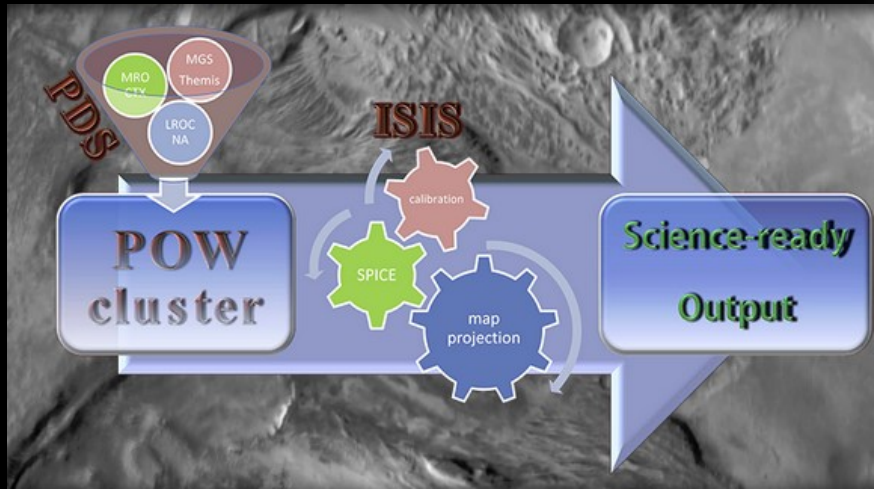


# Map Projection on the Web (POW) “ISIS3 in the cloud”



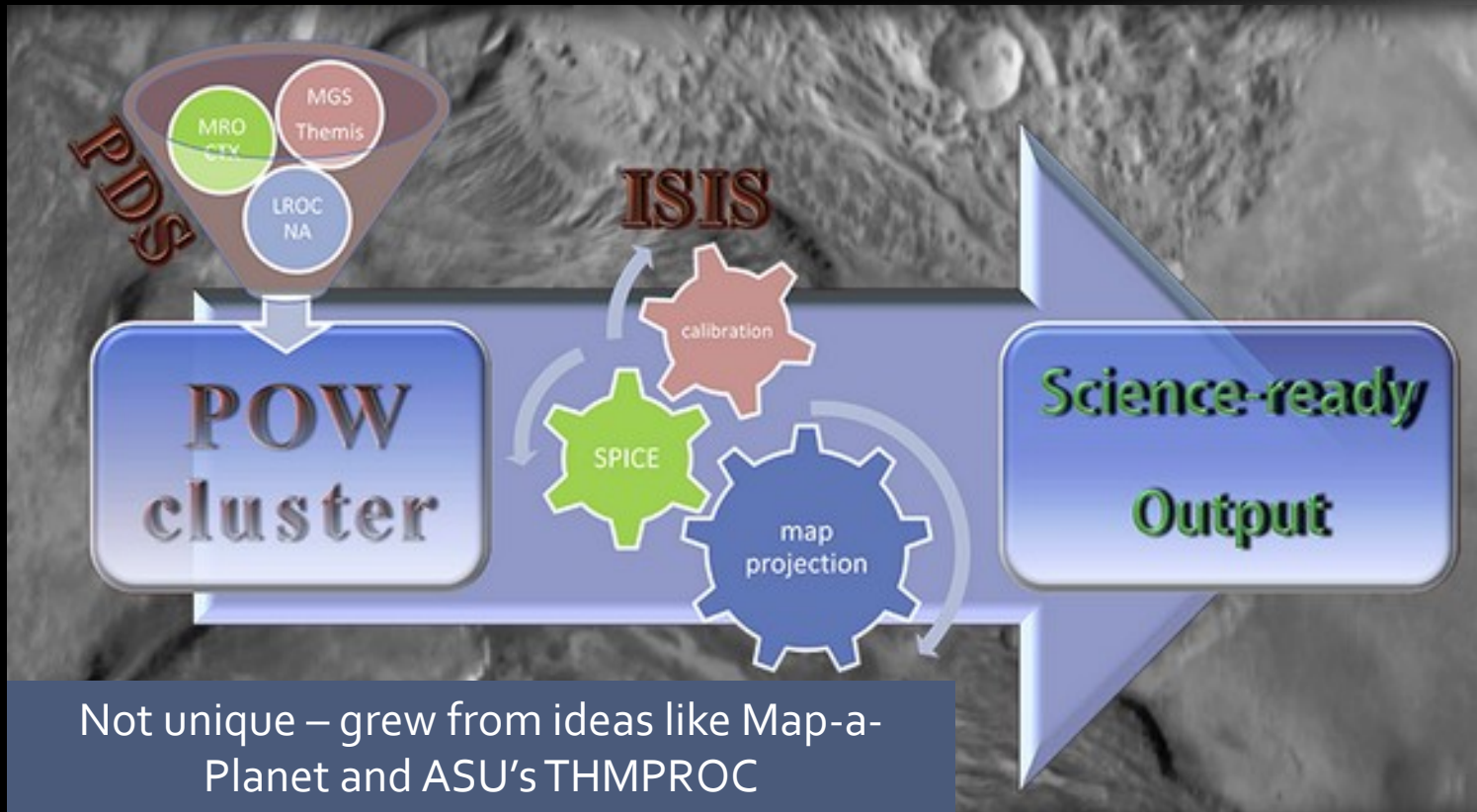
*USGS Astrogeology*

*Trent Hare (thare@usgs.gov), Update in 2022 from 2013 – LPSC 44*

*(Team: PDS Imaging Node)*

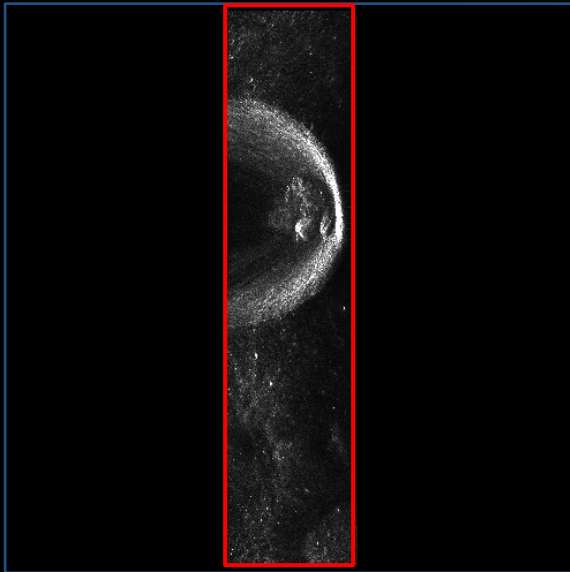
# POW Overview

POW will provide users with calibrated cartographic images that can be used for geologic mapping, analysis in a GIS, change detection, merging of dissimilar instrument images, and use in a host of other scientific applications (e.g., ArcMAP, QGIS, ENVI, Matlab, JMARS, etc.).



# Why Do We Need POW?

- Analysis of surficial features should be on calibrated and geometrically corrected data.
- Many users do not have the time to learn how to use ISIS
- These same users do have a use for **map projected** PDS images in file formats that work in their preferred research tools or for figures in abstracts and papers.



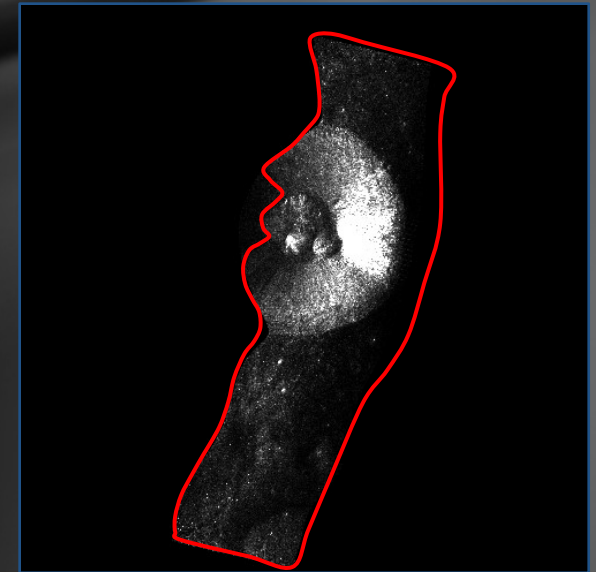
LRO MiniRF Level 1

March 18, 2013

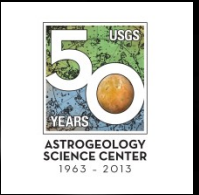
LPSC 44th



Projected onto sphere



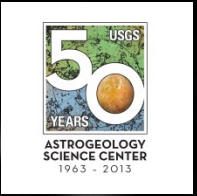
Projected onto DEM



# Supported Instruments (current)

- Odyssey THEMIS IR
- Mariner 10 VID A
- Mariner 10 VID B
- Mars Express HRSC
- Mars Global Surveyor MOC-NA
- Mars Global Surveyor MOC-WA
- Mars Reconnaissance Orbiter CTX
- Viking VIS 1A
- Viking VIS 1B
- Viking VIS 2A
- Viking VIS 2B
- Voyager NAC 1
- Voyager WAC 1
- Voyager NAC 2
- Voyager WAC 2
- Clementine HIRES
- Clementine NIR
- Clementine UV/VIS
- Messenger MDIS-NAC
- Messenger MDIS-WAC
- Cassini ISSNA
- Cassini ISSWA
- Galileo Orbiter SSI

Support currently depends on ISIS<sub>3</sub>



# Integrated Tools

**ISIS<sub>3</sub>** - Integrated Software for Imagers and Spectrometers (version 3) is an image processing software package. Manipulates imagery (using **SPICE** and created camera models) for planetary missions.



**PILOT and UPC** – The Planetary Image LOcator Tool is a web based search tool for the Unified Planetary Coordinate (UPC) database of the Planetary Data System. PILOT features **SPICE**-corrected image locations and searching capabilities using a navigable map, user selectable image constraints (e.g., incidence angle, solar longitude, pixel resolution and phase angle), and facilitates bulk downloads and/or image processing using POW.



**GDAL** – Geospatial Data Abstraction Library is used for conversion from ISIS (version 3) format to GeoTiff, GeoJpeg2000, Jpeg, and PNG. Conversion to PDS (compatible) format is handled by ISIS.





# How to Select Images to Process

Users will be able to select a set of up to 50 image files (at one run) to be map projected either through:

- Searches from PILOT (<http://pilot.wr.usgs.gov>)
- Eventually browsing the PDS Imaging Node holdings at the USGS (<http://pdsimage2.wr.usgs.gov>)

# PILOT



The Planetary Image Locator Tool (PILOT) is a web-based interface that provides a robust search interface for several Planetary Data System (PDS) image catalogs available from the Unified Planetary Coordinates (UPC) database.

The PILOT interface complements other PDS data search tools and many mission supported tools

e.g.

- PDS Imaging Node's Planetary Image Atlas,
  - <http://pds-imaging.jpl.nasa.gov/search>
- PDS Geosciences Node's Orbital Data Explorer,
  - <http://ode.rsl.wustl.edu/>

# PILOT - Walkthrough

## 1. Select Supported Body



The screenshot shows the PILOT (Planetary Image Locator Tool) web application. The browser address bar shows [pilot.wr.usgs.gov](http://pilot.wr.usgs.gov). The page features the USGS logo and the PILOT title in large orange letters. A navigation menu includes 'downloads', 'contact', 'support', and 'help'. The main content area is divided into two columns. The left column, titled 'Welcome to PILOT (Planetary Image Locator Tool)', lists search targets with their image counts. The right column, titled 'News', contains several news items with dates and 'Read more' links.

**Welcome to PILOT (Planetary Image Locator Tool)**

Select a search target. . .

<b>Mercury</b> (139,227 images)	<b>Saturn</b> (332,929 images)
<b>Venus</b> (7,135 images)	Atlas (1,067 images)
<b>Earth</b> (17,161 images)	Calypto (791 images)
Moon (1,803,498 images)	Daphnis (386 images)
<b>Mars</b> (1,255,741 images)	Dione (8,851 images)
Deimos (244 images)	Enceladus (16,066 images)
Phobos (444 images)	Epimetheus (1,530 images)
<b>Jupiter</b> (85,490 images)	Helene (1,807 images)
Adrastea (23 images)	Hyperion (4,767 images)
Amalthea (227 images)	Iapetus (8,836 images)
Callisto (1,933 images)	Janus (2,323 images)
Europa (2,192 images)	Methone (561 images)
Ganymede (2,247 images)	Mimas (5,628 images)
Himalia (393 images)	Pallene (721 images)
Io (3,063 images)	Pan (1,143 images)
Metis (27 images)	Pandora (1,247 images)
Thebe (46 images)	Phoebe (2,271 images)
<b>Uranus</b> (5,021 images)	Polydeuces (403 images)
Ariel (101 images)	Prometheus (3,492 images)
Miranda (90 images)	Rhea (14,039 images)
Oberon (74 images)	Teleso (801 images)
Titania (102 images)	Tethys (8,672 images)
Umbriel (100 images)	Titan (87,401 images)
<b>Neptune</b> (5,588 images)	Ymir (66 images)
Nereid (188 images)	
Triton (613 images)	

**Untargeted Images**

**News**

- PILOT / UPC Data Release: Messenger - MDIS-WAC**  
Mar 8, 2013  
... Read more
- PILOT / UPC Data Release: Messenger - MDIS-NAC**  
Mar 8, 2013  
... Read more
- PILOT / UPC Data Release: Mars Reconnaissance Orbiter - CTX**  
Mar 6, 2013  
The NASA/USGS PDS Imaging Node has added the following data to the Unified Planetary Coordinate (UPC) Database. MISSION / INSTRUMENT: Mars Reconnaissance Orbiter / CTX Mapped: 1,823 Unmapped: 1 Total: 1,824 Please visit PILOT to access/download the ne... Read more
- Pilot / UPC Data Release Mars Odyssey - THEMIS**  
Jan 3, 2013  
The PDS Imaging node has added the following data to the Unified Planetary Coordinate(UPC) Database and is now available through PILOT. Mars Odyssey - THEMIS: Release 42, 781... Read more
- Pilot / UPC Data Release Cassini - ISS**  
Jan 3, 2013  
The PDS Imaging node has added the following data to the Unified Planetary Coordinate(UPC) Database and is now available through PILOT. Cassini - ISS: Volumes coiss\_2072 and coiss\_2073, Narrow Angle: 4233... Read more
- Just Released: BETA version of PILOT 3**  
Nov 6, 2012  
Try out the new BETA version of PILOT 3. This version is still going through testing and bugs fixes, but here are a few intended improvements: We are adding one new instrument to the UPC database, Cassini VIMS. We are also greatly improving what's availab... Read more

downloads | contact | support | help  
PILOT was developed by the USGS Astrogeology Science Center / NASA PDS Imaging Node

Background Credit: NASA



# PILOT - Walkthrough

## 2. Select Instrument -- (CTX)



The screenshot shows the PILOT web application interface. The browser address bar displays `pilot.wr.usgs.gov`. The page features the USGS logo and the PILOT logo. The main content area is titled "Mars" and includes a "Missions" tab. A list of image sets is displayed, with the "Mars Reconnaissance Orbiter (2006 - 2012)" section highlighted. Within this section, the "CTX" instrument is selected, and its count of "50,631 mapped" images is circled in red. The "Total" panel on the right shows a search bar and a "Select" button. The "SEARCH TIPS" section on the right provides instructions for using the application.

Mission	Instrument	Mapped	Unmapped
Mars Express (2004 - 2011)	HRSC	27,502	134
	Mars Global Surveyor (1997 - 2006)	MOC-NA	96,328
	MOC-WA	141,050	5,424
Mars Reconnaissance Orbiter (2006 - 2012)	CTX	50,631	30
	HIRISE	701,823	3
Messenger (2010)	MDIS-NAC		3
	MDIS-WAC		5
Odyssey (2002 - 2012)	THEMIS IR	173,166	10,986
	Viking (1976 - 1980)	VIS 1A	16,396
	VIS 2B	7,422	148
	VIS 1B	16,260	332
	VIS 2A	7,341	165

**SEARCH TIPS**

1. Enable the search button by selecting one or more images sets on the **Missions** tab.
2. *Mapped* images have lat/lon coordinates and photometric keywords
3. *Unmapped* images have incomplete data. The images had errors during processing because of improper labels or spacecraft information. Lat/Lon and photometric keywords are unavailable. NOTE: although the sets cannot be mapped, they still may contain quality imagery.
4. Use **Map** tab to limit your search by creating a bounding box (optional). After you complete a search, the map tab will also allow you to view footprints for mapped imagery.
5. Use **Advanced** tab to limit your search by setting ranges for dates and photometric keywords (optional).
6. When you are ready to search, click the search button . If you refine your search, you must re-click the search button.
7. The **Total** will show up above. **Results** will show up in this panel. If your result set is greater than 50,000 images, you will only receive a total.
8. Click on action buttons to investigate images. Use checkboxes  to select images.
9. To download selected images, click the arrow in the **Select** box (upper right).

# PILOT - Walkthrough

## 3. Use wrench (advanced tab) to constrain images



The screenshot shows the PILOT web interface with the 'Advanced' tab selected. The 'Solar Longitude' filter is highlighted with a red circle and the text 'parameter histograms'. An orange 'CTX Histogram' overlay is visible, showing a bar chart for 'Solar Longitude' with a tooltip indicating '306 - 324 degrees' and '1,593 mapped images'. The interface includes various search filters, a search button, and a results panel on the right.

**parameter histograms**

**CTX Histogram**

Solar Longitude

306 - 324 degrees  
1,593 mapped images

**SEARCH TIPS**

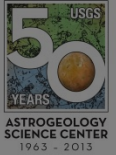
1. Enable the search button by selecting one or more images sets on the **Missions** tab.
2. *Mapped* images have lat/lon coordinates and photometric keywords
3. *Complete* data. The images had errors or improper labels or spacecraft photometric keywords are unavailable. If not mapped, they still may contain
4. Search by creating a bounding box. In a search, the map tab will also allow mapped imagery.
5. Refine your search by setting ranges for dates and photometric keywords (optional).
6. When you are ready to search, click the search button . If you refine your search, you must re-click the search button.
7. The **Total** will show up above. **Results** will show up in this panel. If your result set is greater than 50,000 images, you will only receive a total.
8. Click on action buttons to investigate images. Use checkboxes  to select images.
9. To download selected images, click the arrow in the **Select** box (upper right).

downloads | contact | support | help  
pilot.wr.usgs.gov

5 Imaging Node

# PILOT - Walkthrough

## 4. Use map polygon to constrain images



The screenshot shows the PILOT web application interface. The browser address bar displays `pilot.wr.usgs.gov`. The page features the USGS logo with the tagline "science for a changing world" and the PILOT logo. Navigation tabs include Home, Mars, Missions, Map, and Advanced. A search button, represented by a magnifying glass icon, is circled in red. The main map area shows a grayscale image of Mars with a red rectangular bounding box overlaid. A "SEARCH" button is positioned over the map. Below the map, there are input fields for "Lat Lon: -11.71, 135.77" and a "Set bounding box below..." section with fields for Min Lon, Max Lon, Min Lat, and Max Lat. A "Feature Finder" section includes a "Select Type" dropdown. On the right side, a "Total" field is visible, and a "SEARCH TIPS" section contains a list of instructions. At the bottom, there are links for "downloads | contact | support | help" and a footer note: "PILOT was developed by the USGS Astrogeology Science Center / NASA PDS Imaging Node".

USGS science for a changing world

PILOT

NASA

Home Mars Missions Map Advanced

SEARCH

Lat Lon: -11.71, 135.77

Set bounding box below...

Positive East

0° to 360°

Planetocentric

Min Lon Max Lon

Min Lat Max Lat

Feature Finder Select Type

Total

Order By Date (ASC) Zoom Thumbs

SEARCH TIPS

1. Enable the search button by selecting one or more images sets on the **Missions** tab.
2. *Mapped* images have lat/lon coordinates and photometric keywords
3. *Unmapped* images have incomplete data. The images had errors during processing because of improper labels or spacecraft information. Lat/Lon and photometric keywords are unavailable. NOTE: although the sets cannot be mapped, they still may contain quality imagery.
4. Use **Map** tab to limit your search by creating a bounding box (optional). After you complete a search, the map tab will also allow you to view footprints for mapped imagery.
5. Use **Advanced** tab to limit your search by setting ranges for dates and photometric keywords (optional).
6. When you are ready to search, click the search button . If you refine your search, you must re-click the search button.
7. The **Total** will show up above. **Results** will show up in this panel. If your result set is greater than 50,000 images, you will only receive a total.
8. Click on action buttons to investigate images. Use checkboxes  to select images.
9. To download selected images, click the arrow in the **Select** box (upper right).

downloads | contact | support | help

PILOT was developed by the USGS Astrogeology Science Center / NASA PDS Imaging Node

# PILOT - Walkthrough

## 5. Select and interact with images



The screenshot displays the PILOT web interface. On the left, a map of Mars shows a red bounding box and a yellow rectangle. The map includes a coordinate grid and a scale bar. Below the map, the coordinates are set to Lat Lon: -11.71, 135.77. The right side of the interface features a gallery of 18 image thumbnails, each with a date and a selection checkbox. Several checkboxes are circled in red, indicating selected images. The gallery also includes a 'Total' count of 80, a 'Select' dropdown set to 10, and various interaction icons for each image.

Image ID	Date	Selected
1	2010-05-03	Yes
2	2010-05-08	Yes
3	2010-05-13	Yes
4	2010-05-14	No
5	2010-05-20	Yes
6	2010-05-24	No
7	2010-05-29	Yes
8	2010-06-04	Yes
9	2010-06-06	No
10	2010-06-10	No
11	2010-06-27	Yes
12	2010-07-07	No
13	2010-07-30	Yes
14	2010-08-04	No
15	2010-08-09	No
16	2010-08-15	No
17	2010-08-16	Yes
18	2010-08-21	No

# PILOT - Walkthrough

## 6. Select download script or process in POW



The screenshot shows the PILOT web interface. At the top, there are logos for USGS (science for a changing world), PILOT, and NASA. Below the logos, there are navigation tabs: Home, Mars, Missions, Map, and Advanced. A search bar is visible. The main content area displays a map of Mars with a red bounding box and a yellow rectangle. To the right, there is a search results list with a 'Total' of 80 items. A red circle highlights the download and process icons in the search results. A dialog box titled 'Projection on the Web' is open, providing information about the POW service and a 'Submit' button.

**Download or Process in POW**

**Projection on the Web**

Projection on the Web (POW) is a beta web service provided by the USGS Astrogeology Science Center. Submission requires account registration. If you decide to submit a job to POW, you will be transferred to another website to complete image processing.

Submit 10 CTX images to POW.

**Cancel** **Submit**

# POW – Submission Walkthrough



## Listed Images

### Choose Options for Map Projection on the Web (POW) Processing

Files to Process ▼

- URL: [http://pdsimage.wr.usgs.gov/Missions/Mars\_Reconnaissance\_Orbiter/CTX/mrox\_0066/data/P05\_002832\_1769\_XI\_03S189W.IMG]

Name or Label ▶

Image Options ▶

Projection ▶

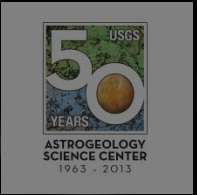
Download File Format ▶

Add Job

[Home](#) | [Downloads](#) | [Contact](#) | [Support](#) | [Help](#)

[U.S. Department Of The Interior](#) | [U.S. Geological Survey](#)

# POW – Submission Walkthrough



## Name the job

Choose Options for Map Projection on the Web (POW) Processing

Files to Process ▶

Name or Label ▼

Job Name

2 CTX Images Mar 14, 2013

Job Description

Research topic for LPSC

Image Options ▶

Projection ▶

Download File Format ▶

Add Job

**Tips**  
**Job Name** and **Job Description** are both optional but recommended. **Job Name** will be automatically filled but you can modify. Example:  
**Job Name:** 6 CTX Images Mar 4, 2013  
**Job Description:** Images covering MSL landing site (no length restriction).

# POW – Submission Walkthrough



Output Resolution (optional) -- Chose Bands (single, RGB, ALL)

Choose Options for Map Projection on the Web (POW) Processing

Files to Process ▶

Name or Label ▶

Image Options ▼

Output Resolution (meters/pixel)

Single Band Image

Choose filter ▼

RGB Image

All Bands Image

**Resolution**

**Default:** empty parameter values

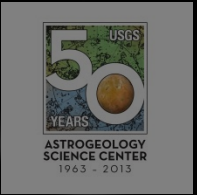
By default the image will be generated at the optimized resolution (in meters/pixel) for each image. If you wish to more easily merge the images later, some applications like ISIS require that the resolution be constant for all the images. However, most remote sensing and GIS applications support many images at different resolutions. Some instruments like Viking have widely varying resolutions thus it is best to allow ISIS to automatically calculate the resolution for you. For instruments like CTX and THEMIS you can generally use a single resolution for all images. For example, 6 (m/pixel) is recommend for CTX images or 100 (m/pixel) for THEMIS. If you are unsure, leave this parameter blank.

Projection ▶

Download File Format ▶



# POW – Submission Walkthrough



## Choose projection

Choose Options for Map Projection on the Web (POW) Processing

Files to Process ▶

Name or Label ▶

Image Options ▶

Projection ▼

Specify Longitude/Latitude Direction/Domains

Latitude Domain

Longitude Domain

Longitude Direction

**Projection**

▼

- Equiarectangular
- Lambert Conformal
- Mercator
- Orthographic
- Polar Stereographic
- Simple Cylindrical
- Sinusoidal
- Transverse Mercator

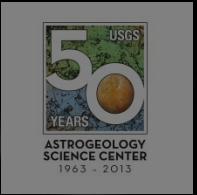
**Specify Longitude/Latitude Direction/Domains**

**Defaults:** Latitude Domain: Planetocentric, Longitude Domain: 0 to 360, Longitude Direction: East

These are optional parameters to control Longitude and Latitude environment for the projection. [Planetocentric](#) is the recommended latitude type for most planetary bodies. Longitude domain defaults to use a "0 to 360" degrees of Longitude. Longitude Direction can be set as East or West. Note: for GIS users, it is recommended to use the "-180 to 180" Longitude Domain and Positive East Longitudes for the best 3rd party application support.

[Projection Tips](#)

# POW – Submission Walkthrough



## Choose Download Format and Stretch

Choose Options for Map Projection on the Web (POW) Processing

Files to Process ▶

Name or Label ▶

Image Options ▶

Projection ▶

Download File Format ▼

GeoJPEG 2000

- GeoJPEG 2000
- GeoTiff/BigTiff
- ISIS3
- JPEG
- PDS
- PNG

Floating Point, 32 Bit

Maximum Stretch Percent

99

**Format Tips**

**Default:** GeoJpeg2000 (geospatial jpeg2000, lossless compression)

POW currently support 5 output types ISIS (version 3), PDS compatible (version 3), GeoJpeg2000, GeoTiff, PNG, and Jpeg. All formats are lossless except for Jpeg. The PDS output format should be PDS compatible but not necessarily PDS compliant for archival purposes.

**Select Byte Type**

**Default:** 8 bit (0 - 255), 8 bit is recommend for visual images to help with size and ease of use.

Three output bit ranges are supported: unsigned 8 bit (0 to 255), signed 16 bit (-32768 to 32767), and 32 bit floating point. All available formats

[Add Job](#)

# POW – Created Products



Users will receive an e-mail notification and can access the generated products through the POW web site. These products include:

- A .zip archive of all the files created
- Individual download links for the image products, GIS headers, and other supporting data files
- A text document which:
  - Identifies any errors which occurred
  - Lists the ISIS<sub>3</sub>/GDAL commands which were used to create the products.

\* Allows user to learn ISIS using POW recommended workflows.