GIS Architecture and its Applicability for the Planetary Science Archive. R. Docasal¹, I. Barbarisi¹, C. Rios¹, A. Montero¹, J. Saiz¹, J. Osinde¹, J. Ruano¹, J. Arenas¹, S. de Castro¹, C. Laantee¹, E. Alonso¹, B. Merin¹, S. Besse¹, D. Coia², T. Lim², E. Grotheer³, M. Bentley⁴, D. Heather⁵, D. Fraga⁵

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Introduction: Geographical information systems (GIS) are becoming increasingly used for planetary science. GIS are computerised systems for the storage, retrieval, manipulation, analysis, and display of geographically referenced data.

Some data stored in the Planetary Science Archive (PSA) have spatial metadata associated to them. To facilitate users in handling and visualising spatial data in GIS applications, the PSA should support interoperability with interfaces implementing the standards approved by the Open Geospatial Consortium (OGC).

These standards are followed in order to develop open interfaces and encoding that allow data to be exchanged with GIS Client Applications (e.g. OpenLayers, Cesium...). Access to this data for use in applications can be provided through OGC Web Service (OWS) implementations.

An existing open source server is GeoServer, an instance of which has been deployed for the PSA, that uses the OGC standards to allow the sharing, processing and editing of data and spatial data through the Web Map Service (WMS) and Web Feature Service (WFS) standards. On the back-end side, a PostgreSQL/PostGIS instance allows the spatial queries.

The final goal is to enhance the PSA (accessible through http://psa.esa.int) further as a portal which enables science exploitation of ESA's planetary missions datasets. This can be facilitated through the GIS framework, offering interfaces (both web GUI and scriptable APIs) that can be used more easily and scientifically by the community, and that will also enable the community to build added value services on top of the PSA.

Some of the current operational ESA planetary missions, such as Mars Express, ExoMars 2016, and BepiColombo, as well as other future missions such as ExoMars 2020, Juice, etc. will benefit of a GIS tool to visualize their targets (Mars, Mercury, Jupiter...) allowing spatial queries to retrieve geometrical information like features, footprints, rover path tracking, rover drill sites, etc.

GIS architecture: The PSA relies on 3-tiered system for the GIS architecture (see Figure 1). The database layer is composed of a PostgreSQL database with the PostGIS extension to store the spatial information. The server layer uses GeoServer as a map server to provide WMS/WFS responses (e.g. GeoJson, kml...) to the web application’s requests (implemented on the Vaadin framework). Finally, the client layer (browser) runs the OpenLayer Javascript library to render the map.

Other external GIS tools like QGIS might be used to get the PSA spatial data from either the GeoServer or the database.

Views Consistency: The PSA provides different views to show the same planetary data. These views are integrated and synchronized to each other to visualize the information as the data type requires. All of them use the filter menu to search by a given criteria and offer similar features such as sorting, pagination, downloading and product detailed info. Once a query is executed on a view, the information is automatically loaded when changing views. The map view is integrated in the current PSA (see Figure 2) as the other views (Table, Image) giving other perspective of displaying results when it comes to search for spatial data.
**GIS Applicability:** GIS technology on the PSA will offer a common way to filter (by mission, instrument, target, dates, geometry…) and search for spatial data, even for legacy missions, thanks to the homogenization of the geometrical information with perproduct spatial metadata computed in a consistent way via SPICE.

PSA will provide spatial data retrieval of both versions of the NASA Planetary Data Systems archival formats, PDS3 and PDS4, based on a criteria search, and, the possibility of selecting PDS3/PDS4 products from a particular area of interest, by either zooming or drawing (see Figure 3). All of this within a friendly environment, which will allow the user to navigate through the layers, pan, zoom, etc.

**Figure 3: Footprint selection and information**

PSA will also provide the projection of Browse Images over the footprints (CaSSIS data has been used as part of a prototype) as well as cross matching visualization between PDS3 and PDS4 data (e.g. Mars Express/HRSC & ExoMars 2016 CaSSIS). See Figure 4.

**Figure 4: Browse Images projection and Cross Matching visualization**

Finally, ExoMars 2020 will bring useful use cases related to the Rover such as its path tracking (traverse map), drill sites, mosaicked images location, 2D/3D/DEM interfaces, etc. which will be integrated into the PSA. Now they are part of a prototype (see Figure 5) that will be evolving during the coming years.

**Figure 5: Exomars 2020 traverse map mock-up**

**Acknowledgments:** Some results/figures have been extracted from Mars Express HRSC browse images (February 2006, April 2017 & October 2017) and ExoMars 2016 CaSSIS browse images (November 2016).

In addition, some data from Curiosity Analyst’s Notebook has been used to mock the ExoMars 2020 traverse map.

**References:**