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Consolidating the radiative transfer code to analyze VenSpec-H measurements

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The VenSpec-H instrument is part of the EnVision payload. EnVision is a medium class mission to determine the nature and current state of geological activity on Venus, and its relationship with the atmosphere, to understand how Venus and Earth could have evolved so differently. The launch of the spacecraft is planned in 2031 for a 4 years mission duration.

VenSpec-H is part of the VenSpec suite [1], including also an IR mapper and a UV spectrometer [2] suite. The science objectives of this suite are to search for temporal variations in surface temperatures and tropospheric concentrations of volcanically emitted gases, indicative of volcanic eruptions; and study surface-atmosphere interactions and weathering by mapping surface emissivity and tropospheric gas abundances. Recent and perhaps ongoing volcanic activity has been inferred in data from both Venus Express and Magellan. Maintenance of the clouds requires a constant input of H_2O and SO_2. A large eruption would locally alter the composition by increasing abundances of H_2O, SO_2 and CO and perhaps decreasing D/H ratio. Observations of changes in lower atmospheric SO_2, CO and H_2O vapour levels, cloud level H_2SO_4 droplet concentration, and mesospheric SO_2, are therefore required to link specific volcanic events with past and ongoing observations of the variable and dynamic mesosphere, to understand both the importance of volatiles in volcanic activity on Venus and their effect on cloud maintenance and dynamics.

To contribute to this investigation, VenSpec-H is designed to measure H_2O, HDO, CO, OCS and SO_2 both on the nightside and on the dayside. To ensure the reliability of the analysis, the BIRA-IASB radiative transfer code, ASIMUT-ALVL [3], has been scrutinized making sure all contributions were properly modelled. The radiances of the nightside atmosphere of Venus originate from the thermal emission of the surface and atmosphere while on the dayside they originate from the sunlight penetrating the atmosphere and bouncing back on the cloud cover.

While VenSpec-H will be able to measure 4 spectral ranges between 1 to 2.5 microns, we focused on the upper wavelengths' range, from 2.35 to 2.5 microns, identified as Band#2 in VenSpec-H's design and enabling simultaneous measurements of the different molecular species. A sensitivity study was performed on nightside spectra. The impacts of the molecular species (line by line and collision induced absorption) and of the aerosols were quantified. We will discuss the choices we

have made in terms of absorption line parameters and clouds' physical properties

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