

THE ANNEX OF THE PDS CARTOGRAPHY AND IMAGING SCIENCES NODE IN 2020.

M. A. Hartke, L. R. Gaddis, T. M. Hare, A. Sunda, D. P. Mayer, M. Bailen, B. Kindrick. USGS Astrogeology Science Center, 2255 N. Gemini Dr., Flagstaff, AZ 86001 (mhartke@usgs.gov).

Introduction: The [Cartography and Imaging Sciences Node](#) (“Imaging” or IMG) of the NASA Planetary Data System (PDS) archives and delivers large digital image collections from planetary missions. Included among these collections are nearly 1600 TB of digital image archives, ancillary data (calibration files and software, geometric data, etc.), software, tutorials and tools.

While the great majority of archived products are delivered to IMG from planetary mission instrument teams, smaller research products from individual, NASA-funded investigators are often archived at PDS or PDS-equivalent sites. This effort represents a significant increase in the variety and complexity of data holdings for IMG.

[The Annex](#) of IMG is a facility hosted at the U.S. Geological Survey’s Astrogeology Science Center. It was developed by IMG to support scientists who use PDS data to create derived geospatial products that can be registered to a solid planetary body [1, 2]. Many of these products are developed through data analysis programs, often years after a mission is complete and archive accumulation has ended. Since January 2017, NASA has considered the Annex to be PDS-Equivalent as a long-term data repository for such data products.

The Annex is built upon an online data catalog at USGS Astrogeology Science Center called Astropedia [3]. Astropedia provides quick and easy access to derived data products, a robust search interface supported by thorough metadata labeling of each product, cross-references to ancillary data and other related products, downloads in a variety of image formats, and interaction through a web-enabled interface [4]. These detailed metadata can readily be viewed for any product and will facilitate easy access through the existing Astropedia search interface.

Annex products are required to be (or to have been) 1) derived from data in the PDS archive, 2) delivered with extensive metadata that meet PDS archive documentation standards and 3) reviewed by PDS for PDS4 compliance and by science peers for validity and usability.

Recent improvements: Updates completed in 2019 now streamline public access to geospatial

data products and PDS archives through 108 product pages as of January 2020 (Figure 1).

These improvements include:

- extensive metadata including PDS status classifications,
- online linkages to source PDS data archives,
- processing descriptions for the product, and
- reference literature and supplemental information.

FGDC metadata. The metadata standard used for Astropedia was created by the U.S. Federal Geographic Data Committee (FGDC) with small modifications to better support planetary data [5, 6]. FGDC geospatial metadata, sometimes called “data about data,” is documentation that describes the rationale, authorship, attribute descriptions, spatial reference, errors and other relevant information about a given set of data. Products submitted to the Annex must have extensive metadata that meets PDS standards using these joint PDS and FGDC planetary metadata standards.

Use of these metadata standards supports search and retrieval of data and allows us to expand both the holdings and accessibility of planetary derived data products. These standards, along with existing PDS3 standards, are being used to help develop updated image and file labels for PDS4 products, the next-generation information model now required by NASA for new products [7, 8].

Source Online Linkages. Each Annex product page includes metadata fields that point to source data and information. The Source Online Linkage field in the Lineage section points to the online data volumes of the associated PDS archive and to mission-specific PDS websites. This allows the user to learn about the location and types of raw data in the PDS archives through the lens of one of many derived products. Other related resources such as a mission team’s website, NASA mission websites, and associated publications are collected in the Supplemental Information field in the General section.

PDS status classifications. Each product page displays the current status of the source archive both in a PDS Status tag at the top right and in the

Lineage section. PDS status classifications are described in an accompanying [chart](#). Although most data presented are in PDS3 format, several are PDS4-compliant, and a few are PDS#-like (e.g. international products such as those derived from JAXA's SELENE Kaguya orbiter). IMG is committed to migrating each PDS3 archive to PDS4 formats as resources permit.

Standardized page titles. The title of each product page is now standardized to contain precise keywords including the target body, mission(s), instrument(s) used to collect the data, a product description, pixel resolution and version number. Database products include the author's name. These titles improve search results, product retrieval and delivery for users.

References. Reference citations for associated publications are collected on each product page and standardized per American Psychological Association (APA) style format, the standard adopted by the American Geophysical Union (AGU). Reference citations display a Digital Object Identifier (DOI) when one exists for a source.

Using the Annex: Annex product pages are accessible by browsing or searching of product pages. The [browse feature](#) displays all Annex product page titles with embedded quick links. The [search feature](#) uses a web interface to provide a keyword-based search and an interactive mapping tool. The tool allows for selection of planetary targets upon which the user can restrict searches based on mission, data type (e.g., image mosaic, topography, geology), GIS-ready formats (e.g. GeoTiff including PDS label) and more.

Submission Requirements: The Annex accepts submission of NASA-funded geospatial products that have a PDS data heritage. Data providers are required to provide extensive metadata that meets PDS standards and benefits from FGDC requirements.

IMG personnel will guide users through the process and help define which metadata fields are required. New products will be archived in the PDS in PDS4-compliant formats by working with IMG node members at USGS to develop public Annex product pages. Product pages for closely related products may be gathered on a single site.

Summary: The Annex is a PDS-equivalent data repository that provides the public with fast and easy access to geospatial data products derived

from data in the PDS archive and related resources. Extensive development of a variety of features of Annex product pages in the past year increase the functionality that it provides to the user community. The Annex continues to evolve to meet the immediate need for public release of NASA-funded data products in highly usable formats and to simultaneously support the long-term archiving requirements of PDS and NASA.

References: [1] Gaddis et al. (2012) USGS Open File Report 2014-1056, p. 65. [2] Hare et al. (2019) 4th PDW, abs. #7054. [3] Bailen et al. (2012) 43rd LPSC, abs. #2478. [4] Hare et al. (2013) 44th Lunar and Planetary Science Conference (LPSC), abs. #2044. [5] Federal Geographic Data Committee, 2011, Preparing for International Metadata, Federal Geographic Data Committee, Washington, DC. [6] Hunter et al. (2020) A Proposed Planetary Extension for FGDC Geospatial Metadata, this volume. [7] Planetary Data System Standards Reference, v. 3.8, JPL D-7669, Part 2. [8] Gaddis & Hare (2019) 4th PDW, abs. #7045.

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The screenshot shows the Annex product page for 'Moon LRO LOLA Color Shaded Relief 386m v4'. The page layout includes a header with the 'Annex' logo and 'ASTROPEDIA' branding. Below the header is a map of the Moon's surface. The main content area is divided into several sections: 'Product Information', 'References', 'Metadata', and 'Online Linkage'. The 'Product Information' section contains a description of the data and a 'PDS Status: PDS 3 Line' tag. The 'References' section lists several scientific papers. The 'Metadata' section provides details about the publisher, publication date, and other technical information. The 'Online Linkage' section contains a link to the data. Red circles highlight the 'PDS Status: PDS 3 Line' tag, the 'FGDC xml metadata' link, and the 'Online Linkage' section.

Figure 1. An example of an Annex product page with highlights on a PDS status tag, FGDC xml metadata, product information, references, and online linkage.