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

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# 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

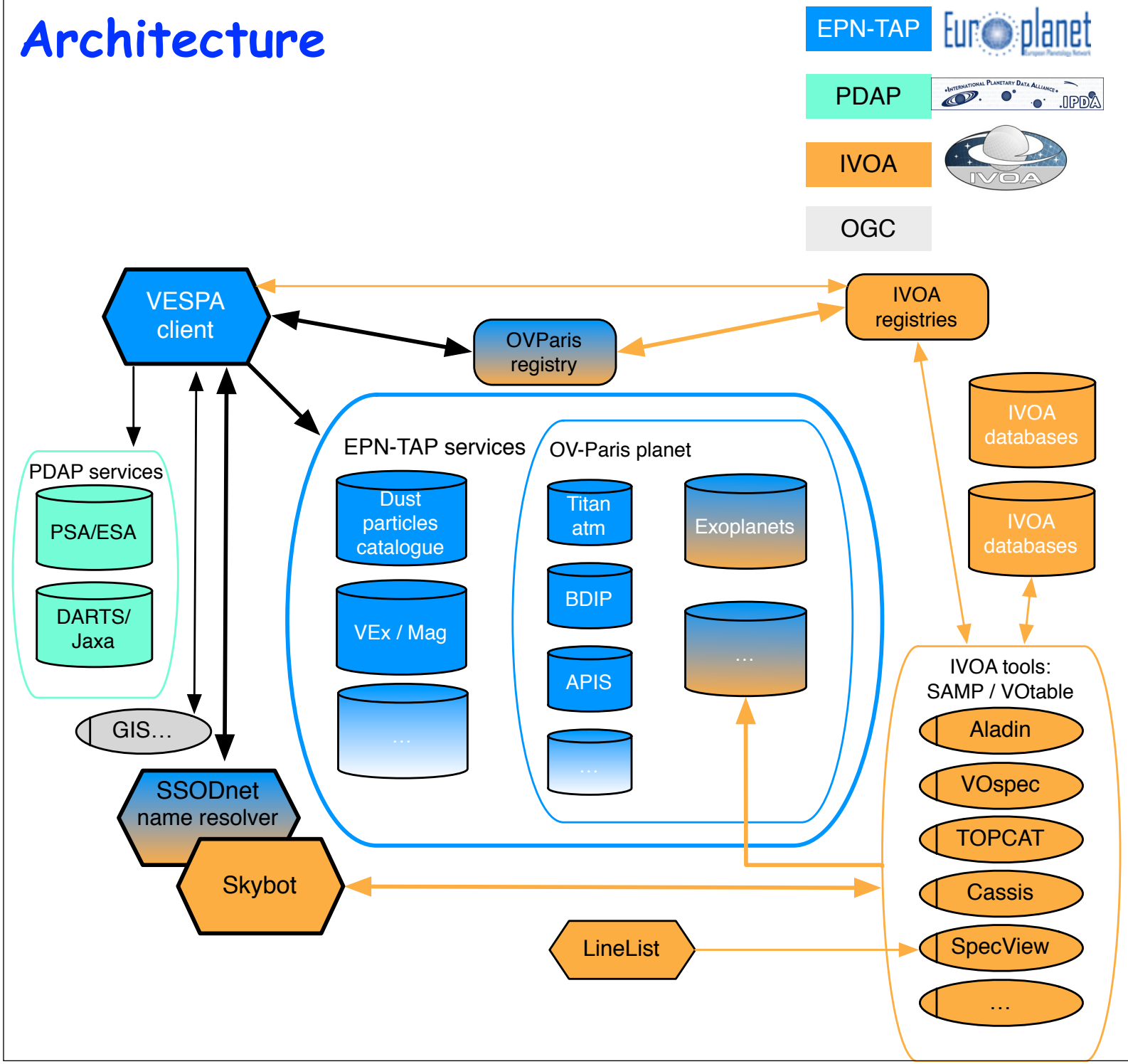
- Make "small" derived data sets accessible
- Develop specific processing/visualisation tools

} 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://voparis-europlanet-new.obspm.fr/


**Query form: All VO**

Target name

Resource type: granule

Dataset ID

Time selection: Data range is included in

Time min

Dataproduct type: image, spectrum, dynamic_spectrum

Query All VO | Reset

**Plotting tools**

## Europlanet Client

All VO | Custom resource

### Query results

**Auroral planetary imaging and spectroscopy**

Results: SAMP VOTABLE HTML

Planetary aurorae are powerful emissions radiated from auroral regions of magnetized planets by accelerated charged particles, in a wide range of wavelengths (from radio to X-rays). The UV range in particular is adequate to measure collisionaly excited transitions of H and H2, the dominant species in the upper atmosphere of giant planets, produced by precipitating auroral particles, and benefits a good angular resolution. Auroral UV observations therefore provide a rich source of informations on planetary atmospheres and magnetospheres. They also offer a unique diagnostic to remotely probe the solar wind activity throughout the heliosphere..

**Copyright notice: this research have been made using APIS database by LaurentLamy Lesia-Observatoire de Paris**

**August onboard Phobos2, atmospheric composition of mars**

Results: SAMP VOTABLE HTML

<No resource description provided>

### Useful info

**VO applications**

- TOPCAT
- Aladin

**Example queries**

- Jupiter in January 2004

# First data services

- 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 features catalogue (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: IVOA

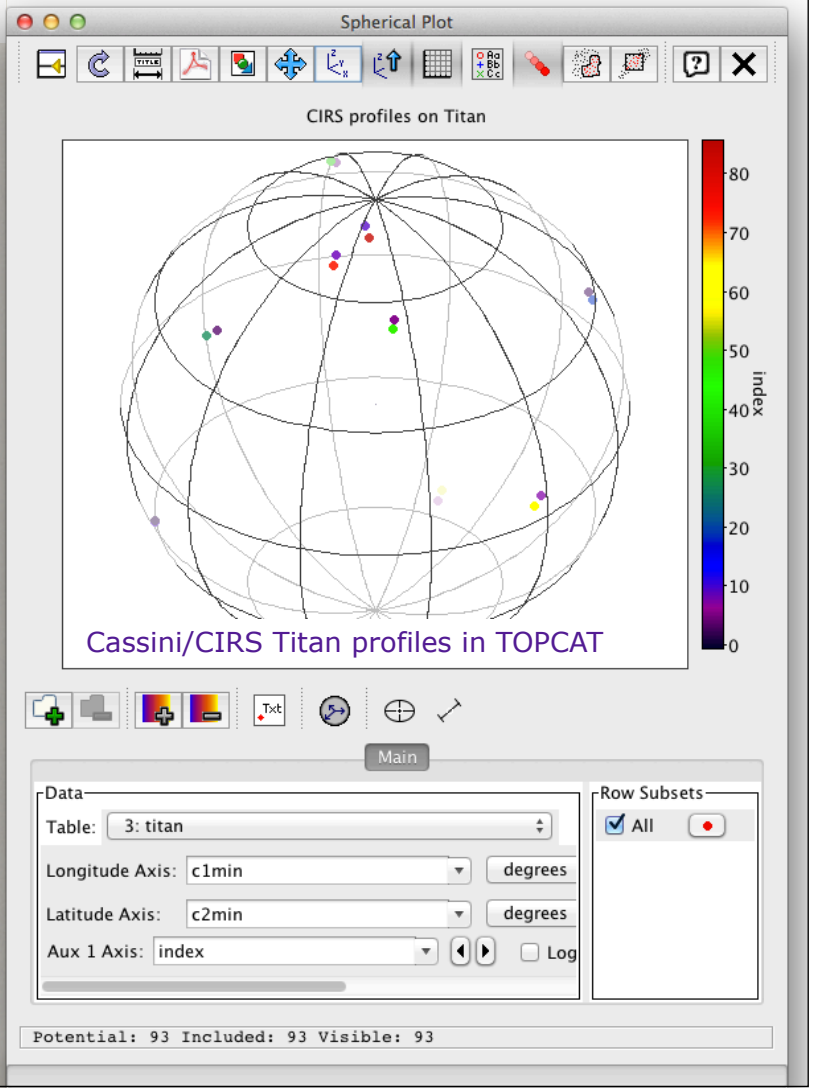
## Aladin:

- plots images/cubes
- handles sky/spheroid coordinates


HST / Saturn image from APIS in Aladin

## TOPCAT:

- Handles tables
- 2D/3D plots



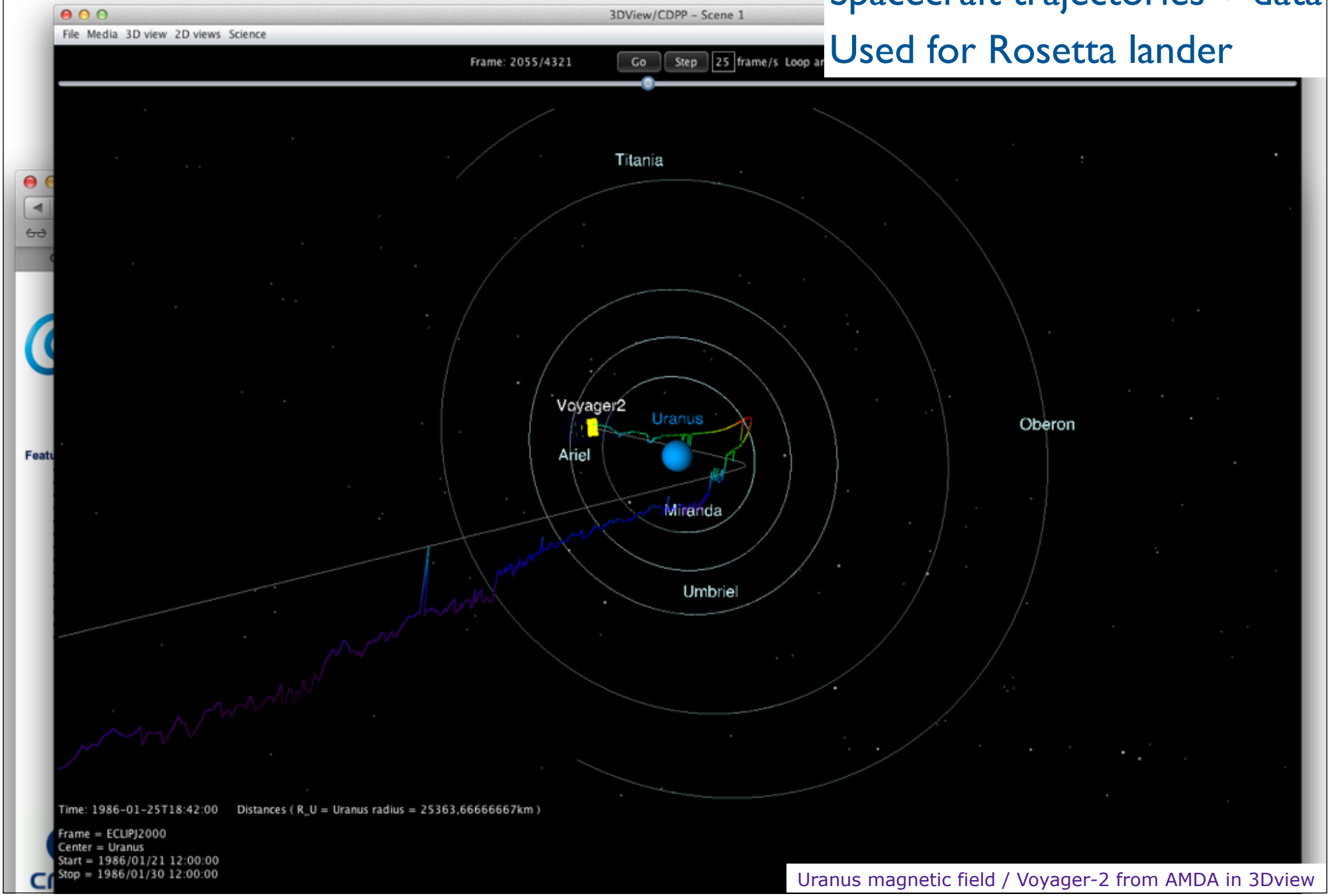

Cassini/CIRS Titan profiles in TOPCAT

# Visualization tools: others

**3Dview / CNES**:

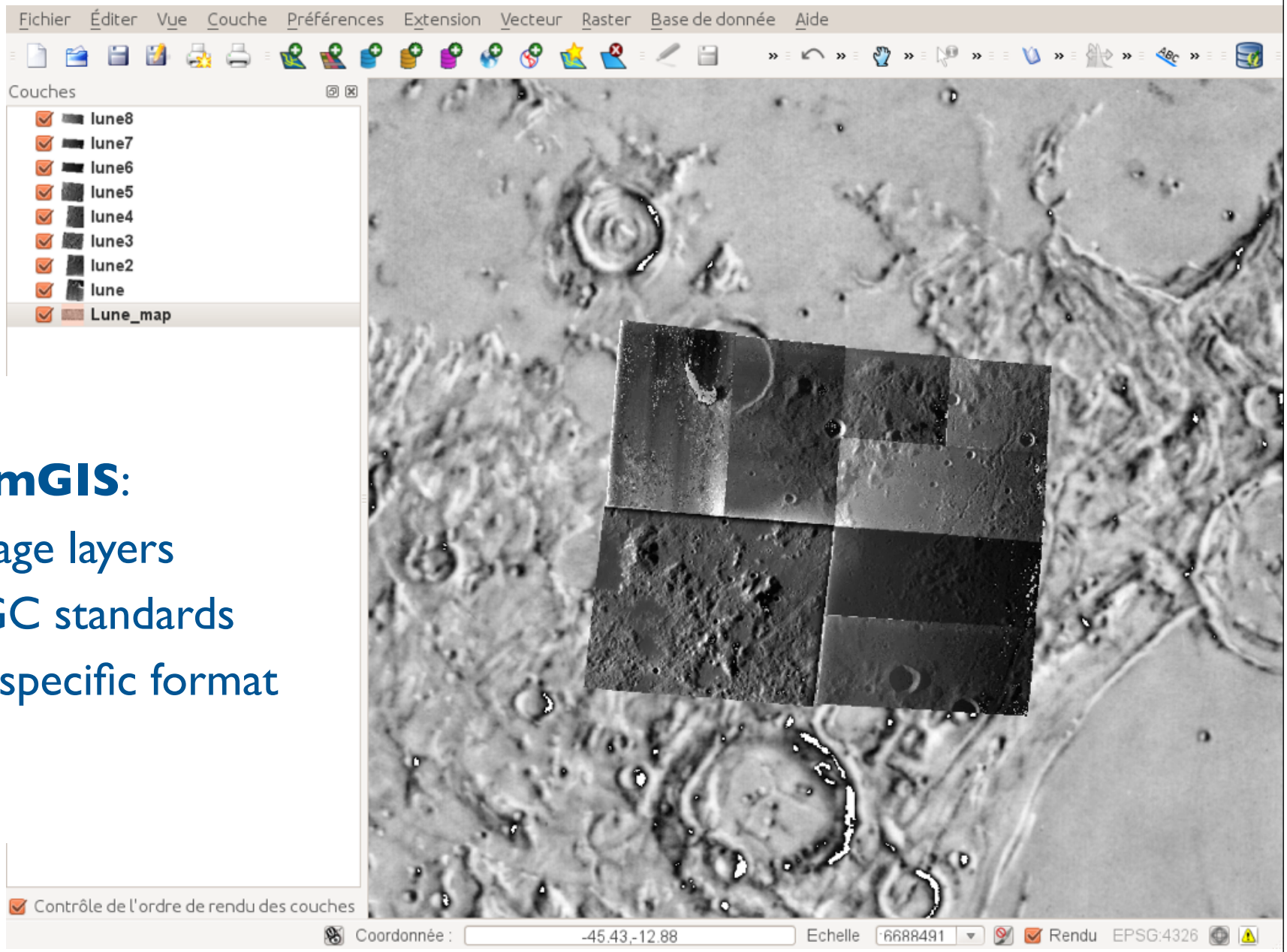
Spacecraft trajectories + data

Used for Rosetta lander




Uranus magnetic field / Voyager-2 from AMDA in 3Dview

# Visualization tools / GIS (OGC standards)

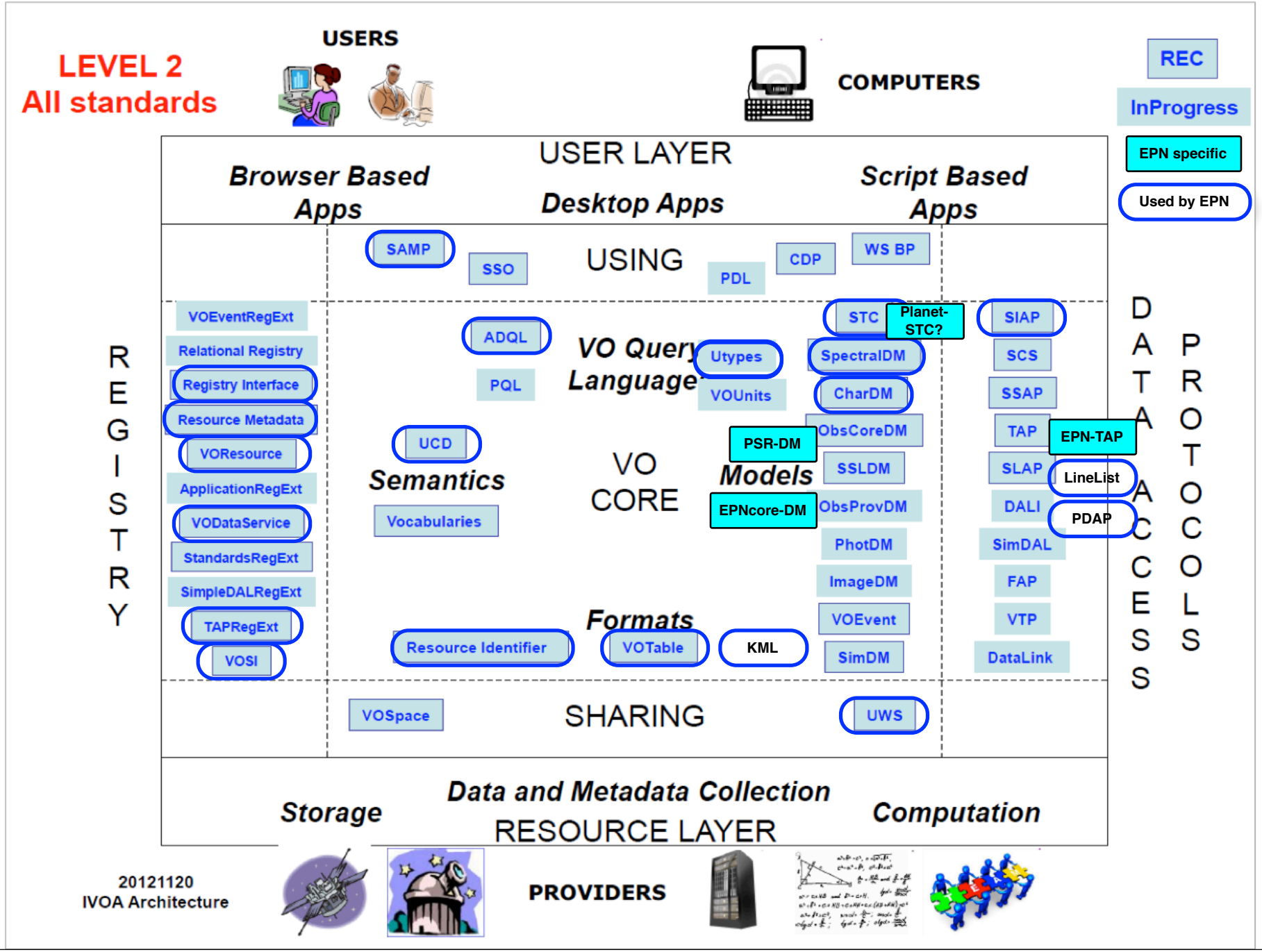



**QuantumGIS**:

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

AMIE/Smart-1 image frames on Clementine basemap in QuantumGIS

# IVOA loan standards



# 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)

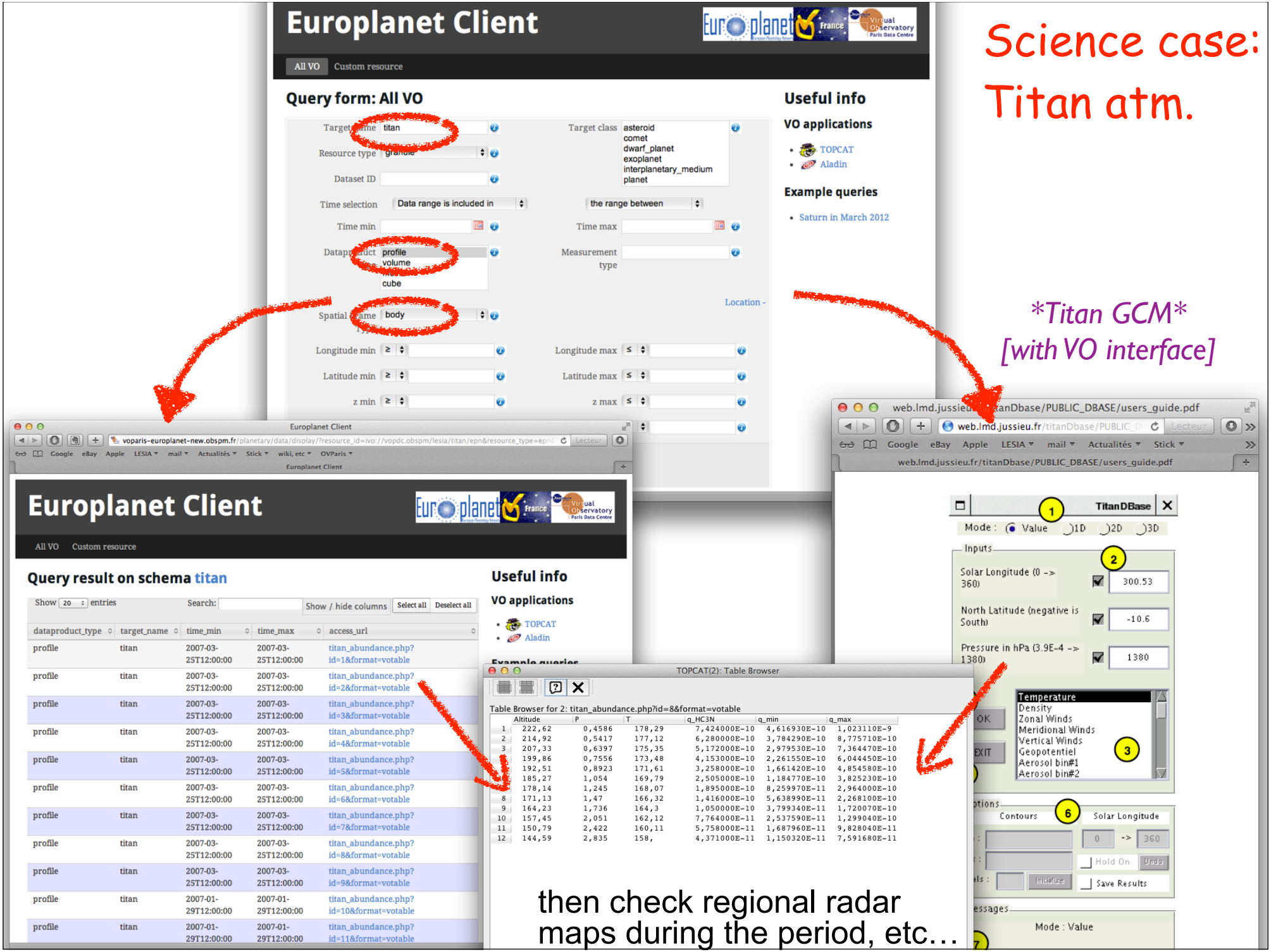
- Science value increases with number of connected services
  - Related data services increase science coverage
  - Services can provide extra information on same objects (exoplanets), or same information on new objects (small bodies)
  - Need for reference laboratory data (e.g. mineral spectroscopy)
    + modeling (e.g. GCM)
    + ground support observations for space missions (Venus?)

- Currently in basic form => 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 - Identification of new objectives / partners / activities

# Science case: Titan atm.

*Titan GCM*
*[with VO interface]*



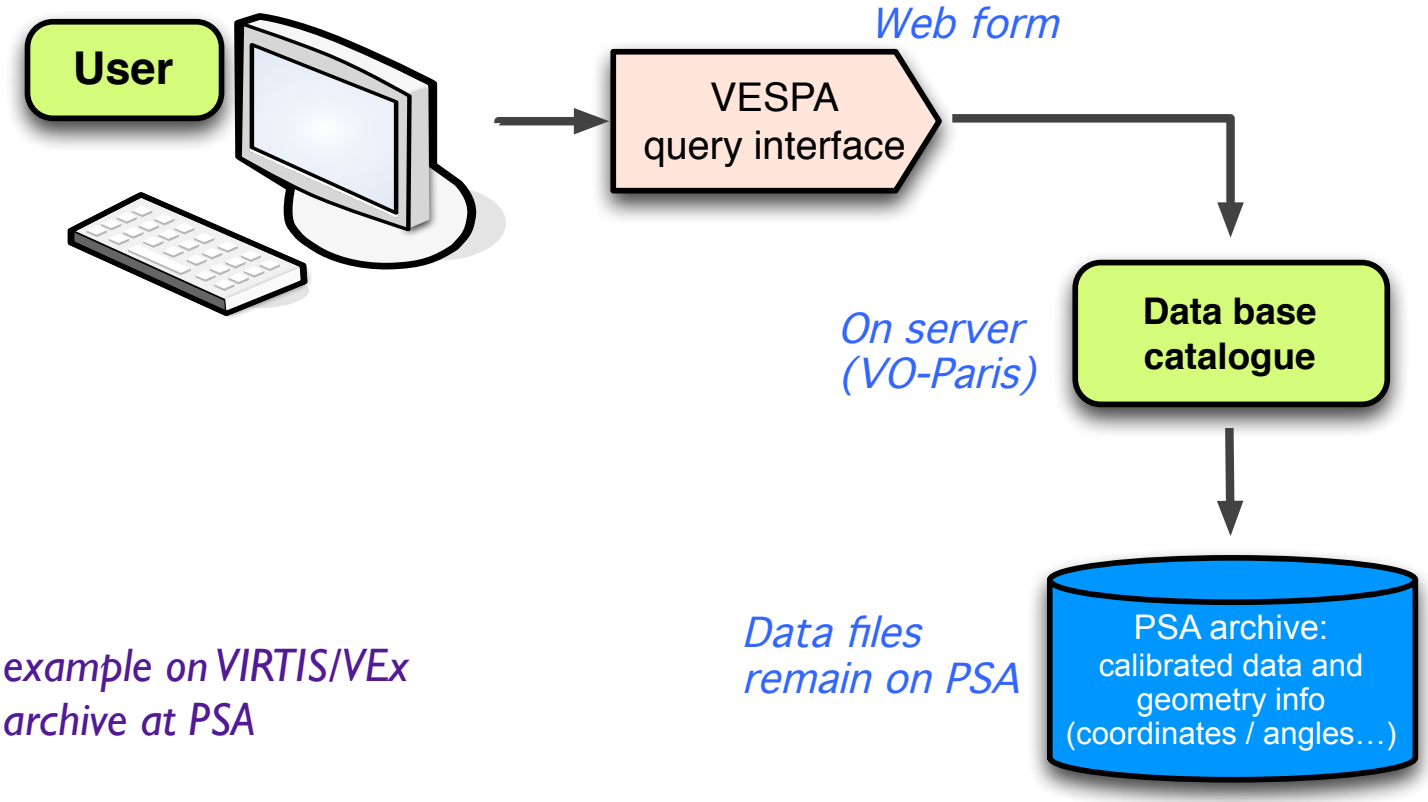

then check regional radar maps during the period, etc…

# 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




*example on VIRTIS/VEx archive at PSA*

# Some objectives for H2020

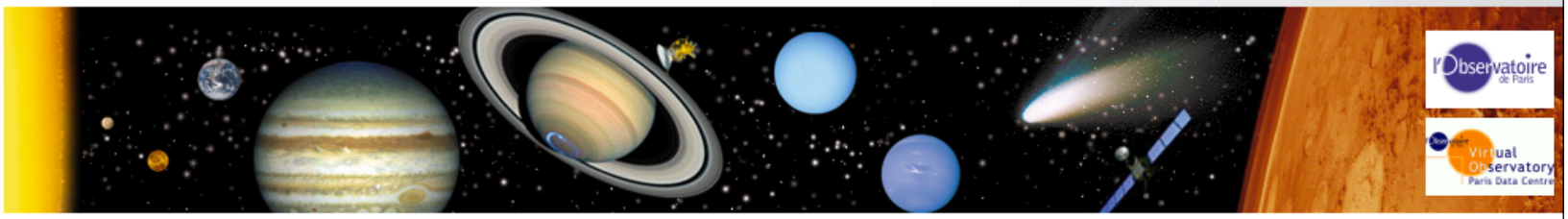
- Increase number of data services
  - Handled by thematics
  - Link to large topical services (AMDA, GhoSST/SSHADE…)
  - + calls open to external partners
  - + some selected amateur resources
- Tools update + adaptation
  - Specific functions in Aladin / TOPCAT / DS9?
  - Use 3Dview (or other…) to 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
  - …

# Extra information

http://voparis-europlanet.obspm.fr

Europlanet Research Infrastructure

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 |