

# VIRTIS / Venus-Express

## post-operations data archive



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### Access to VIRTIS Venus-Express data

The VIRTIS/Venus-Express data set is publicly available on ESA's Planetary Science Archive (PSA). However, large archives mainly focus on data preservation and are not optimized to provide quick and efficient services such as search functions based on observational parameters. To enlarge the usage of this data set, the team decided to distribute the dataset as a data service in the new Planetary Science Virtual Observatory developed in Europlanet / VESPA.

This environment provides powerful search functions, previews, on-line access, on-line display and processing capacities, and potentially the ability to compare different datasets.

The VVEx service is currently available as a demonstrator (nominal mission only, no geometry) and will be completed in the coming months.

### The VESPA activity in Europlanet

The goal of VESPA (Virtual European Solar and Planetary Access) is to build a Virtual Observatory (VO) for Solar System Sciences, based on mechanisms which have been developed for the Astronomy VO. The user interface is available at:

<http://vespa.obspm.fr>

Currently, 37 data services are connected to VESPA, installed and maintained in 13 different institutes.

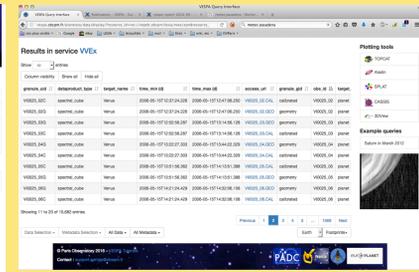
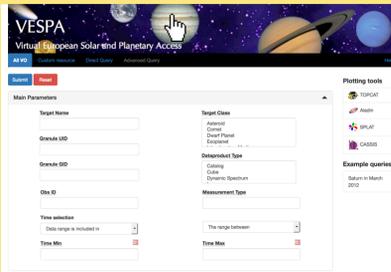
### Data service & search interface

The VVEx data service is compliant with the EPN-TAP data access protocol developed by the VESPA activity in the Europlanet-2020 programme.

Search parameters are both observational (e.g., coordinates, local time, viewing angles, etc) and instrumental (e.g. integration time, observing & pointing modes, etc). They are completed by descriptive data (e.g., spectral range, space mission and instrument, etc).

Both calibrated data and geometry files are reachable based on the same parameters. Data files are distributed in their original format (PDS3) which can be read with the software provided by the PI team (the versatile VirtsPDS library running under IDL/GDL).

A modification date is also included, which is intended to help tracking possible updates and to handle persistent data identifiers in the future.



VESPA search interface and results page from VVEx with thumbnails

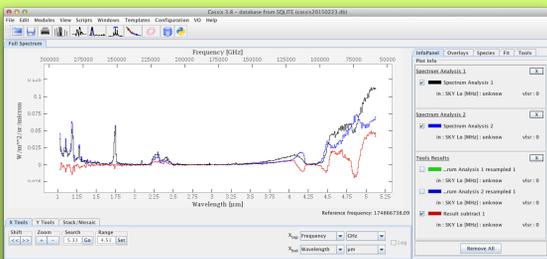
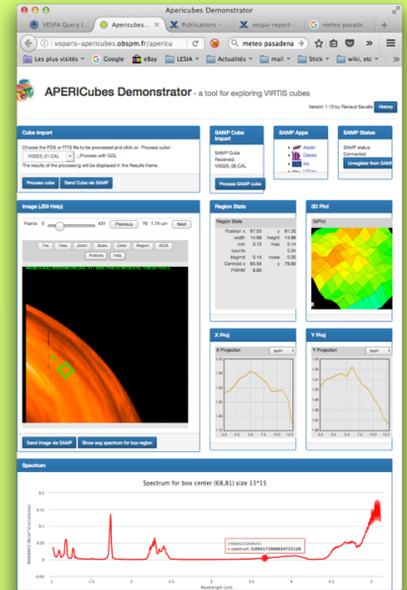
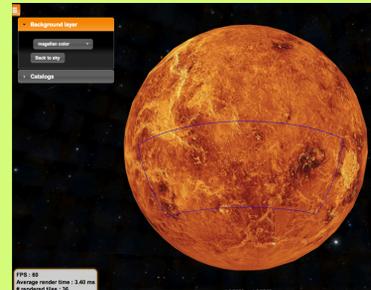
The VESPA portal sends queries to all data services available; the query interface therefore returns results from all instruments available in VESPA. Currently, two other VESPA services include data from VEX: SOIR atmospheric profiles (in IASB/BIRA) and MAG measurements (in OeAW, Graz). Results from related services will presently be returned together for further processing and comparison.

Other data services related to planetary atmospheres currently include Titan profiles from CIRS/Cassini (LESIA), Mars profiles from SPICAM/Mars-Express (LATMOS), and sampled profiles from the Mars Climate Database under various scenarios (LMD).

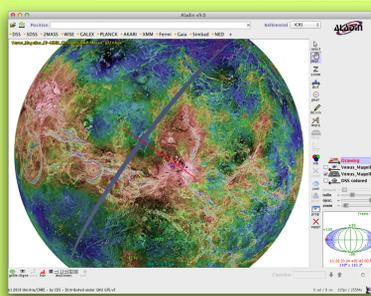
### On-line functions

Simple thumbnails are available in the result list to document the files. Footprint outlines can be sent on mouse-click to either Mizar (as bounding box) or Aladin (as sampled contour).

A dedicated display interface has been set up for spectral cubes in PDS format: APERICubes reads the data files in a local GDL/IDL session, and plots both spectral images and spectra (either individually or averaged over a region of interest). Selected spectra can then be sent via VO protocols to specialized tools such as CASSIS or SPLAT-VO to perform various analyses, including comparisons with reference laboratory data and simulations.



Spectra selected in APERICubes and passed to CASSIS for analysis (difference is plotted after on-the-fly resampling)



Footprints in Mizar (bounding box, purple) and Aladin (sampled, red)

A VVEx spectral cube of the night side sliced on-line in APERICubes

### References

Drossart, P. et al. (2007). Scientific goals for the observation of Venus by VIRTIS on ESA/Venus Express mission, Planet. Space Sci., 55, 1653–16723.  
 Erard S., et al (2017) VESPA: A community-driven Virtual Observatory in Planetary Science. Planet. Space Sci., in press. <https://arxiv.org/abs/1705.09727>  
 Erard S., P. Le Sidaner, B. Cecconi, J. Berthier, F. Henry, M. Molinaro, M. Giardino, N. Bourrel, N. André, M. Gangloff, C. Jacquey, F. Topf (2014) The EPN-TAP protocol for the Planetary Science Virtual Observatory. Astronomy & Computing, 7-8, 52-61. <https://arxiv.org/abs/1407.5738>  
 Savalle R., Erard S., Le Sidaner P. (2016) APERICubes: An on-line astronomical & planetary ergonomic research interface for data cubes (poster). ADASS XXVI, Trieste, It, 16-20/10/2016.

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### Prospects

Developments of the VVEx data service will be two-fold:

- First, the present service will be extended to encompass the complete mission, and will include more parameters. In particular viewing angles will be ingested in the coming months.
- Second, the service may be enlarged to include derived products, i. e., results of analyses such as abundance maps, profiles, wind maps, surface emission maps, etc. Such data are not normally delivered to the PSA, and are seldom available to other researchers in digital form. This will therefore constitute a significant added value compared to the public archive. In addition, python access and distribution in netCDF format are being studied.

A different service is also planned which will provide descriptions of individual pixels. This will make it possible to immediately identify, for instance, spectra at the limb in a given viewing geometry, local time, or latitude inside the dataset. Such queries are impossible by construction in the current PSA, which only documents the data at the file level.