



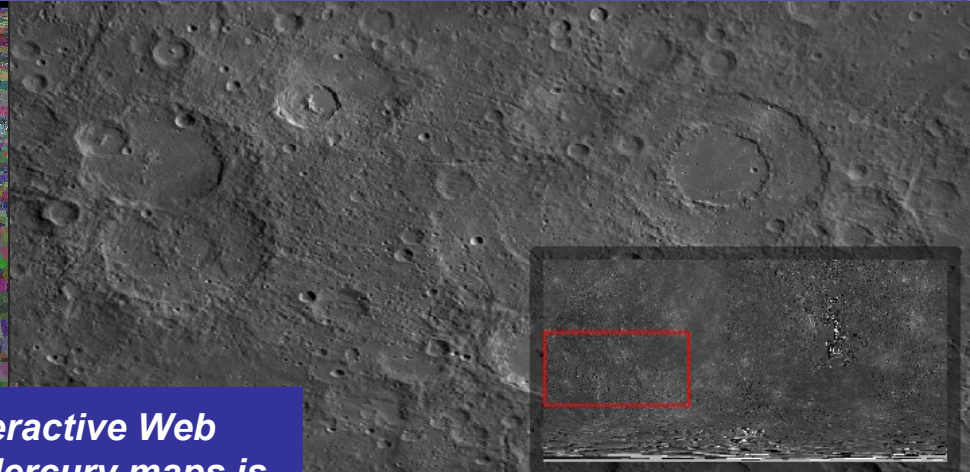
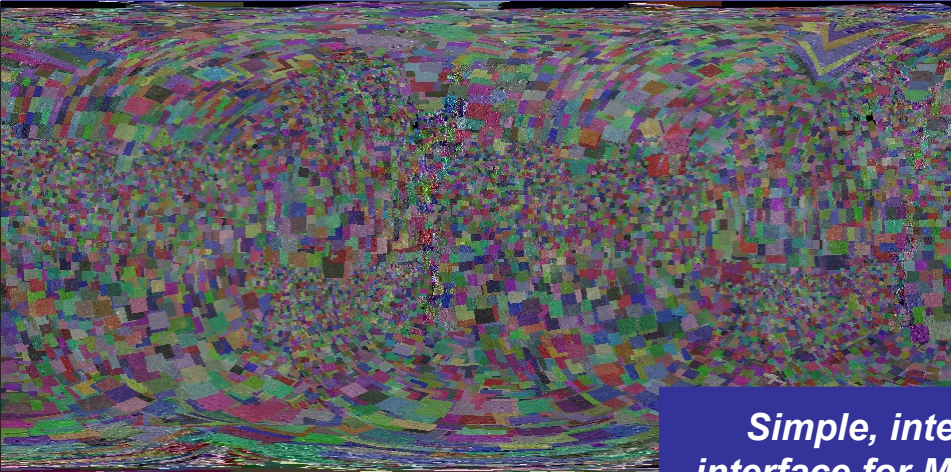
MESSENGER

Explore Mercury Orbital Data

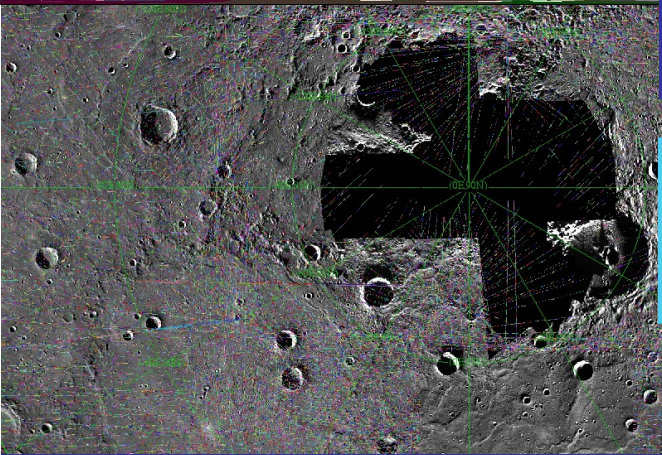


APL

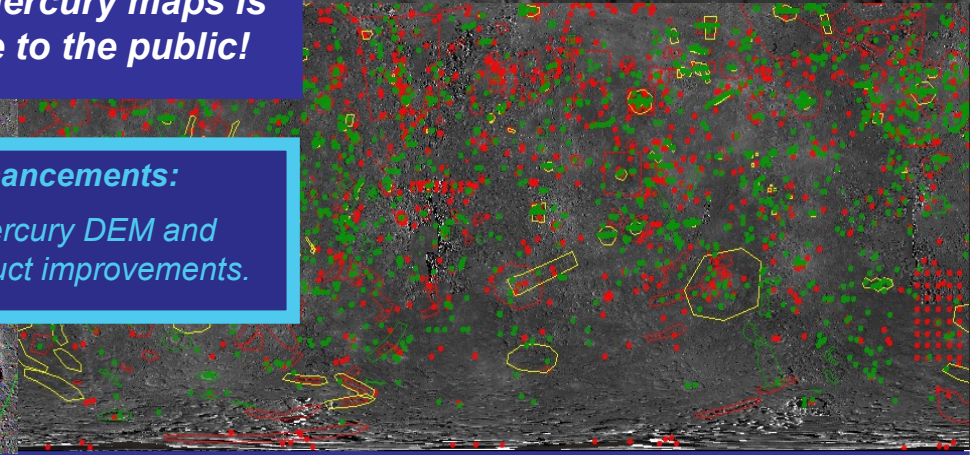
ACT-REACT Quick Map



Simple, interactive Web interface for Mercury maps is now available to the public!



*Recent enhancements:
New global Mercury DEM and many other product improvements.*



Links to Quick Map can be found at <http://messenger.jhuapl.edu/> and <http://www.nasa.gov/messenger>



MESSENGER

Explore Mercury Orbital Data



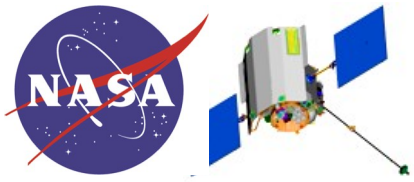
APL

ACT-REACT Quick Map allows users to:

- *Locate craters and other named Mercury features and track MESSENGER spacecraft.*
- *Explore global mosaics and mini-mosaics of targeted regions. The global mosaics currently include a subset of images acquired during MESSENGER orbital operations and will be updated when the corresponding map products delivered to the Planetary Data System (PDS) are updated. Global mosaics are available for download.*
- *Explore Mercury topography with elevation profile and 3-D interactive tools.*
- *Locate orbital images within user-defined regions of interest (ROI) and download those images from PDS. Also access spectra and observation meta-data.*

Watch for additional Quick Map capabilities and enhancements in the future.

Links to Quick Map can be found at <http://messenger.jhuapl.edu/> and http://www.nasa.gov/messenger_
All of the MESSENGER data archived at PDS to-date are available at <http://pds.nasa.gov>



MESSENGER

Quick Map Controls



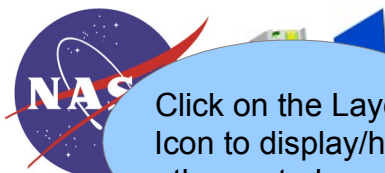
APL

Links to Quick Map can be found at <http://messenger.jhuapl.edu/> and <http://www.nasa.gov/messenger>

The screenshot shows the MESSENGER Quick Map interface with the following callout boxes:

- Zoom in/out/full extent**: Points to the zoom controls (+, o, -) and the ACT logo.
- Manage layers**: Points to the layer management icon (stack of squares).
- Use Path tool to measure distances on ground and map**: Points to the path tool icon (line with dots).
- Use Area tool to highlight regions of interest for observation searches**: Points to the area tool icon (rectangle).
- Use Probe tool to get data on specific points of interest**: Points to the probe tool icon (circle with crosshair).
- Open tools menu**: Points to the tools menu icon (wrench).
- Share Permalink capturing the current map state**: Points to the share icon (person with arrow).
- Link to overview and feedback report tool**: Points to the question mark icon.
- View in fullscreen mode (NEW!)**: Points to the fullscreen icon (two arrows).
- Show coordinates of mouse pointer and allow re-centering**: Points to the coordinate display area (Lat: -29.8515, Lon: 113.0538).
- Show Context Map**: Points to the context map icon (small map).
- Change Map scale**: Points to the scale bar (1000 km, 500 mi, 16000 m per pixel).

Startup view shows complete MESSENGER Mercury global mosaic created from images acquired during orbital operations.



MESSENGER



APL

Quick Map Layer Controls

Click on the Layers Icon to display/hide the control panel

Mercury Layers

- Location Overlays
- Instrument Footprints
- Special Products
 - Master Targets
 - Info
 - Opacity: 90%
 - Description: Regions over which high resolution targeted observations are being collected by some of the MESSENGER instruments. Present Status is shown using the following color coding: GREEN = Observed YELLOW = Partially Observed RED = Not Observed (Note: Targets are subject to change)
 - Master Targets - Mosaics (PDS Del 9)
- Elevation models
- Global Mosaic Campaigns
- Basemaps

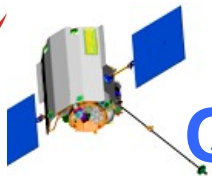
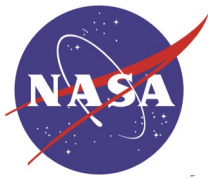
Click triangle to expand/hide Special Products layer group listing

Click triangle to display/hide Master Targets layer legend

Check box to display Master Targets layer in map panel

Drag to change Master Targets layer opacity

Example of adding a map layer: adding Master Target overlay to Mercury global mosaic. Additional special products will be added as mission progresses.



MESSENGER



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Quick Map Navigation Controls

Zoom view
In / out / full extent

Map navigation:

- Pan view by click-and-dragging mouse on map
- Pan view using keyboard arrows
- Redraw zoom box by shift-click-and-dragging mouse on map

Select resolution

Lat/Long view/control

- Hoover cursor on map to see lat/lon position here
- Enter lat/lon here to recenter view

Click here to display/hide Context Map (red box indicates zoomed region)

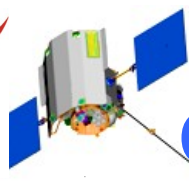
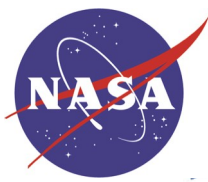
Move zoomed region by click-and-dragging the red zoom box

100 km
100 mi
2000 m per pixel

? Fullscreen

Lat: 25.1136, Lon: 65.1628

Controls for resolution, zoom, pan, lat/long sensing, and selecting and overviewing zoomed region.



MESSENGER



APL

Quick Map Projection Controls

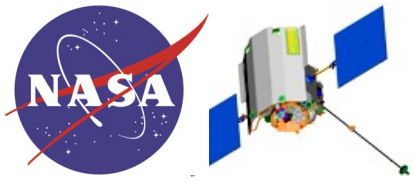
Choose map projection

The screenshot displays the ACT-REACT Quick Map interface for Mercury. On the left is a 'Mercury Layers' panel with various data layers. A 'Change Projection to:' menu is open, listing four options: North Polar Stereographic (selected), Equidistant Cylindrical, Sinusoidal, and South Polar Stereographic. The main map area shows a global mosaic of Mercury with a green grid overlaid, representing the selected North Polar Stereographic projection. A large dark crater is visible in the center of the map.

Mercury Layers

- Location Overlays
 - Mercury Charts
 - MESSENGER Tiles
 - Long/Lat Grid
 - Sunlit Region
 - Mercury features
 - MESSENGER Featured Images
 - Current Satellite Position
- Instrument Footprints
 - MDIS Color Coverage (total)
 - MDIS Mono Coverage (total)
 - MDIS Color Coverage (recent)
 - MDIS Mono Coverage (recent)
 - MASCS/VIRS Coverage
 - XRS Coverage density
 - NS Coverage density
 - GRS Coverage density
 - MLA Tracks
- Special Products
 - Terrain Elevation
- Global Mosaic Campaigns
 - MDIS Multispectral (MDR PDS Del 9)
 - MDIS Monochrome (BDR PDS Del 9)
- Basemaps

Example north pole stereographic projection of MLA tracks and lat/long grid overlaid on MDIS global mosaic.

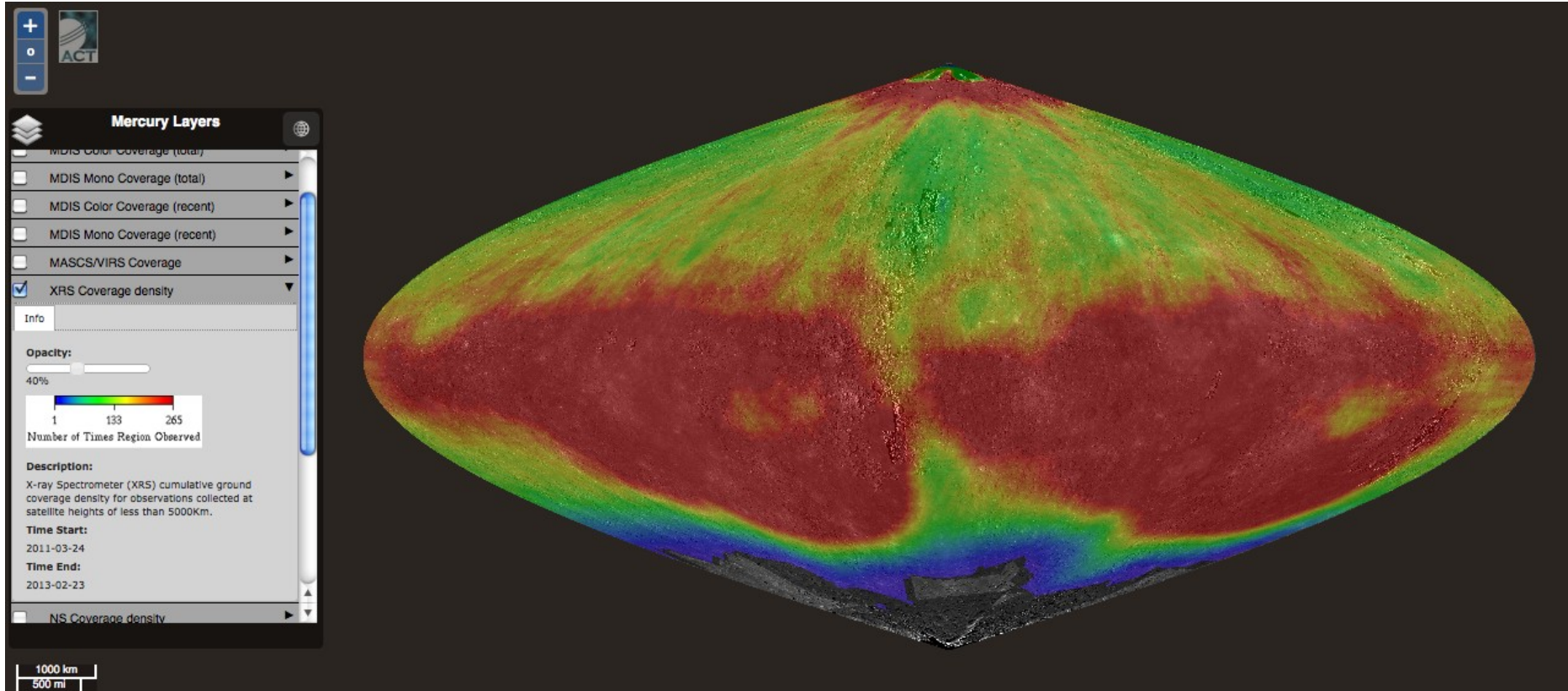


MESSENGER

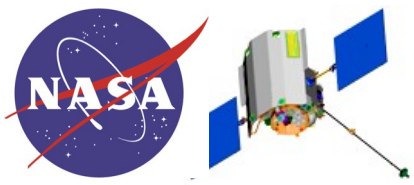
Sinusoidal Projection



APL



Example sinusoidal projection of XRS coverage density overlaid on MDIS global mosaic.



MESSENGER

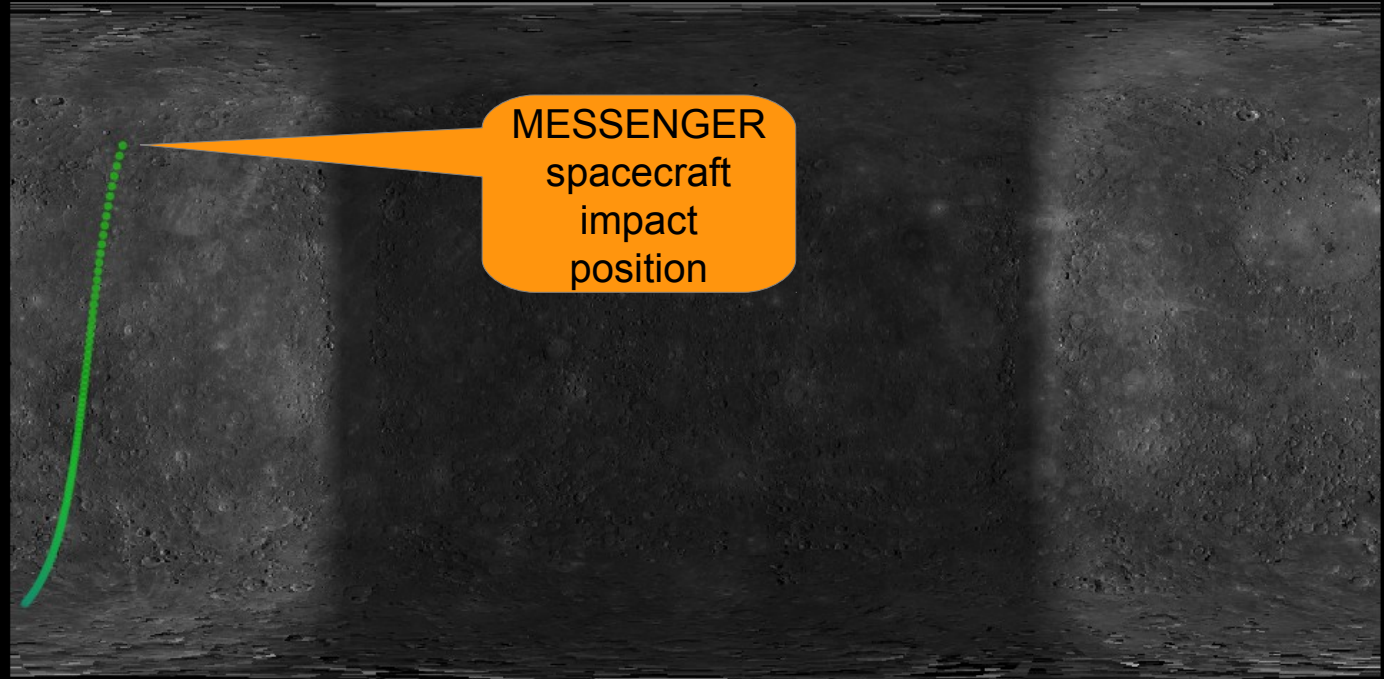
Sunlit Region and Spacecraft Tracking



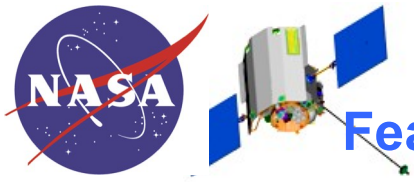
APL

QuickMap layers allow users to view the sunlit region of Mercury and display the last portion of the MESSENGER journey

- Mercury Layers**
- ▶ Instrument Footprints
 - ▼ Location Overlays
 - Mercury Charts ▶
 - MESSENGER Tiles ▶
 - Long/Lat Grid ▶
 - Sunlit Region ▶
 - Mercury features ▶
 - Final Satellite Position ▶
 - MESSENGER Featured images ▶
 - ▶ Arecibo Radio Telescope
 - ▶ XRS composition maps
 - ▶ GRS Composition Maps
 - ▶ Special Products
 - ▶ Terrain Elevation
 - ▶ MASCS/VIRS Global Mosaic
 - ▶ MDIS Regional Targeted Mosaics
 - ▼ MDIS Global Mosaic Campaigns
 - 8-Color Global Map ▶
 - 3-Color High-Resolution Northern Hemisphere Map ▶
 - 5-Color High-Resolution North Polar Map ▶
 - Low-Incidence Angle Map ▶
 - East Illumination Map ▶
 - West Illumination Map ▶
 - Moderate-Incidence Angle Map ▶
 - ▶ Historical Basemaps



MESSENGER spacecraft impact position



MESSENGER



APL

Featured Images from MESSENGER Website

Mercury Layers

- Location Overlays
 - Mercury Charts
 - MESSENGER Tiles
 - Long/Lat Grid
 - Sunlit Region
 - Mercury features
 - MESSENGER Featured Images
- Info Search
 - revisiting Find Clear
 - Search Results: Revisiting Boccaccio
- Current Satellite Position
- Instrument Footprints
- Special Products
- Terrain Elevation
- Global Mosaic Campaigns
- MDIS Multispectral (MDR PDS Del 9)
- MDIS Monochrome (BDR PDS Del 9)
- Basemaps

Search for featured images:

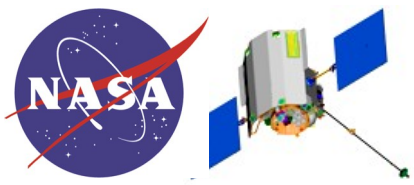
- With MESSENGER featured images layer selected, click on **Search** tab.
- Enter full or partial feature name (“revisiting” for this example search) and click on *Find*. Results are listed below where you entered search text and marked by orange rings in display. Features are highlighted in white as the cursor is hovered over their names in results list.
- Click on image of interest in *Search Results* list to navigate to a higher-resolution view.
- Double-click on the featured image ring to display the image and associated description from the MESSENGER website.

Feature Info

Revisiting Boccaccio

Date acquired: March 30, 2011
Image Mission Elapsed Time (MET): 209950645
Image ID: 67380
Instrument: Narrow Angle Camera (NAC) of the Mercury Dual Imaging System (MDIS)
Center Latitude: -82.5°

QuickMap allows users to locate and link to the featured images and associated descriptions from the MESSENGER website. With the satellite position layer also enabled, this view shows the path of the MESSENGER spacecraft past the site of the “Revisiting Boccaccio” featured image near Mercury’s south pole.



MESSENGER

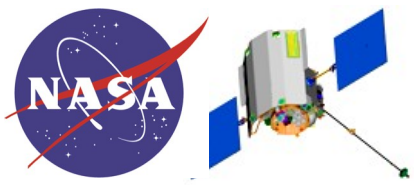
MASCS/VIRS Global Mosaics



APL

The screenshot shows the ACT-REACT Quick Map interface. On the left, a 'Mercury Layers' panel is expanded to show 'MASC/VIRS Global Mosaic' with sub-options: '750nm Mosaic (DAP PDS11)', '750nm Mosaic Interpolated (DAP PDS11)', 'Color Mosaic', and 'Color Mosaic Interpolated'. The main map area displays two global mosaics: a 'Color (Multispectral) mosaic' (top) and a 'Monochrome mosaic' (bottom). A scale bar at the bottom left indicates '1000 km', '500 mi', and '16000 m per pixel'. A 'Fullscreen' button is at the bottom right.

Global mosaic layers are now available for exploring MASCS/VIRS data.



MESSENGER

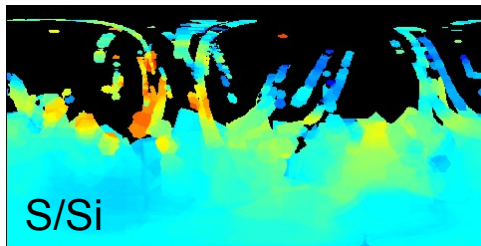
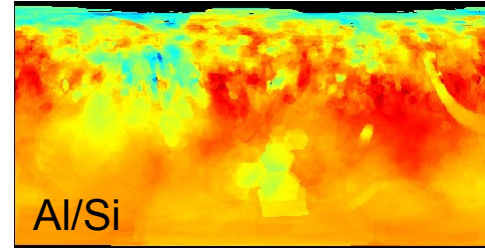
XRS Composition Maps



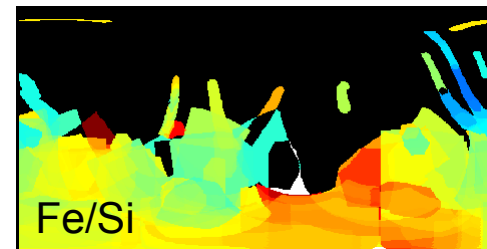
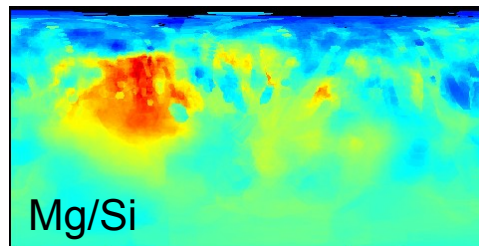
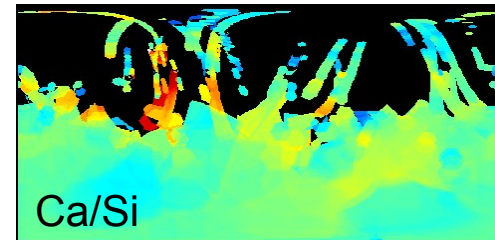
APL

Mercury Layers

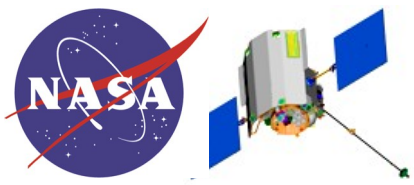
- ▶ Instrument Footprints
- ▶ Location Overlays
- ▶ Arecibo Radio Telescope
- ▼ XRS composition maps
 - Ratio of Al to Si ▶
 - Ratio of Ca to Si ▶
 - Ratio of Fe to Si ▶
 - Ratio of Mg to Si ▶
 - Ratio of S to Si ▶



NEW



Global composition maps layers (showing element weight ratios) are now available.

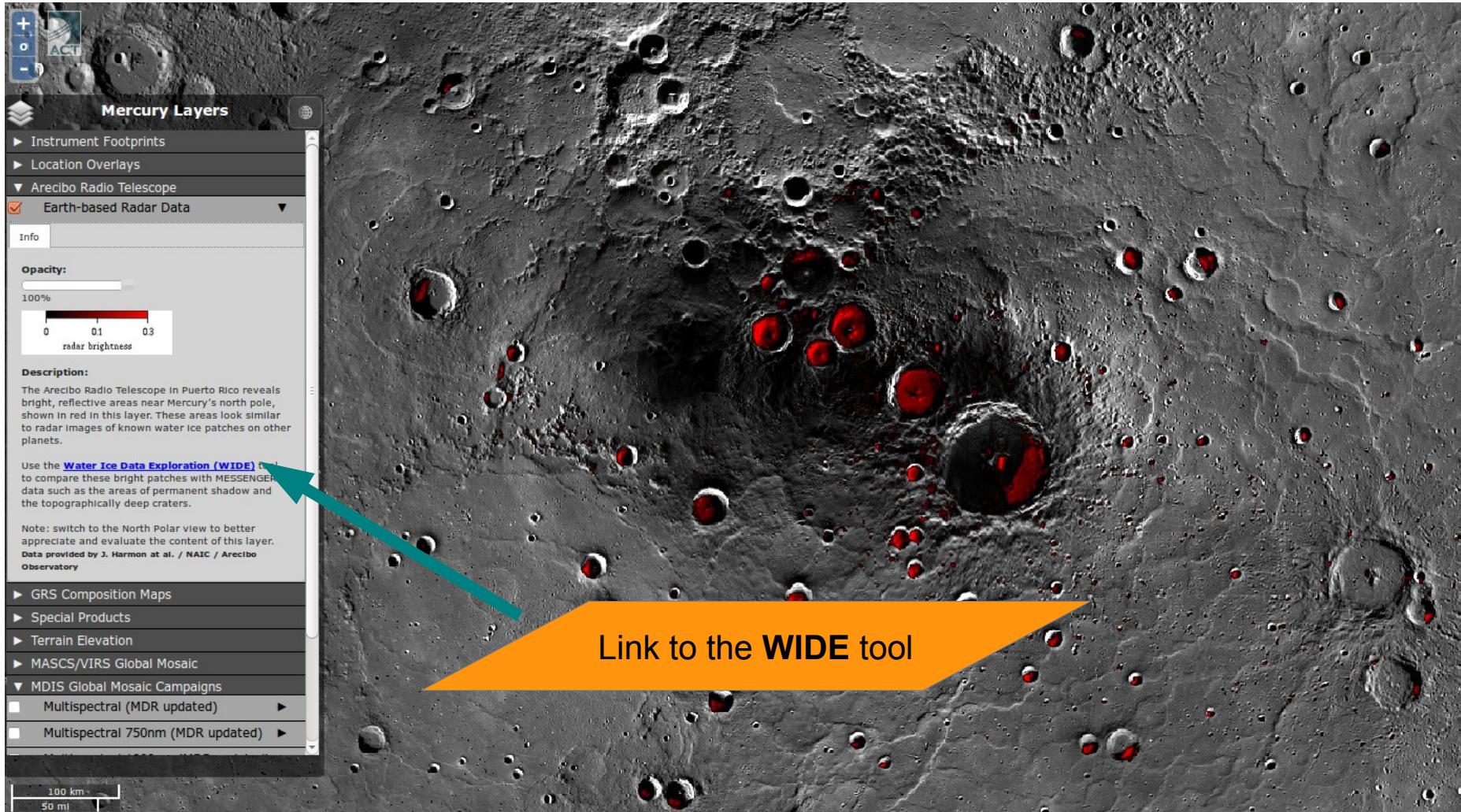


MESSENGER

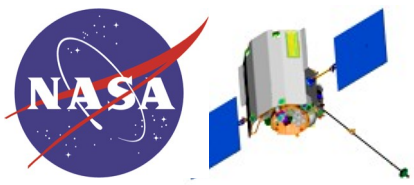
WIDE tool sample layer



APL



A sample layer from the WIDE (Water Ice Data Exploration) tool has been included. It shows radar bright patches (in red shades) that are a signature of water ice presence. (Best viewed on the north polar projection)

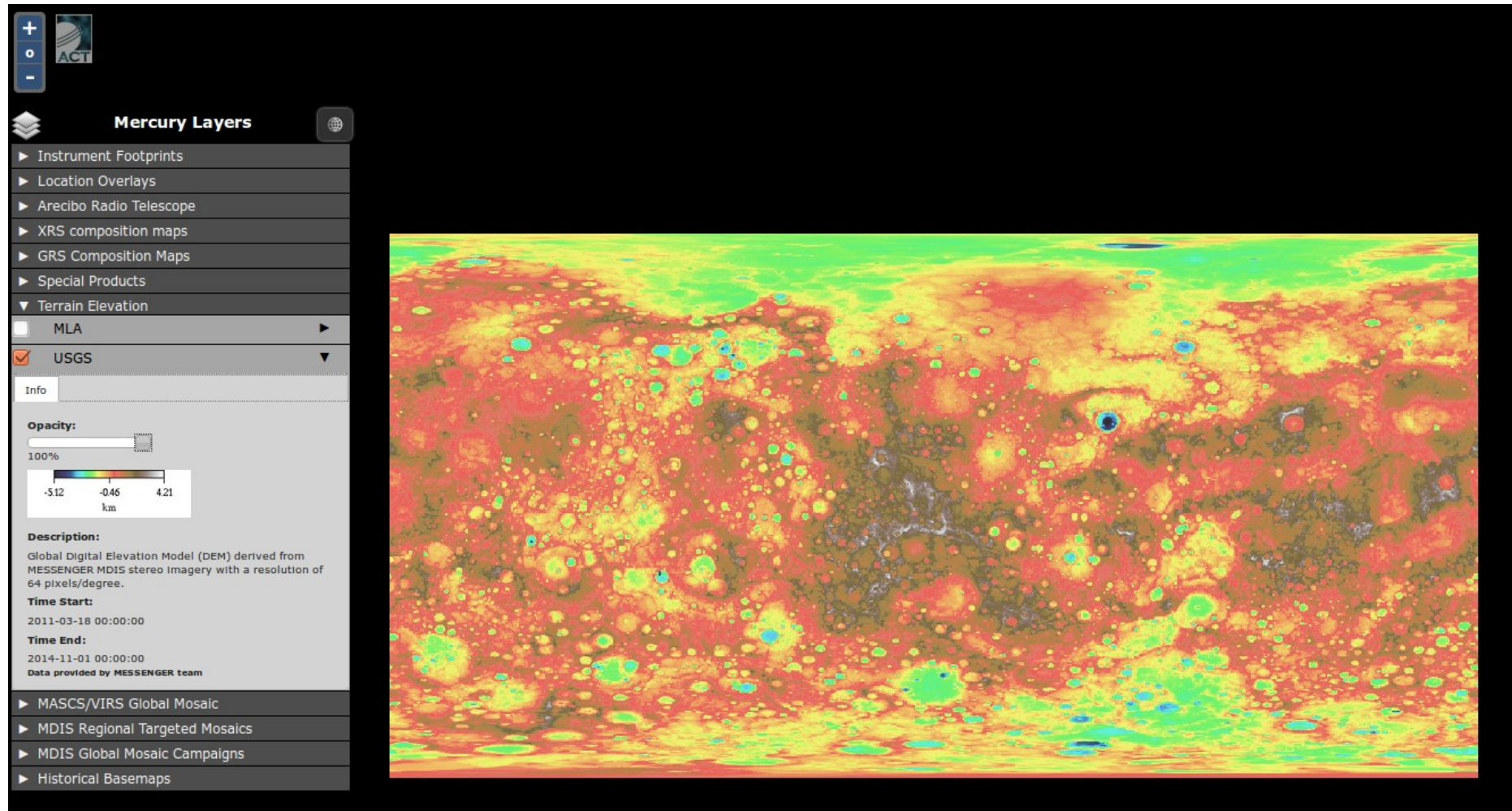


MESSENGER

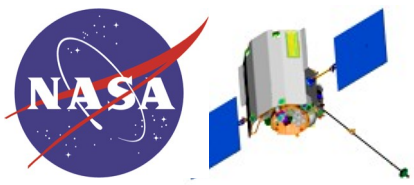
USGS Elevation Model



APL



The new USGS Digital Elevation Model is now available. It was used in generating MDIS and MASCS map products for latest release.



MESSENGER

MDIS Global Mosaics



APL

The screenshot displays the ACT-REACT Quick Map interface for Mercury. On the left is a 'Mercury Layers' panel with a list of map types. On the right are three map thumbnails: a global map, a high-resolution northern hemisphere map, and a high-resolution north polar map. Teal arrows point from the layer list to the corresponding thumbnails.

Mercury Layers

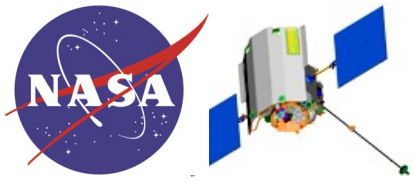
- ▶ Instrument Footprints
- ▶ Location Overlays
- ▶ Arecibo Radio Telescope
- ▶ XRS composition maps
- ▶ GRS Composition Maps
- ▶ Special Products
- ▶ Terrain Elevation
- ▶ MASCS/VIRS Global Mosaic
- ▶ MDIS Regional Targeted Mosaics
- ▼ MDIS Global Mosaic Campaigns
 - 8-Color Global Map
 - 3-Color High-Resolution Northern Hemisphere Map
 - 5-Color High-Resolution North Polar Map
 - Low-Incidence Angle Map
 - East Illumination Map
 - West Illumination Map
 - Moderate-Incidence Angle Map
- ▶ Historical Basemaps

8-Color Global Map

3 Color High Resolution Northern Hemisphere Map

5 Color High Resolution North Polar Map

MDIS global mosaics are being prepared for download from the MESSENGER website, <http://messenger.jhuapl.edu/>



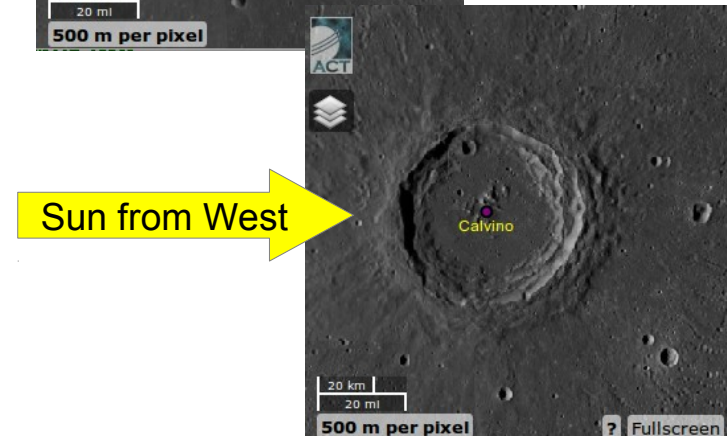
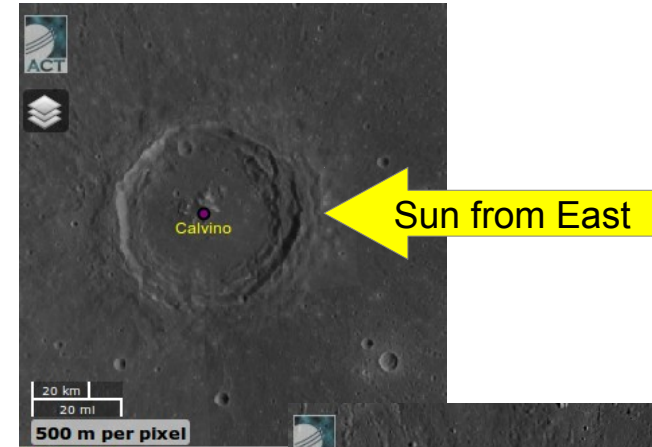
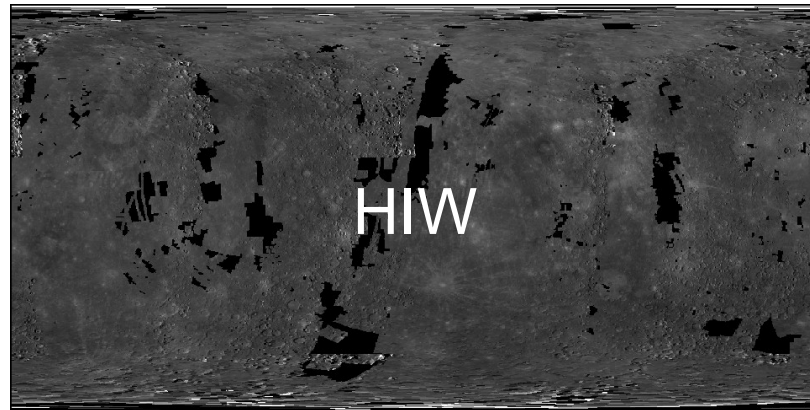
MESSENGER

MDIS Global Mosaics

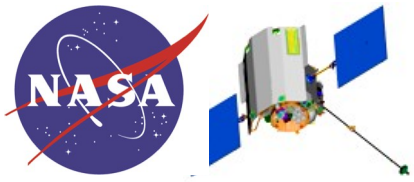


APL

Global mosaics with high incidence illumination (big shadows)



These global mosaics were assembled from images acquired at high solar incidence angles (average $>70^\circ$), illuminated from the east and from the west, to highlight topography and surface morphology.



MESSENGER

MDIS Global Mosaics

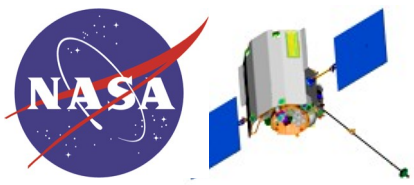


APL

NEW mosaic with low incidence illumination (no shadows)



These global mosaics were assembled from images illuminated at minimized solar incidence angle to accentuate albedo variations.



MESSENGER

Master Target Mosaics



APL

Mercury Layers

- ▶ Instrument Footprints
- ▶ Location Overlays
- ▶ Arecibo Radio Telescope
- ▶ GRS Composition Maps
- ▼ Special Products
 - Master Targets
 - Master Targets - Mosaics (PDS12)

Info

Opacity:
100%

0.005 0.128 0.250
REFLECTANCE (unitless)

Description:
Dynamic mosaics of the Target regions of interest, showing a composite view of the MDIS monochrome targeted observations collected so far. These images have a better resolution compared to the Global Campaign mosaics. In the north pole region the resolution can be as good as 10 meters. The mosaics are shown if the resolution is 1 km/pixel or better; otherwise the imaged areas are shown in white.
Note: The spatial registration of these products is expected to improve once Mercury topography is used in the creation of the map products.

Time Start:
2011-04-04 00:00:00

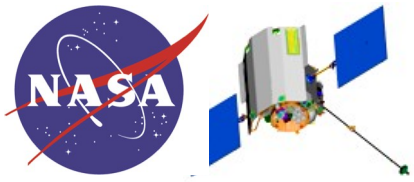
Time End:
2013-03-17 00:00:00

Data provided by MESSENGER team

- ▶ Terrain Elevation
- ▶ MASCS/VIRS Global Mosaic
- ▶ MDIS Global Mosaic Campaigns
- ▶ Basemaps

100 km
50 mi

To view mini-mosaics of images satisfying targeted observations, select Master Target and Master Target Mosaic layers and resolutions of 1000 meters per pixel or higher. Mosaics include images delivered to PDS.

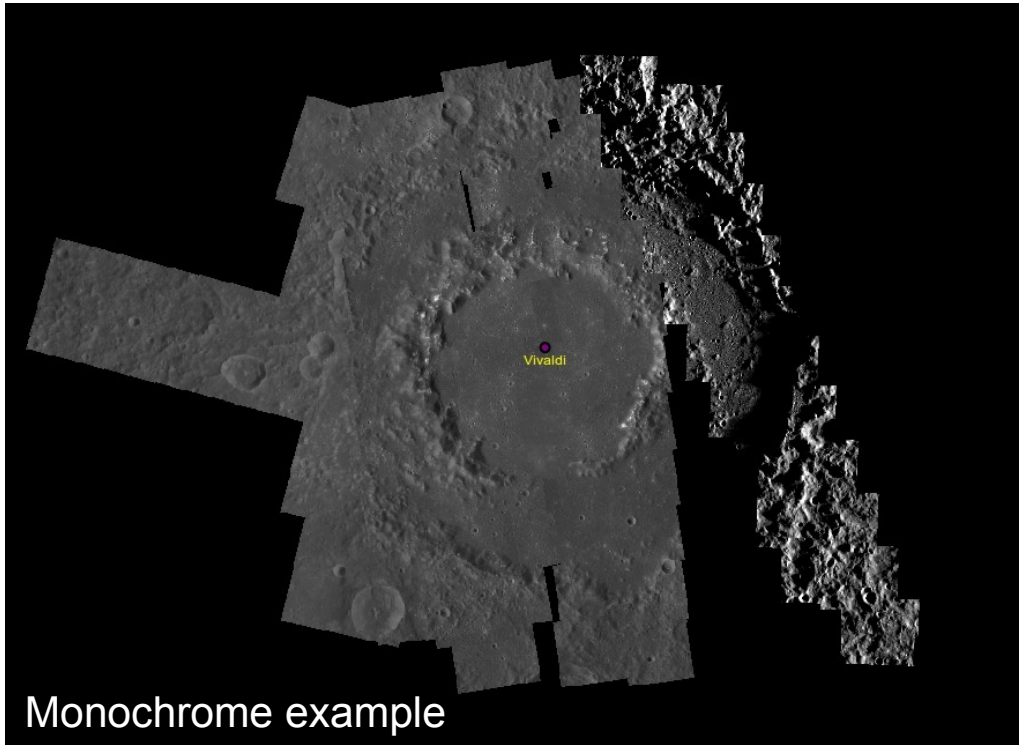


MESSENGER

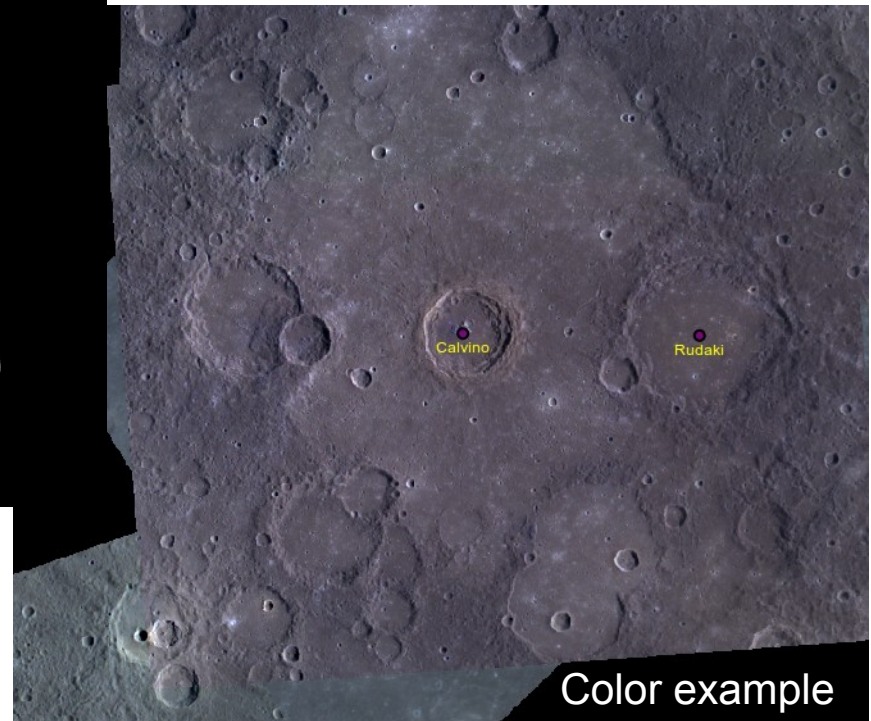
Regional Target Mosaics



APL

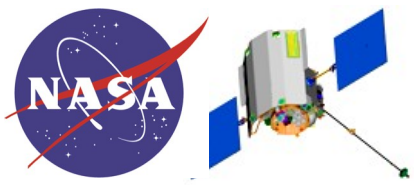


Monochrome example



Color example

Regional mosaics of enhanced observations pointed at special regions of scientific interest, like features for which higher-resolution morphological or multispectral imaging or denser spectral sampling could help in geological characterization, hypothesis testing or creating context for other MLA and MASCS observations.



MESSENGER

Probe Tool



APL

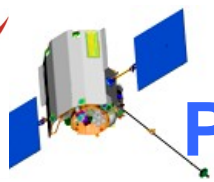
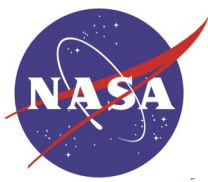
The screenshot displays the ACT-REACT Quick Map interface for Mercury. The main view shows a grayscale image of the Mercury surface with numerous impact craters and a network of colorful, dashed lines representing probe footprints. A red crosshair is positioned over a specific location labeled "Hemingway".

On the left side, there is a "Mercury Layers" panel with the following options:

- Location Overlays
- Instrument Footprints
- Special Products
- Terrain Elevation
- MDIS Global Mosaic Campaigns
 - Multispectral (MDR PDS9)
 - Multispectral 750nm (MDR PDS9)
 - Multispectral 1000nm (MDR PDS9)
 - MDIS Monochrome (BDR PDS9)
 - MDIS Complete Monochrome
- Basemaps

Three blue callout boxes provide instructions:

1. Select Probe Tool (pointing to the top right corner of the map area)
2. Click to place probe (pointing to the red crosshair on the Hemingway crater)
3. Click triangle to open probes list (pointing to a small triangle icon in the top right corner)



MESSENGER

Probe Tool: accessing spectra



APL

Links to the MASCS/VIRS QuickSpectra Retriever

Query Results

Links to MESSENGER MASCS/VIRS - QuickSpectra-Retriever

+ p1 at (-2.29378, 17.80322):
Access VIRS spectra over [1x1] [3x3] [5x5] km^2 region

Query Results

Choose averaging window: [5x5] pixels

MDIS/WAC spectra (avg on 5x5 pixels) from current MDRs

Inspect the plotted values as: CSV

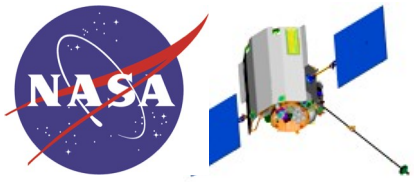
MASCS/VIRS Spectra Retriever
MDIS/WAC spectra

Request >

Probes - Lat, Lon
+ 17.80322, -2.29378

Hemingway

4. Click Request and choose an instrument from the available options

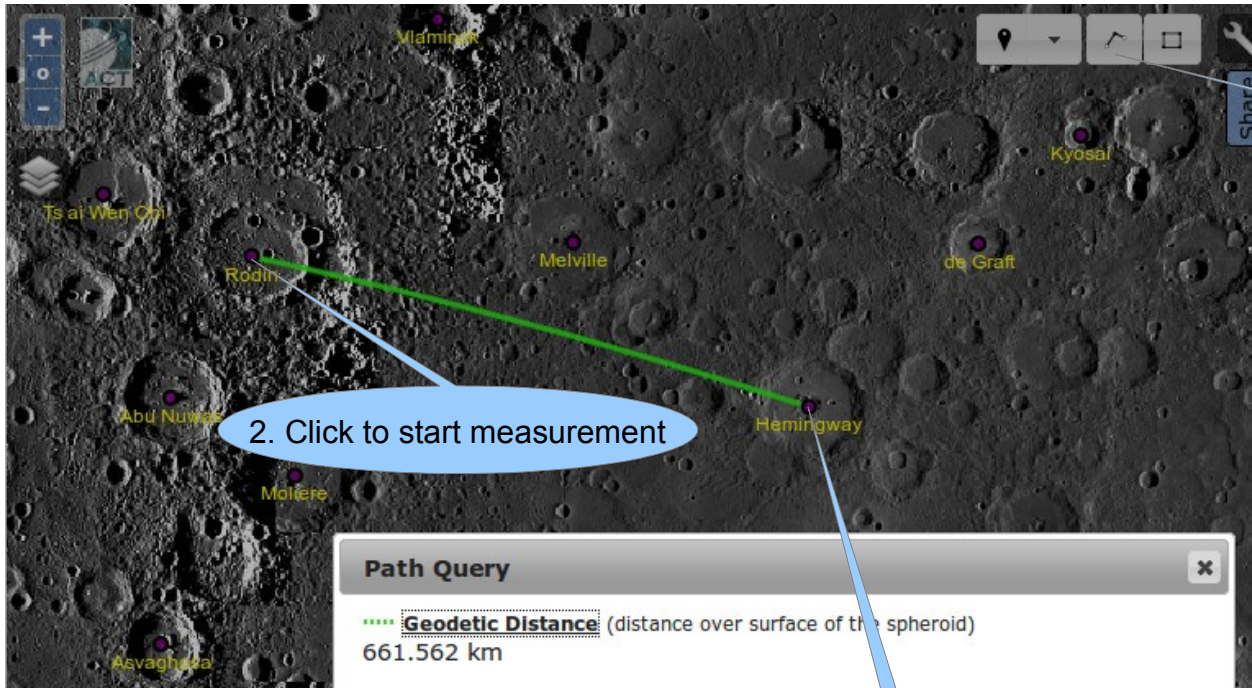


MESSENGER

Enhanced Path Tool



APL



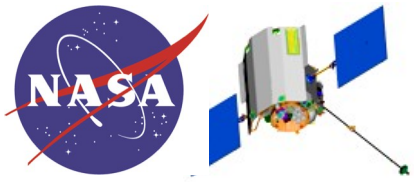
1. Select Line Path Tool

2. Click to start measurement

3. Double-click to end measurement and view results

Supports geodetic distance measuring

Example use of path button to measure geodetic distance between Rodin and Hemingway craters on Mercury. The geodetic distance (path shown in green) is measured over the surface of Mercury.

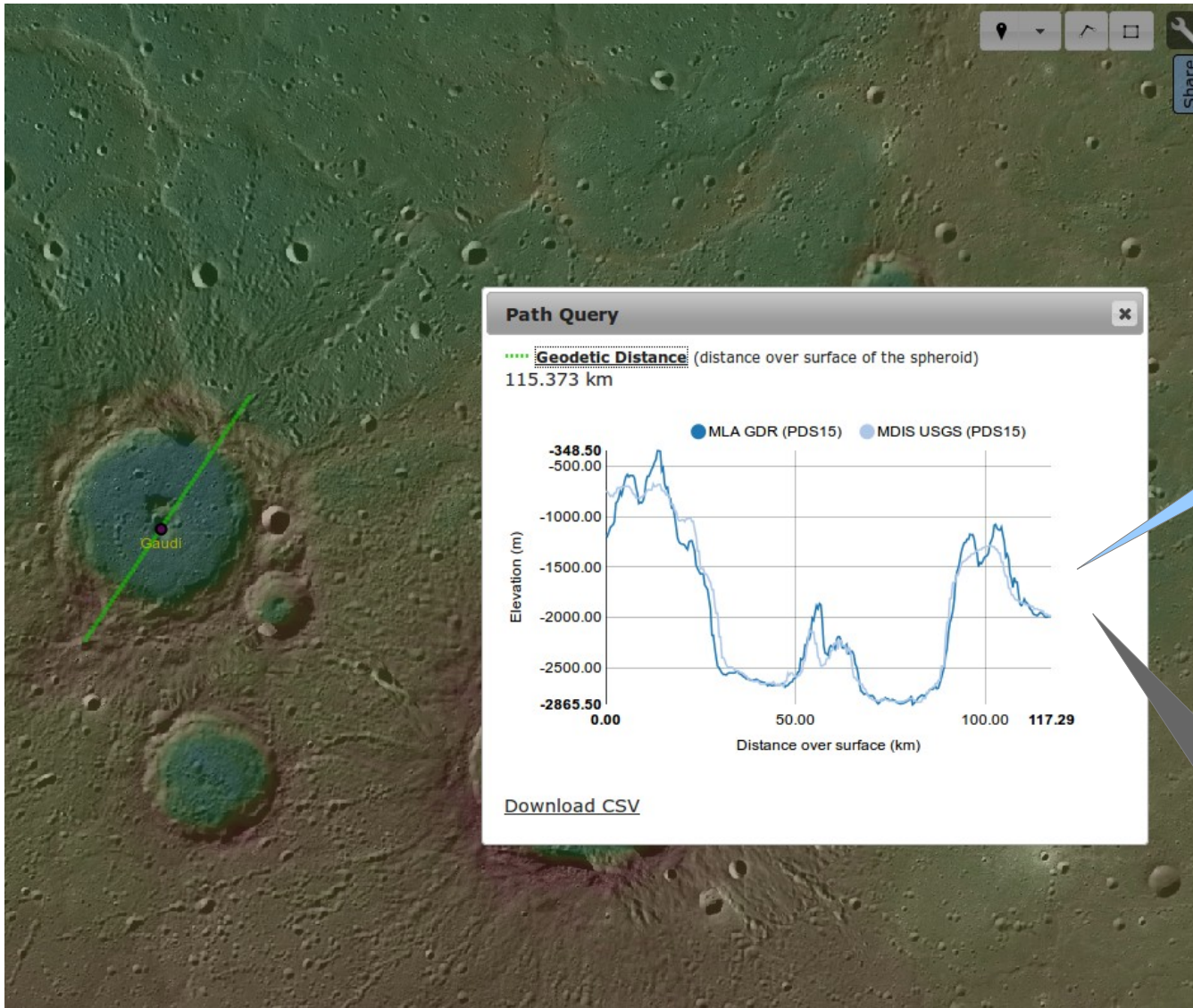


MESSENGER

Enhanced Path Tool

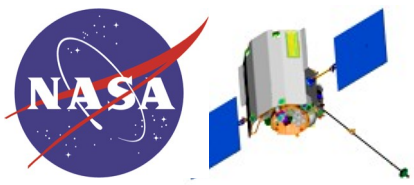


APL



The elevation profile over the selected path is plotted in addition to the measured distance

Note: Available for northern hemisphere (MLA data) **and globally using the new USGS topographic map**



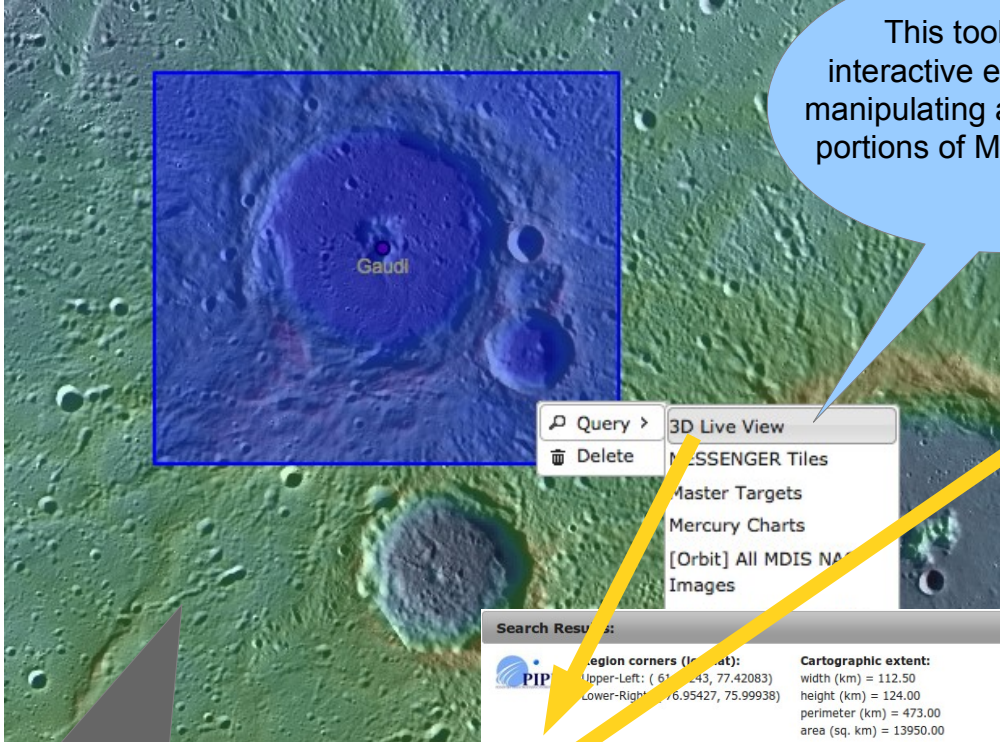
MESSENGER

3-D Live Tool



APL

INTERACTIVE 3D views



This tool enables interactive exploration by manipulating a 3-D model of portions of Mercury surface

- Query >
- Delete
- 3D Live View
- MESSENGER Tiles
- Master Targets
- Mercury Charts
- [Orbit] All MDIS NA
- Images

Search Results:

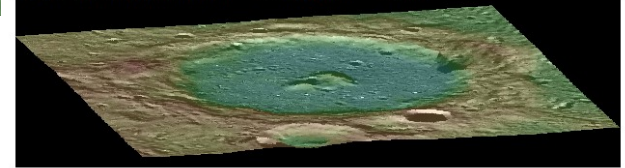
Region corners (lat/lon):
 Upper-Left: (61.243, 77.42083)
 Lower-Right: (66.95427, 75.99938)

Cartographic extent:
 width (km) = 112.50
 height (km) = 124.00
 perimeter (km) = 473.00
 area (sq. km) = 13950.00

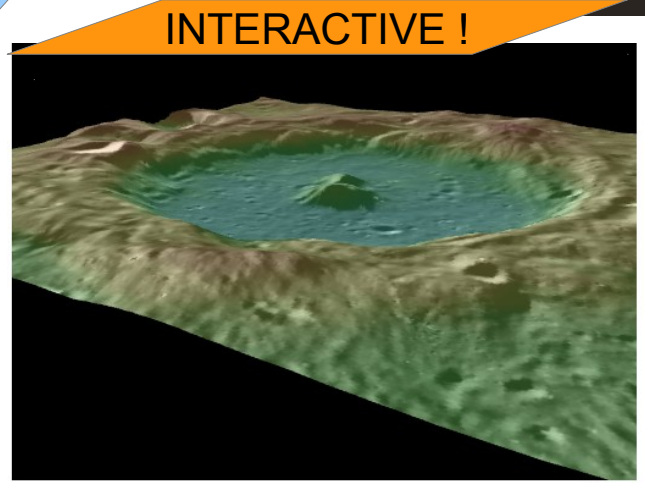
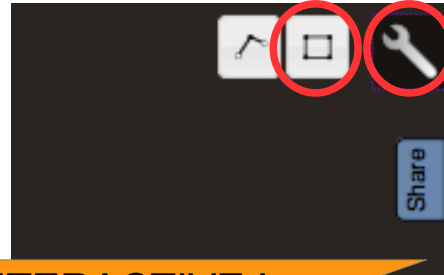
Click [here](#) to access 3D visualization/printing tool

Using the MDIS USGS (PDS15) elevation model

Scene elevation (meters): min = -2885.00, max = -203.00



Note: Available for northern hemisphere (MLA data) and globally using the new USGS topographic map



Vertical exaggeration: 3x

Projection: Perspective

Rotation: [<] [>] [Autorotate]

Tilt: [+] [-]

Scale: [+] [-]

Visualization Options

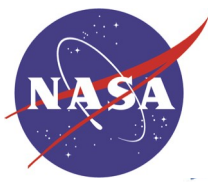
3D printer export (NEW!)

Number of pieces: 1

NOTE: each model piece will have about 261

Build 3D model (then wait about 30 seconds)

Creation of 3D models for printing



MESSENGER

Quick Map Permalink Sharing



APL

1. Click on the Share button


2. Copy and use the provided URL as a way to capture the current map view

A shortened version of the Permalink is available, as well as its QR encoded version for easier sharing on mobile devices!

Permalink

Copy raw link:
http://messenger-act.actgate.com/quickmap/msgr_

Copy short link:
<http://bit.ly/12qggfC>



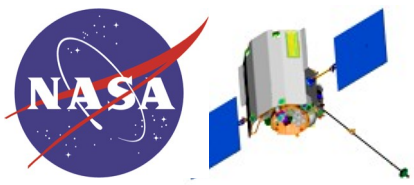
Note: Permalink preserves current layer configuration and map view. Does not preserve user drawn objects (probes, lines, boxes) or query results

10 km
10 mi
250 m per pixel

Fullscreen

Lat: 12.9000, Lon: -84.0232

Using Quick Map permalink to save view region.



MESSENGER

Mercury Features Layer



APL

Mercury Layers

- Sunlit Region
- Mercury features

Info Search

Description:
Displays the location and name of topographic and albedo features approved by the International Astronomical Union.

- Albedo Feature
- Crater, craters
- Dorsum, dorsa
- Fossa, fossae
- Mons, montes
- Planitia, planitiae
- Rupe, rupes
- Vallis, valles

Data provided by USGS Gazetteer of Planetary Nomenclature

- MESSENGER Featured Images
- Current Satellite Position
- Instrument Footprints

1000 km
500 mi
16000 m per pixel

? Fullscreen

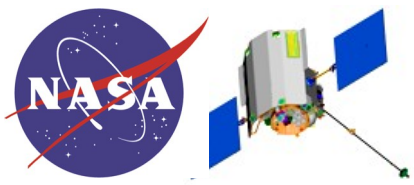
Check Mercury features layer box to view feature locations, names, and meta-data

Click triangle and select info tab for key to color coding of features by type

Increase resolution to view feature names and smaller features

The feature name database updates automatically when new feature names are approved by the IAU !

Example view of larger features among over 400 International Astronomical Union (IAU) approved named Mercury features. Smaller features are displayed in higher resolution views. Feature names are displayed at 2000 m/pixel and higher resolutions. See next slides for feature searches and higher resolution example.



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Mercury Feature Searches

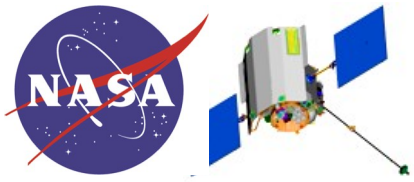


APL

Search for named Mercury features:

- With Mercury features layer selected, click on **Search** tab.
- Enter full or partial feature name (“mo” for *this example search*) and click on **Find**. *Results are listed below where you entered search text and marked by orange rings in display. Features are highlighted in white as the cursor is hovered over their names in results list.*
- Click on feature of interest in **Search Results** list to navigate to a higher-resolution view of that feature.

Example Mercury feature search yields features with names containing search text “mo” – shown in results list on left and with orange rings on map display. Hovering the cursor over a feature in the results list highlights that feature in white on map display – in this example the *Mozart* feature is highlighted. Clicking on *Mozart* in the Search Results list navigates to higher resolution view of that crater – see next slide.



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Navigating Mercury Features



APL

Mercury Layers

- Location Overlays
 - Mercury Charts
 - MESSENGER Tiles
 - Long/Lat Grid
 - Sunlit Region
 - Mercury features

Info Search

mo Find Clear

Search Results:

- Caloris Montes
- Campos
- Monteverdi
- Lermontov
- Mafofo
- Mollere
- Monet
- Mozart
- Simonides
- Moody

Feature Info

Feature_Name: Mozart
Clean_Feature_Name: Mozart
Approval_Date: 1976-01-01 00:00:00
Origin: W. A.; Austrian composer (1756-1791).
Diameter: 241.0400000000
Center_Longitude: 169.5883527005
Center_Latitude: 7.7902140214
Type: Crater, craters
Feature_Type_Code: AA
Approval_Status: Adopted by IAU
Western_Longitude: 166.7343807220
Eastern_Longitude: 172.4451732636
Southern_Latitude: 4.9599914551
Northern_Latitude: 10.6204280853
Ethnicity: Austria
Continent: Europe
Quad_Name: Tolstoj
Quad: H-08
Link: <http://planetarynames.wr.usgs.gov/Feature/4058>

20 km
20 m
500 m per pixel

Fullscreen

High-resolution view of Mercury Mozart crater navigated to via Quick Map Mercury feature search (as described on previous slide). Clicking on feature provides IAU information shown.



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Region of Interest (ROI) Searches

Search Results:

PIPE

Region of interest (ROI):

Lower-Left corner (lon, lat) = (-128.44707, 35.92765)
Upper-Right corner (lon, lat) = (-125.96973, 37.85317)

Projected extent (in cartographic coordinates):

width (km) = 105.50
height (km) = 82.00
perimeter (km) = 375.00
area (sq. km) = 8651.00

[Orbit] PDS-released 750nm images within ROI (22 records):

filename	date
CN0211981004M_IF_3.IMC	2011_112
CW0227260700G_IF_3.IMC	2011_289
CW0212111491G_IF_3.IMC	2011_114
CW0217141631G_IF_3.IMC	2011_172
CW0212024579G_IF_3.IMC	2011_113
CW0217184117G_IF_3.IMC	2011_172
CW0211981114G_IF_3.IMC	2011_112
CW0214460077G_IF_3.IMC	2011_141
CW0217141417G_IF_3.IMC	2011_172
CW0232288003G_IF_3.IMC	2011_347
CW0232330425G_IF_3.IMC	2011_348
CW0211980953G_IF_3.IMC	2011_112
CW0217056704G_IF_3.IMC	2011_171
CW0217099181G_IF_3.IMC	2011_171
CW0217056621G_IF_3.IMC	2011_171
CW0217141667G_IF_3.IMC	2011_172
CW0217184154G_IF_3.IMC	2011_172
CW0211981156G_IF_3.IMC	2011_112
CW0217056551G_IF_3.IMC	2011_171

2. Search for images in ROI

- Draw ROI box by click-and-dragging mouse on map.
- Click on the created box and then click on one of the Query menu items
- Search Results window will appear, listing requested results in ROI. *Search can be iterated on same ROI for 750-nm mosaic images, all NAC images, and all WAC images.*
- Links in search results: rightmost links enable image file download from PDS. Leftmost links indicate PDS image filenames which when clicked provide additional image meta-data.

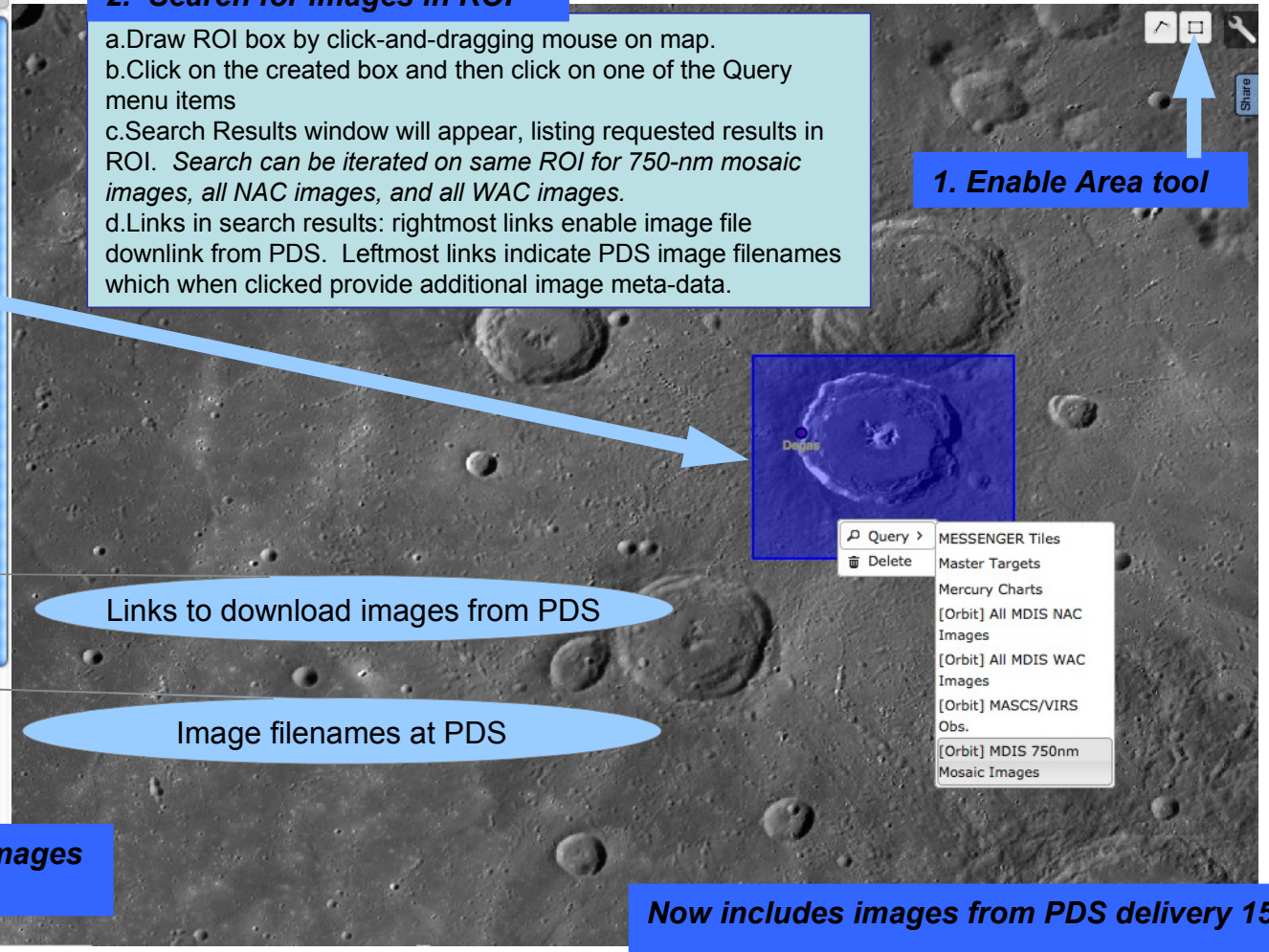
1. Enable Area tool

Links to download images from PDS

Image filenames at PDS

3. Download Images from PDS

Now includes images from PDS delivery 15



Example search for images in user-defined region of interest (ROI). Links are provided to downlink images from PDS. Users can also search for targets and MASC/S/VIRS observations in an ROI.



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Quick Map Browsers



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ACT-REACT Quick Map can be used with all the major browsers

As of May 6, 2016 it has been tested on the latest version of each of the following browsers/devices:

Firefox

Safari

Google Chrome

Internet Explorer

Mobile Browsers: iOS and Android web browsers

Browser settings: Javascript enabled