ESA PLANETARY SCIENCE ARCHIVE ARCHITECTURE AND DATA MANAGEMENT.

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Introduction: The Planetary Science Archive (PSA) is the European Space Agency's (ESA) repository of science data from all planetary science and exploration missions. First released in 2004, it went through a completely renewed user interface and system architecture, with the "new" PSA v5.0 released early 2017 and can be accessed at http://psa.esa.int.

The PSA is being developed and operated within the ESAC Science Data Centre (ESDC) in collaboration with ESA's planetary Science Operations Centres, also located at the European Space Astronomy Centre near Madrid, Spain and with the missions' instrument teams mostly in Europe. The ESDC also hosts other science archives for ESA space science astronomy and heliophysics missions (http://archives.esac.esa.int/).

PSA content: The PSA is a multi mission archive containing science datasets from ESA's active planetary missions (Rosetta, Mars Express and Exomars TGO), legacy missions (Venus Express, Huygens, Giotto and Smart-1) and will include science data holdings from future missions (BepiColombo, Exomars RSP and Juice).
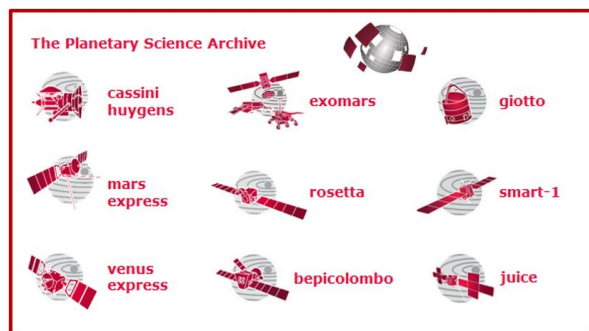

Figure 1: ESA Planetary Missions

All data sets are scientifically peer-reviewed by independent scientists, and are compliant with the Planetary Data System (PDS) standards. From PSA v5.0 early 2017, the archive can ingest datasets from PDS3 and PDS4 and offer them to scientists through common interfaces.

PSA interfaces: The primary way to access ESA planetary science data holdings is through the PSA GUI, which offers a powerful and user friendly faceted search web interface (Figure 2: PSA web GUI). Lots of work has been done to ensure homogenous metadata across the many instruments, to enable science driven searches across instruments across missions.
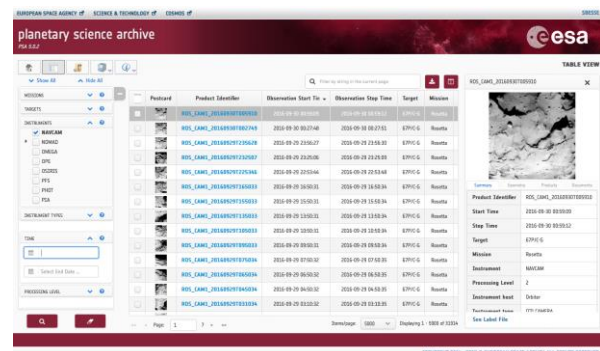

Figure 2: PSA web GUI

Most of the data is public and can be downloaded directly. Login is required for proprietary data download for authorized users, but most of the data is public and accessible without requiring to login.

Although planetary scientists represents the main users of the PSA, there are many spectacular images that can also be of interest of the general public and the media. To facilitate access to these, an archive image browser (Figure 3: PSA Archive Image Browser) is also available to quickly search and visualize Rosetta browse products. Plans for a map browser using GIS technologies are on-going, based on a still to be defined uniformed geometry information across missions datasets.

Users more experts with the ESA planetary missions can directly download full instruments datasets from the PSA FTP server.

Figure 3: PSA Archive Image Browser

The new PSA also attempts to increase interoperability with the international community by implementing recognised planetary science specific protocols such as the PDAP (Planetary Data Access Protocol) and EPN-TAP (EuroPlanet-Table Access Protocol).

PSA Architecture: The PSA is based on a modular and flexible 3-tier architecture (Figure 4: PSA System Architecture). The storage layer consists of a data repository (around 45TB) and a RDBMS (PostgreSQL). The Client layer offers the main interfaces to scientists, either through a thin web client or through command line interface. The Server layer takes care of handling all database queries, data distribution services and all archive administrative services (ie user login and authentication, usage statistics).
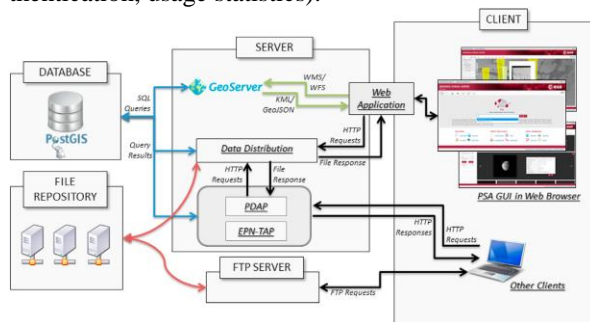

Figure 4: PSA System Architecture

PSA and IPDA: The International Planetary Data Alliance (IPDA) is an association of partners worldwide with the aim of improving the quality of planetary science data and services to the planetary science community (http://www.planetarydata.org). IPDA's mission is to facilitate global access to, and exchange of, high quality scientific data products managed across international boundaries. Ensuring proper capture, accessibility and availability of the data is the task of the individual member space agencies. Through the PSA

team, ESA has been a co-founder of the IPDA with NASA and PDS and continues to be an active members of the alliance.

PSA's interoperability with other planetary data archives is obtained through the usage of common data formats (PDS3 and PDS4) and the implemention of common data interoperability protocols (ie PDAP and more recently EPN-TAP).

References:

[1] Besse, S. et al. (2017) *Planetary and Space Science, doi*, ESA's Planetary Science Archive: Preserve and present reliable scientific data sets.

[2] Macfarlane A. et al. (2017) *Planetary and Space Science, doi,* Improving accessibility and discovery of ESA planetary data through the new Planetary Science Archive.