Tutorial for New Users of NASA's PILOT Data Search Service

- **Welcome, you've found the Planetary Image Locator Tool (PILOT)! (https://pilot.wr.usgs.gov/)**
- **Start here for help getting going with your data search**
- **PILOT Snapshot**
  - PILOT is an image data portal designed for searching through the raw image archives of the Cartography and Imaging Sciences ("Imaging" or IMG) Node of NASA's Planetary Data System (PDS)
  - PILOT uses a catalog of spacecraft images acquired at visible, infrared and radar wavelengths of planetary bodies in our Solar System
  - The catalog differs from other PDS catalogs because it has been improved by characterizing image geometry in great detail
- **For information and additional data services, please visit the IMG home page:**
  - **https://pds-imaging.jpl.nasa.gov/**

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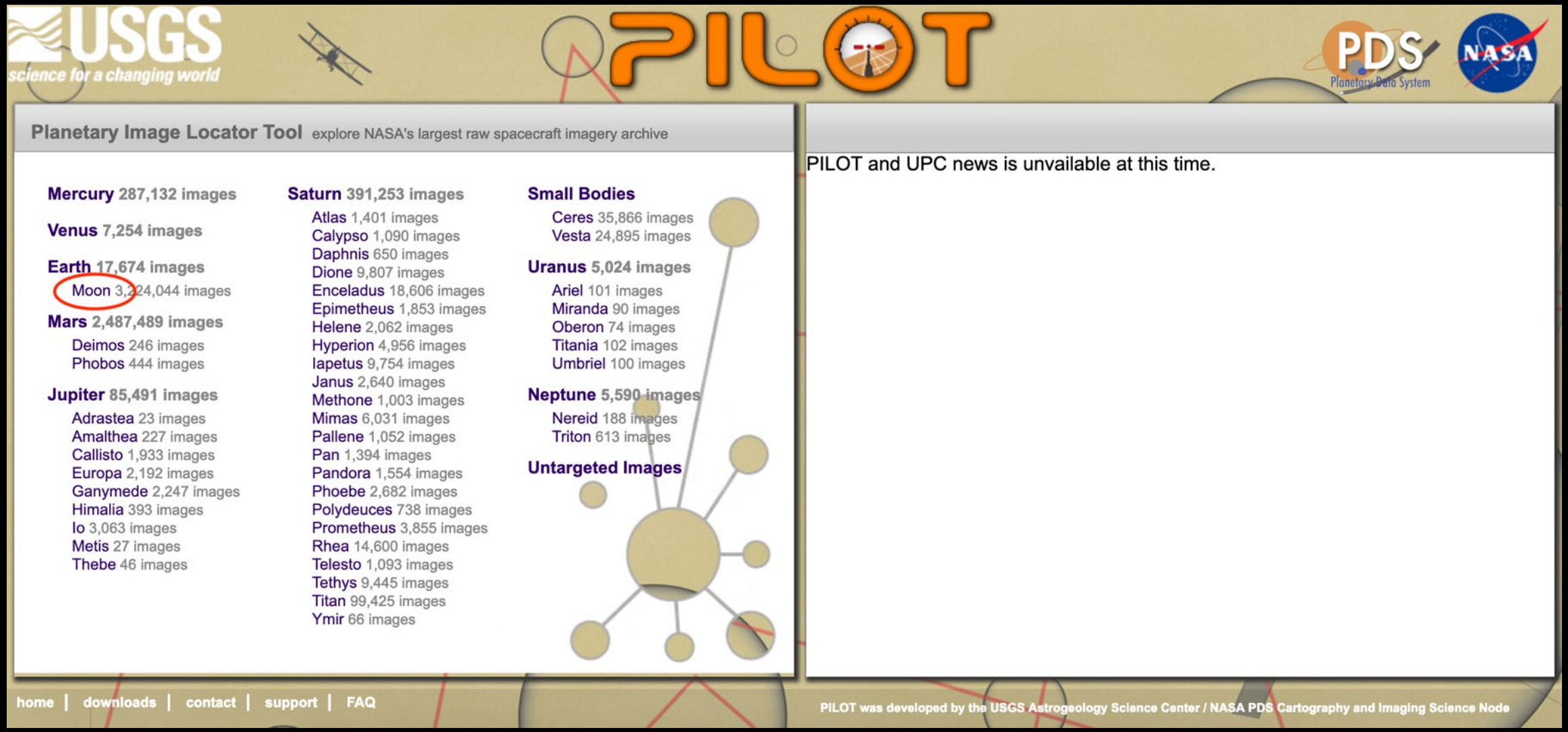
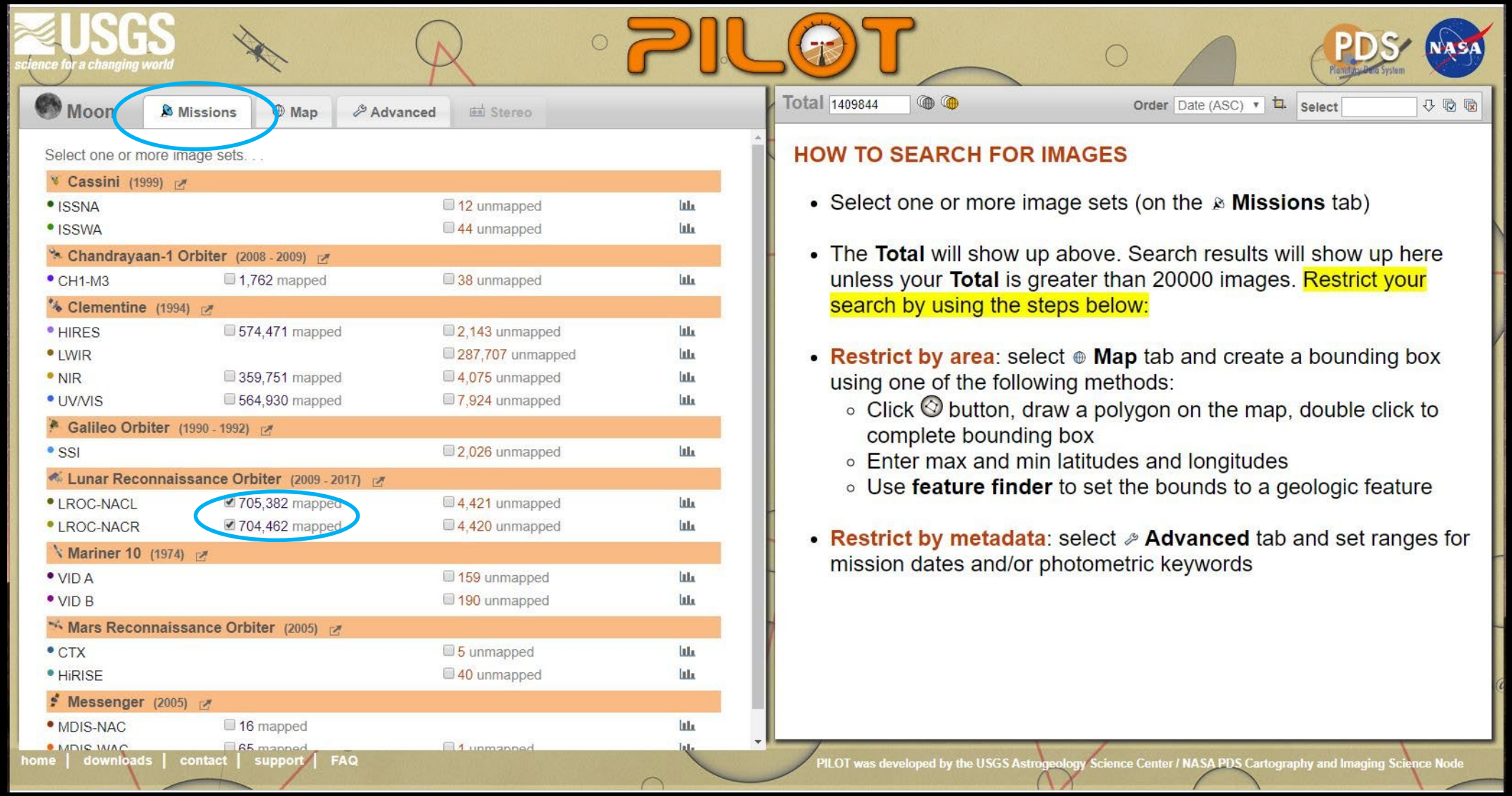
Overview of PILOT

- PILOT is an online data portal used to search through the raw image archives of the Cartography and Imaging Sciences (“Imaging” or IMG) Node of NASA’s Planetary Data System (PDS). It accesses a large catalog of spacecraft images acquired at visible, infrared and radar wavelengths of planetary bodies in our Solar System.
- ***PILOT supports data searches using the most accurate image and spacecraft geometry, planetary coordinates, and image positional information for PDS images.***
- PILOT relies on the Unified Planetary Coordinate (UPC) database developed at the USGS Astrogeology Science Center. The UPC database has detailed geometric and positional information about planetary image data calculated using a uniform coordinate system (Positive East Longitude, 0° to 360° E) and projected onto a 3D planetary surface shape.
- The UPC benefits from cartographic processing and map development at USGS using the Integrated Software for Imagers and Spectrometers (ISIS) software. ISIS is the primary tool for computing, maintaining, and continually improving the UPC database. The database is populated with up-to-date SPICE kernels, and improved pointing and location data are calculated for corners, edges, and for potentially every pixel in an image. The database is regularly updated with new and recalculated image data as improved location data are made available.
- An ISIS camera model for a given imaging instrument is required for ingestion of image data into the UPC. Thus PILOT presently supports ~85% of image data served by the PDS IMG node.
- **For the complete data catalog of the IMG node, please visit the home page: https://pds-imaging.jpl.nasa.gov/**

https://pilot.wr.usgs.gov/



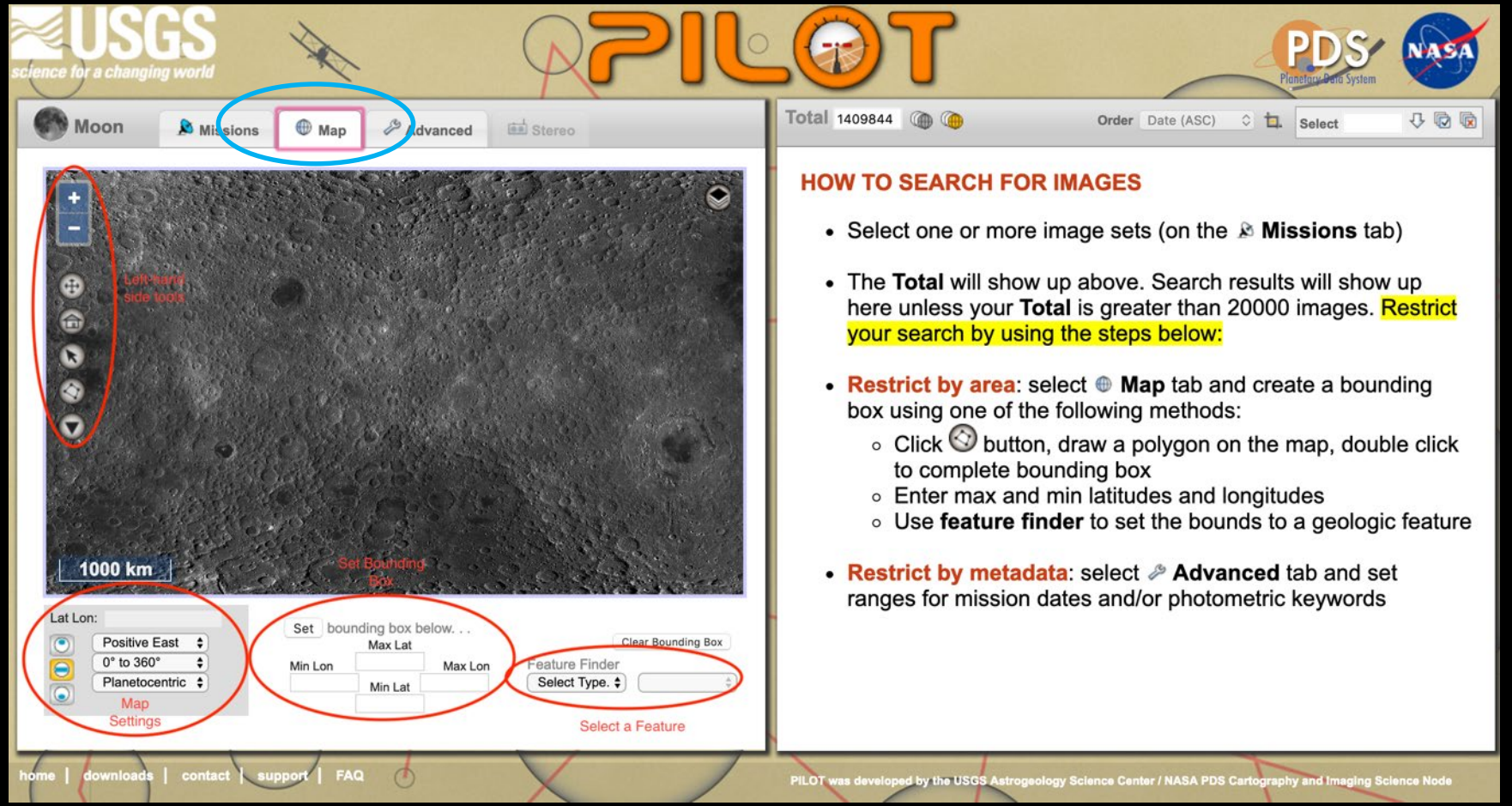
Starting at the PILOT home page (https://pilot.wr.usgs.gov/), first select the planetary body for which you want to find an image. In this example, we will choose Earth's Moon.



In the default Missions tab, choose the mission you want to browse for images. In this example, choose the Lunar Reconnaissance Orbiter Narrow Angle Camera image sets. Check both the left (LROC-NACL) and right (LROC-NACR) cameras, as shown.

Next, click on the Map tab at the top. This will take you to a map view of the Moon with tools for finding images. The upper left side button functions (top down) are as follows:

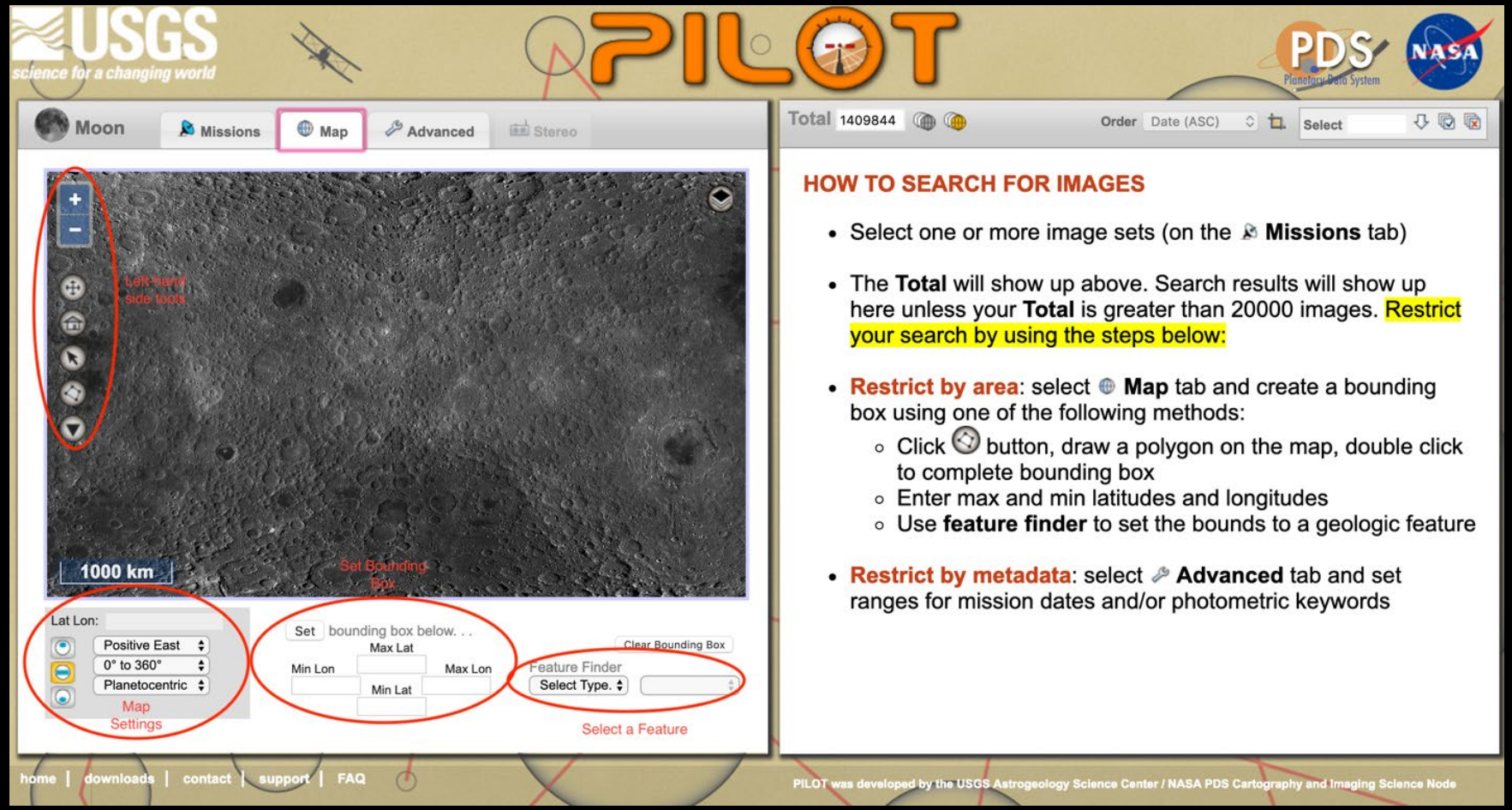
- Zoom in
- Zoom out
- Enable navigation by cursor
- Home (reset)
- Select footprint (only works when you have several footprints showing on the map)
- Draw Bounding Box tool
- Download map

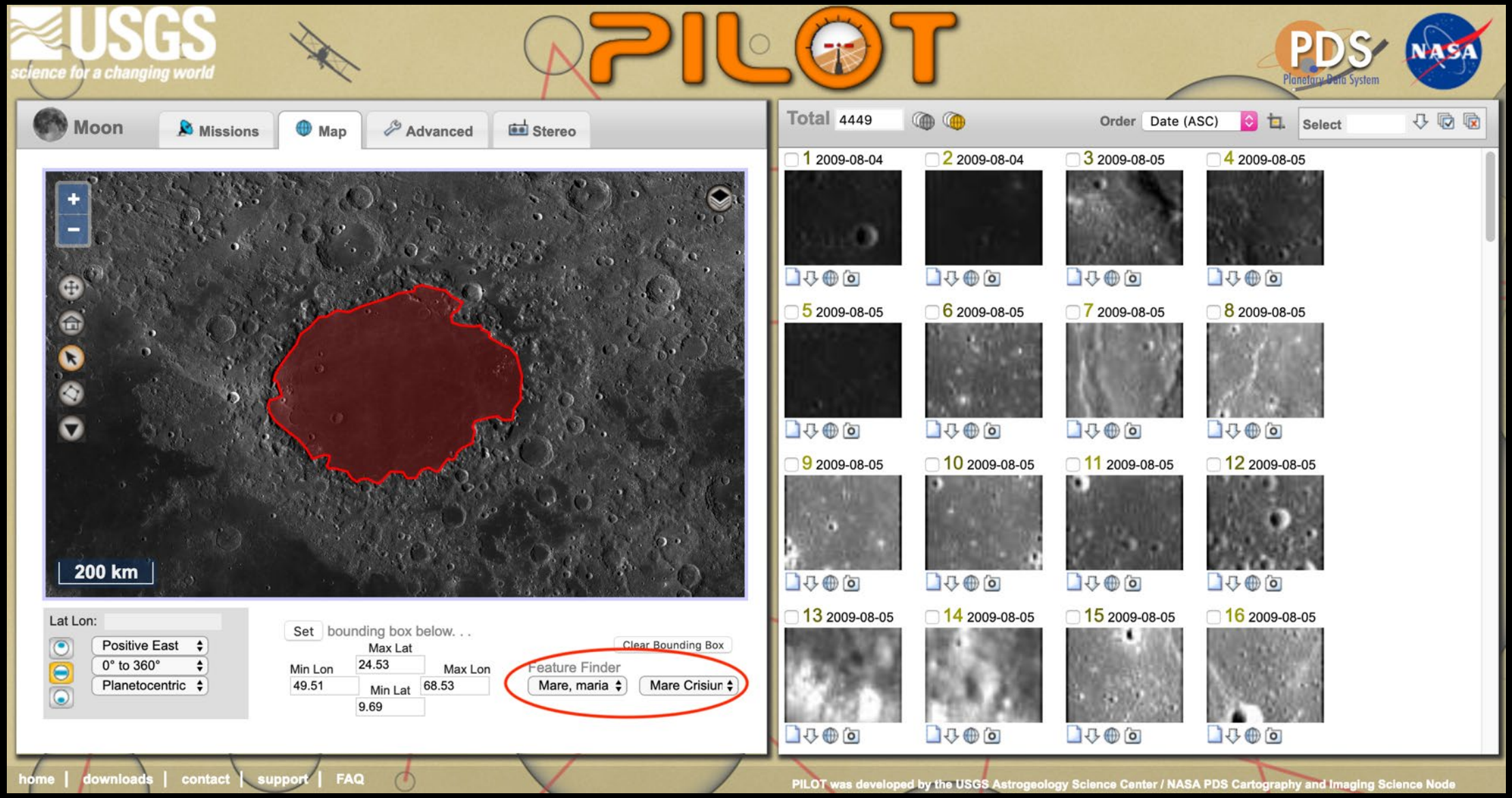


To draw a bounding box, select the Bounding Box tool (second from bottom at left) and click once on the map to start, then move the cursor to surround your feature and click once for each corner. Double-click to complete the box.

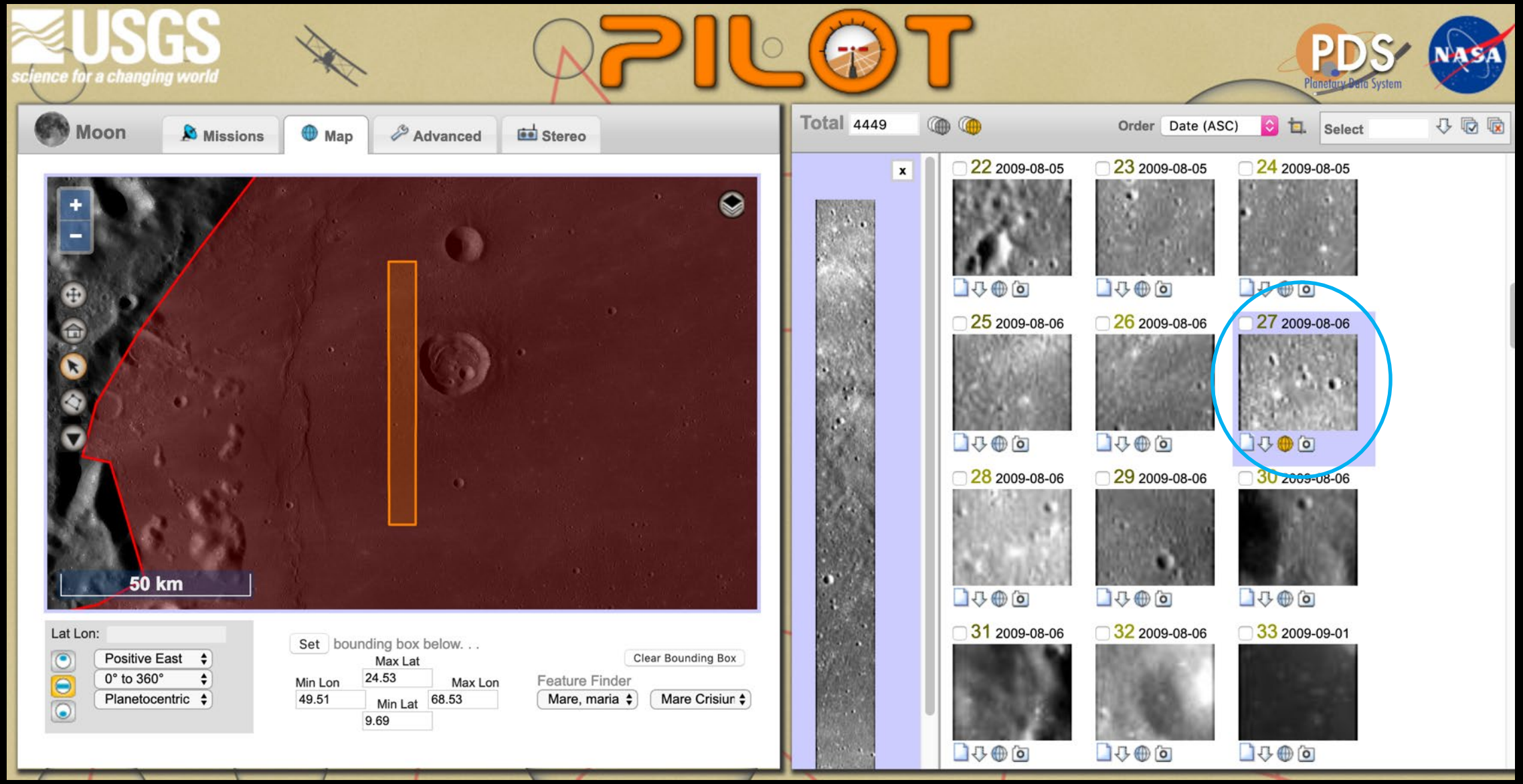
In the lower left corner, below the scale bar, there are tools that allow you to change the map projection, choose how the latitude and longitude are displayed, and show the latitude and longitude of the cursor.

At bottom center, you can set a min and max latitude and longitude, instead of drawing a bounding box. You can also zoom in to a particular feature (at lower right), if you know its type and name.

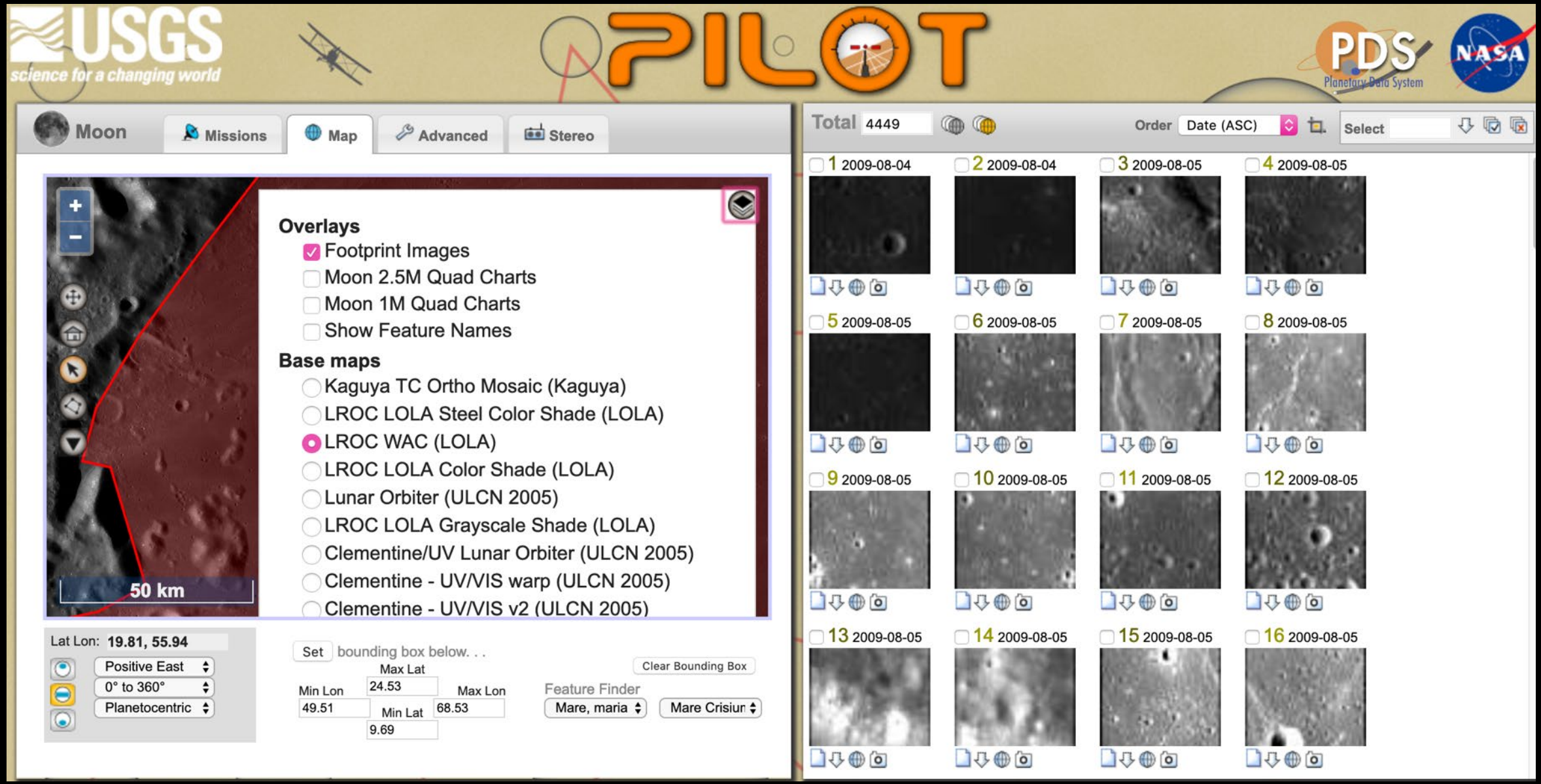




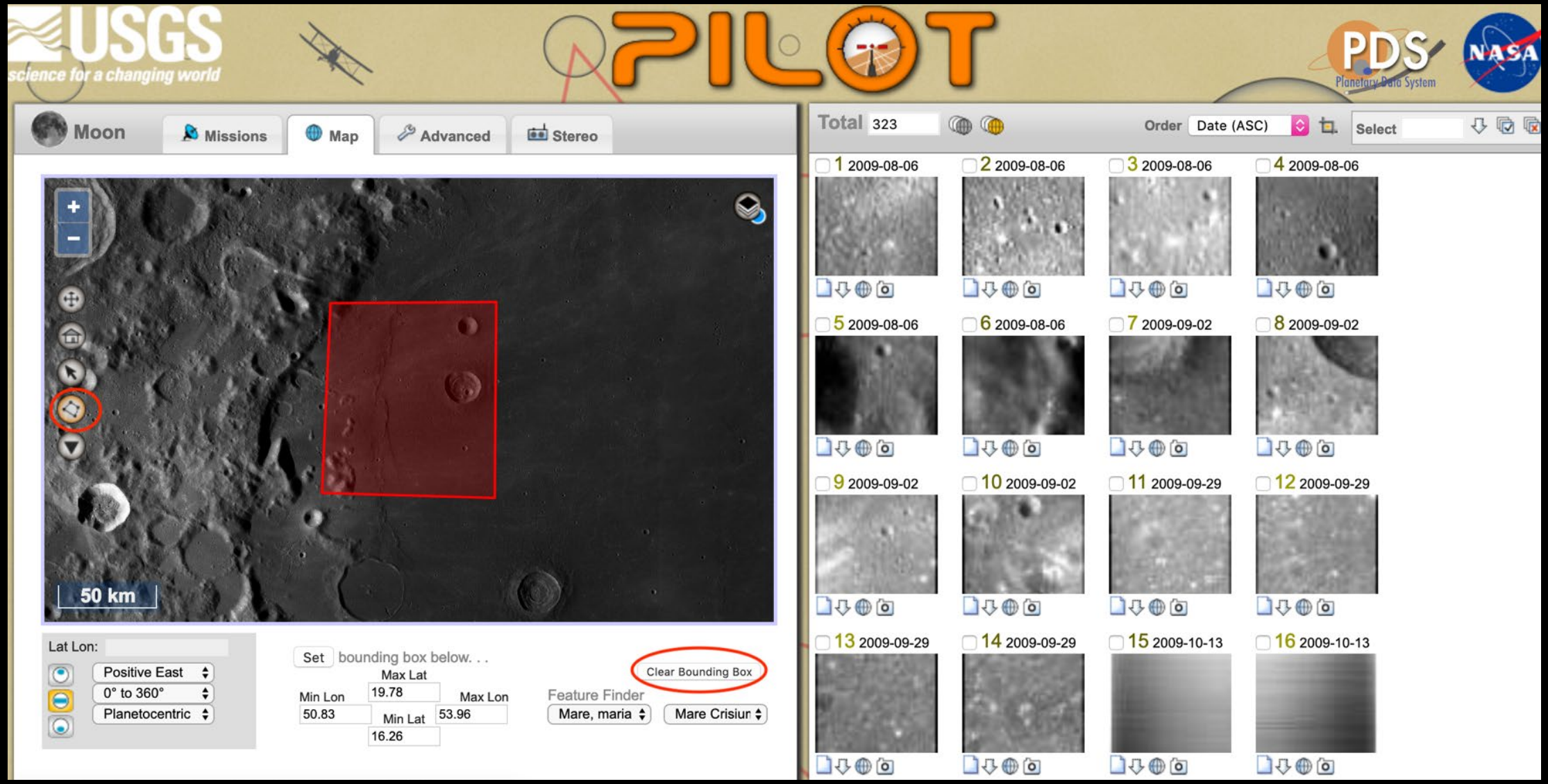
Here I have chosen feature type as Mare using the Feature Finder and the specific feature Mare Crisium. Once selected, all of the images at least partially covering Mare Crisium are displayed at right as browse or thumbnail images.



To view a specific image, click on its thumbnail at right. The footprint of the image will appear on the map to the left. The full image itself will appear in the middle. You can use this feature to see if the image covers the right area or has adequate resolution for your needs.

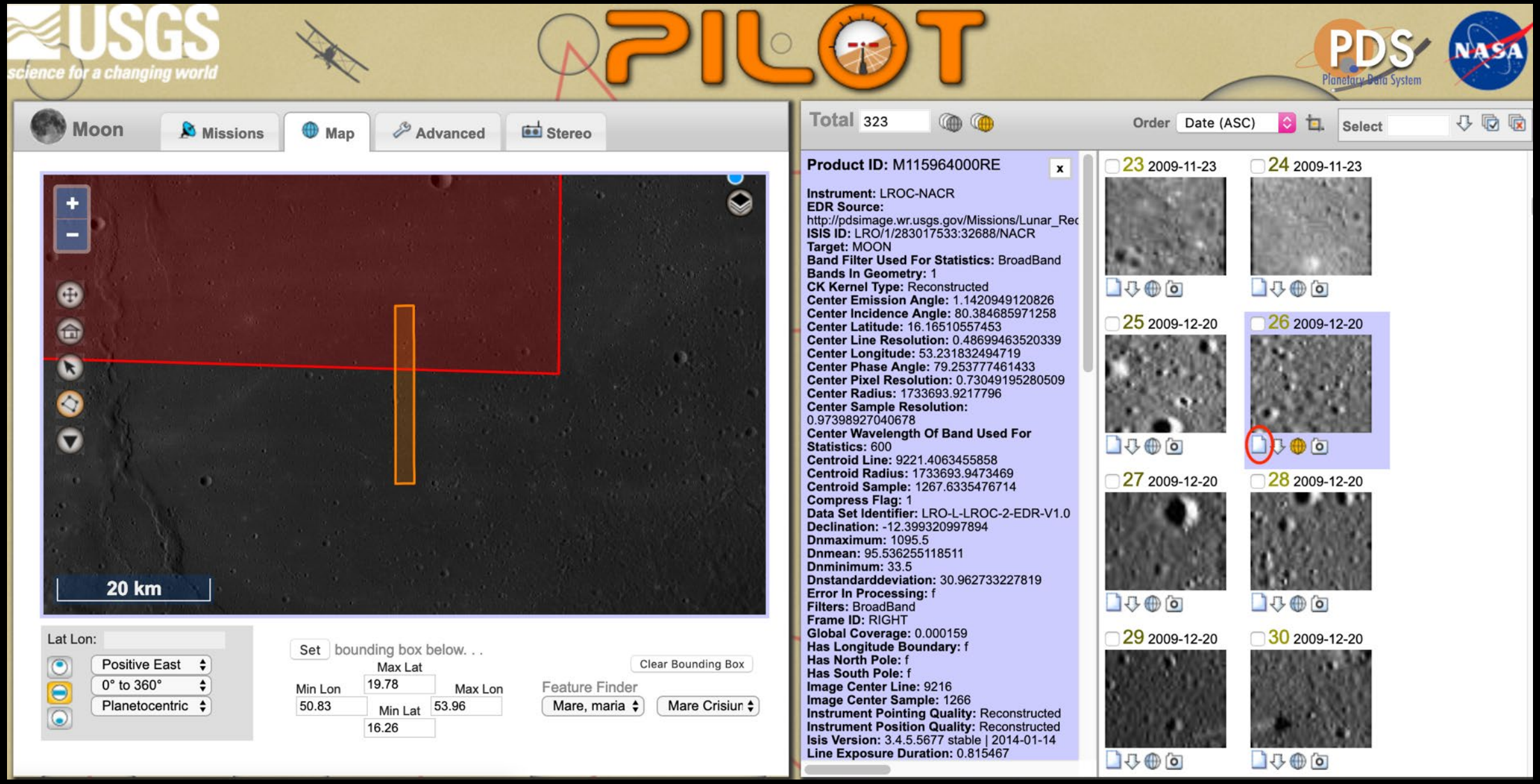


At upper right in the map view, you can choose different layers to overlay on the map view to help you find the right place on the planetary body for which you need images.

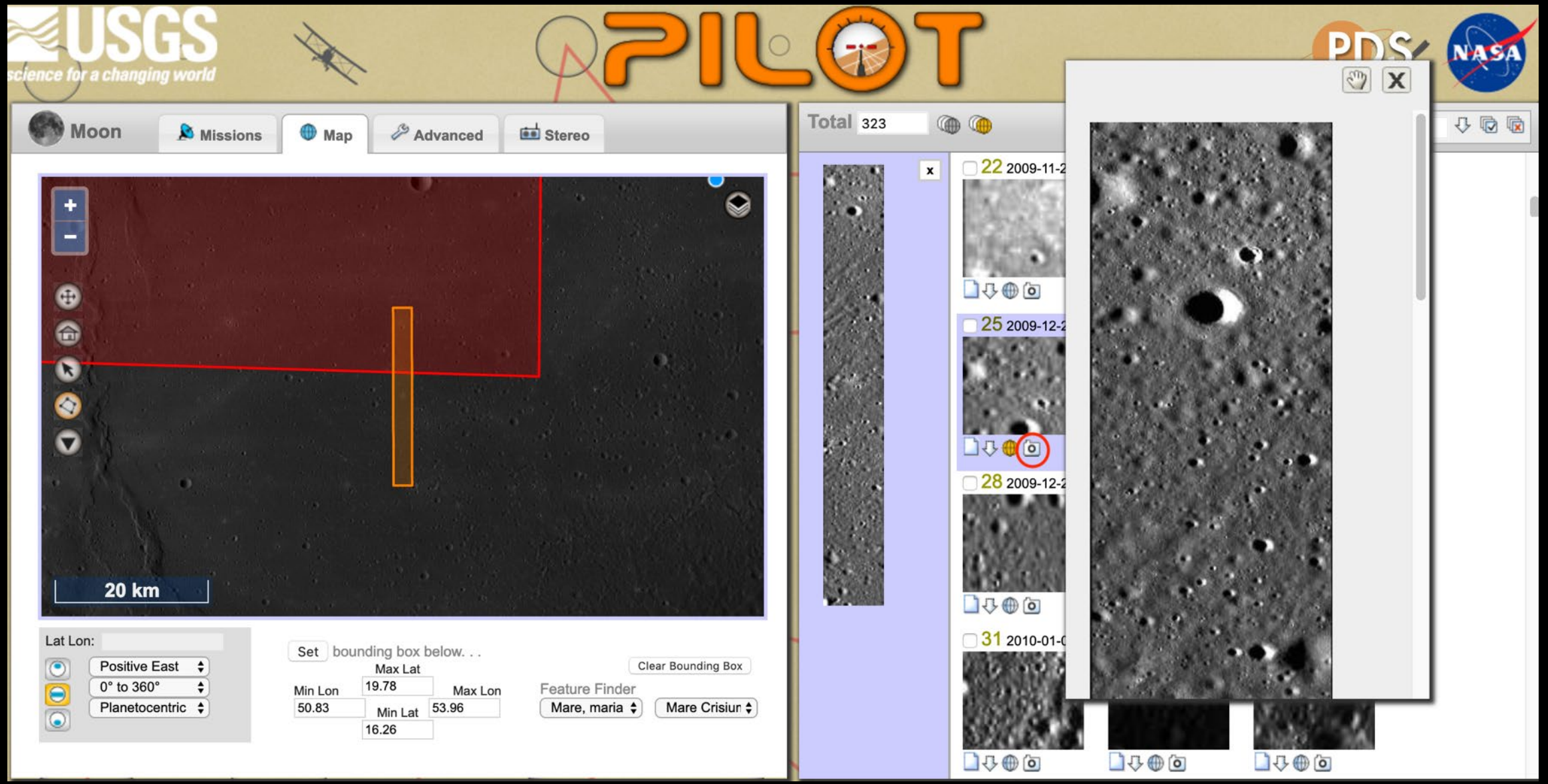


In the previous view of Mare Crisium, 4449 images covered the selected area. PILOT cannot display more than 500 image footprints at once on the map, so to see all of them we need to select a smaller area. To do this, zoom in to the desired area and click "Clear Bounding Box." Now draw a new box over a smaller area, using the "Draw Bounding Box" tool in the map menu at left, as shown.

Now we can see how many images are covering the area of the new bounding box we have made: 323. This is fewer than 500, so we can view all the footprints at once and see how complete the coverage is of the area we have chosen. To do this, click on the orange globe icon to the right of the Total box at the top of the list of images on the right. To remove all footprints from the map, click the gray globe icon. If we wanted to choose specific images for an area, we could view the footprints one at a time by clicking on the globe icon beneath each thumbnail individually.

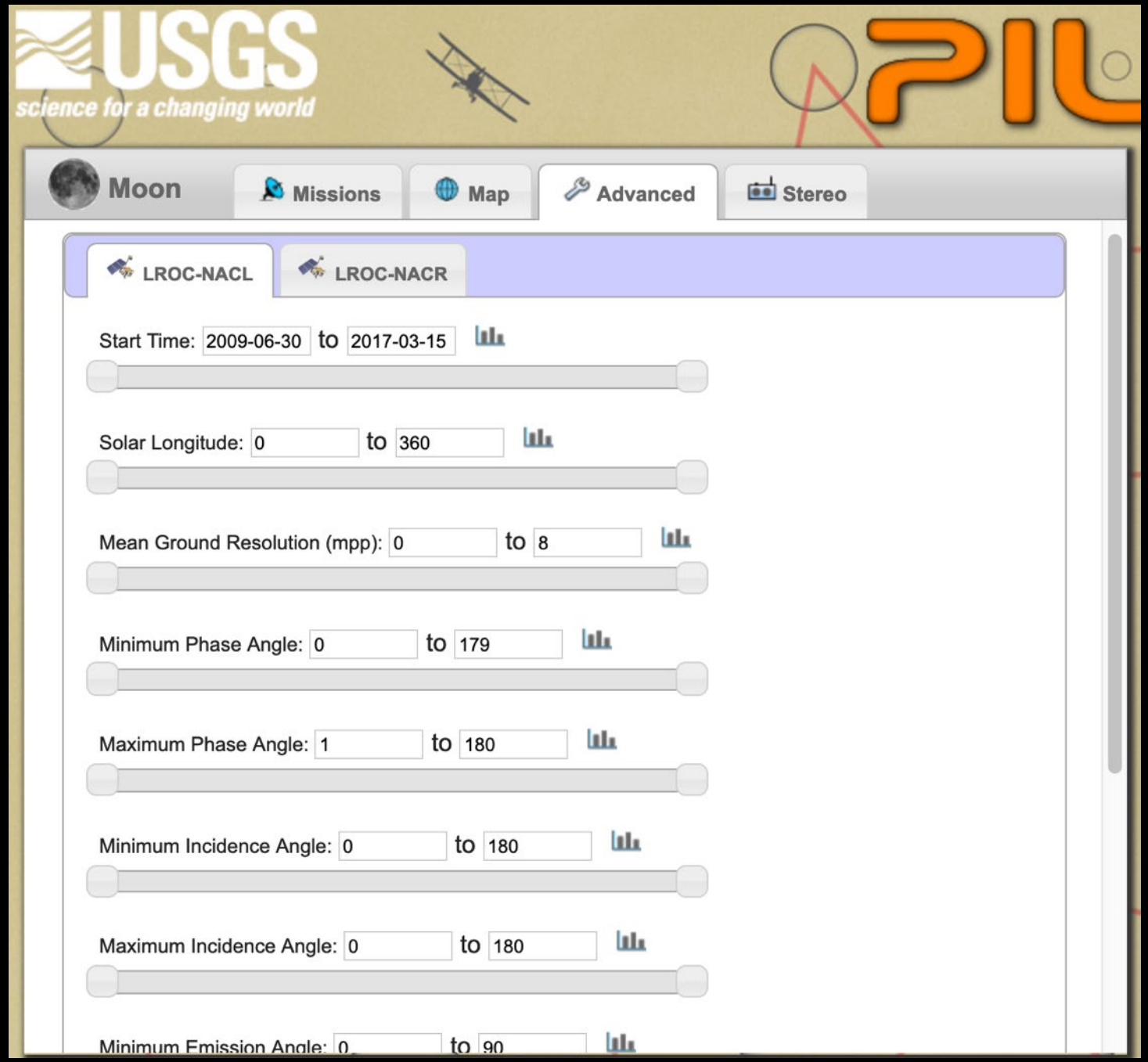


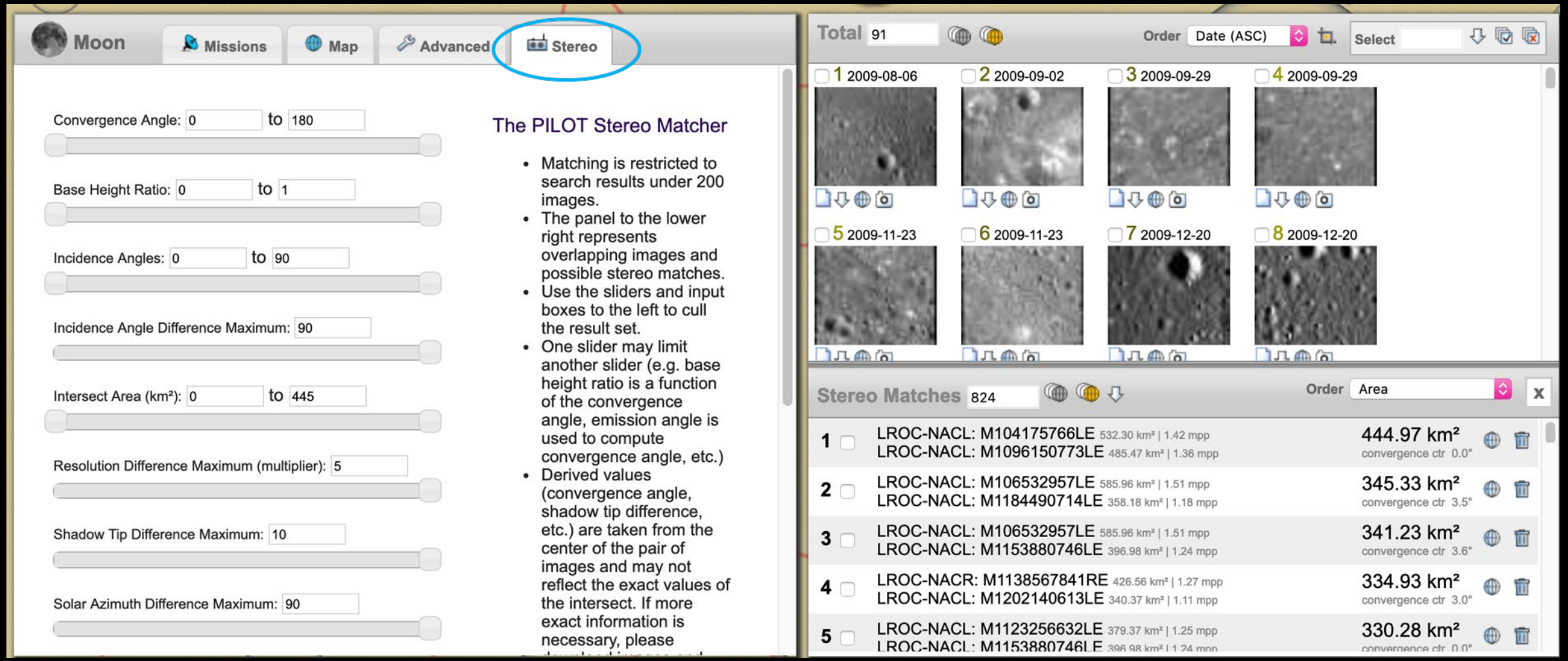
To view the metadata for an image, click on the icon at the bottom left of its thumbnail.



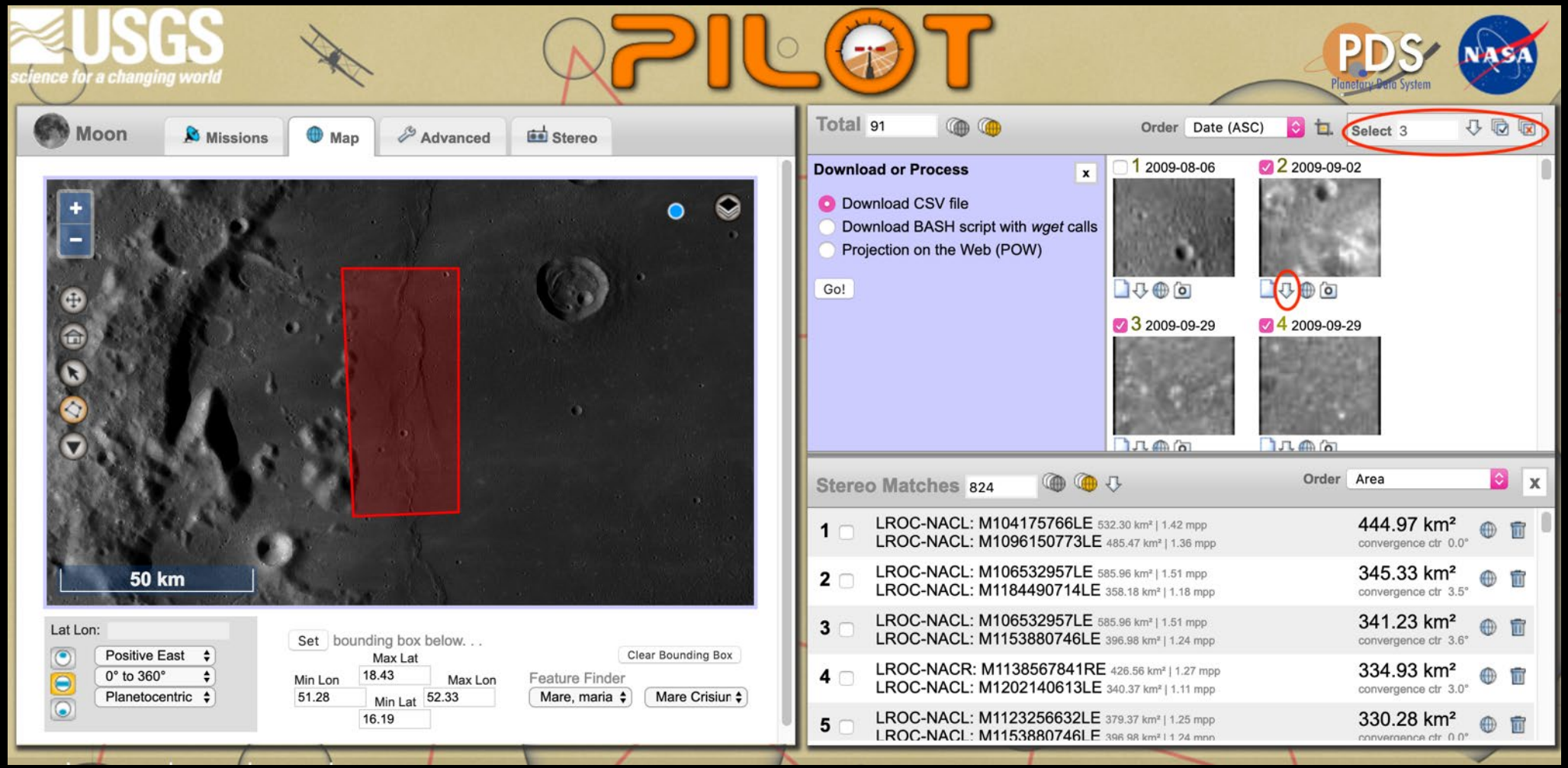
To view a zoomed-in version of the selected full image, click on the camera icon at the bottom right of the thumbnail.

Another way to get a smaller and more relevant set of images is to filter by metadata. To do this, click on the Advanced tap at the top of the screen and move the sliders or manually input a specific range for each criteria you want to filter by. This will return only the images within the bounding box you set that match these criteria.

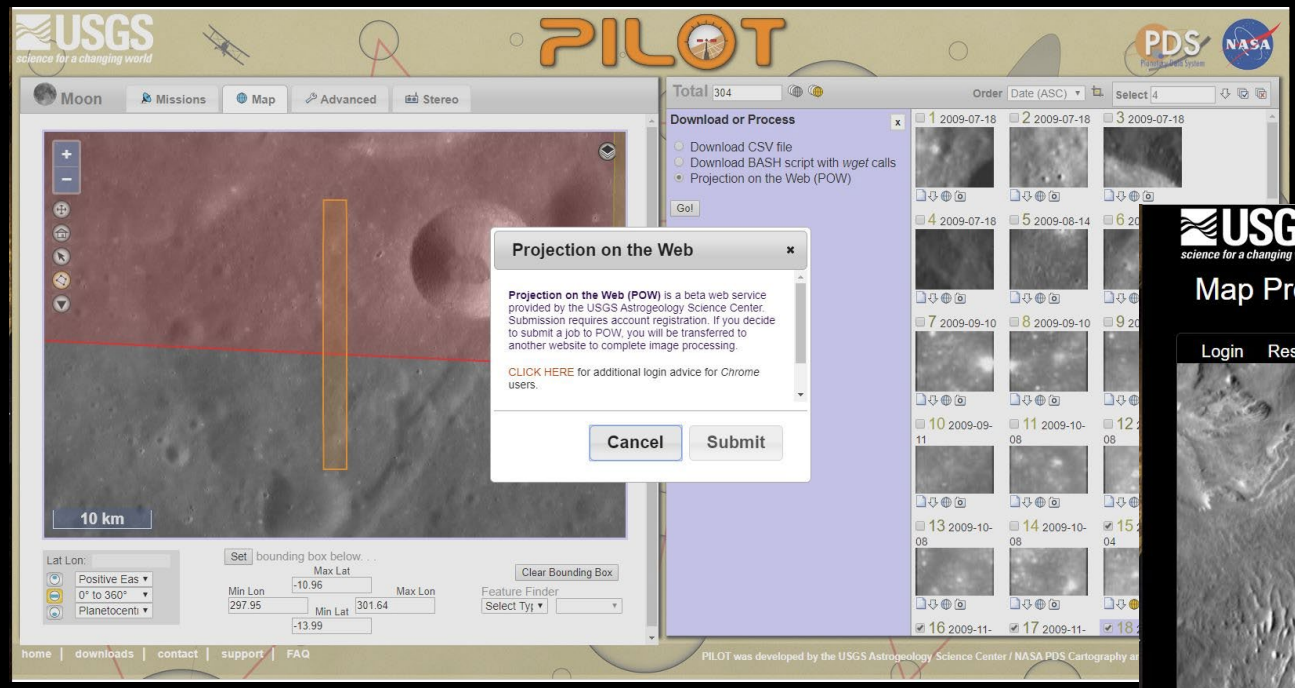


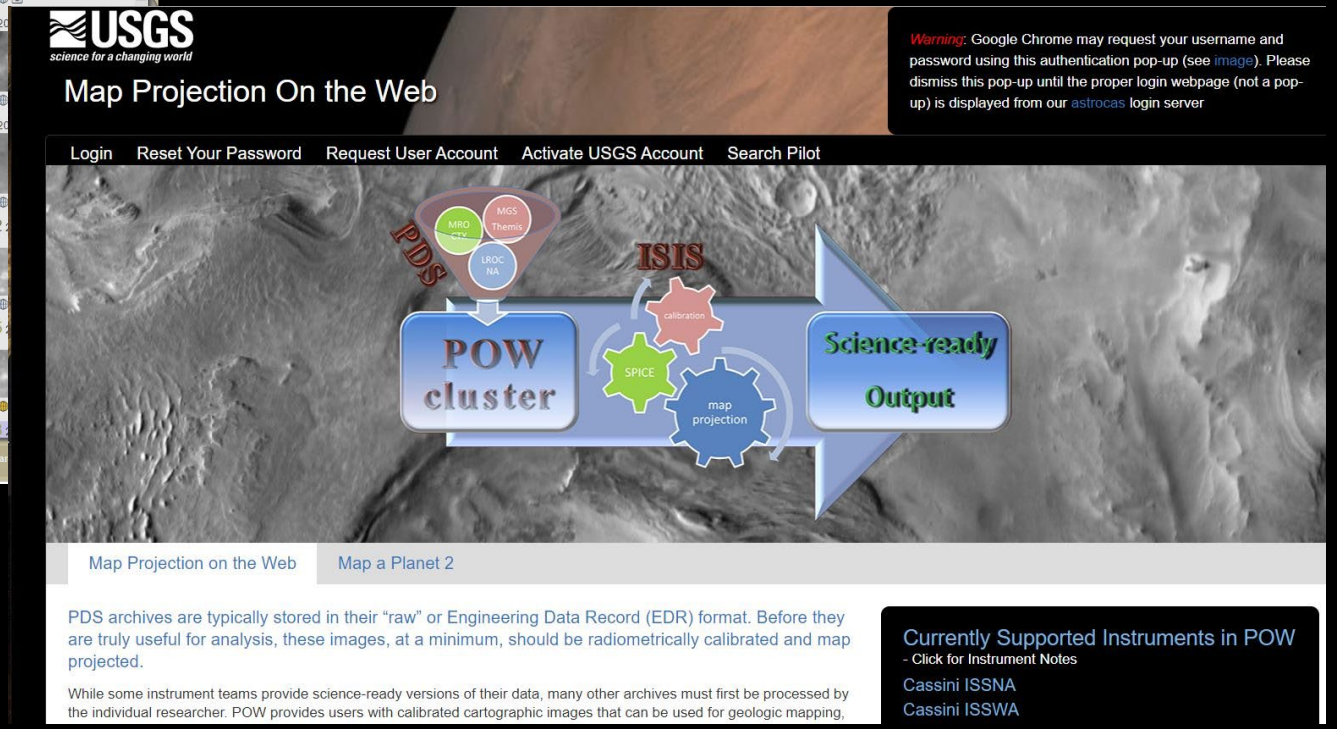


To search for stereo pair images for making Digital Elevation Models (DEMs), click on the Stereo tab at top right of the left panel. This tools is limited to 250 images or less, so I have drawn an even smaller bounding box. The Stereo tab allows you to filter images within your bounding box even further by choosing only those images that fall within your selected criteria. The identified stereo pairs are listed on the bottom right of the screen. View each one on the map by clicking on the globe icon to the right of the names of the images.



To download an individual image as a .IMG (PDS native image format) file, click on the white down arrow beneath the thumbnail. To download more than one image at a time, or to process before downloading, select one or more images using the box above the thumbnail and choose from the download options. The first option will download a CSV (comma separated values table) file with some metadata about each image and a link to download the .IMG file. The second option will give you a script to download the images with a BASH script using wget. The third option will take you to Projection on the Web (POW).





If you select Projection on the Web (POW, see https://astrocloud.wr.usgs.gov/), you will be directed to a site to create a user account and log in before submitting your job. POW allows users to submit up to 50 selected images to be processed by ISIS at USGS before returning the processed images to the user. Typical processing steps are radiometric calibration and map-projection. Please refer to the POW site linked above for more information on that tool and how to use it.