

IASB-BIRA contribution to VESPA for planetary aeronomy studies

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Abstract

VESPA (Virtual European Solar and Planetary Access) [1] is a planetary science virtual observatory aiming to facilitate data access and to connect science tools from different institutions. IASB-BIRA is contributing to VESPA activities by developing all necessary facilities to make SOIR profiles and the radiative transfer code ASIMUT accessible through this new infrastructure.

1. Introduction

SOIR (Solar Occultation in the InfraRed) is an infrared spectrometer that work in the 2.2-4.3 μm spectral range. It made solar occultation observation of the atmosphere of Venus during the complete mission of the Venus Express spacecraft from May 2006 till November 2014. Profiles of pressures, temperatures and densities of different constituents of the atmosphere of Venus have been derived from the spectra recorded by SOIR. Mahieux et al. (2015,2012,2010) [2-4] describe the algorithm used to derive these profiles. Nine species have been studied: CO_2 , CO , H^{35}Cl , H^{37}Cl , HF , SO_2 , H_2O , HDO and the aerosols. Vandaele et al. [5] gives an overview of these studies.

ASIMUT is a modular program for radiative transfer calculations in planetary atmospheres, particularly for Mars, Venus and the Earth, considering different geometries. This program can simulate spectra or retrieve columns and/or profiles of atmospheric constituents simultaneously from different spectra. This allows the possibility to perform combined retrievals.

Any SOIR profile file or ASIMUT calculation result should be obtained by a query through the search interface of the VESPA infrastructure at

<http://vespa.obspm.fr>. These query will lead to different mechanisms depending if it is experimental data or calculated data that are requested.

2. Description and access to SOIR profiles

SOIR profiles of pressures, temperatures and densities are available in two formats: in HDF5 for efficient read/write operations and in VOTables. The later is required to use the VO tools for quick and convenient data plotting. Figure 1 is an example of plot generated using the TOPCAT VO tool [6] showing the latitudes and longitudes of all profiles of CO_2 , CO , H^{35}Cl , H^{37}Cl , HF , SO_2 . The content of the HDF5 files is separated under different groups: Science, Geometry, Observation and Reference. The Science group contains the profiles with units as attributes. The corresponding altitudes, latitudes and longitudes can be found in the Geometry group. The other groups contain useful data: the time of the observation, the attitude of the spacecraft, the coordinates of the profile, etc. The VOTables contain the same data as the Science group of the HDF5 files in addition to the altitudes. All these files are available online.

Each of these files has a unique set of EPNcore parameters (version 2). These parameters are required for compatibility with the Europlanet Table Access Protocol (EPN-TAP) developed by the International Virtual Observatory Alliance (IVOA). These EPNcore parameters are the metadata of our database called *soir*. They have to be described by a view called *epn_core* which is accessible through a TAP query to our EPN-TAP data service called *BIRA-IASB TAP*. The VESPA server can query the *soir.epn_core* view since our data service has been registered in the IVOA registry. More information can be found in Trompet et al. (2017) [7].

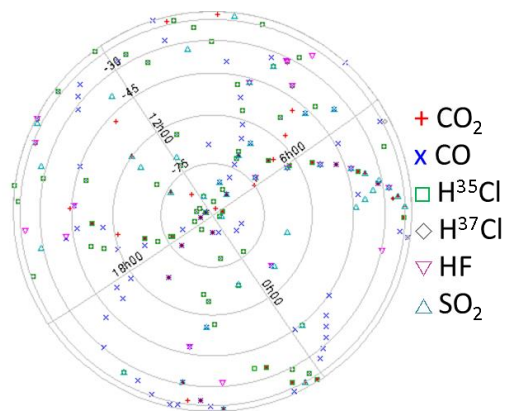


Figure 1: Position on the South hemisphere of Venus for all SOIR profiles of CO₂, CO, H³⁵Cl, H³⁷Cl, HF, SO₂.

3. ASIMUT calculations through VESPA

VESPA infrastructure will be enhanced with the ASIMUT radiative transfer code. Another VESPA research interface (than the one used to query experimental data) has to be filled. The parameters will be sent by VESPA to IASB-BIRA with an HTTP query. Some parameters will be restricted to avoid too long calculations. The query with these parameters will be parsed at the IASB-BIRA side: if the set of parameters is incomplete or if the value of a parameter does not make sense or is not contained in the required limits, a VOTable will be returned with a description of the error. If the input parameters are correct, several calculations of ASIMUT can be launched in the same time using slots. Obviously, a limit of this number of slots has to be defined. Once the calculation are finished, the results will be transformed in VOTable and returned to the user.

In a first step, a simplified version of ASIMUT will be available through VESPA, with no possibility to perform retrievals and without any scattering processes included. These options will be added in the future if they do not appear to be too much time consuming. Similarly, at first, only IASB-BIRA internal atmosphere models for the different planets will be available. But in a second step, an attempt will be done to use other atmosphere models from other data services accessible through the VESPA infrastructure.

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