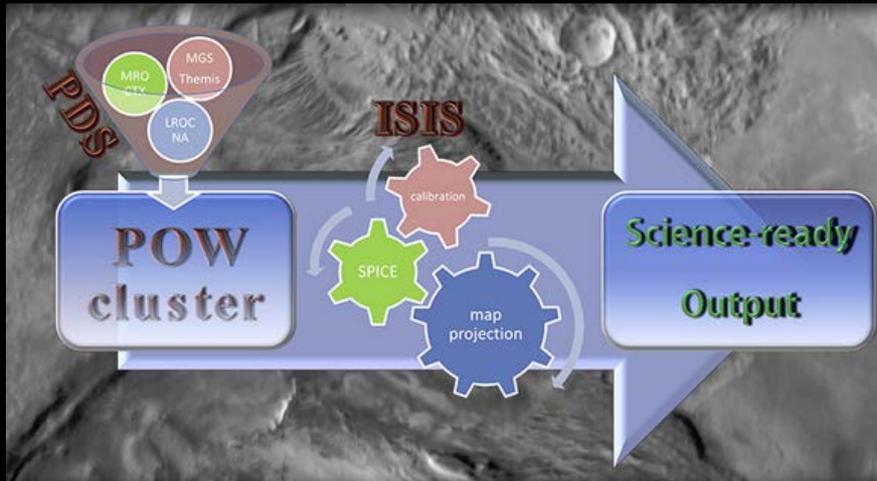
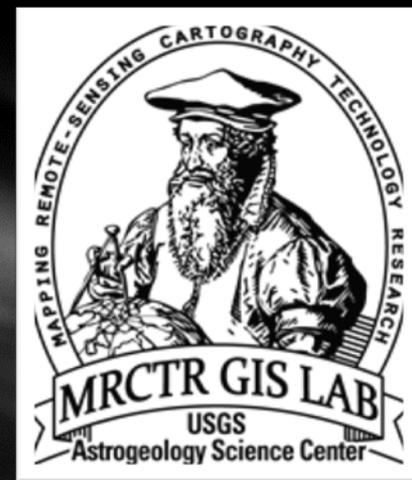


Map Projection on the Web (POW) “ISIS3 in the cloud”



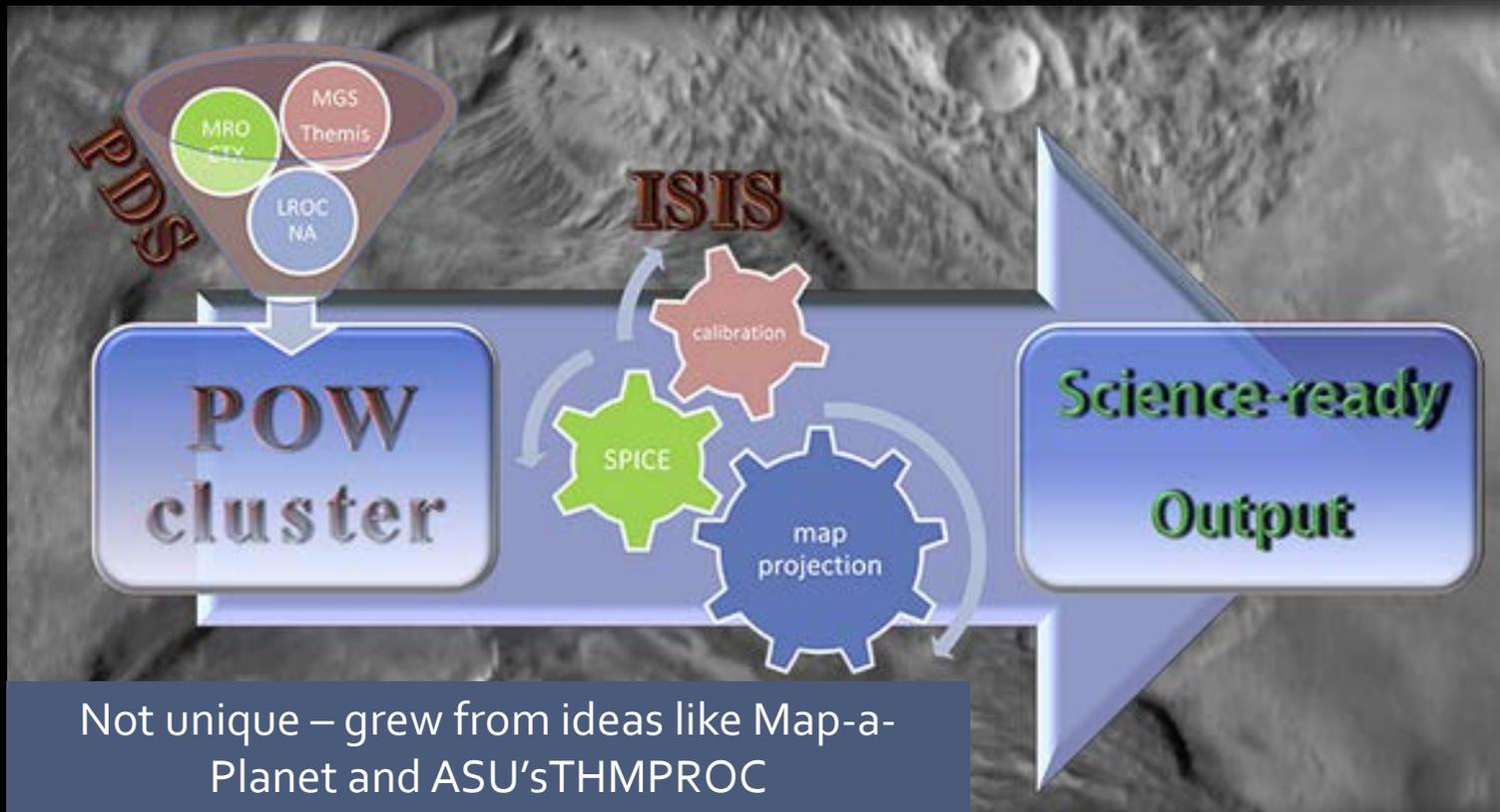
USGS Astrogeology

Trent Hare (thare@usgs.gov), March 2013 – LPSC 44

(Team: Scott Akins, Bob Sucharski, Janet Richie, Mark Bailen, Jordan Shute, Jeff Anderson)

POW Overview

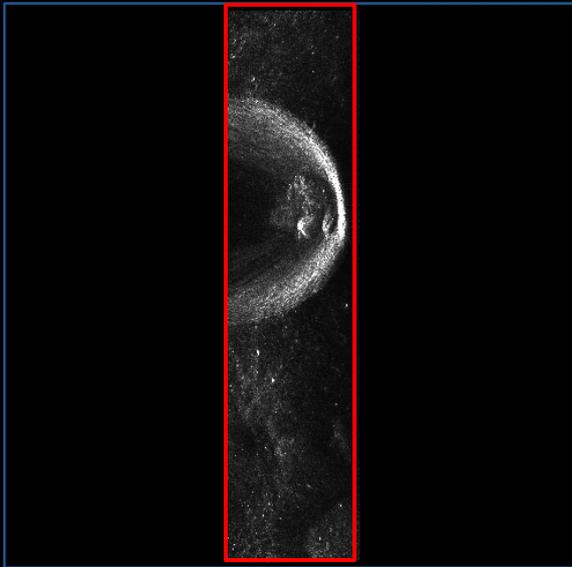
POW will provide users with calibrated cartographic images that can be used for geologic mapping, analysis in a GIS, change detection, merging of dissimilar instrument images, and use in a host of other scientific applications (e.g., ArcMAP, QGIS, ENVI, Matlab, JMARS, etc.).



Not unique – grew from ideas like Map-a-Planet and ASU's THMPROC

Why Do We Need POW?

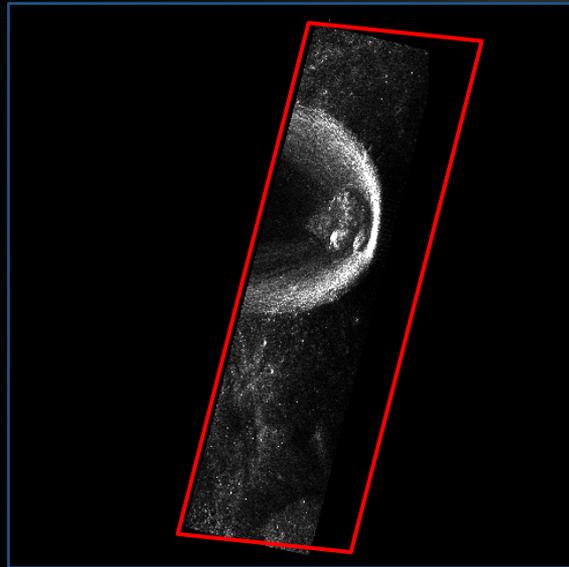
- Analysis of surficial features should be on calibrated and geometrically corrected data.
- Many users do not have the time to learn how to use ISIS
- These same users do have a use for **map projected** PDS images in file formats that work in their preferred research tools or for figures in abstracts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



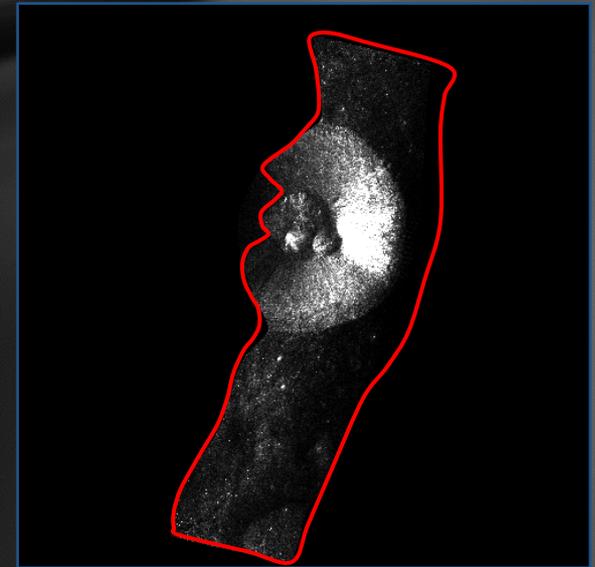
LRO MiniRF Level 1

March 18, 2013

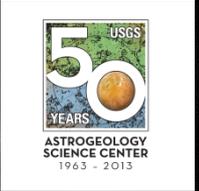
LPSC 44th



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 ISIS₃

Integrated Tools

ISIS₃ - 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://pdsimage.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`. The page features the USGS logo and the PILOT title in large orange letters. A navigation menu at the bottom includes links for `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 respective 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 . . .

Mercury (139,227 images)	Saturn (332,929 images)
Venus (7,135 images)	Atlas (1,067 images)
Earth (17,161 images)	Calyppo (791 images)
Moon (1,803,498 images)	Daphnis (386 images)
Mars (1,255,741 images)	Dione (8,851 images)
Deimos (244 images)	Enceladus (16,066 images)
Phobos (444 images)	Epimetheus (1,530 images)
Jupiter (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)
	Polydeuces (403 images)
	Prometheus (3,492 images)
	Rhea (14,039 images)
	Telesto (801 images)
	Tethys (8,672 images)
	Titan (87,401 images)
	Ymir (66 images)

Uranus (5,021 images)

- Ariel (101 images)
- Miranda (90 images)
- Oberon (74 images)
- Titania (102 images)
- Umbriel (100 images)

Neptune (5,588 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 Mars missions is displayed, with the "Mars Reconnaissance Orbiter" mission selected. The "CTX" instrument is highlighted with a red circle and the text "CTX" next to it. 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.

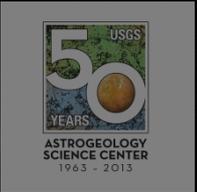
Mission	Instrument	Mapped	Unmapped
Mars Express (2004 - 2011)	HRSC	27,502	134
Mars Global Surveyor (1997 - 2006)	MOC-NA	96,328	206
	MOC-WA	141,050	5,424
Mars Reconnaissance Orbiter (2006 - 2012)	CTX	50,631	30
	HIRISE	701,823	3
Messenger (2010)	MDIS-NAC		3
	MDIS-WAC		5
Odyssey (2002 - 2012)	THEMIS IR	173,166	10,996
Viking (1976 - 1980)	VIS 1A	16,396	366
	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 labeled 'parameter histograms'. A 'CTX Histogram' overlay is visible, showing a distribution of Solar Longitude from 306 to 324 degrees with 1,593 mapped images. The interface includes various search filters, a search button, and a results panel on the right.

parameter histograms

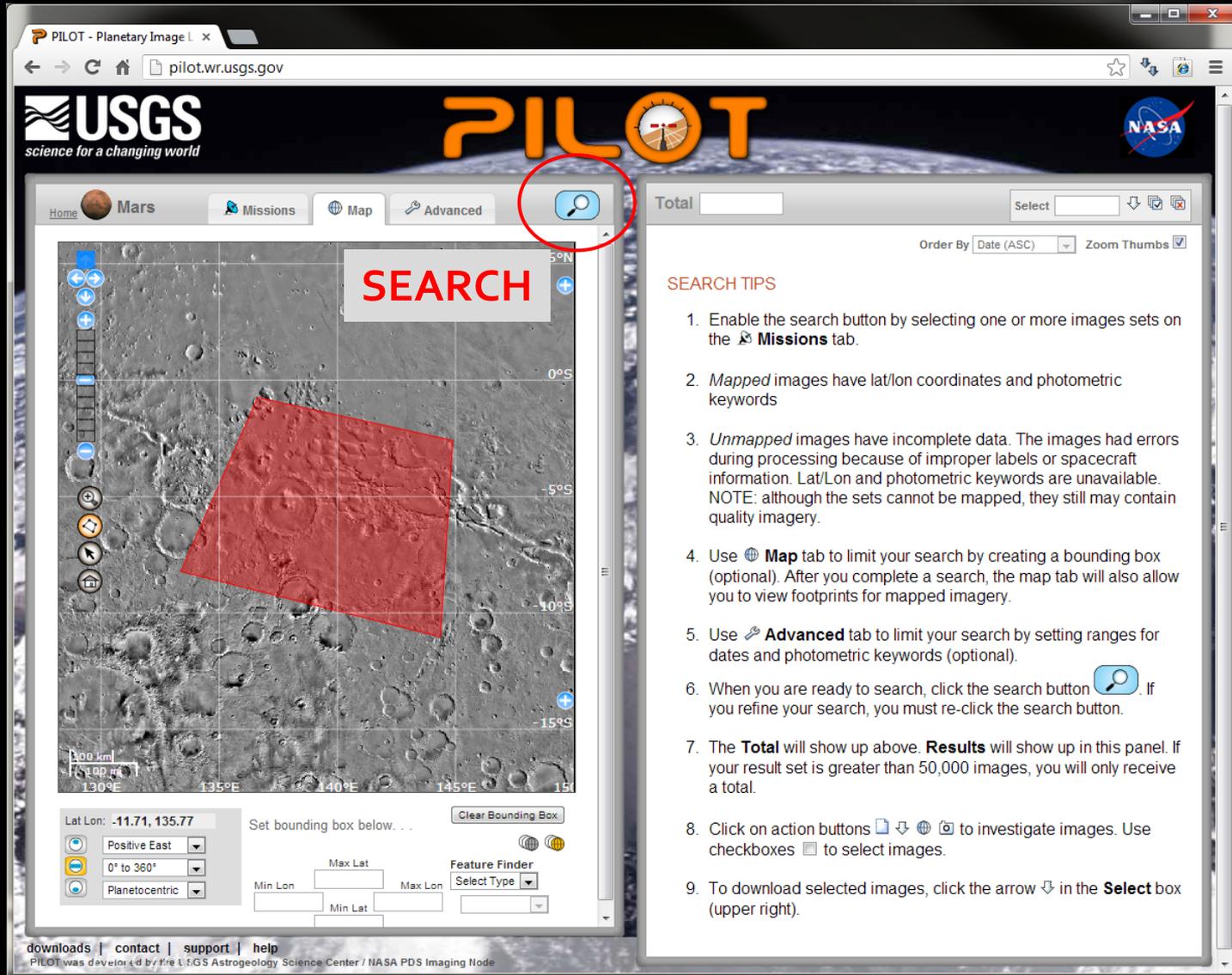
CTX Histogram
Solar Longitude
306 - 324 degrees
1,593 mapped images

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).

PILOT - Walkthrough

4. Use map polygon to constrain images



The screenshot shows the PILOT web application interface. The main map displays a grayscale image of Mars with a red polygon overlaid, indicating a search area. The search results panel on the right lists search tips and provides a search button (magnifying glass icon) circled in red. The interface includes navigation tabs (Home, Mars, Missions, Map, Advanced) and a search bar. The search results panel shows a 'Total' count and a 'Select' box with a download arrow. The search tips list 9 steps for using the application.

USGS science for a changing world

PILOT

NASA

Home Mars Missions Map Advanced 

SEARCH

100 km 100 m

Lat Lon: -11.71, 135.77 Set bounding box below... Clear Bounding Box

Positive East 0° to 360° Planetocentric

Min Lon Max Lon Min Lat Max Lat Feature Finder Select Type

Total Select

Order By Zoom Thumbs

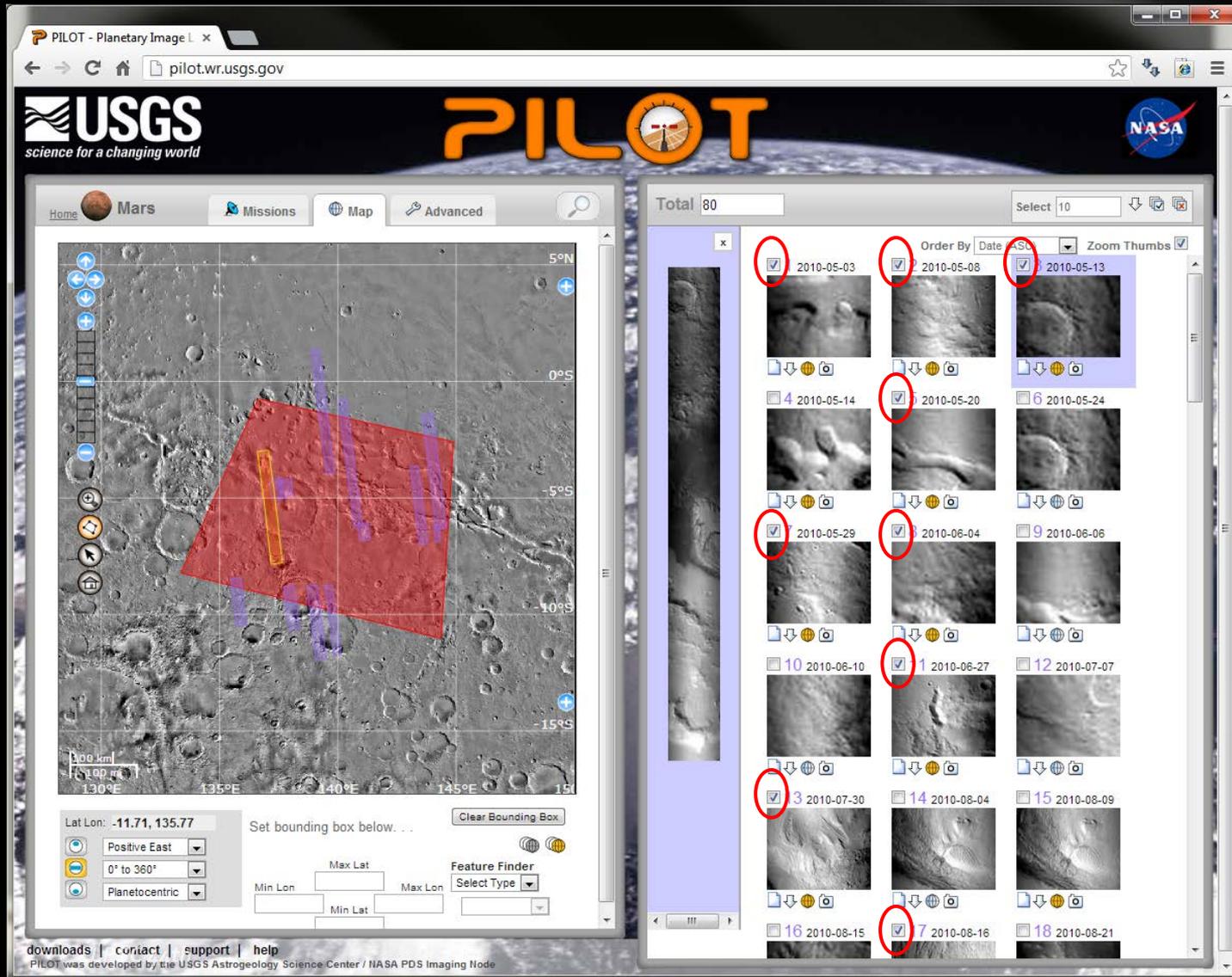
SEARCH TIPS

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 application interface. The browser address bar shows the URL `pilot.wr.usgs.gov`. The page header includes the USGS logo with the tagline "science for a changing world", the PILOT logo, and the NASA logo.

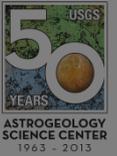
The main interface is divided into two main sections:

- Map View (Left):** Shows a topographic map of Mars with a red bounding box and a yellow rectangle. The map includes a coordinate grid and a scale bar. Below the map, the current location is given as "Lat Lon: -11.71, 135.77". There are controls for "Set bounding box below..." and "Feature Finder".
- Image Gallery (Right):** Displays a grid of 18 image thumbnails, each with a date. The gallery is titled "Total 80" and "Select 10". Several thumbnails have red circles around their selection checkboxes, indicating they are selected. The selected images are: 2010-05-03, 2010-05-08, 2010-05-13, 2010-05-20, 2010-05-29, 2010-06-04, 2010-06-27, 2010-07-30, and 2010-08-16.

At the bottom of the page, there are links for "downloads | contact | support | help" and a note: "PILOT was developed by the USGS Astrogeology Science Center / NASA PDS Imaging Node".

PILOT - Walkthrough

6. Select download script or process in POW



The screenshot shows the PILOT web interface. The main map displays a Mars surface with a red bounding box and a yellow rectangle. The interface includes a search bar, navigation tools, and a list of images. A red circle highlights the download and process icons in the image list. 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_035189W.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

Job Description

Image Options ▶

Projection ▶

Download File Format ▶

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 ISIS₃/GDAL commands which were used to create the products.

* Allows user to learn ISIS using POW recommended workflows.

POW – How Does it Work?



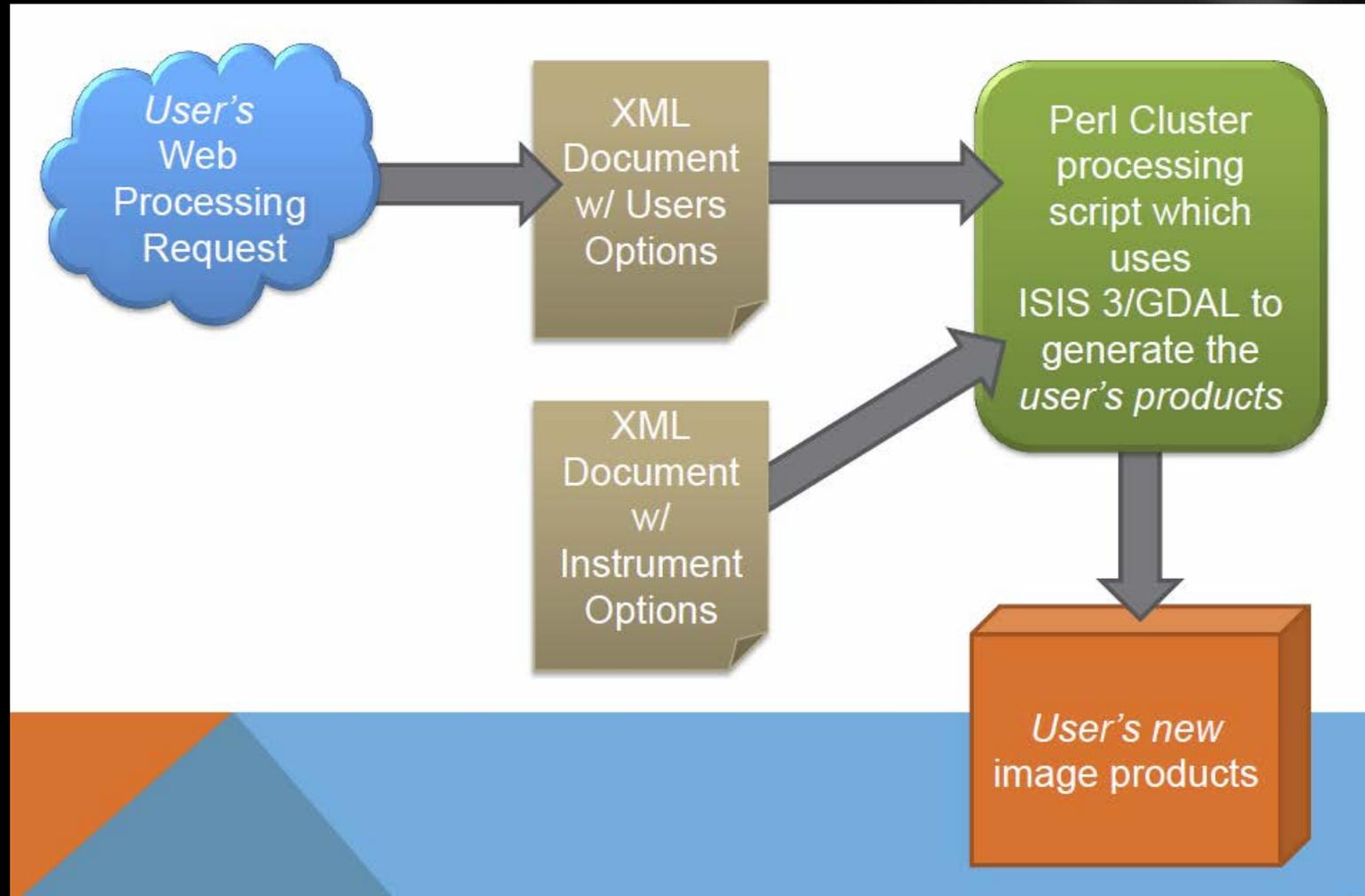
Web interfaces to
select files and
choose processing
options

PDS Imaging Node
SAN with 4 Gb
network access to
111 TB of data

Database server to
track the status of
processing jobs

Moab/Torque
Processing Cluster
with 132 CPUs

POW – How Products are Created





Planned Future Add-ons

- Use case “Wizards” for GIS users, ISIS users, Matlab, etc.
- Non-linear stretches
- Multi-image tone matching
- Automated image registration
- Mosaic creation