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Newest results from SPICAV on-board *Venus Express*

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Abstract

Venus Express has now entered its eighth year of operation in Venusian orbit. Among the still working instruments, all three channels of the SPICAV[5] spectrometer are still fully working and provide new insights on the Venusian atmosphere. We propose to review and highlight these results (non exhaustive list).

Dayglow due to CO and CO_2^+

Aeronomic emissions of CO and CO_2 are expected in any CO_2-dominated atmosphere. As a matter of fact, Cameron bands (CO $a^3\Pi - X^1\Sigma^+$ system) in the 190-250 nm spectral range, as well as the CO_2^+ $B^2\Sigma^+ - X^2\Pi$ line near 295 nm have been detected on Mars[4] using SPICAM. Following the same methodology, Chaufray et al.[7] have detected the same spectral lines in the upper atmosphere of Venus. Comparative studies between Venus and Mars have yielded comparable values for the altitude of emission (135 km for Venus, 110-120 km for Mars), but the intensity is about 10 times higher in the Venusian case (CO: $2\,\mathrm{MR}$ vs. $150\,\mathrm{kR}$; CO_2^+: $270\,\mathrm{kR}$ vs. $30\,\mathrm{kR}$) , whereas a factor of 4 only should be expected from the difference in solar flux. Further investigation on this, as well as a more complete mapping with respect to the solar zenith angle is ongoing.

NO nightglow

Nitric oxide nightglow is a powerful tracer of the general circulation in the complex transitional region between the lower atmosphere, dominated by the super-rotation, and the lower thermosphere, dominated by the subsolar-antisolar (SSAS) circulation. Actually, this nightglow is thought to be due to the recombination on the nightside of free nitrogen and oxygen atoms carried by the SSAS from the dayside where they are created through photo-dissociation of CO_2, CO and N_2. Recent mapping from SPICAV confirm that the maximum of the NO emission is shifted with respect to the local midnight (between 2 am and 4 am). This is somewhat puzzling since the analogous O_2 nightglow measured by VIRTIS[6] is not shifted albeit it originated from a lower altitude level (94 km for O_2 vs. 114 km for NO).

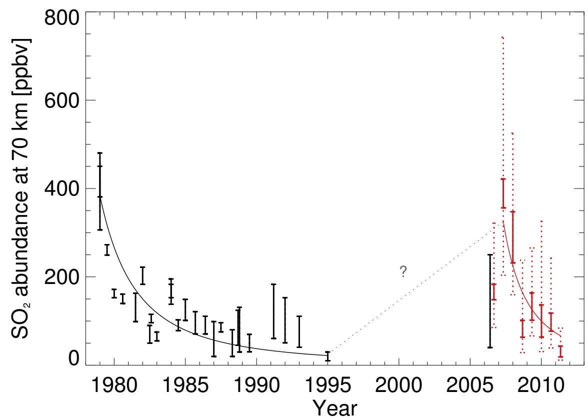

Figure 1: Secular evolution of SO_2 above Venus cloud tops from[10]. Red: data from SPICAV-UV. Black: Other measurements from[3]

Secular evolution of SO_2

We now have two long-term records of comparable length of the sulphur dioxide abundance above Venus' clouds. The first one extends from 1978 to 1992, using UV measurements from the PVO instrument onboard the *Pioneer Venus* orbiter[3]. The second one extends from 2006 onwards and uses also UV measurements from the SPICAV instrument onboard the *Venus Express* orbiter[10]. Both data sets, although thirty years apart, exhibit a striking similar behavior: a strong short-term variability, also seen by ground based observers[8], superimposed to a long-term decrease by a factor of about 10 in less than a decade. Latitudinal variability was also observed, consistent with a fast destruction of SO_2 by UV sunlight in competition with advection from the lower atmosphere reservoir. Further work will (1) extend the data set as the mission progress, in close cooperation with ground-based telescopes and HST-STIS; and (2) provide a quantitative interpretation using various chemical models embedded in the LMD-GCM.

Polarimetric studies

The IR channel of SPICAV[9] is sensitive to polarization, which has been neglected in previous studies. Still, polarization data were of paramount importance to constrain the size distribution and composition of the clouds and hazes of Venus[1, 2]. A PhD work has started in October 2012 to fill this gap. Work is still in progress, but the preliminary results indicate that: (1) polarization rate is consistent with smaller particles at higher latitudes and (2) glory effect at low phase angles that enable a fit of the composition (refractive index) and/or the size distribution of the main cloud (mode 2) particles. Further quantitative interpretation will probably require a multiple scattering radiative transfer model still in development.

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