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ESA's Planetary Science Archive: Status, Activities and Plans.

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1. Introduction

The European Space Agency's Planetary Science Archive (PSA) is the central repository for all scientific and engineering data returned by ESA's planetary missions, making them accessible to the world-wide scientific community. The PSA currently holds data from Mars Express, Venus Express, SMART-1, Huygens, Rosetta and Giotto, as well as several ground-based cometary observations. It will be used for archiving on ExoMars, BepiColombo and for the European contributions to Chandrayaan-1. This presentation will outline the current status of the PSA, activities underway to improve our services and plans for the future.

2. Archiving with PDS standards

All PSA data are compliant with NASA's Planetary Data System (PDS) Standards for formatting and labelling files, including requirements for documentation and the structuring of data sets. This maximises the cross-compatibility of ESA and NASA data. The Standards are based around a 'Data Dictionary' containing a set of keywords that can be used to provide all of the information required to access and analyse the data. PSA maintain their own 'PSA Data Dictionary', appending many of their own 'local data dictionaries' to specify information pertinent only to individual ESA missions.

2.1 IPDA and the PDS4 Standards

PSA provides the ESA membership of the International Planetary Data Alliance (IPDA), an international collaboration of space agencies with a mission of providing access to scientific data returned from Solar System missions archived at international data centers. A key IPDA project that is currently underway is the implementation of the emerging PDS4 data standards. PSA are co-leading this project, using the upcoming BepiColombo mission to develop our first PDS4 data models. The PDS4 Data Standards aim to provide a framework for capturing planetary science data results in international archives based on a homogeneous set of standards that can be extended as needed for international usage.

3. Ensuring long term preservation

The long-term preservation of data and knowledge from all of ESA's planetary missions is a core focus. All data provided within the Planetary Science Archive are therefore passed through a set of rigorous procedures designed to ensure the usability of the data not only at the time of ingestion, but also in the long-term, after the mission has closed and direct support from personnel involved with the mission can no longer be guaranteed.

Compliance with the conventions and requirements on each mission / instrument, and with the PDS Standards is verified using a tool developed by ESA and distributed to all data providers. A tool is in development that will provide a more qualitative validation step at the PSA to ensure correctness, completeness and cross correlation of all information, label and data content.

Each phase of the archiving process is controlled by a corresponding peer review, during which external experts are asked to validate the data and documentation for their suitability for long-term archiving.

4. Data Query / Retrieval

Several interfaces are available to query and retrieve data from the PSA: a java-based user interface provides advanced search, preview, download, notification and delivery basket functionality. Map-

based querying is also available for the Mars Express HRSC and OMEGA instruments.

All publicly available data are also accessible via an anonymous FTP server. This has no search capability but a user can quickly browse the content of the archive using any FTP-client application.

Lastly, expert users can develop software applications to query and retrieve data from the PSA using ESA's Planetary Archive Inter-Operability system (PAIO). The PAIO is a server-side implementation of the Planetary Data Access Protocol (PDAP) being developed by the IPDA in order to enable interoperability of planetary data archive systems.

5. Scientific Support

The PSA supports the scientific community and the production of scientific data in many ways:

Help desk: enquiries related to access or usage of the data can be addressed directly by the PSA experts.

Data Workshops: Once the scientific instrument data are available in the PSA, workshops are organized to demonstrate the best practices for their use. These are aimed at the scientific community at large, and take the form of hands-on workshops, with expert members of the instrument teams providing direct support on the best ways in which to calibrate and use their data for science. Typically, these workshops are organized for two instruments at once and some effort is put in to show how data can be combined to maximize the science output. These workshops have been very successful, and have engendered a very positive response from the students attending, who are provided with the opportunity to meet instrument team members and build working relationships, as well as getting direct experience with data handling, processing and analysis. All presentations and software used during the workshops are made available via the PSA website. Future workshops are planned on data from both Mars Express and Venus Express. Depending on interest, future workshops could be used to address scientific themes (e.g. planetary upper atmospheres) rather than specific Mars or Venus science.

Data analysis: ESA and the PSA support both internal and external efforts to enhance the scientific content of the archive. SMART-1 was primarily a technology-testing mission, and no resources were available for teams to provide archive data themselves. As a result, the data were produced after intense efforts internally at the PSA to develop pipelines and data sets in close collaboration with remaining team members.

For Mars Express, ESA have funded contracts to produce calibrated data from the MARSIS subsurface radar experiment. The resulting Total Electron Count (TEC) data sets are now available online, and the pipeline is stable for further data deliveries. Calibrated profiles have been also been delivered by the Ionospheric Sounder and the PSA are working with the science team to produce valid archive products and data sets from these.

PSA staff are actively involved in the production of global mineral maps of Mars using the OMEGA data, and geo-referencing of the data in close collaboration with the instrument team.

Consultancy is also provided to teams producing their own calibrated data. High-level products are being delivered by HRSC, ASPERA, MARSIS, and are in preparation for PFS on Mars Express. On Venus Express, calibrated data are provided for VMC, MAG, VIRTIS and SPICAV-SOIR, and for SMART-1 there are calibrated data from the AMIE camera. Many Rosetta instruments have also provided calibrated data for the Mars, Earth and asteroid flybys.

5.1. PSA User Group

A major focus for the PSA in 2013 is the establishing of a PSA User Group (PSA-UG) and to host a first working meeting. The PSA-UG is comprised of 6-8 members chosen to ensure an appropriate range of expertise in disciplines important for the PSA. They shall be a major driver for the future development of the PSA and its data content, and will be a focus for the interests of the scientific community. The first meeting will take place in July and the presentation from this abstract will summarise the outputs.

6. Additional Information

Further information about ESA's Planetary EPSC_Science Archive and the data workshops can be found here: http://archives.esac.esa.int/PSA