VESPA: recent progress & shopping list

Stéphane Erard	PADC / Observatoire de Paris
Baptiste Cecconi	
Pierre Le Sidaner	
François Andrieu	
Angelo Pio Rossi	Jacobs Univ, Bremen
Mikhail Minin	
Pierre Fernique	CDS, Strasbourg
Chiara Marmo	GEOPS, Univ Paris Sud
Vincent Génot	IRAP, CDPP
Nicolas André	
Michel Gangloff	
Nick Achilleos	UCL, London
Kevin Benson	
Bernard Schmitt	IPAG, Grenoble
Maria Teresa Capria	IAPS, Rome
Benoît Carry	OCA, Nice + IMCCE
Ricardo Hueso	EHU/PVU, Bilbao
Anni Määttänen	LATMOS
Ehouarn Millour	LMD, Paris
Ondrej Santolìk	IAS, Prague
Jan Soucek	
Manuel Scherf	IWF, Graz
Tarek Al-Ubaidi	
William Thuillot	IMCCE
Ann Carine Vandaele	IASB-BIRA, Brussels

Interop meeting 2018, Victoria
28/5/2018

stephane.erard@obspm.fr

VESPA / Participants

EuroPLANET 2015-19

VESPA includes 18 contributing participants (labs) in 13 beneficiary institutes:

Observatoire de Paris (IMCCE, LESIA)

IAPS/INAF Rome

Jacobs Univ. Bremen

CNRS (IRAP IPAG LATMOS GEOPS CDS)

IWF Graz

IASB-BIRA Brussels

UCL London

IAP Prague

+ Contributions from the community

UPV/EHU Bilbao

IGN/PAS Wroclaw

Univ. Bern

SINP/Lomonosov Univ.

GFI Toulouse

Variety of data / specificities for the Solar System

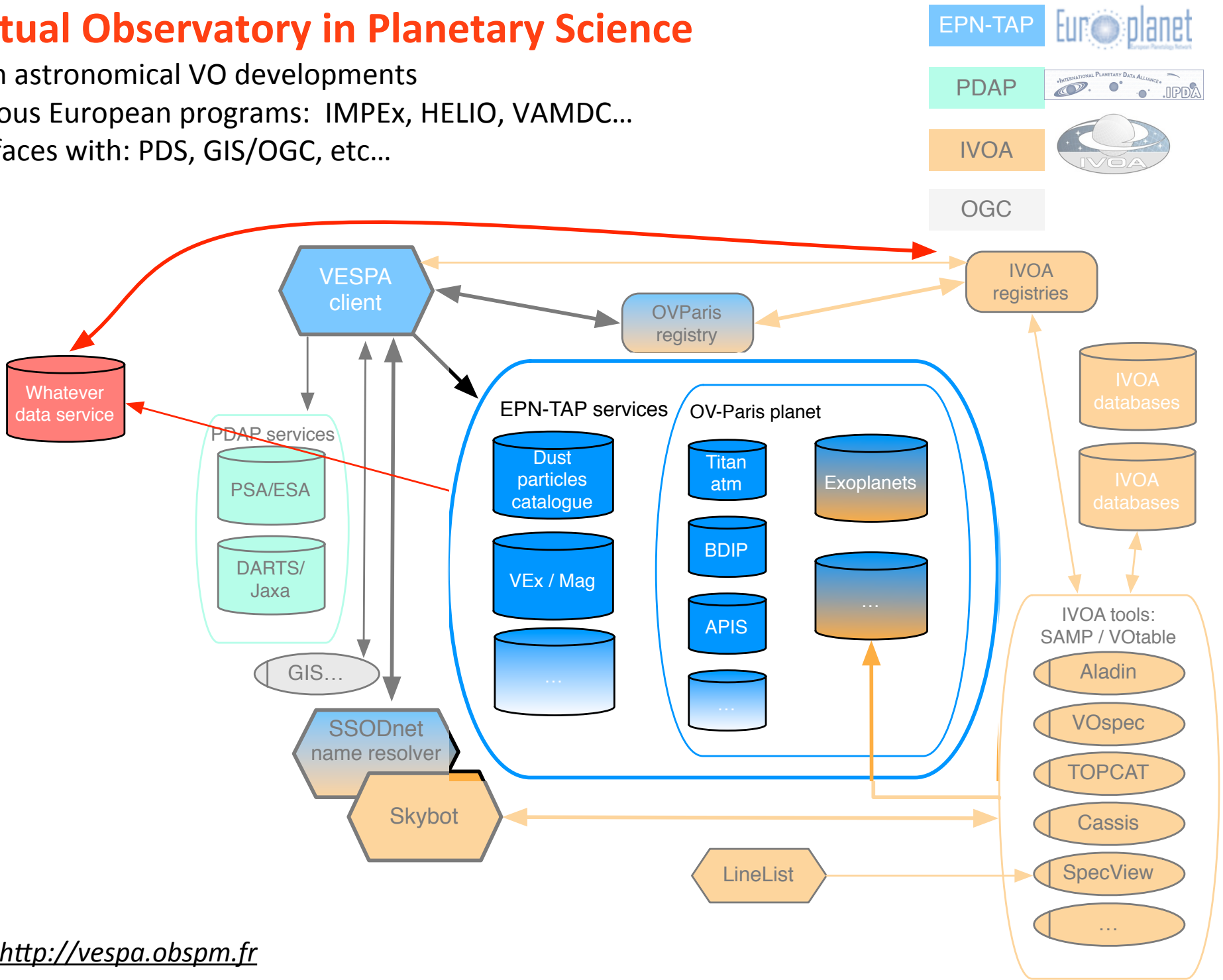
- Perimeter of data to be accessed
  - Ground-based: moving objects on dark sky
  - Space-borne (PSA/PDS), including HR imaging in various coord frames
  - Time series, Parameter lists, Atmospheric / 3D, Volume…
  - Variations with time (secular, seasonal, local time)
  - Experimental / lab support data
  - Simulations on demand

- Physical data access:

  Main issue: existing PDS3 (space borne) archives - no software!
  FITS (sometimes)
  CDF (plasma physics)
  + funny formats: netCDF, HDF5, TIFF, GeoTIFF, data streams…

A Virtual Observatory in Planetary Science

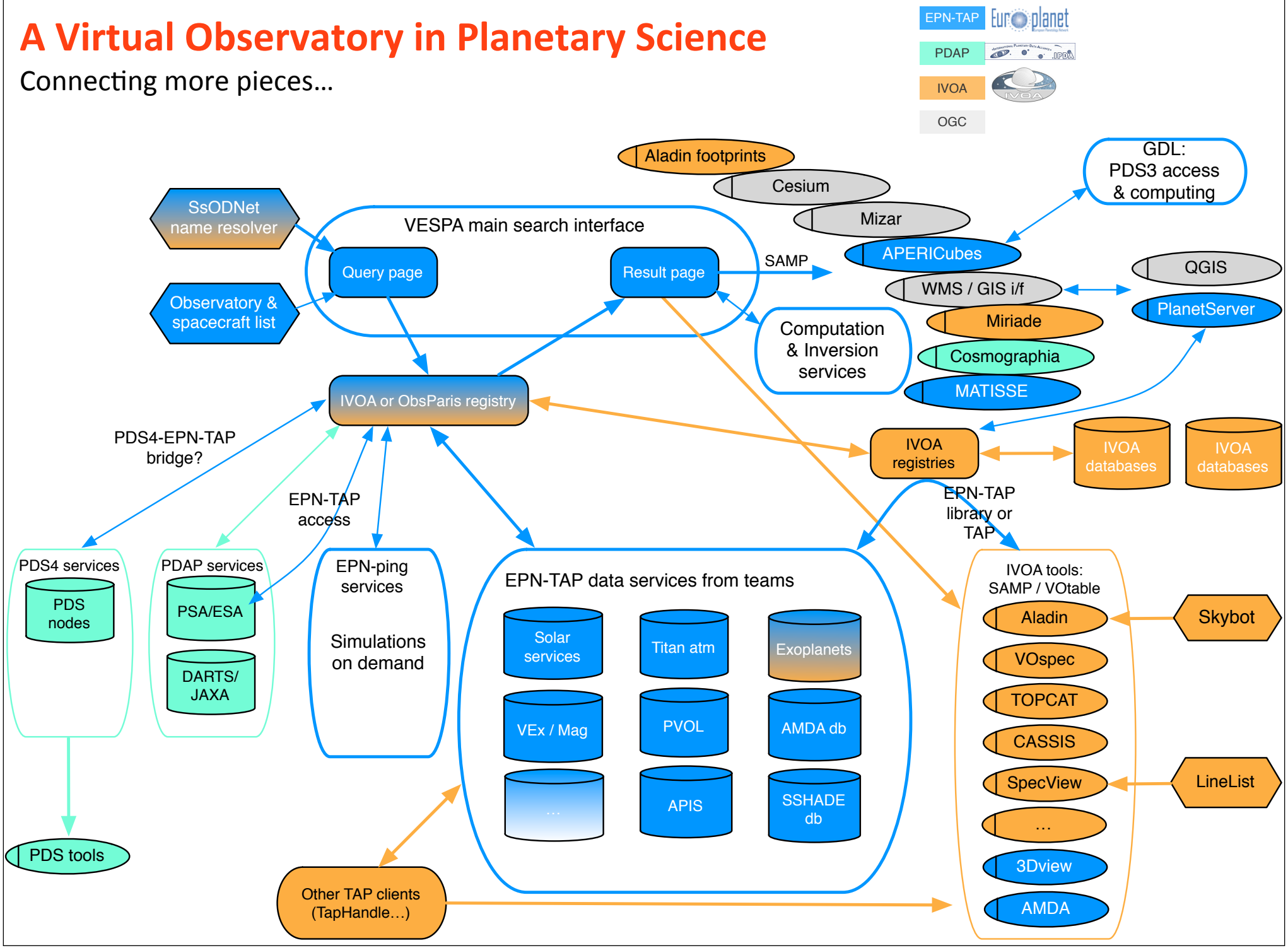
Built on astronomical VO developments
+ previous European programs: IMPEx, HELIO, VAMDC…
+ interfaces with: PDS, GIS/OGC, etc…



http://vespa.obspm.fr

A Virtual Observatory in Planetary Science

Connecting more pieces…



VESPA DAL:

Data Model: EPNCore (EPN-TAP parameters)

- Similar to ObsCore, but wider scope

- Describe all data axes: spatial, spectral, time, viewing geometry

=> IAU body-related coord systems needed in STC, to be reviewed

- Some parameters are entirely new e.g., incidence/emergence angles

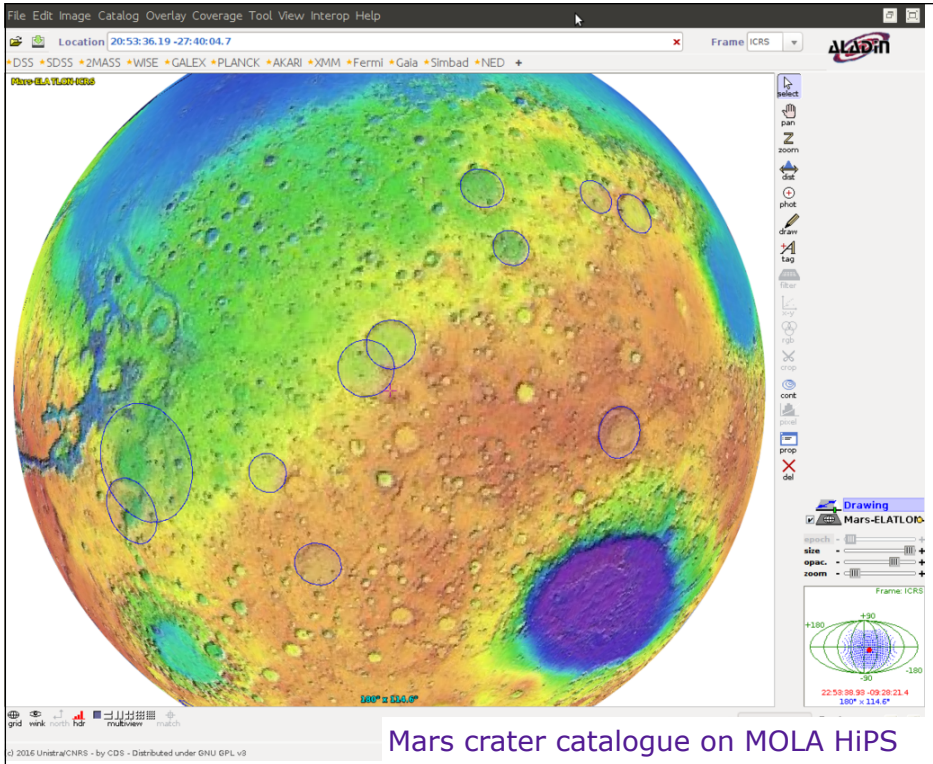
- Include description of data in files e.g., reflectance measurements

- Some parameters reused from ObsCore, with specificities

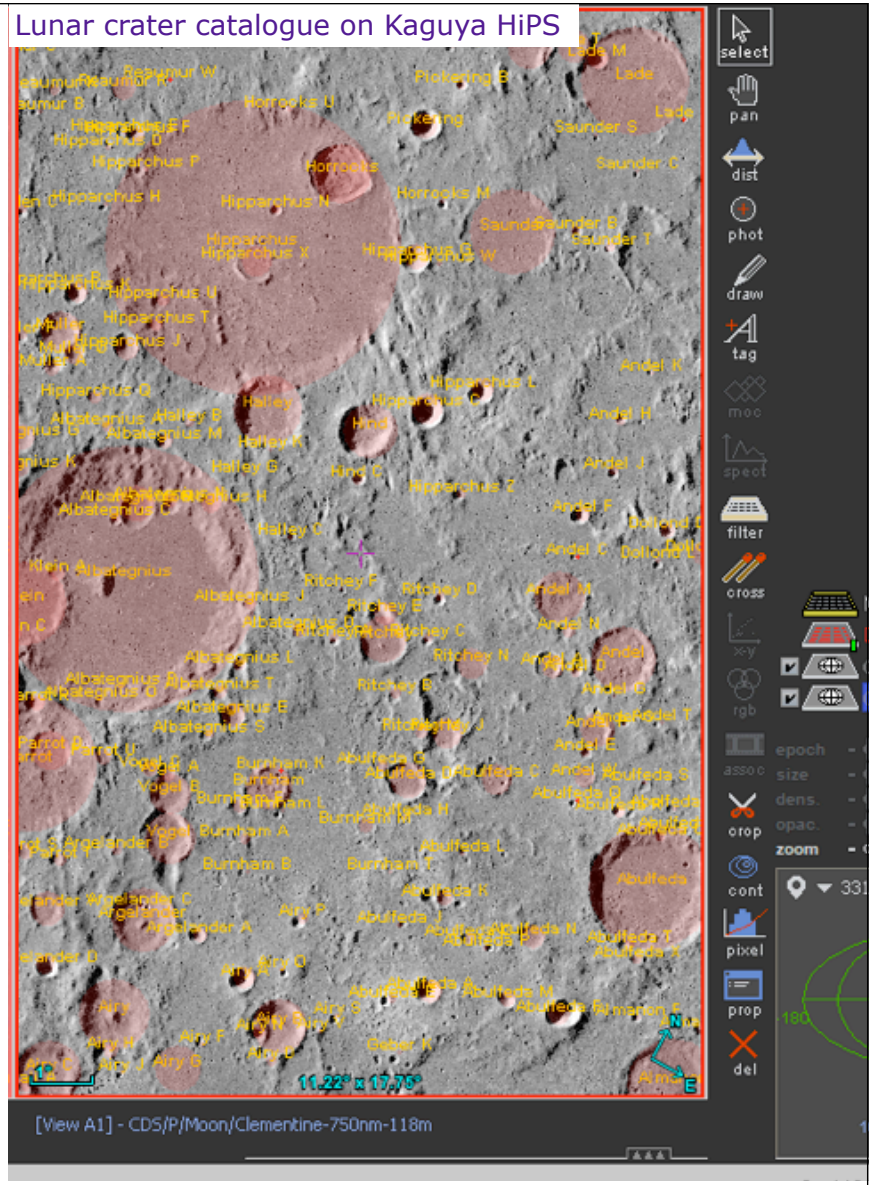
Ex: s_region - must use E-handed frames (IAU standard on planets)

=> We need at least a generic E-handed frame in STC strings to implement the IAU standard! Call it BODY, or BODY-FIXED, or E-HANDED?

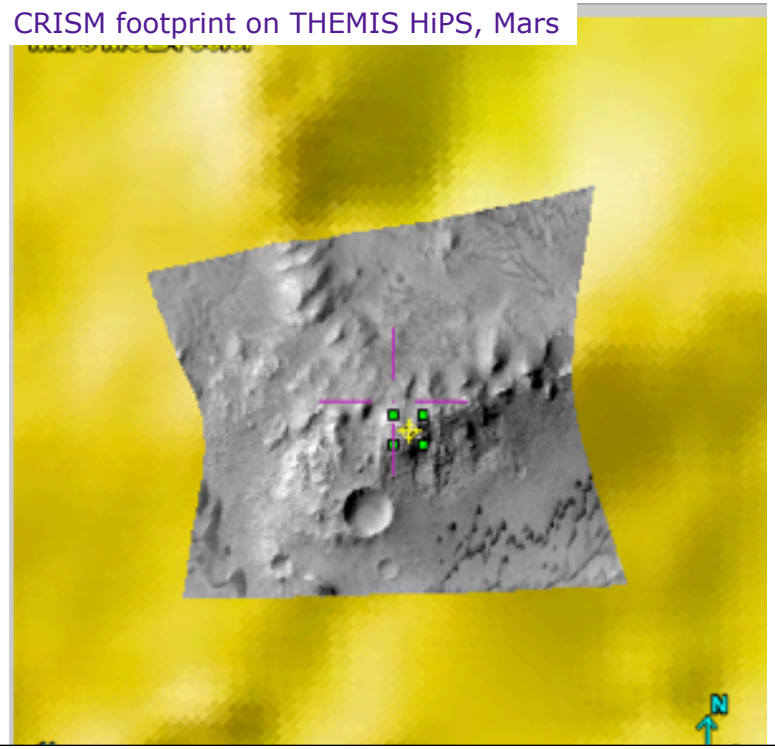
=> POLYGON('BODY-FIXED', 150, -30, 30, -30… etc



Mars crater catalogue on MOLA HiPS



CRISM footprint on THEMIS HiPS, Mars



Coordinates are provided in eastward convention (IAU)

s_region must use the same convention

VESPA DAL:

Main Data Access Protocol: EPN-TAP 2.0

- TAP + set of EPNCore parameters — similar to ObsTAP, wider scope

- Data can be integrated in the table or in linked files (one file / table entry)

- **Require Utype** (EPNCore / EPN-TAP doc in progress)

UCDs - used by some tools to understand data correctly (spectro, …)

=> First contribution to UCD list discussed this week

(viewing angles, main reflectance quantities…)

- Need to identify observations / simulations / experimental data

- Use hash lists for multivalued fields (UCDs, targets, instruments…)

=> additions required in ADQL to support search functions

ivo_hashlist_has RegTAP function to handle lists of values

Need to combine ivo_hashlist_has with LIKE e.g., to extract UCDs from lists

Ex from TNOsarecool (trans-Neptunian objects properties) multiple alt_target_name bib_reference for each granule

te	release_date	service_title	alt_target_name	bib_reference	ta
2:11	2015-03-17T00:00:00	tnosarecool	1999 TC36#47171	2012A&A...541A..93M#2012A&A...541A..93M	4
2:11	2015-03-17T00:00:00	tnosarecool	2005 RO43	2014A&A...564A..92D#2014A&A...564A..92D	3
2:11	2015-03-17T00:00:00	tnosarecool	2005 RO43	2014A&A...564A..92D#2014A&A...564A..92D	3
2:11	2015-03-17T00:00:00	tnosarecool	2005 RO43	2014A&A...564A..92D#2014A&A...564A..92D	3
2:11	2015-03-17T00:00:00	tnosarecool	2003 WL7#136204	2014A&A...564A..92D#2014A&A...564A..92D	2
2:11	2015-03-17T00:00:00	tnosarecool	2003 WL7#136204	2014A&A...564A..92D#2014A&A...564A..92D	2
2:11	2015-03-17T00:00:00	tnosarecool	2003 WL7#136204	2014A&A...564A..92D#2014A&A...564A..92D	2
2:11	2015-03-17T00:00:00	tnosarecool	2003 WL7#136204	2014A&A...564A..92D#2014A&A...564A..92D	2
2:11	2015-03-17T00:00:00	tnosarecool	2003 WL7#136204	2014A&A...564A..92D#2014A&A...564A..92D	2
2:11	2015-03-17T00:00:00	tnosarecool	2003 CO1#120061	2014A&A...564A..92D#2014A&A...564A..92D	1

Ex from MPC (asteroid list) multiple measurement_type provided in the table

	measurement_type	processi
	phys.angSize.smajAxis;src.orbital.smajAxis#src.orbital.eccentricity#src.orbital.node#src.orbital.periastron#src.orbital.meanAnomaly#phys.magAbs	5
	phys.angSize.smajAxis;src.orbital.smajAxis#src.orbital.eccentricity#src.orbital.node#src.orbital.periastron#src.orbital.meanAnomaly#phys.magAbs	5
	phys.angSize.smajAxis;src.orbital.smajAxis#src.orbital.eccentricity#src.orbital.node#src.orbital.periastron#src.orbital.meanAnomaly#phys.magAbs	5
	phys.angSize.smajAxis;src.orbital.smajAxis#src.orbital.eccentricity#src.orbital.node#src.orbital.periastron#src.orbital.meanAnomaly#phys.magAbs	5
	phys.angSize.smajAxis;src.orbital.smajAxis#src.orbital.eccentricity#src.orbital.node#src.orbital.periastron#src.orbital.meanAnomaly#phys.magAbs	5
	phys.angSize.smajAxis;src.orbital.smajAxis#src.orbital.eccentricity#src.orbital.node#src.orbital.periastron#src.orbital.meanAnomaly#phys.magAbs	5
	phys.angSize.smajAxis;src.orbital.smajAxis#src.orbital.eccentricity#src.orbital.node#src.orbital.periastron#src.orbital.meanAnomaly#phys.magAbs	5

VESPA DAL:

Registry:

- Initial issue sorted out Dec 2017 (ivo-id related)

- EPN-TAP currently in v 2.0, v 2.1 in development — will co-exist

Protocol version can be retrieved from registry

- VESPA client will soon combine results from many services

Need to tracks credits & origin of data

=> Need to retrieve credits, bib reference, boiler plate, etc… from registry

=> Add in param or field of TAP output VOtable — to be used by the clients

VESPA DAL:

Other Data Access Protocols

- **(EPN-)TAP covers most needs** — e.g., a sort of basic planetary SIAP
- **PDAP (IPDA) supported by VESPA client** — seems stalled
- **VOevents —** need to be able to tell that the event occurs at a named planet or a spacecraft (e.g., "Jupiter", "Juno") in the WHERE section

- **Connects with non-VO protocols: das2stream, OGC** (WMS, WCS…)

  (see Baptiste's presentation for the former)

- **Need a method to call simulations and compare with observations - now experimenting with datalink** (see Pierre LS's presentation)
- **Will use SLAP in the near future** to handle both solid phase and gas spectroscopy (to support identification of species)

VESPA / EPN-TAP clients:

Main portal : http://vespa.obspm.fr

- Current version queries all services, then lists individual results

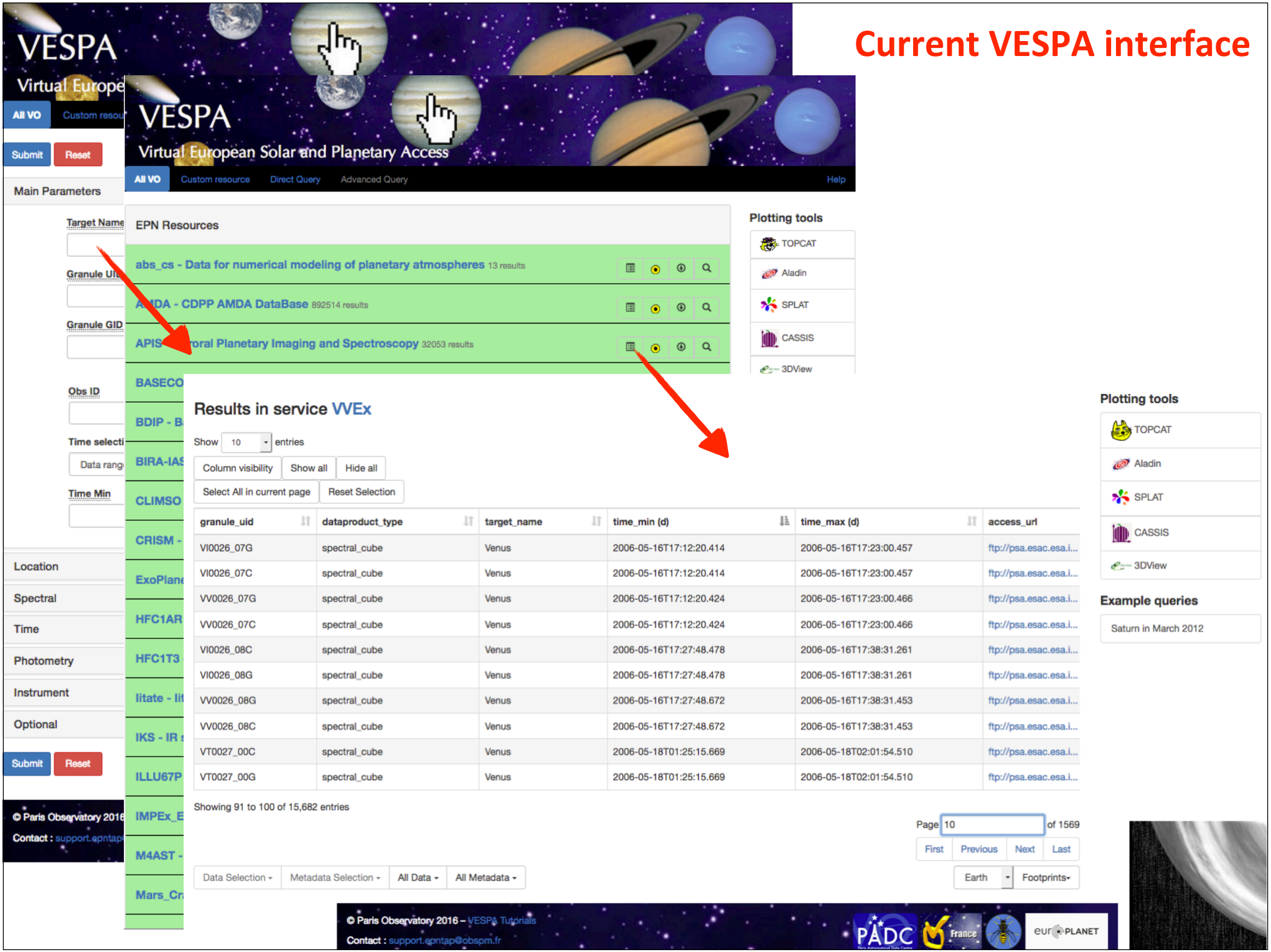
- Next version will integrate queries & service results pages

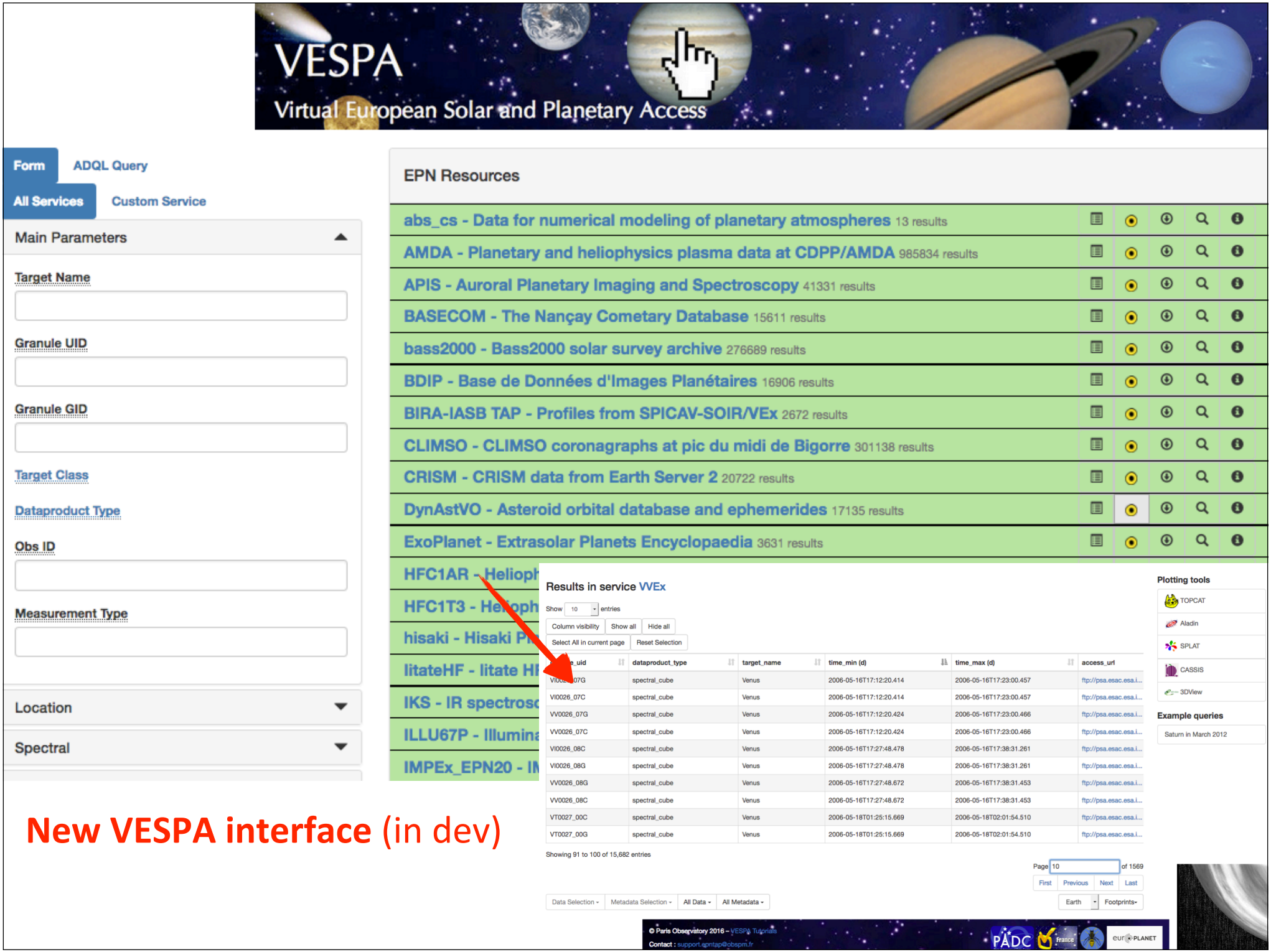
- A future version will integrate individual results from all services

Only displays selected EPN-TAP services from the registry

<= quality check is expected from the portal (requirement from Europlanet and CNRS/INSU in France)

Current VESPA interface





New VESPA interface (in dev)

VESPA / other EPN-TAP clients:

EPN-TAP libraries

- Java version in 3Dview, CASSIS

- JavaScript version to be implemented in AMDA

Generic TAP clients (TAPhandle, TOPCAT, Aladin…)

- Complete access to EPN-TAP services, but no extra support (conversions, etc…). Datalink support welcome in TOPCAT 4.6!

Astropy & PyVO for VESPA

- Working on Jupyter tutorials

Data services connected via EPN-TAP

Currently:

39 interoperable data services connected, from 13 institutes (~ 15 in dev)

Encompass many aspects of Solar System studies:

- surfaces
- small bodies / satellites / rings / dynamics
- atmospheres
- magnetospheres / radio observations
- solar physics / planetary plasmas
- exoplanets
- solid spectroscopy / experimental reference data

Several high-quality amateur services preselected (PVOL, RadioJove…)

Most services implemented on DaCHS + some on TAPlibrary (ESA/PSA…)

Very efficient call/workshop procedure to involve the community

Future/possible data services raising issues

- PSA (ESA space missions archive)

10 millions files, 70 experiments — service open, but table ~ empty

Data description need to be extracted from headers and docs

- discussion tomorrow in SSIG II

- Vizier catalogues (solar system related)

Description scheme to be identified — on-going at CDS

- Telescopic / ground-based archives?

e.g. other ESA archives (Herschel…)

e.g. CADC, ESO interfaces ;)

Tools connected to / used by VESPA

- Standard/existing tools associated to VESPA/Europlanet:

Aladin (CDS/CNRS), **CASSIS** (IRAP/CNRS) - See Pierre F's presentation
Both include Planetary Science updates from VESPA

3Dview (CNES/IRAP/GFI): plot along s/c trajectories

MATISSE (ASI/IAPS): 3D visu for *some* PDS3 data, supports shape models

- New tools developed in VESPA:

Planetary Cesium Viewer (GEOPS/CNRS)

APERICubes (*some* PDS spectral cubes, ObsParis) - see Renaud's presentation

QGIS SAMP plug-in (VO-GIS bridge, Jacobs Univ)

ImageJ SAMP plug-in & **improved fits support** (ObsParis, in progress)

- Other useful tools in VESPA context:

TOPCAT (Bristol), **SPLAT-VO** (Heidelberg), **Autoplot** (Iowa), **Mizar** (CNES)
+ possibly **VOspec** (ESA), **DS9** (SAO), **Cosmographia** (JPL)

Tools connected to / used by VESPA

Tools are connected though SAMP

Need for additional SAMP messages:

- **For PDS files, possibly several ones** (PDS3 vs 4, detached labels…)
- **geoJSON**
- **das2stream**
- **etc…**

Functions needed (but not found yet):

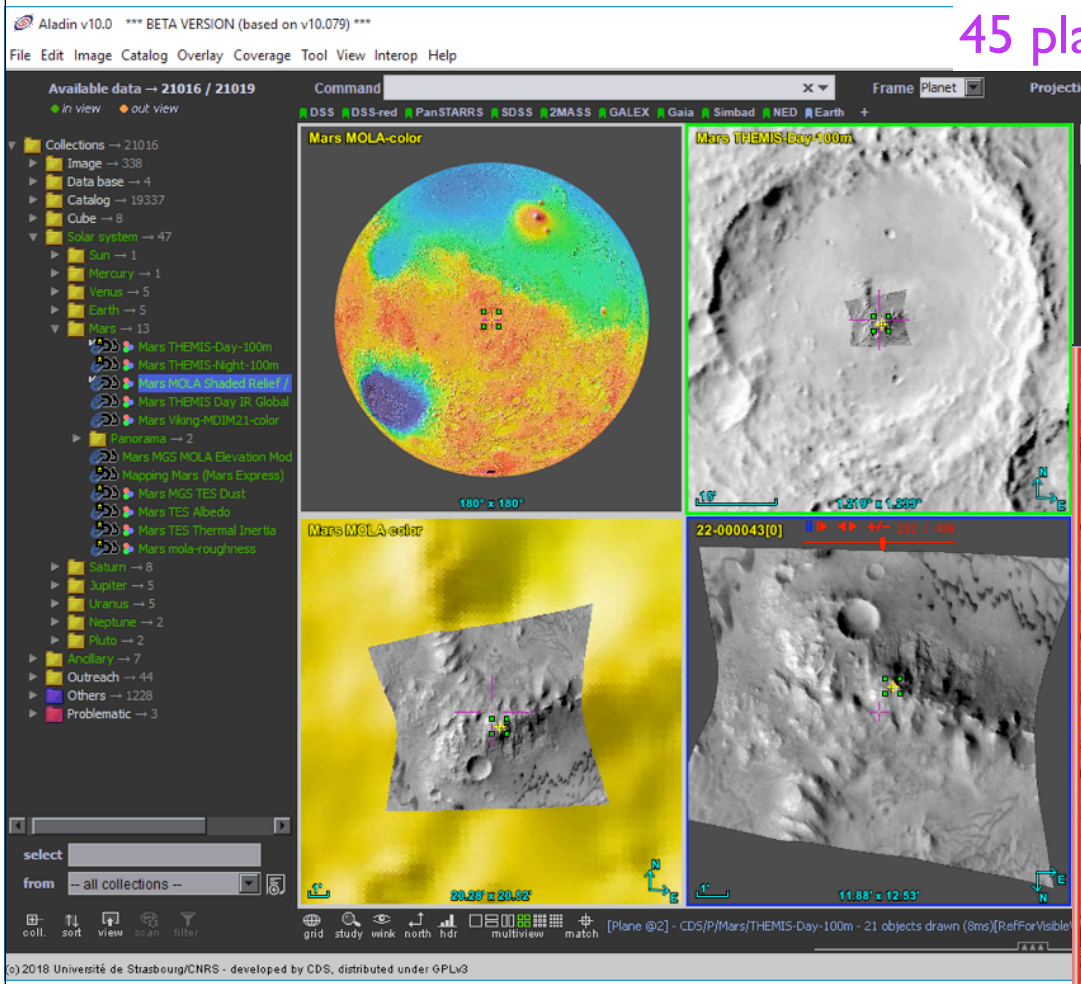
- **statistic tools**
- **basic arithmetic tools** (averaging on the fly, in particular vectors/profiles)
- **image segmentation**

Favorite VESPA tools

Aladin (CDS/CNRS):

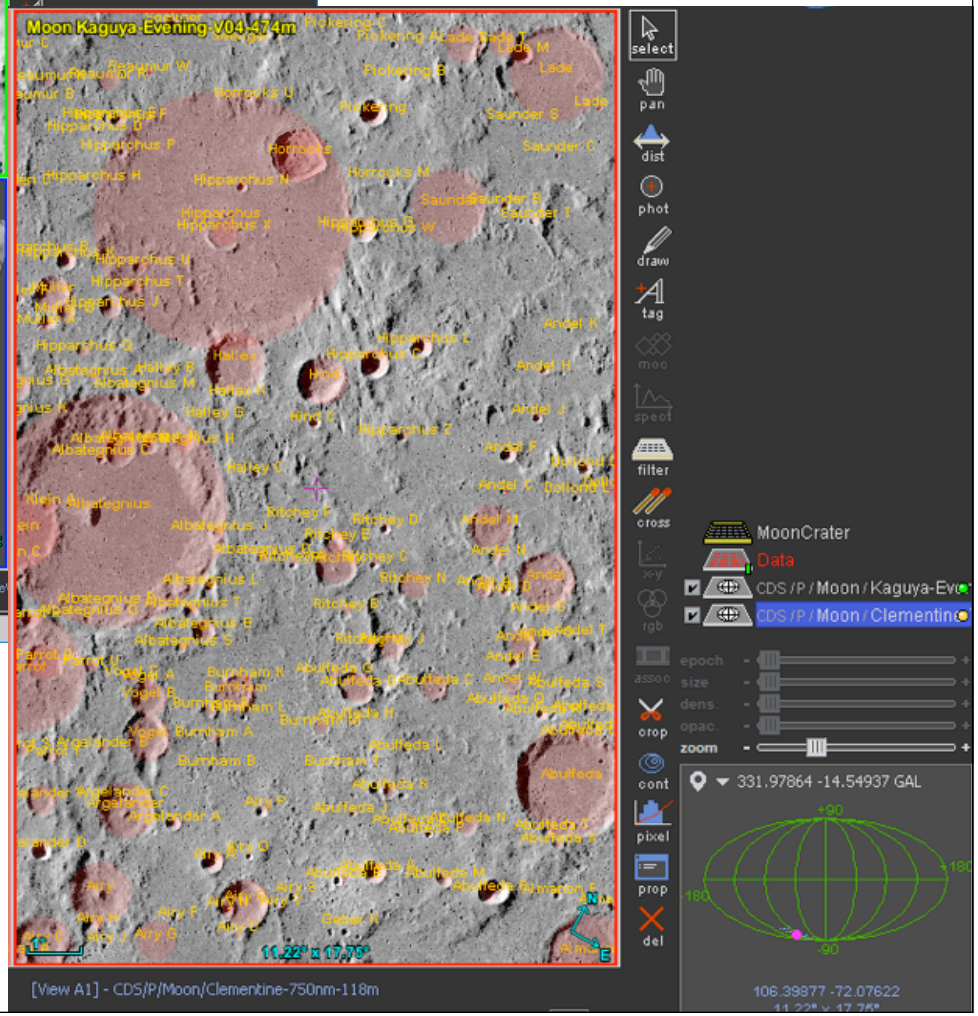
Georeferenced images + objects superpositions

45 planetary HiPS (USGS maps)



CRISM cubes on MOLA HiPS

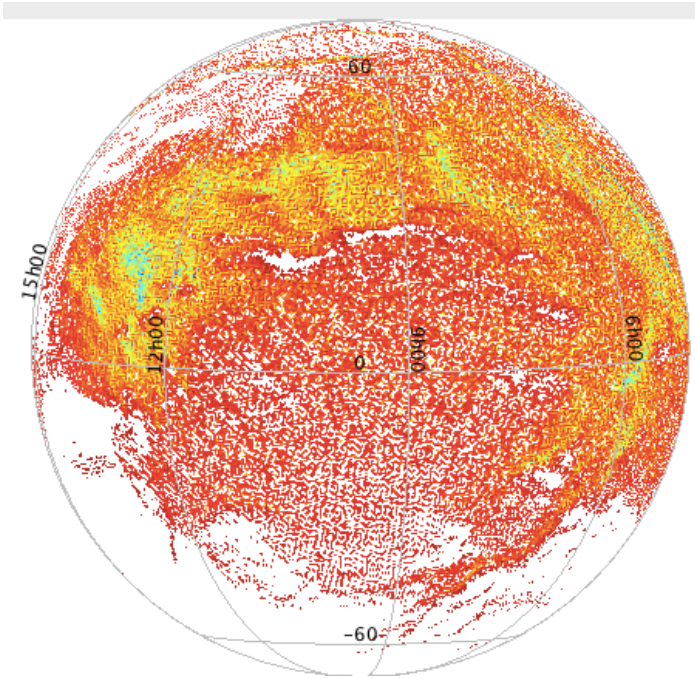
Lunar crater catalogue on Kaguya HiPS



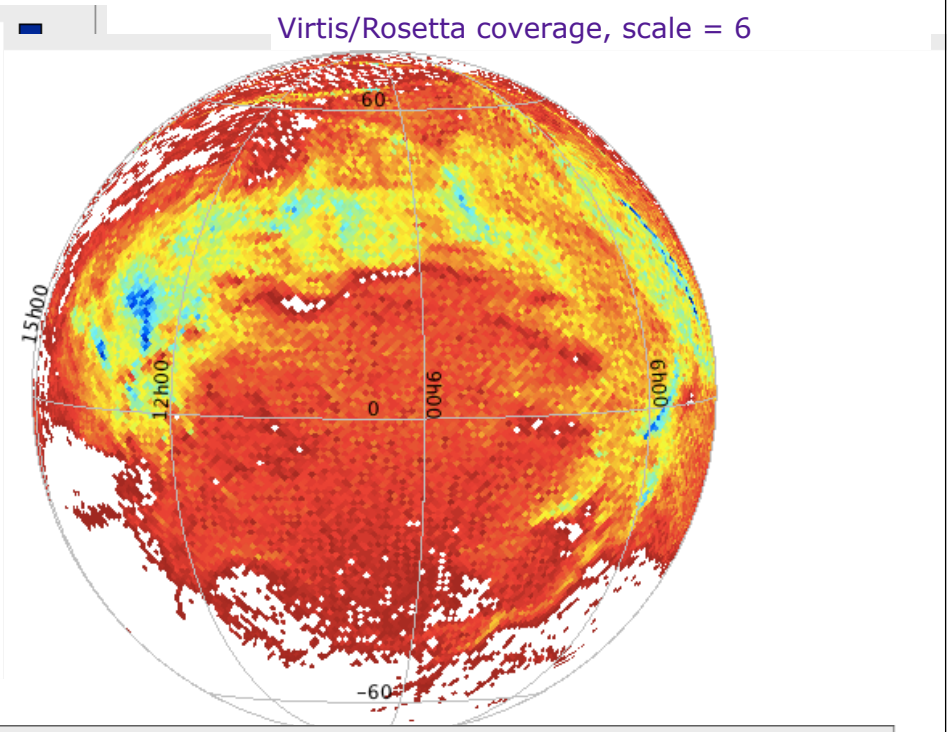
Relies on IAU planetary coordinate frames (fits' WCS)

New functions in VESPA

Multiresolution maps in TOPCAT (Bristol Univ)



Virtis/Rosetta coverage of 67P for a selected mission phase, scale = 7



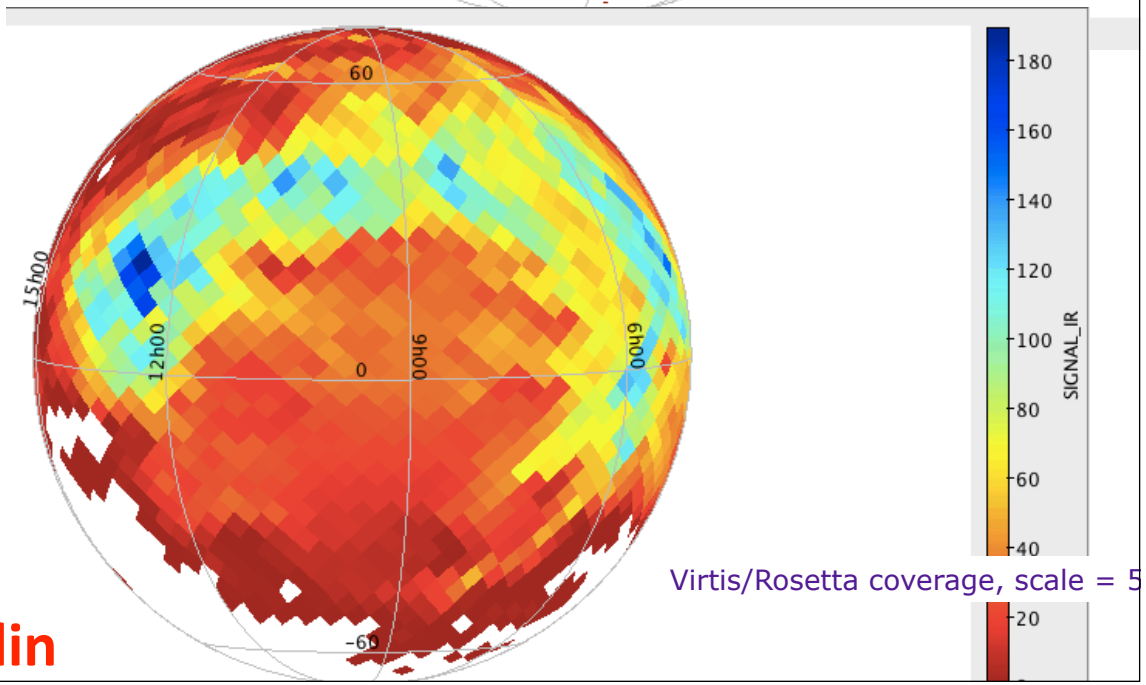
Virtis/Rosetta coverage, scale = 6

Start from a table of sparse observations (lon/lat)

VIRTIS/Rosetta on 67P

Integrate / average on healpix cells

Modify resolution / scale on the fly



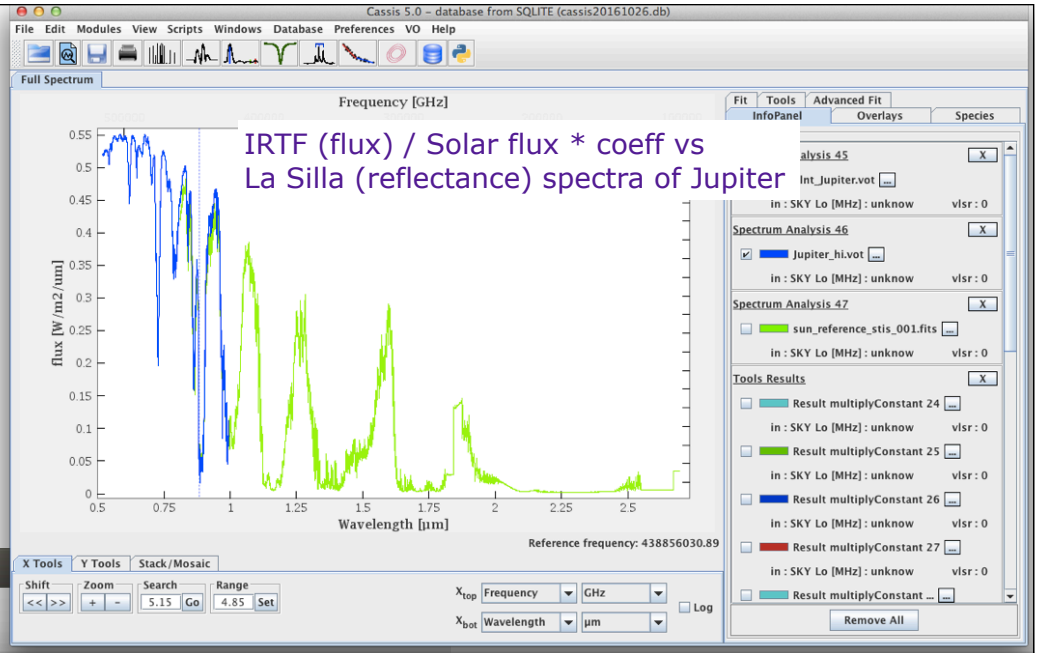
Virtis/Rosetta coverage, scale = 5

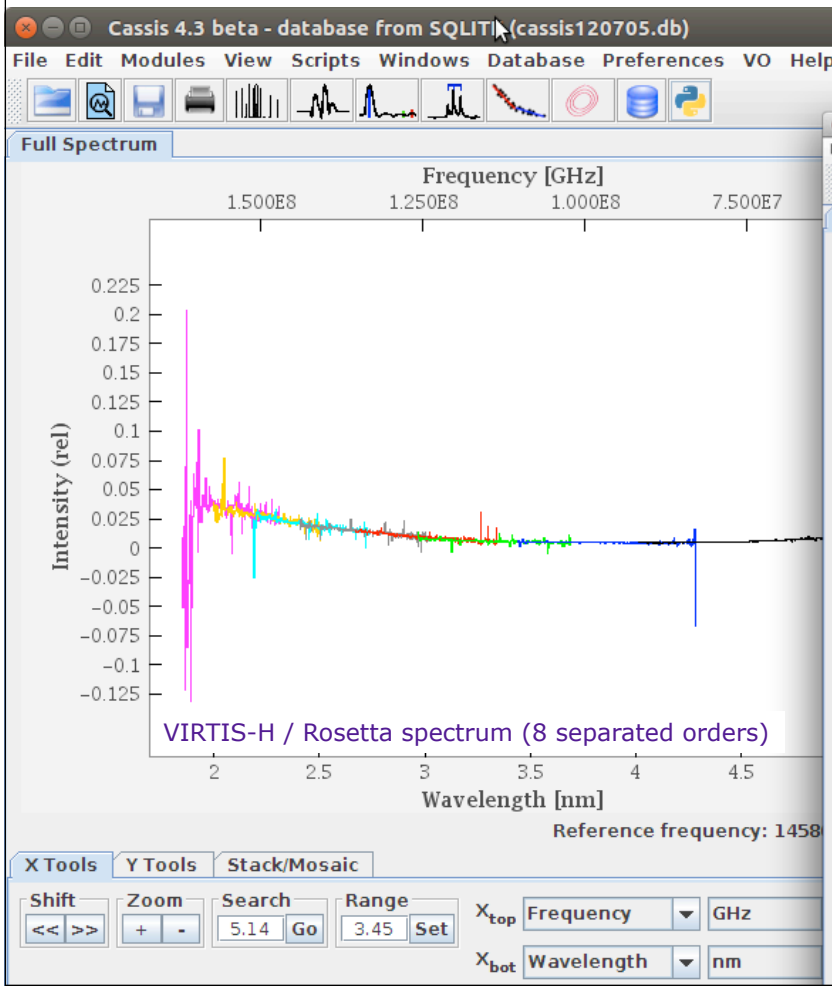
Need a std format usable in Aladin

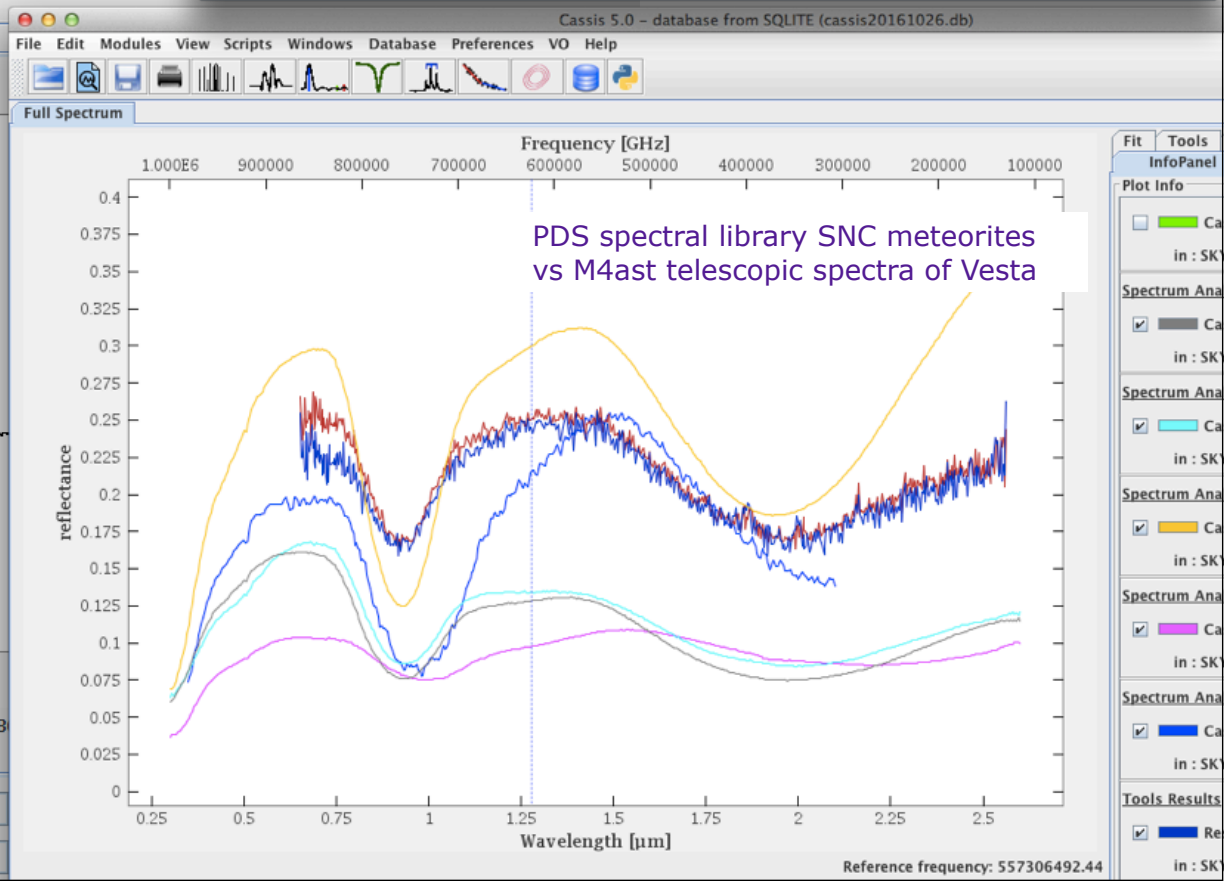
Updated VESPA tool

CASSIS v5 (IRAP/CNRS)

- Auto converts spectral axis & flux
- Support data in flux & various types of reflectance (scaling)
- Now supports échelle spectra

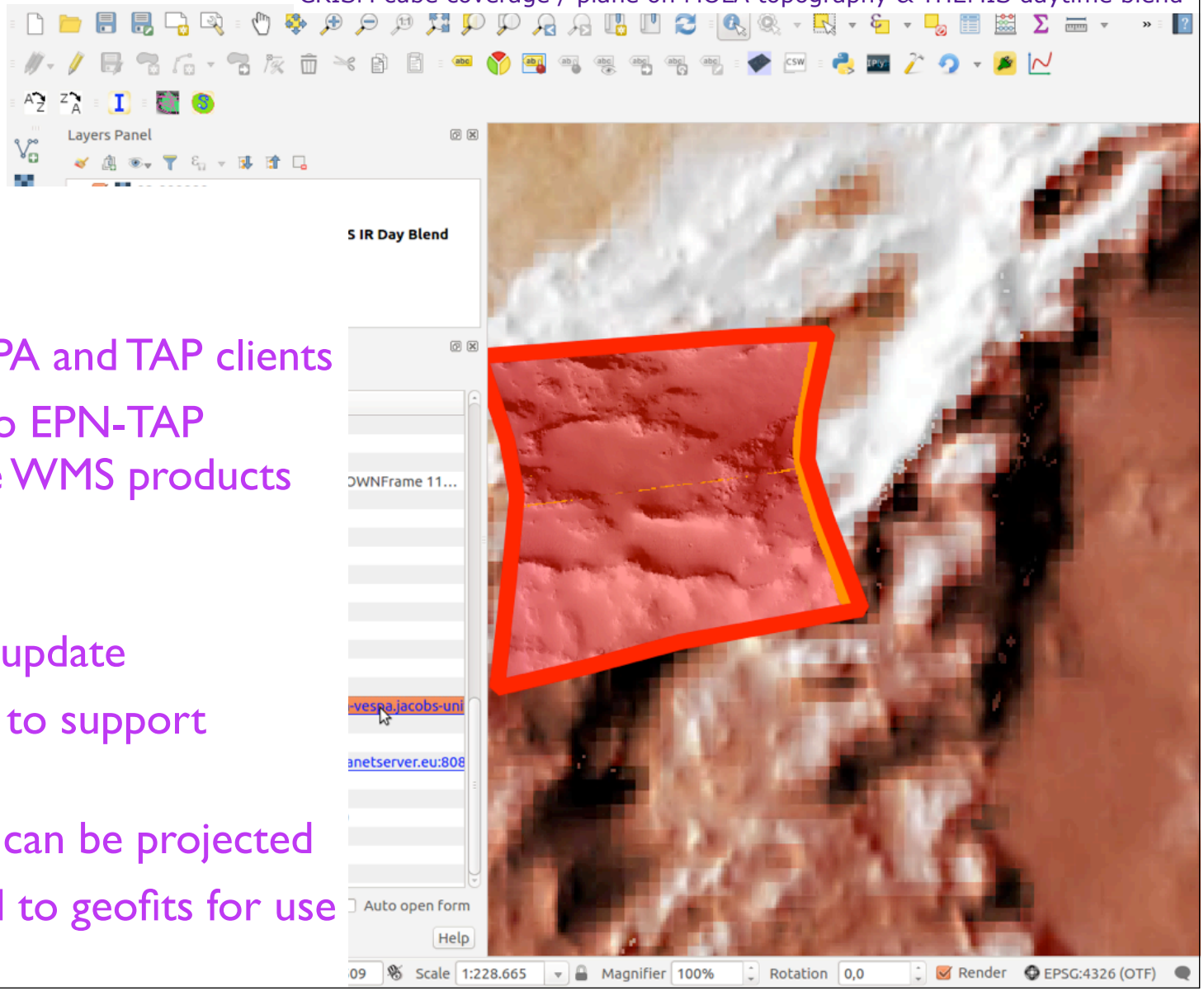






New VESPA tools: VO-GIS connection

CRISM cube coverage / plane on MOLA topography & THEMIS daytime blend



QGIS (open source):

SAMP plug-in installed

- receives data from VESPA and TAP clients

- Provides visualization to EPN-TAP services which distribute WMS products

(=> planetary mapping)

GEOfits format / GDAL update

- WCS (small) extension to support planetary surfaces

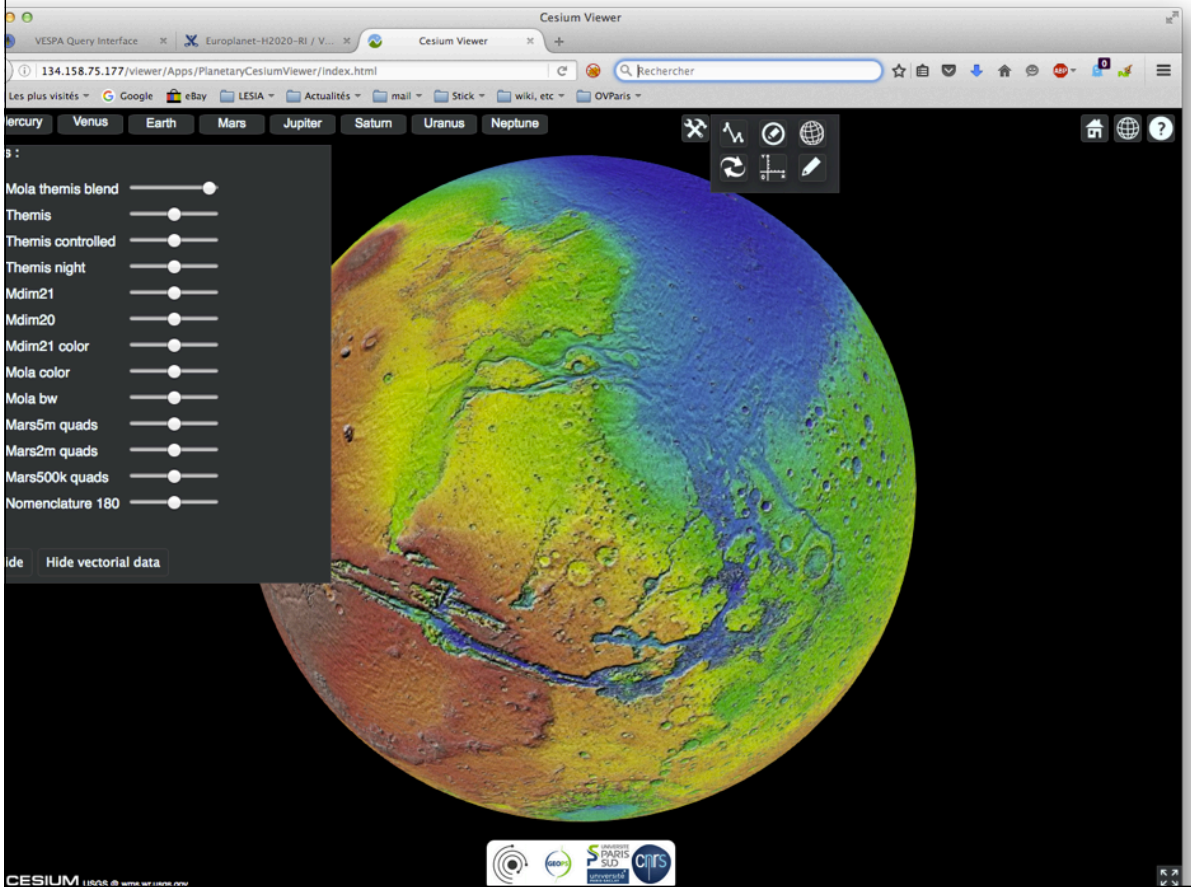
- georeferenced fits files can be projected

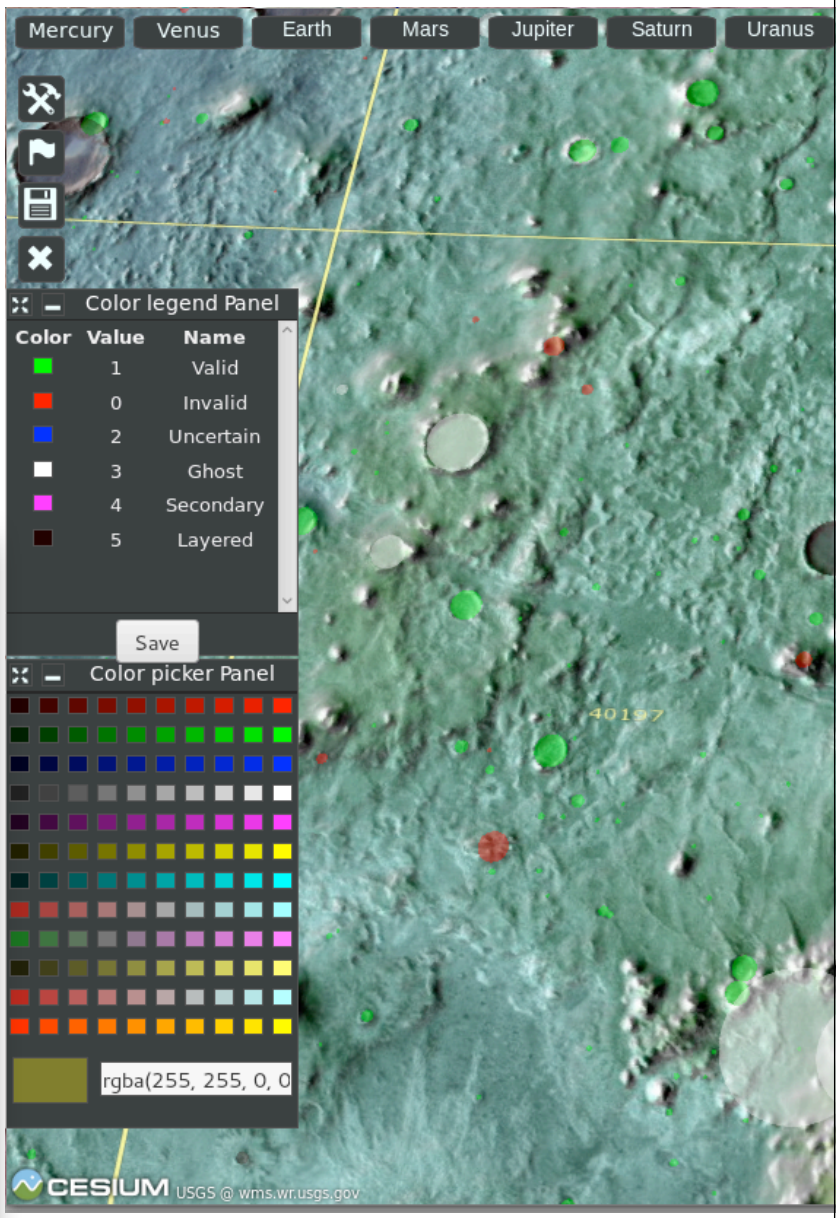
- geoTIFF files converted to geofits for use in VO tools

New VESPA tool

Planetary Cesium Viewer (GEOPS/CNRS)

- Quick multiresolution 3D visu
- Supports elliptic shapes
- Annotation/validation tool
- SAMP implementation





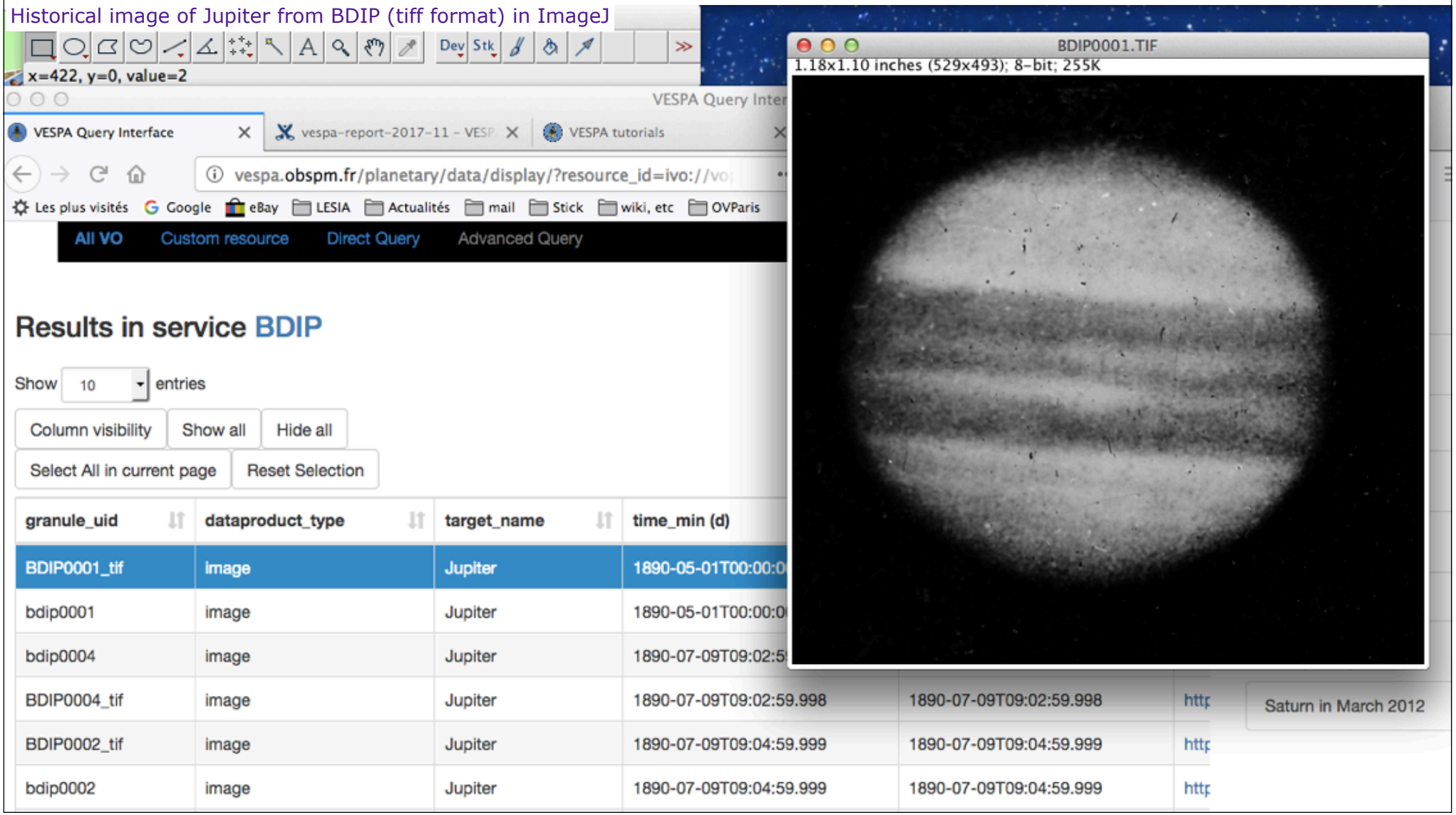
Robbins Mars craters database in PCV

New tools in VESPA

ImageJ (open source):

- SAMP connection installed (input only)
- Provides support for unusual data types (TIFF…) & format conversion
- Provides image processing functions in the VO

Historical image of Jupiter from BDIP (tiff format) in ImageJ



Next steps

- **More data services!** - including external contributors
- **Process answers from multiple services**
- **Finalize VO-GIS interface** - including geofits (ESS paper being reviewed)
- **Develop interface with lab spectroscopy services**
  (minerals and ices spectra, band lists, etc) - now 4 services implemented
- **Bridge EPNCore and PDS4**
- **Connect simulation services, use with related data services**
  requires different protocols
- **Formalize docs / standards => submit to IPDA & IVOA**
  and refine/complete tutorials

Next steps, 2

- **Europlanet Gateway proposal**, submitted to EU call, March 2018

Application of FAIR principles, consolidation, sustainability, collaborations

- **Europlanet-RI next bid** to be submitted, March 2019

Will focus more (= also) on knowledge extraction, machine, learning, etc

Will associate non beneficiary teams / institutes

search interface	http://vespa.obspm.fr
web site (w/ tutos)	http://www.europlanet-vespa.eu
wiki	https://voparis-confluence.obspm.fr/
github	https://github.com/epn-vespa