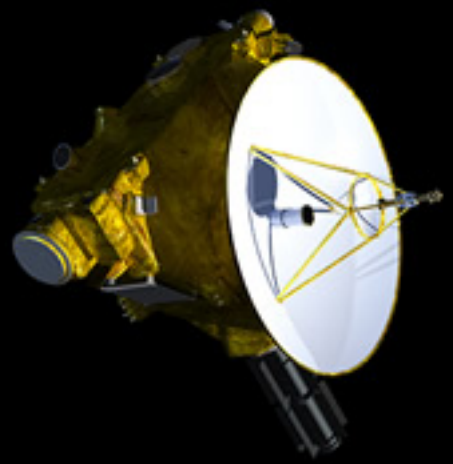
Pluto – For the First Time



… but wait

Curiosity Rover on Mars – January 2016

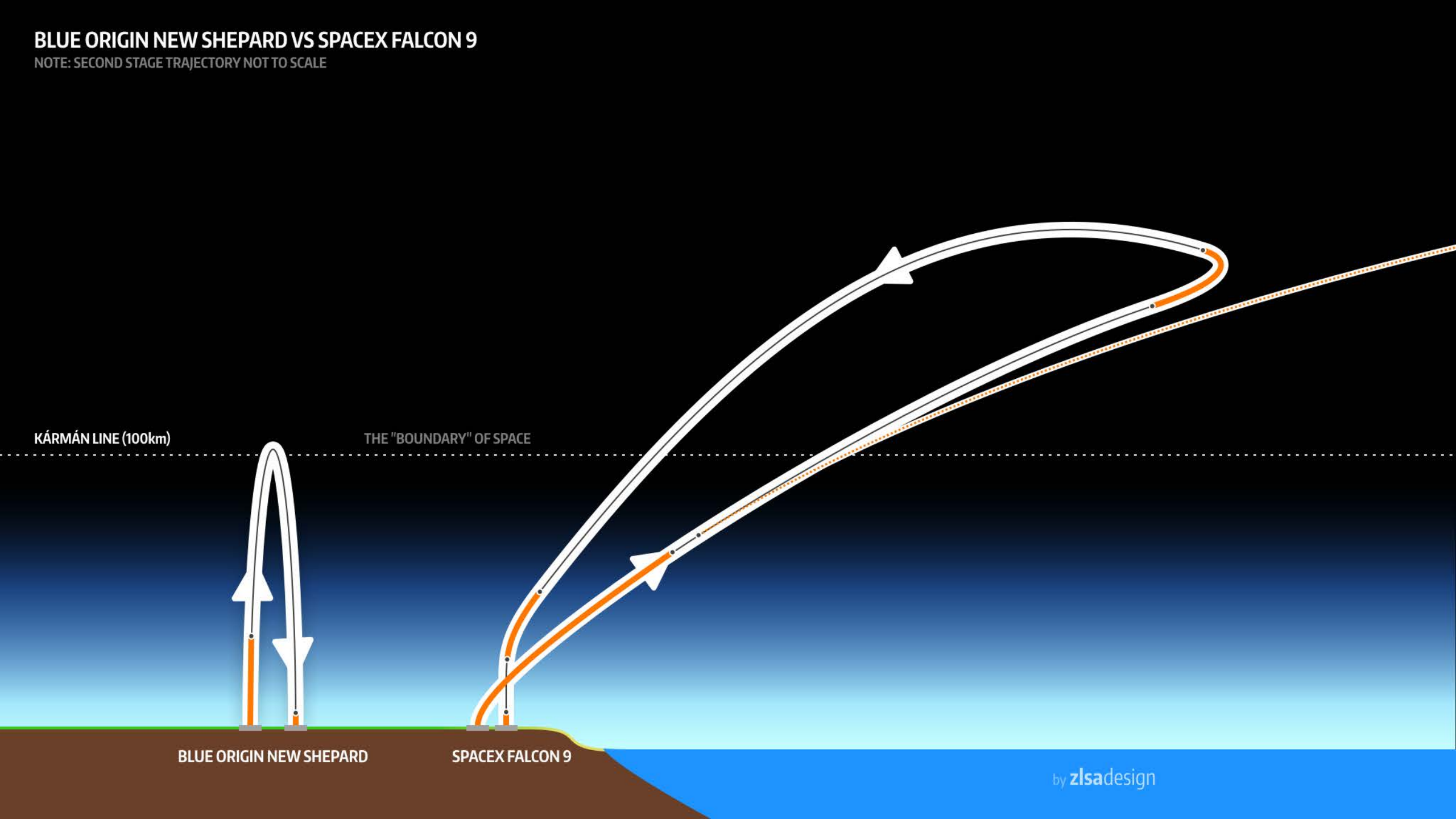
The Bagnold Dune System in Gale Crater

SpaceX Historic Launch – and Landing – December 21, 2015

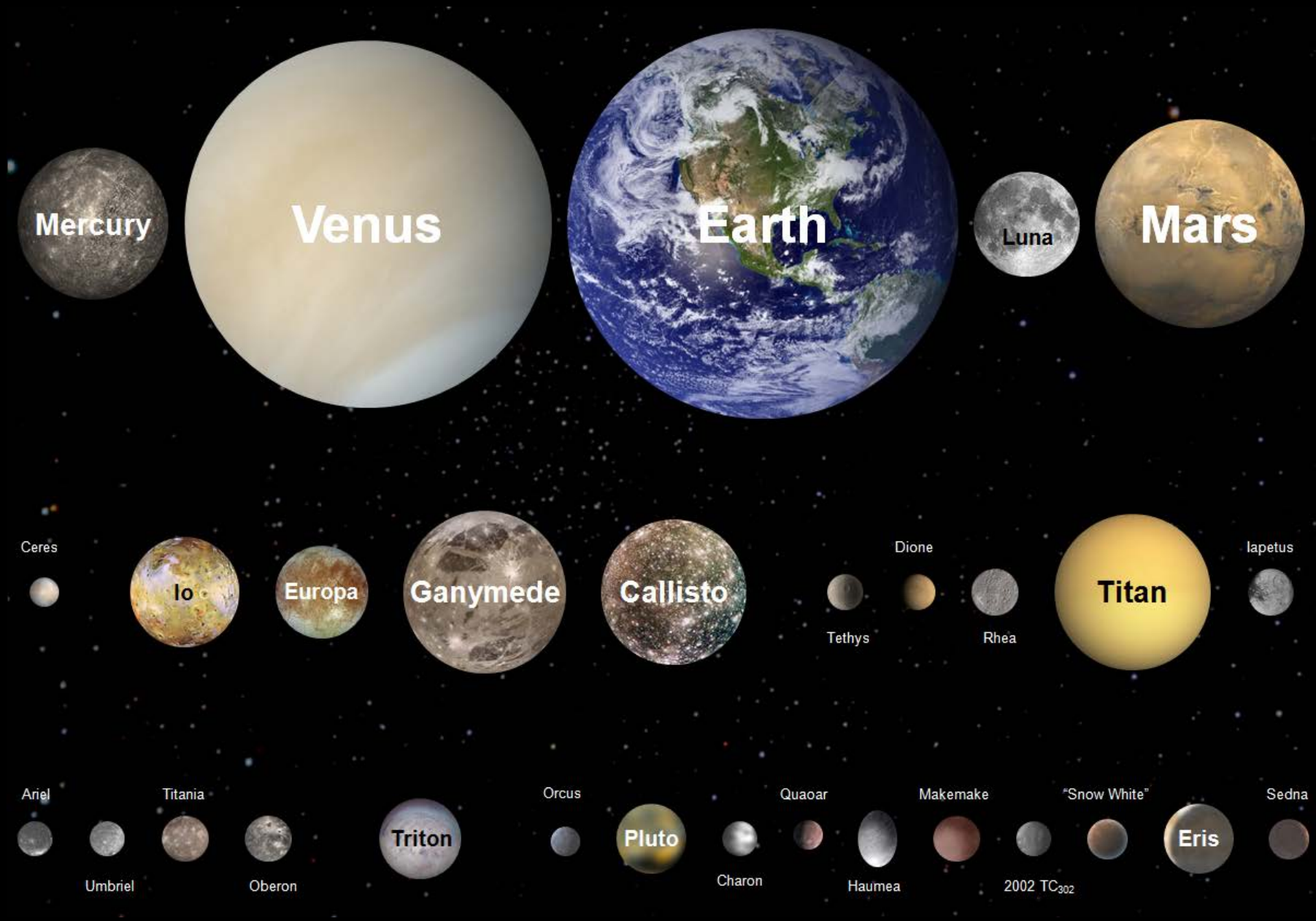

BLUE ORIGIN

BLUE ORIGIN NEW SHEPARD VS SPACEX FALCON 9

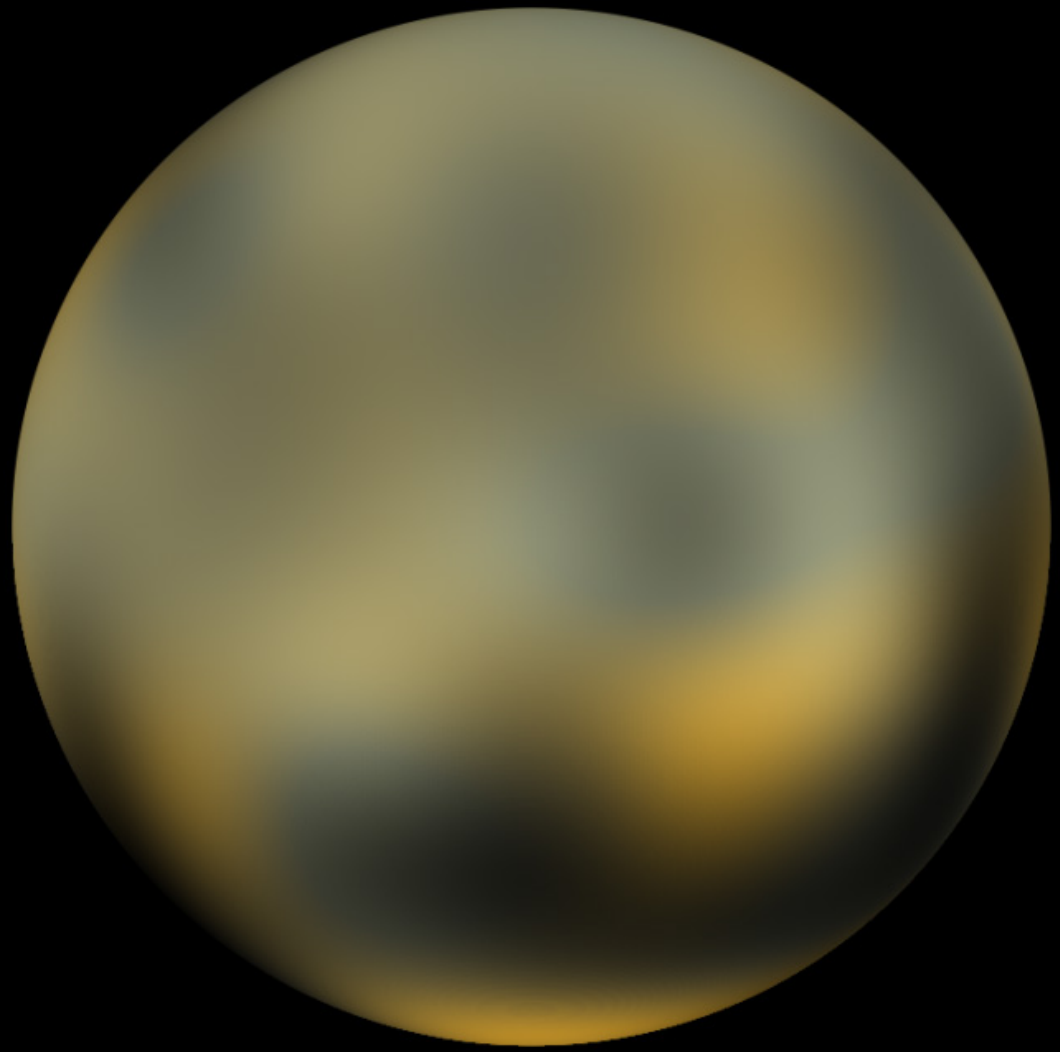
NOTE: SECOND STAGE TRAJECTORY NOT TO SCALE

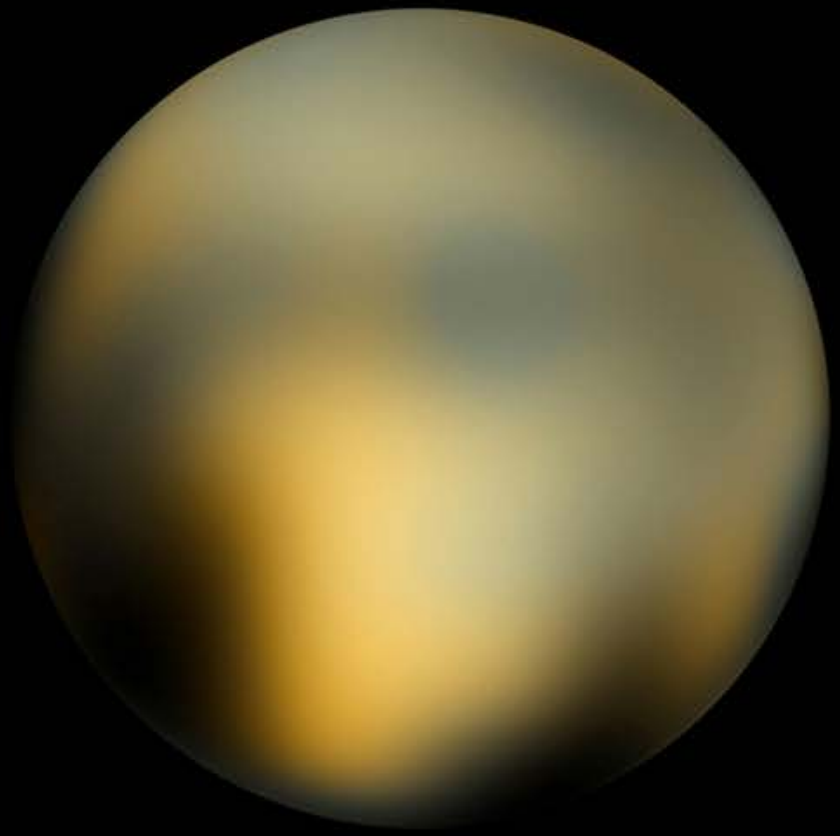



Meanwhile – 5 billion miles – 5.5 light hours away….


Mercury
Venus
Earth
Luna
Mars
Ceres
Io
Europa
Ganymede
Callisto
Dione
Iapetus
Tethys
Rhea
Titan
Ariel
Titania
Orcus
Quaoar
Makemake
"Snow White"
Sedna
Triton
Pluto
Eris
Umbriel
Oberon
Charon
Haumea
2002 TC302

Pluto from Hubble Space Telescope



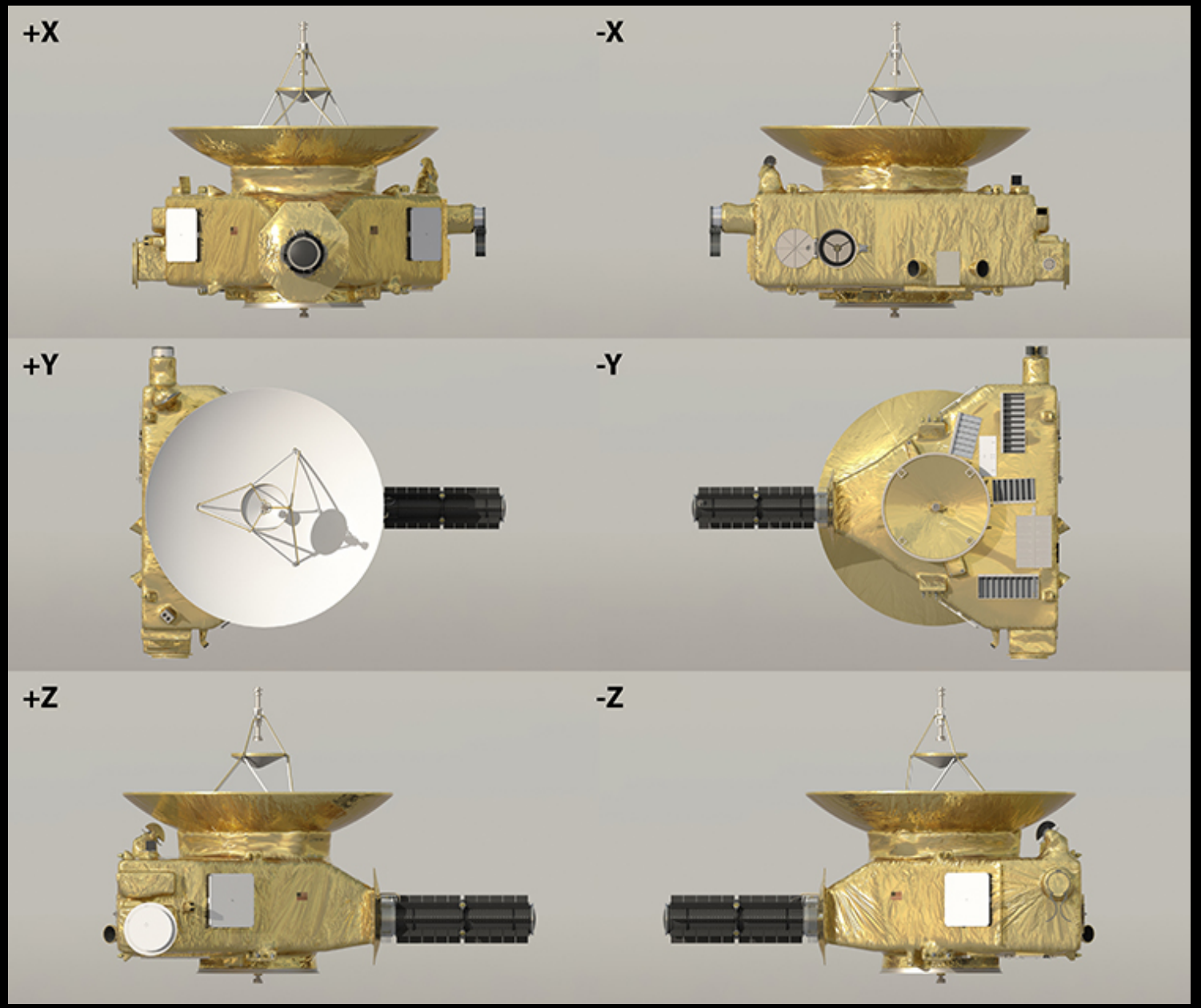


Hubble 2002

New Horizons 2015

New Horizon's Launch – 19 January 2006

Arrived at Pluto 9.5 years later cruising outbound at 36,000 MPH.

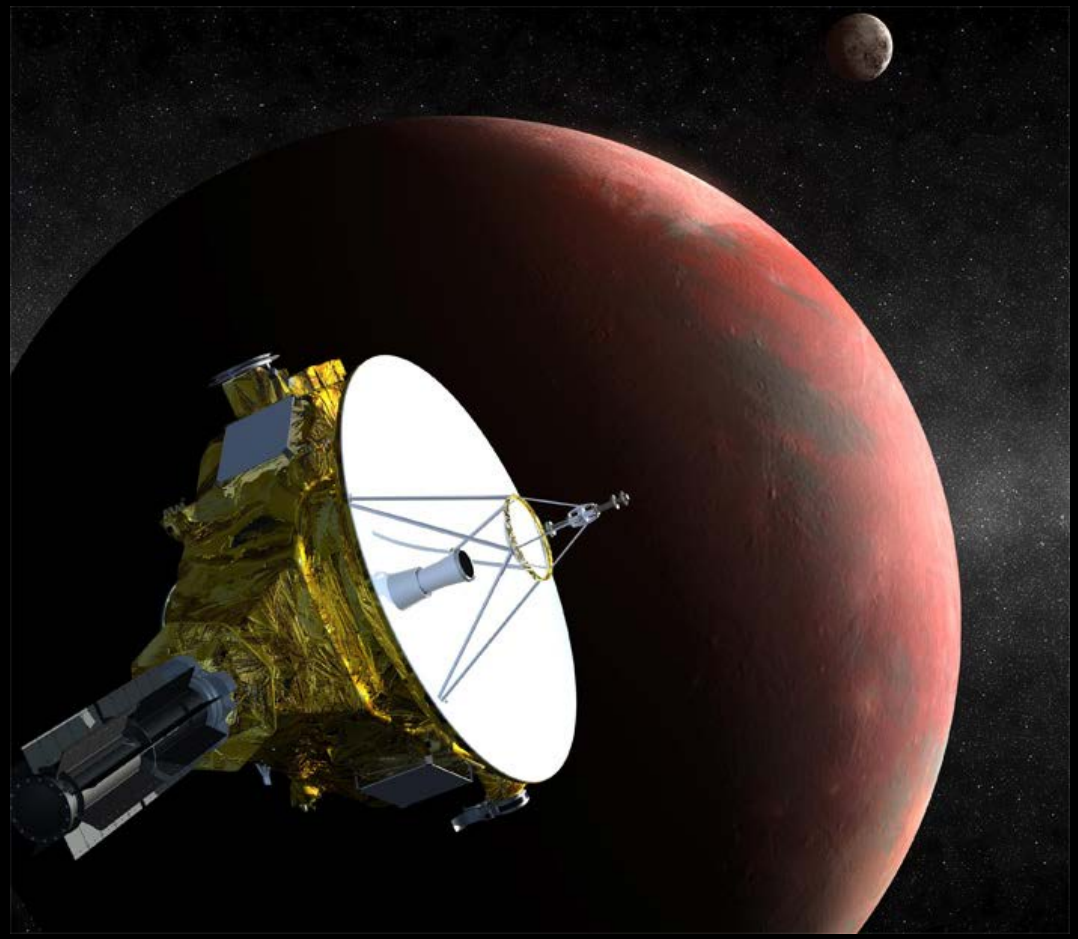

+X
-X
+Y
-Y
+Z
-Z

To Pluto by Way of Jupiter

Pluto Discovered by Clyde Tombaugh on February 18, 1930

His remains now headed to interstellar space onboard New Horizons.

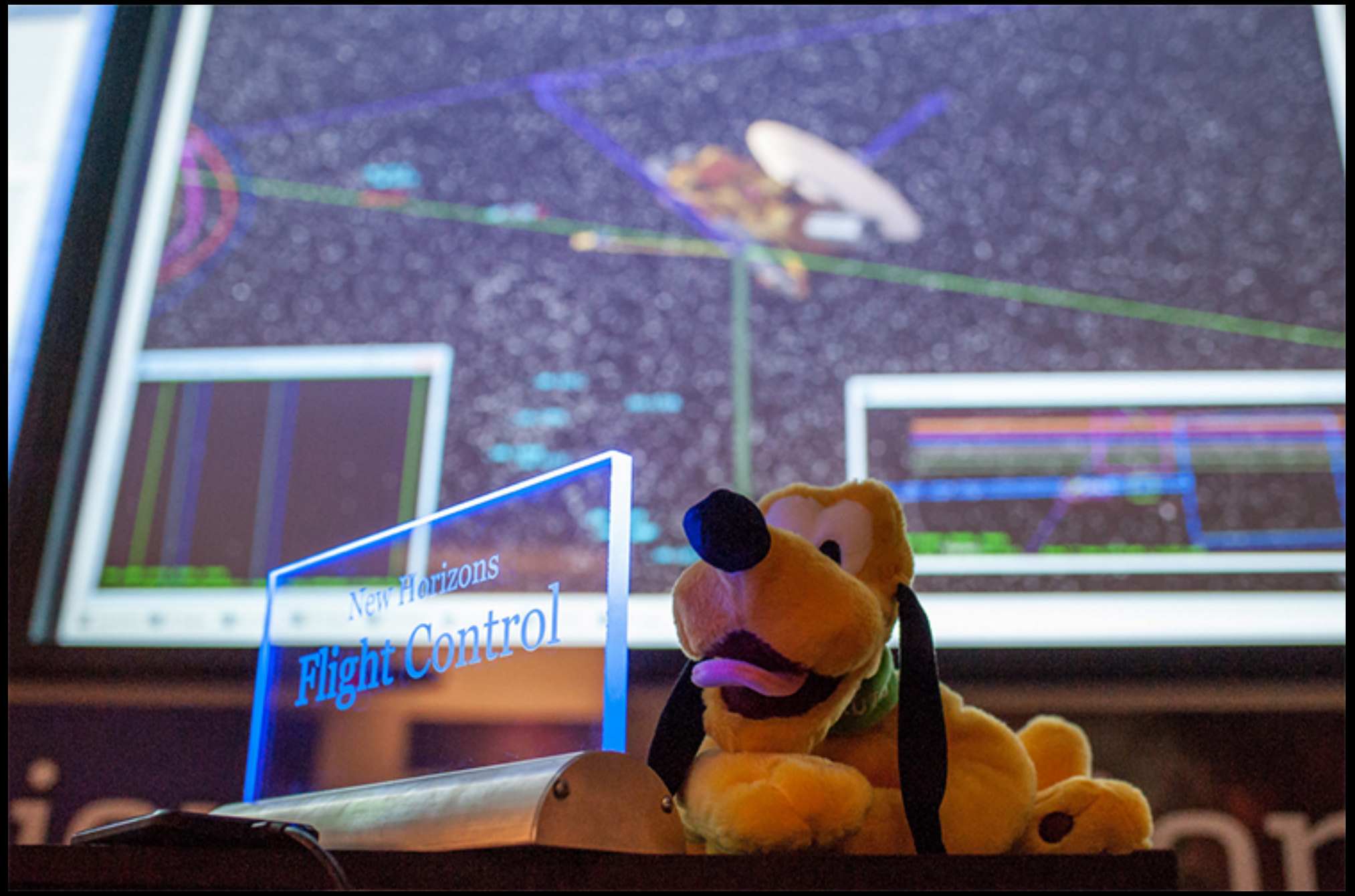
Nuclear Powered Mission



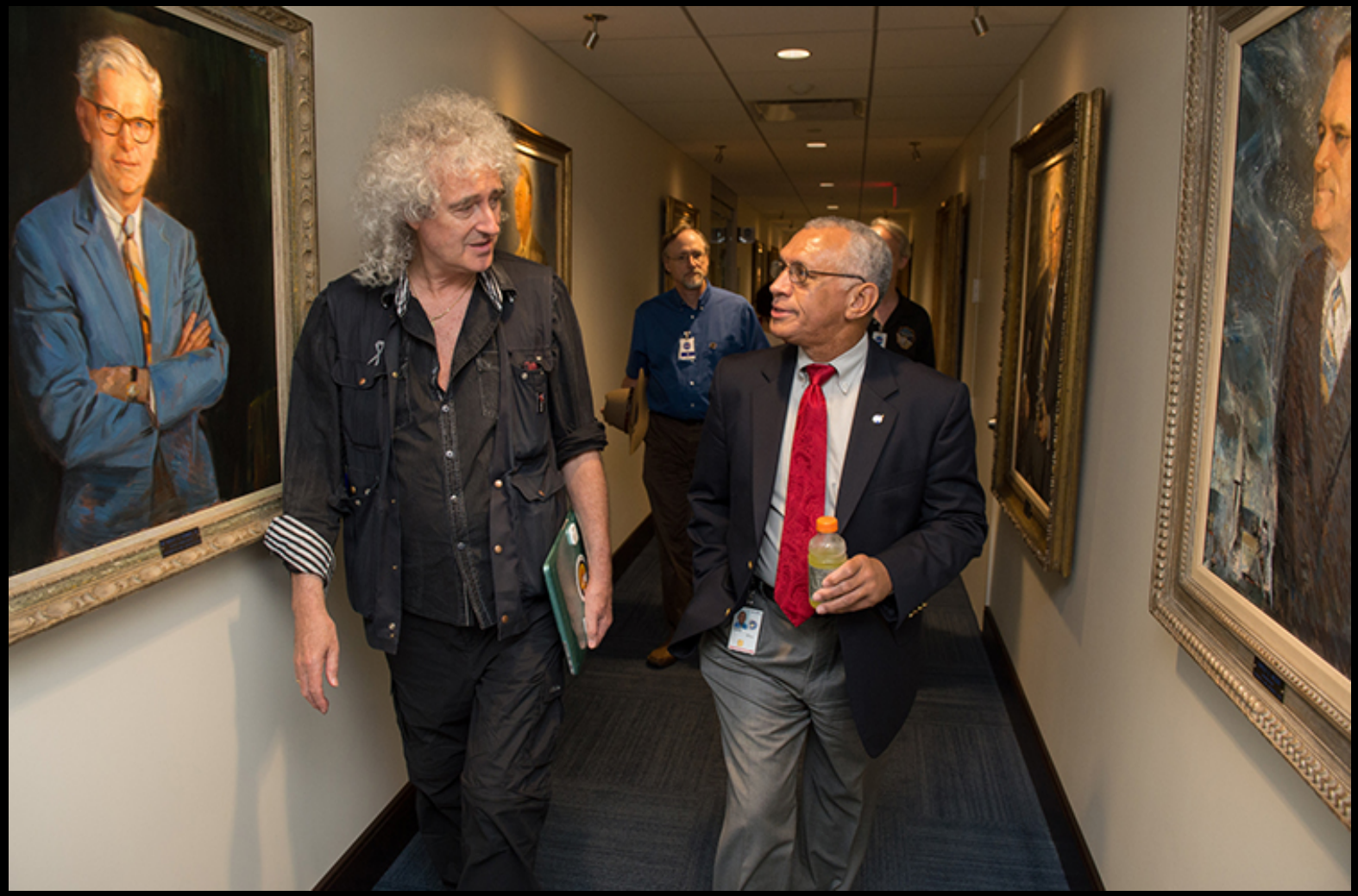
About the Radioisotope Thermoelectric Generator

Electrical power for the New Horizons mission to Pluto is furnished by a single radioisotope thermoelectric generator (RTG), which transforms the heat from the natural radioactive decay of plutonium dioxide into electricity. The compact, rugged General Purpose Heat Source (GPHS)-RTG aboard New Horizons, developed and provided by the U.S. Department of Energy, carries approximately 11 kilograms (24 pounds) of plutonium dioxide fuel.

At the time of the Pluto flyby in July 2015, the GPHS-RTG aboard New Horizons will supply 202 watts of power, down from 240 watts at launch. Onboard systems manage the spacecraft's power consumption (at 30 volts of direct current) so that the load does not exceed the output from the RTG, which slowly decreases by about four watts per year.


New Horizons
Flight Control

Mission Control - Southwest Research Institute in Colorado
Dr. Alan Stern – Principal Investigator and NH Team



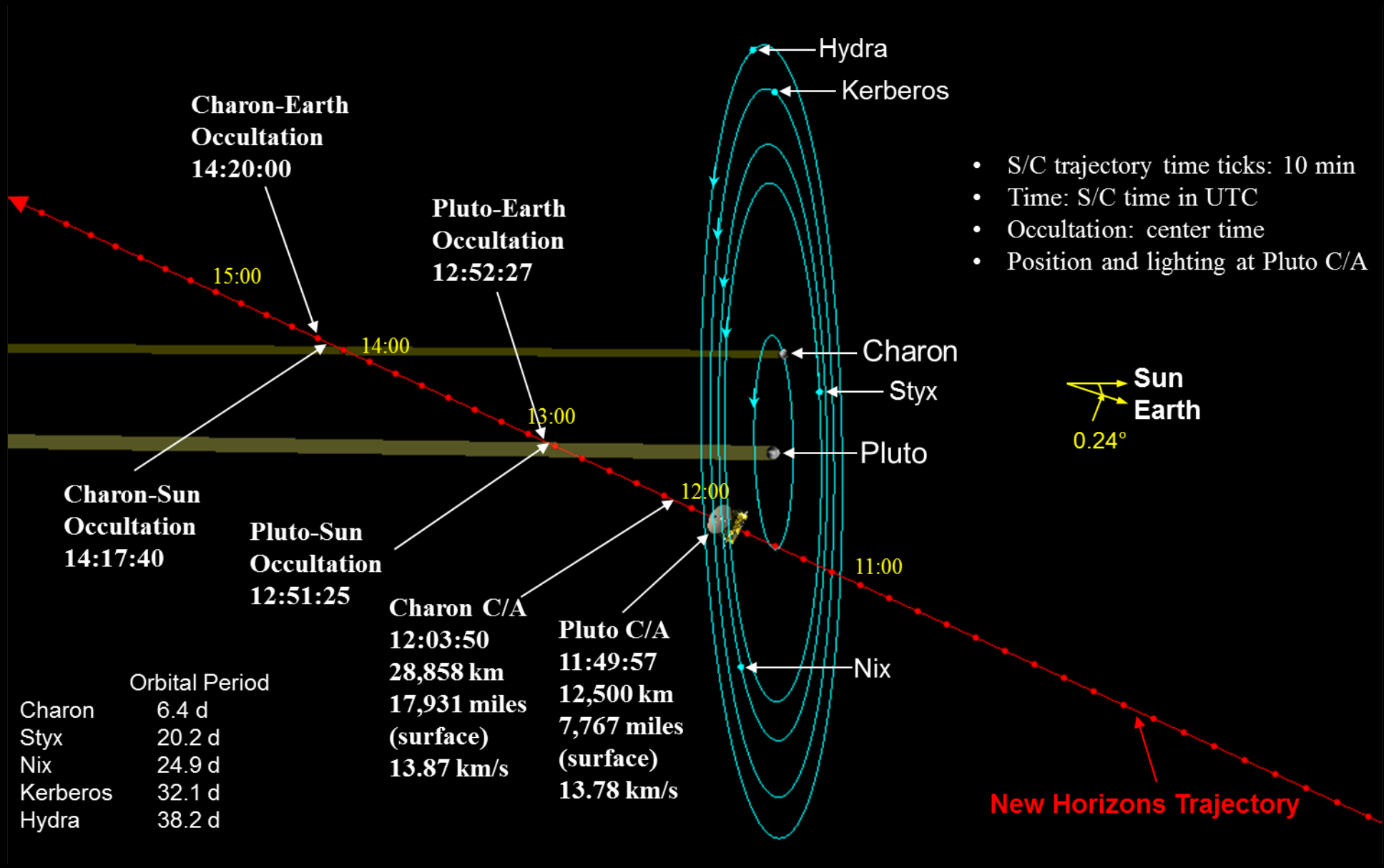
NASA Administrator and Dr. Brian May – a New Horizons Principal Investigator
… also formerly the Lead Guitarist for QUEEN and co-wrote Bohemian Rhapsody.

Goldstone, California;
Madrid, Spain
Canberra, Australia

One way signal travel time:
5.5 hours at lightspeed

- Uplink rate: up to 2000 bps
- Downlink rate: up to 104 kbps; 2 kbps at Pluto

Total data captured at Pluto: 50 MB
Time to download to earth: 52 weeks



- S/C trajectory time ticks: 10 min
- Time: S/C time in UTC
- Occultation: center time
- Position and lighting at Pluto C/A

	Orbital Period
Charon	6.4 d
Styx	20.2 d
Nix	24.9 d
Kerberos	32.1 d
Hydra	38.2 d

July 15, 2015

Density: 1.17 oz/in^3 (2.03 g/cm^3)
(Earth density 5.5g/cm^3)

Gravity: 1/12 earth
(150 # astronaut = 12.5 #)

Radius: 736 miles (1,185 km)
(Earth radius = 3,959 miles)

Orbital period: 247.85 years
(Earth period = 1.0 year)

Surface area: 6.43 million sq miles
(Earth surf. Area: = 196.9 msm)

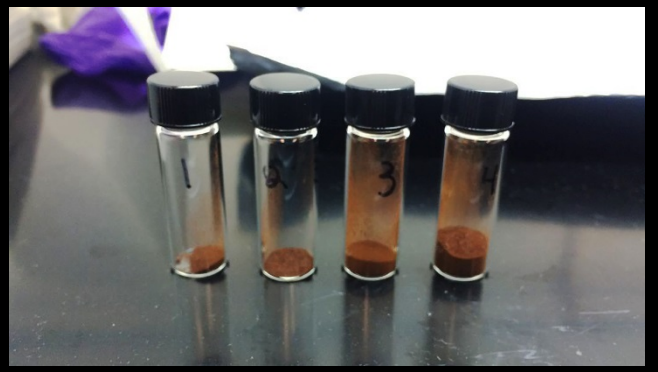
Surprise Number One:

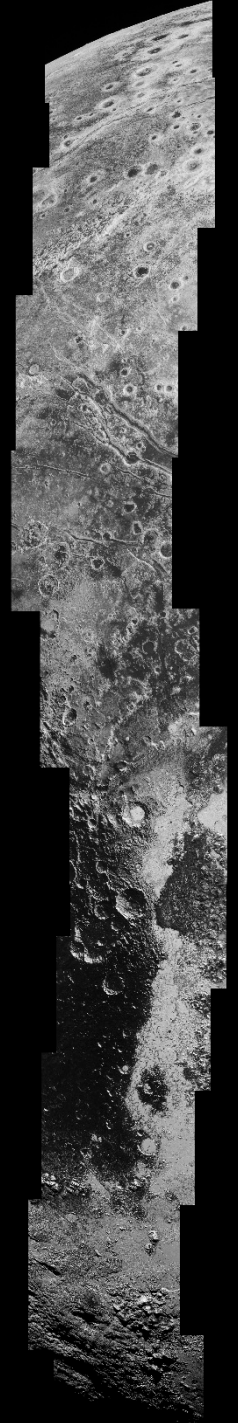
It's red! The second red planet in the solar system!

WHY?

THOLINS

Small soot-like particles generated from reactions involving methane and nitrogen in the atmosphere.

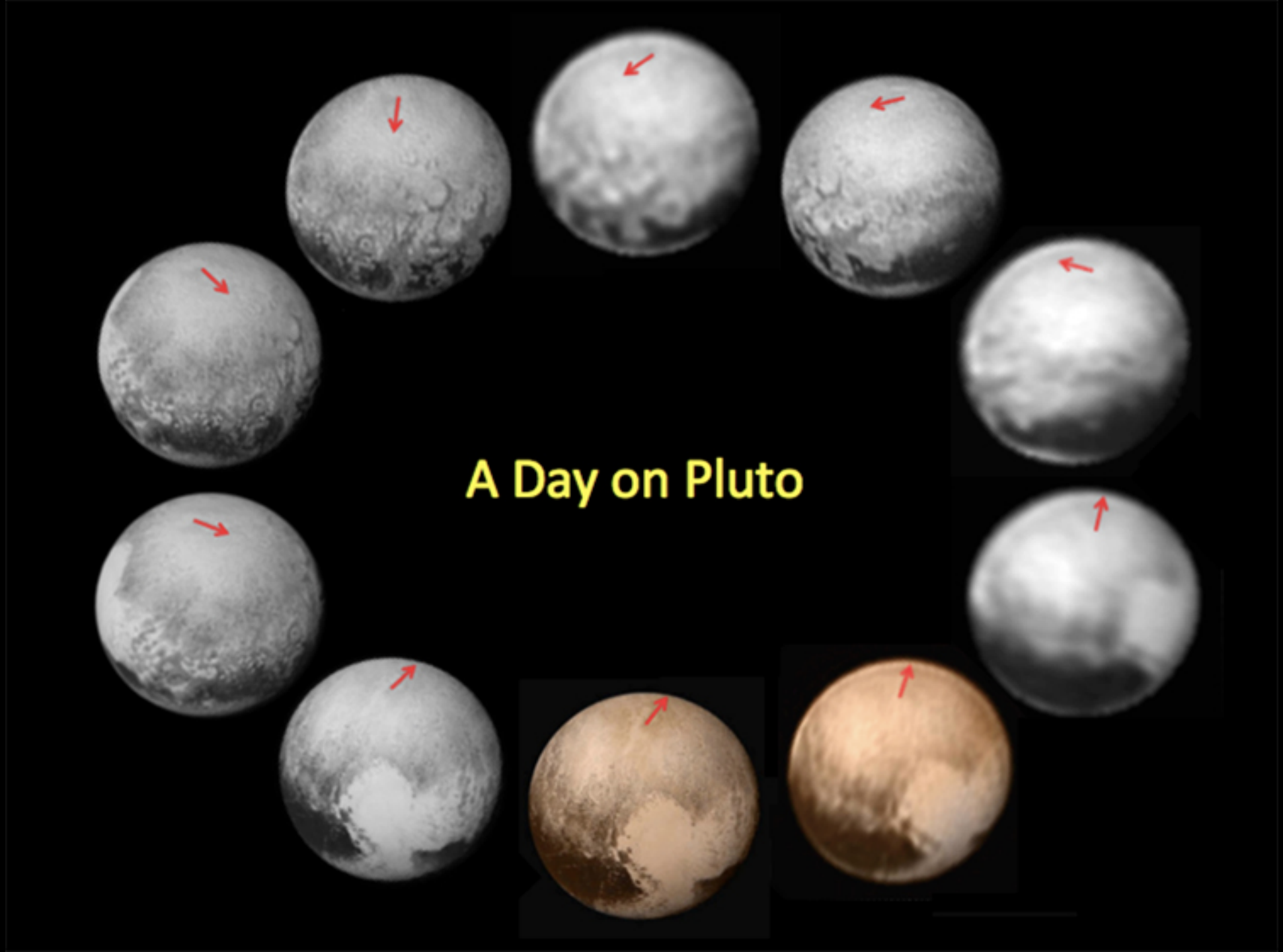


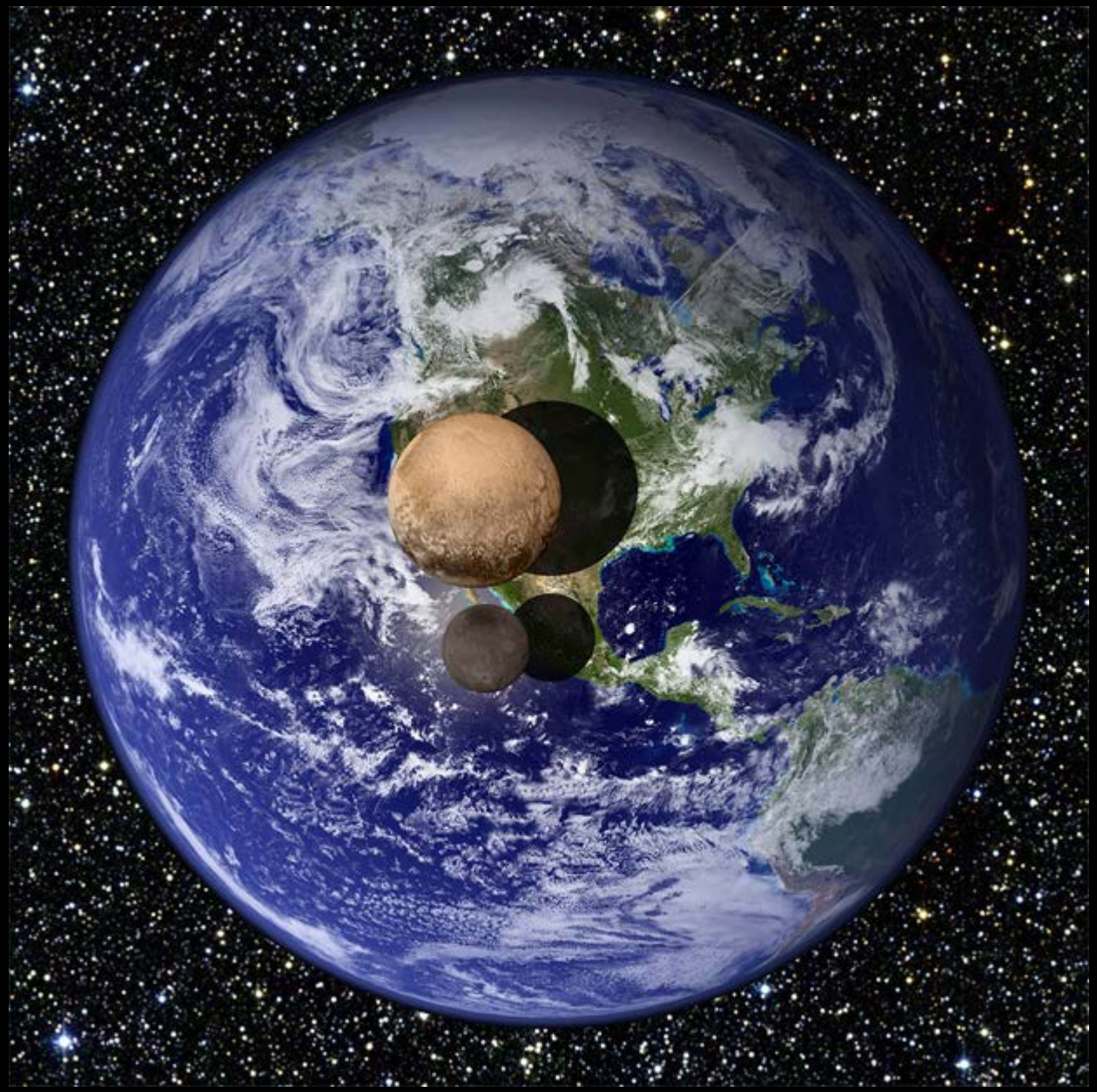


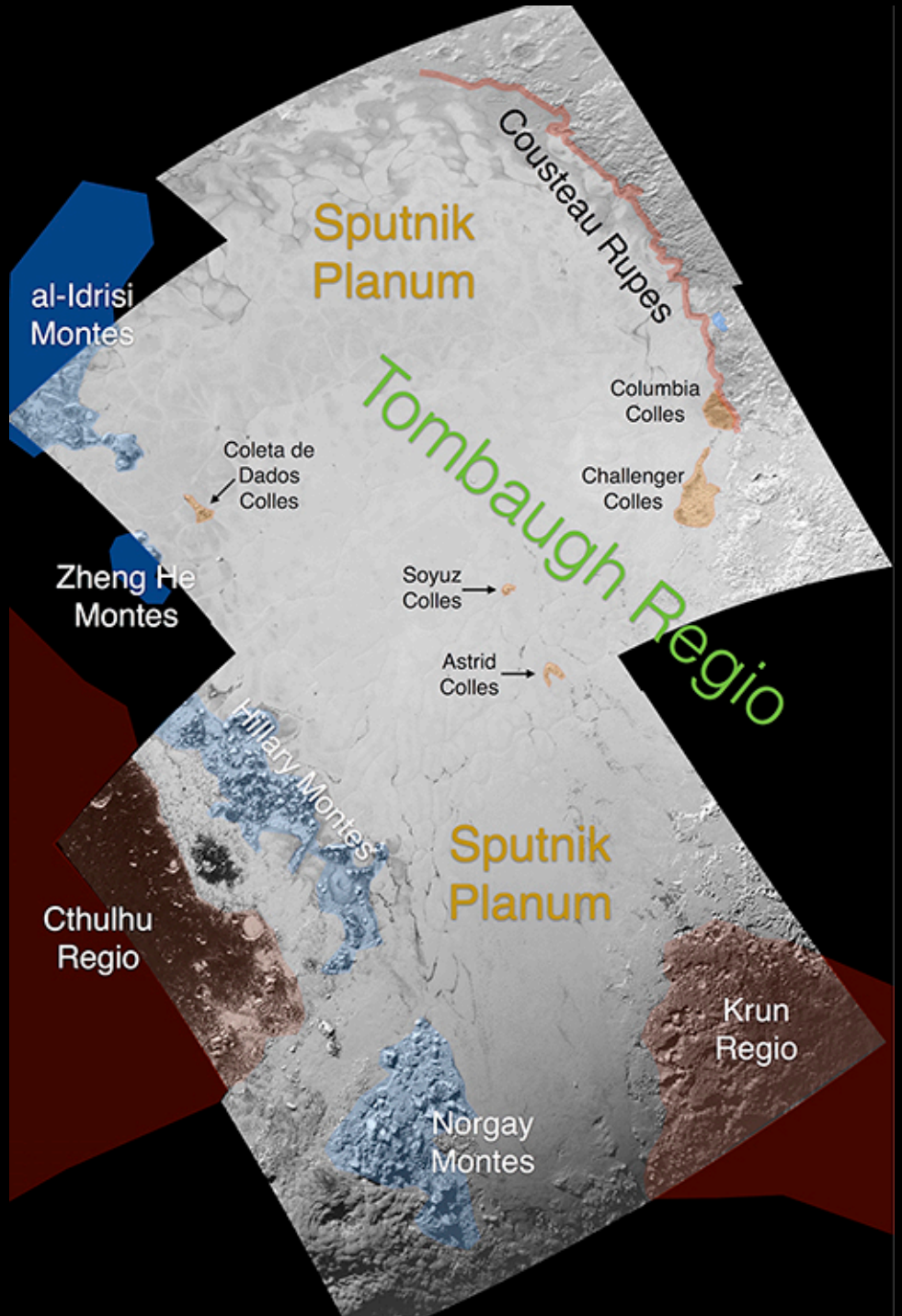
Big surprise Number Two:

Even at 38 degrees above absolute zero – Pluto has an active atmosphere and is geologically active”

* The presence of tholins is an example of this activity!


A Day on Pluto





Naming the features of a new planet

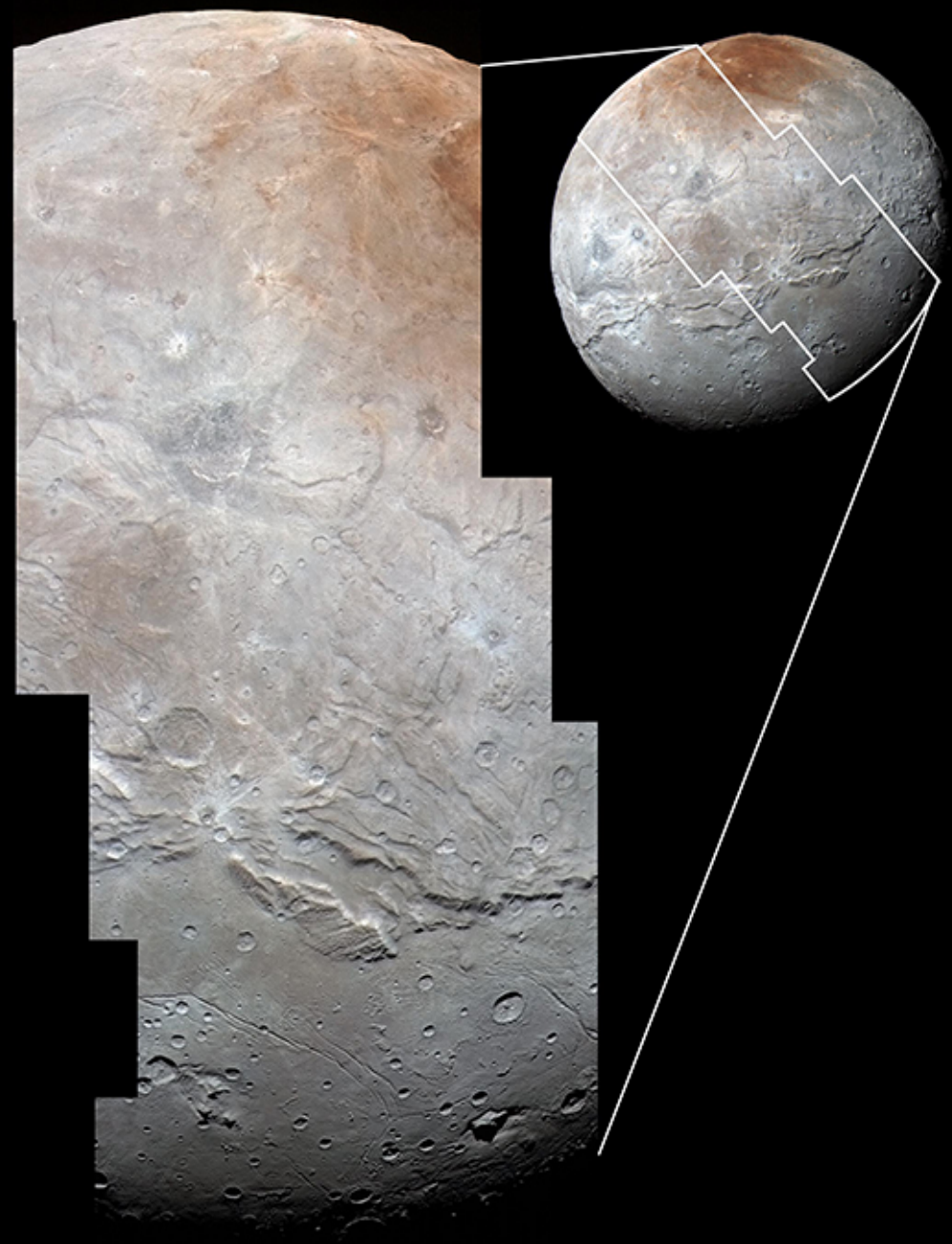
Names are approved formally by the

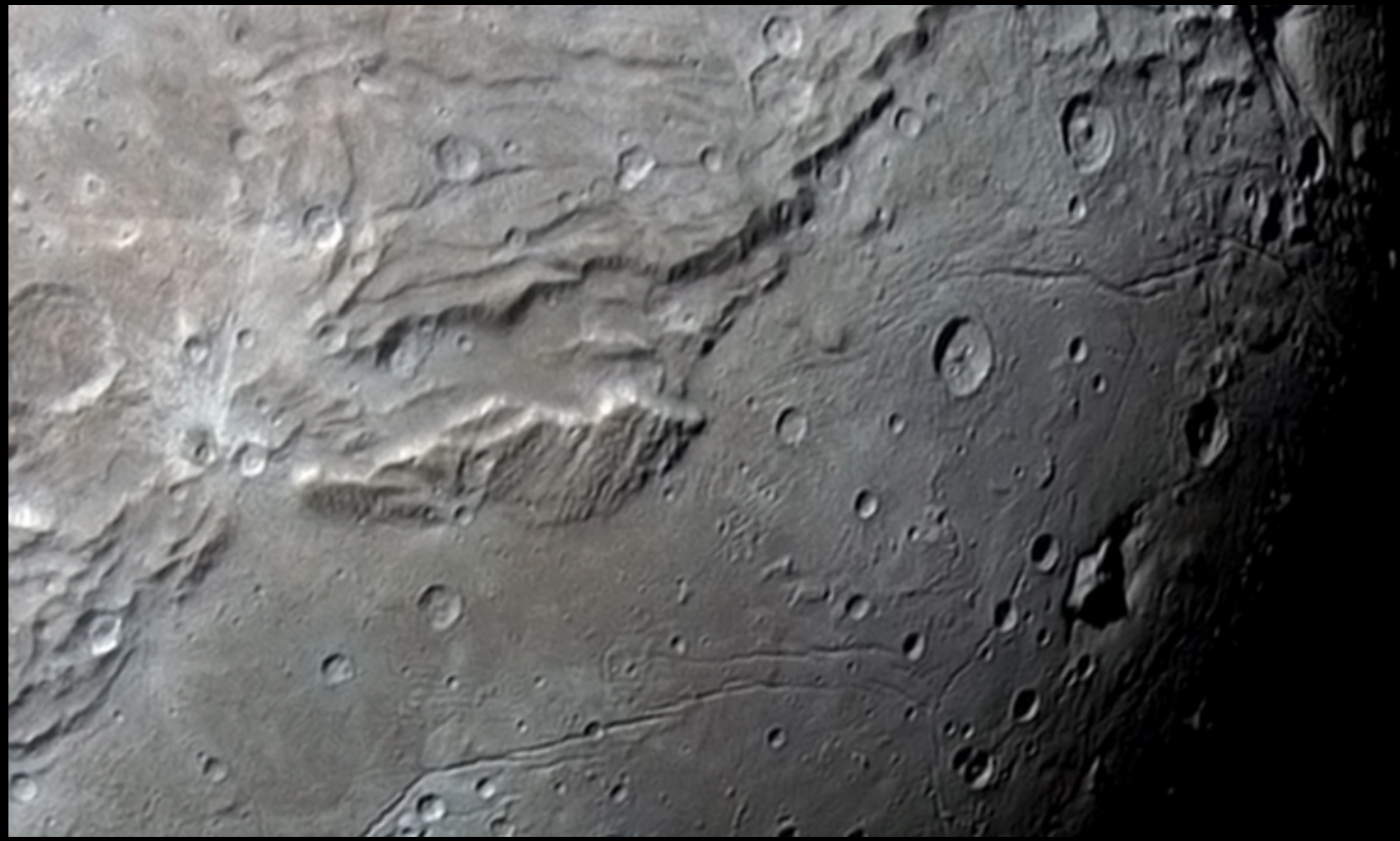
International Astronomical Union

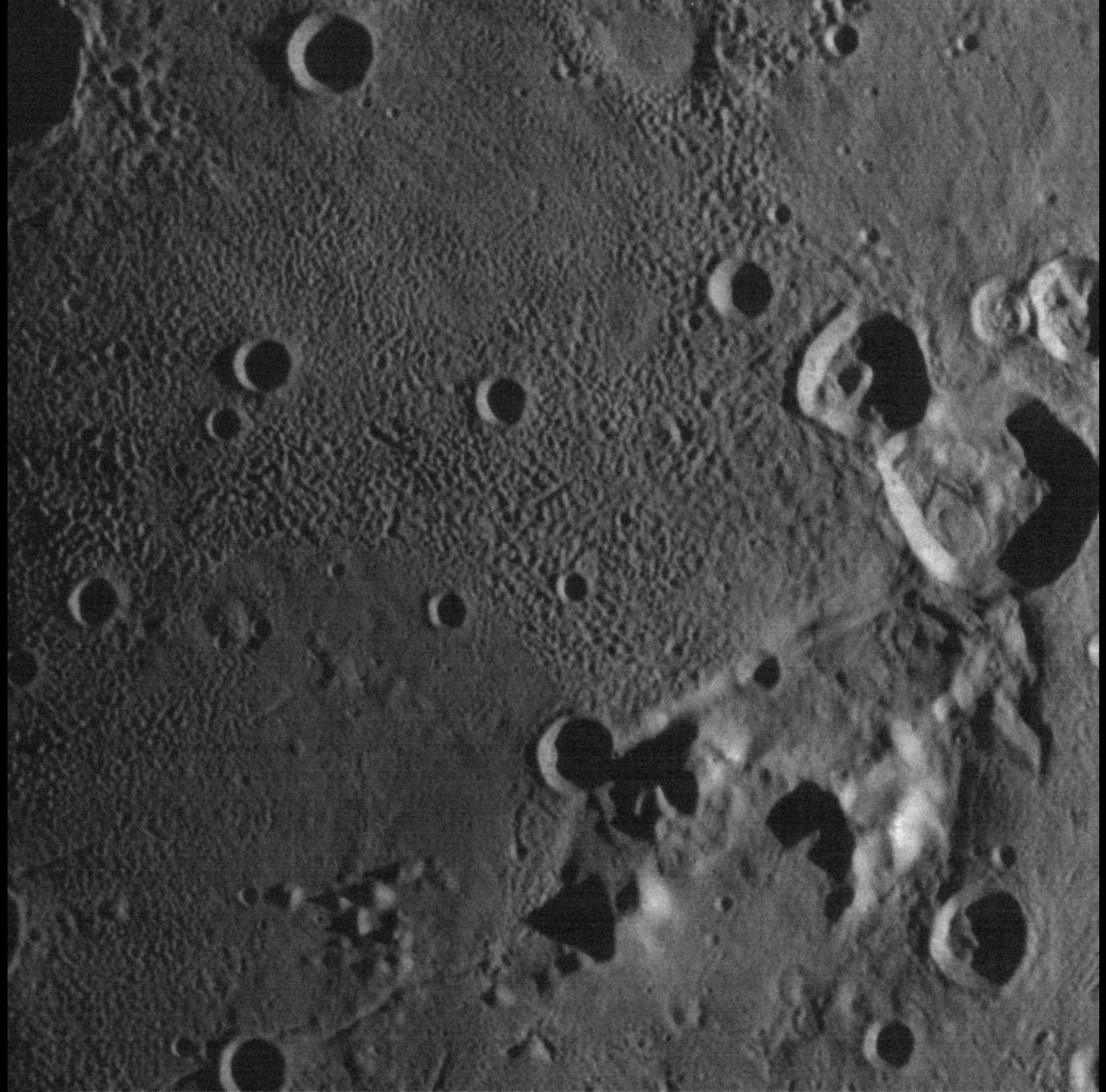
Pluto – Charon

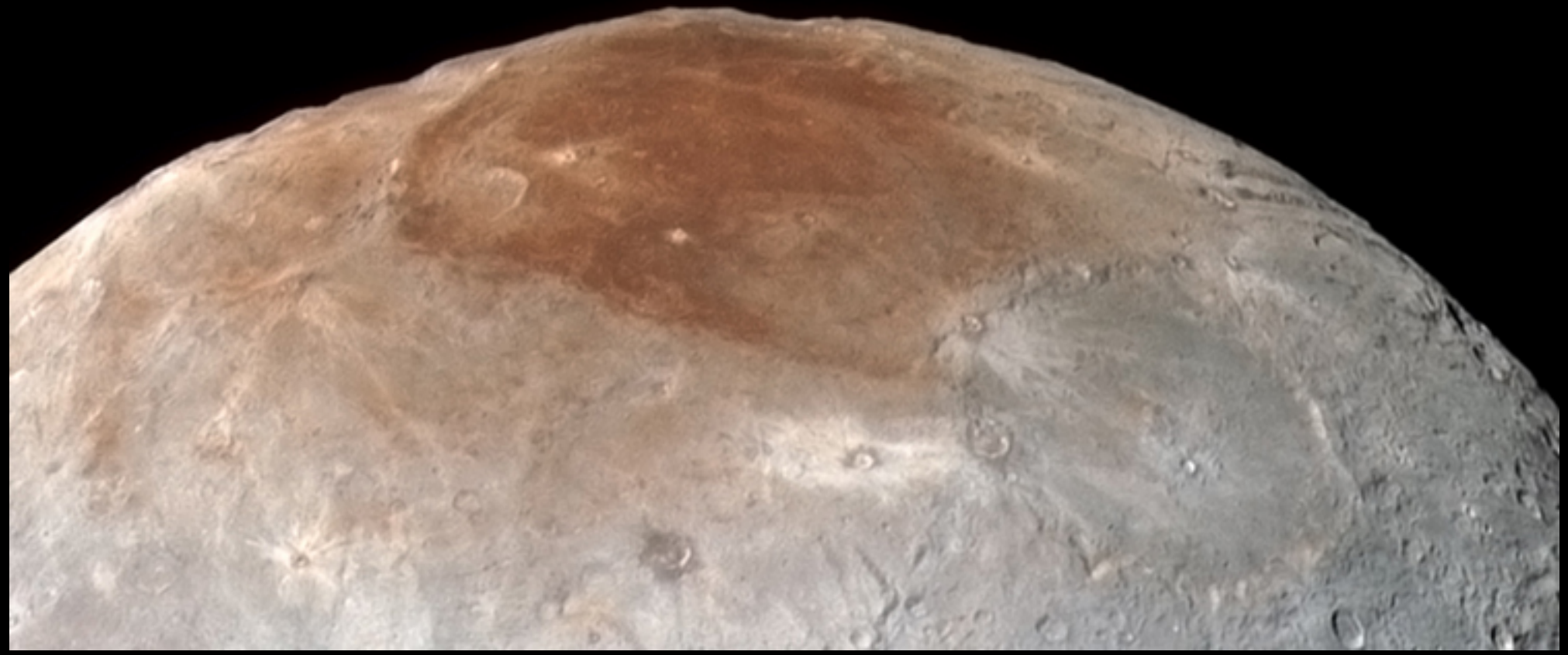
Double Planet System

New Horizons MVIC Color Imager
Distance from Pluto: 54.8 million km
Date: 2015-05-29 11:38 UTC
Barycentric view

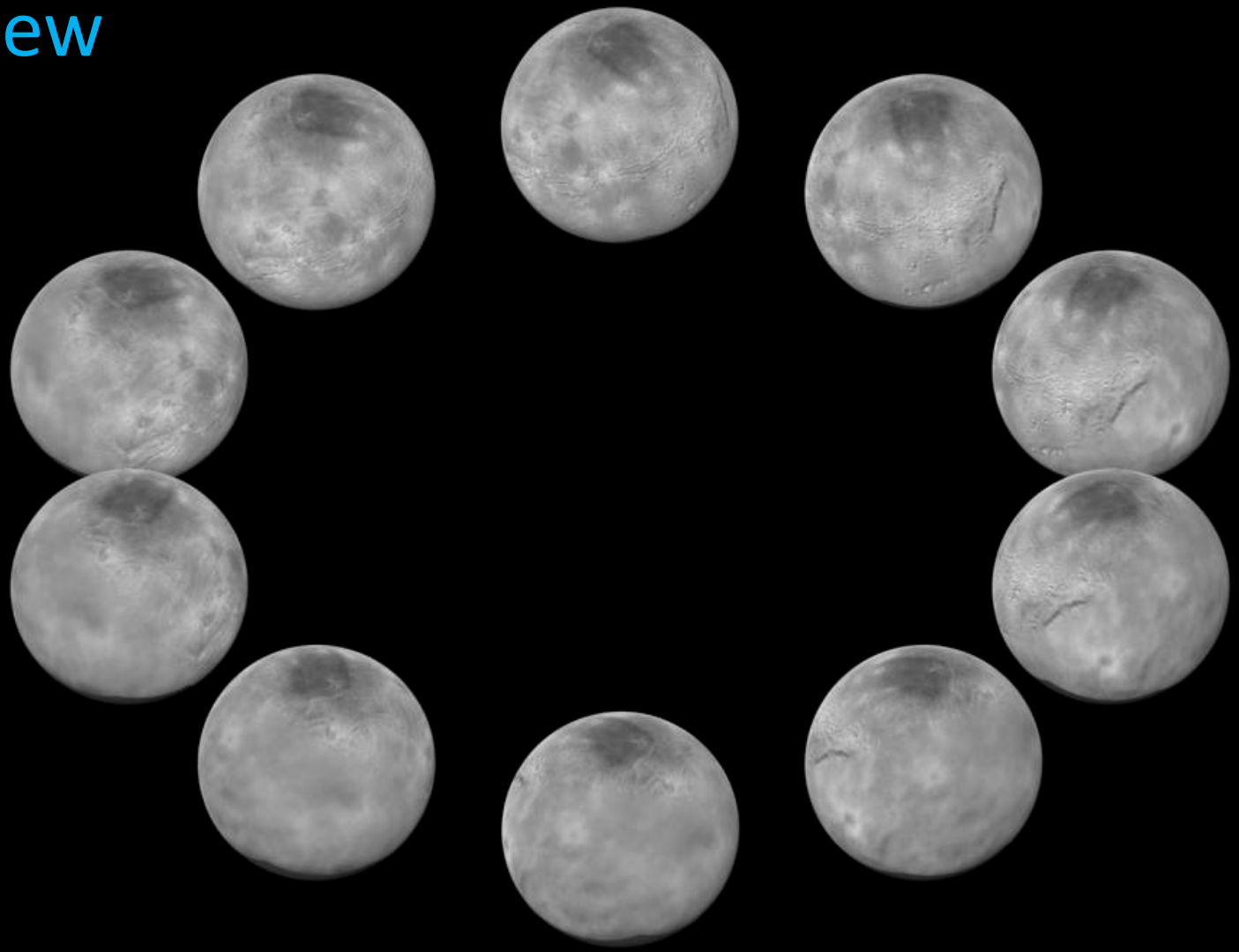




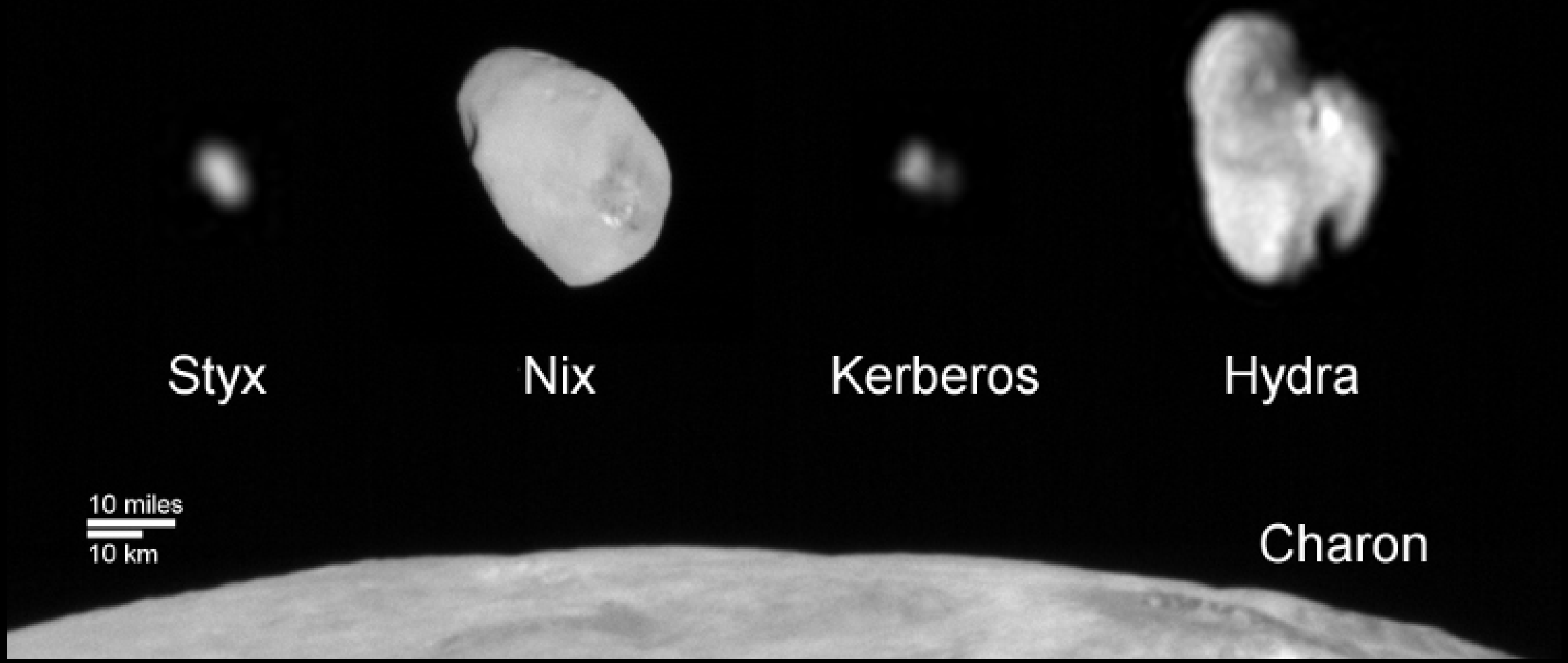




Charon’s Global View



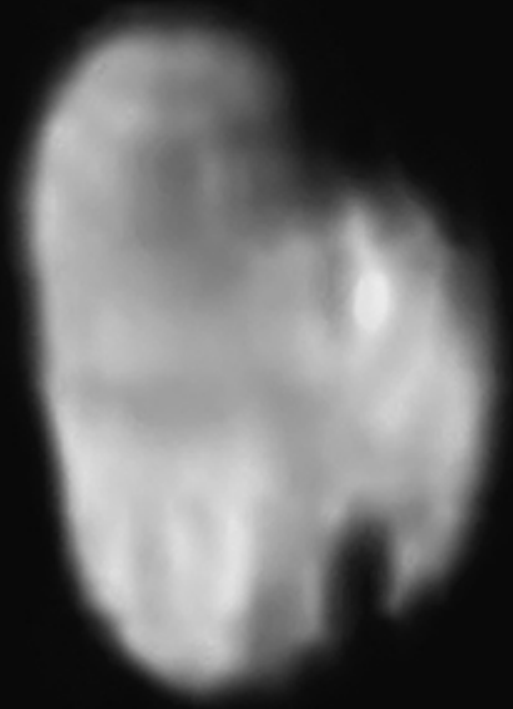
Charon and the Small Moons of Pluto



Nix

enhanced color

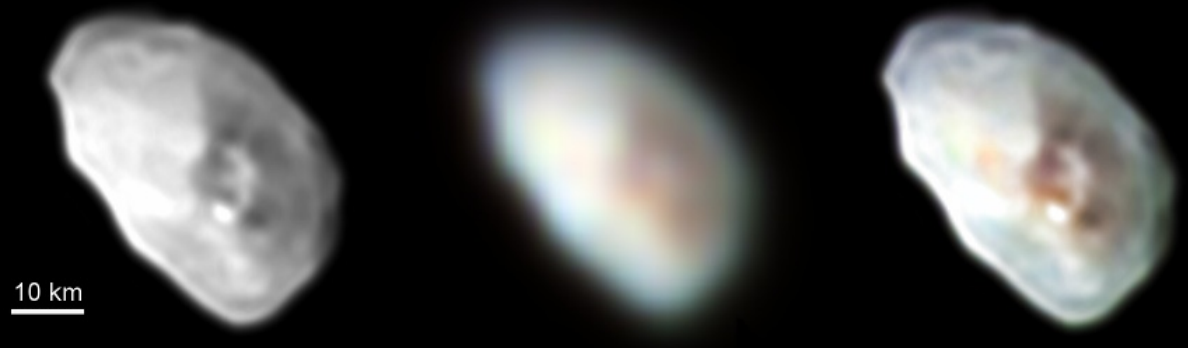
Hydra



black and white

Pluto's moon Hydra as seen by *New Horizons*

Pluto's moon Nix as seen by *New Horizons*



LORRI
Panchromatic

MVIC
Enhanced Color

LORRI/MVIC
Composite

NIX

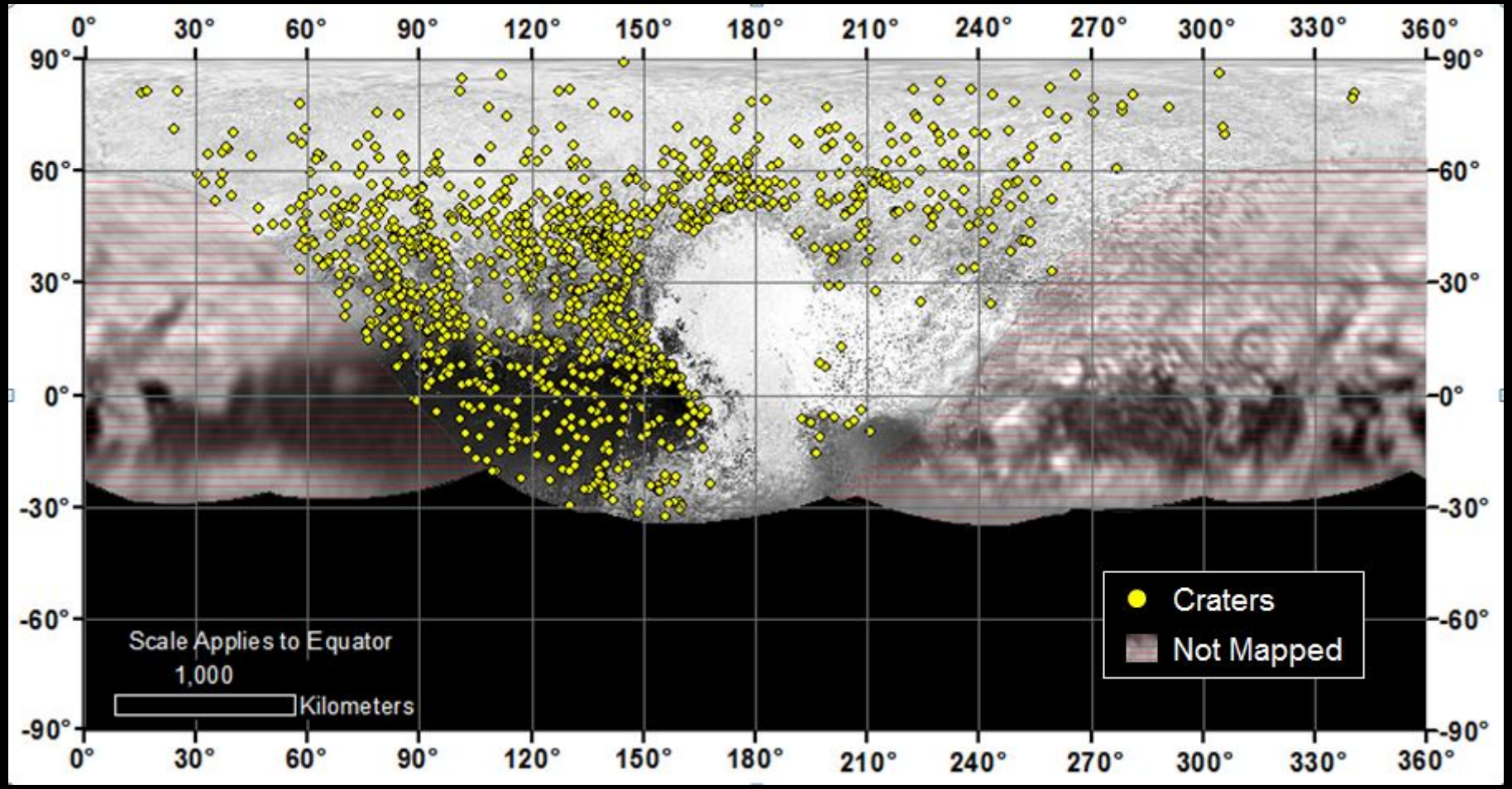
Three Faces of Nix from *New Horizons*

On Approch
July 13, 23:19 UTC

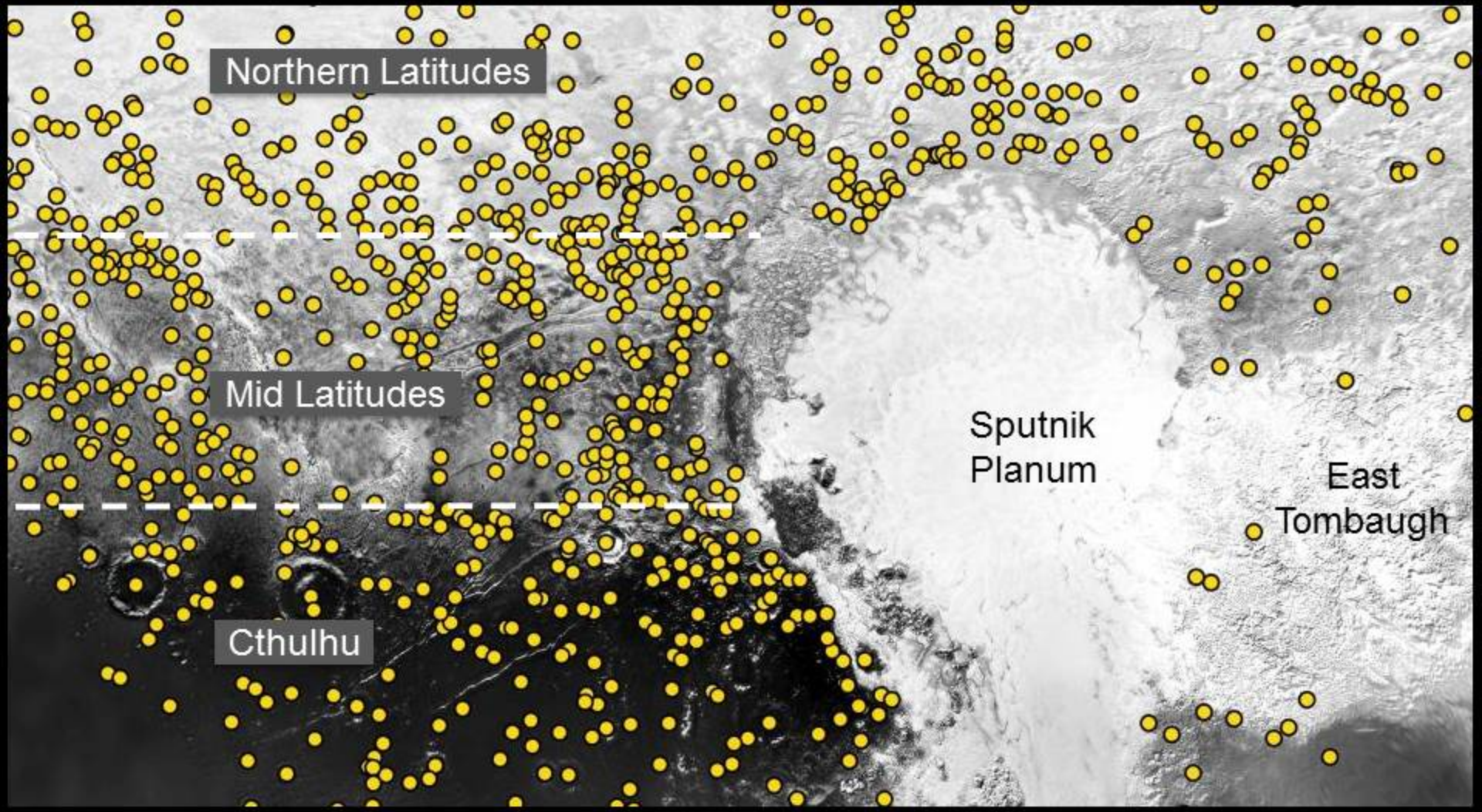
Second-best Image
July 14, 08:05 UTC

Departing
July 14, 14:55 UTC

Pluto's Mapped and Un-mapped Surface

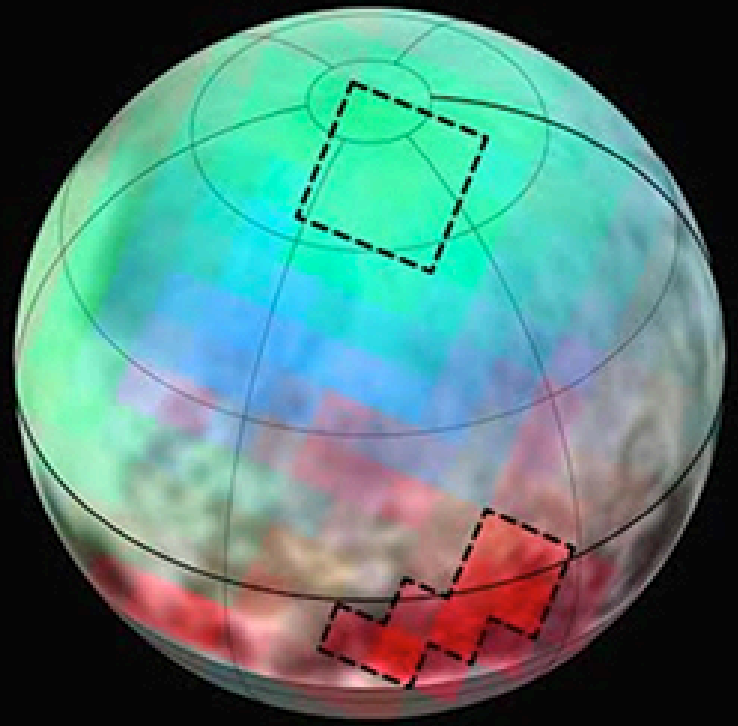


Varied Crater Densities

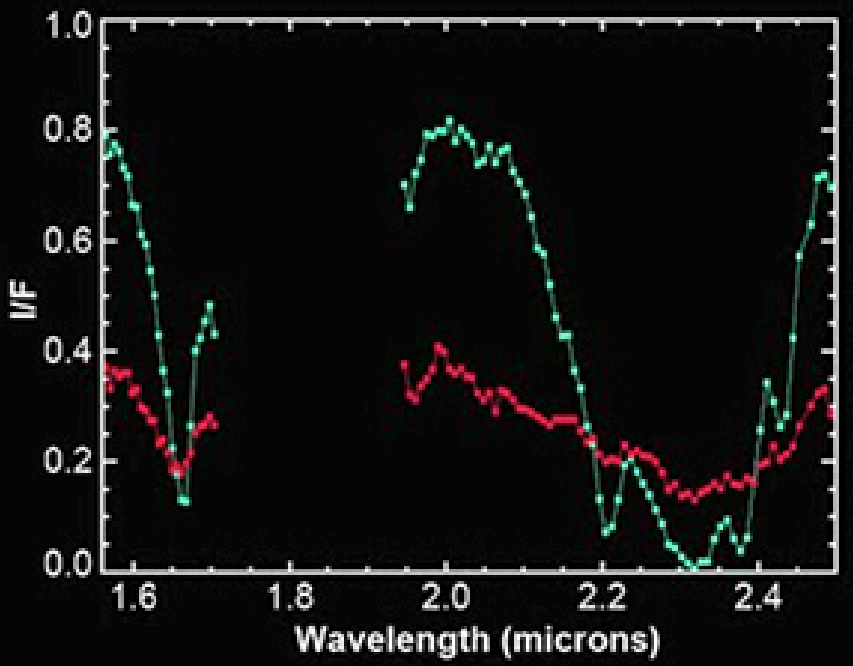


Note: All feature names are informal.

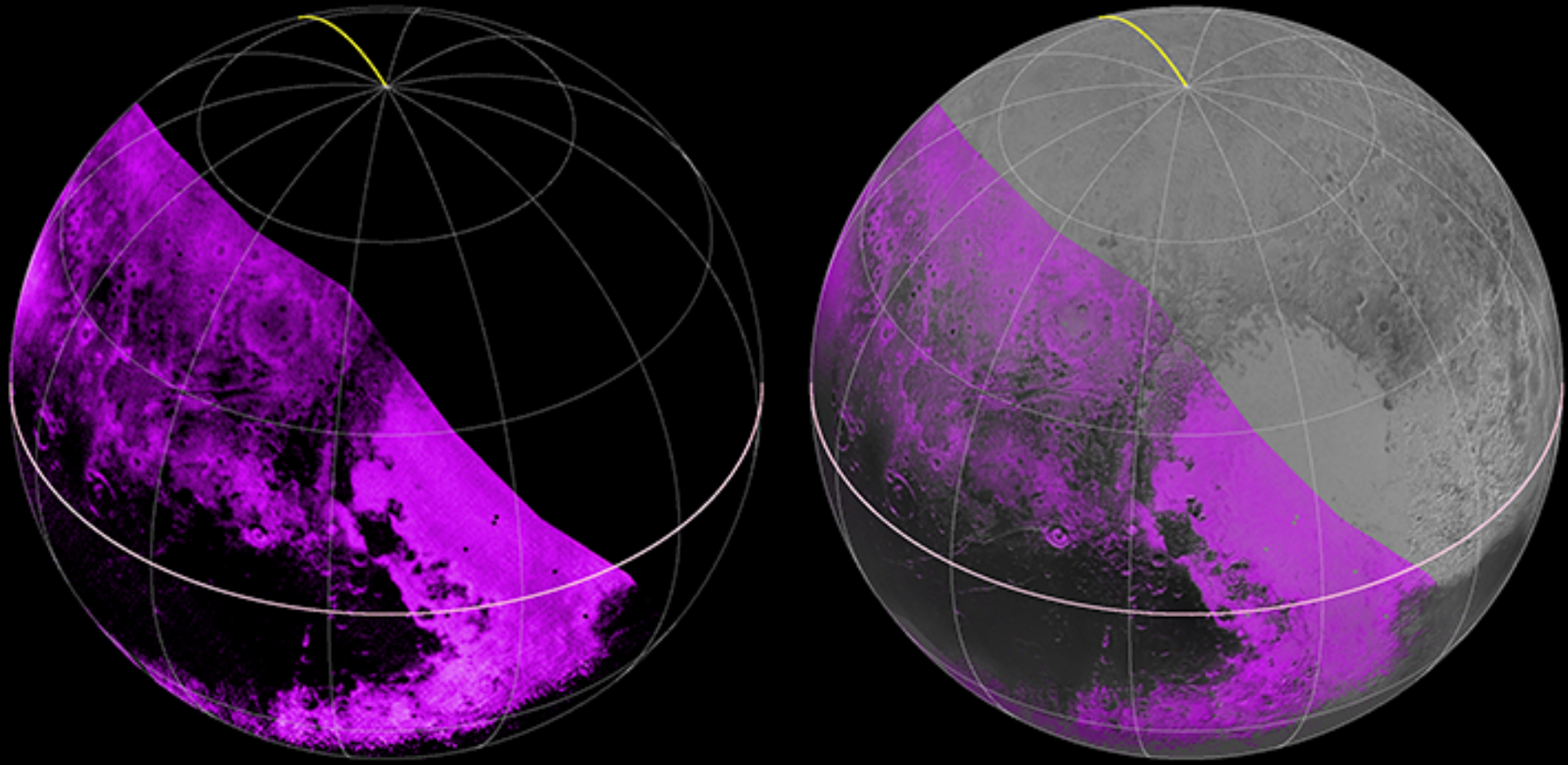
Methane on Pluto



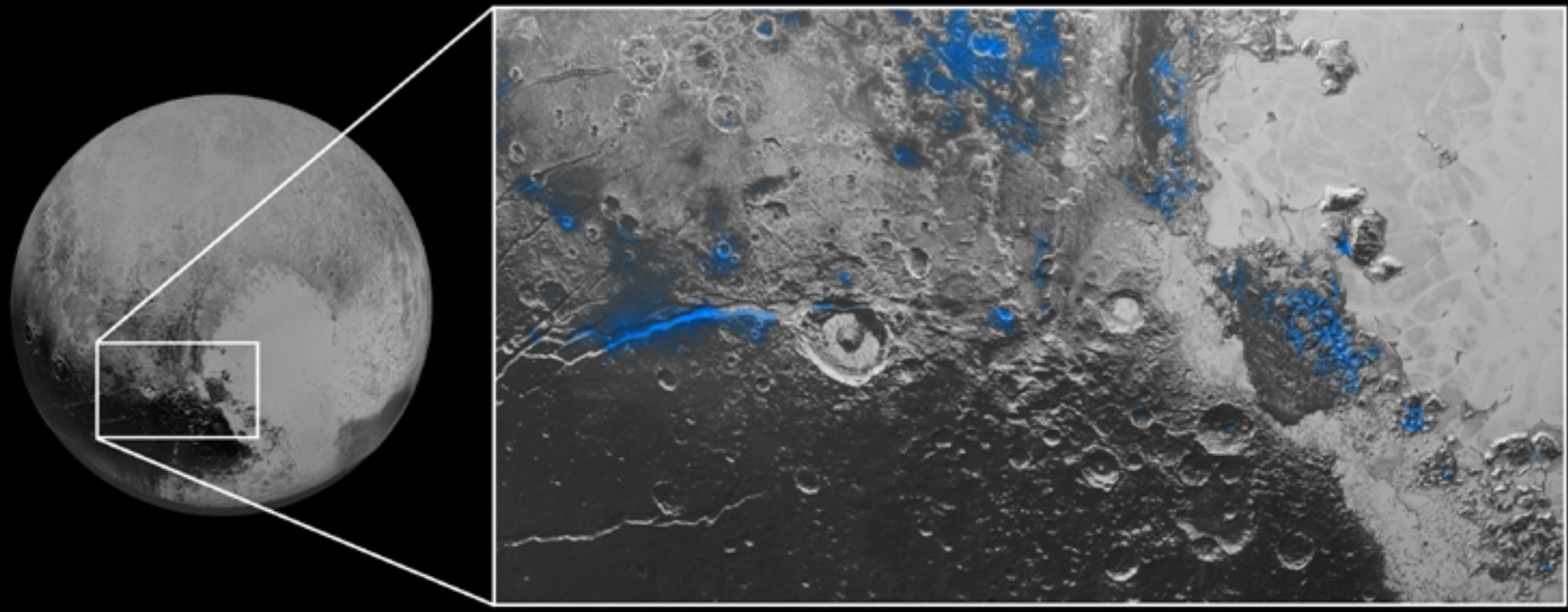
Infrared Spectral Image



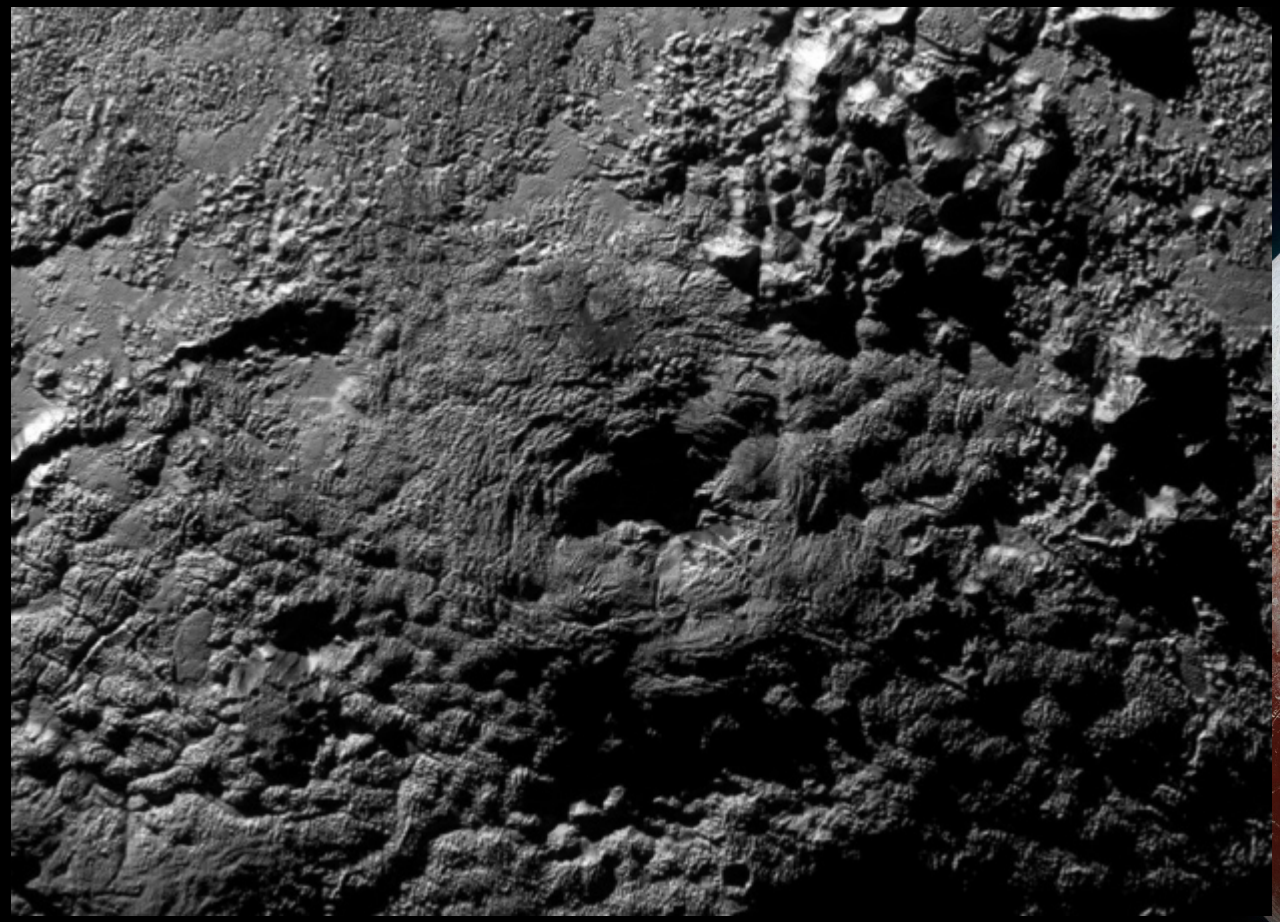
Methane Ice Mapped on Pluto's Surface

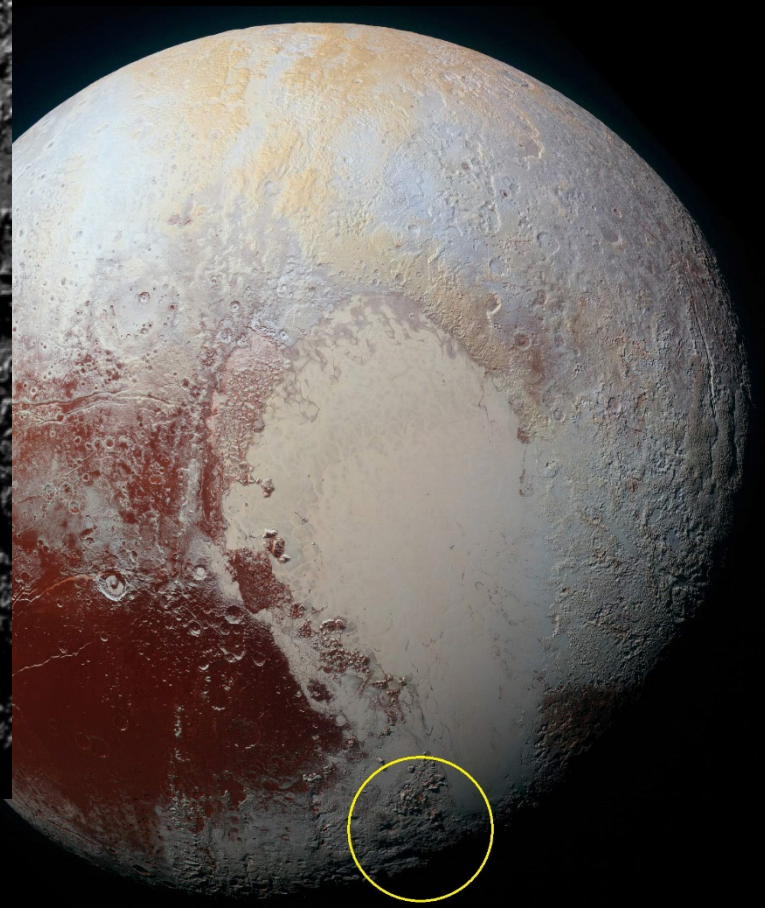


Exposed Water Ice

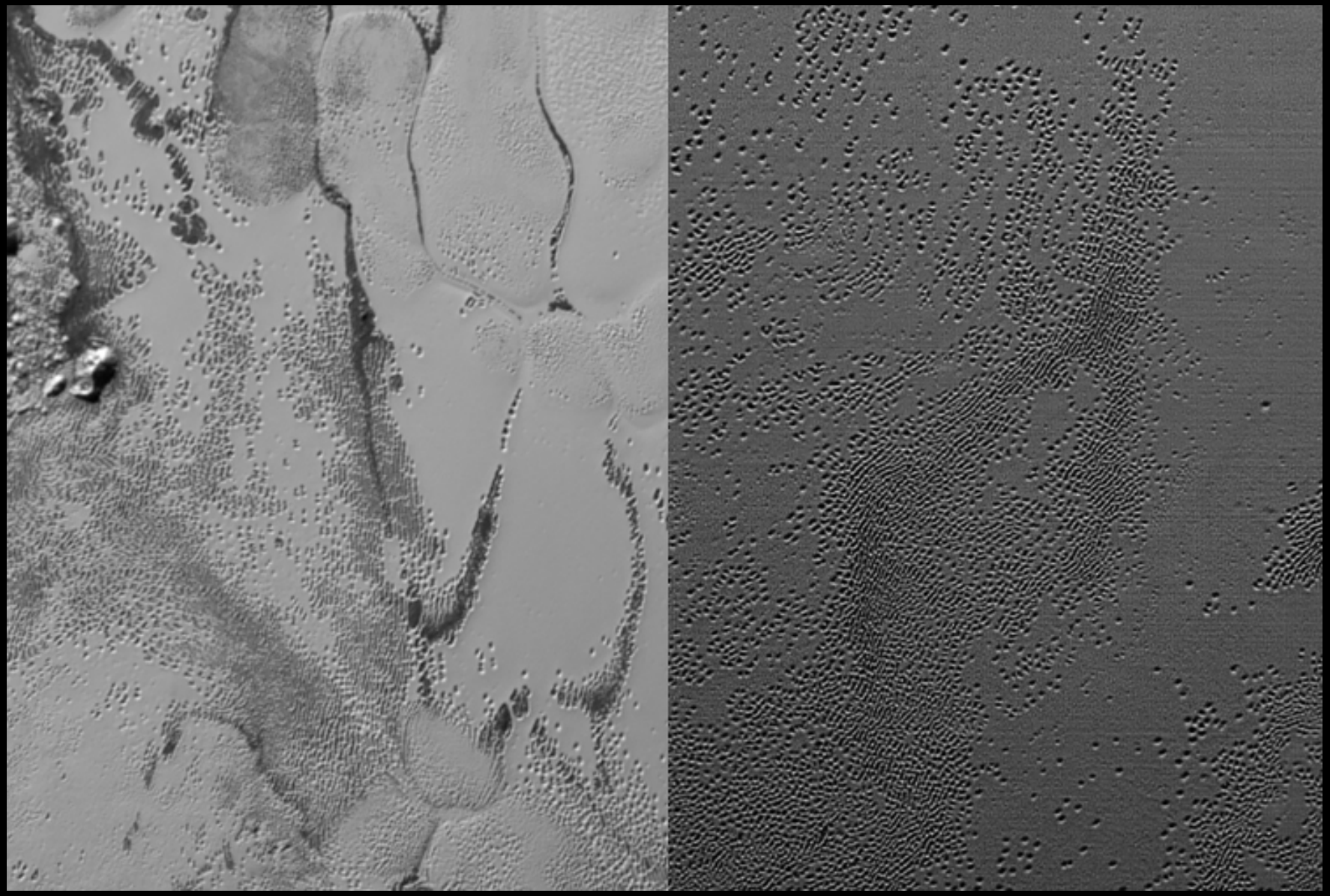


Wright Mons Cryovolcano

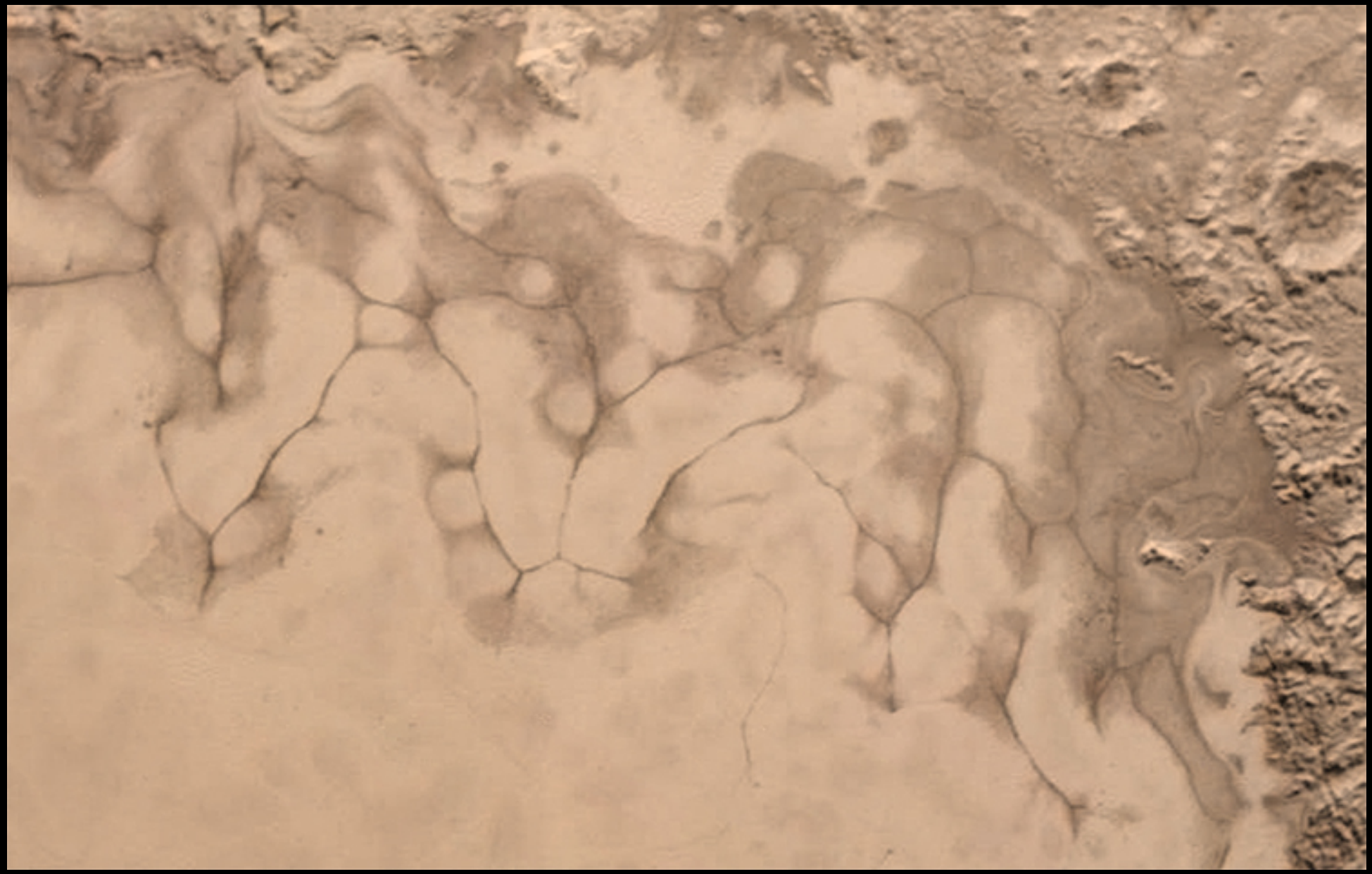


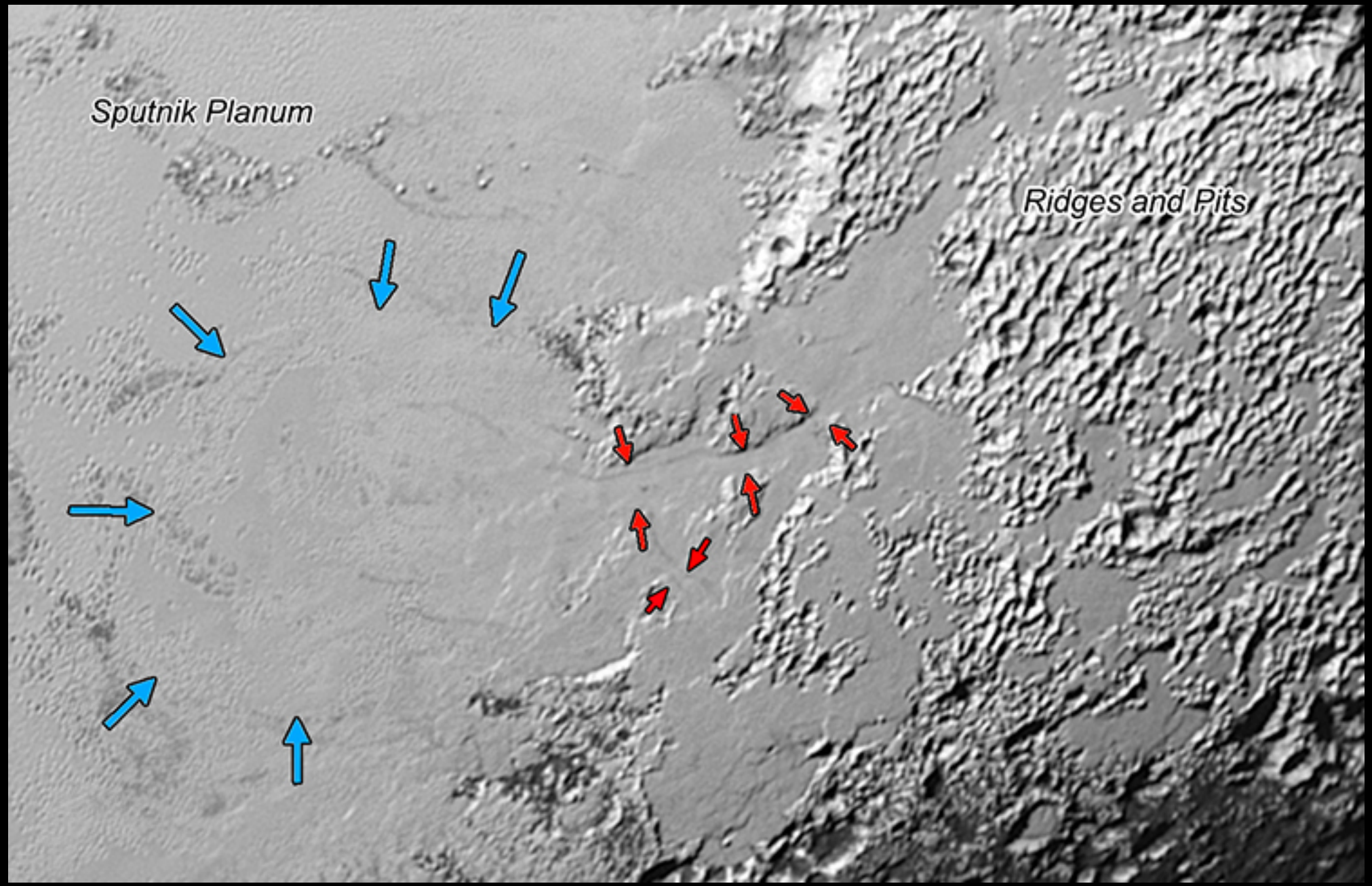


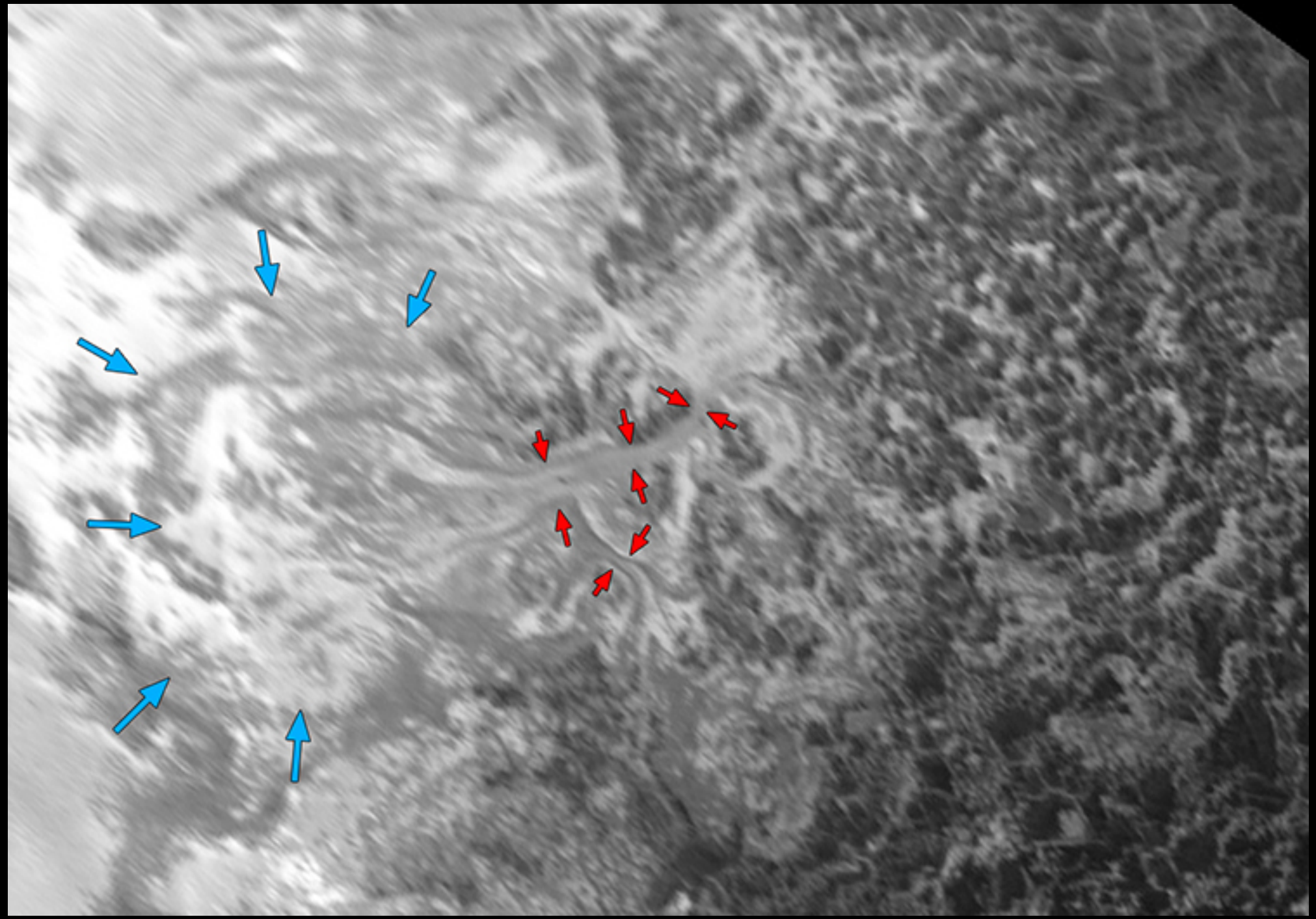
Pitted Surface Methane Ices – Closest Approach

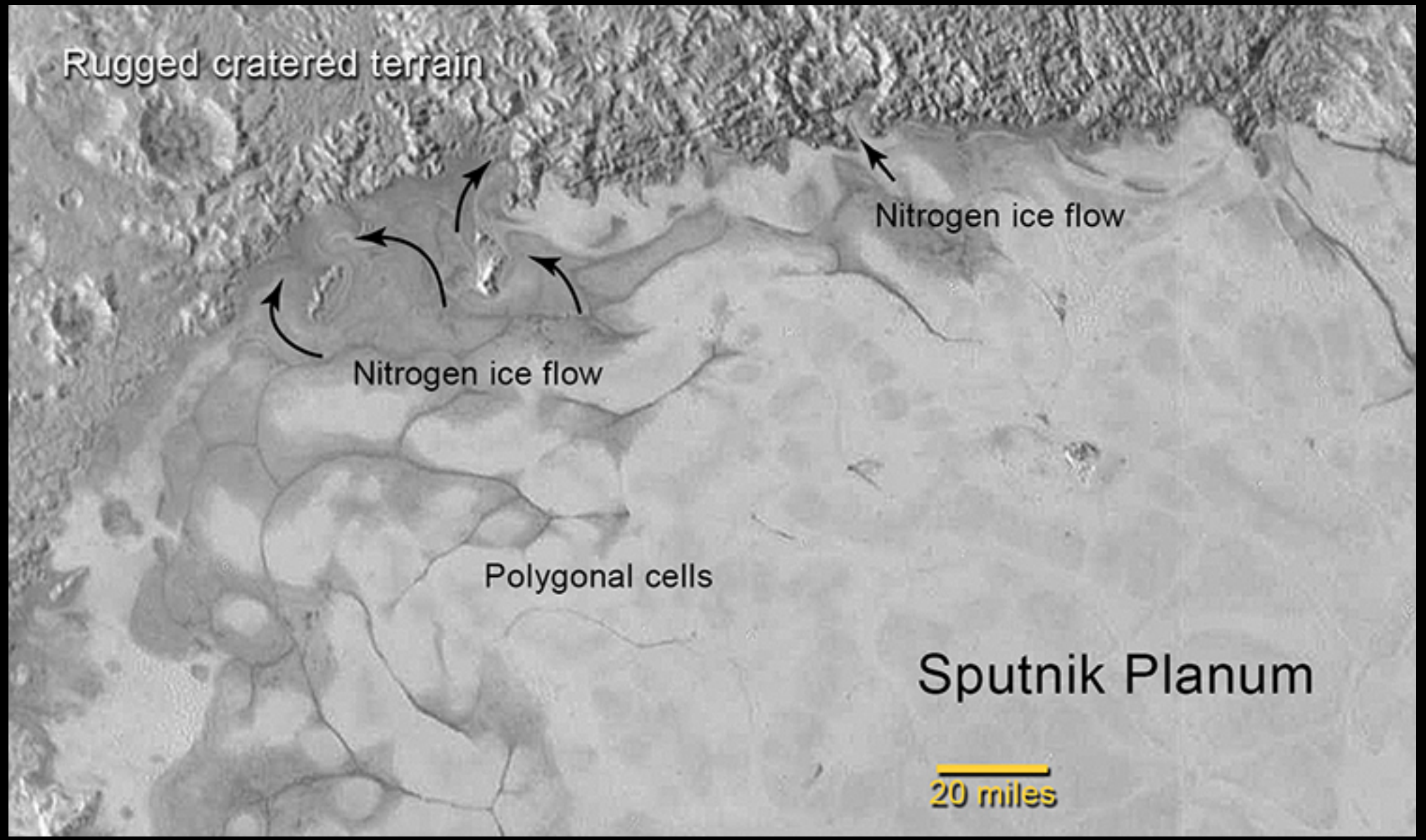


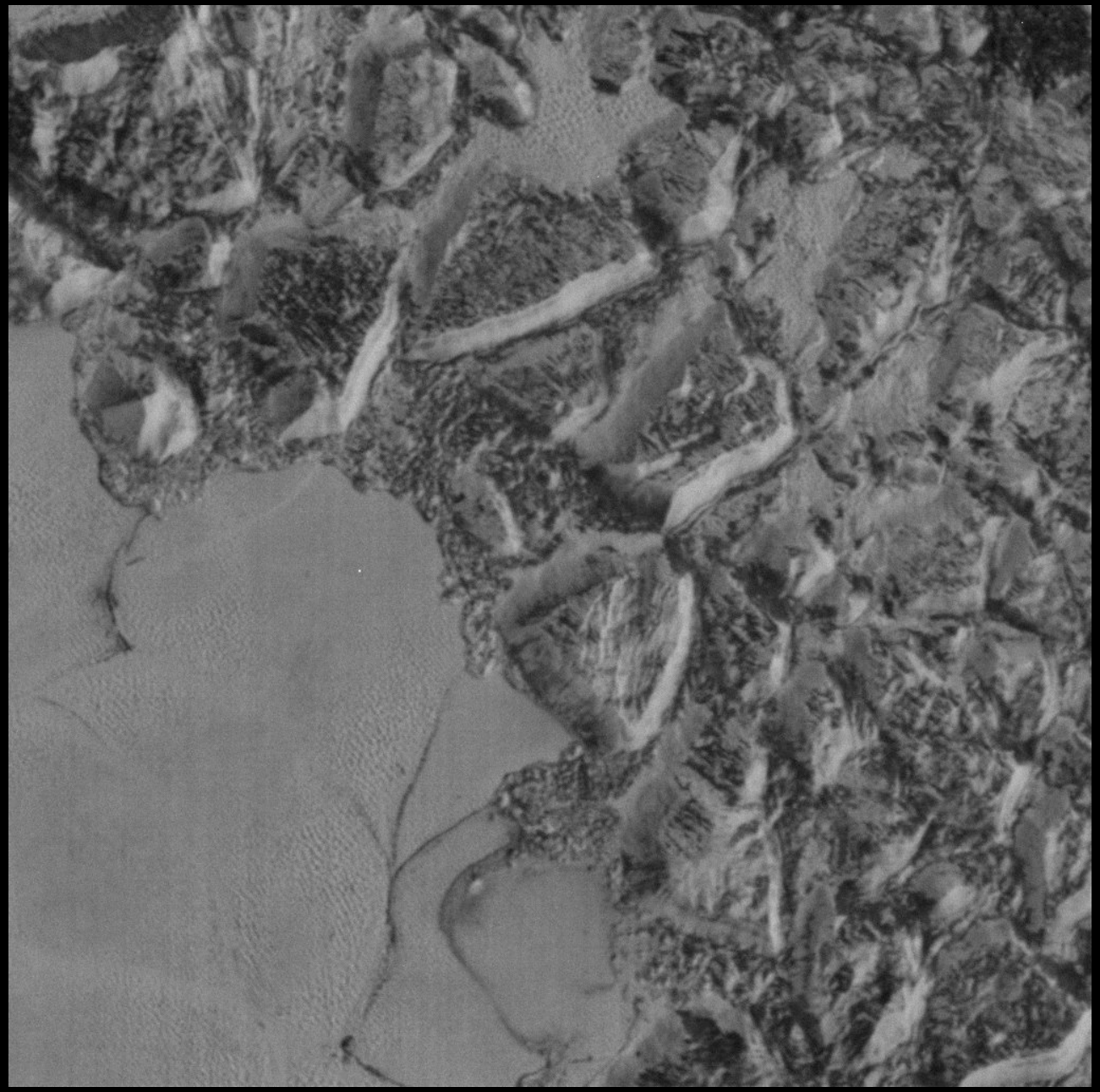
Ice Flows – Sputnik Planum

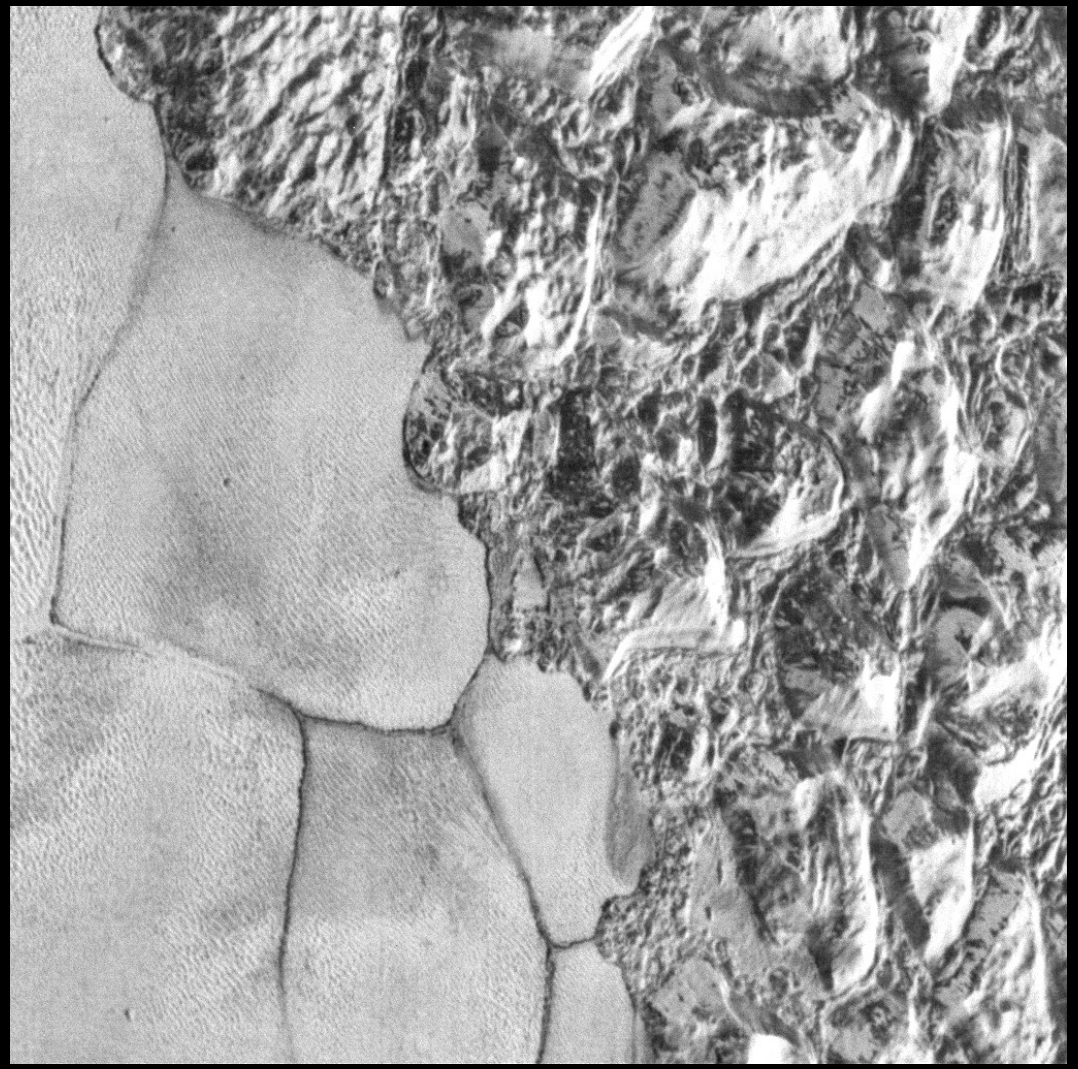


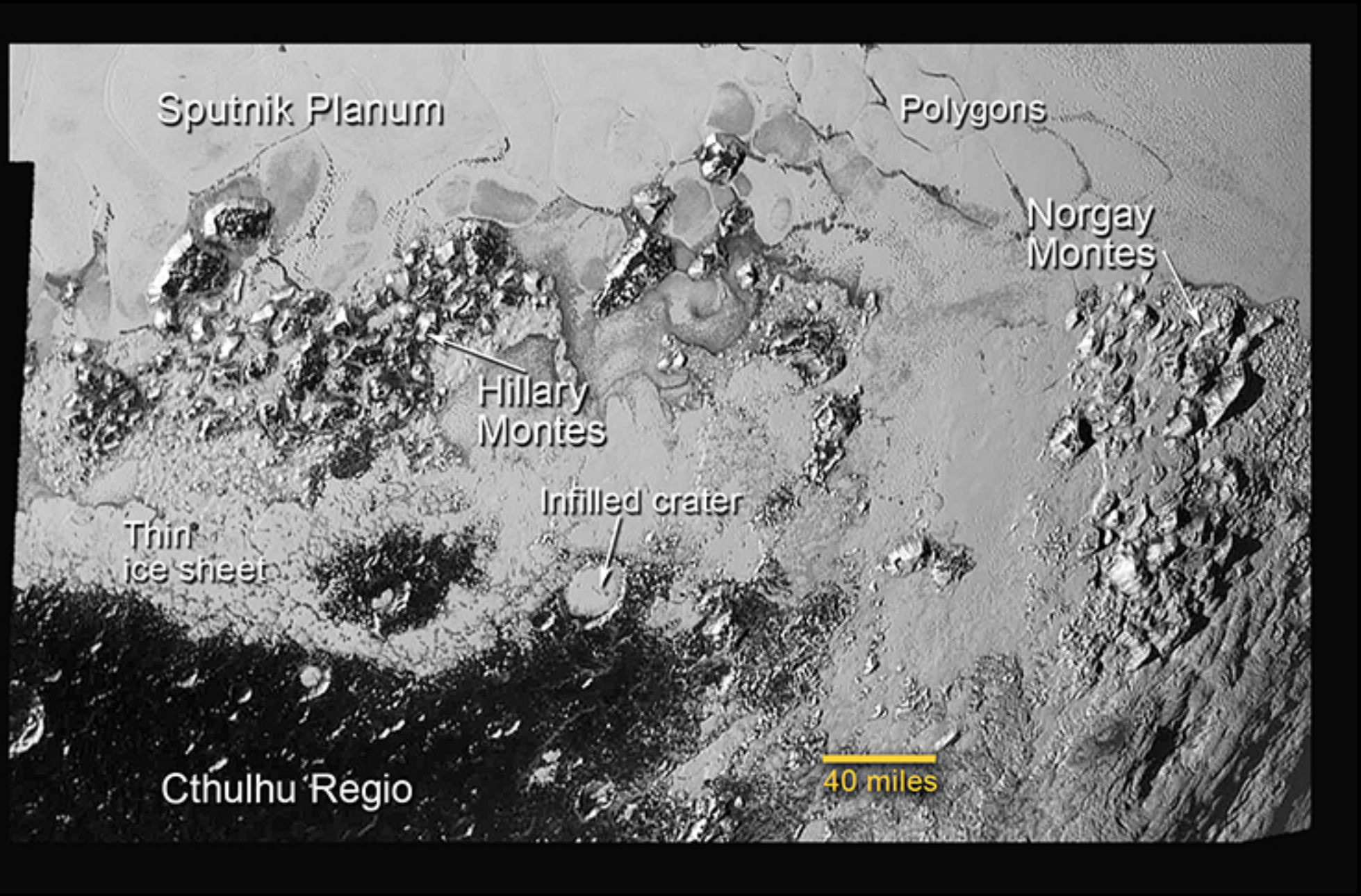

Sputnik Planum
Ridges and Pits

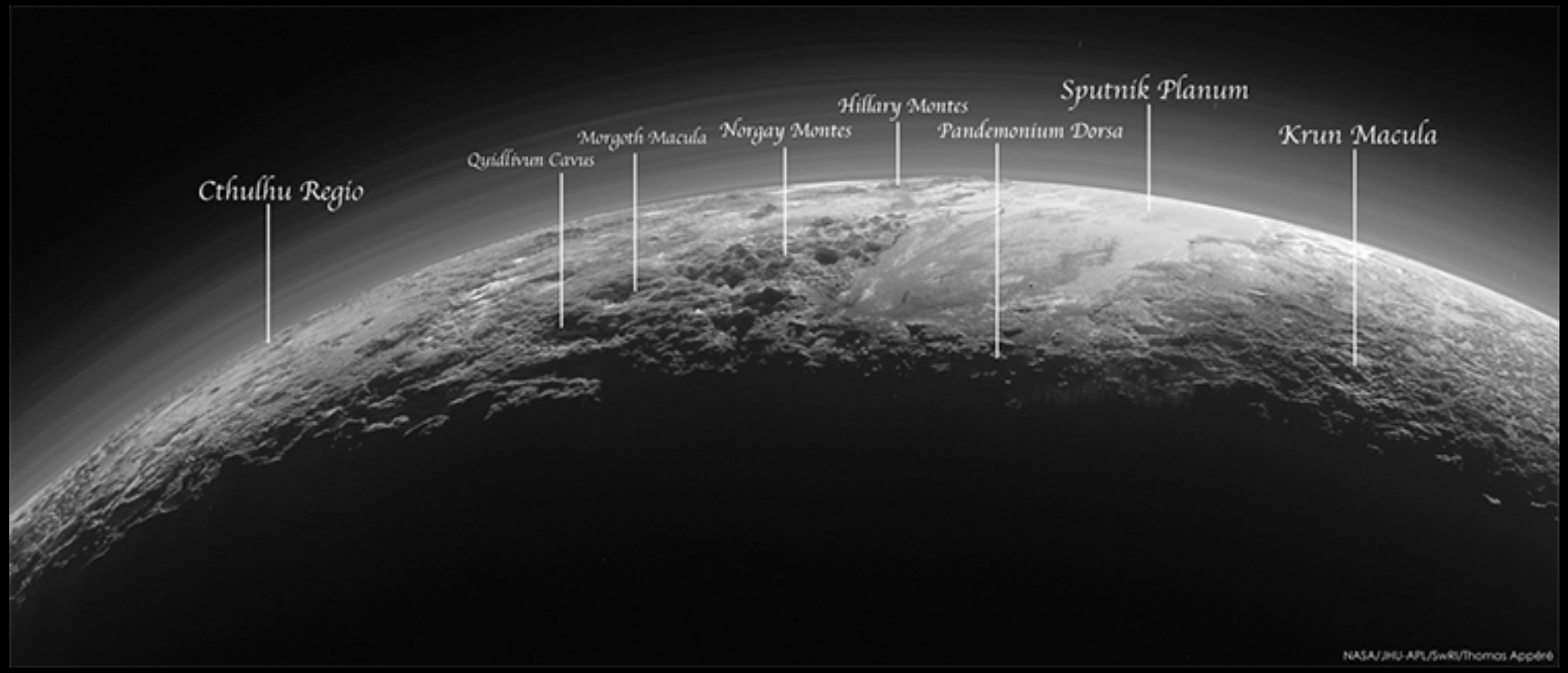



Rugged cratered terrain
Nitrogen ice flow
Nitrogen ice flow
Polygonal cells
Sputnik Planum
20 miles

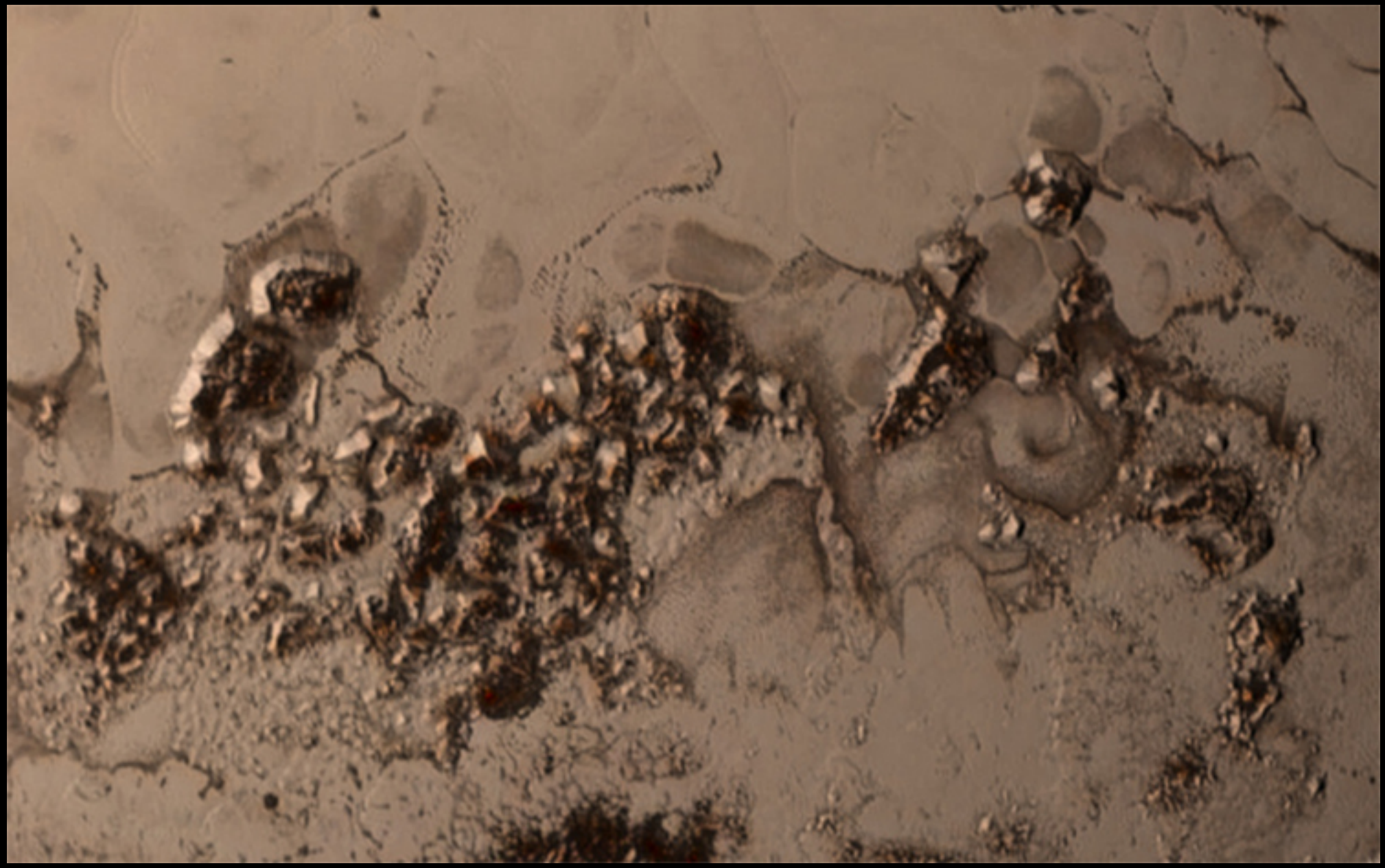


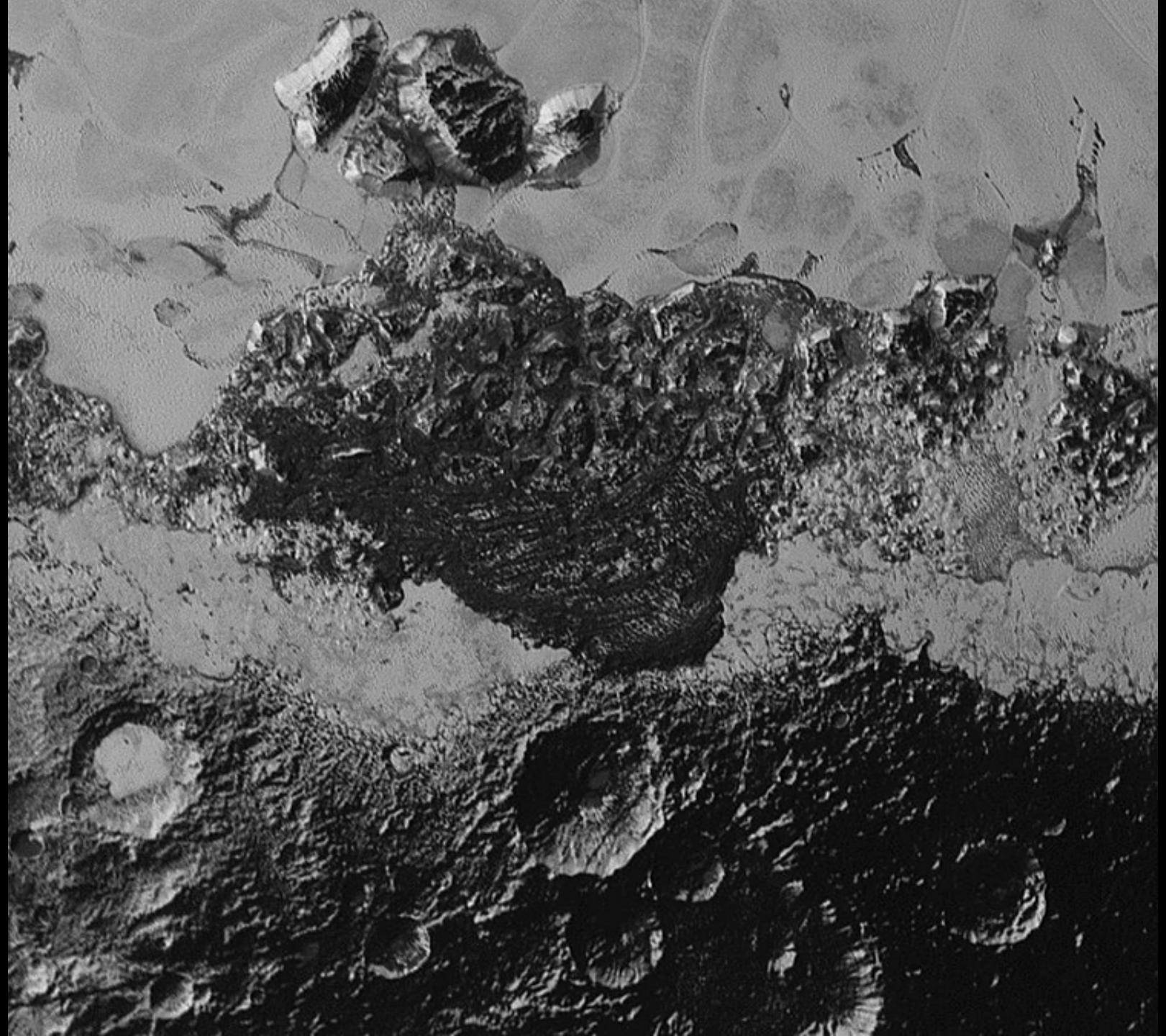



Sputnik Planum
Polygons
Norgay Montes
Hillary Montes
Infilled crater
Thin ice sheet
Cthulhu Regio
40 miles

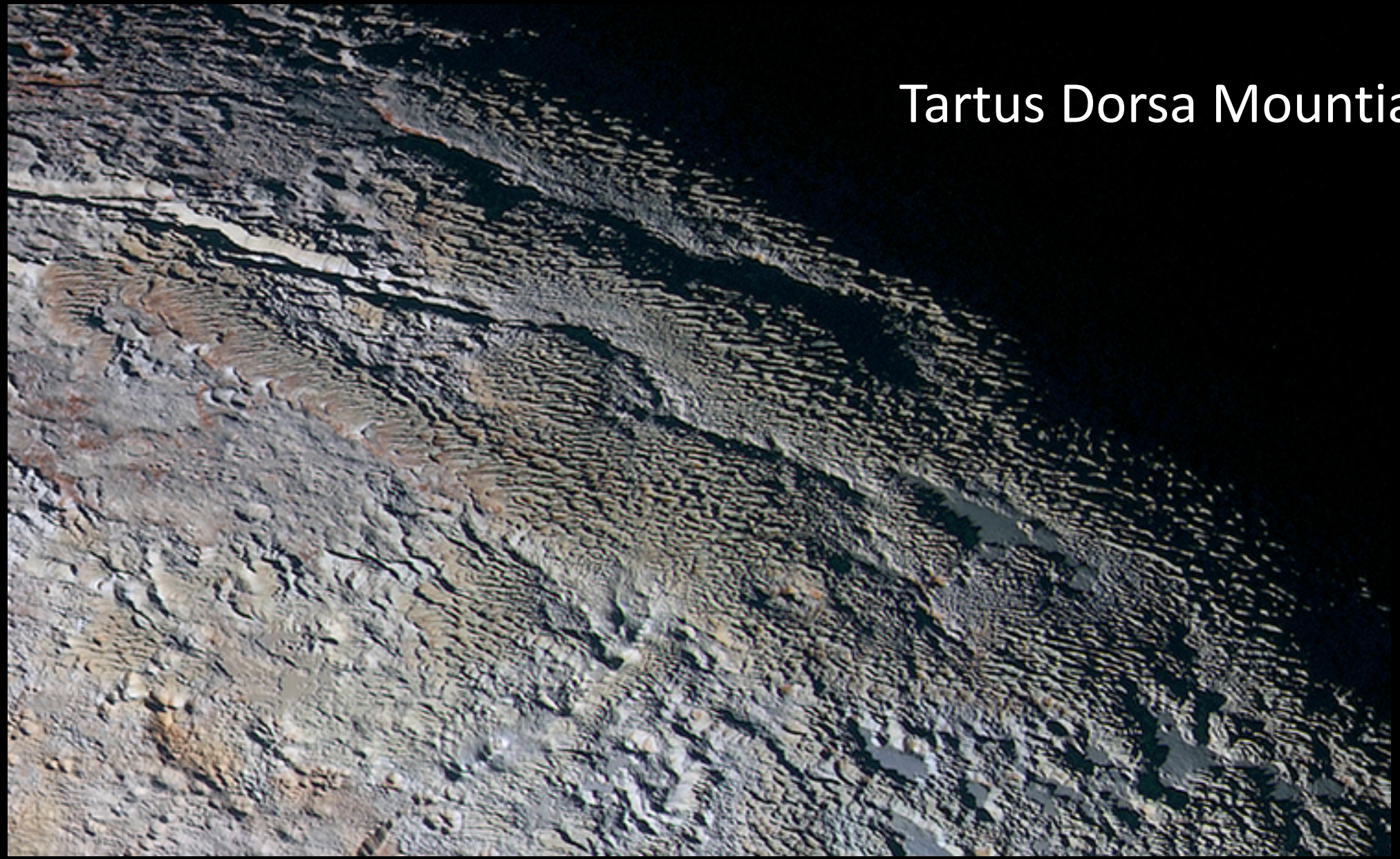

Cthulhu Regio
Quiddlivun Cavus
Morgoth Macula
Norgay Montes
Hillary Montes
Pandemonium Dorsa
Sputnik Planum
Krun Macula
NASA/JHU-APL/SwRI/Thomas Appéré

Hillary Montes – Water Ice Mountains

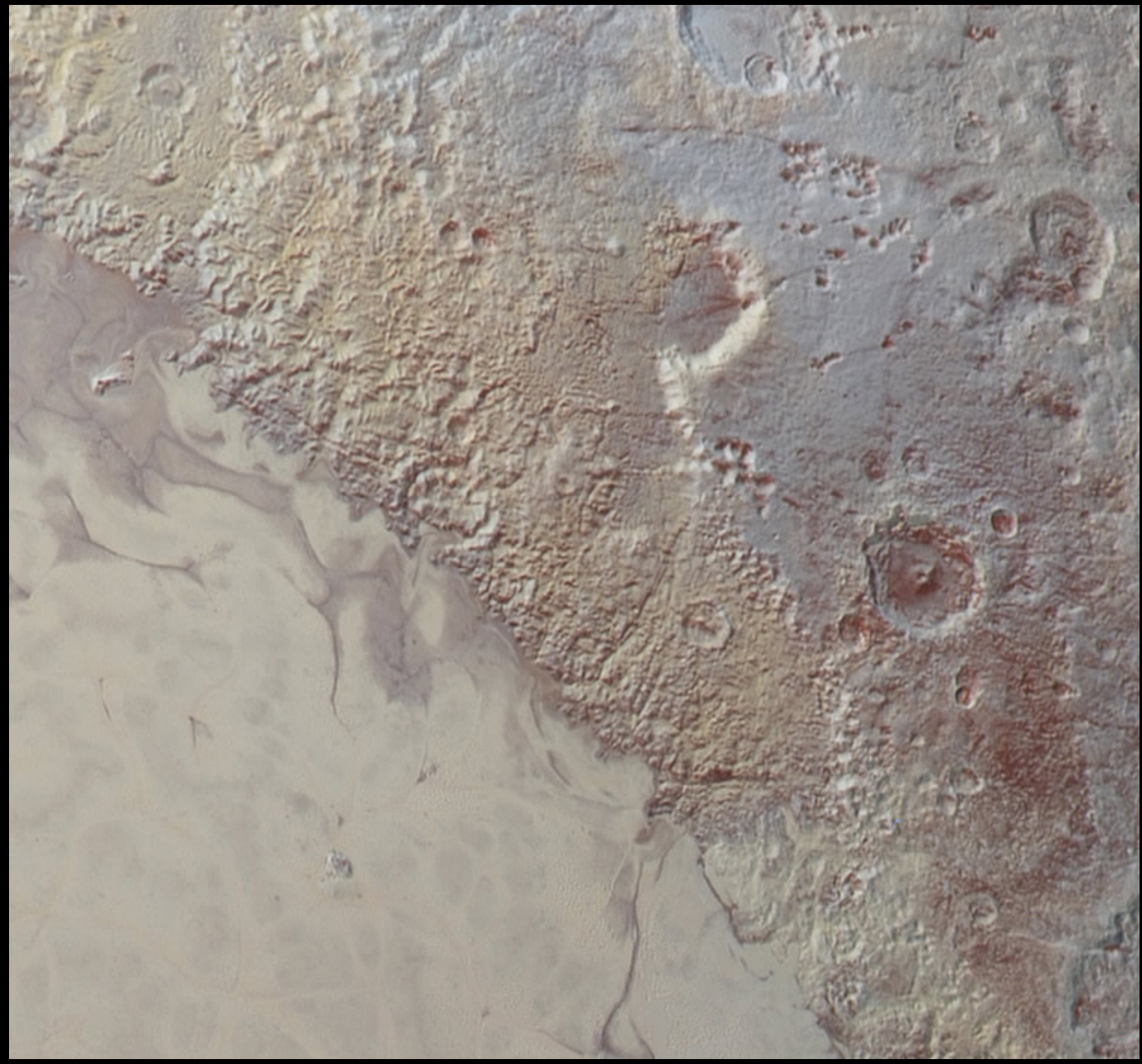


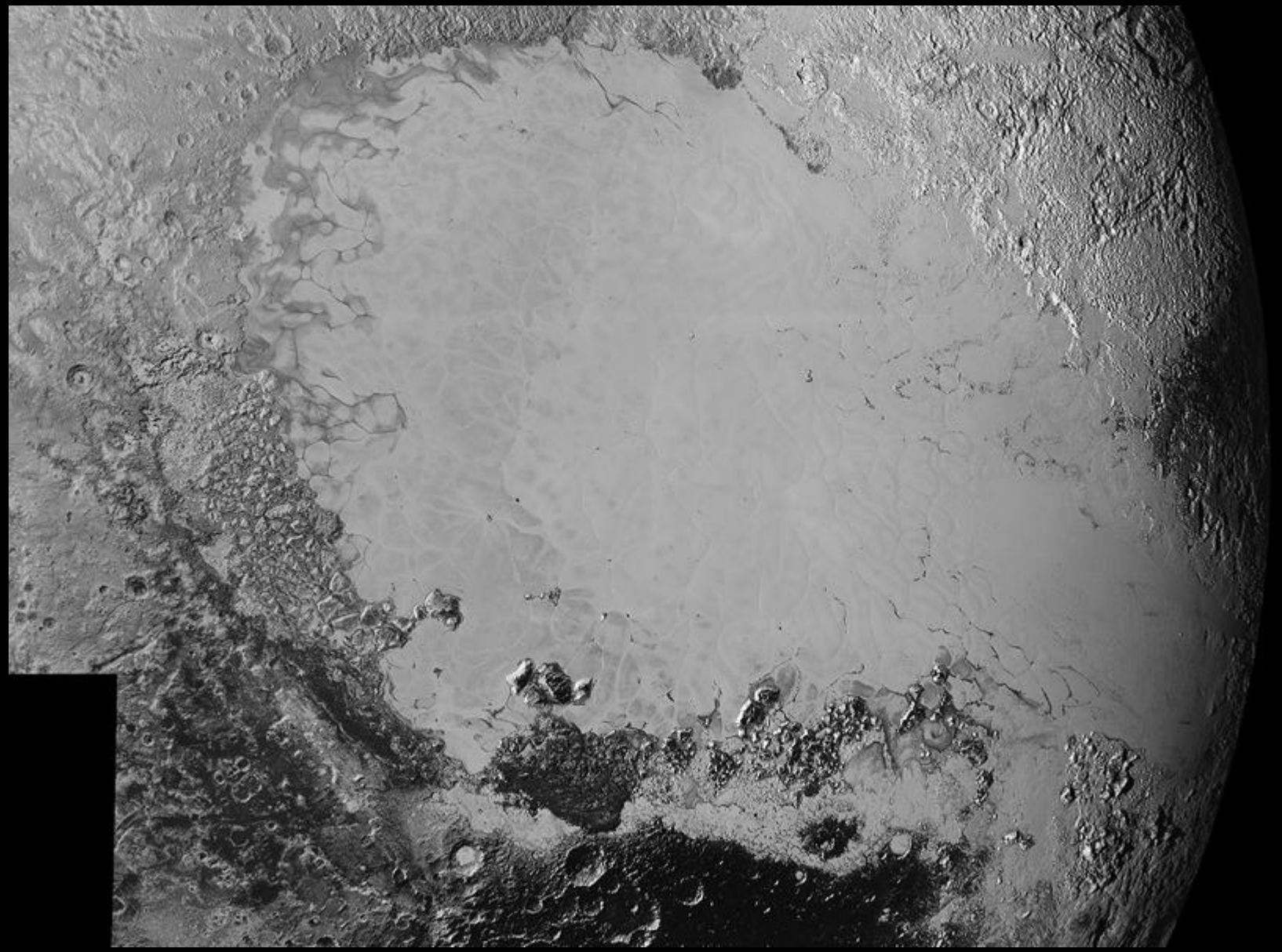


Water Ice Mountains



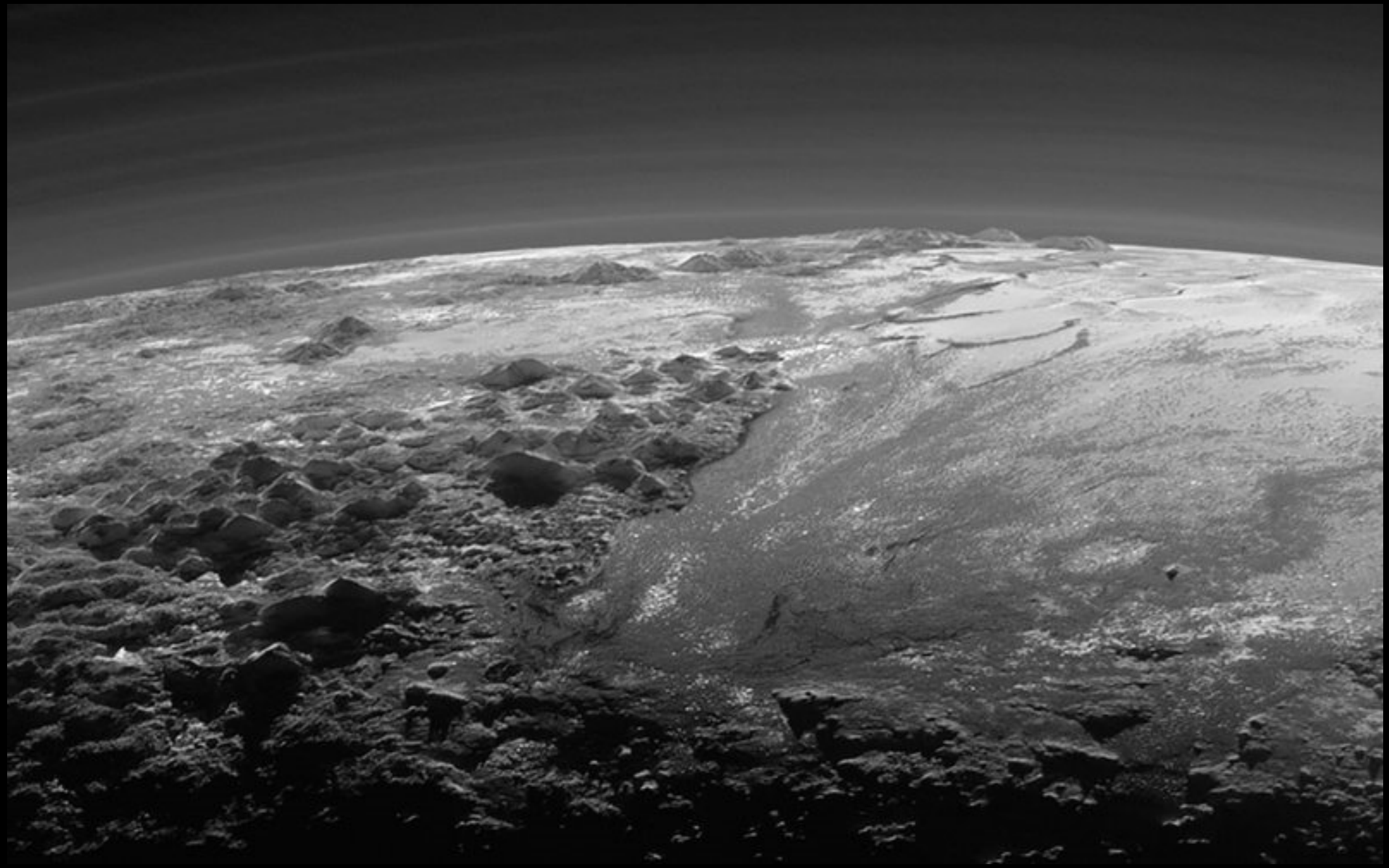
Tartus Dorsa Mountians





The Great Sputnik Planum Nitrogen Sea

Larger and Deeper than Hudson Bay



Active Internal Thermal Convection / Upwelling Causes Plate Formation
And Venting of N2 and CH3

Plates are ‘Domed’
And In Slow Motion > Earth Glacier

Movement Like ‘Lava Lamp’ at 38 degrees K

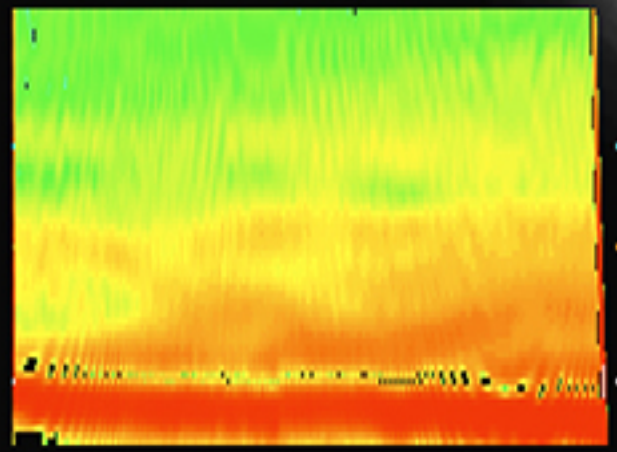
Pitting caused by sublimation

Water Icebergs Floating in the Nitrogen Slush Of Sputnik Planum

Surprise Number 3:

Pluto’s active atmosphere at 38 degrees K!

Haze Layers

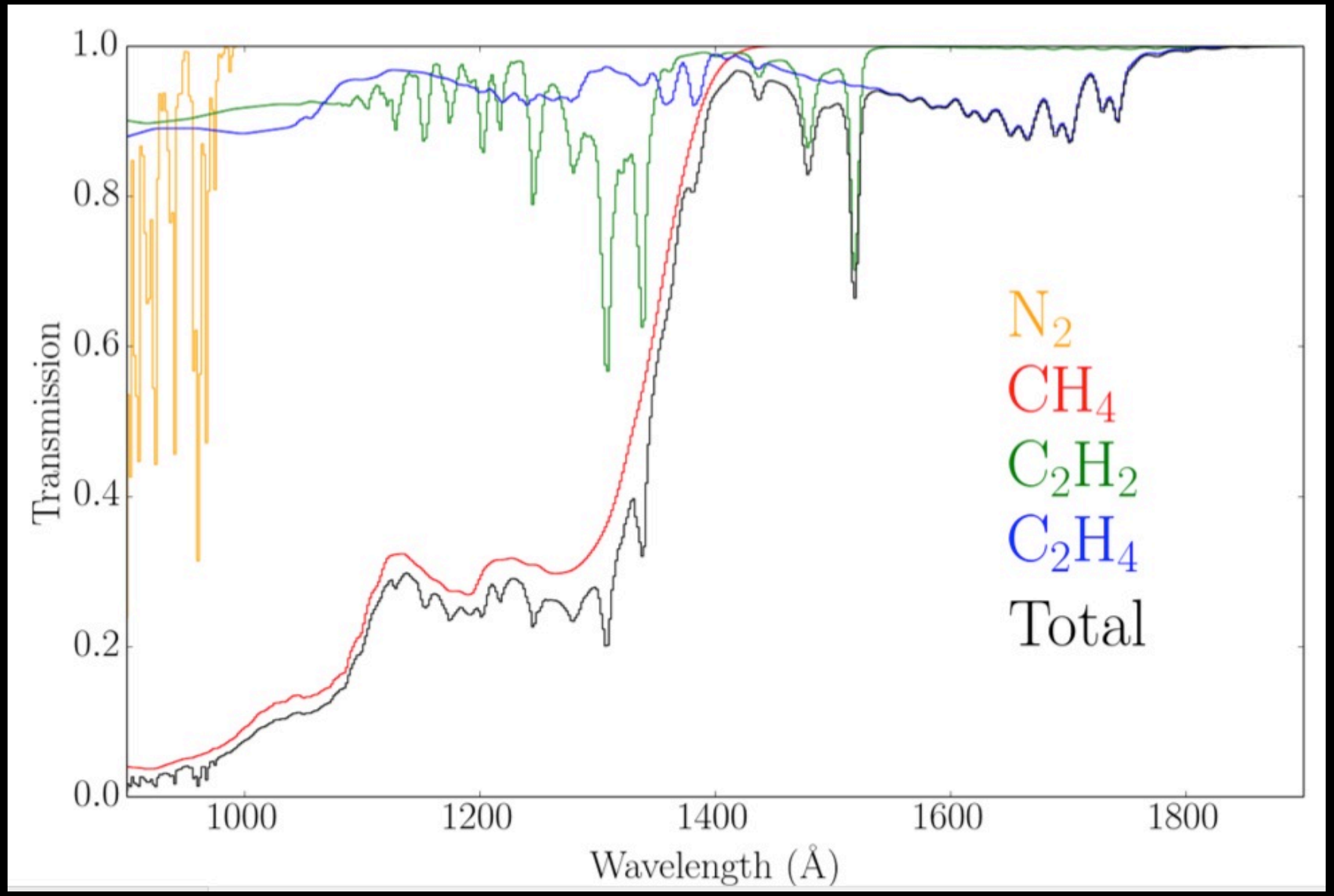


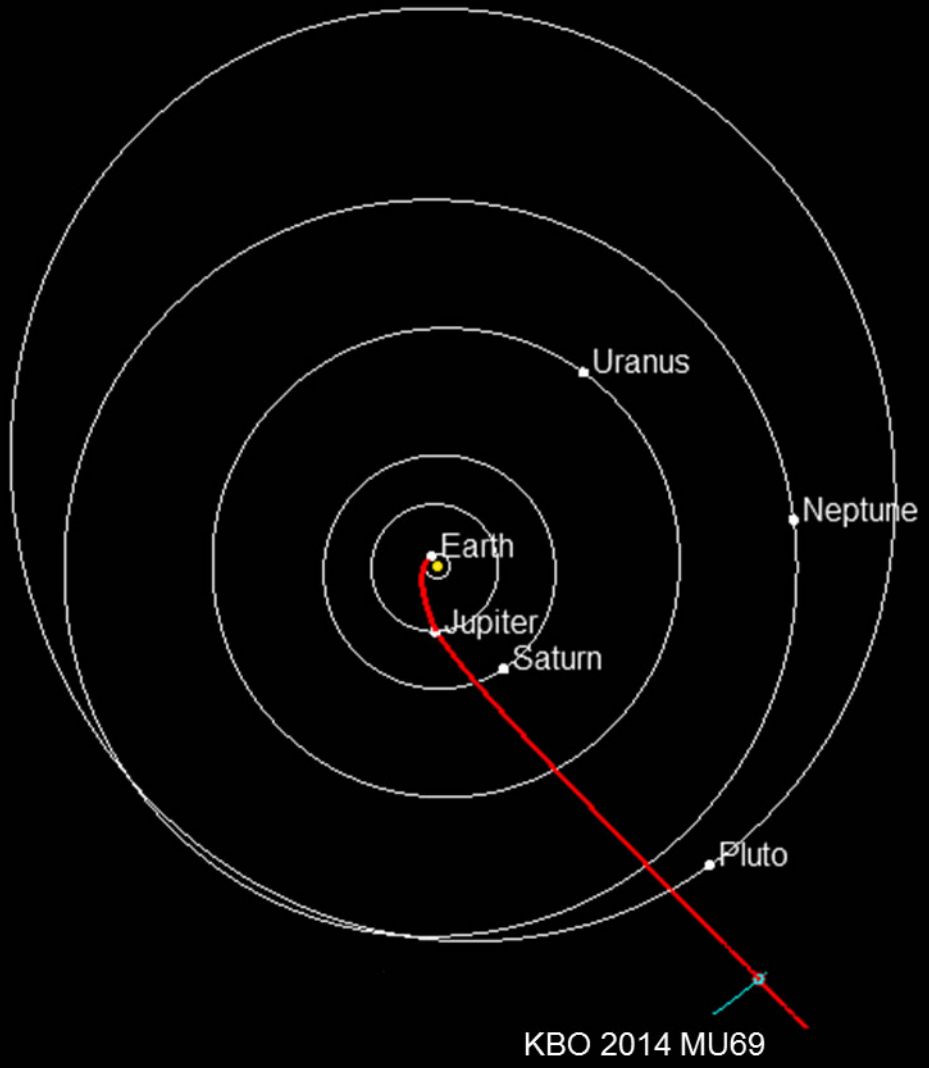
52 mi above Pluto's surface

31 mi above Pluto's surface

Pluto's surface

The Spectra of Pluto's Atmosphere





New Horizon's Extended Mission

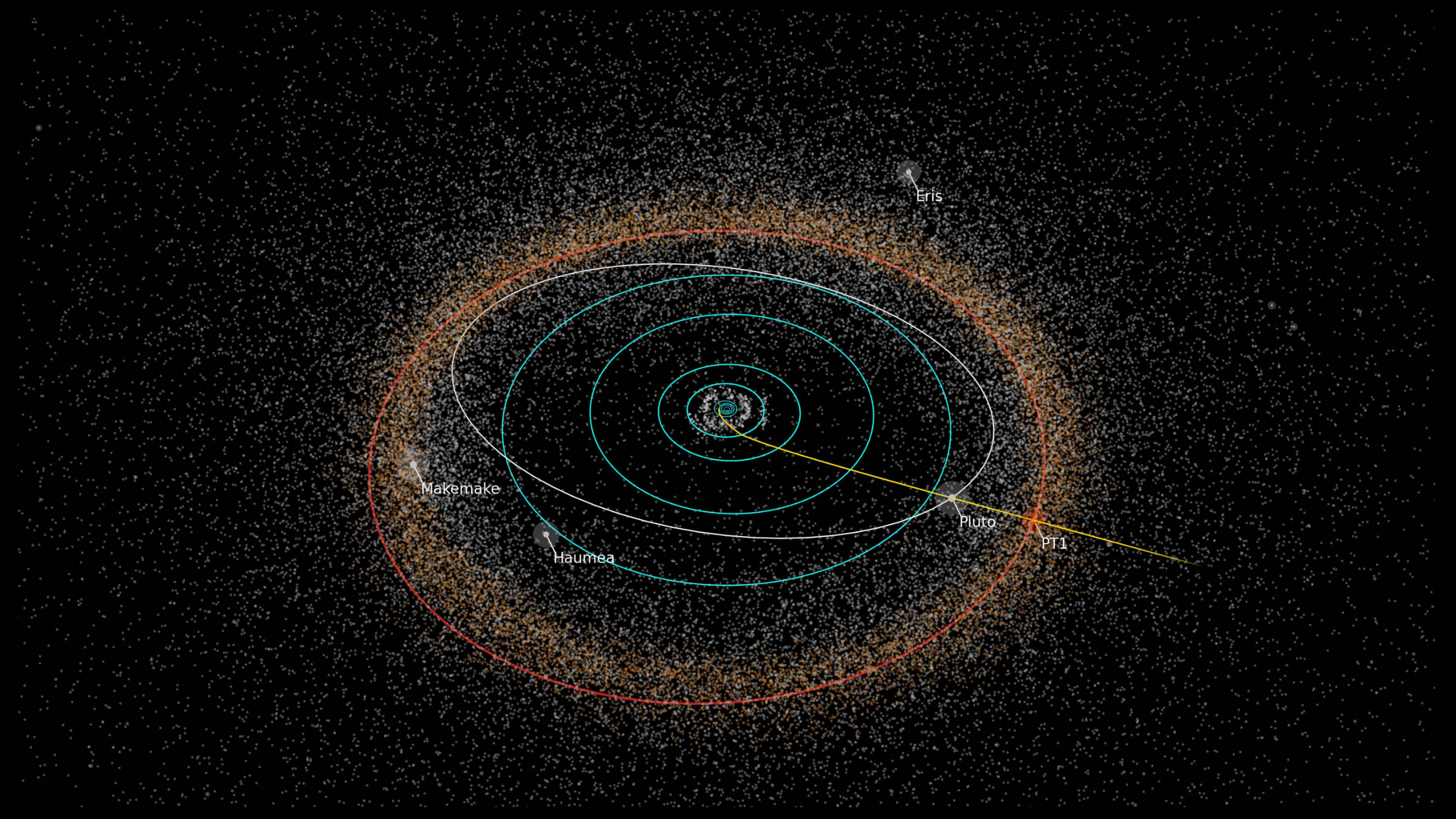
New Target

Kuiper Belt Object

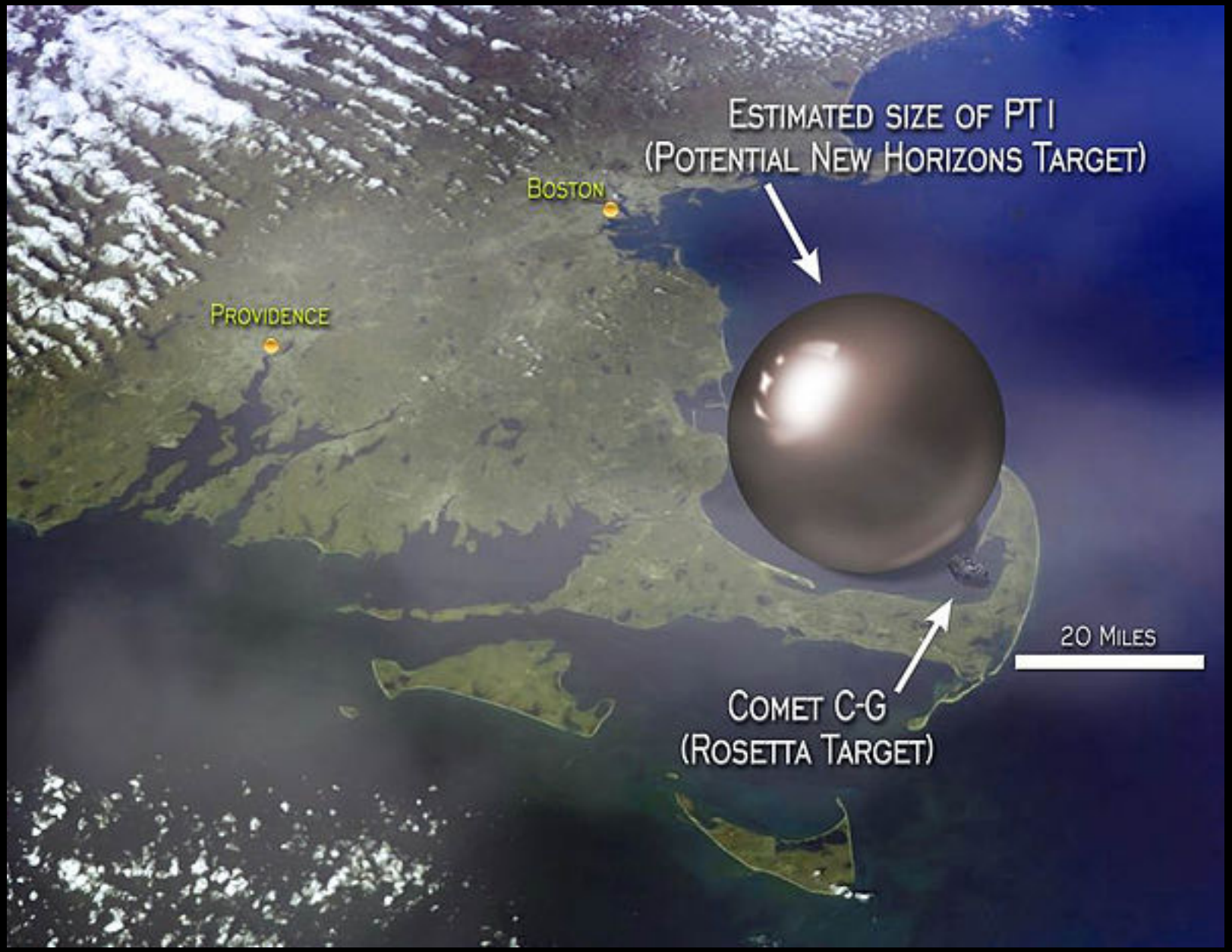
2014 MU69

One Billion Miles from Pluto

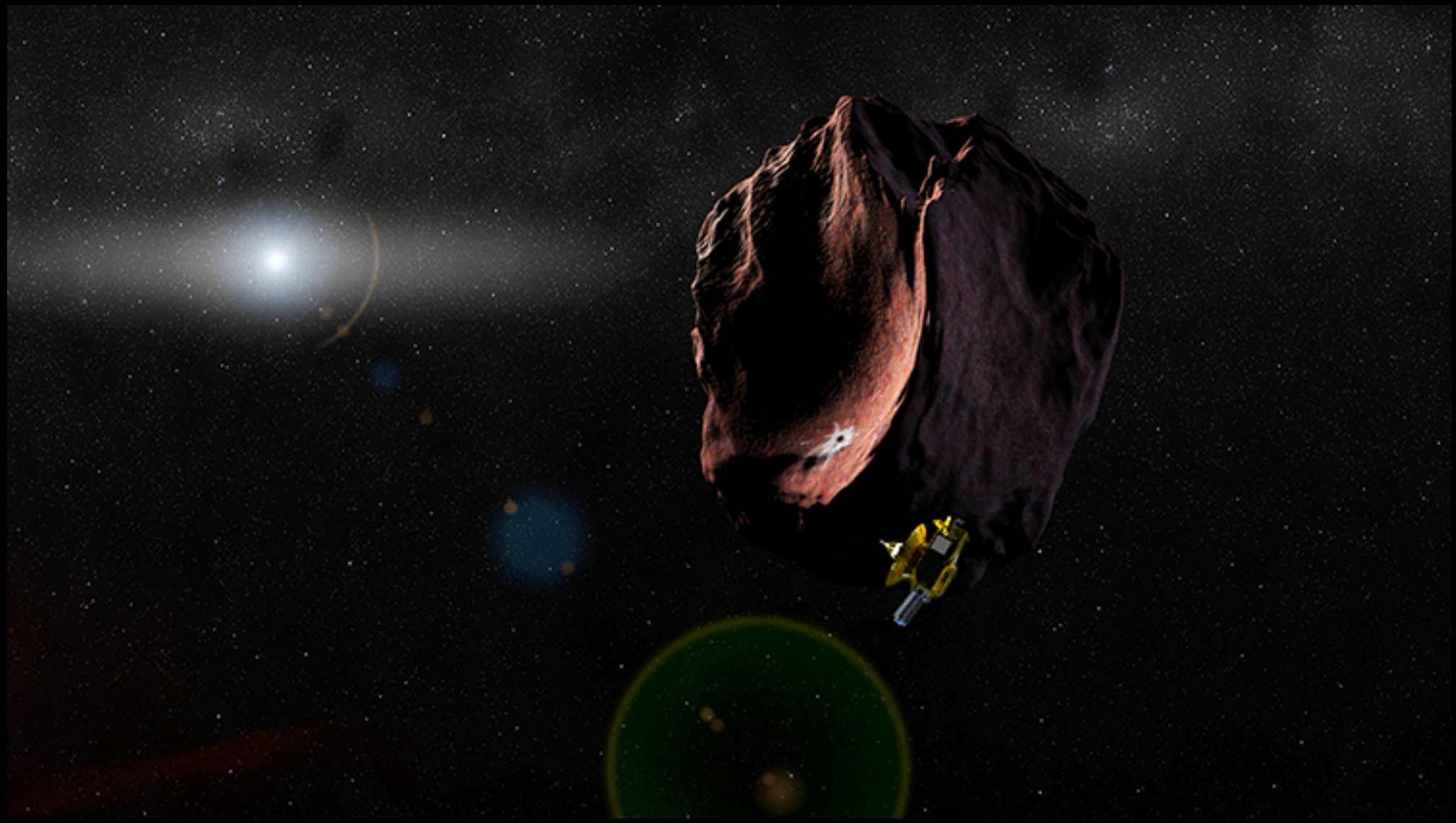
Six Billion Miles from Earth


Eris
Makemake
Haumea
Pluto
PT1

2014 MU69 From Hubble Space Telescope


ESTIMATED SIZE OF PT1
(POTENTIAL NEW HORIZONS TARGET)
BOSTON
PROVIDENCE
20 MILES
COMET C-G
(ROSETTA TARGET)

Arrival MU69 – January 2019



Astronomer Clyde Tombaugh

QUESTIONS?