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Preparing EnVision: SO₂ measurements below and above Venus' clouds

E. Marcq (1), K. L. Jessup (2), T. Encrenaz (3), L. Baggio (1), I. Amine (1), M. Duquesnoy (1), F. Montmessin (1), F. Lefèvre (1), J.-L. Bertaux (1), A. C. Vandaele (4), S. Robert (4), J. Helbert (5), T. Widemann (3), C. Wilson (6), R. Ghail (7)
 (1) LATMOS/IPSL/CNRS/UVSQ/SU, Guyancourt, France, (2) SWRI, Boulder, CO, USA, (3) LESIA/Obs. Paris/CNRS/UVSQ, Meudon, France, (4) BIRA-IASB, Brussels, Belgium, (5) DLR, Berlin, Germany, (6) AOPP, Oxford, UK, (7) Royal Holloway, Univ. of London, UK (emmanuel.marcq@latmos.ipsl.fr)

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 (SO₂). Monitoring SO₂ below the clouds can be performed on the nightside near 2.4 μm , and is one science objective of the VenSpec-H channel (P.I.: A. C. Vandaele, BIRA) on-board EnVision. Monitoring SO₂ 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 reanalysis 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, SO₂ [3, 4] and O₃, (2) UV absorption caused by a yet unknown UV absorber mixed with submicron particles, and marginally (3) cloud top altitude (via differential CO₂ absorption). The most recent analysis of SO₂ measurements [9] mostly confirm the results obtained previously [6, 8]: SO₂ 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 topog-

raphy 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.)

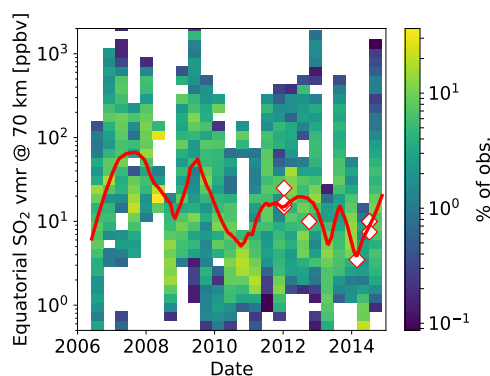


Figure 1: Temporal evolution of cloud top SO₂ seen by SPICAV. White diamonds indicate TEXES measurements from [8]

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 μm 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, H₂O, HDO, HF, and SO₂. We are currently in the first stages of the analysis of this dataset, but our preliminary studies (Fig. 2) show that

SO₂ 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.)

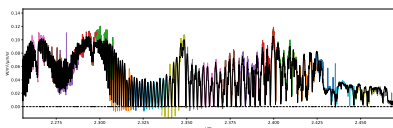


Figure 2: Processed night side spectrum sample acquired on 2019-01-03 compared with the radiative transfer output from B. Bézard (in black)

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