D11.2 - First VESPA incremental report

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Abstract: This document summarizes VESPA infrastructure progress (JRA) during the first year of the Europlanet 2020 contract

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This document summarizes VESPA infrastructure progress during the first year of the Europlanet 2020 contract and deals with the JRA activity. Actions taking place in the VA are mentioned wherever they interact directly with design and development activities in the JRA. They are described in the VA progress report: D6.6 VESPA progress report.

Task1 - Coordination

Communication tools

Tools to share information in the WP have been installed from the start:
GitHub (code repository), wiki (document elaboration and monitoring of actions), Slack (real time interaction): see D11.1 - VESPA website/GIT
Their content is publicly accessible.

The VESPA web site, mostly intended for the general public, was installed as a VA action (D6.1 - VESPA Website)

Task2 - Tools and interfaces

Data Access Protocol

An important action during the first year was to perform a major upgrade of EPN-TAP (version 2). This will result in easier and straightforward design for data providers, better documentation of data, and more services to the end users (ObsParis and all).
Associated parameters, value lists, and UCDs have been entirely checked for consistency with other protocols, in particular with IVOA's ObsCore protocol, to ensure optimal consistency with VO tools maintained by IVOA developers. This is included in D6.9 - First set of standards documentation.

The design of the new list of observatories and spacecraft has started - this will be implemented both as a resolver and as an EPN-TAP data service (ObsParis, IWF)
A public input interface (for amateur observatories) will be adapted from an older FP7 prototype (IWF): http://europlanet-na1.oeaw.ac.at/matrix/index.php?page=browse

Service set up

A "manual" service installation procedure has been identified as a VA action and reviewed during the service implementation workshop in Toulouse: server installation, service design, registration (ObsParis, IRAP, Jacobs U., all).
Declaration in the IVOA registry is currently difficult in practice; this is being discussed in the IVOA WG, and a temporary procedure is being designed.

A related JRA action was to develop an EPN-TAP v.2 mixin to set up a service with minimal effort, by parsing either a catalogue or the file headers. A first prototype was developed by Jacobs U. (https://github.com/epn-vespa/DaCHS-for-VESPA/tree/master/mixin-EPN-TAP-2.0) and an independent study is being performed in direct collaboration with the DaCHS developer at U. of Heidelberg. These two solutions will be compared and merged in the coming year to produce an easy ingestion mechanism for potential large data providers outside VESPA, in particular to provide an EPN-TAP interface to existing archives (e.g. at the PDS Small Bodies Node).

Main user interface

The VESPA user interface is the main EPN-TAP search interface, which allows the user to explore/discover EPN-TAP data services (http://vespa.obspm.fr).

The interface has been completely redesigned to support EPN-TAP v.2, and many functions were added. This includes: unit conversions, case support, support for multi-valued fields, thumbnails, extended queries on all present parameters in custom mode (for services not registered), new schemes for spatial & spectral searches, new help system, etc. The result page has also been considerably accelerated by using pagination, and will support larger services.
Footprints can now be sent to Mizar (as bounding box) and Aladin (as actual contour). Powerful searches on footprints (with intersections, inclusions, etc) are available in the interface in direct query mode.
Developments were based on use cases involving VESPA, CASSIS, Aladin, TOPCAT, 3Dview, and Mizar, e. g., direct VESPA connection to Mizar and Aladin for footprints on planets/satellites, to APERICubes for spectral cubes, and to CASSIS for reflectance spectra. Other use cases involve simultaneous work with related data services, in particular for small bodies.

The new interface will become public in September 2016.
See VESPA interface on-line help (http://vespa.obspm.fr/planetary/data/epn/help) and roadmap for development (VESPA user interface).

Data access though other tools

Alternative access to EPN-TAP services will be possible directly from the VO tools. For this purpose, an EPN-TAP library was developed in java by IRAP. This is intended to provide a lower-level and more direct access to individual services, and will result in increased visibility of Planetary Science data in the VO. IRAP coordinated the EPN-TAP v.2 library specifications (VESPA EPN-TAP Library specification) and performed the implementation. The library is currently implemented with a GUI in CASSIS and 3Dview (D11.5) and is being tested.
Besides, a Google Sheets add-on was developed to query generic TAP servers, and is currently being reviewed by the Google team for official inclusion into their web store (IWF).
Finally, extensive tests of EPN-TAP alternative access from existing generic TAP clients were performed, in particular from TOPCAT and TapHandle (Jacobs, ObsParis, IRAP).
These access methods will ensure complete access to EPN-TAP services through the more general TAP mechanism, even in case the VESPA interface and EPN-TAP disappear.

A general purpose VOevent server was also installed in ObsParis. This will be used mainly for the PSWS WP but also for some applications in VESPA, e.g., the FRIPON meteorite fall alert system (in collaboration with GEOPS) and coordination of Jupiter radio observations in support of the Juno mission.

Improvement of standard VO tools

CASSIS (IRAP)
The EPN-TAP java library has been integrated in CASSIS as a prototype (beta version dated 29/6/2016).
CASSIS now supports reflectance spectra, under test.

Aladin (CDS)
As of v.9, Aladin correctly builds 3D spherical models of planets from cylindrical maps and processes them as a hierarchical tiling scheme (HiPS). Footprints defined as pgSphere sPoly variables can be sent via SAMP and overplotted in Aladin. This format, used for the s_region parameter in ObsCore, has therefore been included as a new standard in EPNCore to define accurate footprints on planetary surfaces.

3Dview (GFI & IRAP)
Capacities of 3Dview have been greatly enlarged by reading Spice kernels from the public NAIF server which is always up to date (instead of a private server at GFI) - this will allow the user to access any mission definition in the future, with no update on the code or server part of 3Dview. The updated version also handles spacecraft attitude and field of view for several individual instruments. User-specific kernels can now be imported to study hypothetical configurations, e.g., for observation planning (see: D11.4 - Spice Kernels and Instrument FOV in 3Dview).
The EPN-TAP java library has been integrated in 3Dview by GFI (D11.5)

VOSpec (ESA)
The VESPA team has provided user requirements to ESA for a possible upgrade of VOSpec, with use in Planetary Science. Possible new functions could include support for reflectance spectra, EPN-TAP access, LineList protocol, and possibly extraction and summations from 2D spectra sets (which was available in STScI's SpecView, apparently no longer maintained).

Link with non-VO applications

Mizar (from CNES) is now used to display 3D views of planets and satellites from the VESPA interface. It supports overplotting of rough footprints as bounding box or point (ObsParis).

Suggestions of improvements of external tools interface have been issued:
- WebGeoCalc from Spice/JPL – VOTable output (agreed, underway)
- Improved connections with WMS Mars maps servers at USGS and ASU (pending)
- QFitsView from Max-Planck-Institute for Extraterrestrial Physics - VOTable support and SAMP interface (pending)

Workflows

At this stage, only initial considerations were performed. This action will develop when more data services are connected, but we already schedule to somehow implement state-of-the-art methods to analyze spectroscopy of planetary surfaces, including multivariate analyses and retrieval of Hapke's radiative transfer parameters.

Other workflows will be studied in relation with magnetosphere and atmosphere themes.

More specific workflows will be studied when several related services are implemented, e. g., comparison of simulated and observed atmospheric profiles in the atmospheres of Mars and Titan, or small bodies properties.

Task3 - SSHADE

SSDM data model

The Solid Spectroscopy Data Model (SSDM, currently v 0.7.0) was greatly enhanced during the first year, and is now reflected in the database structure (IPAG + contributors).

Many changes were necessary to go from the single database structure (formerly developed for the GhoSST database) to a multi-database infrastructure with multiple levels of managements. Reorganization and simplification of SSDM make the data model more adapted and more 'user friendly' for the wide range of data produced by the consortium partners. Several modules were also added to extend its capabilities (extraterrestrial materials, micrometeorites objects, etc).

SSHADE infrastructure

During the first year, the major actions of the development of the SSHADE infrastructure were to design the multi-database architecture from the new SSDM data model and to build the tools dedicated to data producers (import, data search, and visualization). The technical choices implied a development from scratch in order to provide a reliable and scalable infrastructure.

The main part of the development focused on data ingestion. The GUI for the ingestion of most types of fundamental (common) data and of spectral data from data producer were developed. This tool is more reliable and more accurate than its GhoSST equivalent. Still using XML files, the import tool includes a validator that checks the presence of "mandatory" data or optional blocks when specific conditions are satisfied. On error, the validator stops the ingestion and provides guidance without recording any wrong data into the database. A history is stored for every successful import and provides a way to download all imported files.

The second step of the development focused on the GUI for data producer: import, conversions, search, and visualization are implemented. A data producer can search all kind of data through several forms and filters. The spectra can be visualized on an interactive plot providing a dynamic unit conversion. Another tool was developed in order to convert BibTeX files into XML "publication" files for semi-automatic import.

A first prototype of the SSHADE infrastructure will be delivered end of August 2016, together with SSDM v0.7.0 (D11.6), an ingestion system, and interfaces for data producers and users. The prototype database will be filled with a large set of generic fundamental data (molecules, minerals, bonds, chemical functions, publications, etc) and a small test set of spectral data of ices, minerals, and rocks from at least 2 laboratories (IPAG, IGS-PAS) to assess its ability to manage a set of databases.

Task4 - Surfaces

Jacobs Univ.:
VO data queries were implemented in the JavaScript Cesium client for 3D maps.
Initial work has started on a plug-in to connect QGIS to the VO hub (https://github.com/epn-vespa/QGIS-VO_plugin) - this is currently impaired by an issue in accessing the IVOA registry.
EPN-TAP to wms server connection study has started. This is based on PlanetServer & CASSIS use cases, e.g., spectra (subgranules) can be extracted from PlanetServer and broadcast to CASSIS via SAMP.
Predefined spectral parameters for CRISM data have been Implemented in the PlanetServer API.
Initial developments on footprints in Aladin: simple polygons are supported; next step will focus on circles (e.g., craters and volcanoes), polygons with holes and multi-polygons (e.g., complex geological/spectral units).

GEOPS:
Initial work on fits extension for planetary surfaces (document in preparation), plus fits to GDAL conversion (https://github.com/epn-vespa/fits2vrt)
Assessment of CORS implementation in the DaCHS TAP server.
Integration of dataset from future FRIPON service + study of VOevent use in this context (alert for meteorite falls in real time)

Task5 - Magnetospheres

Installation of a TAP server at UCL.
Installation of new server at IRAP, dimensioned to support the complete AMDA database (currently being ingested in v2)
A web server has been installed at IAP, which will host the iPECMAN client service under development. A TAP server has also been installed, and a database populated with Cluster data.

Task6 – Small bodies

Asteroid Dynamical db DynAstVO (IMCCE):
- validation of the improvement of the dynamical model; validation of the orbital fitting process; First tests of PostgreSQL

implementation.
- definition of the database structure - computation of first samples of database, validation and comparison with existing ASTORB

Task7 - Atmospheres

IASB-BIRA:
Server installation. Finalization of the internal HDF5 file format and file generation. Scripts/routines will be provided to convert the data into a format handled by VO tools.

Latmos & LMD:
Installation of data servers and common use case for Mars atmosphere (profiles), comparison of measurements (Mars-Express) and simulations (Mars Climate Database)

Task8 - Exoplanets

Design of new section on atmospheric properties in the Encyclopedia of extra-solar planets, and test implementation on the development server (see, e.g., hd_189733_b).

Prospects

The basic infrastructure of VESPA is now essentially upgraded to a version which is easier to handle for both data providers and developers, and provides more functions to the user. Documentation is available in deliverable D6.9.

The EPNCore Data Model has been revised to be more flexible and provide better description of the data.

The main search interface has been hugely improved and now proposes more versatile input options (spectral range in wavelength or frequency, etc). Extra functions such as thumbnail and footprint visualization have been added, as well as searches on complex footprints. Alternative access modes have also been set up to support long term sustainability.

Connection with dedicated tools have been formalized in particular to support spectroscopic measurements, maps, and radio observations. Support of Planetary Science particularities has been enlarged.

Large specific services are being designed and prototyped, in particular SSHADE, PlanetServer, and AMDA.

The next steps in year 2 will focus on:

- handling data products from several services to favor cross-data analysis (from use cases in several fields)
- making the search interface even more independent from EPN-TAP standards (e.g., entry of coordinates in planetographic convention, etc)
- connection to ephemeris and computation systems (Miriad at IMCCE, WebGeoCalc from JPL, etc)
- improved handling of Planetary Science data with VO tools
- implementing the EPN-TAP access library in more VO tools
- refined bridging with GIS applications and wms servers
- connecting other related environments to the VESPA interface (SSHADE and smaller spectral databases)
- designing workflows for spectral observations of surfaces, magnetospheres, and atmospheric studies