# THE CARTOGRAPHY & IMAGING SCIENCES NODE OF THE NASA PLANETARY DATA SYSTEM

AKA The Imaging Node ("Imaging," IMG, PDS-IMG)

*PI, Science Lead:* **Lisa Gaddis (USGS, Astrogeology)**

*Co-I, Technical Lead: Myche McAuley* **(JPL)**

- **Curator of NASA's larger digital image collections from past, present and future planetary missions**
  - Terrestrial planets, icy satellites
  - **~1.5 PB**, growing ~100 TB/yr

- **Develops & supports archive standards for**
  - Image data formats
  - Documentation of observation and acquisition parameters, image properties, etc. (metadata)
  - Image calibration, documentation

- **Supports validation, delivery of digital image archives, ancillary & supporting information**
  - Landed and orbital cameras and imagers, metadata
  - Cartographic products such as mosaics, maps, DEMs, geospatial databases, etc.
  - Links to heritage, publications, figures, etc.

- **Leverages USGS/ISIS software to serve processed, derived data products**
  - *When ISIS is used*, supports pipeline processing from raw to calibrated, photometrically corrected, map-projected products

https://pds-imaging.jpl.nasa.gov/

# Science Discipline Focus: Cartography & Imaging Science

- ⦿ Interdisciplinary expertise
  - Instrument/image geometry, cartographic data acquisition & processing
  - Orbital & landed camera instrument design, data processing & calibration
    - ○ Detailed geometric & physical characterization of cameras
  - Planetary remote sensing at UVVIS to thermal to RADAR wavelengths
    - ○ Single, multi- and hyperspectral images
  - Cartographic & geospatial data analysis
    - ○ Geographic information systems, geologic & thematic mapping, 3D terrain mapping & analysis, slope & hazard mapping, site characterization
  - Data engineering & informatics, data mining

- ⦿ Serves data from the NASA collection of digital planetary images
  - Terrestrial planetary surfaces
    - ○ Mercury, Venus, Earth, Moon, Mars, Mars' moons Phobos and Deimos, asteroids Gaspra, Ida
  - Icy and outer Solar System satellites, dwarf planets
    - ○ 9 moons of Jupiter (Io, Europa, Ganymede, Callisto, etc.)
    - ○ 23 moons of Saturn (Titan, Enceladus, Iapetus, etc.)
    - ○ 2 moons of Neptune (Triton, Nereid)
    - ○ 5 moons of Uranus (Ariel, Titania, etc.)
    - ○ Vesta, Ceres, Pluto, Charon

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- ## Mission Interface
  - Work with imaging instrument teams to ensure cost-effective data delivery to PDS and public
  - Apply systems engineering principles to data to ensure rapid identification, easy access & download of PDS data
- ## Data Delivery & Cartographic Support
  - Support delivery of planetary image data in raw & derived formats
  - Deliver improved ancillary data (pointing, calibration) resulting from radiometric, geodetic & cartographic processing, restoration, scientific research, etc.
- ## Data User Support
  - Maintain and support online data, provide state-of-the-art search & access tools
  - Provide sophisticated tools & instructions for simple to complex data interaction by users
  - Provide training, expert assistance to users for cartographic and scientific data analysis (LPSC, Planetary Data Users workshops, etc.)
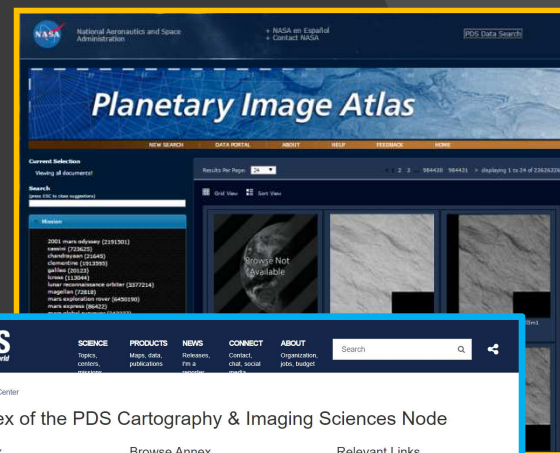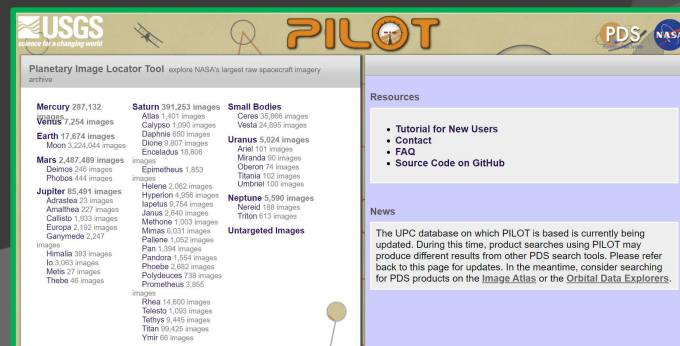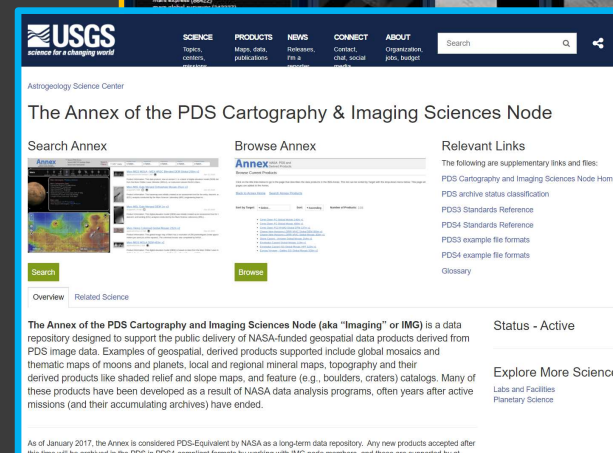
# IMG OFFERS BOTH DATA DELIVERY SYSTEMS

- **Planetary Image Atlas**
- **Data Portal**
- **Photojournal**
- **Map-A-Planet**
- **Annex**

# AND DATA PROCESSING SYSTEMS

- **Planetary Image Locator Tool (PILOT)**
- **Map Projection on the Web (POW)**

https://pds-imaging.jpl.nasa.gov/

- ◎ **Planetary Image Atlas**
  - • Faceted searches based on image label data, geographic coordinates, etc.
    - ○ Start by selecting Mission at the top, then Instrument, etc.
    - ○ View results as browse at right
    - ○ Select desired images, then download or bulk download (includes labels)
  - • *Beta:* Supports landmark feature classification and searches or "Image Content"
    - ○ Available for MRO HiRISE, MSL MAHLI & MASTCAM, Cassini ISS and Galileo SSI images
    - ○ Features: Craters, dark streaks, dunes, etc.
  - • Online tutorial:
    - ○ https://pds-imaging.jpl.nasa.gov/Atlas/intro.html
  - • https://pds-imaging.jpl.nasa.gov/search/

https://pds-imaging.jpl.nasa.gov/

# IMG Data Delivery Systems (2 of 4)

## Data Portal

- All image data served by IMG, sorted by mission name
- Links to online data directories & Atlas for image selection
- Links to mission documentation
- https://pds-imaging.jpl.nasa.gov/portal/

## Photojournal

- Press-release images, other quick-release "pretty pictures" from NASA missions
- Captions and variable image resolutions available
- https://photojournal.jpl.nasa.gov/

https://pds-imaging.jpl.nasa.gov/
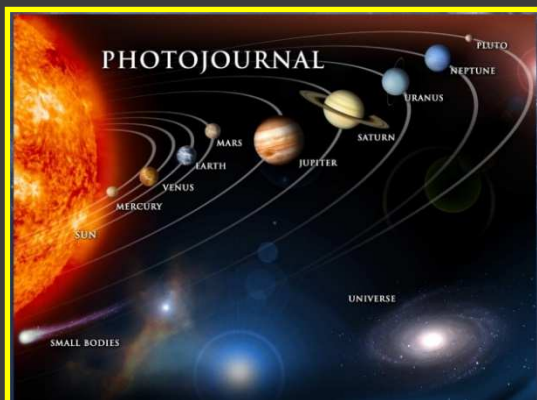
# IMG DATA DELIVERY SYSTEMS (3 OF 4)

- **Map-a-Planet (MAP)**
  - Serves map-projected mosaics & derived data from PDS images
    - **158 products right now!**
  - Basemaps for EDR searches at IMG and GEO
  - Standardized Web Mapping Services (WMS) for ~all mapped bodies
  - Supports cartographic extraction and some translation and/or reformatting of data products
  - Online tutorial:
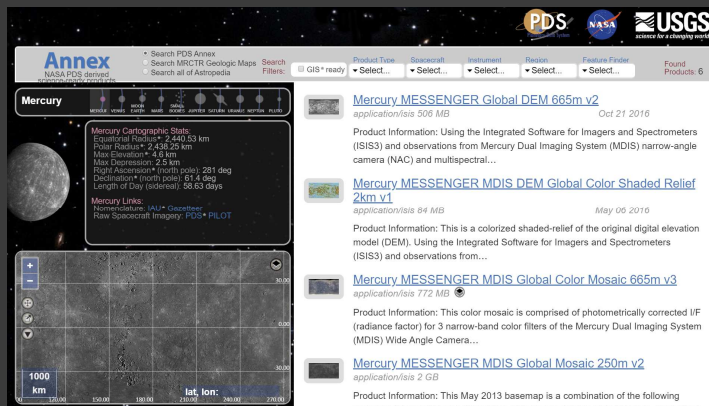    - ftp://pdsimage2.wr.usgs.gov/pub/pigpen/tutorials/Map-a-Planet2_MAP2_Oct2015.pdf
  - https://astrogeology.usgs.gov/tools/map-a-planet-2

https://pds-imaging.jpl.nasa.gov/
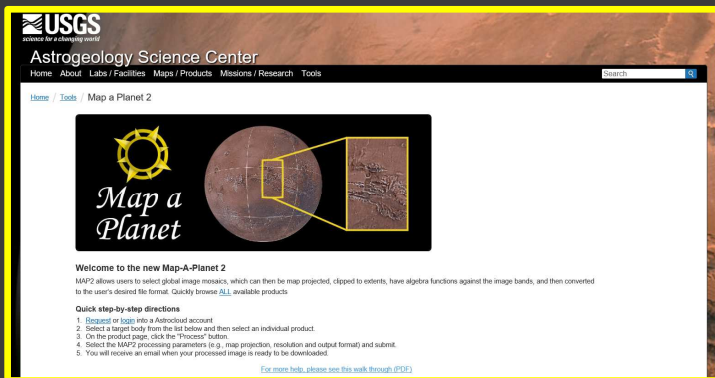
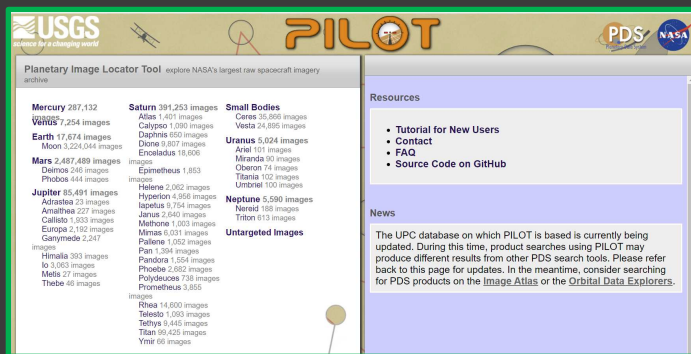# IMG Data Delivery Systems (4 of 4)
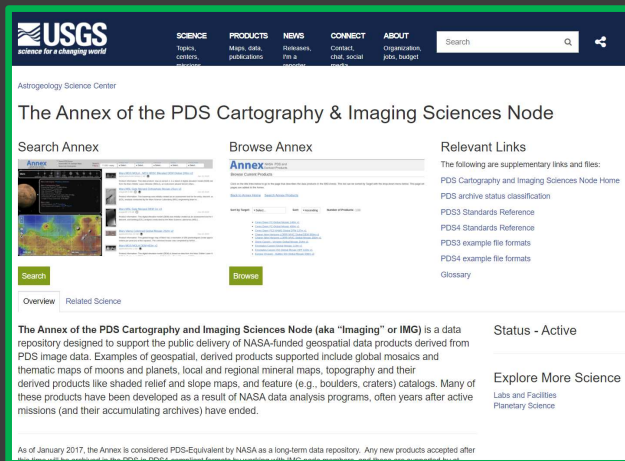
◉ **The Annex of IMG**

- Repository for NASA-funded geospatial products derived from PDS products
  - Mosaics, maps, shapefiles, tables
  - 108 products right now!
- Map-based search or browse list
- Retains heritage to source data & metadata
- Links to publications, accuracy information, etc.
- Online tutorial:
  - https://prd-wret.s3-us-west-2.amazonaws.com/assets/palladium/production/atoms/files/Annex_Tutorial_2020.pdf
- https://www.usgs.gov/centers/astrogeology-science-center/science/annex-pds-cartography-imaging-sciences-node

https://pds-imaging.jpl.nasa.gov/

# IMG DATA PROCESSING SYSTEMS (1 OF 2)



- **Planetary Image Locator Tool (PILOT)**
  - Uses Unified Planetary Coordinates (UPC) database to standardize coordinates
  - Supports PDS image data <u>for which there is an ISIS3 camera model</u>
    - Accurate, detailed surface placement
    - About 95% of IMG data holdings supported
  - Geospatial and parameter search of PDS EDR image archives
  - Ties to online POW processing tools
  - Online tutorial (thanks to Rose Borden!):
    - https://pilot.wr.usgs.gov/doc/PILOT_Tutorial_lg_12.16.19.pdf
  - https://pilot.wr.usgs.gov/

https://pds-imaging.jpl.nasa.gov/

# IMG DATA PROCESSING SYSTEMS (2 OF 2)

- **Projection on the Web (POW) Service**
  - From PILOT, users can send selected images straight to ISIS3 for processing on a compute cluster
  - Runs ISIS3 cartographic software directly (*no need to download and run it!*)
  - Pipeline data processing from raw to fully processed data products for up to 50 images (soon to be 200 images)
  - Online tutorial:
    - ftp://pdsimage2.wr.usgs.gov/pub/pigpen/tutorials/Map_Projection_on_the_web_POW_March2013.pdf
  - https://astrocloud.wr.usgs.gov/

https://pds-imaging.jpl.nasa.gov/

# IMG also works with 3 NASA (Mission) Data Nodes:

- **Lunar Reconnaissance Orbiter (LRO) Cameras (LROC) (ASU)**
  - Serves a wide variety of LROC EDR, CDR, RDR products
    - Images, mosaics, derived products, maps, GIS shapefiles, etc.
  - About **1.1 PB** of data at present
  - https://www.lroc.asu.edu/archive

- **Mars Odyssey THEMIS (ASU)**
  - Search image directories, browse collections, analyze with JMARS
  - Numerous derived data products
  - About **30 TB** of data at present
  - https://themis.asu.edu/

- **Mars Reconnaissance Orbiter HiRISE (Univ AZ)**
  - Search image catalog, browse collections, view with HiView
  - Numerous derived data products
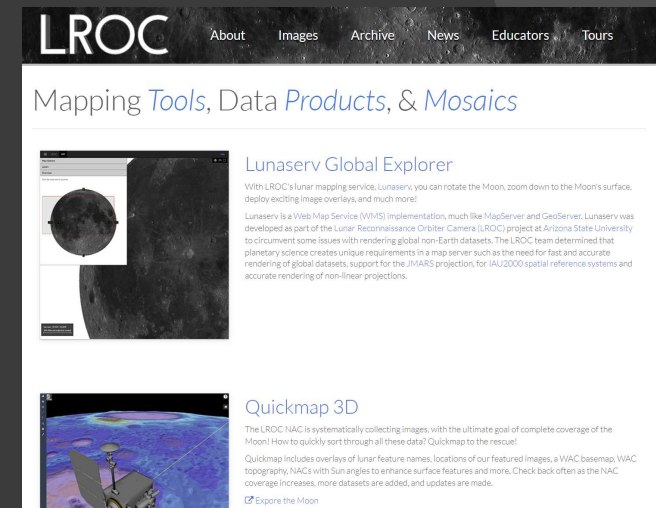  - About **190 TB** of data at present
  - https://hirise.lpl.arizona.edu/

https://pds-imaging.jpl.nasa.gov/

# IMG Data Nodes (1 of 3):

- ◉ **Lunar Reconnaissance Orbiter (LRO) Cameras (LROC)**
  - Serves a wide variety of LROC EDR, CDR, RDR products
    - ○ Images, mosaics, derived products, maps, GIS shapefiles, etc.
    - ○ About **1.1 PB** of data at present
  - Several ways to search for products
    - ○ WMS Map interface: http://wms.lroc.asu.edu/lroc
    - ○ QuickMap 3D viewer: https://quickmap.lroc.asu.edu/
    - ○ Thumbnail browser: http://wms.lroc.asu.edu/lroc/thumbnails
    - ○ Metadata search: http://wms.lroc.asu.edu/lroc/search
    - ○ RDR (mosaics, maps) products: http://wms.lroc.asu.edu/lroc/rdr_product_select

  - https://www.lroc.asu.edu/archive

https://pds-imaging.jpl.nasa.gov/

# IMG Data Nodes (2 of 3):

- **Mars Odyssey THEMIS (ASU)**
  - Numerous data and derived data products
    - THEMIS, CTX, HRSC, HiRISE, MOC, Viking coverages
  - Several ways to find data:
    - Search based on metadata: http://viewer.mars.asu.edu/viewer/themis#T=0
    - Interactive maps: https://themis.asu.edu/maps
  - Analyze and view data with JMARS:
    - https://jmars.mars.asu.edu/
  - About **30 TB** of data at present

  - https://themis.asu.edu/



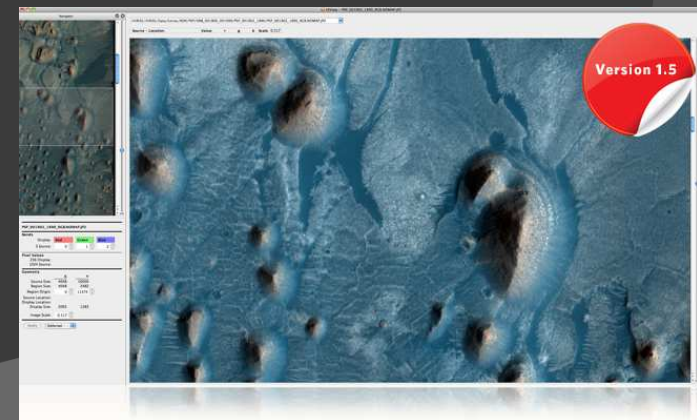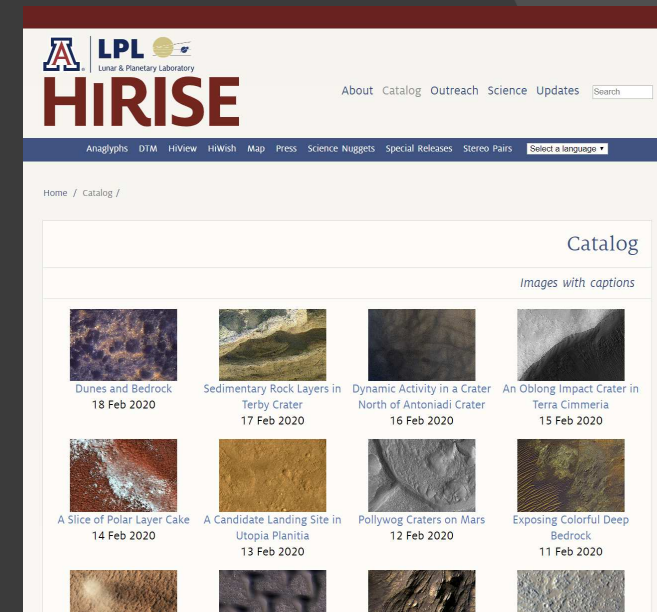https://pds-imaging.jpl.nasa.gov/
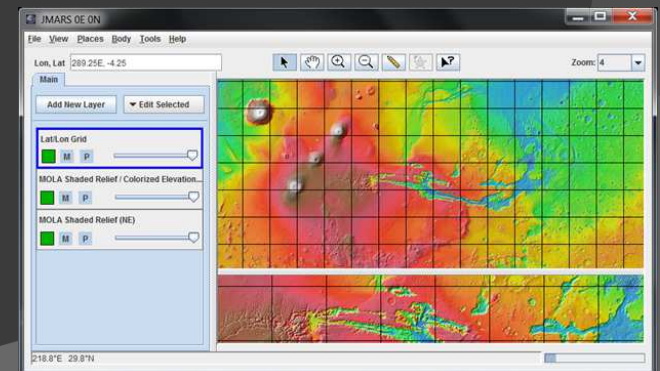
# IMG Data Nodes (3 of 3):

◉ **MRO HiRISE (Univ AZ)**

- Search image directories, browse catalog
- Numerous derived data products (anaglyphs, DTMs, mosaics) and press-release images
- Map-based search
- Analyze and view data with HiView:
  - https://pirlwww.lpl.arizona.edu/software/registration/registration.cgi?software=HiView
- About **190 TB** of data at present

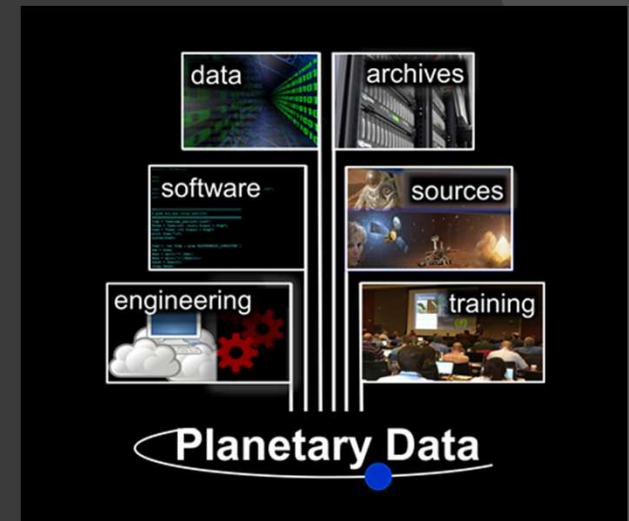- https://hirise.lpl.arizona.edu/

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