

The International Planetary Data Alliance (IPDA): Overview of the Activities

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Abstract. An overview of activities of the IPDA is presented in the frame of the recently growing number of successful space experiments dedicated to planetary observation, with a significantly growing number of people involved in such activity and with significantly growing numbers of web services willing to share data and services in our research domain, but also, in close by domains such as astronomy, heliophysics and atmospheric sciences for the Earth. An overview of a number of space agencies and organizations is given. In total, IPDA consists of 13 national organizations: NASA (USA), CNES (France), ESA (Europe), STFC (UK), JAXA (Japan), ASI (Italy), ISRO (India), DLR (Germany), RKA (Russia), RCSA (China), FMI (Finland), ArSA (Armenia) and United Arab Emirates. Some projects of 2015 in frame of the IPDA activities are described.

1. Introduction

The charter of the International Planetary Data Alliance (IPDA), developed in 2007 states: “The main emphasis of the IPDA is to ease discovery, access and use of planetary data by world-wide scientists regardless of which agency is collecting and distributing the data. Ensuring proper capture, accessibility and availability of the data is the task of the individual space agencies participating in this alliance. The IPDA and its partners are focusing on developing an international standard that allows the following capabilities: query, access and usage of data across international planetary data archive systems. While, trends in other areas of space science are concentrating on the sharing of science data from diverse standards and collection methods, the IPDA shall concentrate on promoting standards which drive common methods for collecting and describing planetary science data across the international community. Such an approach will better support the long term goal of easing data sharing across system and agency boundaries. An ini-

tial starting point for developing such a standard will be internationalization of NASA's Planetary Data System standards".

We will present here an overview of the activities of the IPDA in the frame of the recently growing number of successful space experiments dedicated to planetary observation, with a significantly growing number of people involved in such activity and with significantly growing numbers of web services willing to share data and services in our research domain, but also, in close by domains such as astronomy, heliophysics and atmospheric sciences for the Earth.

2. Background

The IPDA was formed in 2006 with the purpose of adopting standards and developing collaborations across space agencies to ensure data is captured in common formats. Six space agencies or international institutions were involved in the origin of the IPDA, including NASA, ESA, CNES, JAXA, ISRO and IASF, represented by a number of different groups through the IPDA Steering Committee (see at www.planetarydata.org). The IPDA Steering Committee oversees the execution of projects and coordinates the international collaborations. To limit the influence of individual partners and enhance the available expertise, up to three members of participating institutions or countries can be members of the steering committee. From its onset, an effort has been made to streamline operations and provide a framework for efficient operations and ease of collaboration.

The chairman of the IPDA is elected by the steering committee for a 2-year term. Selection is structured to allow rotation of the office among the participating institutions. For example, the last four chairmen were from JAXA (2009-2011), NASA (2011-2013), CNES (2013-2015) and ISRO (2015-2017). Other than the Steering Committee, there is one other standing group, The Technical Experts Group that supports the steering committee. There are no standing committees; instead in executing its mission, the IPDA conducts a number of focused projects to enable interoperability, construction of compatible archives, and the operation of the IPDA as a whole (Kasaba et al. 2009). These projects have well defined goals and established schedules. This approach has helped to establish the IPDA and to move the collaboration forward. A key project that is currently underway is the implementation of the emerging PDS4 (Planetary Data System, version 4) data standard (Crichton et al. 2013).

Given the international focus, it has been critical that the PDS and the IPDA collaborate on its development. The PDS4 system relies on a master registry where each data product is assigned a unique Uniform Resource Name (URN) and consists of an XML labels and the basic product, which may be data, documentation, user help pages, etc. Data will be stored and maintained in the official archives of the individual participating agencies. And, when this system is fully implemented, international users will be able to search across interfaces connecting the individual archives to obtain all data of interest. Many other projects have been conducted successfully before 2015. The list is quite long, but a particular interest are the IPDA requirements document, the Data Dictionary Modeling, and several demonstrations of interoperability protocols applied to specific missions and data sets, and of course many other documents related to PDS4 and PDAP (Planetary Data Access Protocol). All these documents are available on the web site of the IPDA at <http://www.planetarydata.org>.

The Steering committee meets face-to-face once a year. Our members are committed and work to optimize assessment of previous accomplishments and plan for the coming year. Regular teleconferences are organized every 2 months where we discuss ongoing projects and organizational issues. While the evolving standards from IPDA (i. e. PDS4) are being implemented for the up-coming planetary mission archives by the respective agencies, considerable interaction and sharing is required.

3. A Brief Overview of selected Space Agencies Involved in the IPDA

- a) **NASA/PDS** (text extracted from <https://pds.nasa.gov>): The Planetary Data System (PDS) archives and distributes scientific data from NASA planetary missions, astronomical observations, and laboratory measurements. The PDS is sponsored by NASA's Science Mission Directorate. Its purpose is to ensure the long-term usability of NASA data and to stimulate advanced research. All PDS data are publicly available and may be exported outside of United States.
- b) **ESA/PSA** (text extracted from <http://www.rssd.esa.int/index.php?project=PSA>): The European Space Agency's Planetary Science Archive (PSA) is the central repository for all scientific and engineering data returned by ESA's Solar System missions: currently Giotto, Huygens, Mars Express, Rosetta, SMART-1, and Venus Express, as well as several ground-based cometary observations. The PSA uses NASA's Planetary Data System standards as a baseline for formatting and structuring of all data contained within the archive.
- c) **CNES and associated laboratories**: Planetary data archives in France are supported by the space laboratories where the space experiments are developed. The four important laboratories and data centers in planetary space in France are: (i) the Laboratoire Atmosphères, Milieux, Observations Spatiales (LATMOS); (ii) the Laboratoire d'études spatiales et d'instrumentation en astrophysique (LESIA) at the Observatoire de Paris; (iii) the Centre de Données de la Physique des Plasmas (CDPP) at the Institut de Recherche en Astrophysique et Planétologie (IRAP) in Toulouse; and (iv) the Institut d'Astrophysique Spatiale (IAS).
- d) **ISRO/NRSC** (extracted from <http://www.isro.org/about-isro/national-remote-sensing-centre-nrsc>): The National Remote Sensing Centre of the Indian Space Research Organization (ISRO) is responsible for remote sensing satellite data acquisition and processing, data dissemination, aerial remote sensing and decision support for disaster management. In the field of planetary sciences, ISRO was involved in Chandrayaan-1, the first Indian mission to the Moon, and Mars Orbiter mission. Indian Space Science Data Centre (ISSDC) set up at Bangalore, is the custodian of all the science data from the Indian science missions. ISSDC is responsible science data archive preparation, maintenance and dissemination. Currently it holds Chandrayaan-1 payload data archive and MOM active archive.
- e) **JAXA** (extracted from <http://global.jaxa.jp>): The Japan Aerospace Exploration Agency (JAXA) was born through the merger of three institutions, namely the Institute of Space and Astronautical Science (ISAS), the National Aerospace Laboratory of Japan (NAL) and the National Space Development Agency of Japan (NASDA). It was designated as a core performance agency to support

the Japanese government's overall aerospace development and utilization. The Institute of Space and Astronautical Science carries out basic research to analyze data provided from exploration plans, such as those noted above. The wide range of studies and developments have been conducted, such as the study of planetary science, which have been carried out in the world, especially in the U.S.A., using data from probe vehicles, and developments of measuring instruments to be equipped to probe vehicles. Planetary data archives at JAXA are maintained by Data ARchives and Transmission System (DARTS), a multi-disciplinary space science data archive for, e. g., astrophysics, solar physics, solar-terrestrial physics, lunar and planetary science, and microgravity science. DARTS service is free of charge for scientific and/or educational purposes and personal use.

Note that more than 80% of the data in planetary science obtained from space are available through these institutions, laboratories or services. Because space experiments were originally constrained by on board processing, telemetry and storage, and because each agency was dealing with internal conditions, it is difficult to develop a top-down virtual observatory. The role of the IPDA is then to simplify the whole system for all participants to provide access of all. More, because measurements in planetology from space are so diverse by nature that usual virtual observatories (astronomical for example) are not straightforward to adopt for obvious differences: coordinates systems need more than 6 coordinates (position in space + form + orientation + rotations); time references related to the planet and not to the Earth; and many other parameters.

4. The IPDA in 2015

The IPDA has grown significantly since its first meeting back in November 2006. The steering committee is composed today of 28 members from 24 countries or international organizations, including recently (2014) integrated Finlandian Space Agency, as well as the Armenian Space Agency and the United Arab Emirates Space Agency. It has grown to thirteenn space agencies or regional space institutions (NASA, CNES, ESA, STFC, JAXA, ASI, ISRO, DLR, RKA, RCSA, FMI, ArSA and UAE) also represented by the country or international institution they are respectively: USA, France, Europe, UK, Japan, Italy, India, Germany, Russia, China, Finland, Armenia and United Arab Emirates.

A technical expert group was created in 2013 and is now composed of 20 members from participating countries. The group deals with technical and compatibility issues, providing advice to the Steering Group and Projects. The project model is the basic mechanism of development within IPDA.

A project is first proposed by a member of the IPDA (or an external individual) and submitted to the Steering Committee. After internal discussion and agreement on the scope of the project, a leader is selected, a working group is formed and a schedule is establishedthe project starts and a working group is composed. Progress is reported during Steering Committee meetings and, on completion, a written document containing all useful information is submitted to the Steering Committee. Members of the technical group or a special panel review the results and, on acceptance, the final document is then ready for dissemination.

Here is a list of some on-going projects:

- a) The creation of the Memorandum of Understanding (MOU) template for international missions: Scientific data obtained by international planetary missions should be open and shared widely as human intellectual assets. The MOU itself is the agreement between two or multiple agencies, however, should include data provisions considering international availability.
- b) The investigation of IVOA/IPDA (International Virtual Observatory Alliance-IVOA) interactions: Various virtual observatories in the world are actively developing standards and tools for the use of scientific data. IVOA is one of the most active virtual observatories and many common interests can be explored in these interactions.
- c) PDS4 implementation project: A number of international agencies are now at a stage where work can begin on implementing their PDS4 systems and data. The purpose of this project is to capture recommendations and requirements based on the preparation and implementation of PDS4 by authorities/institutions outside NASA.
- d) The development of international registries to enable registration and search of data, tools and services: The PDS4 project has developed a registration and search infrastructure to enable cross-agency search of planetary data. This infrastructure is currently deployed at the PDS Engineering Node (<http://pds.nasa.gov>) and provides catalog-level search across PDS3 data sets and PDS4 bundles for both NASA PDS and ESA PSA archival data. This project will continue to extend the implementation and deployment of this infrastructure to ensure the search services could be populated and utilized by other IPDA-member agencies.
- e) Chandrayaan-1 interoperability project with PDAP: This project is an implementation of PDAP on Chandrayaan-1 data using PDS.

and many others.

Since 2006, project duration is on average 2-3 years and 8 standard specifications documents have been published by the IPDA and are available on its web site at www.planetarydata.org.

The IPDA held its 10th regular meeting of the Steering Committee at ISAS/JAXA in Japan from July 22 until July 24, 2015. More than 20 participants from space agencies, data bases providers and users, developers etc. participated in this event. The meeting included presentations of the work done during the current academic year (September 2014 – July 2015) by individual agencies, followed by presentations of on going projects followed by discussions. Next IPDA meeting will be organized in Spain, at ESAC/ESA, the European space Astronomy Center of the European Space Agency in July 2016.

5. Outreach

IPDA is also making an effort toward outreach activities, trying to be present or represented at all important national and international levels and meetings such as COSPAR

(The Scientific Assembly of the Committee on Space Research), AGU (Meetings of the American Geophysical Union), EPSC (The European Planetary Science Congress), DPS (Division of Planetary Science), EGU (Annual meetings of the European Geophysical Union) etc. with on an average 3-4 meetings per year. Also, the web page contains many tools for planetologists (services) and new tools can be submitted freely.

6. Conclusion

The IPDA has shown a very impressive efficiency since its creation, with active participation in international meetings, delivery of useful documentation for each project and regular annual meetings as well as regular teleconferences. The contribution of many space agencies has been successfully applied to the IPDA with a very active and broad core. IPDA runs with a good equilibrium of the activities of the various agencies and sharing responsibilities. We invite all partners involved in planetary data to participate to our next annual meeting at ESAC/ESA in Spain, to be announced soon on the IPDA web site at www.planetarydata.org.

References

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