**PLANETARY DATA ACCESS THROUGH THE VENUS ORBITAL DATA EXPLORER FROM THE PDS GEOSCIENCES NODE.** K. J. Bennett, J. Wang, D. M. Scholes, S. Slavney, E. A. Guinness, and R. E. Arvidson, Washington University in St. Louis, 1 Brookings Drive, CB 1169, St. Louis, Missouri, 63130, {bennett, wang, scholes, slavney, guinness, arvidson}@wunder.wustl.edu.

**Introduction:** The Venus Orbital Data Explorer (ODE) is a web-based search tool developed at NASA's Planetary Data System's (PDS) Geosciences Node (http://pds-geosciences.wustl.edu/). Venus ODE helps users search and retrieve multiple instruments data from the Magellan mission and Venus-flyby portion of the MESSENGER mission. The Venus Orbital Data Explorer is part of the Geosciences Node's ODE suite version 3.2, which includes product footprint maps and coverage-based information for searching, displaying, and downloading PDS archive data for Mars, the Moon, Mercury, and Venus. Key features of V3.2 include coverage-, location-, time-, and product ID- based searching, product browse, and shopping-cart-style download ([1, 2]). ODE version 3.2 also provides a searchable map interface with enhanced map capabilities [3]. ODE generates product type coverage KML (Keyhole Markup Language) files and shapefiles for use with Google Earth and other GIS tools. It also provides OGC (Open Geospatial Consortium) WFS (Web Feature Service) and WMS (Web Map Service) services for client accesses.

**Data:** Venus ODE currently supports data products from the Magellan mission as well as the Venus flyby portion of the MESSENGER mission. The datasets imported from the radar system of the Magellan mission include global emissivity, reflectivity, slope, topography, and vector data records. It also includes full resolution radar mosaics (FMAP), surface characteristics vector data, altimeter and radiometry composite data (ARCDR), full-resolution mosaicked image data records (MIDR) in sinusoidal equal-area and polar stereographic map projections, and compressed MIDR data at once (C1), twice (C2), or thrice (C3) compressed resolution. In addition, gravity data, line of sight acceleration profiles, and radio occulation data from the radio science subsystem (RSS) are also included. The Venus flyby portion of the MESSENGER mission includes data from the gamma ray spectrometer, neutron spectrometer, RSS, X-Ray spectrometer, atmospheric and surface composition spectrometer (MASCS), laser altimeter and the dual imaging system with narrow angle and wide angle cameras. The Venus ODE database currently holds a total of 54,001 products.

**Functions:** Venus ODE provides a web-based tool for searching and exploring the Venus orbital data sets as well as accessing and downloading the PDS archives. The major functions are as follows.

*Data searching and retrieval.* Venus ODE allows users to search for science data products via form-based or map-based interfaces. Users can make a form-based query by setting parameters of mission, instrument, product type, coverage, location, time, and product ID with the form-based Data Product Search interface. Users can also make queries on the Map Search interface with the tool Select Products By Area or by setting parameters in the Map Display Controls panel. ODE supports queries on both single and multiple missions, or searches among single and multiple instruments. Search results are shown in a table or on a map. Fig. 1 is the display of map-based search results at Maxwell Montes. In this example, the blue lines are the Magellan ARCDR data covering Maxwell Montes. The light blue and pink rectangles are full resolution Magellan MIDR and FMAP images taken at Maxwell.
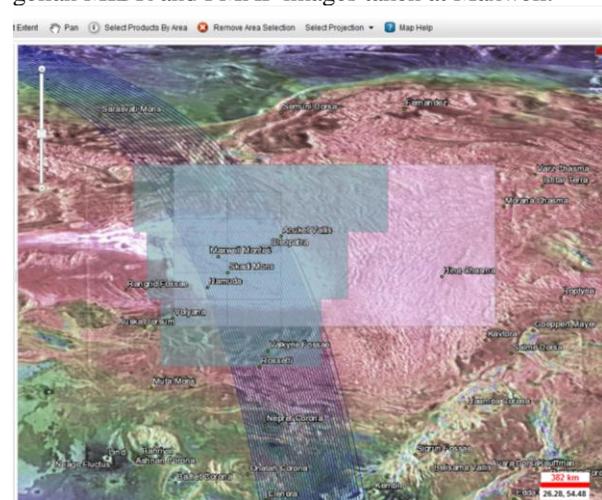


Figure 1. Map-based search results at Maxwell Montes.

*Data representation.* Details of search results are shown in a table with a set of functions to select more product information such as browse, meta data, PDS label, or map content. The browse version of image-oriented products provides an overview of the product to help users make downloading decisions (Fig. 2). In addition, users may view the products with the footprints or bounding boxes plotted on a basemap (Fig. 1).
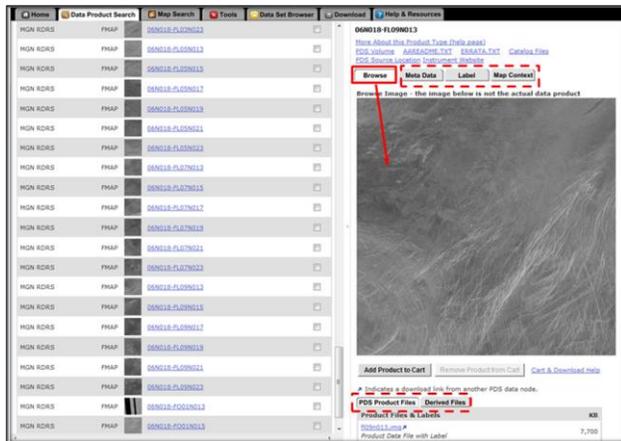
Figure 2. Form-based search results shown in a table.

*Map Display.* The Venus ODE Web map includes both footprint coverage and basemap layers as shown in Fig. 1. The footprint coverage maps display the location of data products. The basemap layers provide context background for Venus. The map interface was built based on the ESRI® ArcGIS Server and ArcGIS Javascript API. Basic mapping and GIS functions include map display, pan, zoom in/out, and navigation. The map visually presents footprints of independent data sets and product types using various colors and symbology, and displays them in separate layers. The footprint maps are overlaid on a number of basemaps. The transparency of each map layer can be adjusted in order to provide for combined presentation of layers. Basemaps and product footprints are available in simple cylindrical and polar stereographic projections. The basemap shown in Fig. 1 is the display of Magellan C3 MIDR Global Mosaic and SAR (Synthetic-aperture radar) backscatter data colorized with topography in a simple cylindrical projection.

*Tools for Footprint Coverage Explorer.* Venus ODE generates product-type coverage KML files and shapefiles for use with Google Earth or other GIS tools. Fig. 3 shows KML files of Magellan FMAP and ARCDR footprints overlaid on the Magellan SAR backscatter basemap, colorized with topography, of Maxwell Montes.
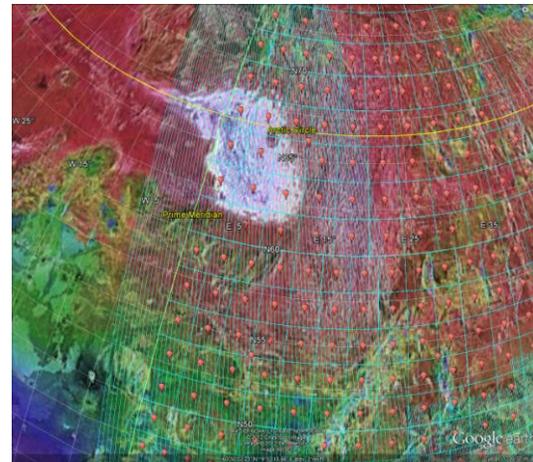


Figure 3. The Venus ODE KML files shown in Google Earth.

*Web Services.* All the GIS resource data and maps are stored on the ArcGIS server. Web services such as OGC web map services and web feature services are published through ArcGIS server. The services make the data easy to share among the clients without buying specialized or expensive GIS software. Users can use the service within a Web browser or custom application. Some free GIS software such as Gaia 3.4.0, NASA WorldWind, and CARIS Easy View, as well as commercial alternatives such as ArcMap and ArcGlobe, can be used to access the GIS services. Fig. 4 is an example of the client accessing of the WFS services from ODE.
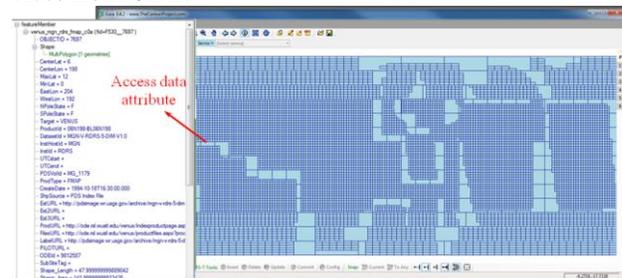


Figure 4. Access the Venus ODE WFS of Magellan FMAP footprint map with Gaia.

*Data Download.* Several options are provided for acquiring data products from ODE. Users can select and order data products using a web-based "shopping cart" approach, or directly download individual files through the ODE interface.

**Contact Information:** The Geosciences Node welcomes questions and comments from the user community. Please send email to geosci@wunder.wustl.edu. Comments on ODE and suggestions for enhancements can be sent to bennett@wustl.edu.

**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.