

Providing visibility to the Rosetta archive with the Planetary Science Virtual Observatory

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Current content of the PSA

- Aim: archive data for preservation and future availability
— not a data distribution system

Content

- Includes raw/calibrated data + geometry/support when relevant
+ documentation & biblio references + index of data files & parameters
- May include derived data, but not very likely

Current user access to the PSA

FTP access to complete PDS tree

ordered by STP, then files - no search function

"Advanced search" (java interface)

limited to few parameters (mostly filename), won't extend easily

Map search:

currently MEx only, won't provide access to coma data

Experimental PDAP access (VO-like)

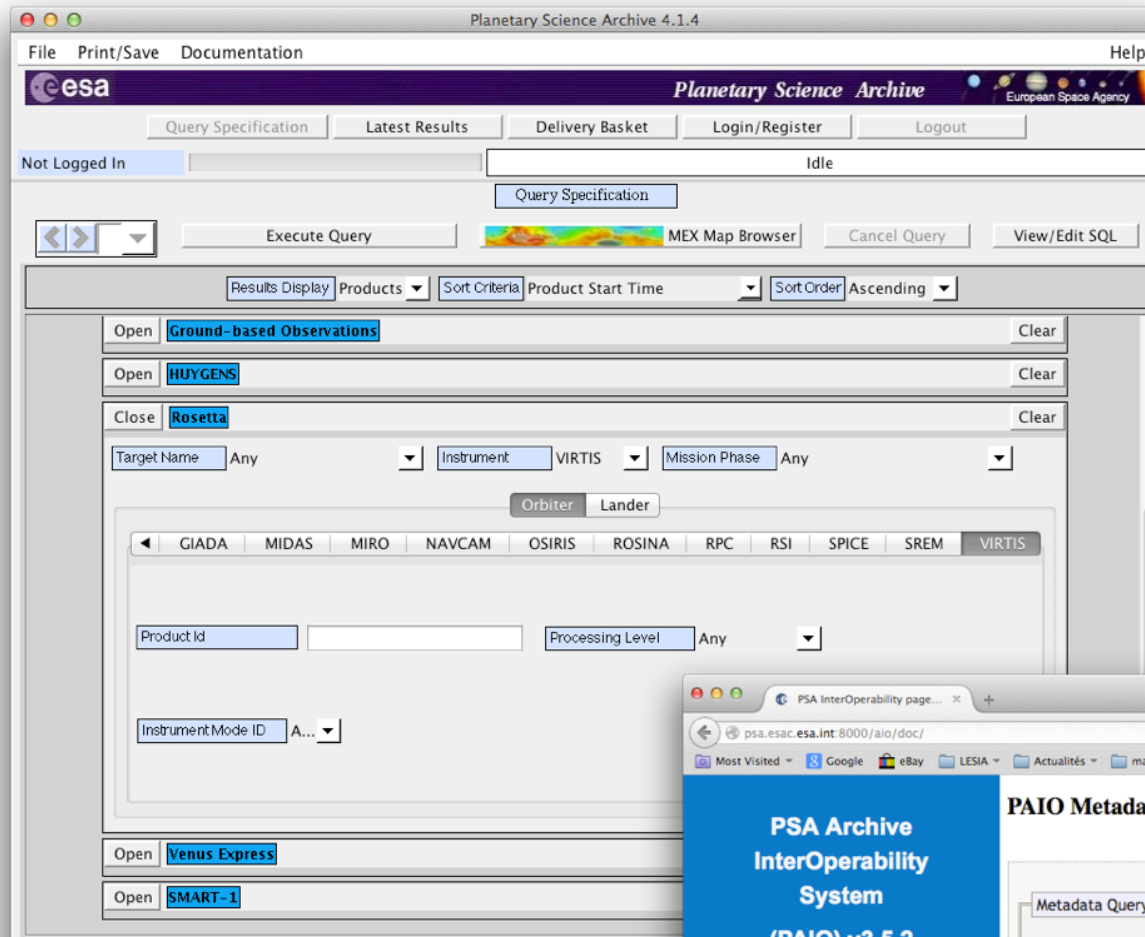
currently uses very few parameters

uses a limited protocol which does not provide full search capacities

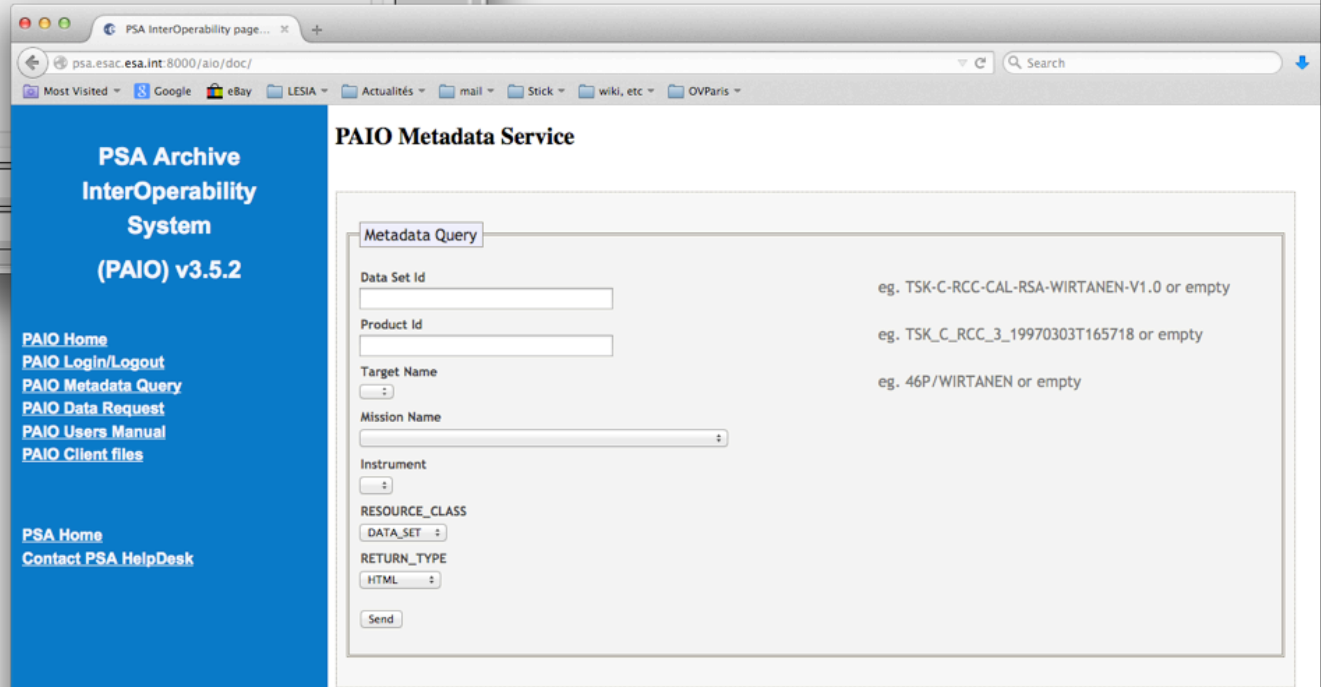
protocol seems deprecated (?)

- => *very limited search functions,
you have to know what you're looking for (ie: filenames)
or manually browse dataset indexes*
- => *No simple way to retrieve corresponding data from different
datasets - practical only for simultaneous observations*

Current user access to the PSA



"Advanced search"
(java interface)



Experimental PDAP
access (VO-like)

Current services on the PSA

Map for selection

MEx only, as a search interface (on footprints)

Quick-look

limited to prepared thumbnails on search result page, for some datasets only — no visualization of data files

Analysis

none available

Data retrieval

individual downloads or bulk archive via FTP

then you have to open and process in your favorite environment
(expect difficulties with PDS "format")

User's experience

- Fulfills PDS purpose, which is to preserve data and make them available
- Are there (cheap and easy) ways to provide more functions on the archive?

Virtual Observatory

Developed in the past 10 years by the Astronomy community
(ESA included)

Information system connecting databases

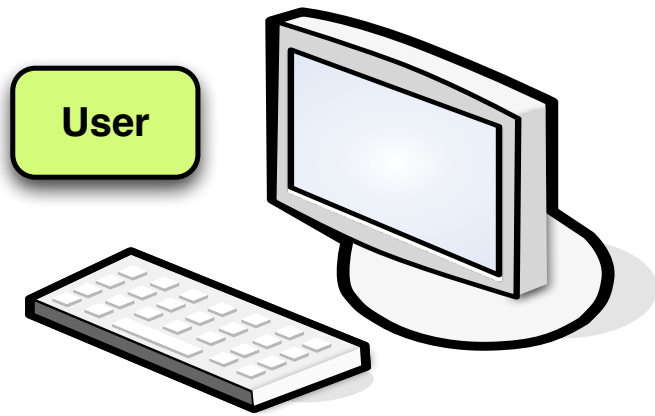
Provides global infrastructure (query system, visualization tools)

PDAP was a first attempt to apply these techniques to space archives

VO was adapted to Planetary Science data in general during the
Europlanet program (2009-2012)

To be developed / extended in Europlanet H2020 (2015-19)

User's experience



User

Queries

Answers

Data access

Catalogue / Registry

SSODnet

GhoSST
KIDA

PSA

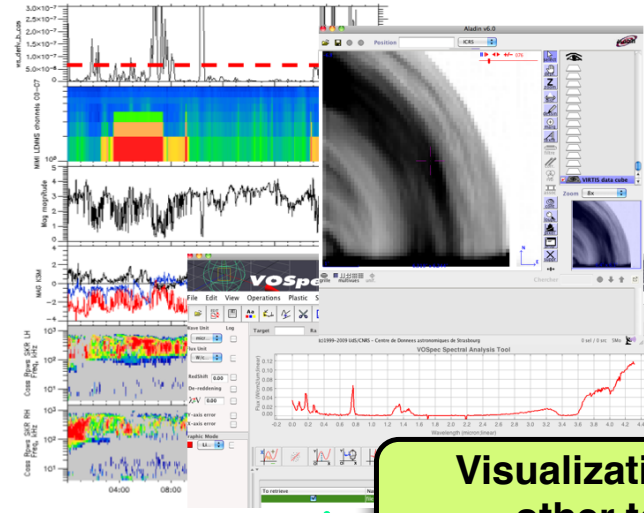
AMDA...

EPN

PDS

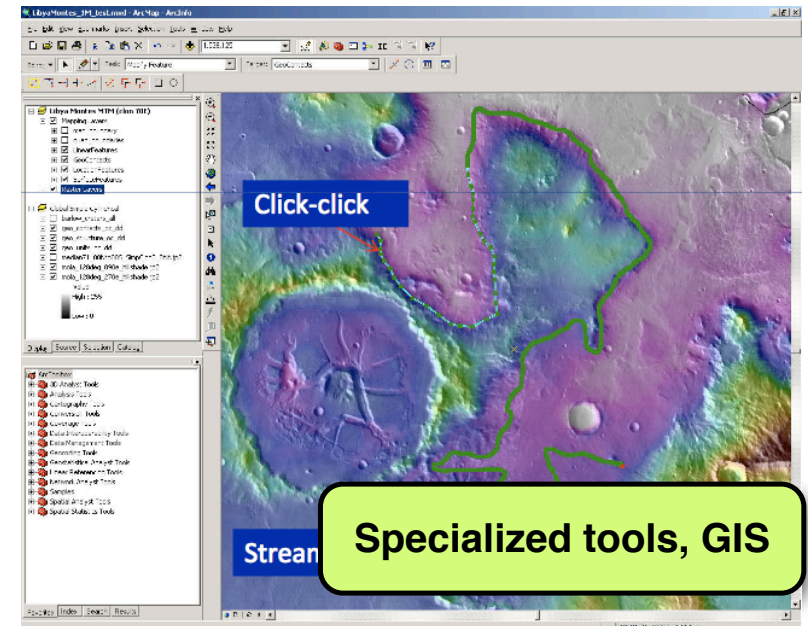
Data bases

Space agency archives



Data exchange

Visualization and other tools



Click-click

Stream

Specialized tools, GIS

Euromlanet VO: VESPA

- A demonstrator exists, currently connecting ~12 databases of different sorts in very different domains
- Can be used easily to provide search functions on a PSA/PDS dataset

Applications:

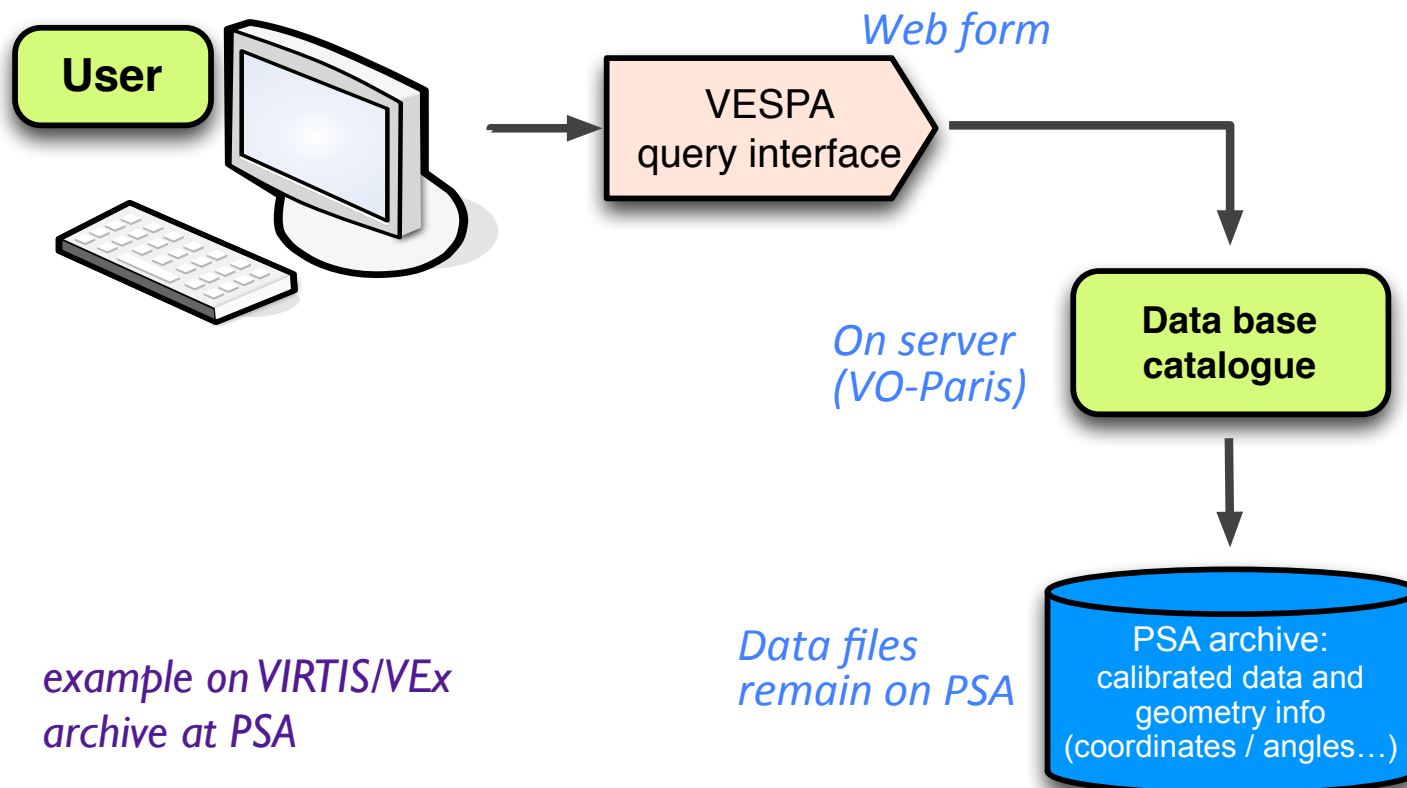
- IKS/Vega-1 to IP/Halley (open)
 - datafiles were refreshed and converted to a different format
- VIRTIS/VEx (designed, still to be implemented)
 - will require maybe two weeks (essentially to check the descriptors)
 - will provide high level search capacity in this dataset
 - + on-line quick-look (on PDS cubes directly)
 - in a second step, will be enlarged to derived data, with quick-look & on-line analysis functions (in VO tools)

VO as search function in a PDS dataset

Archive file VIRTIS_INDEX.TAB => turned to catalogue of the data service

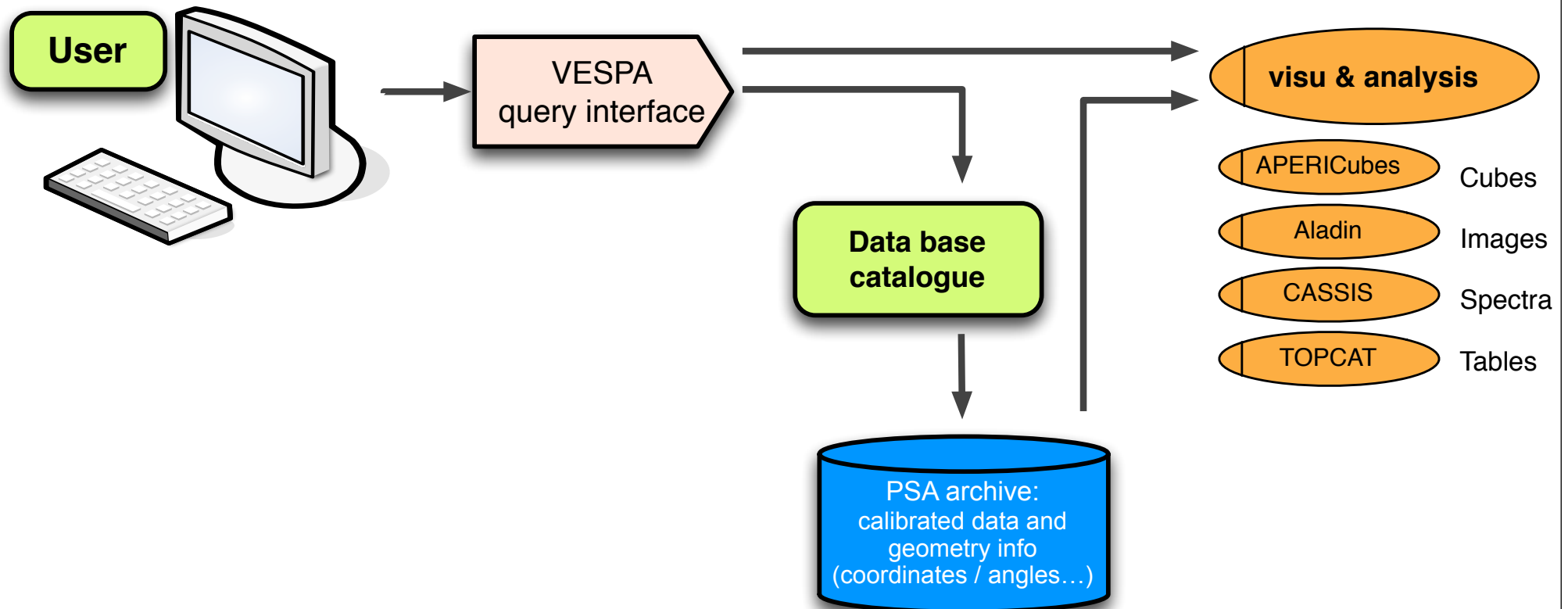
All files/sessions are then described using:

- UTC / location / local time / tangent altitude / viewing angles, etc
- Instrument parameters (including integration time / quality code)
- VESPA can readily use those as search parameters



VO to provide other functions on a PDS dataset

- VO tools provide quick-look and basic analysis functions for images, spectra, tables
- A specific tool is being devised to analyse spectral cubes on-line (APERICubes)
- Data are sent directly from the search interface, no need to download



VESPA access

- Global search interface for Planetary Science services
- Supports EPN-TAP + PDAP

<http://vespa.obspm.fr>



Query form: All VO

Target name

Resource type

Dataset ID

Time selection

Time min

Dataproduct type

Query results for all resources

gran

Plotting tools

- TOPCAT
- Aladin
- VOSpec
- SPLAT

EPN Resources

Auroral Planetary Imaging and Spectroscopy

Results : 341
[DISPLAY RESULTS](#)
▶ Description :
Credits: Creator

Results in service apis

Show entries

Search:

Show / hide columns

dataproduct_type	target_name	time_min (d)	time_max (d)	access_url
image	Titan	2009-01-23T16:09:22	2009-01-23T16:19:22	jb9z01011_proc.f
image	Titan	2009-01-23T16:21:40	2009-01-23T16:38:20	jb9z01021_proc.f
image	Titan	2009-01-23T16:41:58	2009-01-23T16:51:58	jb9z01031_proc.f
image	Titan	2009-01-23T17:42:54	2009-01-23T17:52:54	jb9z01041_proc.f
image	Titan	2009-01-23T17:55:12	2009-01-23T18:11:52	jb9z01051_proc.f
image	Titan	2009-01-23T18:15:30	2009-01-23T18:25:30	jb9z01061_proc.f
image	Titan	2009-01-23T19:18:47	2009-01-23T19:28:47	jb9z01071_proc.f
image	Titan	2009-01-23T19:31:05	2009-01-23T19:47:45	jb9z01081_proc.f
image	Titan	2009-01-23T19:51:23	2009-01-23T20:01:23	jb9z01091_proc.f
image	Titan	2009-01-23T16:09:22	2009-01-23T16:12:42	jb9z01a1q_proc.f
image	Titan	2009-01-23T16:21:40	2009-01-23T16:25:00	jb9z01a4q_proc.f
image	Titan	2009-01-23T16:33:40	2009-01-23T16:37:00	jb9z01a7q_proc.f
image	Titan	2009-01-23T16:37:40	2009-01-23T16:41:00	jb9z01a8q_proc.f
image	Titan	2009-01-23T17:46:54	2009-01-23T17:50:14	jb9z01aeq_proc.f
image	Titan	2009-01-23T17:59:12	2009-01-23T18:02:32	jb9z01ahq_proc.f
image	Titan	2009-01-23T18:11:12	2009-01-23T18:14:32	ib9z01alq_proc.f

Base de Donn

Results : 0
[DISPLAY VOTABLE](#)
▶ Description :
Credits: Creator

Extrasolar Pla

Results : 0
[DISPLAY VOTABLE](#)
▶ Description :
Credits: Creator

Heliophysics P

Results : 0
[DISPLAY VOTABLE](#)
▶ Description :
Credits: Creator

Plotting tools

- TOPCAT
- Aladin
- VOSpec
- SPLAT

Example queries

- Saturn in March 2012

SELECTED DATA

- 1 selected data
- 1 : image

PREVIEW

Visualization tools: adapt IVOA tools

Aladin:

- plots images/cubes
- handles sky/spheroid coordinates

- can build image mosaics
- can handle object catalogs
- Solar System bodies tracking on sky images (SkyBoT)

HST / Saturn image from APIS in Aladin

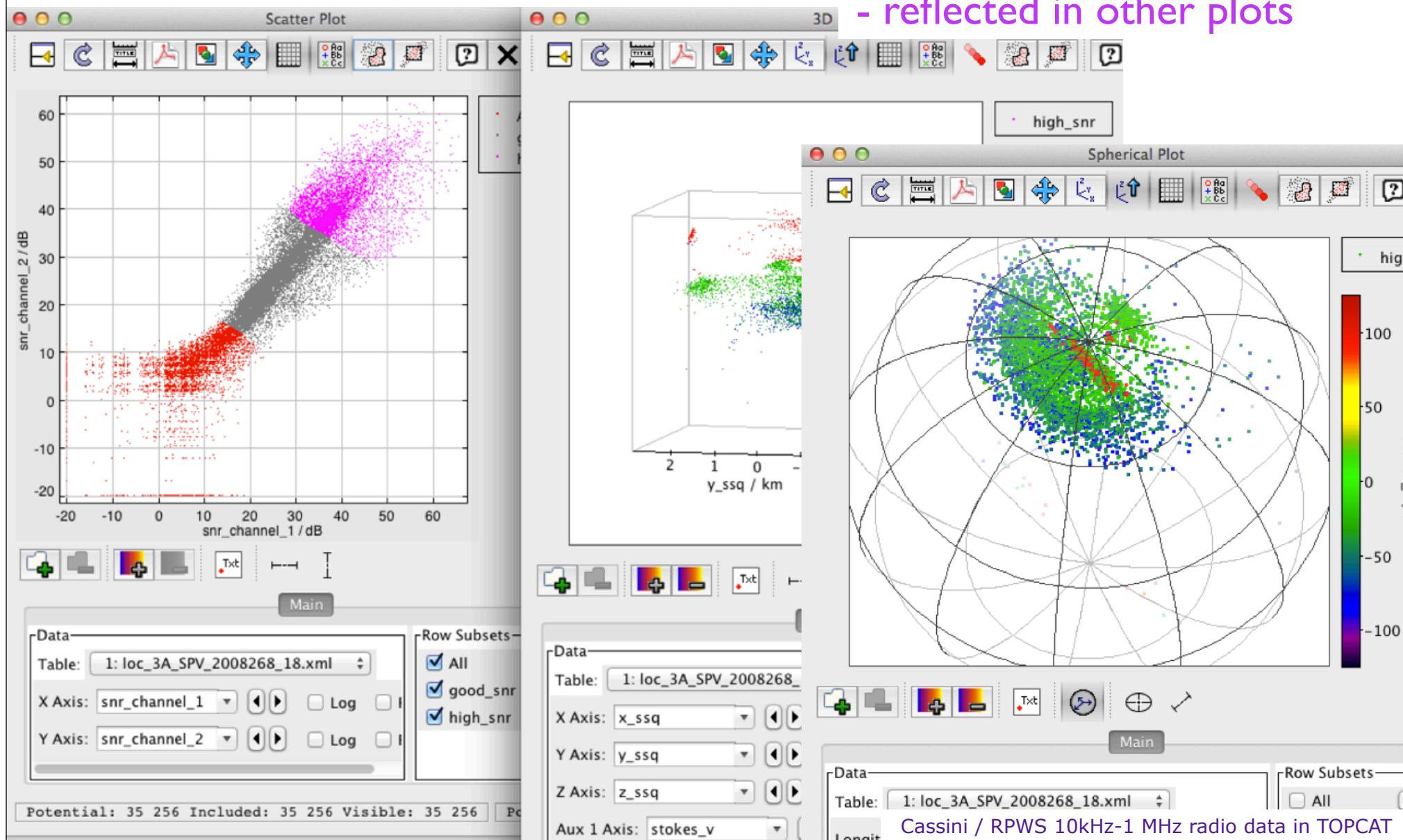
AMIE/Smart-1 image frames & footprint in Aladin

(c) 2012 UDS/CNRS - by CDS - Distributed under GNU GPL v3

TOPCAT:

Allows data selection

- by formula or graphically
- reflected in other plots

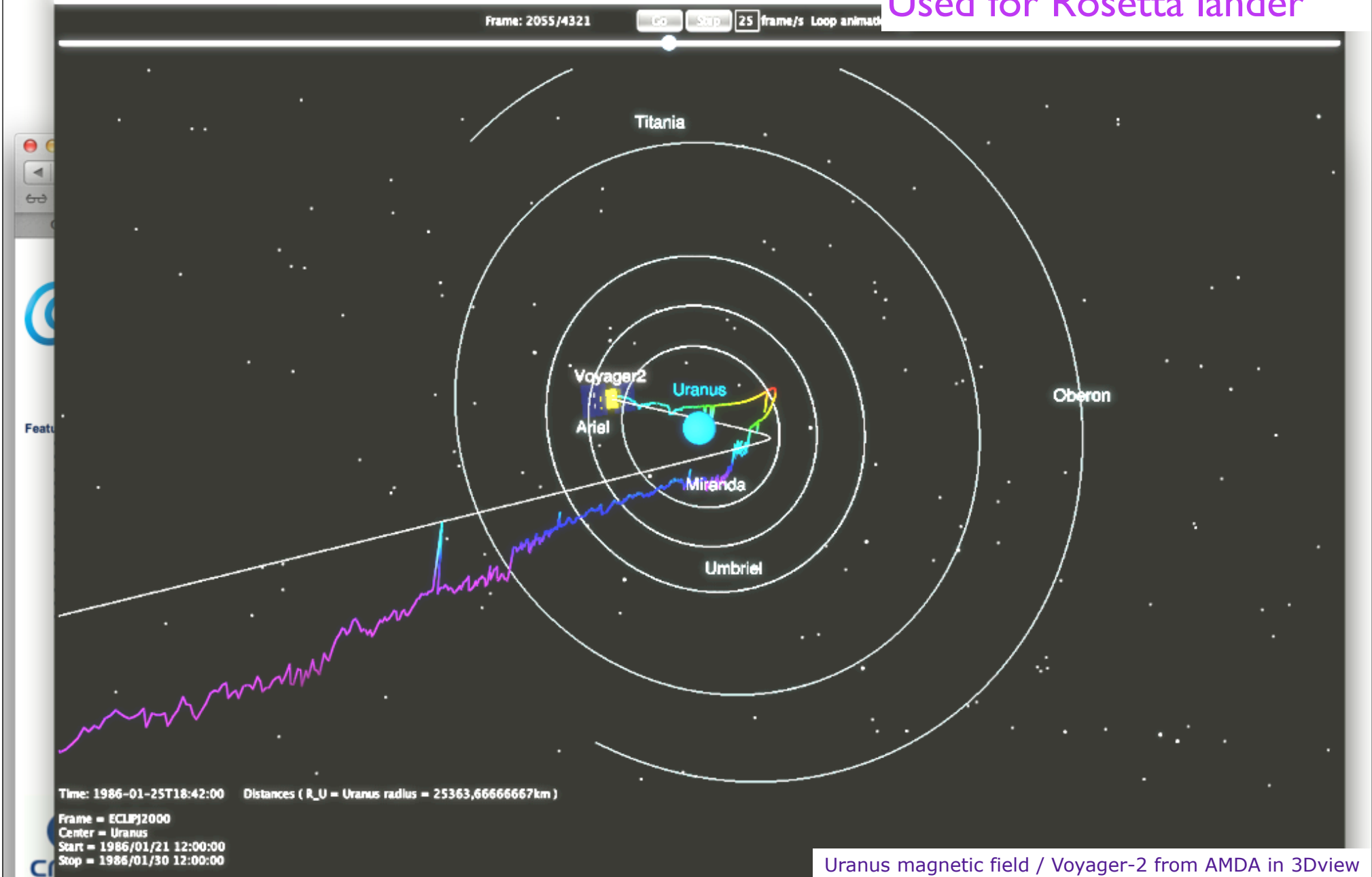


Visualization tools: adapt other existing tools

3Dview / CNES:

Spacecraft trajectories+data

Used for Rosetta lander



On-line visualization of spectral cubes



APERICubes Demonstrator - a tool for exploring VIRTIS cubes

Version 1.5 by Renaud Savalle

Cube Transformation

1. Choose the PDS file to be processed and click on Process:

V10072_05.CAL Process with GDAL

The results of the processing will be displayed in the Results frame.

Results

SUFFIX	UJNT
cube.table:	
TABLE	FLOAT

Creating FITS header for lam
Writing FITS spectrum into F

SAMP Apps

- VO VOSpec
- splat
- Aladin
- Casali

SAMP Status

SAMP status: Connected

Image

Frame: 0 73

File View Zoom Scale Color Region WCS

Region Stats

Region Stats

Create a region to see stats

3D Plot

3dPlot

Create a region to see 3d plot

X Proj

X Projection

Create a region to see projection

Y Proj

Y Projection

Create a region to see projection

Spectrum

Spectrum for pixel (28,48)

VIRTIS / Venus-Express imaging spectroscopy in APERICubes

- Currently a demonstrator, specific to VIRTIS
- Based on java version of DS9 + home-made PDS to FITS conversion
- Linked to search interface and other visu tools

Search several PDS datasets

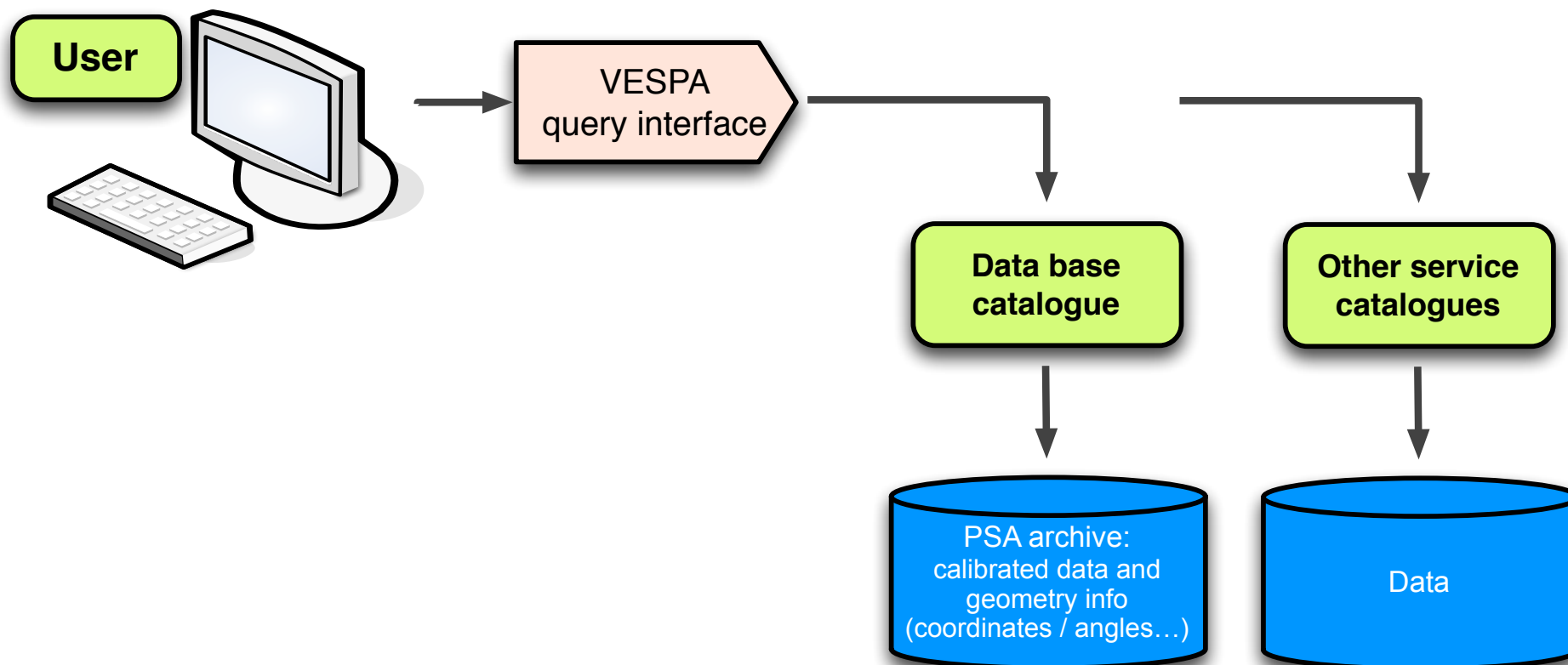
VESPA can send queries to several data services in parallel:

- other Rosetta instruments

=> Cross correlate all Rosetta measurements with a single query

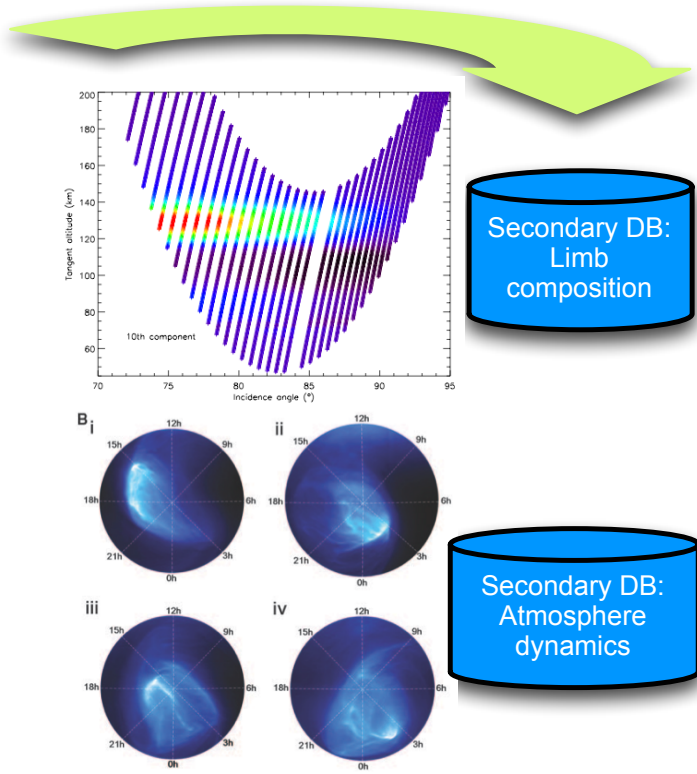
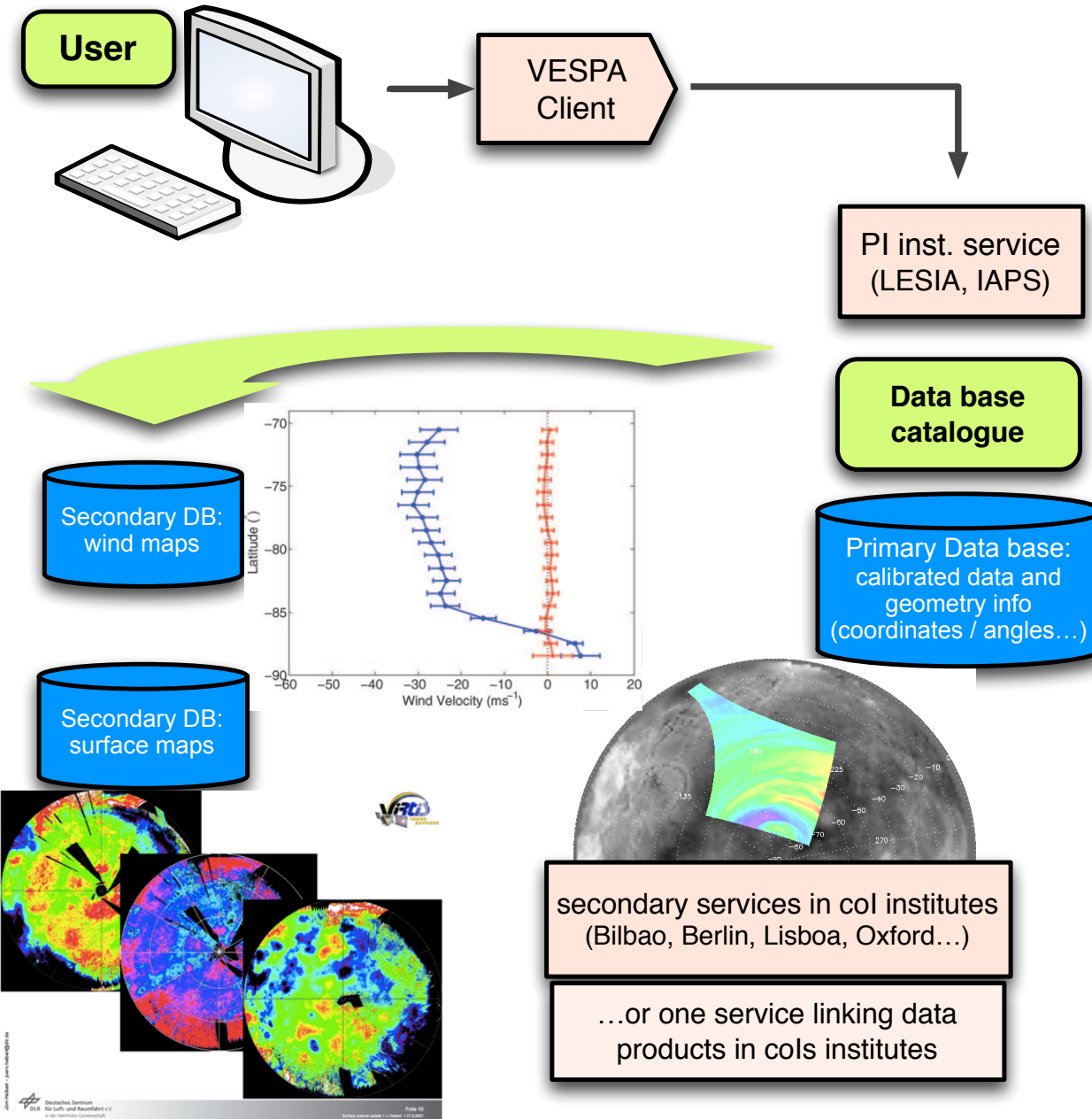
The whole content of the PSA could actually be handled as a single data service

- derived data / results of various analyses from this instrument (not in PSA)



VIRTIS / Venus-Express Data Fuzzy-Center:

Derived products are distributed by associated teams, possibly using a server/catalogue located in PI institutes



Search several PDS datasets

VESPA can send queries to several data services in parallel, possibly outside PSA:

- reference data:

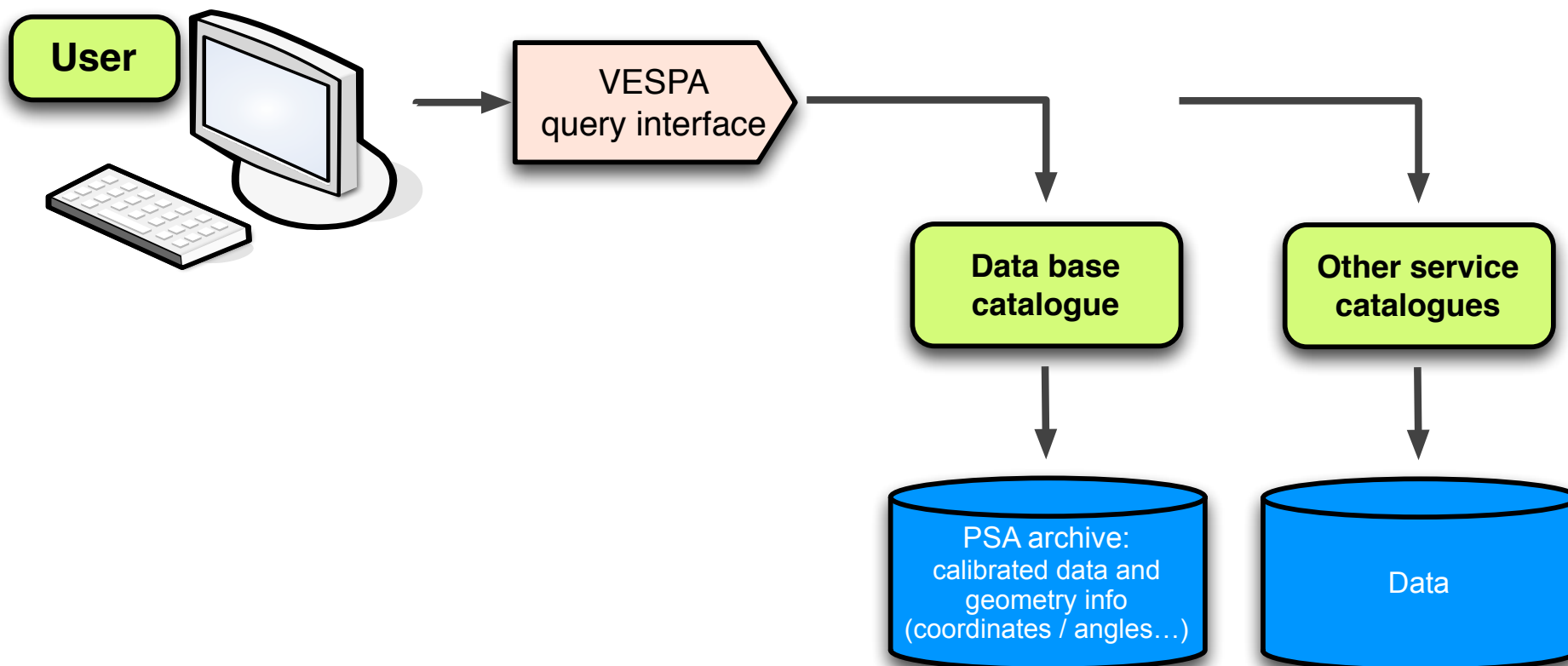
other similar missions,

ground-based observations campaign (handling light path delays)

lab spectra,

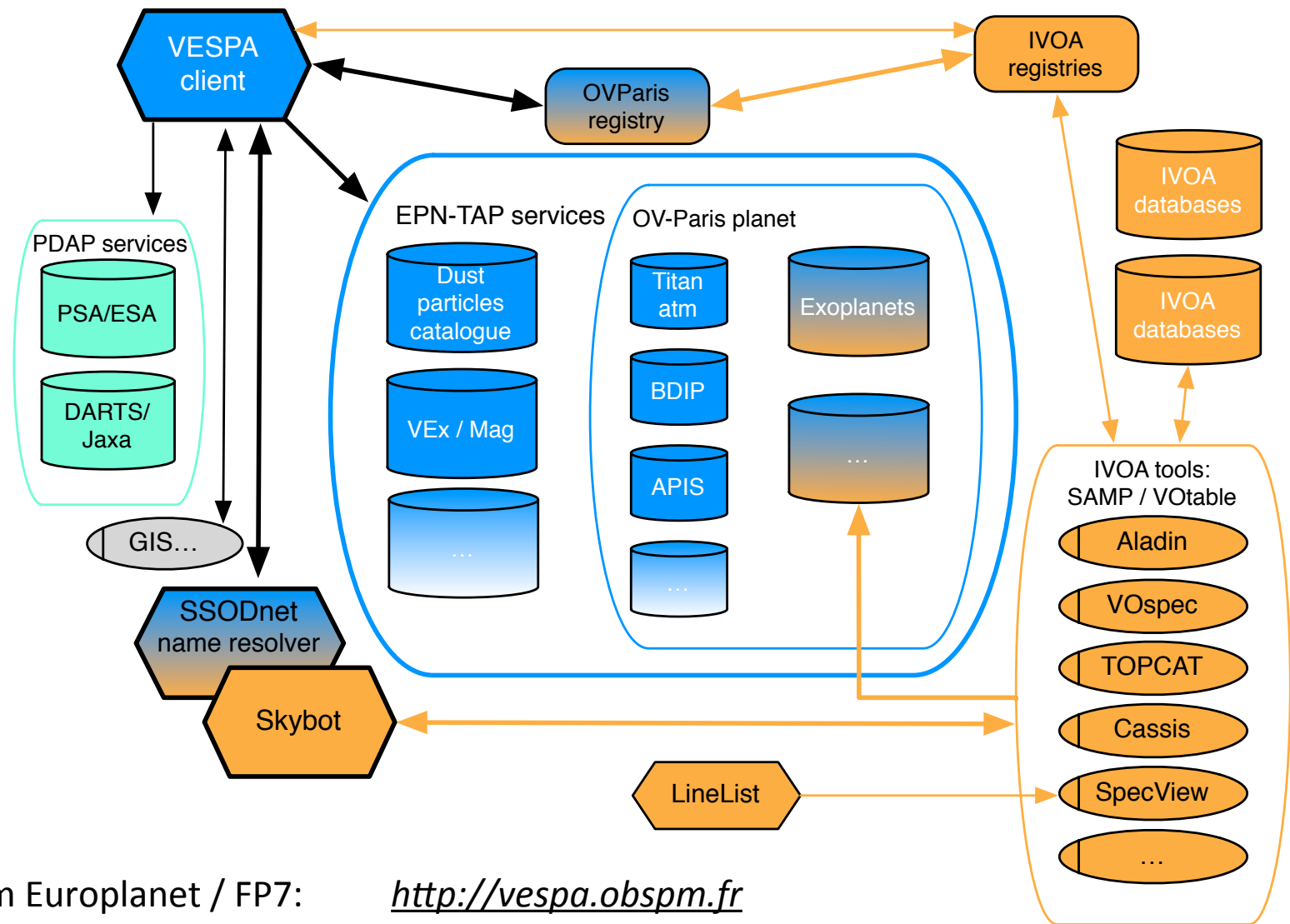
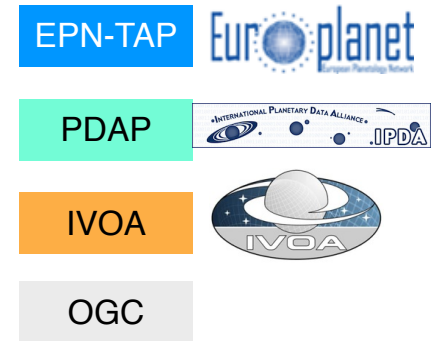
simulations,

etc



VESPA Architecture

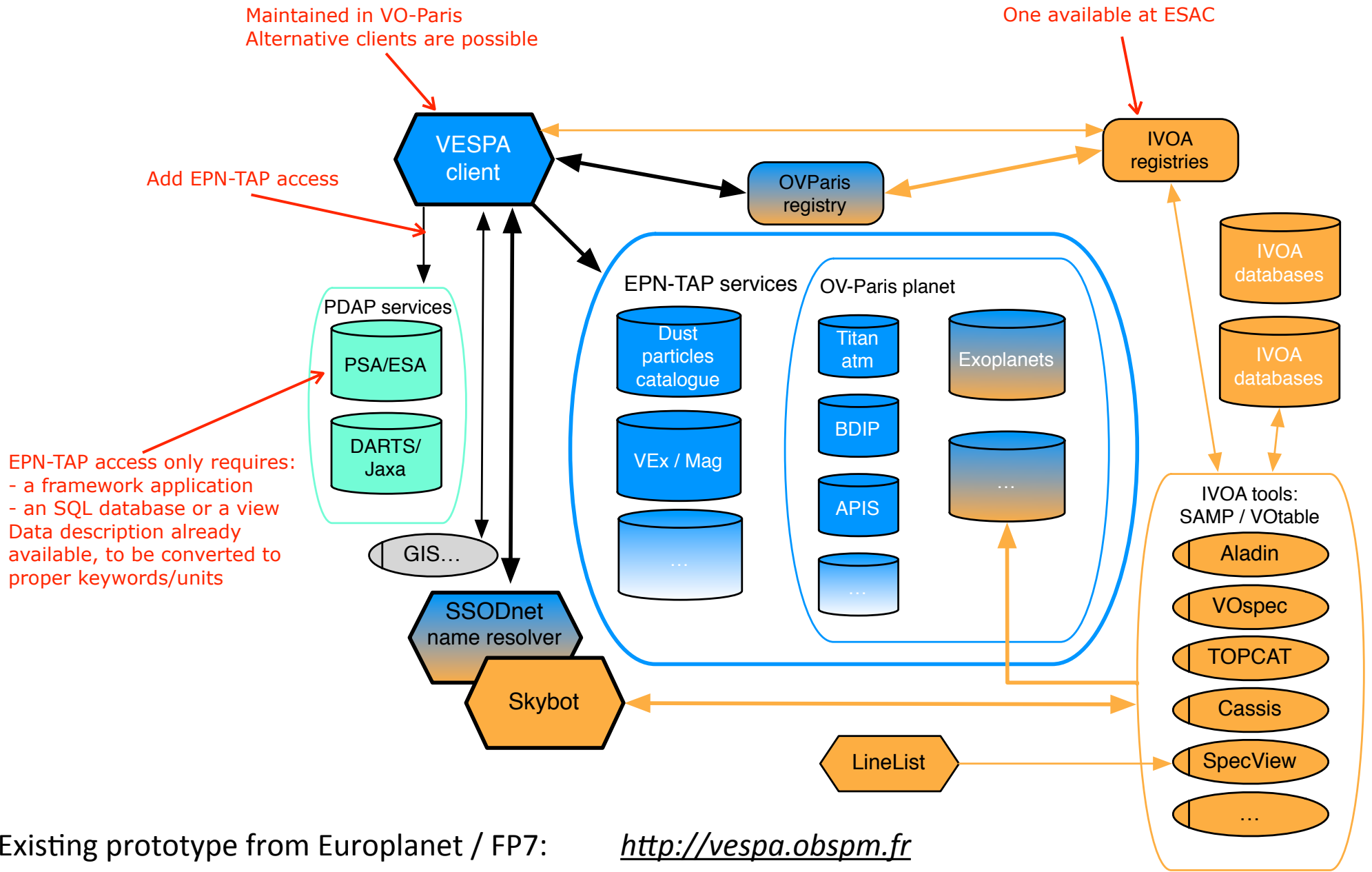
- Centered on data services
- Specific access protocol / user interface to query services together
- Connected to visualization tools from astro community
- All standards are maintained by world-wide alliances



Existing prototype from Europlanet / FP7:

<http://vespa.obspm.fr>

VESPA Architecture



JRA tasks

Coord: VO-Paris
Deputy: IAPS/INAF

Tools & Interfaces

- Improvement of visu tools
Client / query interface
- Enlargement of EPN-TAP for spectroscopy
- Interface studies, new cases
Workflow studies & demonstrators

SSHADE: solid spectroscopy

- Finalization of infrastructure
I/O interface studies

Magnetospheres

- Data calibration / evaluation?
I/O interface studies

GIS-VO link / planetary surfaces

- GIS-VO link
I/O interfaces

Planetary atmospheres

- New services
Radiative transfer codes interfaces

Small bodies, asteroids & comets

- Astorb successor?
Shape models / 3D interfaces?

Exoplanets

- Workflows, services,
use cases

Coordination

JRA / VESPA
Development

Training

- Training session during conferences
- Continuation of FP7 resource list

Dissemination & sustainability

- New standards and reference lists + validation
(meetings with IVOA/IPDA/IAU/PDS)

Amateur community link

- New services, validation/implementation

- Data validation
+ ingestion

- Service
implementation

**Enlarging VO content
from thematic**

- Service
implementation

- Service
implementation

- Service
implementation

- Service
implementation

Coordination

VAA / VESPA
Data ingestion / meetings / support

VAA tasks

Coord: VO-Paris
Deputy: Jacobs U

Lead: IPAG, Grenoble

Lead: IRAP, Toulouse

Lead: Jacob Univ., Bremen

Lead: IASB, Brussels

Lead: IAPS/INAF, Rome

Lead: VO-Paris

VESPA in Europlanet H2020

Summary

- VO techniques can provide added value to the Rosetta archive
 - Search functions in individual datasets
 - Quick-look and basic data analysis
 - Cross-correlation of instrument measurements
- The whole PSA would actually benefit from VO access
 - Easy and cheap (designed for small teams)
 - Specialists are present at ESA
 - Data description is already provided by the teams
 - Will provide (at least) similar functions to PDS3 →4 conversion
- These archives can be complemented by the teams
 - Decentralized system, all contributions accessible from a single interface
 - Derived data can be made available after publications
 - + reference data / ground based support observations
- Users
 - Science community
 - + journalists, general public, education

Will increase use of PSA & provide higher visibility to science activities in Europe

Technical issues

- Data access

This is only another way to access the PSA, it does not impact existing access modes

The only software not currently available in ESA is the VESPA client
— the source can be provided for long-term autonomy

- Data formats

PDS is not standard - e.g., no reader

FITS or CDF are more handy for visualization, if present

PDS-to-anything converter setup at VO-Paris for cubes, can be enlarged to other data types based on VIRTIS software (versatile enough)

- Coordinate frame

Conversions are *very* difficult

=> All related datasets should use the same reference frame

- Navcam images

Should be readily accessible to provide context to other instruments

The important point is that *footprints* are accessible

(not necessarily in the labels, but certainly in a catalogue => INDEX)

More details to be provided at

Planetary GIS Workshop

May 5-7 2015 at ESAC (Madrid, Spain)

During this workshop the following broad areas will be presented and discussed:

- scientific needs and use cases (existing, new, cross-disciplinary);
- existing technical solutions;
- open problems and areas suitable to improvement (particularly with respect to future PSA)

The workshop aims at targeting geospatial data users and producers in broad sense.
An informal combination of presentation, hands-on and discussion sessions is envisaged.

For more details, visit the workshop's web page:

<http://www.rssd.esa.int/index.php?project=PSA&page=gisws>