

UPDATES TO THE PDS ORBITAL DATA EXPLORER. J. Wang, D. Scholes, F. Zhou, S. Slavney, E. A. Guinness, and R. E. Arvidson, Washington University in St. Louis, 1 Brookings Drive, Campus Box 1169, St. Louis, Missouri, 63130, wang@wunder.wustl.edu.

Introduction: The Orbital Data Explorer (ODE, <http://ode.rsl.wustl.edu>) is a web-based search tool developed and maintained at NASA's Planetary Data System's (PDS) Geosciences Node (<http://pds-geosciences.wustl.edu>). ODE provides search, display, and download functionality for PDS archives of orbital data products from planetary missions to Mars, the Earth's Moon, Mercury, and Venus [1,2,3,4]. ODE includes access to archives at the PDS Geosciences and other nodes. Currently, 1.1 petabyte of PDS data are accessible through the ODE.

ODE Key Features: ODE supports searches and retrieval of PDS planetary data products across multiple missions and instruments. It offers form- and map-based searches for named features and user-defined regions. The form-based search can be filtered through coverage, location, time, observation angle, and product ID. The map-based search supports the display of footprint coverage for data products on a number of user selectable basemaps. A user can graphically specify a search area and then receive a list of data products that intersect the specified region [3].

A granular data database contains data from individual records of data products. ODE supports several granular data databases with a specialized query tool for subsetting science data at specified regions [5]. The orbital laser altimetry and thermal emission spectrometer instruments, e.g., MGS (Mars Global Surveyor) MOLA and LRO (Lunar Reconnaissance Orbiter) LOLA and Diviner, produce along-track data products with limited cross-track coverage. The ODE granular search tool extracts the portion of data covering the user's desired search area from the along-track products. It then packages the data in a format appropriate for the user's needs and presents the formatted data for user download.

Another useful ODE tool is the MRO (Mars Reconnaissance Orbiter) coordinated observation search. A coordinated observation is a planned observation involving multiple instruments at a given location and time. ODE tracks the coordinated observations planned by the MRO science operations group, correlates them to PDS products that resulted from the planned coordinated observations, and then allows users to find and view related products from HiRISE (High-Resolution Imaging Science Experiment), CRISM (Compact Reconnaissance Imaging Spectrometer for Mars), MCS (Mars Climate Sounder), and CTX (Context Camera).

ODE generates product type coverage KMZ (zipped file of Keyhole Markup Language, KML) files and shapefiles for use with Google Earth/Mars/Moon and other GIS tools. Additionally, a Representational State Transfer (REST) interface (<http://oderest.rsl.wustl.edu/>, [6]) allows external users to access the ODE metadata and data products without using ODE web interfaces. For example, the NASA Ames efforts to produce automated LRO Narrow Angle Camera Digital Terrain Maps use ODE REST to access PDS metadata [7].

ODE provides a shopping cart model for downloading many files at once. The cart ordering system retrieves data from host PDS nodes and data nodes, adds related files, and provides download information to the user. The user then downloads the files via FTP.

ODE Data Inventory: ODE provides access to data from 13 planetary missions and over 50 individual instruments. Those missions include the ongoing MRO, Odyssey, ESA's (European Space Agency) MEX (Mars Express), and LRO missions, as well as a number of completed missions such as MGS, Viking Orbiter, Clementine, Lunar Prospector, Lunar Orbiter, Indian Space Research Organization's Chandrayaan-1, Magellan, GRAIL (Gravity Recovery and Interior Laboratory), and MESSENGER (Mercury Surface, Space Environment, Geochemistry and Ranging) missions. ODE is updated for active missions as new and accumulating datasets are released by PDS. From 2016 to January 2017 ODE has loaded 14 releases of data from the Odyssey, MESSENGER, MRO, LRO, and GRAIL missions, and over 20 deliveries of data from the MARSIS, OMEGA, and HRSC instruments on the MEX mission. A total of 20.8 million PDS products are currently cataloged in ODE.

ODE has added a number of new datasets to its catalog in 2016, including MRO CRISM TER (Targeted Empirical Record) and MTRDR (Map-Projected Targeted Reduced Data Record) datasets, a new Earth-based Venus radar dataset from Bruce Campbell, new derived LEND counts RDR (Reduced Data Record) data products, MEX HRSC (High/Super Resolution Stereo Colour Imager) data of Phobos, version 3 of the HRSC map projected image data, LRO LOLA RADR (Radiometric Data Record) dataset, as well as a number of MESSENGER MDIS (Mercury Dual Imaging System) advanced map-projected datasets. A detailed list of current ODE holdings can be found at

<http://wufs.wustl.edu/ode/odeholdings/index.html>.

Updates: A number of changes have been applied to the filtering options for the existing ODE search interface since 2016. To allow users to find multiple specific PDS products in one query, ODE has been updated to accept multiple product IDs, along with wildcards when filtering by product ID. Additional observation time filters of Mars Year and Solar Longitude were added as shown in Figure 1 when filtering by time range.

The screenshot shows the 'Filter by Time Range' section of the ODE search interface. It includes a 'Select Desired Time Range' section with an 'Observation Time (UTC)' dropdown and input fields for start and end times. Below this are sections for 'Solar Longitude (Ls)' and 'Mars Year', each with input fields and explanatory text. The 'Mars Year' section notes that April 11, 1955 (Ls=0 deg) is the start of year 1.

Figure 1. Updates for the Filtering Options

Some simplifications to the ODE website interface were made for MRO CRISM users. When searching TRDR (Targeted Reduced Data Record) data products, the DDR (Derived Data Record), RA (Radiance), and EPF (Atmospheric Survey EPF) files associated with a TRDR IF product can be added to the cart at checkout. The ODE search interface's CRISM product type list was streamlined by grouping CRISM special queries under an expandable 'TRDR Subset' list.

ODE has been updated to support multiple browse images for select instrument data, such as MRO CRISM TER and MTRDR browse products, which are available on the product detail page. CTX browse data were also updated with versions processed by the ASU Mars Space Flight Facility and downloadable from their Mars Image Explorer. Figure 2 is the updated CTX browse shown in a product detail page.

Four new map servers have been deployed. This has improved performance and stability of ODE's map interface. The map service processing code was also updated for efficiency. The Mercury ODE map interface was updated with the most recent mosaic base-maps from the MESSENGER. New versions of Mercury footprint coverage maps were deployed with parameters from the updated Mercury coordinate system adopted by the MESSENGER team.

Future Work: ODE will continue to add data from the MRO, MEX, MESSENGER, LRO, and Odyssey missions. We will continue to provide support for ODE website users and ODE REST API users. An upgrade to the ODE website interface is underway, to create a more user friendly interface that incorporates faceted searching.

Contact Information: The Geosciences Node welcomes questions and comments for additional functions

from the user community. Please send email to geosci@wunder.wustl.edu or post on the Geosciences Node forums <https://geoweb.rsl.wustl.edu/community/>. Comments and questions specific to ODE can be sent to ode@wunder.wustl.edu.

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References: [1] Bennett, K. et al. (2008), LPS XXXIX, Abstract #1379. [2] Wang, J. et al. (2009), LPS XL, Abstract #1193. [3] Wang, J. et al. (2010), LPS XLI, Abstract #2251. [4] Bennett, K. et al. (2013), 44th LPS, Abstract #1310. [5] Wang, J. et al. (2011), 42nd LPS, Abstract #1896. [6] Bennett, K. et al. (2014), 45th LPS, Abstract #1026. [7] McMichael et al. (2015), 46th LPS, Abstract #2491.

The screenshot shows the product detail page for a CTX browse image. It includes a product ID (J01_045318_1653_XN_145184W), a title 'MRO CTX EDR - Experiment Data Record and Non-PDS Compliant RDR through ASU Mars Space Flight Facility's Image Explorer', and a 'Browse Image' button. Below the image is a section for 'Full Image Formats' with links for 'JPEG2000', 'PNG', 'TIFF', 'ISIS Header', 'JPEG', and 'PDF'. There are also buttons for 'Add Product to Cart', 'Remove Product from Cart', and 'Cart & Download Help'.

Figure 2. Updates for the CTX Browse