

ACCESSING PLANETARY DATA USING PDS GEOSCIENCES NODE'S ORBITAL DATA EXPLORER.

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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 access to PDS archives of orbital data products from planetary missions to Mars, the Earth's Moon, Mercury, and Venus [1,2,3,4]. The archives at the Geosciences and other nodes can be searched and data products can be downloaded individually through the web interface or placed in a cart for later bulk download with FTP. ODE also provides access to documentation included in the archives.

ODE Data Inventory: ODE provides access to data from 13 planetary missions and over 50 individual instruments. Those missions include the ongoing MRO (Mars Reconnaissance Orbiter), Odyssey, ESA's (European Space Agency) MEX (Mars Express), and LRO (Lunar Reconnaissance Orbiter) missions, as well as a number of completed missions such as MGS (Mars Global Surveyor), 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 data sets are released by PDS. A total of 21 million PDS data products with a volume of 1.13 petabyte are currently cataloged in ODE.

ODE Key Features: ODE supports search and retrieval of PDS data products across multiple planetary missions and instruments. For instruments that collect point data along an orbit track, ODE provides a granular-level search, which will search each of the data products to extract the individual records that match search criteria and place the output into custom data products for download. ODE also provides a REST (Representational State Transfer) interface for external users who want to access the ODE metadata and data products without using the ODE web interface.

Data search and review. ODE offers form-based 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. Form-based and map-based search results are displayed in a table, with options to view individual product information, such as browse, metadata, PDS label, and map context. The browse version of image-oriented products provides an overview of the product to help make downloading decisions. In addition, users may view the product's context with footprints or bounding boxes plotted on a base map.

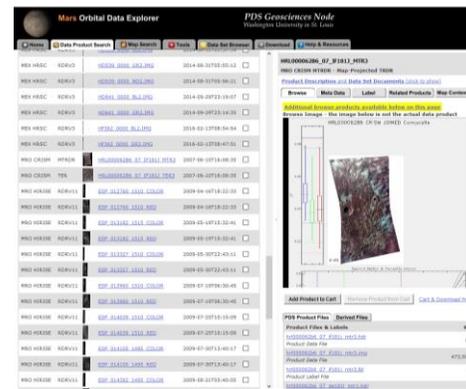


Figure 1. Cross-mission instrument search of MRO HiRISE (High-Resolution Imaging Science Experiment), MRO CRISM (Compact Reconnaissance Imaging Spectrometer for Mars), and MEX HRSC (High/Super Resolution Stereo Colour Imager) data in Mars ODE and view product details.

Data download. Multiple options are provided for acquiring data products from ODE, including direct download of individual files through the ODE interface. A web-based shopping cart model is available for downloading multiple files. The cart ordering system retrieves data from host PDS nodes and data nodes, adds related files, and provides download information to the user. Files can then be downloaded via FTP from a PDS Geosciences Node server. Additionally, an advanced cart feature allows the user to download a list of direct HTTP paths to the files in their cart. An application, such as Wget, can then be used to download the files directly without waiting for the ODE cart process to download files from other PDS nodes.

Granular data search. A granular data database contains data product individual records. ODE supports multiple 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 MOLA and LRO 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 download. Figure 2 is the granular search results of LOLA RDR data at Aristarchus Crater. The derived 3D shapefile feature was displayed in ESRI® ArcGIS. Currently, ODE supports granular-level searches for the 595 million point MOLA PEDR (Precision Experiment Data Record) data set and the 6.9 billion point LOLA RDR (Reduced Data Record) and 310.4 billion point Diviner RDR data sets.

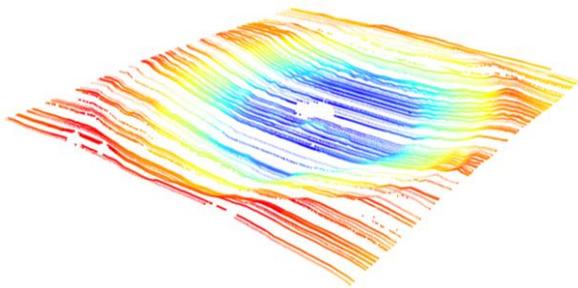


Figure 2. Granular data search results of derived 3D shapefile feature shown in ESRI® ArcGIS.

Coordinated observation. 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, view, and download related products from HiRISE, CRISM, MCS (Mars Climate Sounder), and CTX (Context Camera).

REST interface. The REST interface (<http://oderest.rsl.wustl.edu/>, [6]) allows external users to develop domain-specific tools and interfaces 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]. The ODE REST interface also supports granular-level queries of MOLA PEDR, LOLA RDR, DIVINER RDR, and Mercury MESSENGER MLA RDR data. The query results are

the same as the current ODE web-based granular query.

Footprint coverage maps in KMZ and shapefile format. Footprint coverage maps allow users to see which portion of a planetary surface is covered by the footprints of all products of a given product type of a given mission and instrument. ODEs generate product-type coverage KMZ (zipped file of Keyhole Markup Language, KML) files and shapefiles for use with Google Mars/Moon and other GIS tools. The coverage files include basic product information and links to product details in ODE to assist the user in acquiring product files through this method.

Future Work: ODE will continue to add data from the MRO, MEX, 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] Bennett, K. et al. (2013), 44th LPS, Abstract #1310. [4] Wang, J. et al. (2017), 48th LPS, Abstract #1257. [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.