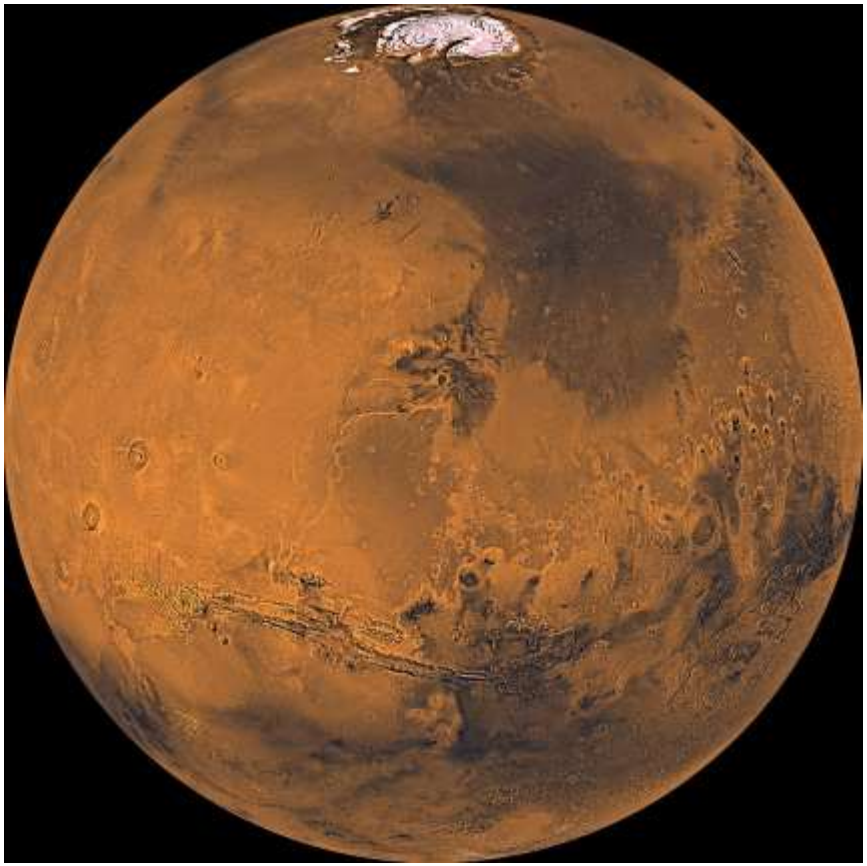
Mars – the most studied planet – similar size to Earth

Rationale for remote sensing:

- Locate future landing sites
- Search for minerals
- Search for signs of life / water



Thermal Emission Imaging System (THEMIS) 2001

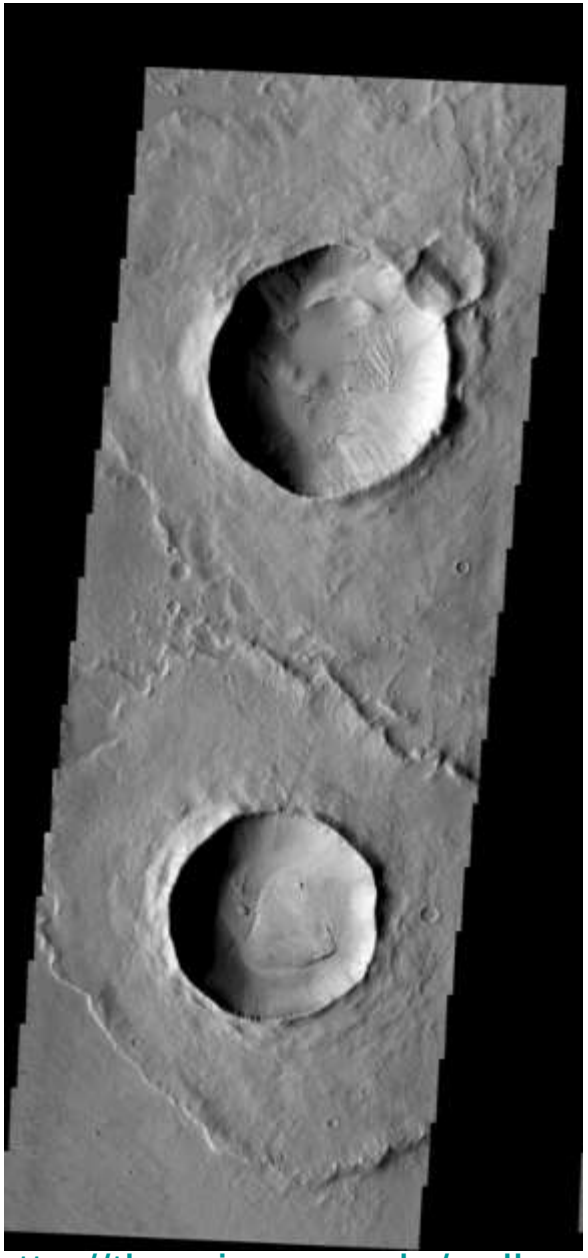
This is a special camera on the Mars Odyssey spacecraft (2001). Its main tasks are mapping rock mineralogies and detecting heat, which yields information on the Martian surface.

THEMIS is a multi-wavelength camera

5 visual bands:
0.425 microns, 0.540 microns, 0.654 microns, 0.749 microns, 0.860 microns

10 infrared bands:
6.78 microns (used twice), 7.93 microns, 8.56 microns, 9.35 microns,10.21 microns, 11.04 microns, 11.79 microns, 12.57 microns, 14.88

Resolution:
visual images, 59 feet (18 meters) per pixel
infrared images, 328 feet (100 meters) per pixel



http://themis.asu.edu/gallery

MARS ODYSSEY MISSION

THEMIS

THERMAL EMISSION IMAGING SYSTEM

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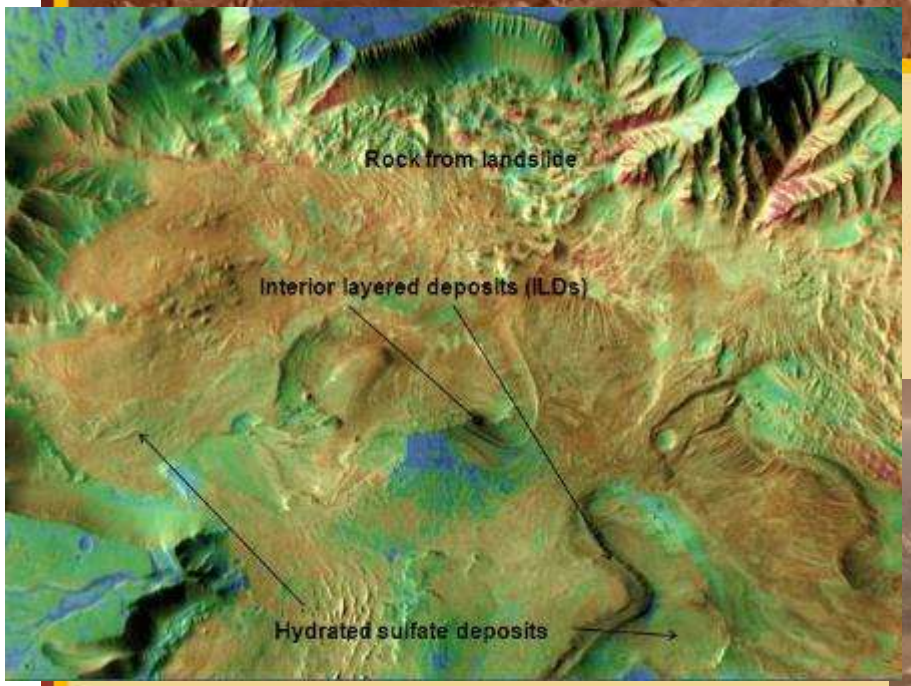
Flight Into Mariner Valley: The Movie



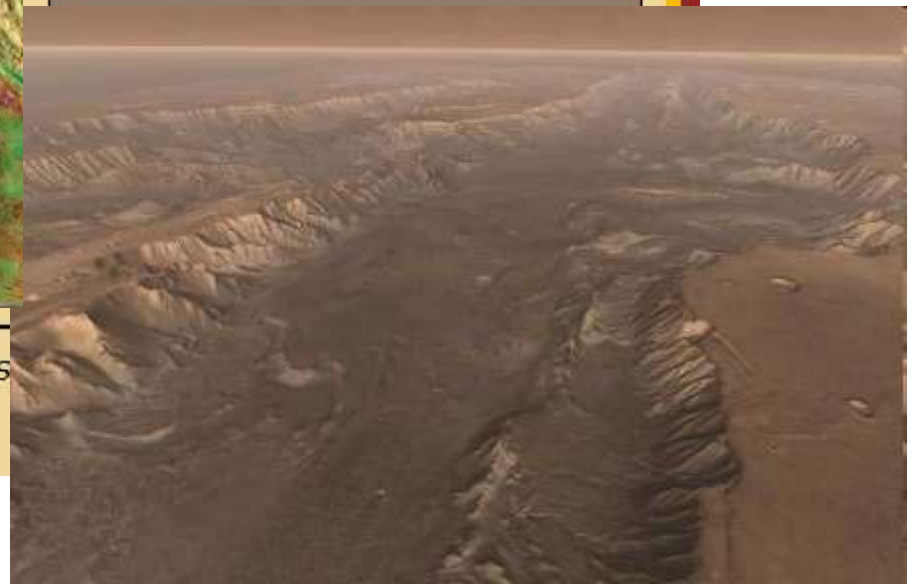
Watch the Movie

Watch on Google Video (low bandwidth)

MPEG1 (872x540: 56MB)

bittorrent

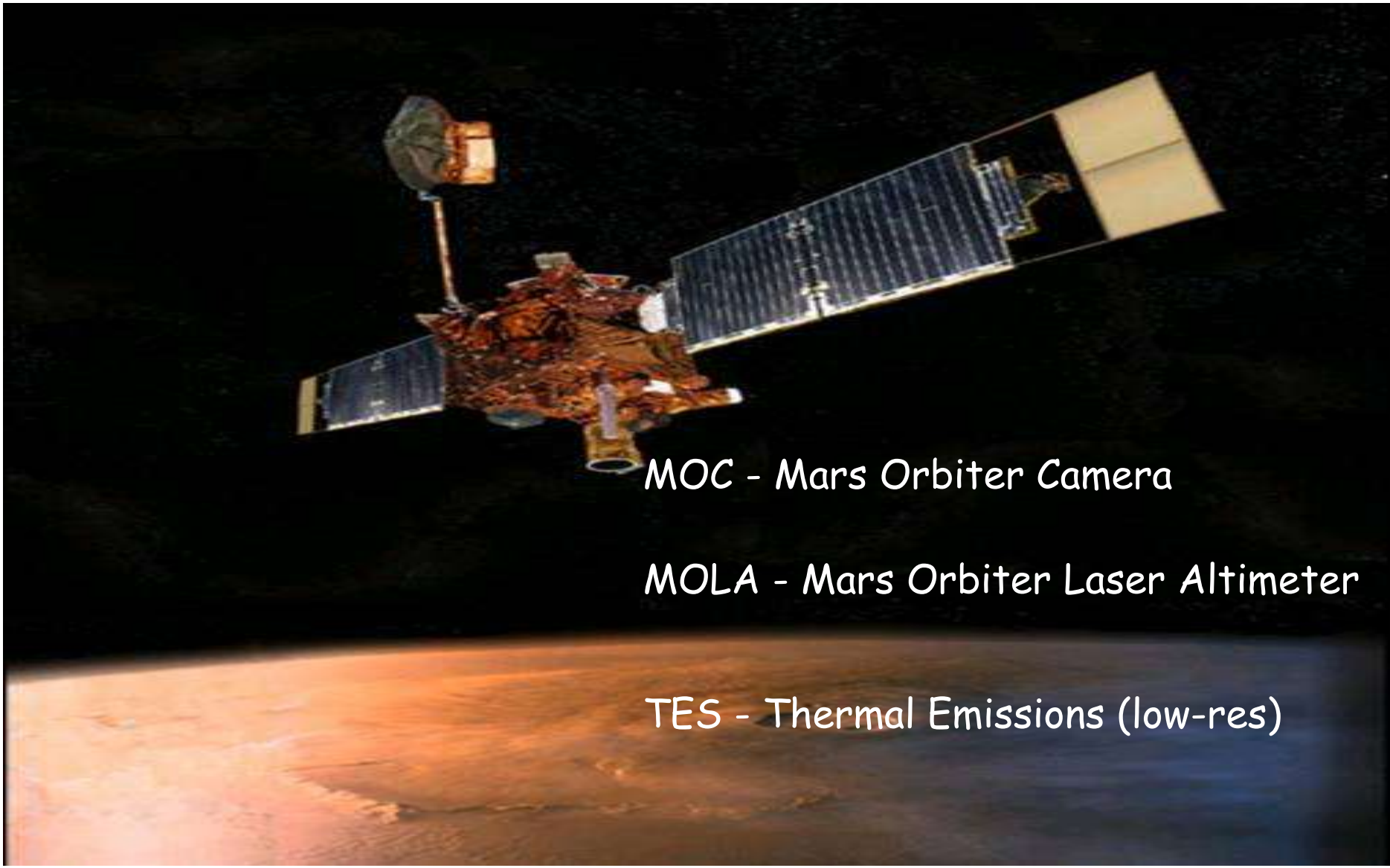
download



The Grandest Canyon of all isn't on Earth, it's on the planet Mars - Valles Marineris, or Mariner Valley.

https://www.youtube.com/watch?v=JUbQM47QXwQ

Mars Global Surveyor (1996) Instruments

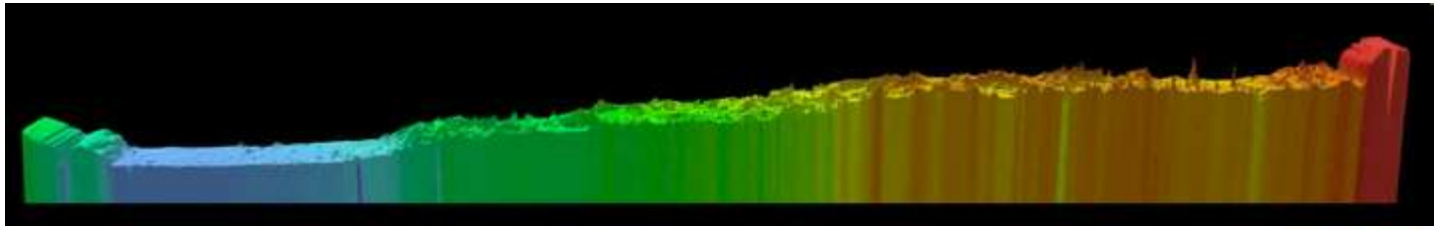


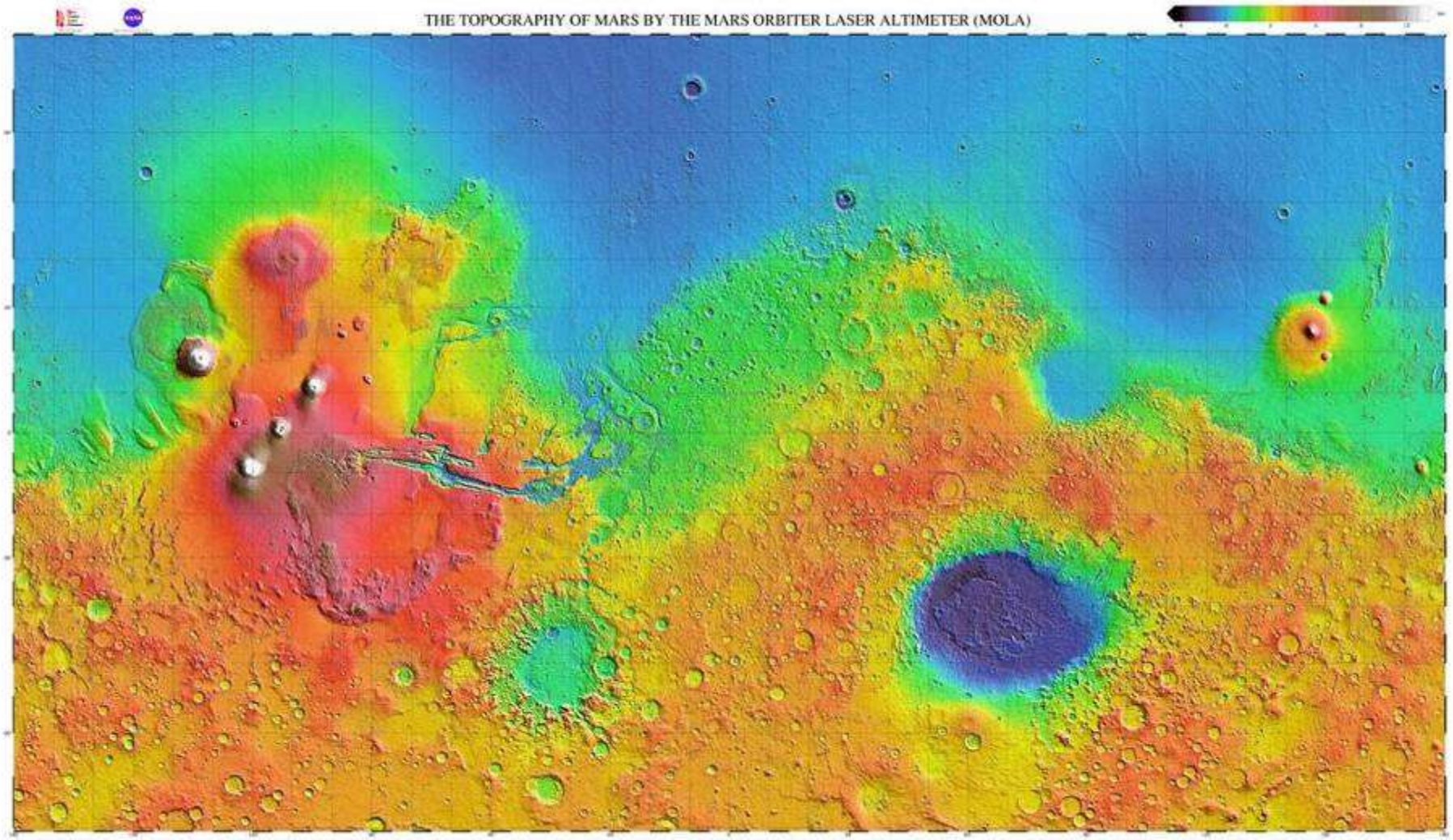
Suspected rock glacier, Mars Orbiter Camera JPL/NASA

Resolution = 1m

- **MOC has produced over 250,000 images (2015)**

DEM resolution in z = 30cm! (N. Pole to S. Pole transect)





http://www.google.com/mars/

Is there ice on Mars?

The perennial portion of the north polar cap consists almost entirely of water ice. In the northern hemisphere winter, this gains a seasonal coating of frozen carbon dioxide (dry ice) about one metre thick.

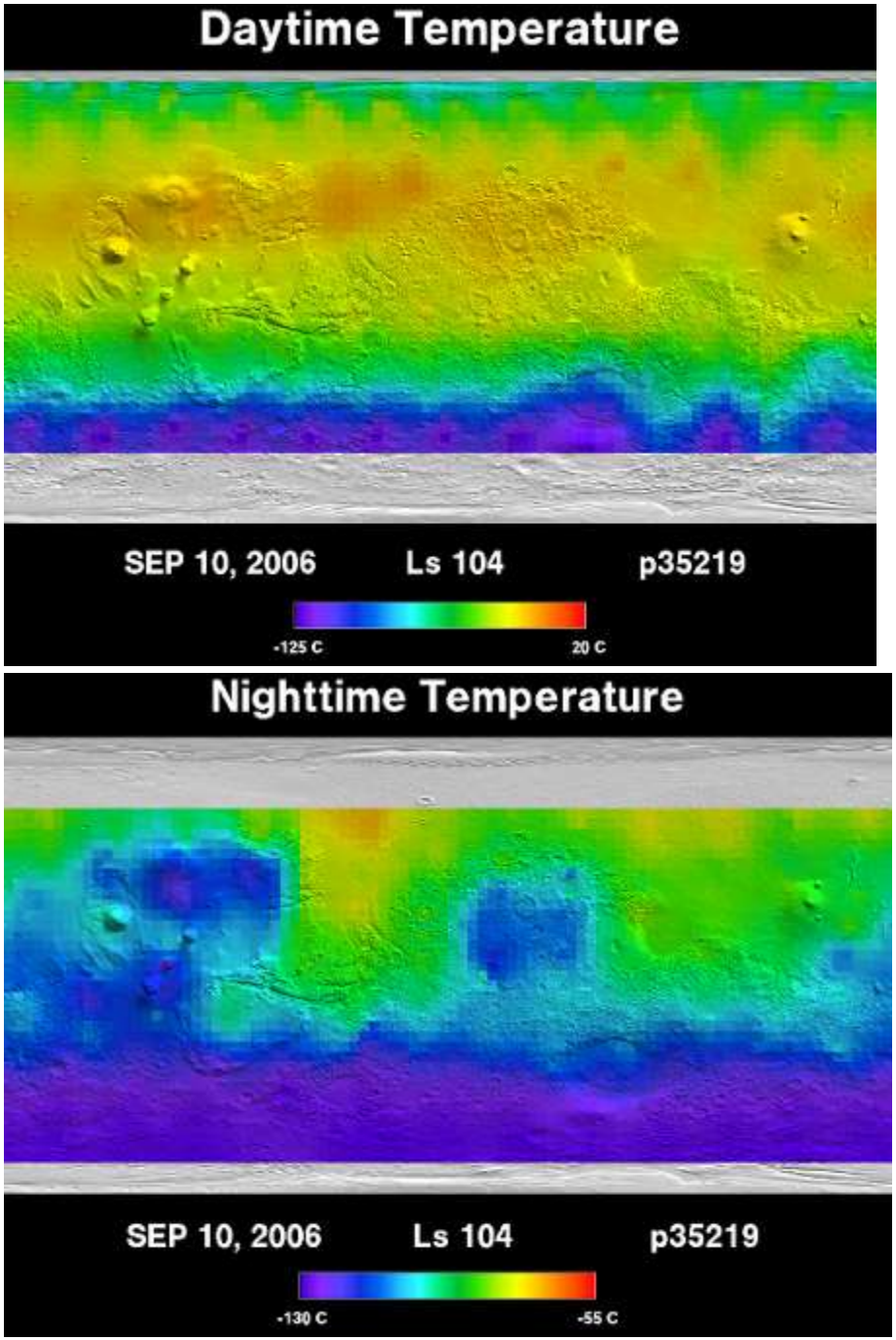
The south polar cap also acquires a thin frozen carbon dioxide coating in the southern hemisphere winter. Beneath this is the perennial south polar cap, which is in two layers. The top layer consists of frozen carbon dioxide and about 8 meters (27 feet) thick. The bottom layer is deeper and is made of water ice.

http://www.daviddarling.info/encyclopedia/M/Marspoles.html

Thermal Emission Spectrometer

Onboard Mars Global Surveyor

1996-2006



Mars Express: High Resolution Stereo Camera

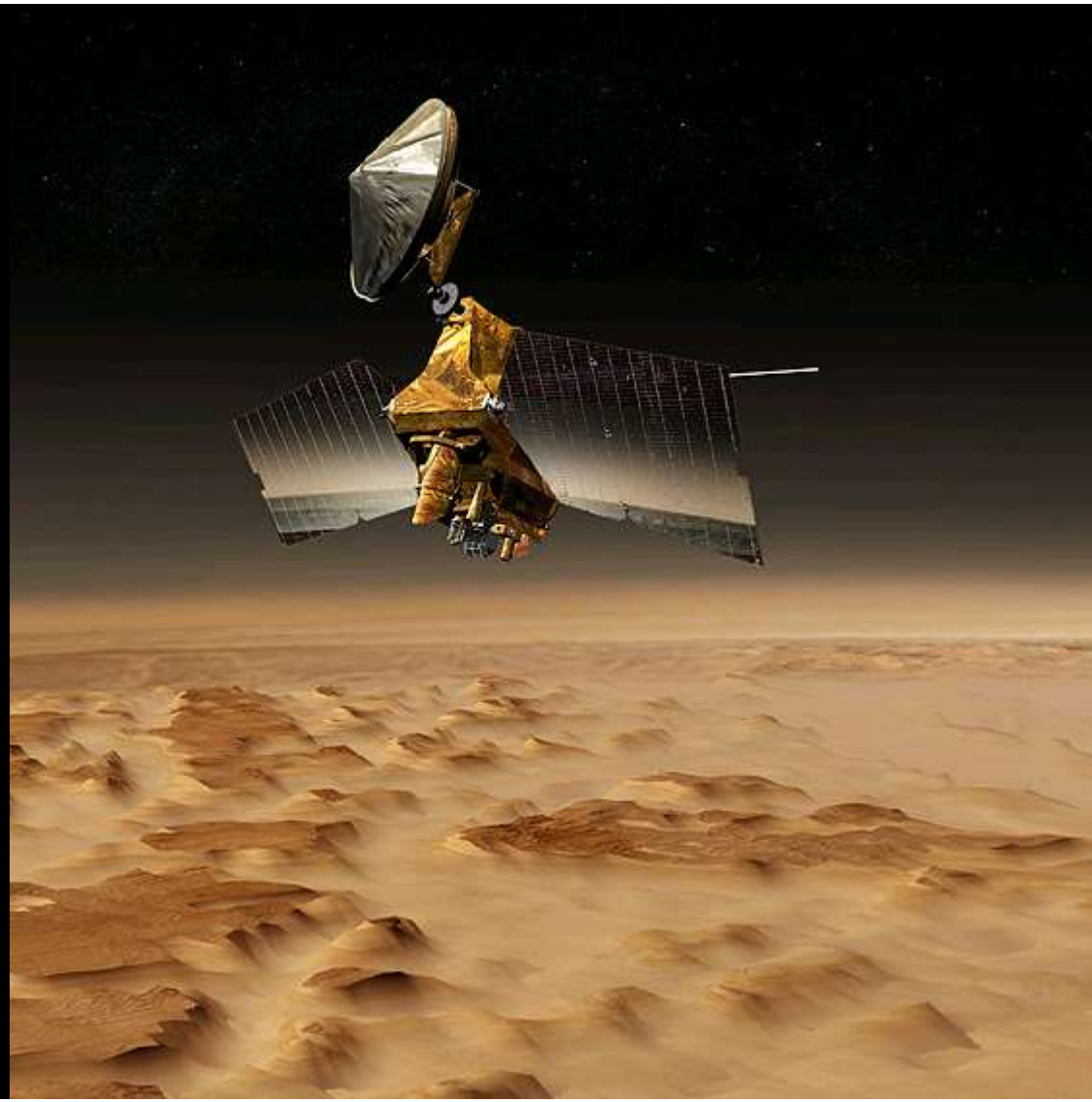
Nicholson Crater
HRSC, ESA 2005

High Resolution Stereo (2m)

Mars Reconnaissance Orbiter (2005)

Onboard:

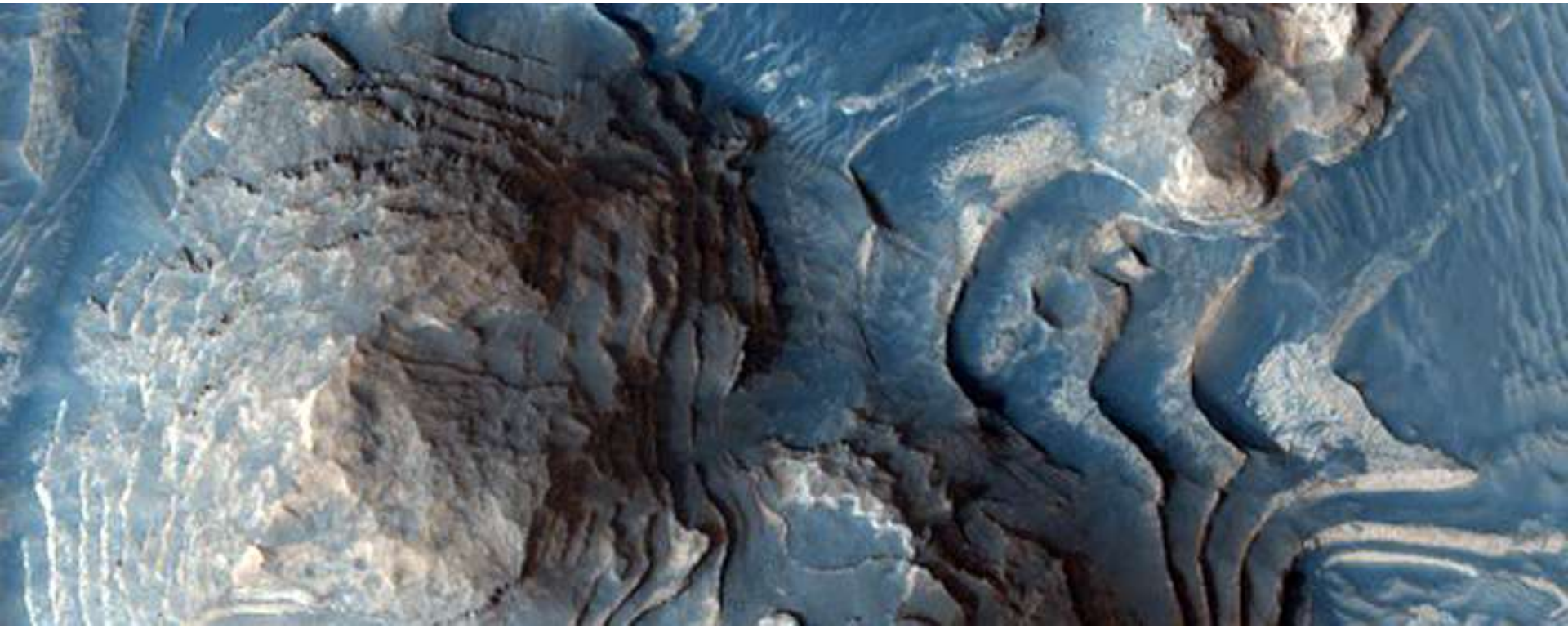
- HiRISE - High Resolution Imaging Science Experiment (Visible / infrared)
- CRISM - Compact Reconnaissance Imaging Spectrometer for Mars
- CTX - Context Imager: Takes low resolution overview images for geology



Mars Reconnaissance Orbiter: HiRISE

MRO HIGH RESOLUTION IMAGING SCIENCE EXPERIMENT (HIRISE)

Resolution: 0.3m (1 foot) RGB Near-IR



http://hirise.lpl.arizona.edu/nea.php

http://marsoweb.nas.nasa.gov/HiRISE/hirise_images/

HiRISE PICTURE OF THE DAY: 4 FEBRUARY 2022

The Amazing Spider-Land https://hirise.lpl.arizona.edu/

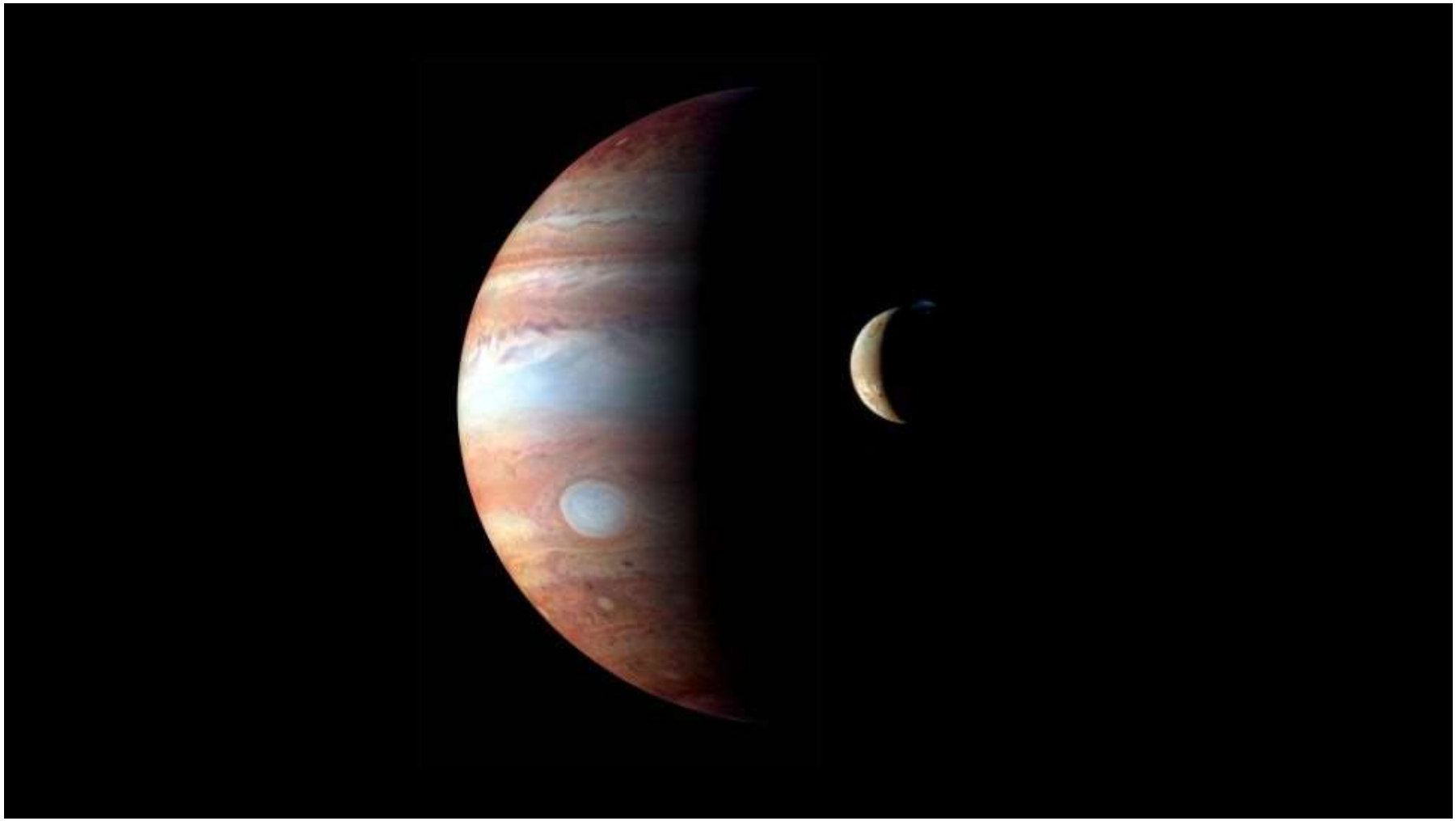
These typically form due to sublimation, where a solid transforms directly into a gas, in this case, carbon dioxide ice. When this occurs, it disturbs the surface and exposes the darker material underneath.

Lost Art Cartography: Marcel Morin

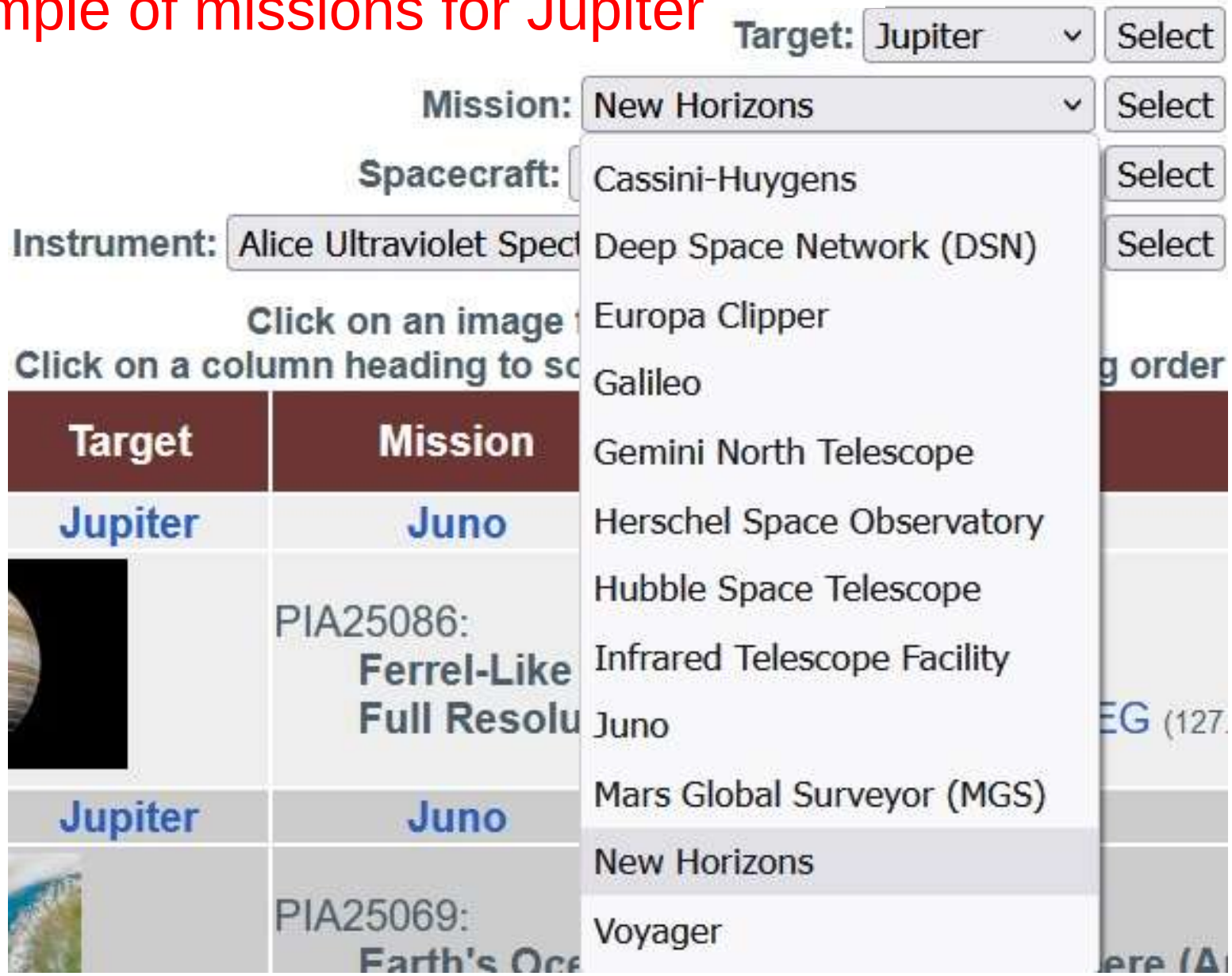
HiRise image DTM enhanced

Perseverance Track, Jezero crater, February 21-December 18 2021

Jupiter – New Horizons fly-by with Io moon



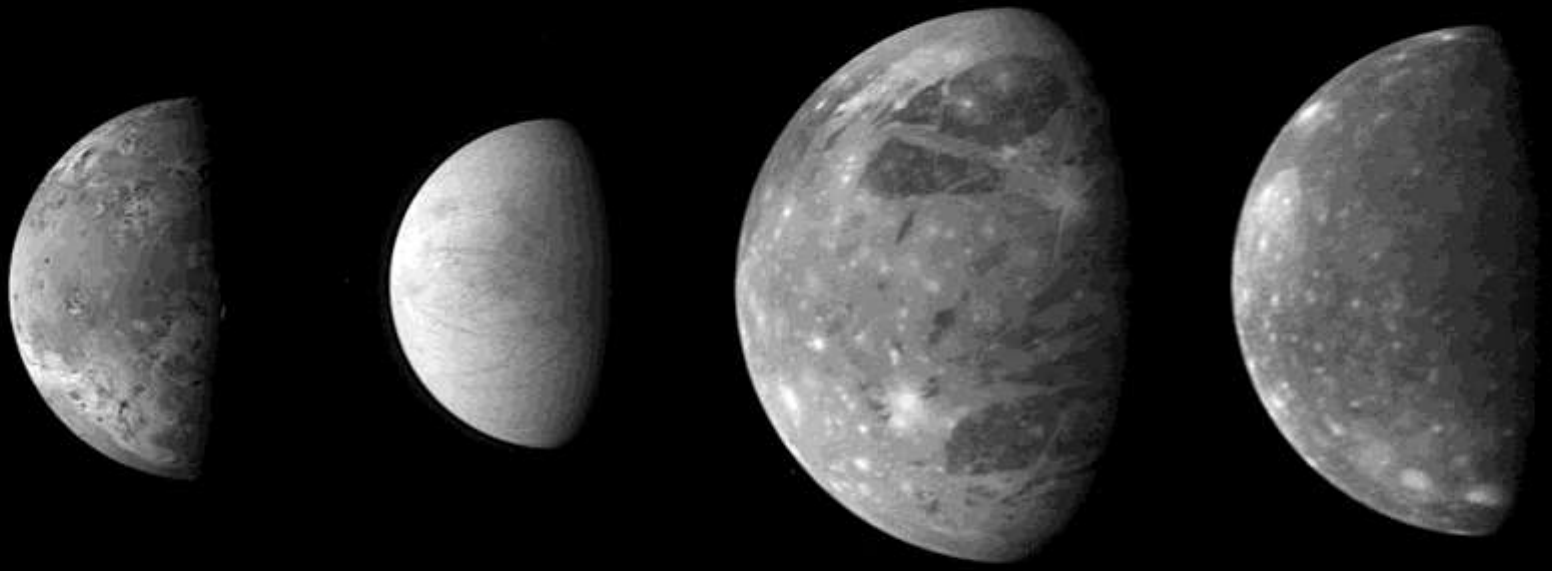
Sample of missions for Jupiter



https://photojournal.jpl.nasa.gov/index.html

Jupiter's Moons 'family portrait' (some of)

Io, Europa, Ganymede and Callisto



New Horizons – LORRI

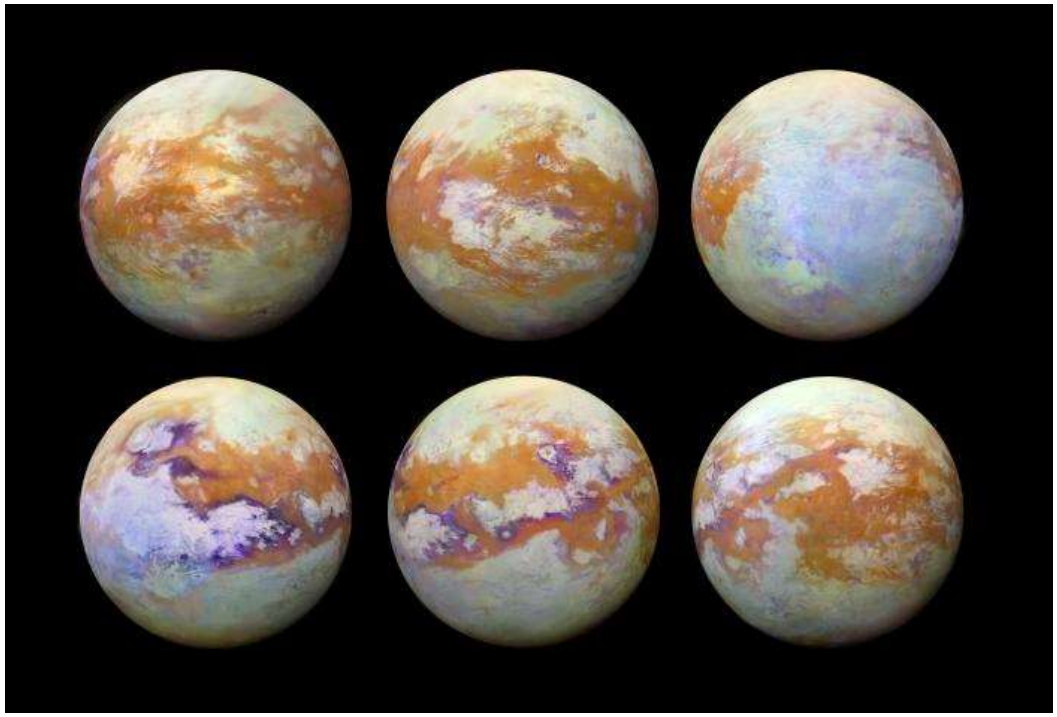
Long Range Reconnaissance Imager

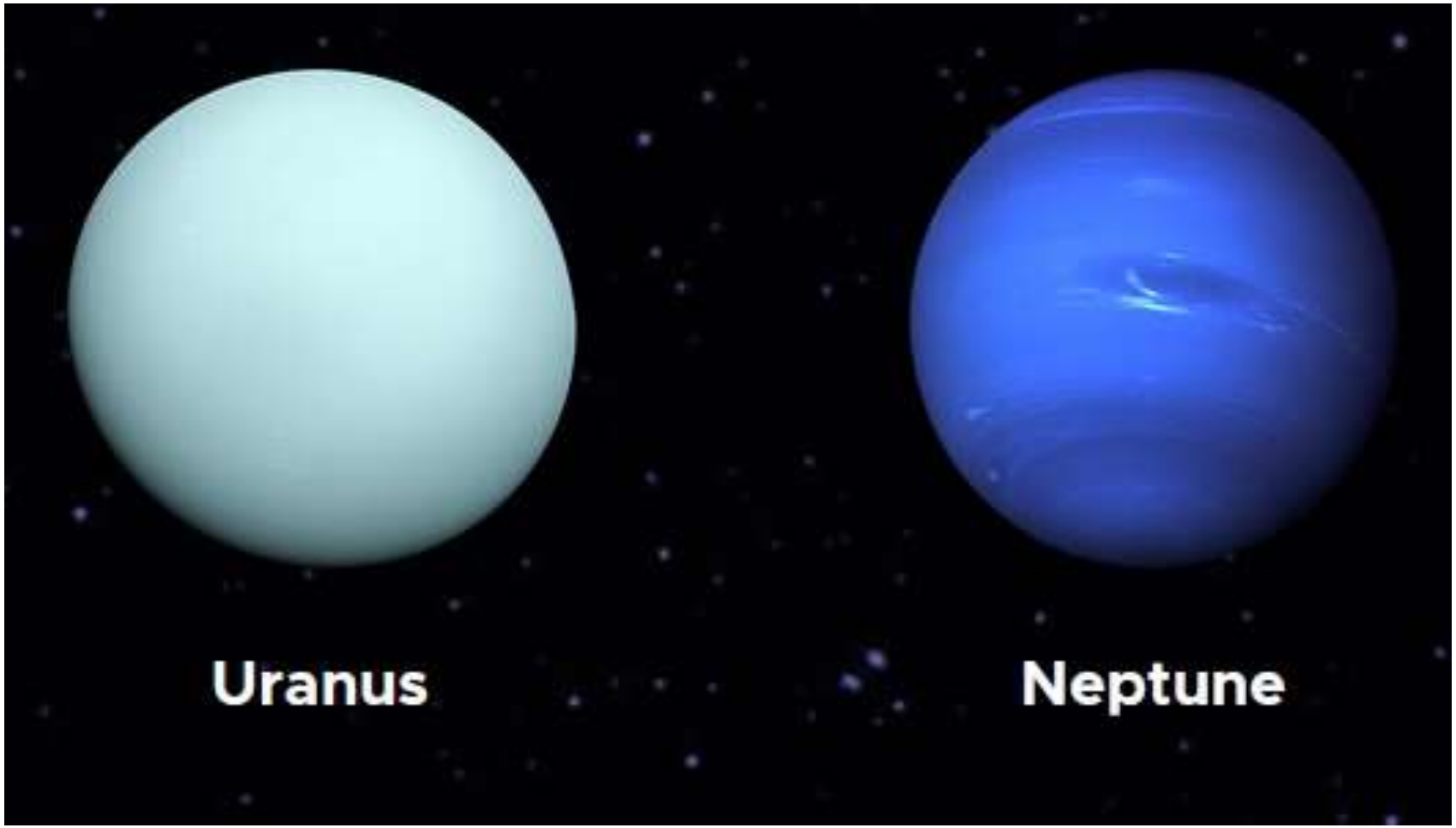
Saturn: Cassini 1997-2017 UV -> NIR

https://www.nasa.gov/cassini

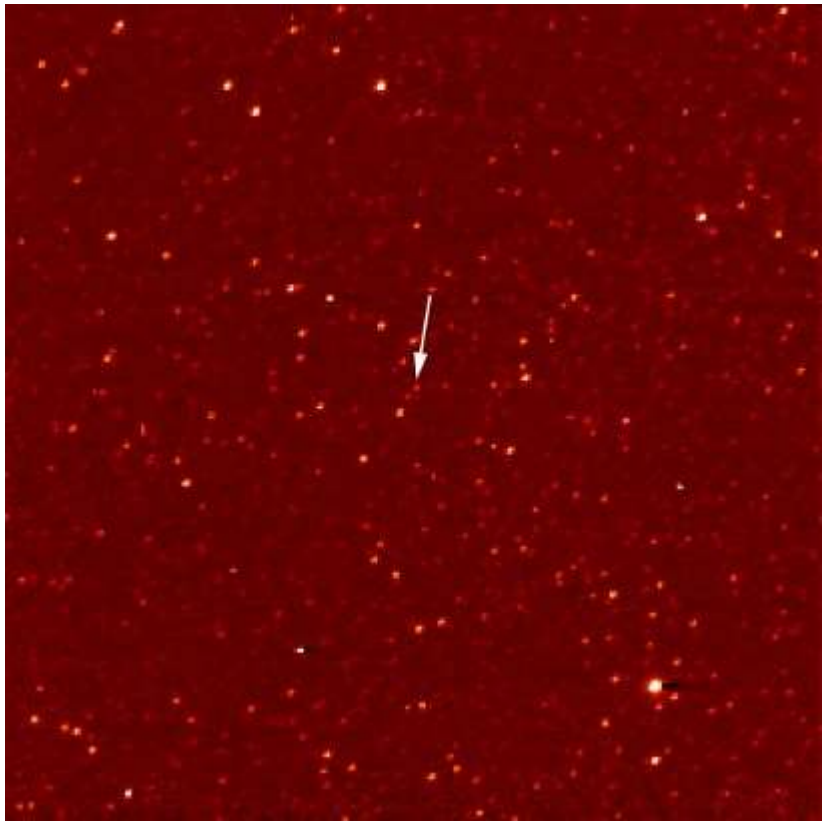
https://saturn.jpl.nasa.gov

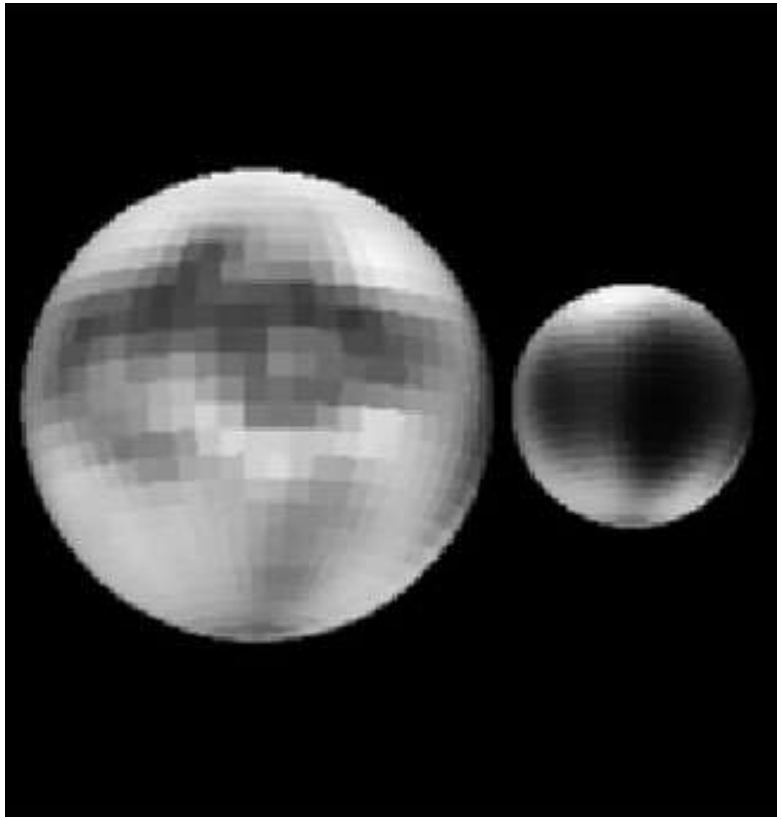
Titan, satellite of Saturn:
VNIR spectrometer




Uranus
Neptune

Pluto and Charon (pre-2015)

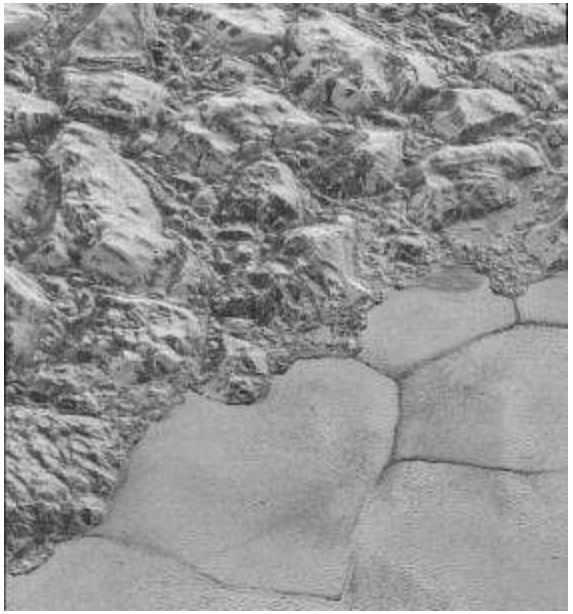




New Horizons Mission 2015

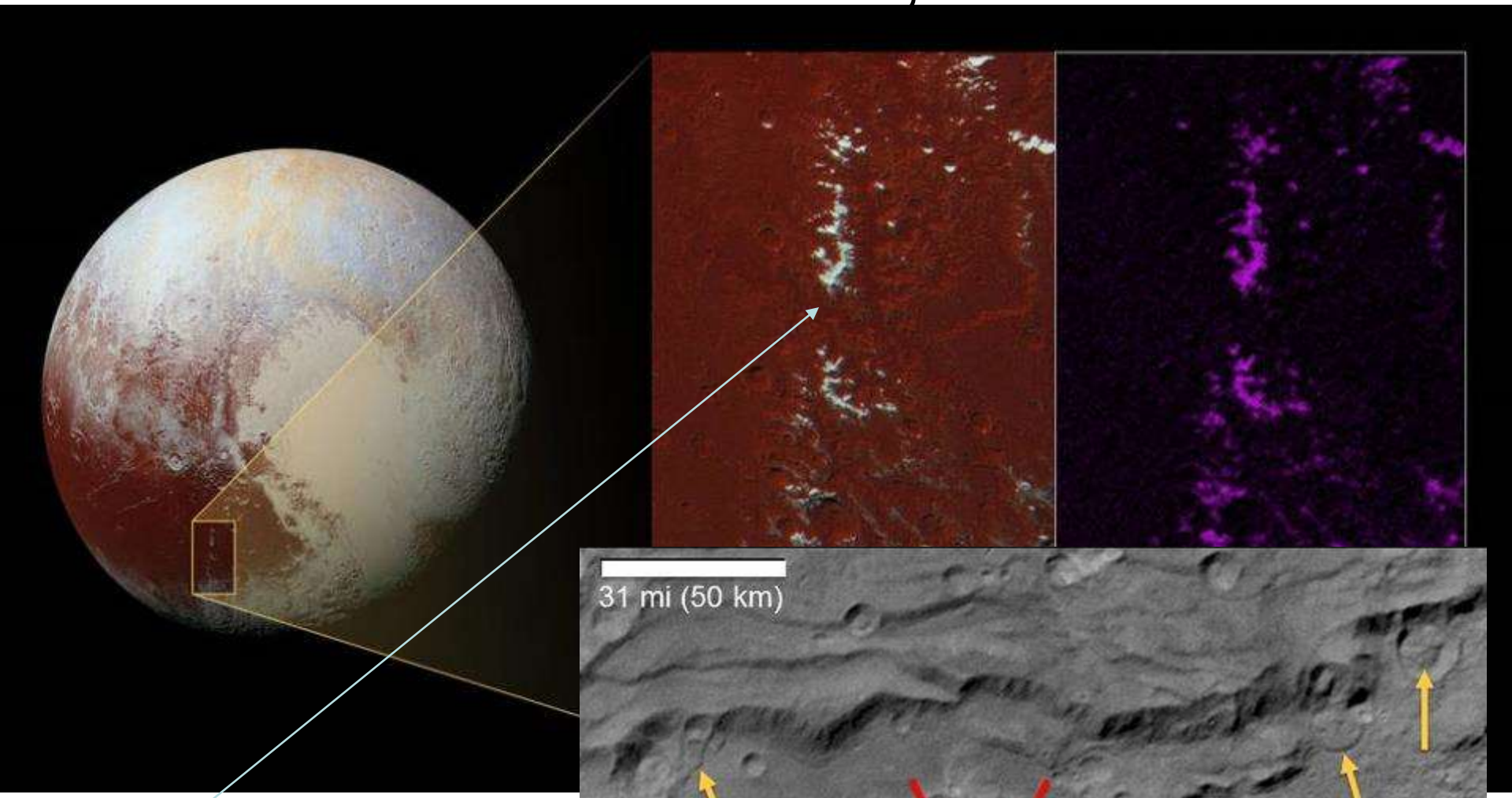
Launched 2006

Alice Ultraviolet  sensor and **Ralph**



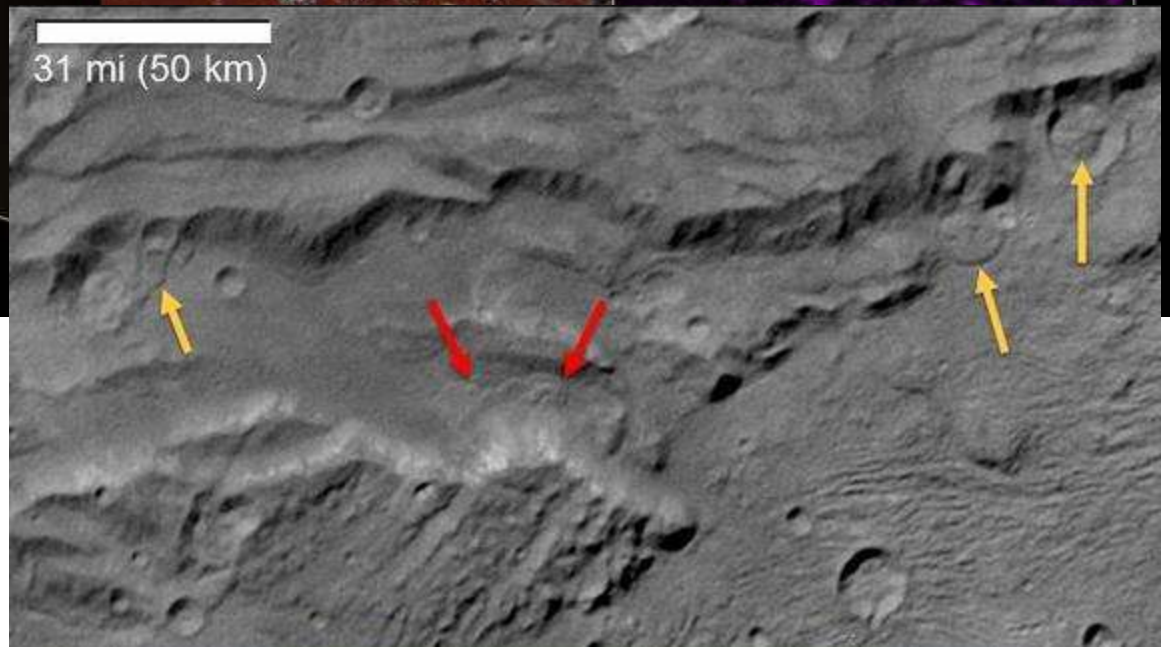
Pluto

PLUTO: New Horizons 2015, launched 2006



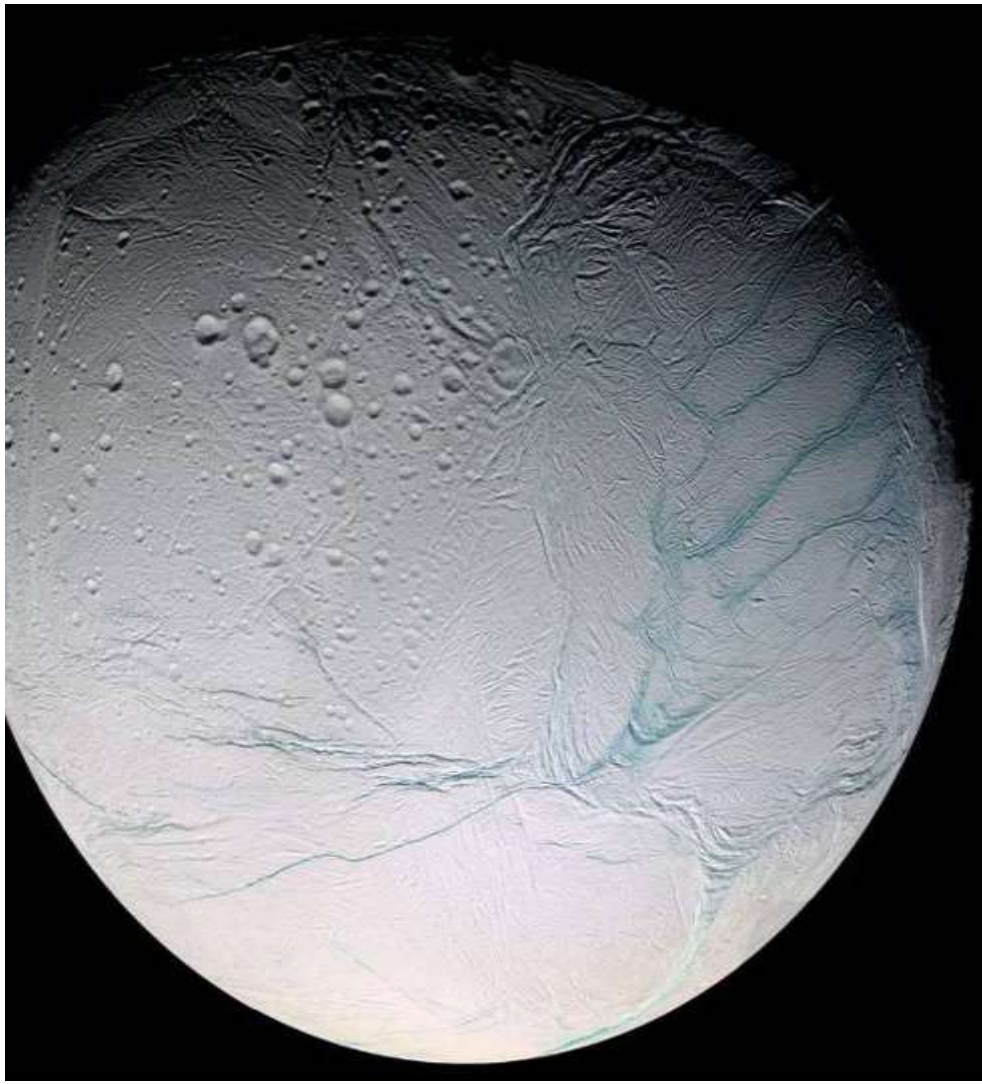
Snow clad mountains on Pluto

Landslides on Charon ⟶



The Planets and Their Moons		
PLANET	**MOONS**	**MOON NAMES**
Mercury	0	
Venus	0	
Earth	1	Moon
Mars	2	Phobos, Deimos
Jupiter	62	Io, Europa, Ganymede, Callisto, Amalthea, Himalia, Elara, Pasiphae, Sinope, Lysithea, Carme, Ananke, Leda, Metis, Adrastea, Thebe, Callirrhoe, Themisto, Kalyke, Iocaste, Erinome, Harpalyke, Isonoe, Praxidike, Megaclite, Taygete, Chaldene, Autonoe, Thyone, Hermippe, Eurydome, Sponde, Pasithee, Euanthe, Kale, Orthosie, Euporie, Aitne, plus others yet to receive names
Saturn	33	Titan, Rhea, Iapetus, Dione, Tethys, Enceladus, Mimas, Hyperion, Prometheus, Pandora, Phoebe, Janus, Epimetheus, Helene, Telesto, Calypso, Atlas, Pan, Ymir, Paaliaq, Siarnaq, Tarvos, Kiviuq, Ijiraq, Thrym, Skadi, Mundilfari, Erriapo, Albiorix, Suttung, plus others yet to receive names
Uranus	27	Cordelia, Ophelia, Bianca, Cressida, Desdemona, Juliet, Portia, Rosalind, Belinda, Puck, Miranda, Ariel, Umbriel, Titania, Oberon, Caliban, Sycorax, Prospero, Setebos, Stephano, Trinculo, plus others yet to receive names
Neptune	13	Triton, Nereid, Naiad, Thalassa, Despina, Galatea, Larissa, Proteus, plus others yet to receive names
Pluto	1	Charon
TOTAL	**139**	

Enceladus, Moon of Saturn, by Cassini Orbiter, 2005



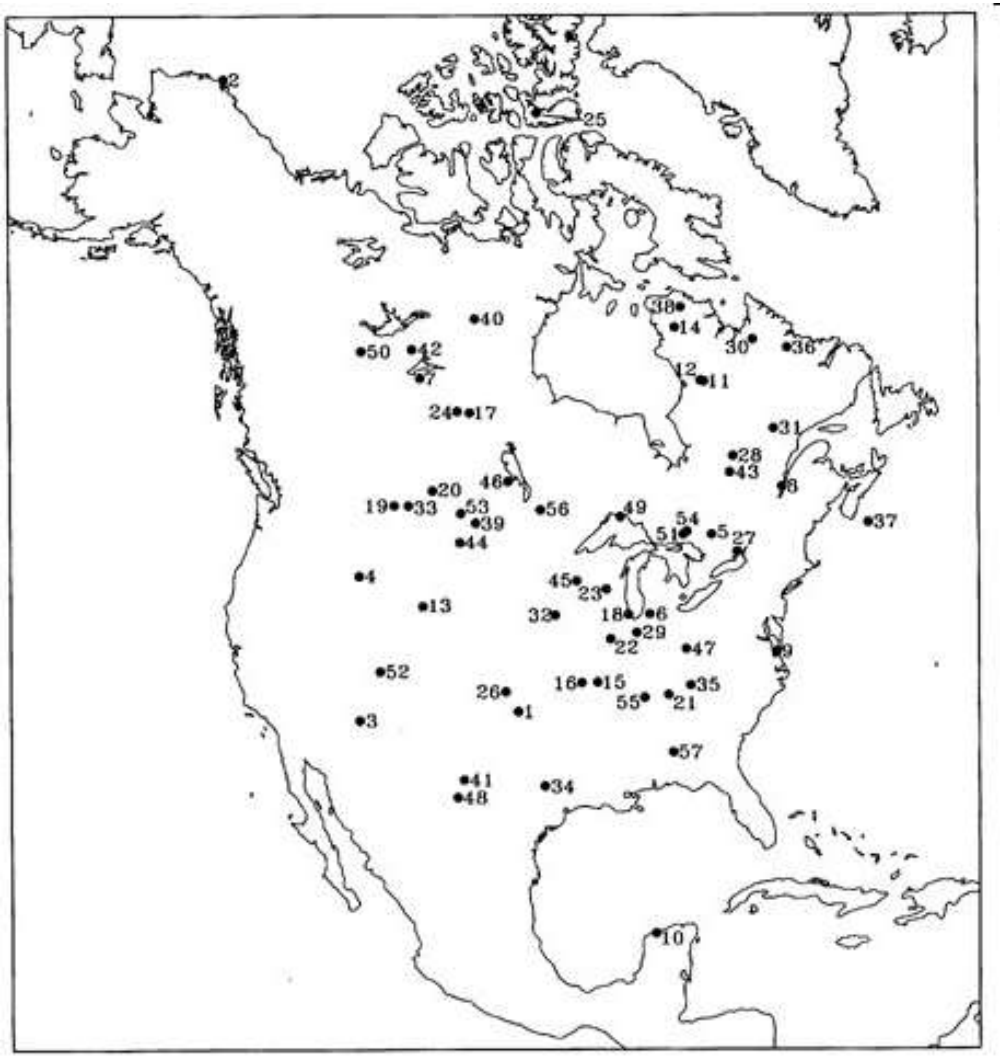
Reference Links

https://photojournal.jpl.nasa.gov/index.html

https://solarviews.com/eng/history.htm

http://pds.jpl.nasa.gov/planets

http://www.nineplanets.org



Pingualuit Crater, Northern Quebec

http://earthobservatory.nasa.gov/IOTD/view.php?id=8472

Meteor and Comet Impact Hazards: North American Impact Craters
Data from Observer's Handbook 2004, Royal Astronomical Society of Canada
http://astro.wsu.edu/worthey/astro/html/lec-meteor-cc.html

Sudden impact: Google unearths rare meteorite crater - Australia

http://www.smh.com.au/news/technology/google-unearths-rare-crater/2008/03/25/1206207065556.html