

A Planetary Science Virtual Observatory prototype (and follow-on)

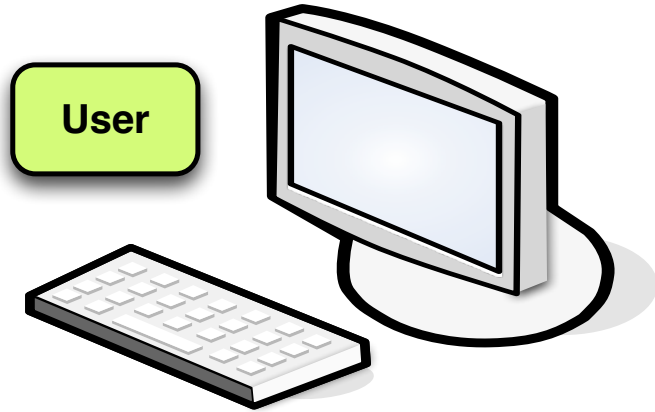
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(OV-Paris / Observatoire de Paris)

+ Many contributions from
CDPP (N. André, V. Génot)
IPAG (B. Schmitt)
G. Chanteur
T. Capria
etc

- Résultats from Europlanet-RI program (ended Dec 2012)
 - => VO infrastructure defined and installed
 - => Some services on-line (demos) + many projects
 - VO-Paris was a major contributor
- European follow-on in Horizon 2020:
 - Work Package focused on VO services in Europlanet H2020: VESPA
 - Objectives? — Essentially availability of new data content
 - 16 partners, including: OV-Paris, IRAP, IPAG, LATMOS, GEOPS, CDS, IAPS/INAF, Jacobs Univ, IWF Graz, IASB, UCL, IAP Prague, EHU Bilbao
- Space mission context:
 - Some themes particularly supported, involve heavy developments

User's experience



User

Queries

Answers

Data access

Catalogue / Registry

SSODnet

GhoSST
KIDA

PSA

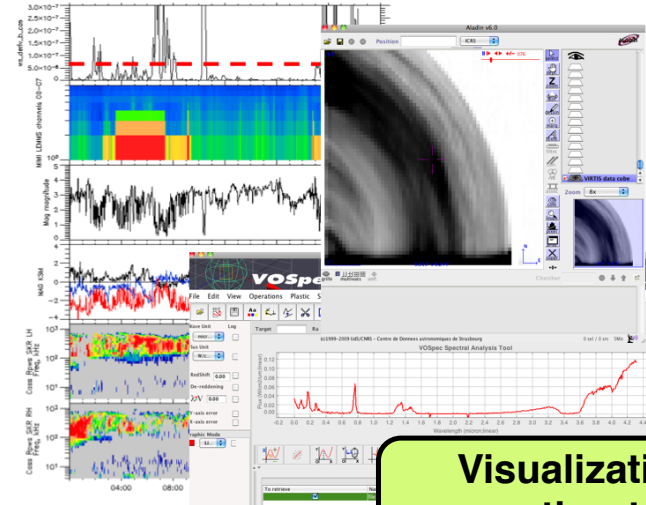
AMDA...

EPN

PDS

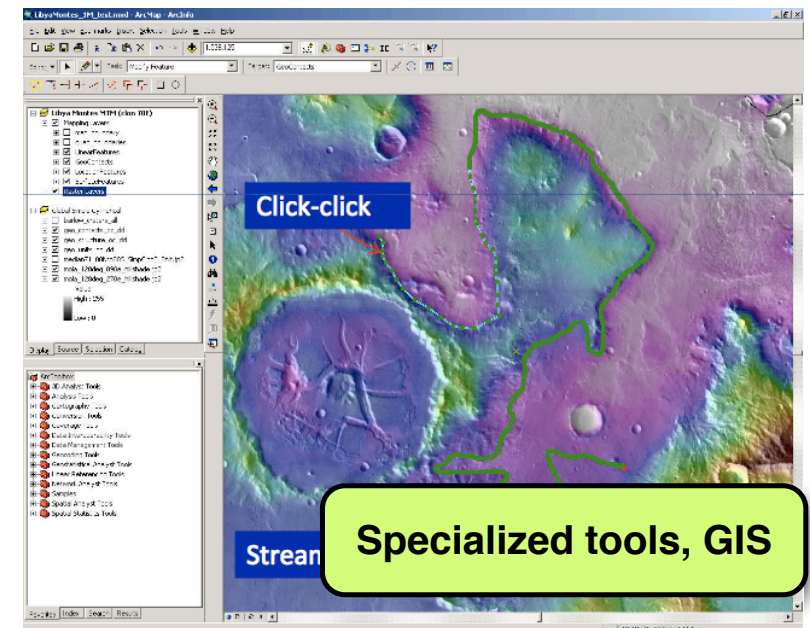
Data bases

Space agency archives



Data exchange

Visualization and other tools



Specialized tools, GIS

Planetary Science VO – Objectives in Europlanet (FP7: 2009-2012)

- Make data search in archives easy
- Allow quick-look visualisation of data
- Allow external users to include their data

Initial set-up in Europlanet

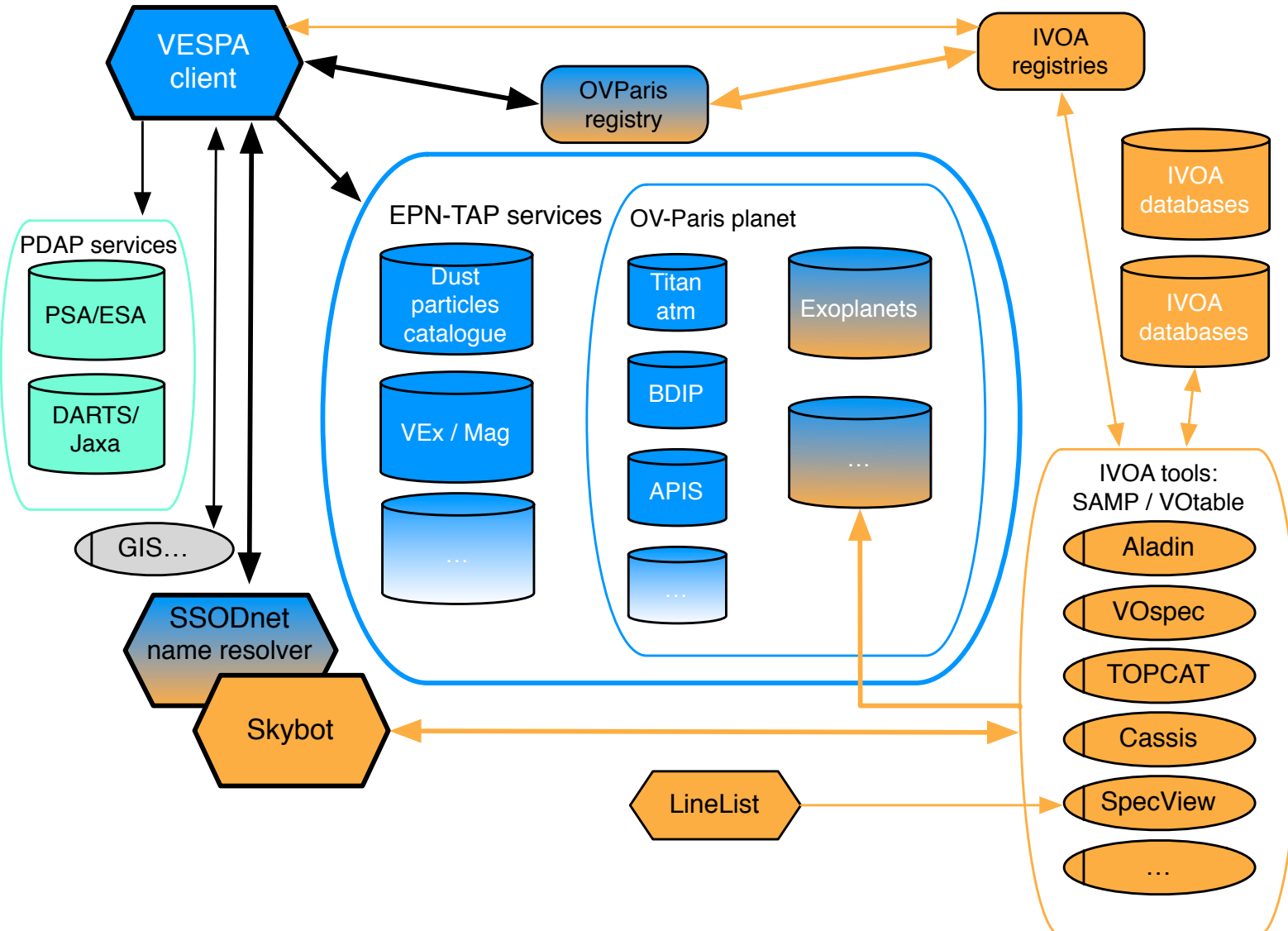
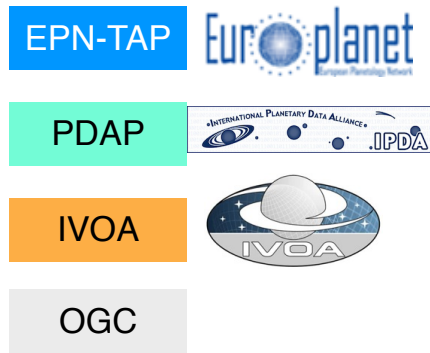
- Make "small" derived data sets accessible
- Develop specific processing/visualisation tools

Contributions by external users

Constraint: minimise developments

Success: the user doesn't see the infrastructure

Architecture



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

EPN Resources

Auroral Planetary Imaging and Spectroscopy

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

Base de Donn

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

Extrasolar Pla

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

Heliophysics F

Results : 0
[DISPLAY VOTABLE](#)
▶ 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

Plotting tools

- TOPCAT
- Aladin
- VOSpec
- SPLAT

Plotting tools

- TOPCAT
- Aladin
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- SPLAT

Example queries

- Saturn in March 2012

SELECTED DATA

- 1 selected data
- 1 : image

PREVIEW

- EPN-TAP services:

Public services at VO-Paris:

- **APIS**: Aurorae images/spectra data base (HST)
- **BDIP**: Historical planetary images in Meudon (ground-based)
- **Encyclopedia of Extra-Solar Planets** (compilation of published data)
- **Atmospheric profiles of Titan** (Cassini/CIRS)
- **IKS / Halley** (Vega-1), **M4ast** (asteroid spectrosc.)
- **BaseCom** (comets from Nançay), **Jupiter radio observations** (from Nançay)
- **Solar feature catalogues** (from HELIO program)

Projects at VO-Paris (from existing databases):

TNO data compilation, VIRTIS/VEx & /Rosetta, mineral spectroscopy...

Other services in development: Rome, Toulouse, Graz

- Other targeted data centres/services (with specific interfaces):

AMDA (under test), **ESO archive**, **GhoSST**

- Space data centres accessible by **VESPA** (via **PDAP**):

PSA and **DARTS** (ESA & JAXA archives, with minimal interface)

Visualization tools: adapt IVOA tools

Aladin:

- plots images/cubes
- handles sky/spheroid coordinates

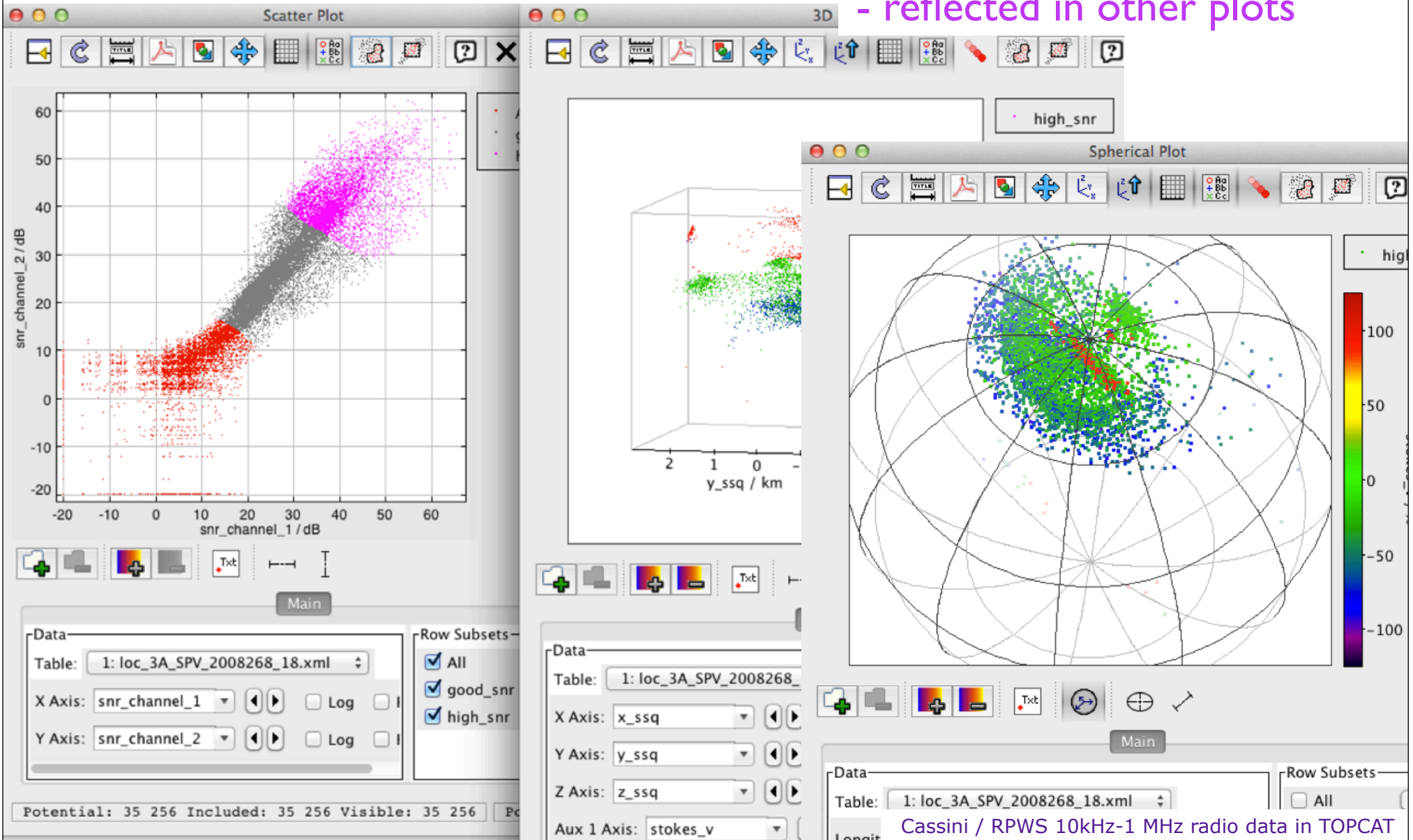
- can build image mosaics
- can handle object catalogs
- Solar System bodies tracking on sky images (SkyBoT)

The screenshot displays the Aladin v7.5 software interface. On the left, a large, detailed image of Saturn is shown, labeled "HST / Saturn image from APIS in Aladin". The interface includes a toolbar with various tools such as "select", "depl.", "zoom", "dist", "phot", "dessin", "marq", "filtre", "corr.", "rvb", "assoc", "coupe", "cont", "pixel", "prop", and "suppr". A central panel contains text in French: "Imaginez votre oeil regardant à travers une pile de calques." (Imagine your eye looking through a stack of layers), "Chaque calque représente une donnée: image, catalogues, graphiques..." (Each layer represents a data: image, catalogs, graphics...), "La vue ci-contre est la combinaison de l'ensemble de ces calques." (The view on the right is the combination of all these layers), and "Pour accéder à d'autres données utilisez le menu Fichier->Ouvrir," (To access other data use the menu File->Open,). Below this text are sliders for "taille" (size), "opac." (opacity), and "zoom", along with a "SAMP" button. On the right, a smaller window displays a mosaic of AMIE/Smart-1 image frames of the Moon, labeled "AMIE/Smart-1 image frames & footprint in Aladin". The main window title is "Aladin v7.5" and the menu bar includes "Fichier", "Edition", "Image", "Catalogue", "Graphique", "Outil", "Vue", "Interop", and "Aide". The status bar at the bottom indicates "(c) 2012 UDS/CNRS - by CDS - Distributed under GNU GPL v3" and "0 sel / 0 src 15Mo".

TOPCAT:

Allows data selection

- by formula or graphically
- reflected in other plots

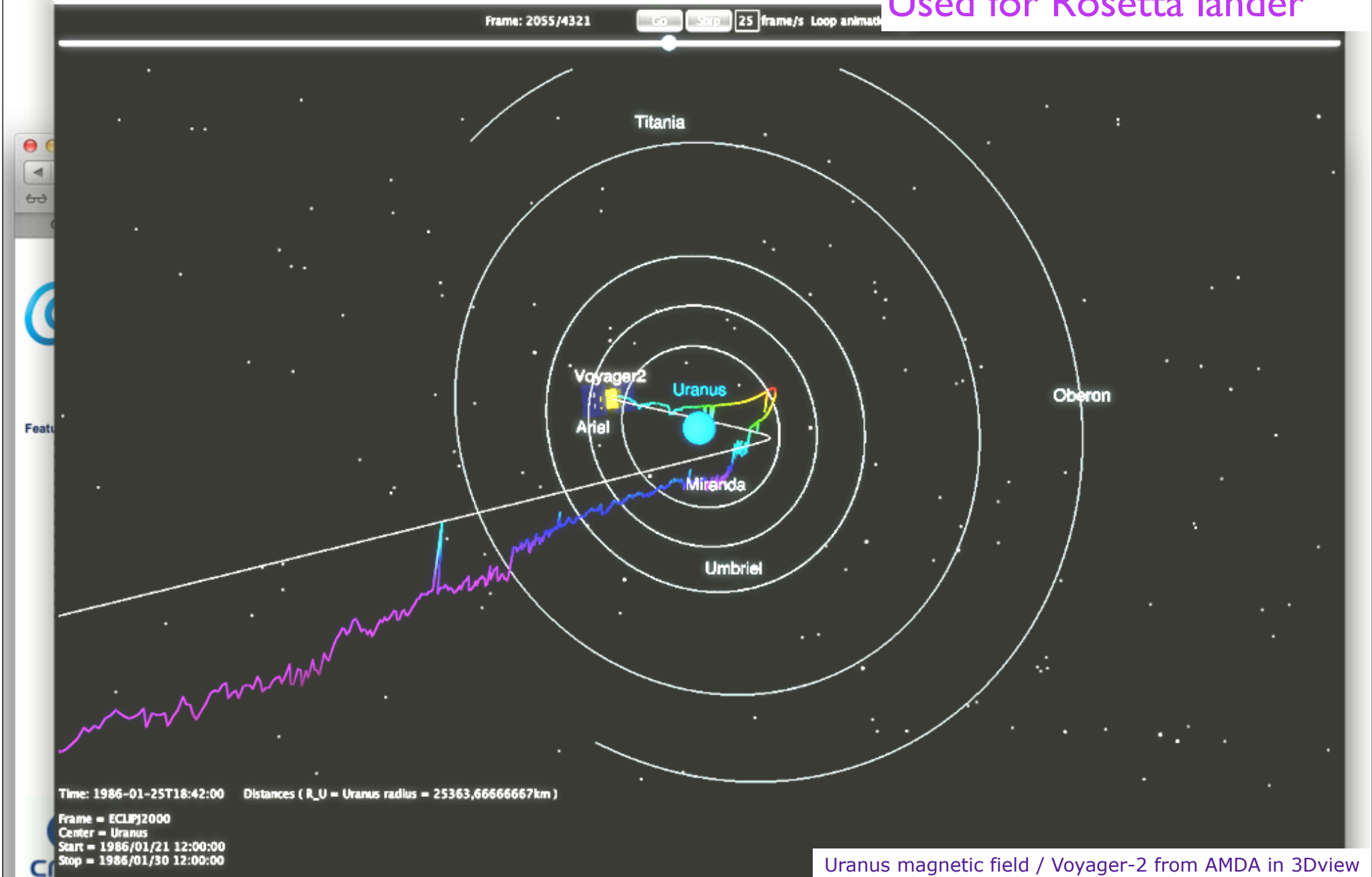


Visualization tools: adapt other existing tools

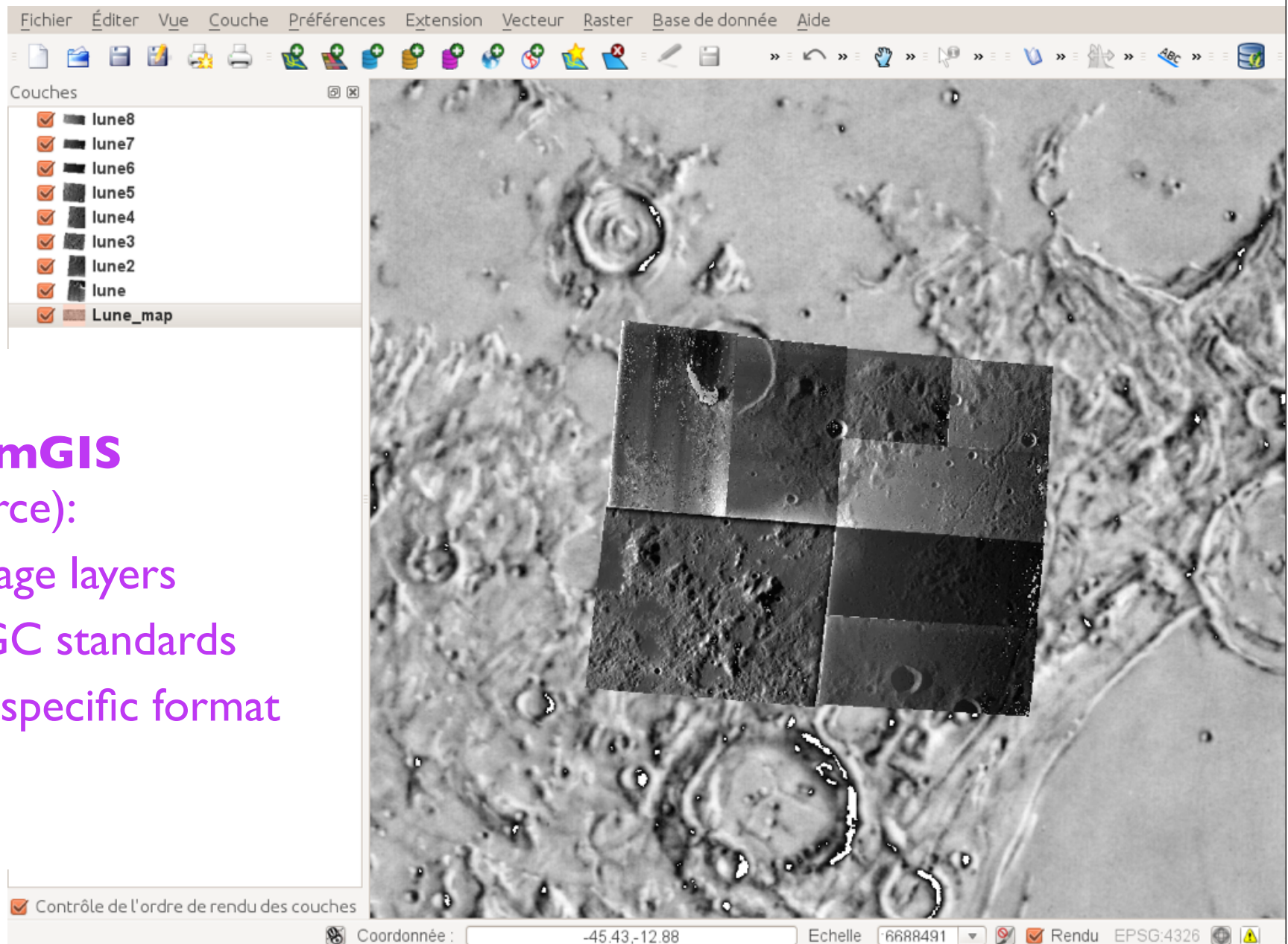
3Dview / CNES:

Spacecraft trajectories+data

Used for Rosetta lander



Visualization tools: connect GIS (OGC standards)



QuantumGIS

(opensource):

- plots image layers
- uses OGC standards
- expects specific format

Visualization tools: connect GIS

PlanetServer:

- Mars GIS with access to CRISM, Marsis, etc...
- New techno, *fast*
- Includes spectral library
- VO interface in H2020

The screenshot displays the PlanetServer GIS interface. The main map shows a topographic view of Mars with several yellow rectangular overlays indicating data footprints. A zoomed-in view of a specific area is shown in the bottom right, with colored dots (red, green, blue, purple) marking specific locations. The interface includes a 'TABLE OF CONTENTS' panel on the left, a 'DIAGRAMS' panel on the right, and a 'Data' panel at the bottom.

TABLE OF CONTENTS

Overlays

- MOLA RGB
- THEMIS IR day
- CRISM footprints

Layers

Reset Select All Deselect All

- IR: frt00003e12_07
- IR: data.233;data.81;data.13

Data

IR	VNIR	Summary products
Band Nr.	Wavelength	Bad
band1	1.00135	yes
band2	1.0079	yes
band3	1.01445	yes
band4	1.021	no
band5	1.02755	no

R: band234
G: band82
B: band14

Grayscale RGB

DIAGRAMS

Spectrum Histogram Cross Section

frt00003e12_07_if1661_trr3_1_01

Average Spectrum

Wavelength

Coord 77.13111, 22.26446

Mars: CRISM on MOLA+MOC, PlanetServer demo

Altogether

- Very efficient data mining & quick-look system

Planetary science supported from Europlanet developments

Based on IVOA standards & tools + IAU references

Some areas to be optimized in collaboration with IVOA / IPDA / IAU
(e.g. description of coordinate systems)

- Science value increases with number of connected services

Related data services increase science coverage

Services can provide extra information on same objects (exoplanets),
or same information on new objects (small bodies)

Need for reference laboratory data (e.g. mineral spectroscopy)

+ modeling (e.g. GCM)

+ ground support observations for space missions (Venus?)

- New data services to be implemented

=> Europlanet #3 pgr being set up for Horizon 2020 (2015-2019?)

Europlanet/IDIS package to evolve into a full VO activity: **VESPA**

Coordination: VO-Paris - new objectives / partners / activities

Some objectives for H2020

- Increase number of data services

Handled by thematics

Link to large topical services (AMDA, GhoSST/SSHADE...)

+ calls open to external partners

+ some selected amateur resources

- Tools update + adaptation

Specific functions in Aladin / TOPCAT

Use 3Dview (or other...) to visualize asteroid/comet shape models?

VESPA client to be upgraded

- VO / GIS link

Includes use of FITS kw for planetary mapping

- Refine standards

Have EPN standards validated by IAU whenever relevant

ADQL update? (uppercase support required for target names...)

- Extra references

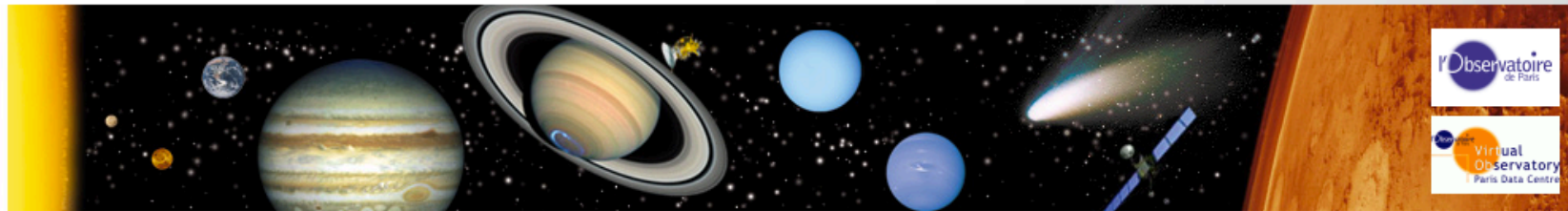
Complete list of observatories + viewing capacities

List of coordinate systems in the solar System

...



IDIS Integrated and Distributed Information System
Planetary Dynamics and Extraterrestrial Matter



EUROPLANET RI
Host Institute: Obs. de Paris
Search

DATA RESOURCES

- . Meteorites & lunar samples
- . Ices & minerals spectra
- . Ephemeris
- . Exoplanets

VO ARCHITECTURE

- . Technical docs
- Use cases/Tutorials**

SERVICES

- . VO demonstrators

TOOLS

- . Visualisation tools
- . Spaceborne Data

DATA

- . Data Access
- . External services
- . Local databases

You are here: Planetary Dynamics Node > Architecture

IDIS Tech. Node Interiors & Surfaces Node Atmospheres Node Plasma Node Small Bodies & Dust Node Planet. Dynamics Node

A Virtual Observatory in Planetary Science

The following documents illustrate how to work with the planetary VO, based on real science cases.

Help / tutorials for VO users	
Name	Comments
TOPCAT & EPN data services	Using TOPCAT to browse EPN-TAP services
EPN client & TOPCAT	Searching and plotting atmospheric profiles

EPSC 2013 use cases (videos)	
Name	Data services + Tools
Planetary Virtual Observatory	Introduction
Auroral processes on Saturn	AMDA & APIS + Aladin & EPN client
Exploring exoplanets	Encyclopedia of exoplanets + EPN client & TOPCAT
Tracking asteroids	Asteroid database + Aladin & SkyBoT
Martian environment	AMDA & LatHyS + TOPCAT
Oxygen ions plume on Mars	AMDA & LatHyS + 3DView & TOPCAT
Pluto surface	Observational spectra + GhoSST

PSA use case: how to add value to a PDS archive?

Stéphane Erard
Florence Henry
Sophie Jacquinod
Pierre Le Sidaner
Baptiste Cecconi
Cyril Chauvin

(OV-Paris / Observatoire de Paris)

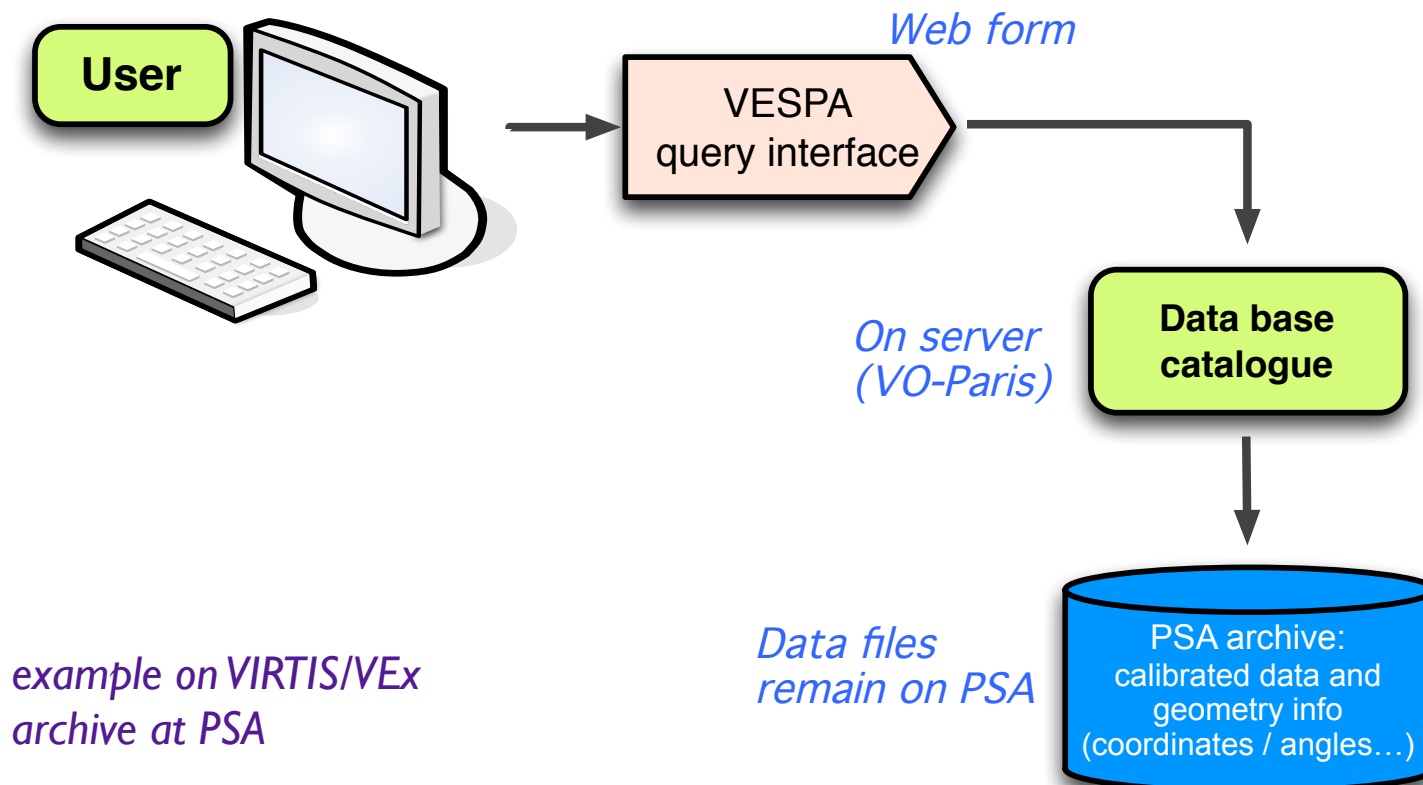
Add search function in a PDS dataset

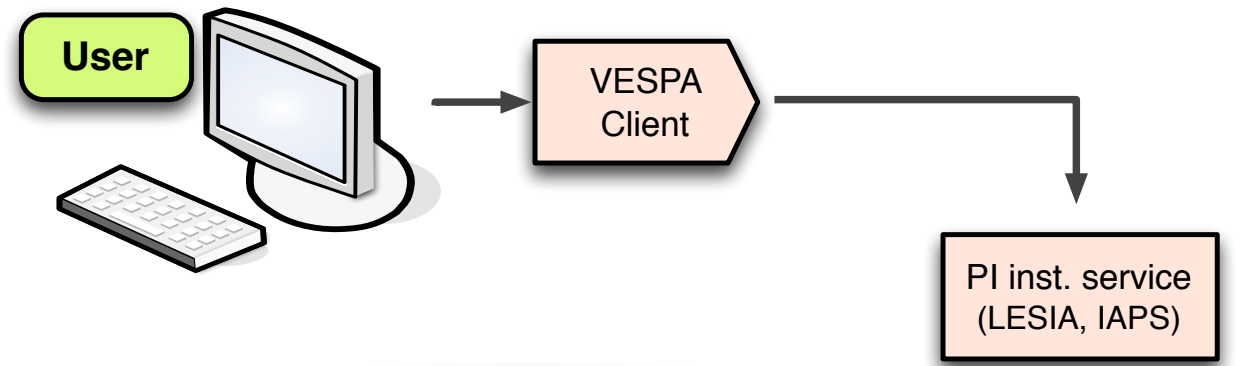
Archive file VIRTIS_INDEX.TAB => service catalogue in database

All files/sessions are described using:

- UTC / location / local time / tangent altitude
- Instrument parameters (including integration time / quality code)

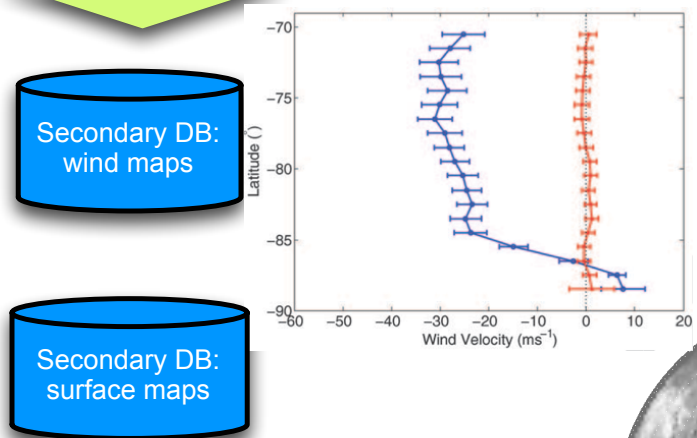
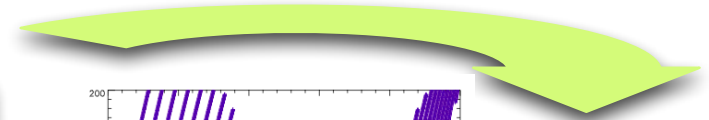
VESPA can use those as search parameters



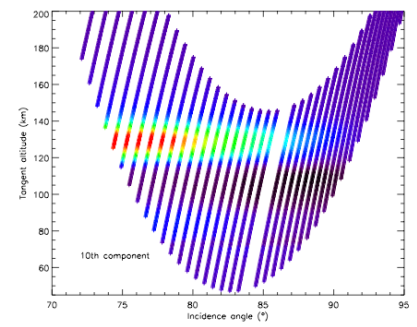


VIRTIS / Venus-Express Data Fuzzy-Center:

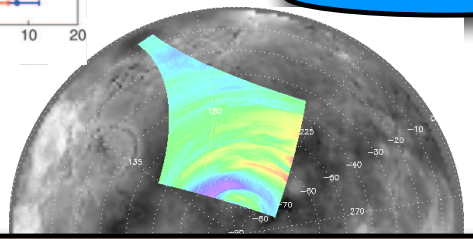
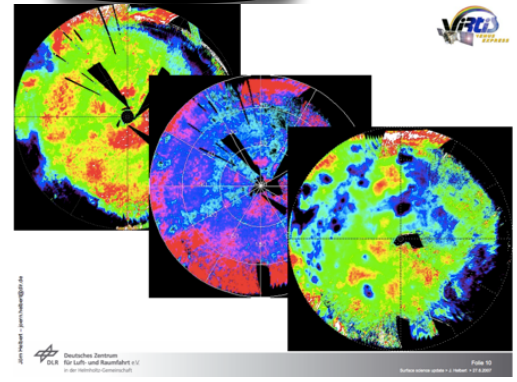
Derived products are distributed by associated teams, possibly using a server/catalogue located in PI institutes



Primary Data base: calibrated data and geometry info (coordinates / angles...)

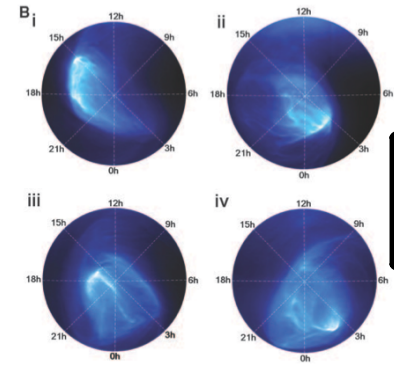


Secondary DB: Limb composition



secondary services in col institutes (Bilbao, Berlin, Lisboa, Oxford...)

...or one service linking data products in cols institutes



Secondary DB: Atmosphere dynamics

Titan Use case

Stéphane Erard
Sandrine Vinatier
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Baptiste Cecconi
Florence Henry
Cyril Chauvin

(OV-Paris / Observatoire de Paris)

Titan profiles database

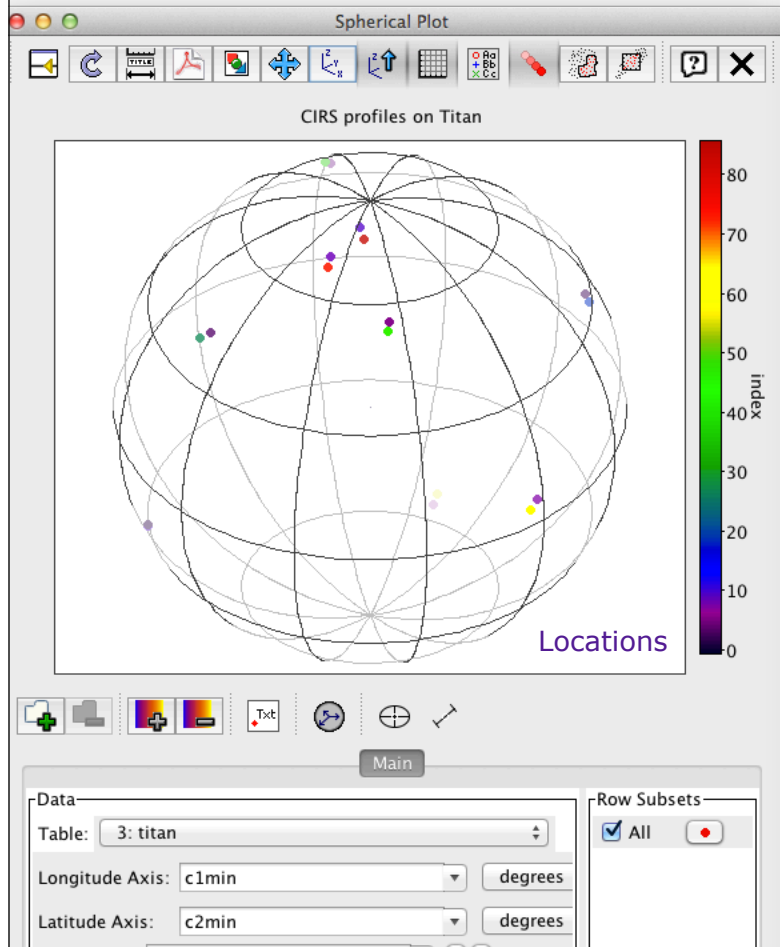
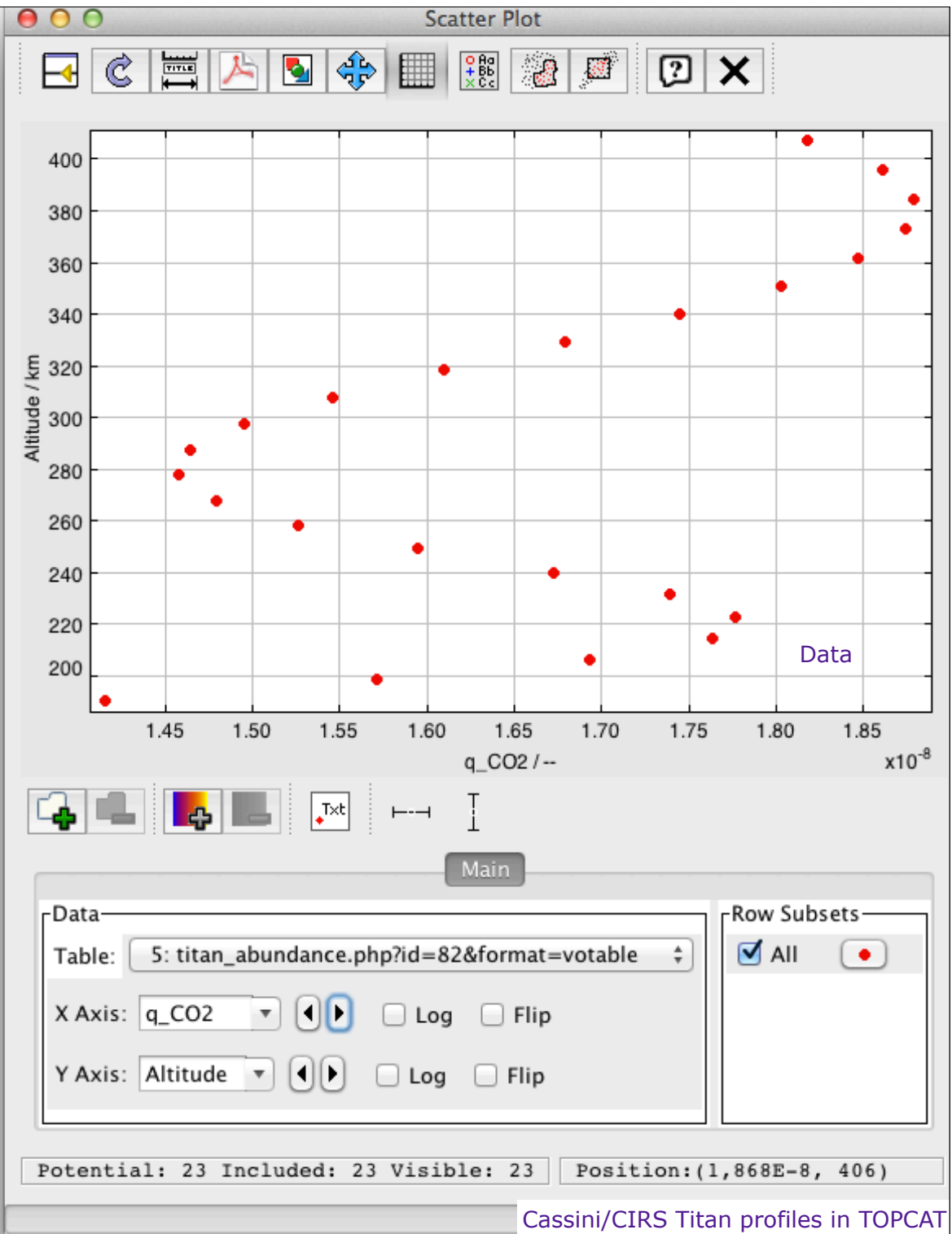
Typical example of VO data service

- Data from CIRS / Cassini, outcome of a publication
- P, T and gaz abundance profiles retrieved from spectral inversion in mid-atm
- Currently 93 profiles published
- Some 100s profiles to be added in 2014 from another publication
- Main parameters are : location, time, local time, season...

See recorded tutorial/demo here:

http://voparis-europlanet.obspm.fr/utilities/Tuto_Titan_TopCat.pdf

Titan profiles database



Europlanet Client



All VO Custom resource

Query form: All VO

Target name: **titan** Target class: asteroid, comet, dwarf_planet, exoplanet, interplanetary_medium, planet

Resource type: granule

Dataset ID: [input]

Time selection: Data range is included in the range between

Time min: [input] Time max: [input]

Dataproduct: **profile**, **volume**, cube

Measurement type: [input]

Spatial name: **body**

Longitude min: [input] Longitude max: [input]

Latitude min: [input] Latitude max: [input]

z min: [input] z max: [input]

Useful info

VO applications

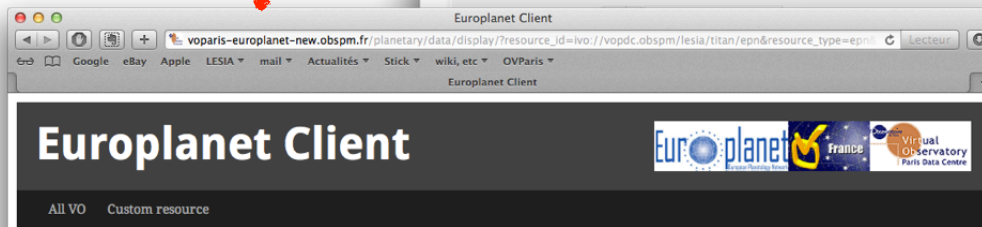
- TOPCAT
- Aladin

Example queries

- Saturn in March 2012

Science case:
Titan atm.

Titan GCM
[with VO web interface]



Query result on schema titan

Show 20 entries

dataproduct_type	target_name	time_min	time_max	access_url
profile	titan	2007-03-25T12:00:00	2007-03-25T12:00:00	titan_abundance.php?id=1&format=votable
profile	titan	2007-03-25T12:00:00	2007-03-25T12:00:00	titan_abundance.php?id=2&format=votable
profile	titan	2007-03-25T12:00:00	2007-03-25T12:00:00	titan_abundance.php?id=3&format=votable
profile	titan	2007-03-25T12:00:00	2007-03-25T12:00:00	titan_abundance.php?id=4&format=votable
profile	titan	2007-03-25T12:00:00	2007-03-25T12:00:00	titan_abundance.php?id=5&format=votable
profile	titan	2007-03-25T12:00:00	2007-03-25T12:00:00	titan_abundance.php?id=6&format=votable
profile	titan	2007-03-25T12:00:00	2007-03-25T12:00:00	titan_abundance.php?id=7&format=votable
profile	titan	2007-03-25T12:00:00	2007-03-25T12:00:00	titan_abundance.php?id=8&format=votable
profile	titan	2007-03-25T12:00:00	2007-03-25T12:00:00	titan_abundance.php?id=9&format=votable
profile	titan	2007-01-29T12:00:00	2007-01-29T12:00:00	titan_abundance.php?id=10&format=votable
profile	titan	2007-01-29T12:00:00	2007-01-29T12:00:00	titan_abundance.php?id=11&format=votable

Useful info

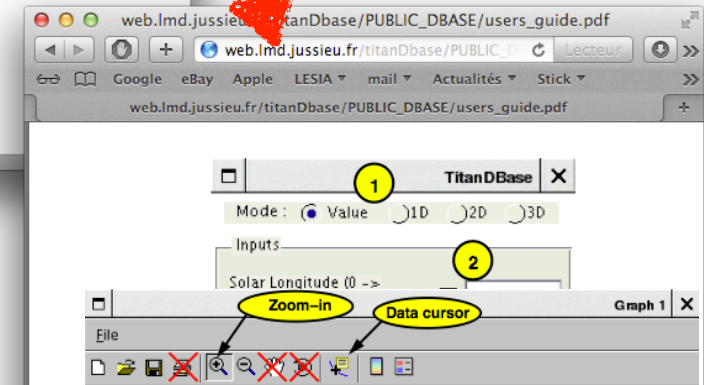
VO applications

- TOPCAT
- Aladin

Example queries

Table Browser for 2: titan_abundance.php?id=8&format=votable

	Altitude	P	T	q_HC3N	q_min	q_max
1	222,62	0,4586	178,29	7,424000E-10	4,616930E-10	1,023110E-9
2	214,92	0,5417	177,12	6,280000E-10	3,784290E-10	8,775710E-10
3	207,33	0,6397	175,35	5,172000E-10	2,979530E-10	7,364470E-10
4	199,86	0,7556	173,48	4,153000E-10	2,261550E-10	6,044450E-10
5	192,51	0,8923	171,61	3,258000E-10	1,661420E-10	4,854580E-10
6	185,27	1,054	169,79	2,505000E-10	1,184770E-10	3,825230E-10
7	178,14	1,245	168,07	1,895000E-10	8,259970E-11	2,964000E-10
8	171,13	1,47	166,32	1,416000E-10	5,638990E-11	2,268100E-10
9	164,23	1,736	164,3	1,050000E-10	3,799340E-11	1,720070E-10
10	157,45	2,051	162,12	7,764000E-11	2,537590E-11	1,299040E-10
11	150,79	2,422	160,11	5,758000E-11	1,687960E-11	9,828040E-11
12	144,59	2,835	158,	4,371000E-11	1,150320E-11	7,591680E-11



then check regional radar maps during the period, etc...

