) when higher spacecraft transmission rates allowed to map ozone and dust with a spatial resolution of approximately 6 km. The IUVS ozone climatology, now covering about 1.5 Martian year, will be compared to prior measurements by SPICAM, and to threedimensional simulations performed with the LMD global climate model [4].

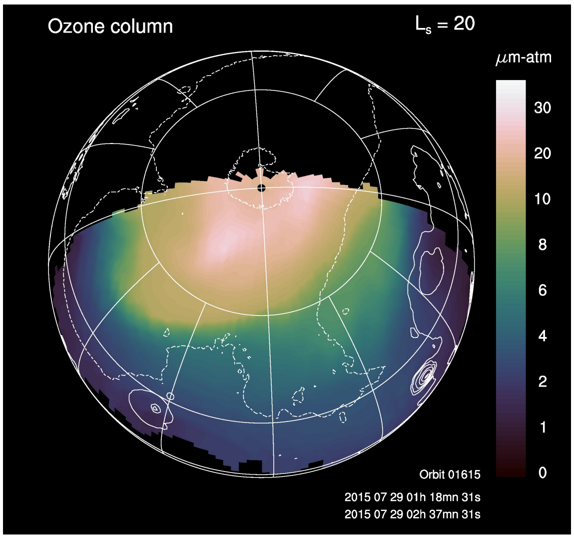

Figure 2: Example of ozone column map (μm-atm) derived from a single orbit of the MAVEN IUVS instrument on 29 July 2015 (L_s = 20°).

References:

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