Preparing EnVision: SO2 measurements below and above Venus' clouds

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EPSC Abstracts
Vol. 13, EPSC-DPS2019-253-1, 2019
EPSC-DPS Joint Meeting 2019

EPSC
EPSC-DPS Joint Meeting 2019
15–20 September 2019 | Geneva, Switzerland

Preparing EnVision: SO_2 measurements below and above Venus' clouds

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Abstract

One of the primary objectives of the preselected EnVision M5 proposal is the monitoring of volcanogenic species in Venus' atmosphere, one of the most prominent being sulphur dioxide (SO_2). Monitoring SO_2 below the clouds can be performed on the nightside near $2.4\,\mu m$, and is one science objective of the VenSpec-H channel (P.I.: A. C. Vandaele, BIRA) onboard EnVision. Monitoring SO_2 above the clouds can be performed on the dayside in the 200-300 nm range, and is the main science objective of the VenSpec-U channel (P.I.: E. Marcq, LATMOS). Here we present the analysis of two analogous datasets, namely IRTF/iSHELL ground based observations on the nightside of Venus, and the most recent reanalaysis of the Venus Express/SPICAV-UV dataset on the dayside of Venus.

1 SPICAV-UV dataset

SPICAV [1] was a UV and IR spectrometer on board Venus Express, ESA's first mission in orbit around Venus (2006−2014). Observations of the reflected UV sunlight (170 to 320 nm, $R \sim 200$) by SPICAV during the whole mission were sensitive to many variable quantities near Venus' day side cloud top (65 to 75 km): (1) gaseous constituents such as SO, SO_2 [3, 4]13 and O_3, (2) UV absorption caused by a yet unknown UV absorber mixed with submicron particles, and marginally (3) cloud top altitude (via differential CO_2 absorption). The most recent analysis of SO_2 measurements [9] mostly confirm the results obtained previously [6, 8]: SO_2 variability is strongest at lower latitudes, with short-lived bursts more prevalent in the 2006-2009 epoch (Fig. 1). We also observe a possible enhancement over the western slope of *Aphrodite Terra*, hinting at an influence of topography on the vertical mixing between the lower and upper atmosphere.

These results will play a key role in defining the science requirements of the analogous instrument VenSpec-U on board EnVision (measurement accuracy, spatial and temporal coverage, spatial resolution, etc.)

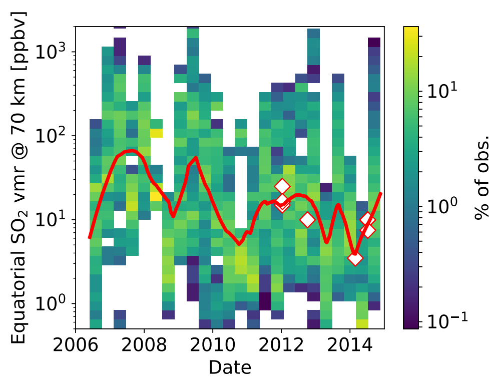

Figure 1: Temporal evolution of cloud top SO_2 seen by SPICAV. White diamonds indicate TEXES measurements from [8]

2 iSHELL dataset

On January 2nd to 4th, we were able to observe the night side of Venus at a high spectral resolution ($R \sim 24500$) in the $2.3\,\mu m$ infrared window, thanks to the iSHELL instrument[7] located at NASA IRTF facility. Previous studies [2, 5] have shown that numerous gaseous species can be retrieved in the 30-40 km altitude range: CO, OCS, H_2O, HDO, HF, and SO_2. We are currently in the first stages of the analysis of this dataset, but our preliminary studies (Fig. 2) show that

SO_2 retrievals can be performed at a quite high accuracy (better than 10%) once other gaseous species have been properly constrained.

Future analysis will play a key role in defining the science requirements of the analogous VenSpec-H instrument on board EnVision (measurement accuracy, spatial and temporal coverage, spatial resolution, etc.)

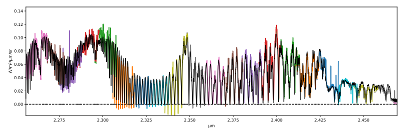

Figure 2: Processed night side spectrum sample acquired on 2019-01-03 compared with the radiative transfer output from B. Bézard (in black)

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