National Aeronautics and Space Administration

Tools and Data From NASA Planetary Science Missions

Planetary Science Division

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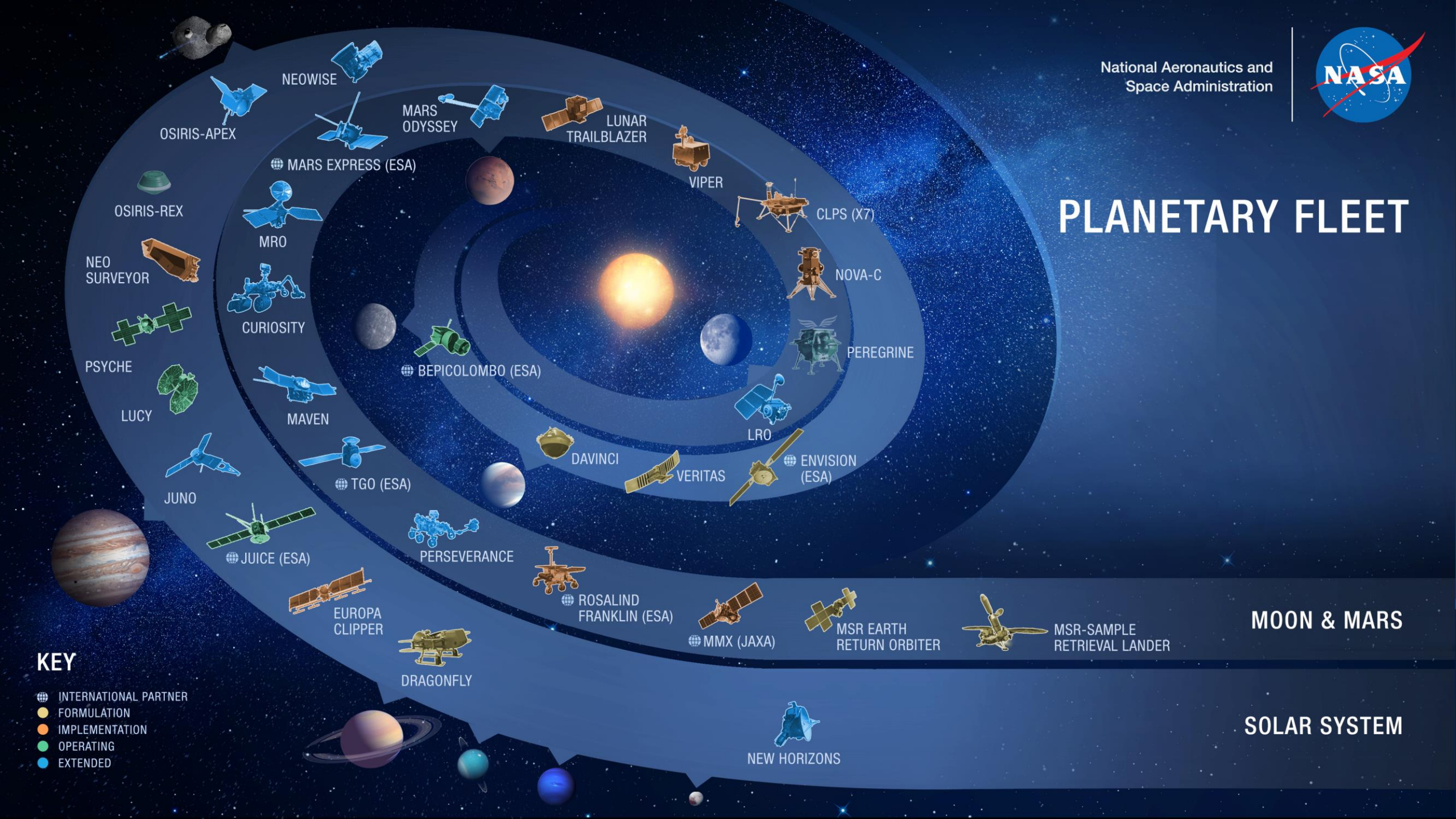
Disclaimers

- Presenting highlights of data and tools available.
  - Intended to give you a starting point for exploring ways to access, explore, and analyze planetary science data without significant technical or scientific expertise.
  - This is not meant to be an exhaustive list of all datasets and analysis tools available to the planetary science community.
- All information was gathered from publicly available information, and primarily on the dataset or tool website.
  - Descriptions of tools and/or datasets may not be exhaustive or complete; additional capabilities may exist. User is encouraged to further explore these examples.
- Any use of trade, firm, or product names is for descriptive purposes only and does not imply endorsement by the U.S. Government.


National Aeronautics and Space Administration
NASA
PLANETARY FLEET
NEOWISE
OSIRIS-APEX
MARS ODYSSEY
LUNAR TRAILBLAZER
MARS EXPRESS (ESA)
VIPER
CLPS (X7)
OSIRIS-REX
MRO
NEO SURVEYOR
NOVA-C
CURIOSITY
PSYCHE
BEPICOLOMBO (ESA)
PEREGRINE
LUCY
MAVEN
LRO
DAVINCI
VERITAS
ENVISION (ESA)
TGO (ESA)
JUNO
JUICE (ESA)
PERSEVERANCE
ROSALIND FRANKLIN (ESA)
EUROPA CLIPPER
MMX (JAXA)
MSR EARTH RETURN ORBITER
MSR-SAMPLE RETRIEVAL LANDER
MOON & MARS
DRAGONFLY
NEW HORIZONS
SOLAR SYSTEM
KEY
INTERNATIONAL PARTNER
FORMULATION
IMPLEMENTATION
OPERATING
EXTENDED

Planetary Data System (PDS)

- PDS is NASA's long-term archive of digital data products returned from NASA's planetary missions.
  - Atmospheres (ATM)
    - Non-imaging atmospheric data
  - Cartography and Imaging Sciences (IMG)
    - Digital image collections
  - Geosciences (GEO)
    - Related to the surface and interiors of terrestrial bodies
  - Planetary Plasma Interactions (PPI)
    - Related to the study of the interaction between the solar wind and planetary winds with planetary magnetospheres, ionospheres, and surfaces
  - Ring-Moon Systems (RMS)
    - Relevant to planetary systems, including planets, rings, and moons and the way they interact.
  - Small Bodies (SBN)
    - Relevant to asteroids, comets, and interplanetary dust
- Data available at: https://pds.nasa.gov/

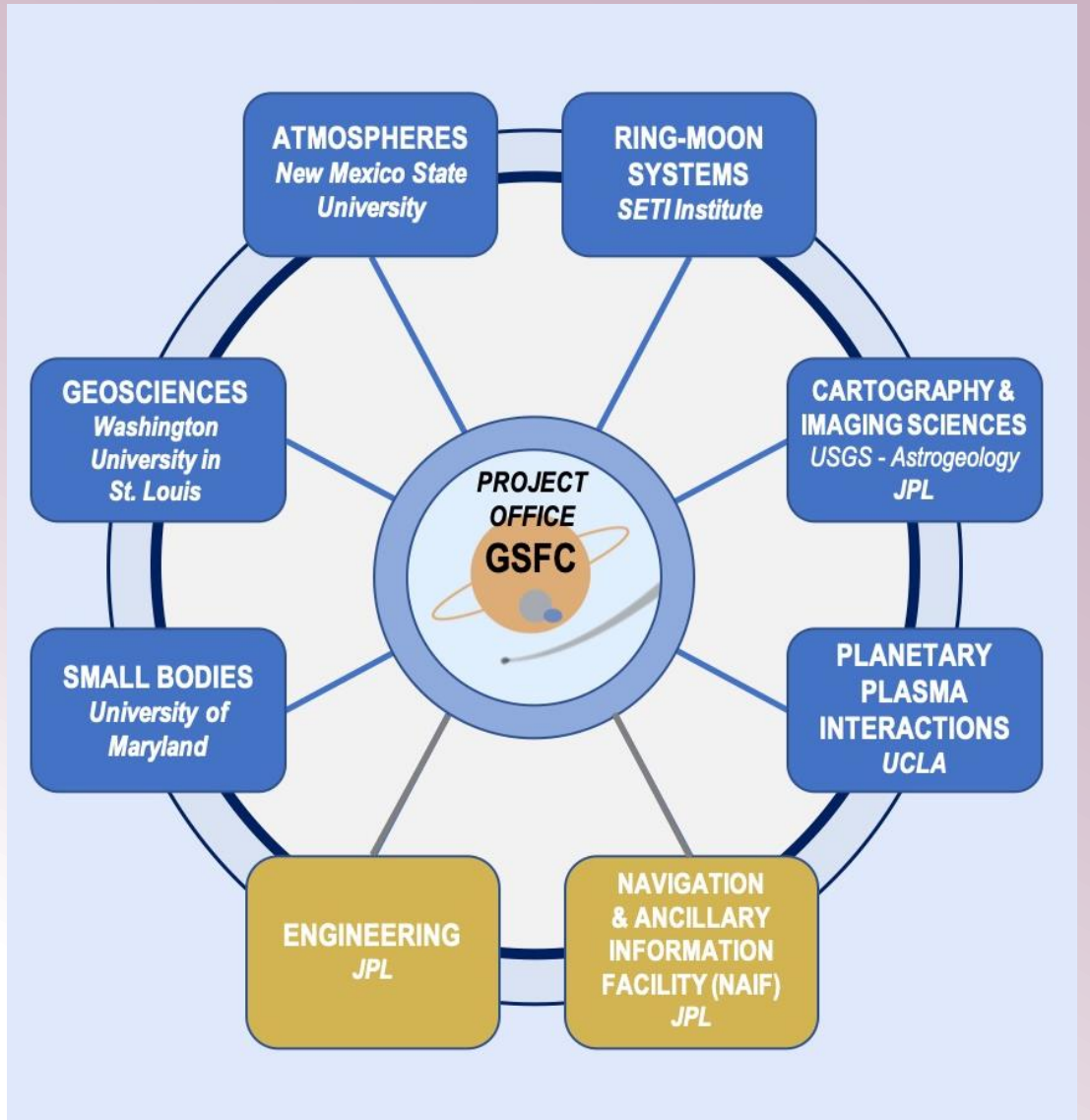


Image credit: https://pds.nasa.gov/home/about/

Analyst's Notebook – Landed Missions

- PDS Geosciences Node Analyst's Notebook
- Tool for accessing the science data archives from NASA landed Mars and lunar missions
- Missions supported: Perseverance, Curiosity, InSight, Opportunity and Spirit, Phoenix, LCROSS, Apollo
- Features
  - Customizable searches for data, targets, and documentation
  - Interactive plot showing rover traverse over time
  - Information on samples collected for return to Earth
  - High-level view of the mission describe by the science and instrument teams
- Web-based service: https://an.rsl.wustl.edu/

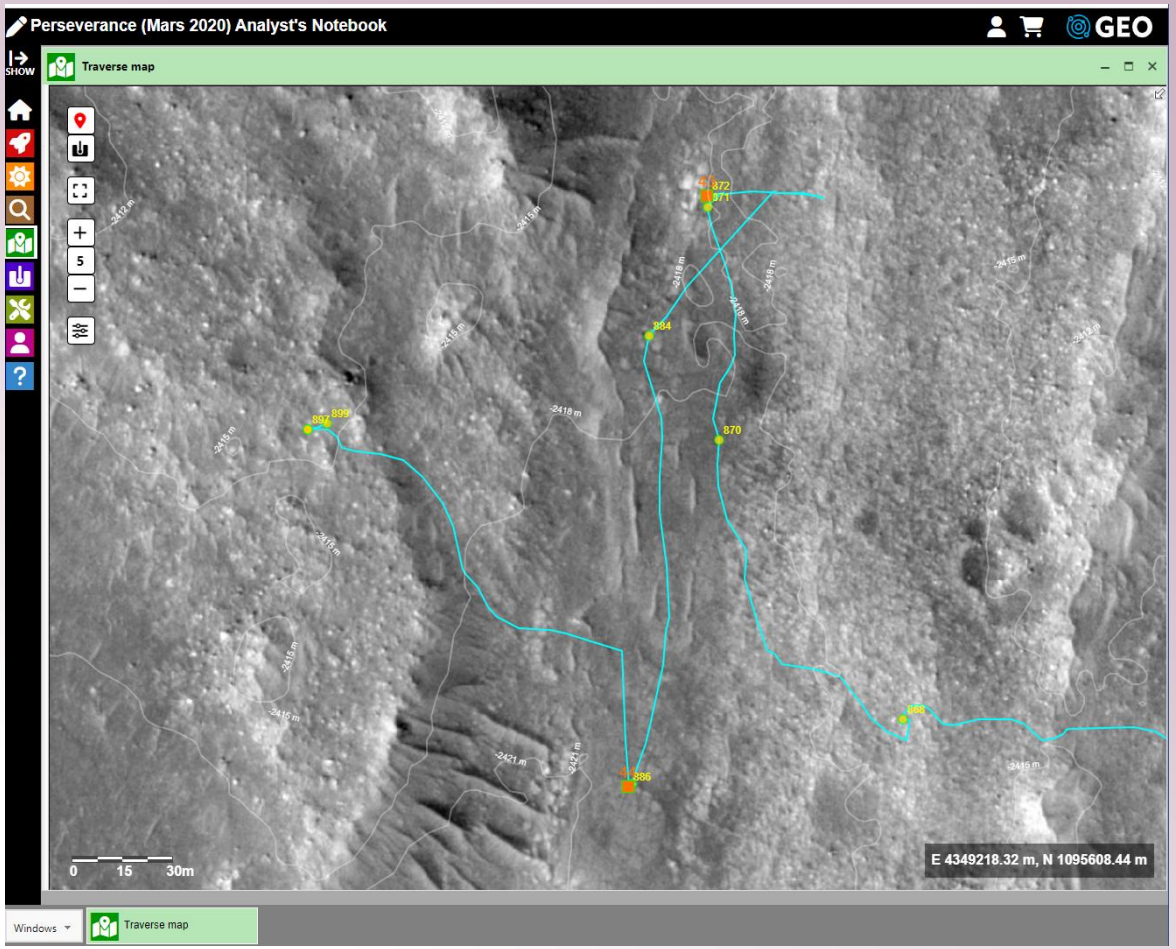
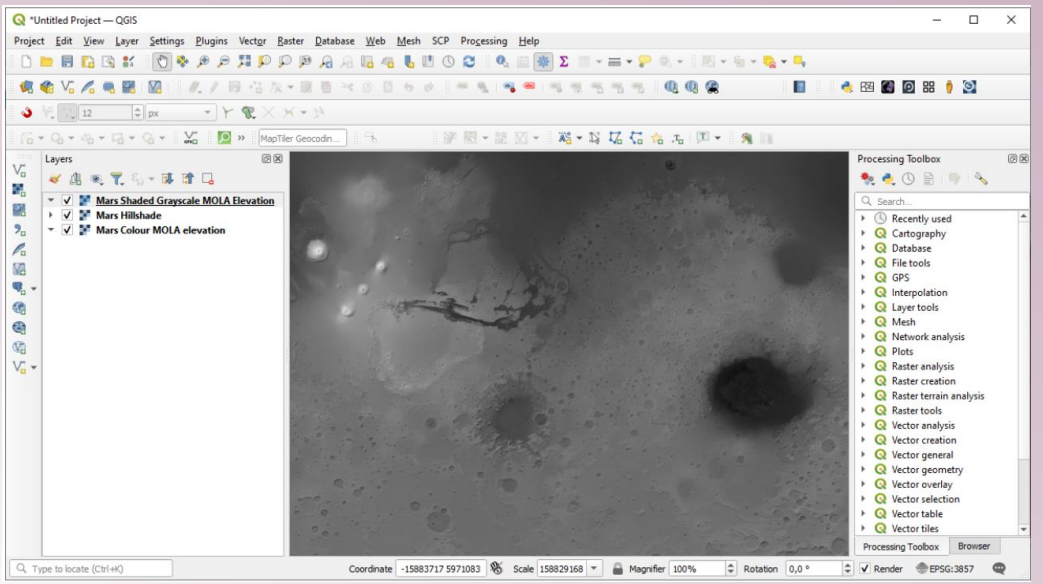


Image credit: Perseverance example; https://an.rsl.wustl.edu/m20/AN/an3.aspx

QGIS – Free and Open-Source GIS

- Create, edit, visualize, analyze and publish geospatial data
  - Highly capable GIS software platform; relatively high learning curve
- Targets supported: Any target with geospatial data
  - Users import individual datasets and builds custom projects
- Features
  - Extensive analysis capabilities
    - Can write custom analysis functions and run those functions on data in QGIS
    - Vector and raster data analysis
  - Data analysis plug-ins are available (or can be written)
  - Data export function
  - Extensive training material
    - User guide, training manual, QGIS tutorials, books
- Website to download: https://www.qgis.org/en/site/forusers/download.html
  - Supported on Mac, Windows, Linux, Berkeley Software Distribution (BSD), and Apps for mobile and tablet



Illustrating a Mars shaded MOLA elevation plug-in; Image credit: https://www.giscourse.com/openplanetary-tile-loader-qgis-plugin/

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JMARS - **J**ava **M**ission-planning and **A**nalysis for **R**emote **S**ensing

- View and perform basic analytics of geospatial orbital data by importing multiple data layers
- Targets currently supported: Mercury, Venus, Moon, Mars, and Jupiter
- Features
  - Can save the state of an entire JMARS session to a file for later use
  - Adjust the opacity of datasets
  - Import custom datasets as data layers
  - Visually compare and plot data values
  - Impact Crater Analysis (in beta)
  - Data export function
- Website to download: https://jmars.asu.edu/
  - Supported on Mac, Windows, Linux, and Solaris

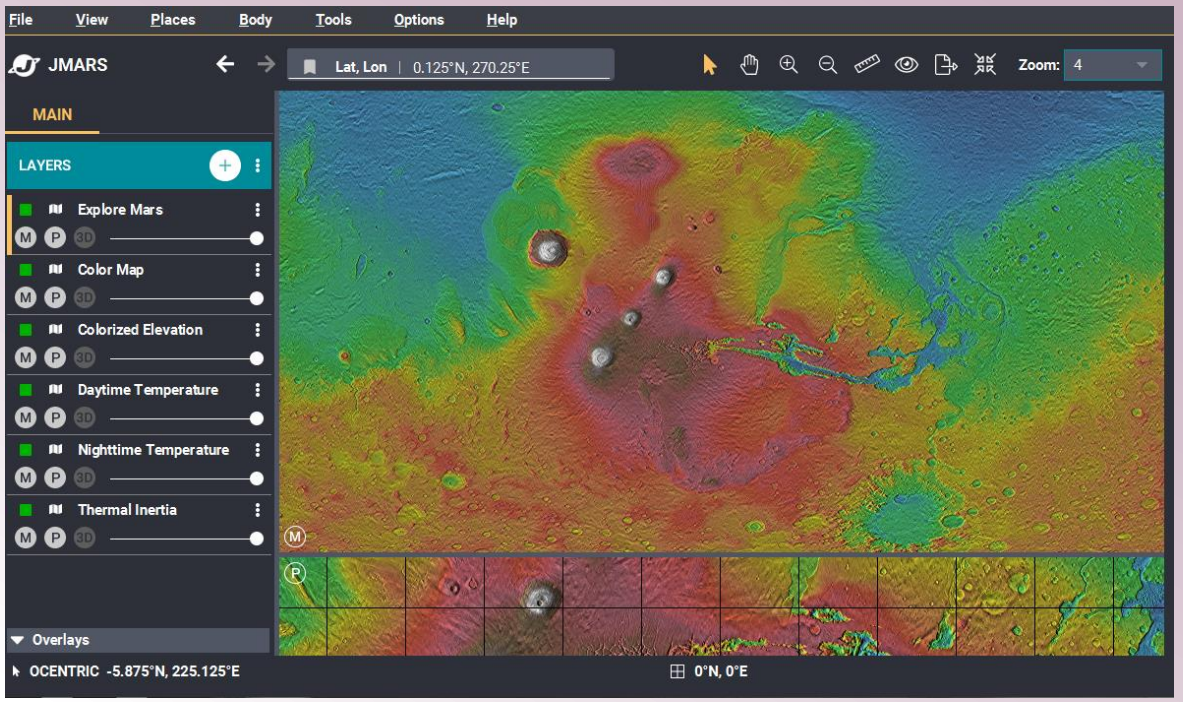

Image credit: https://jmars.asu.edu/tour-interface/overview

JMARS team has four posters during the Tuesday poster session

Solar System Treks

- View and perform basic analytics of geospatial orbital data by importing multiple data layers
- Targets supported:
  - Planets: Mercury, Venus, Mars
  - Moons: Europa, Ganymede, Icy Moons, Moon, Phobos, Titan
  - Asteroids: Bennu, Ceres, Ryugu, Vesta
- Features
  - Calculate distance, elevation, sun angles
  - 3D visualization
  - 3D printing
  - Can download products
  - Most map layers are available through a RESTful tile service
- Web-based service: https://trek.nasa.gov/#

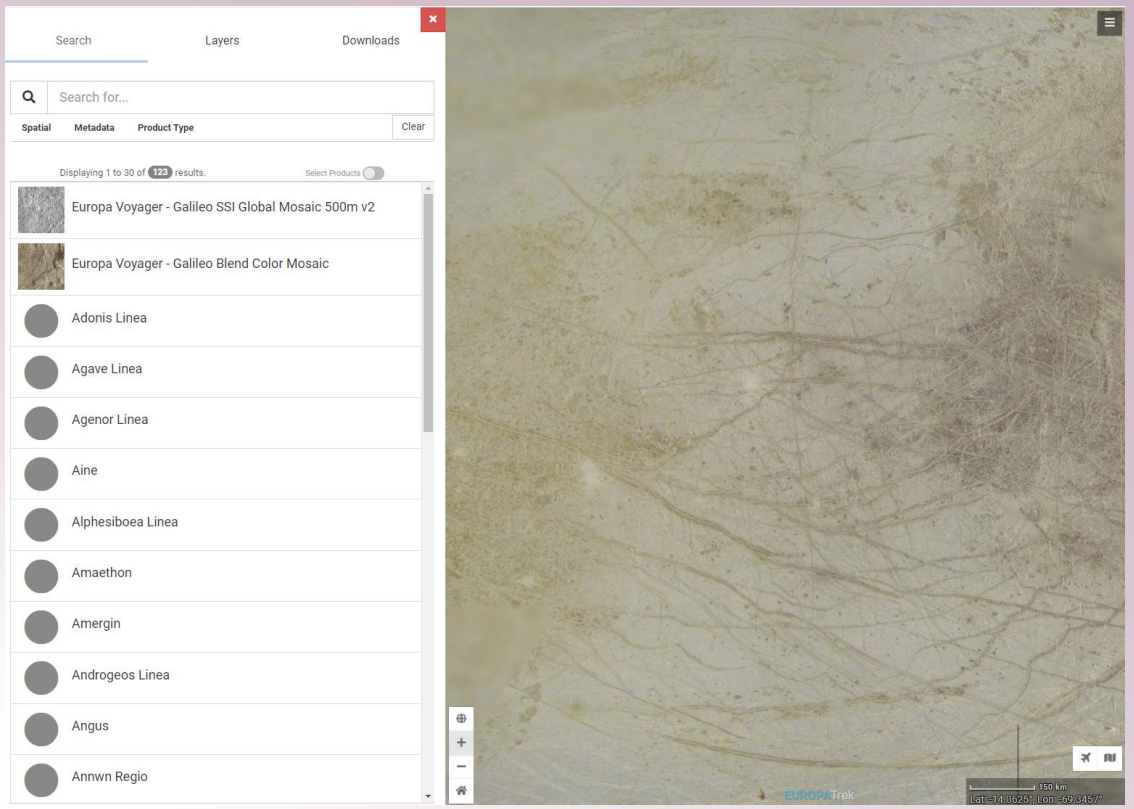

Image credit: https://trek.nasa.gov/europa/

QuickMap

- View and perform basic analytics of geospatial orbital data by importing multiple data layers
- Targets supported: Mercury, Venus, Mars, Moon
- Features
  - Display lunar data from current and past missions
    - Arecibo, Clementine, Chandrayaan-1, GRAIL, Kaguya, Lunar Prospector, LRO
  - Provides metadata information for each image
    - Additional description about the image processing and image capture conditions
  - Draw polygons and select areas for plotting data
  - Enable 3D terrain
  - Data export function
- Web-based service: https://quickmap.lroc.asu.edu/

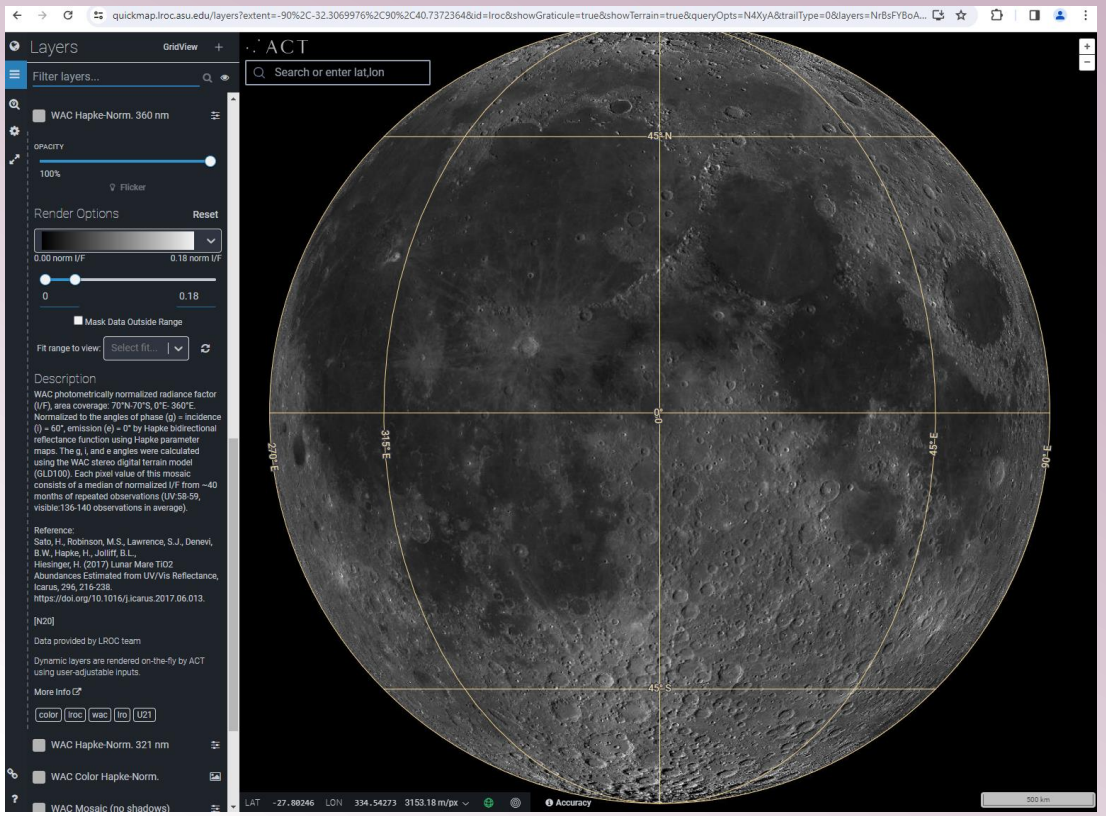

Image credit: https://quickmap.lroc.asu.edu/

Small Body Mapping Tool (SBMT)

- Search, access, and analyze spacecraft data of small bodies

- Targets supported:
  - Asteroids
    - Main Belt: Ceres, Vesta, Lutetia, Ida, Mathilde, Gaspra, Steins
    - Near-Earth: Eros, Itokawa, Bennu, Ryugu, Toutatis
  - Comets
    - Hailey, Tempel 1, Wild 2, Hartley 2
  - Moons
    - Mars: Deimos, Phobos
    - Saturn: Dione, Epimetheus, Hyperion, Janus, Mimas, Pandora, Phoebe, Prometheus, Tethys

- Features
  - Allows users to visualize and manipulate small body shape models in three dimensions
  - Built-in analysis and mapping capabilities
  - Can save a previous session and reload
  - Data export function
  - Training videos and tutorials available

- Website to download: https://sbmt.jhuapl.edu/
  - Supported on Mac, Windows, and Linux

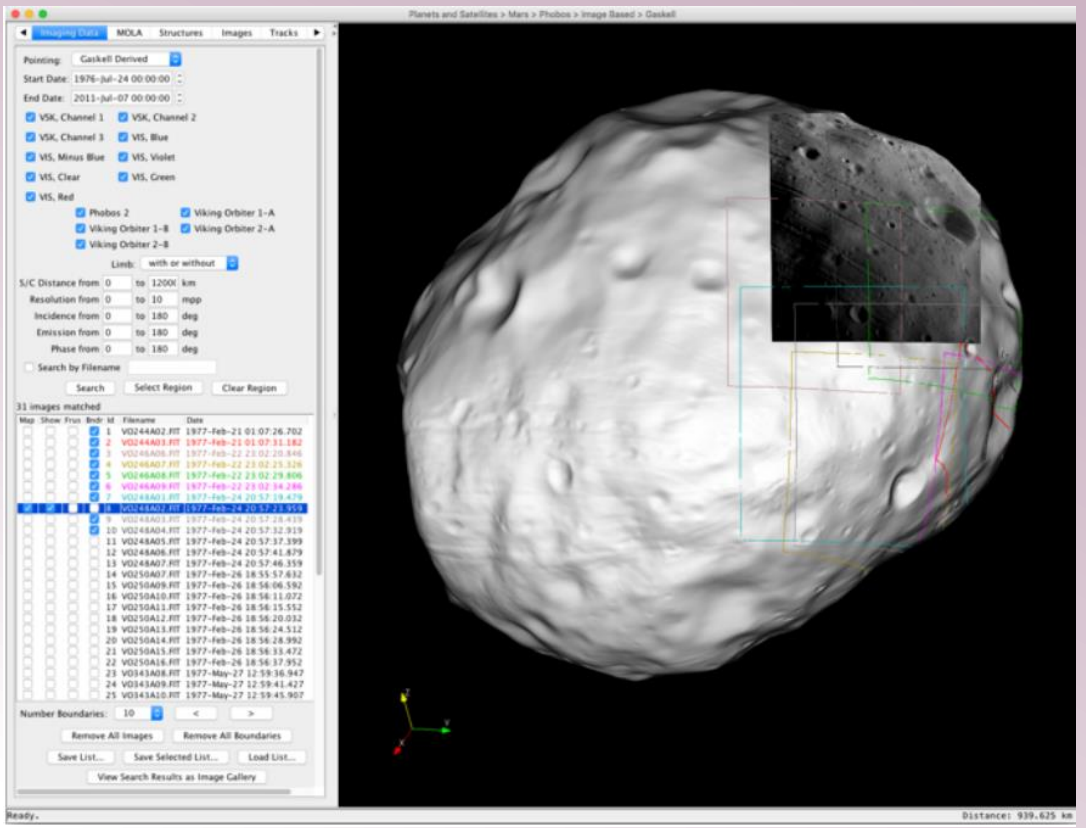

Image credit: Ernst et al., 2018, LPSC, Abs. 1043

Near-Earth Asteroids

- The Daily Minor Planet – Catalina Sky Survey
  - Examples of current Citizen Science efforts
  - Discussion Forum
  - Examples of what asteroids look like in survey images
- International Search Collaboration (IASC)
  - Provides high-quality astronomical data to citizen scientists around the world
- PDS Small Bodies Node (SBN)
  - NEO survey data
  - Catalina Sky Survey data
  - Survey data holding continues to grow
- CATCH – Comet Asteroid Telescopic Catalog Hunter
  - Search for an astronomical object with the CATCH tool
  - Features and functionality continue to be added
- NEOWISE – Space telescope to hunt for asteroids and comets

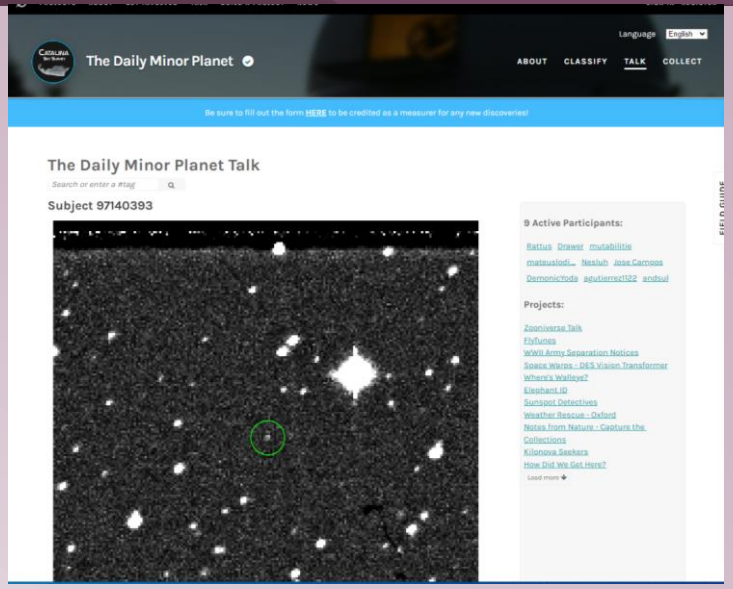

Image credit: The Daily Minor Planet; comet identified by a Citizen Scientist

Image credit: Example CATCH search for a comet (comet 243P/NEAT)

Astromaterials 3D Explorer

- A virtual library for exploration and research of NASA's space rock collections
  - Apollo lunar collection
  - Antarctic meteorite collection
- Features
  - View high-resolution 3D images of astromaterials
  - 3D images are produced using:
    - High-resolution precision photography
    - Structure-from-motion photogrammetry
    - Micro x-ray computed tomography
  - Extensive metadata of each sample
  - Data export function
    - High resolution 3D models of the rocks can be downloaded as .obj files
- Web-based service: https://ares.jsc.nasa.gov/astromaterials3d/

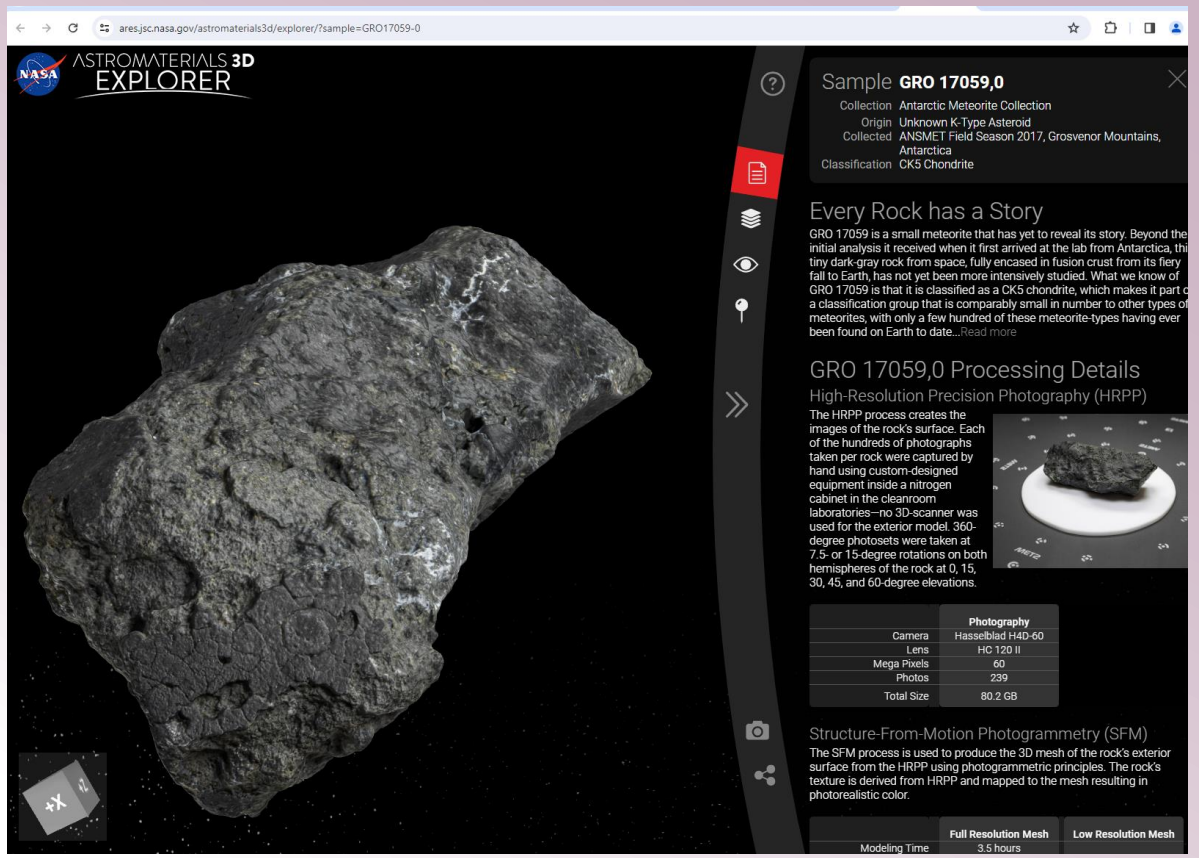

Image credit: https://ares.jsc.nasa.gov/astromaterials3d/explorer/?sample=GRO17059-0

THANK YOU!