NEW HORIZONS

PRE-FLYBY MATERIALS

NEW HORIZONS
ON PLUTO'S DOORSTEP

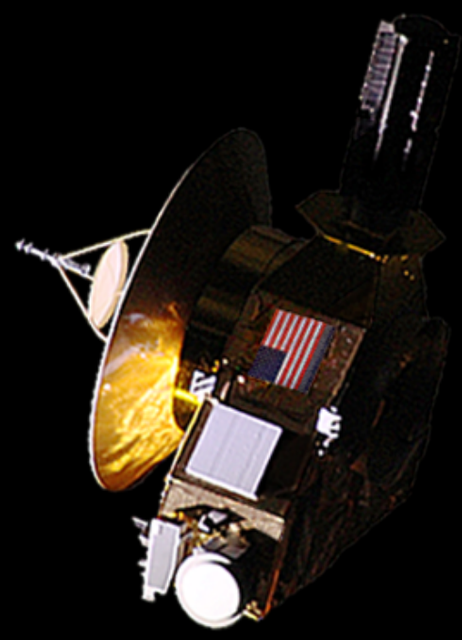
NEW HORIZONS:

THE SPACECRAFT

Objective:
First exploration of the Pluto system and small KBOs beyond

Launched:
January 19 2006, Atlas V rocket

Power supply:
RTG with 11kg Pu-238, 202 watts at Pluto



Communications:
2.1 meter high-gain antenna,
X-band uplink/downlink, 3000 bps max at Pluto.

Science instruments:
LORRI - high resolution camera
MVIC - color and panchromatic camera
LEISA - NIR spectral mapper
Alice - UV spectral mapper
SWAP and *PEPSSI* - Plasma environment instruments
REX - Radio science experiment
Venetia Burney Student Dust Counter

NEW HORIZONS:

THE PRIME TARGET

The Pluto/Charon System:
- *The only known binary dwarf planet*
- *Orbited by at least four small moons*

Pluto: system primary
D=2360km, discovered 1930
- Tidally locked to Charon
- Dynamic atmosphere
- High contrast surface

Charon: system secondary
D=1207km, Discovered 1978
- Tidally locked to Pluto
- 6.4 day orbit

Small outer moons
Styx (10-25km, 20.2 day orbit)
Nix (46-136km, 24.9 day orbit)
Kerberos (13-34km, 32.1 day orbit)
Hydra (60-168km, 38.2 day orbit)

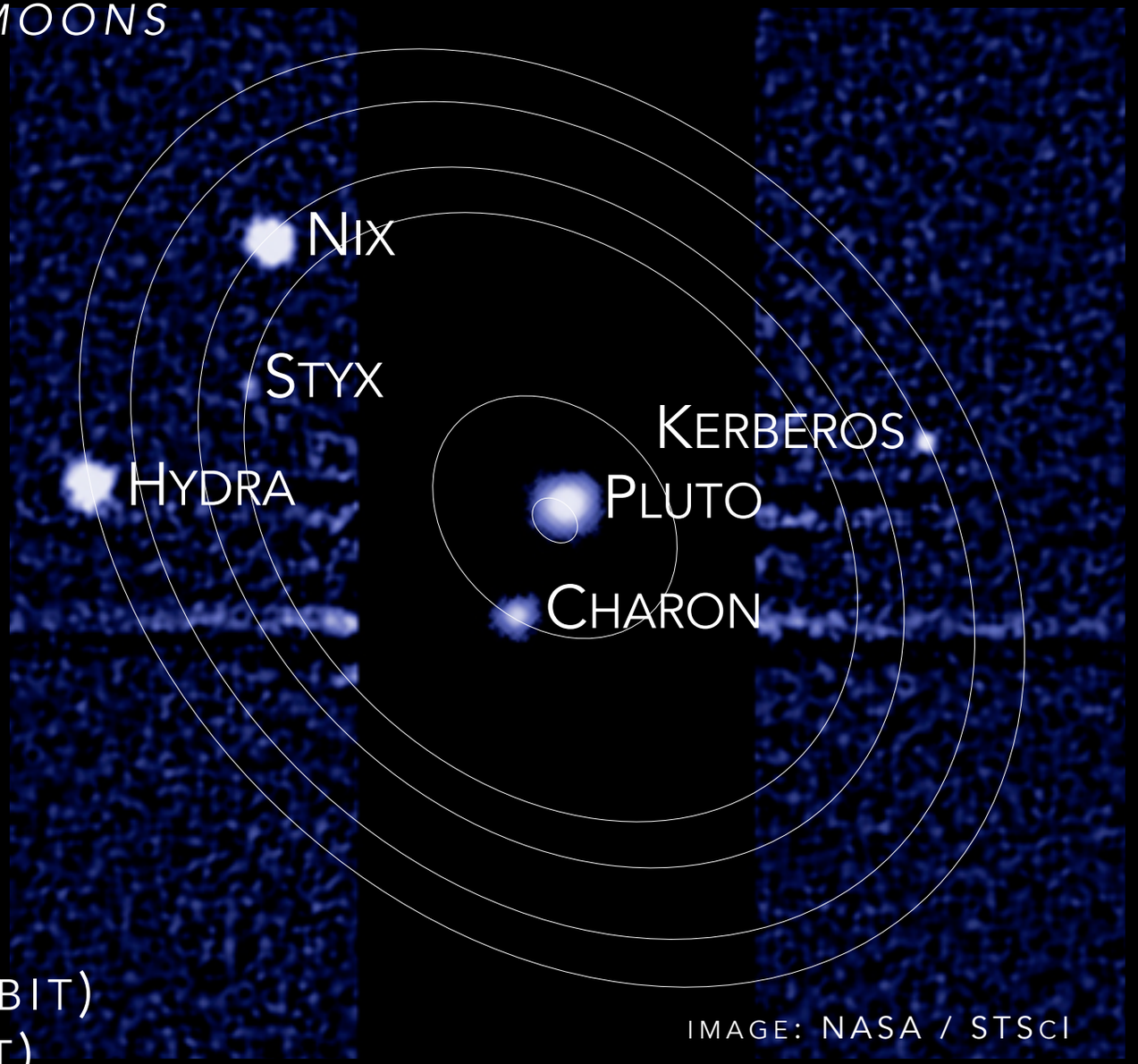


IMAGE: NASA / STScI

NEW HORIZONS:
SCIENCE AT PLUTO

Geology

Is Pluto an active or dead world? What processes shape the surface of an icy dwarf planet?

Atmosphere

Does it "freeze out" when Pluto is far from the sun? How fast is it escaping from Pluto? Do clouds or hazes form?

Moons

Are there more of them? What are they made of? What are their shapes and spins? Does Charon have an atmosphere?

Interactions

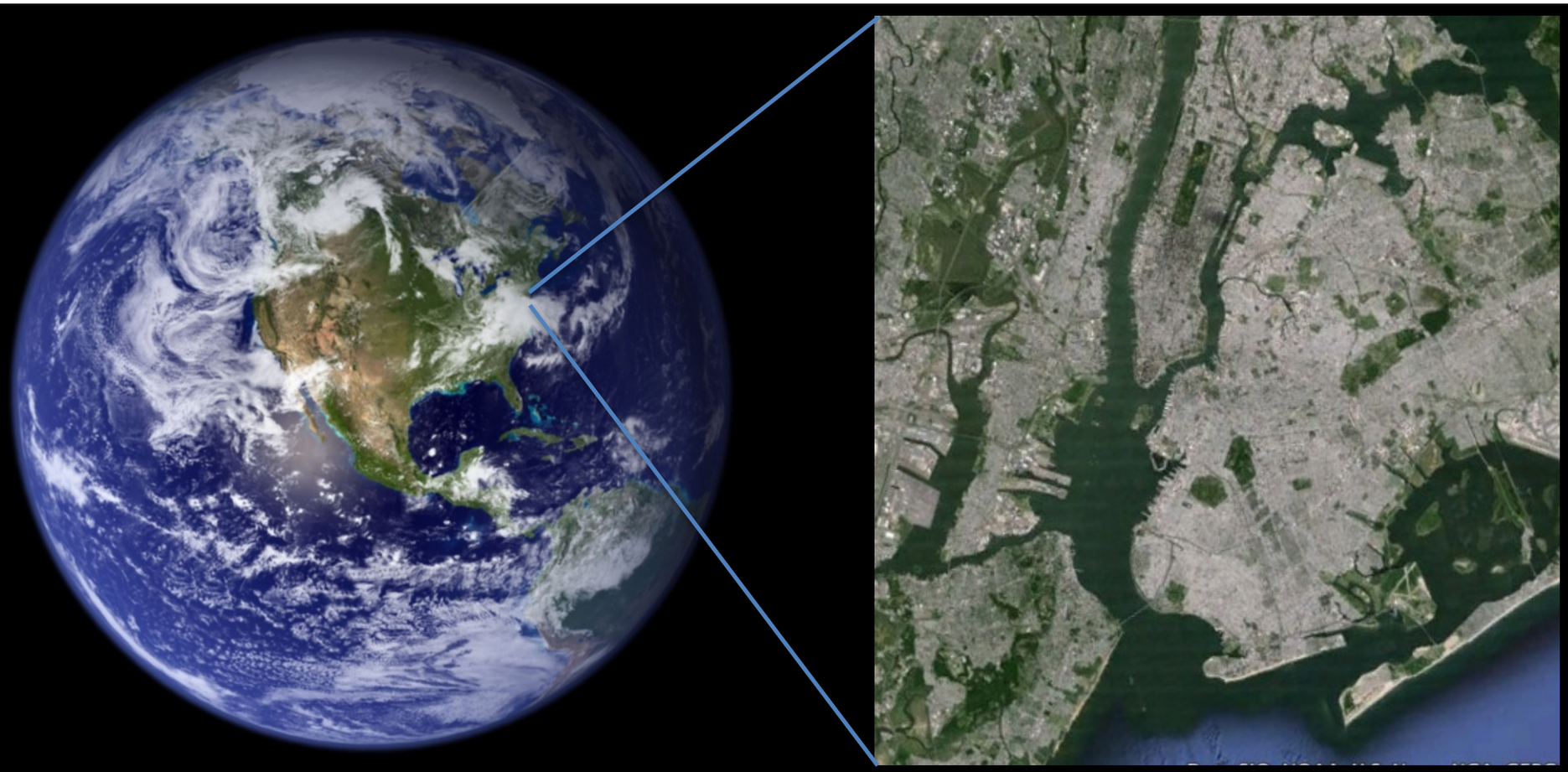
Craters: How many very small Kuiper Belt Objects are there?

NEW HORIZONS:

MISSION OBJECTIVES

PRIMARY OBJECTIVES:

- CHARACTERIZE GLOBAL GEOLOGY AND MORPHOLOGY OF PLUTO AND CHARON
- MAP SURFACE COMPOSITION OF PLUTO AND CHARON
- CHARACTERIZE THE NEUTRAL ATMOSPHERE OF PLUTO AND ITS ESCAPE RATE



EARTH'S SURFACE (NEW YORK CITY) AT NEW HORIZONS' HIGHEST RESOLUTION (70 METERS / PIXEL)

VIZ: DR. AMANDA ZANGARI

NEW HORIZONS:

MISSION OBJECTIVES

Primary objectives:

- Characterize global geology and morphology of Pluto and Charon
- Map surface composition of Pluto and Charon
- Characterize the neutral atmosphere of Pluto and its escape rate

Secondary objectives:

- Characterize time variability of Pluto's surface and atmosphere
- Image Pluto and Charon in stereo
- Map terminators of Pluto & Charon at high res
- Map composition of selected areas of Pluto and Charon at high res
- Characterize Pluto's ionosphere and solar wind interaction
- Search for neutral species, hydrocarbons, and nitriles in Pluto's upper atmosphere
- Search for atmosphere around Charon
- Determine Bond albedos for Pluto and Charon
- Map surface temperatures of Pluto and Charon

Tertiary objectives:

- Characterize energetic particle environment of Pluto and Charon
- Refine bulk parameters (radii, masses, densities) and orbits of Pluto and Charon
- Search for magnetic fields of Pluto and Charon
- Search for additional moons and rings

NEW HORIZONS:

PLUTO'S SURFACE

CURRENT KNOWLEDGE

EXTREME RANGE OF REFLECTIVITY
RICH IN VOLATILE ICES OF N2, CH4, CO
REDDENED BY IRRADIATED HYDROCARBONS

POSSIBILITIES

DUNES
TECTONICS
CRYOVOLCANISM
EVIDENCE OF INTERNAL OCEAN

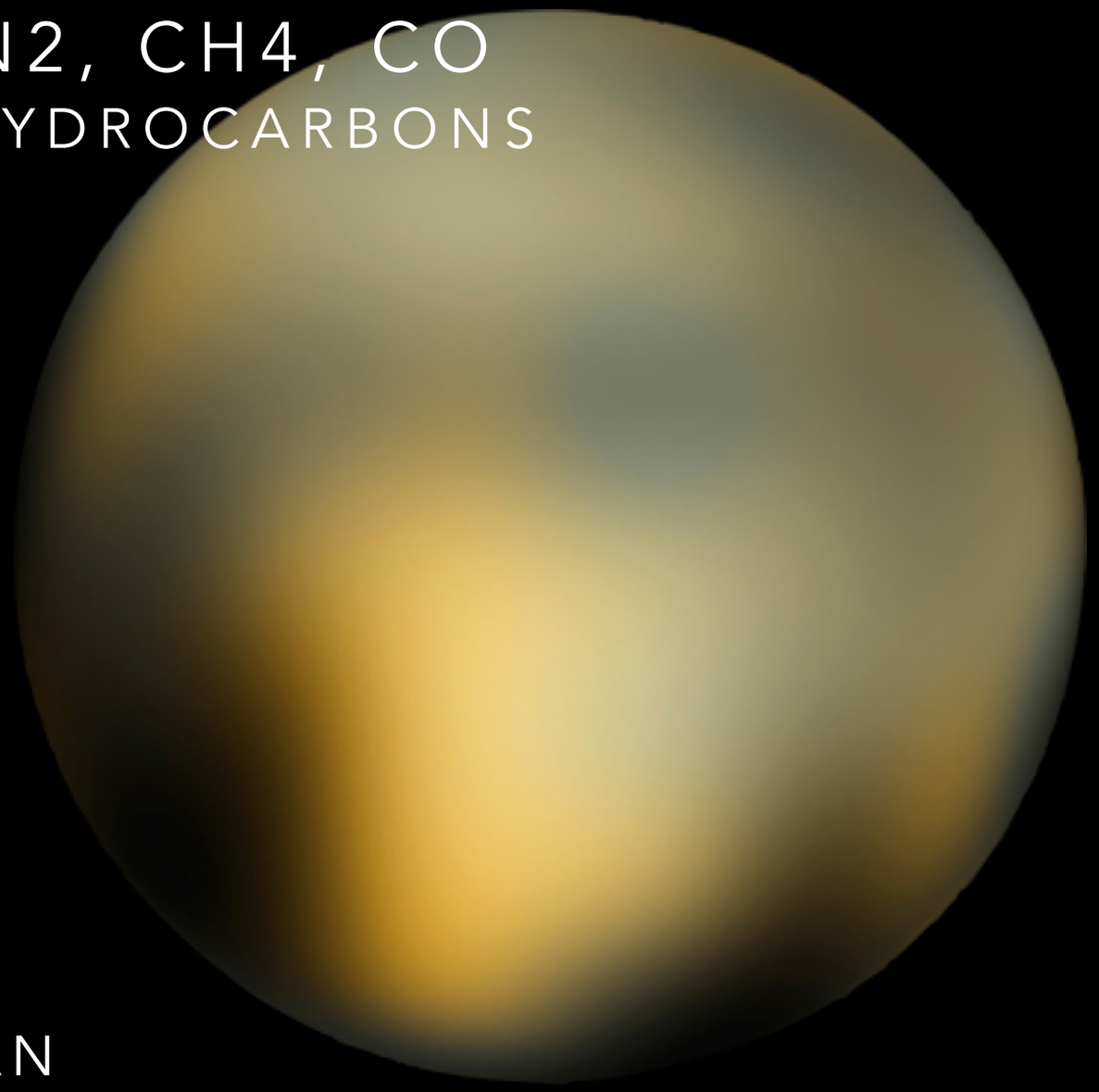


IMAGE: MARC BUIE

NEW HORIZONS:
PLUTO'S ATMOSPHERE

Current knowledge

Dynamic atmosphere, changes with time
Nitrogen, Methane, and Carbon Monoxide
About 1/500th the surface pressure of Mars

Possibilities

Clouds and haze layers
Evidence of global winds (dunes)
Evidence for seasonal atmospheric "Freeze out"

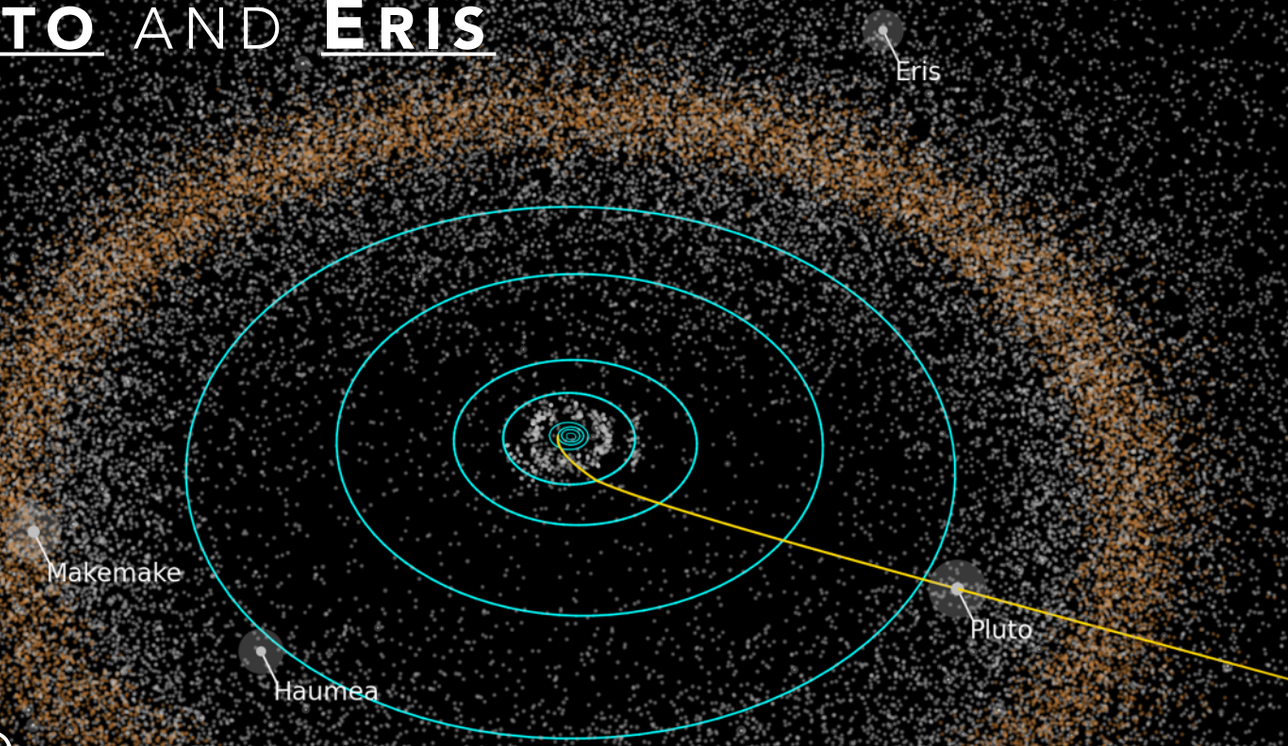
IMAGE: ESA

NEW HORIZONS:

THE KUIPER BELT

A ring of icy objects beyond the orbit of Neptune

largest known members: **Pluto** and **Eris**



Best-preserved remnant
of the primordial disk
that planets grew from

Most Kuiper Belt Objects
are *much* smaller than Pluto

Tens of thousands are larger than 100 km across
Billions are larger than 1 km across

NEW HORIZONS:

MISSION HISTORY

First concept: 1989

Many iterations of a Pluto recon mission, until...

New Horizons concept selected: Nov 29, 2001

First mission in "New Frontiers" class

Launch: Jan 19, 2006

Atlas V rocket from Cape Canaveral, Florida

Jupiter Flyby: Feb 28, 2007

Gravity assist and instrument shakedown

Crossed Neptune's orbit: Aug 25, 2014

25 years to the day after Voyager 2 visited Neptune

Pluto Flyby Spans Jan-July 2015

Closest approach July 14, 2015

Data downlinked through late 2016

NEW HORIZONS:

PLUTO ENCOUNTER

TIMELINE

2015 2016

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec Jan Feb Mar Apr May Jun Jul Aug Sep Oct

PRIMARY OPERATIONS

S/C orbit and timing updates

Pluto Closest Approach

OpNav #2

OpNav #3

Data Downlink

OpNav #4

Science Data Playback

Departure Science

Science Data Playback

Post encounter instr. cal. Jul 2016

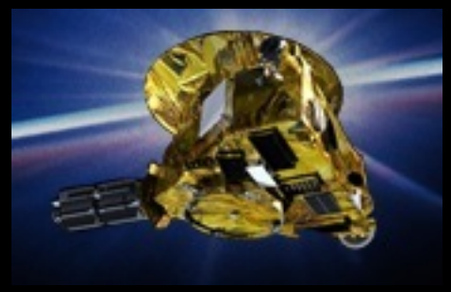
HAZARD SEARCH

MANEUVERS

Pluto Targeting

KBO Targeting

NEW HORIZONS:
MORE INFORMATION



MISSION WEBSITE: *PLUTO.JHUAPL.EDU*

MISSION TWITTER FEED: *@NASANEWHORIZONS*

PI TWITTER FEED *@NEWHORIZONS2015*

COUNTDOWN TO PLUTO: *SEEPLUTONOW.COM*

PPOD

PLUTO PICTURE OF THE DAY: *BOULDER.SWRI.EDU/PPOD*

National Aeronautics and Space Administration

After Nine Years and Three Billion Miles

Pluto Awaits 2015

NEW HORIZONS

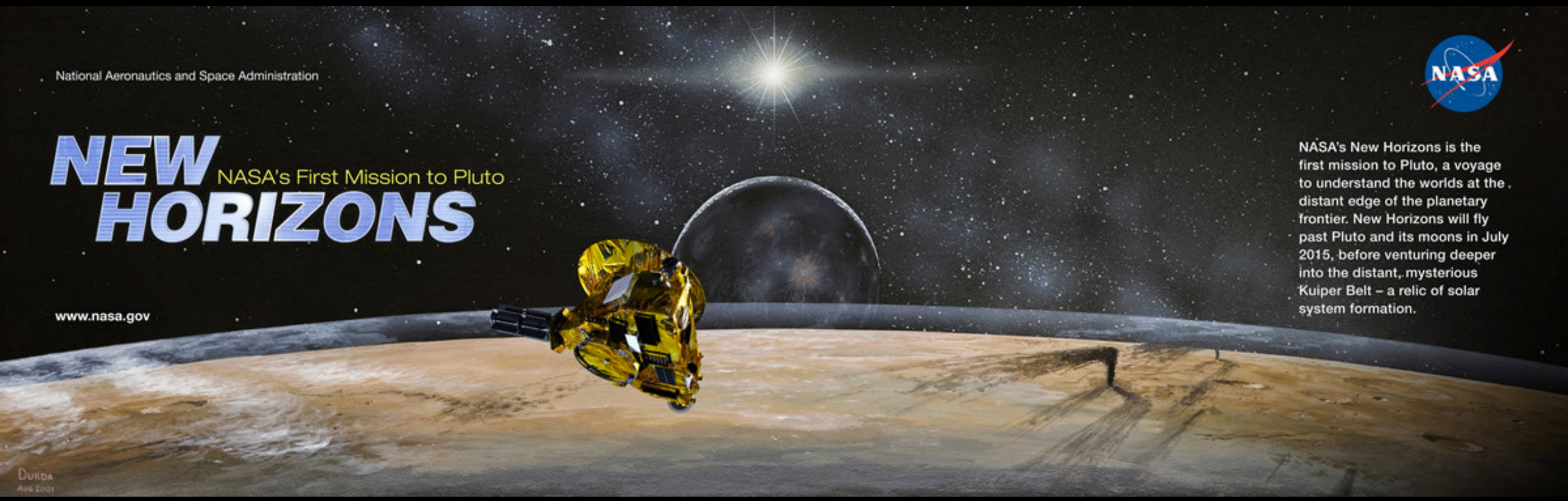
A NASA New Frontiers Mission

National Aeronautics and Space Administration

NEW HORIZONS

NASA's First Mission to Pluto

www.nasa.gov

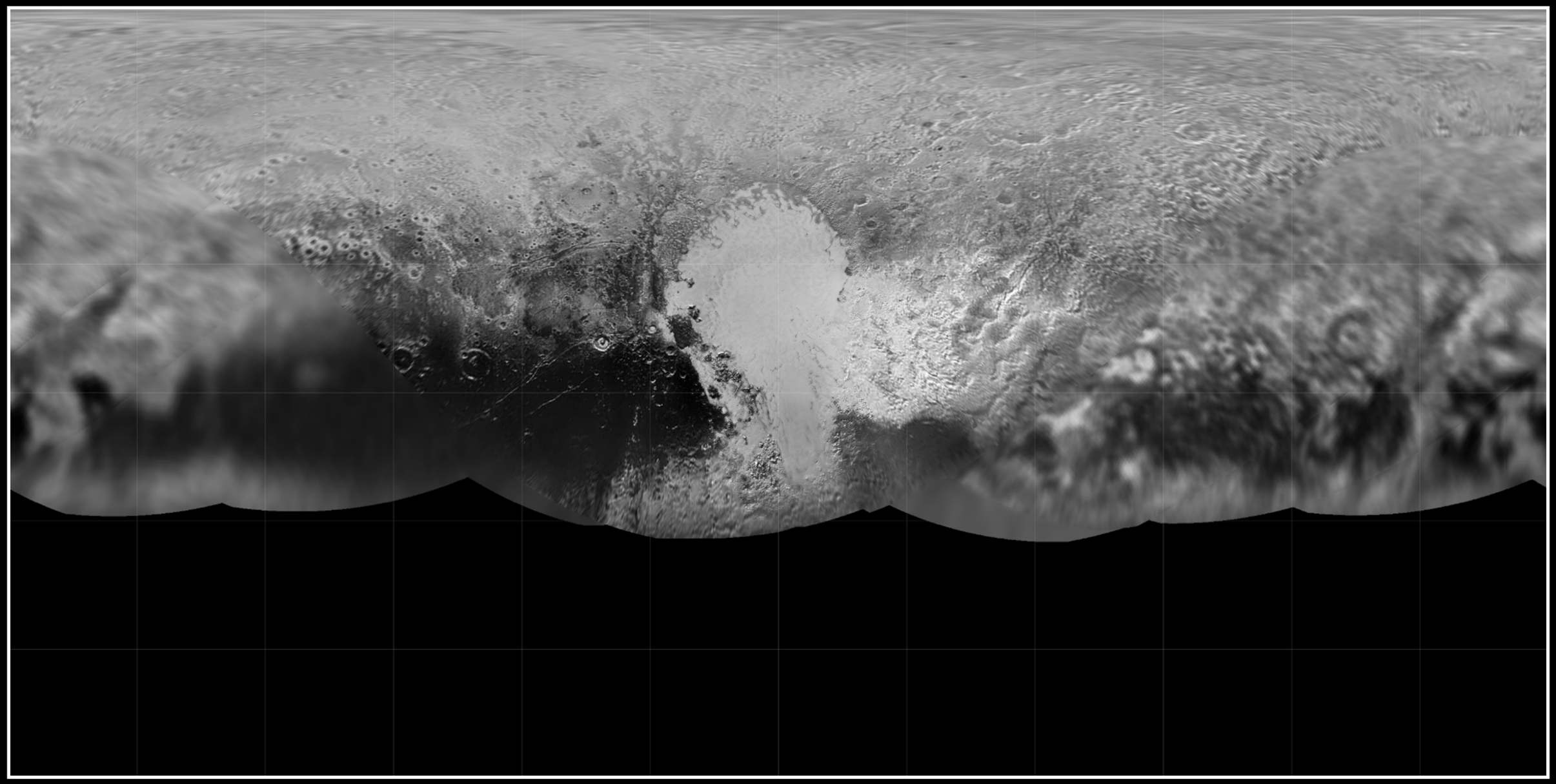


NASA's New Horizons is the first mission to Pluto, a voyage to understand the worlds at the distant edge of the planetary frontier. New Horizons will fly past Pluto and its moons in July 2015, before venturing deeper into the distant, mysterious Kuiper Belt – a relic of solar system formation.

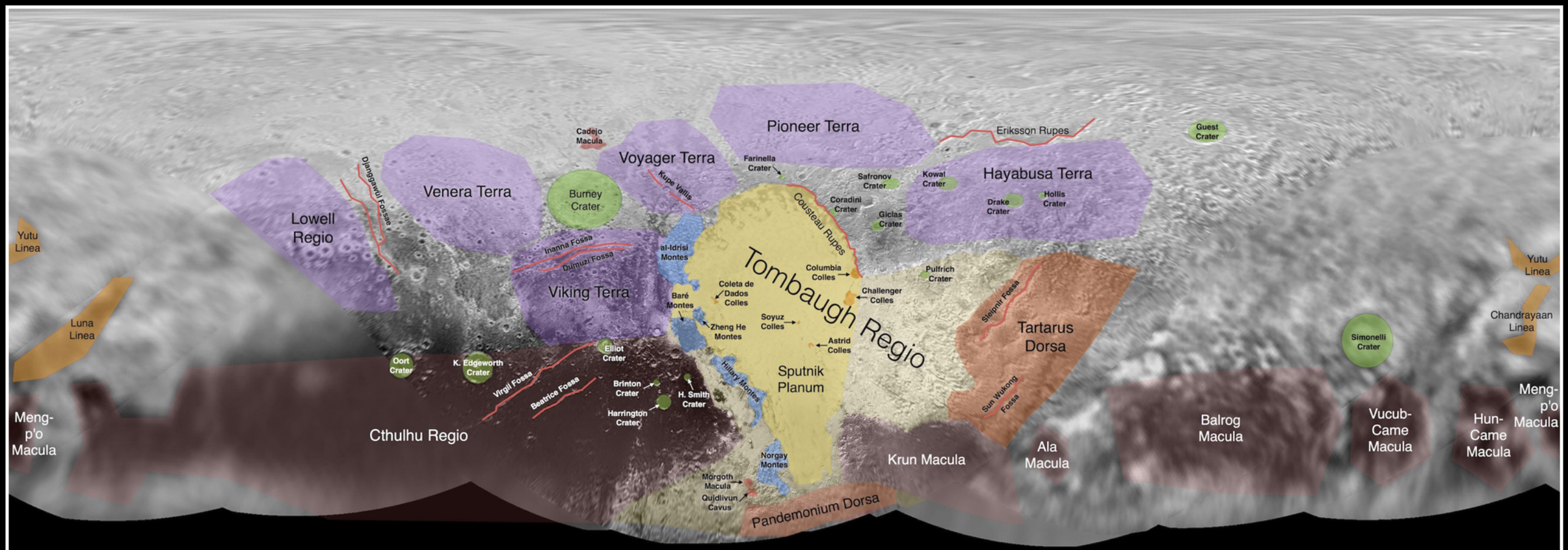
NEW HORIZONS

POST-FLYBY UPDATES

NEW HORIZONS:
MAP OF PLUTO



NEW HORIZONS:
MAP OF PLUTO



Informal Names for Features on Pluto

NEW HORIZONS:
THE SIZE OF PLUTO

LARGEST OBJECT KNOWN BEYOND THE ORBIT OF NEPTUNE

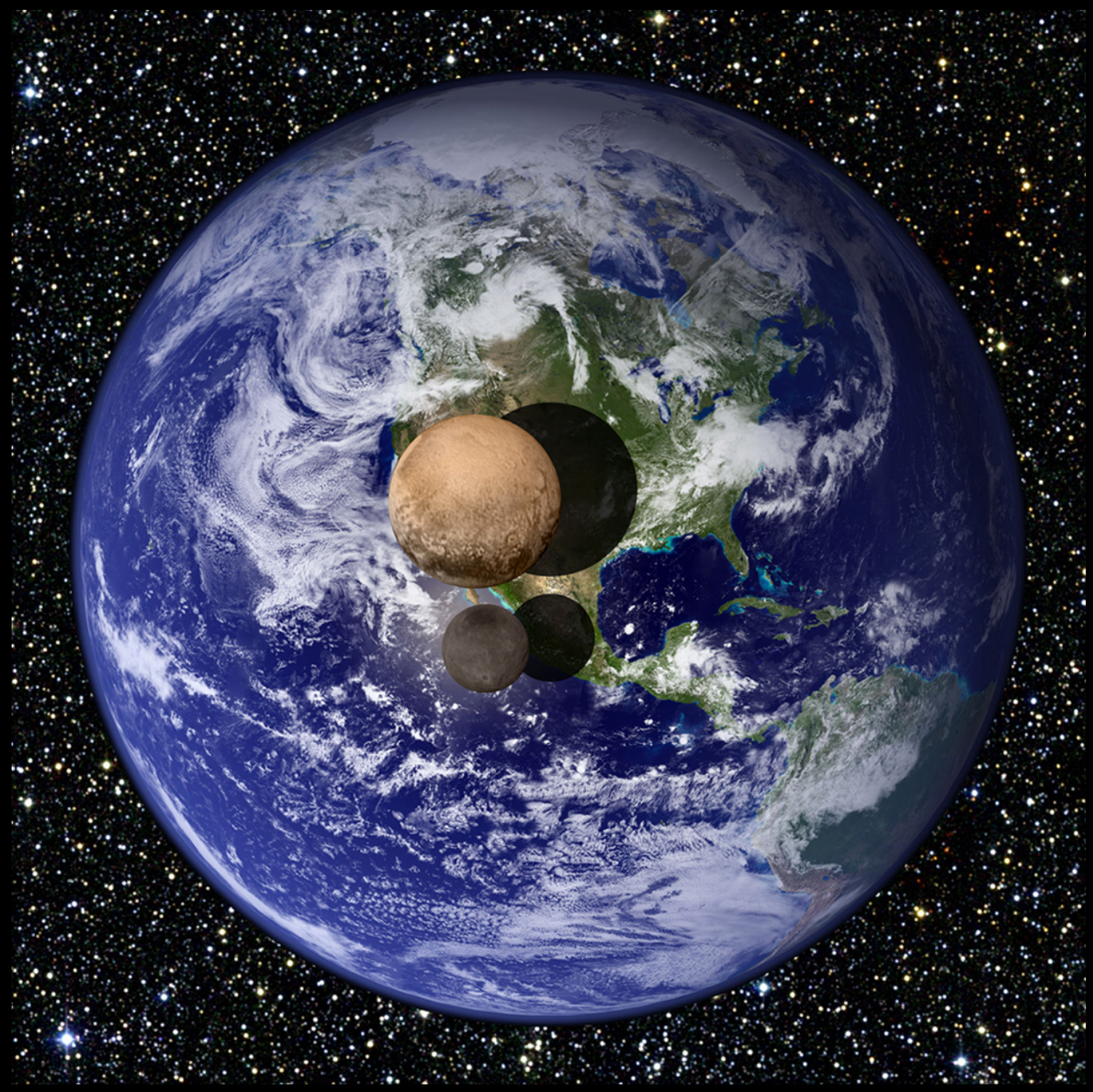
PLUTO EXCEEDS DIAMETER OF ERIS BY ~50 KM.

9TH LARGEST OBJECT KNOWN IN SOLAR ORBIT

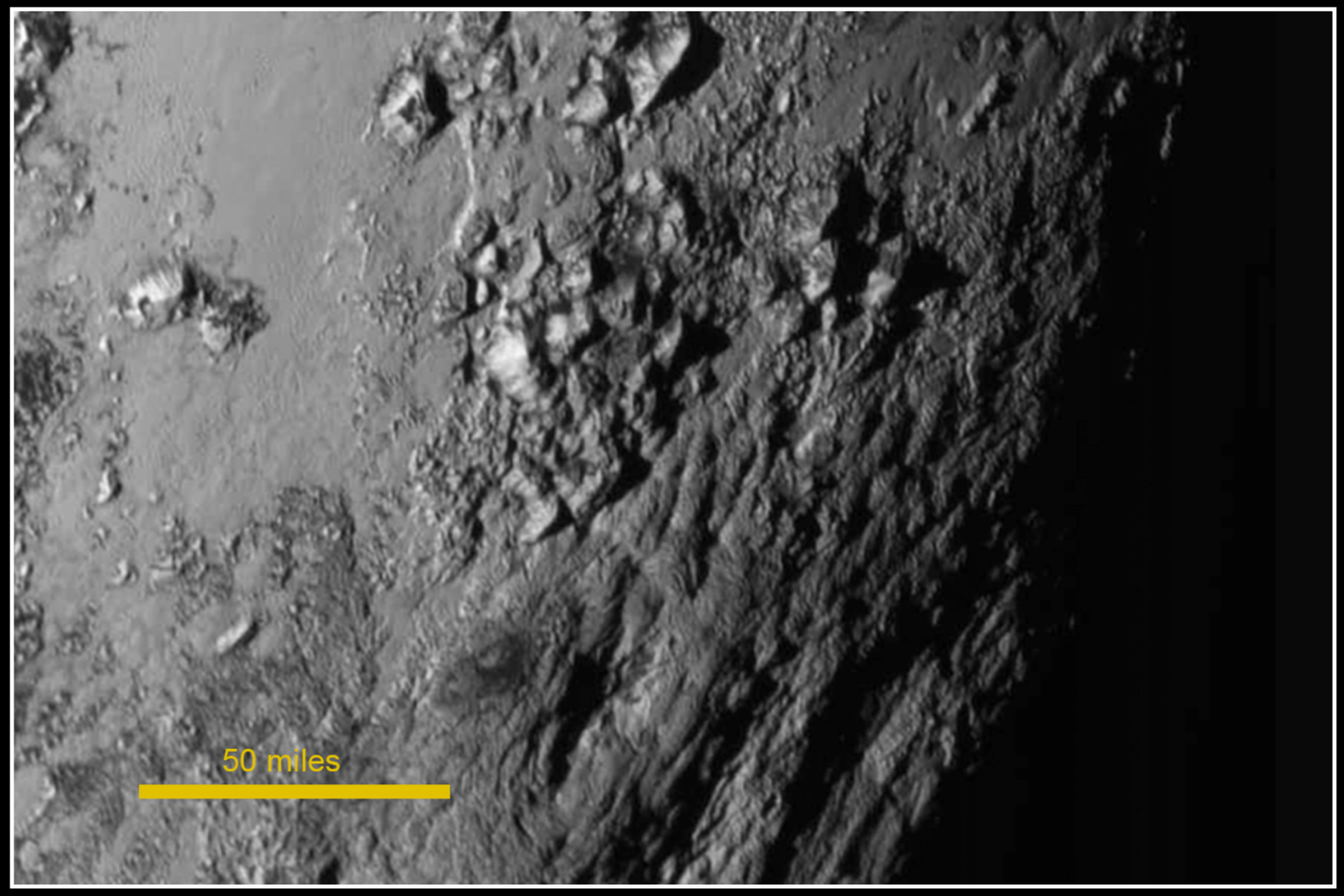
RADIUS: 1187 KM (±4 KM)

NO OBLATENESS YET DETECTED

UPPER LIMIT OF <1% POLAR FLATTENING



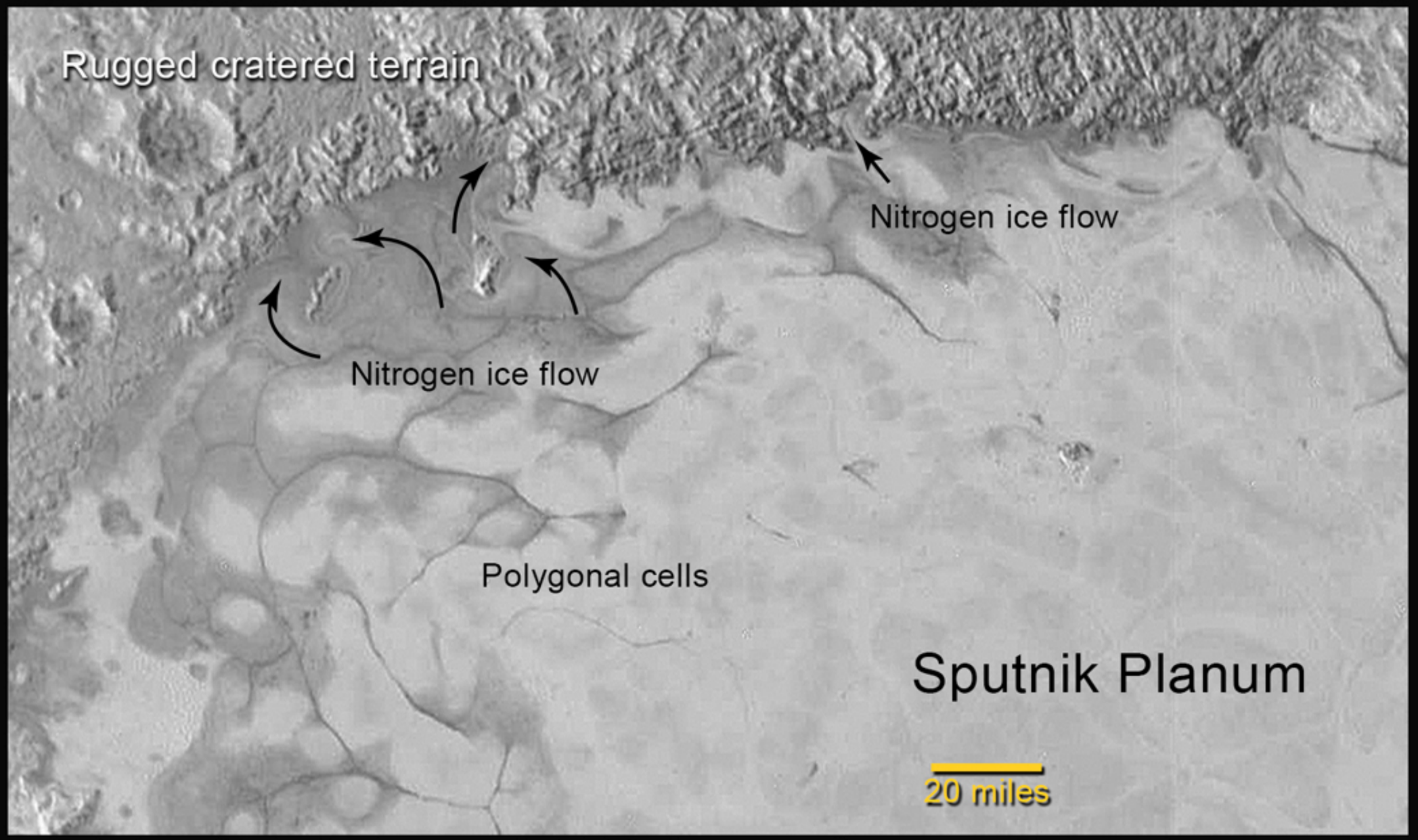
NEW HORIZONS:
MOUNTAINS ON PLUTO



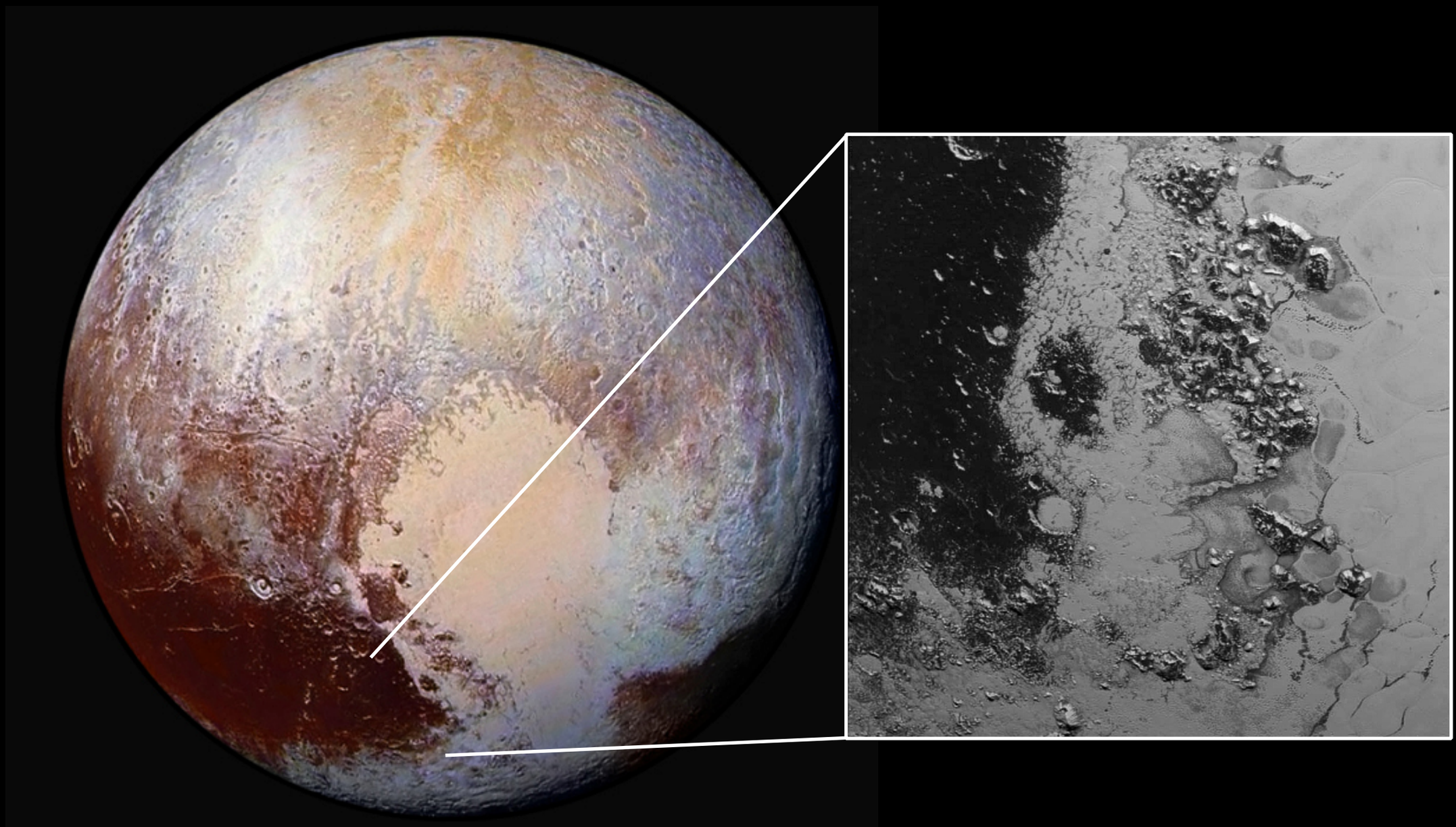
STEEP-SIDED MOUNTAINS LOCALLY RISE 2-3 KM.

IMPLY STIFF "BEDROCK" LIKELY COMPOSED OF WATER ICE.

NEW HORIZONS:
GLACIAL FLOW ON PLUTO



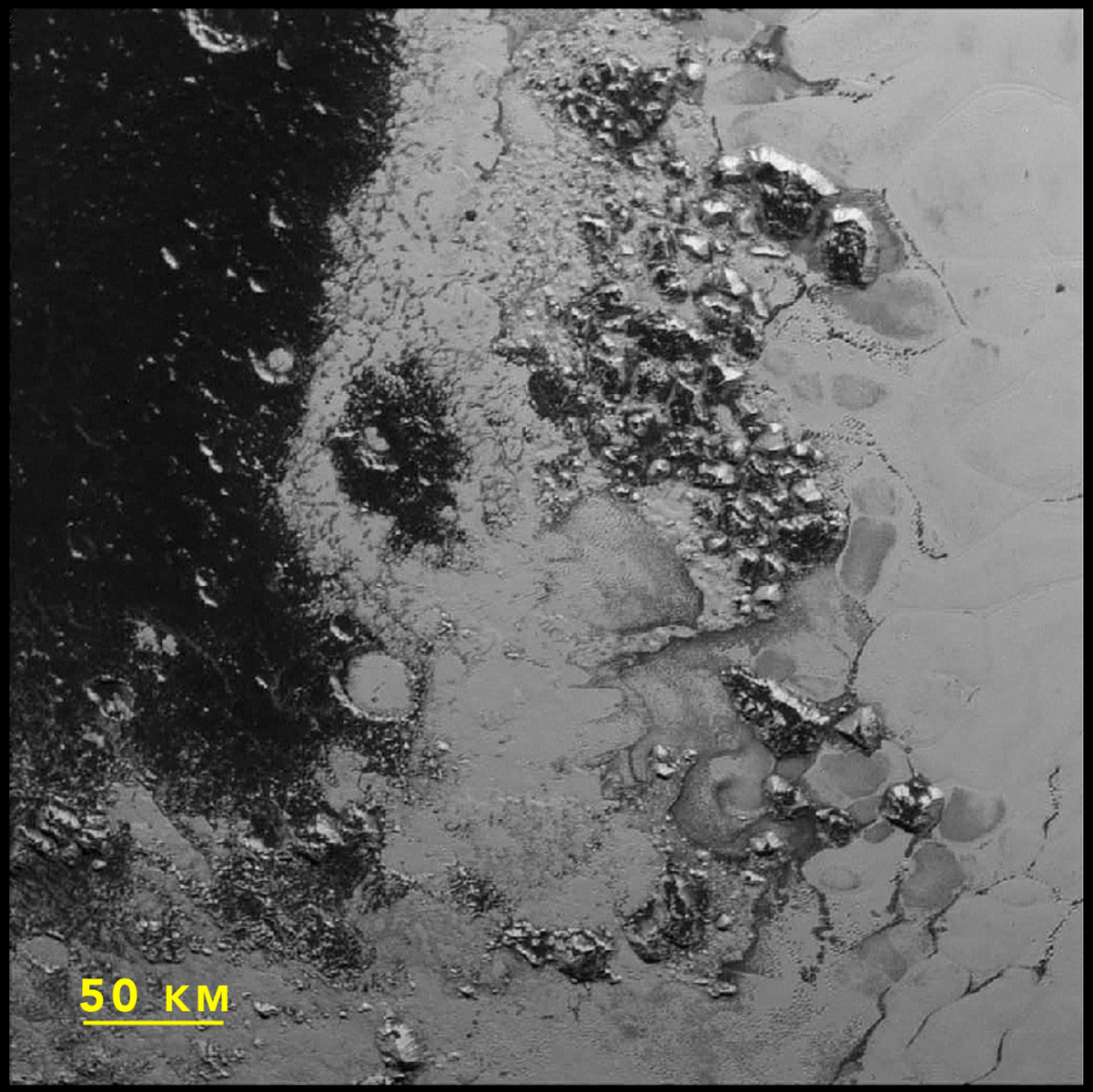
NEW HORIZONS:
COMPLEX TERRAINS ON PLUTO



Both smooth and sharp boundaries between distinct color, albedo, and morphological units

NEW HORIZONS: SURFACE AGES ACROSS PLUTO

Dark terrain heavily cratered, old surface



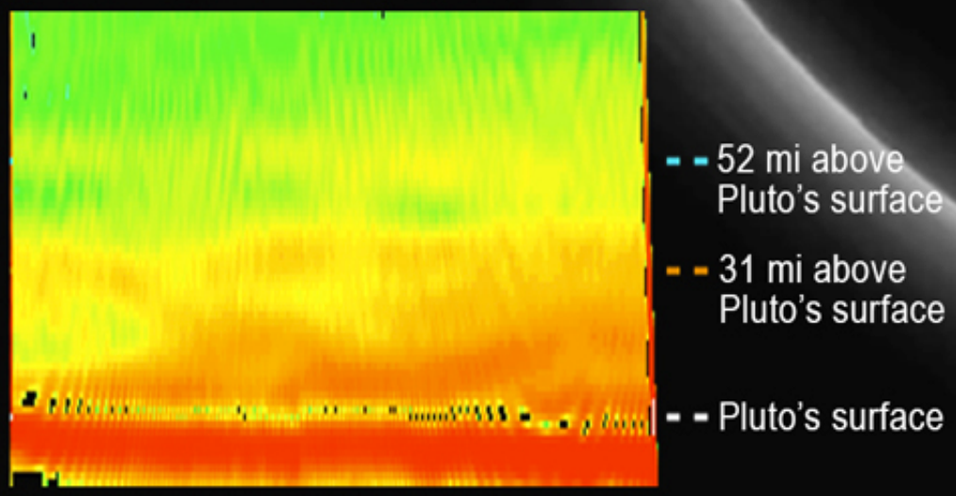
Smooth, bright terrain shows very few craters

Model ages less than several hundred million years

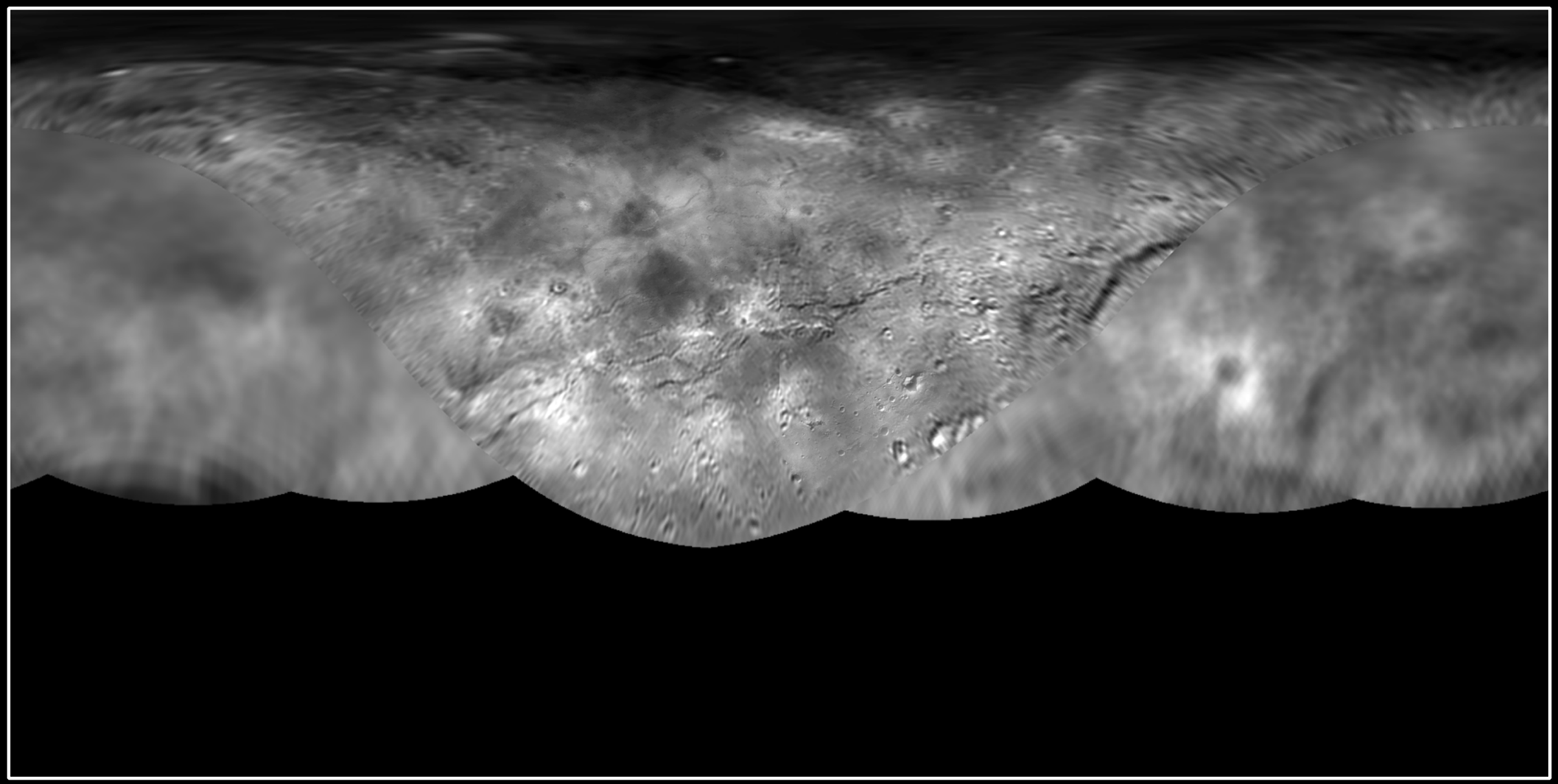
NEW HORIZONS: PLUTO'S ATMOSPHERIC HAZE

HAZES ARE DETECTED UP TO AND BEYOND 150 KM FROM PLUTO'S SURFACE

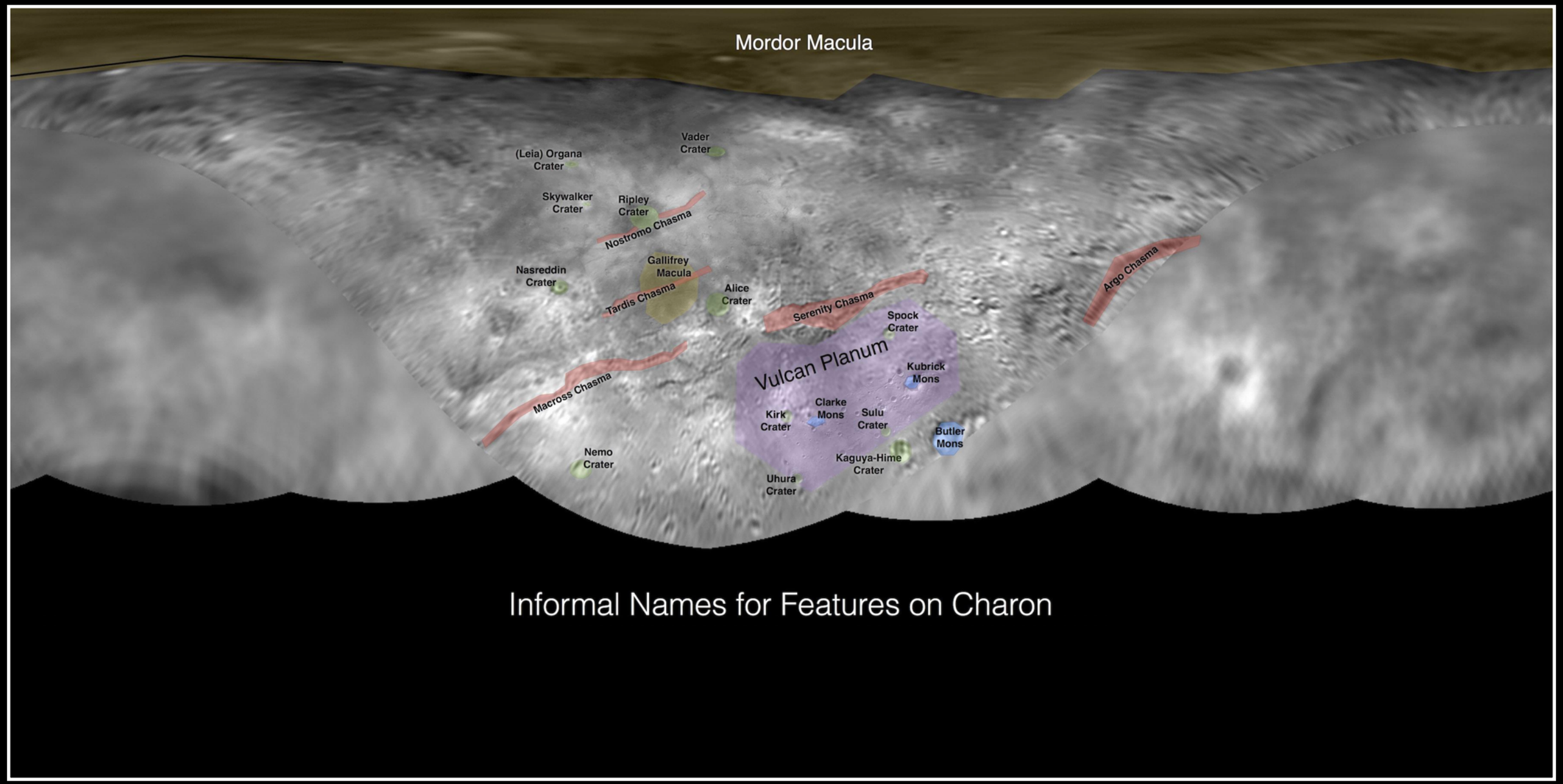
LONGITUDINAL STRUCTURES IN HAZE MAY REPRESENT LAYERS OR WAVES



NEW HORIZONS:
MAP OF CHARON



NEW HORIZONS:
MAP OF CHARON



Informal Names for Features on Charon

NEW HORIZONS:
CHARON'S POLAR SPOT

NATURAL COLOR
(RALPH + LORRI)

ENHANCED COLOR
(RALPH)

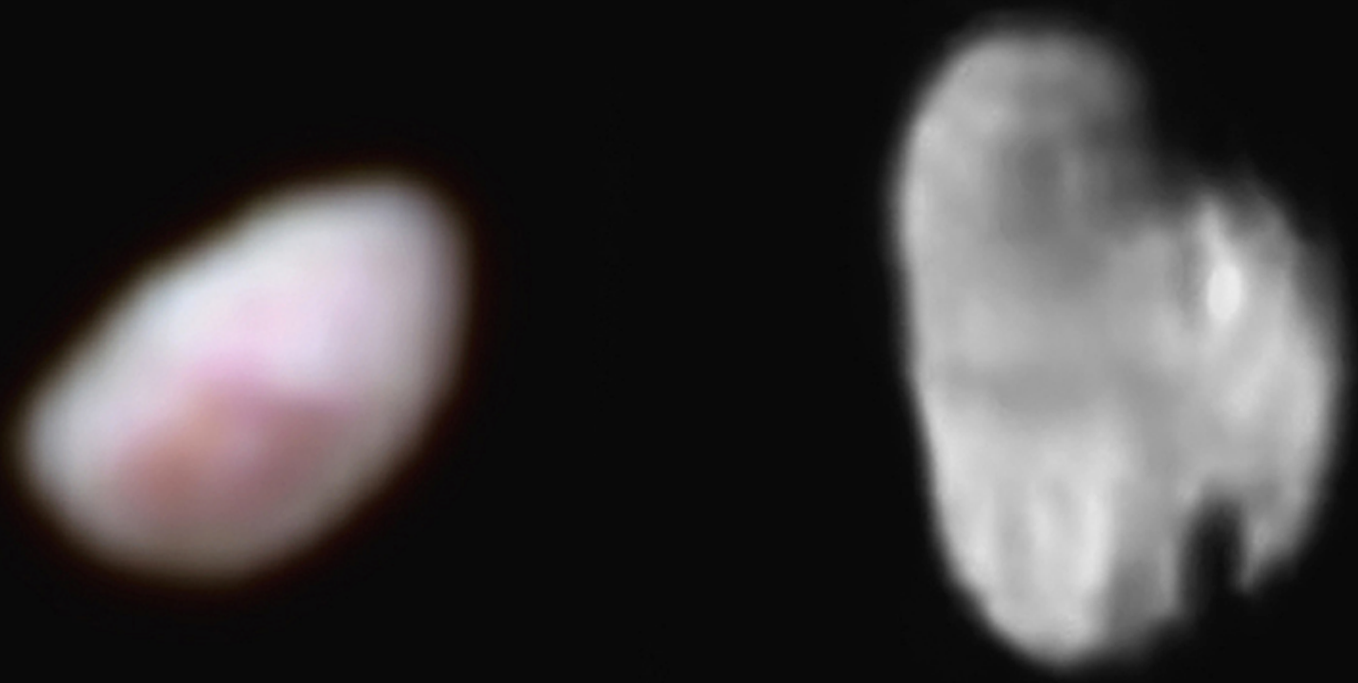
DARK POLAR SPOT IS REDDER THAN CHARON AVERAGE

RED TERRAIN EXTENDS BEYOND DARK CORE OF SPOT

DARK CORE MAY BE CORRELATED WITH GEOLOGIC STRUCTURES

NEW HORIZONS:
NIX AND HYDRA

Nix (enhanced color) **Hydra (grayscale)**



Approximate Dimensions

Nix	Hydra
36 x 24 km	44 x 33 km

Approximate Geometric Albedos

Nix	Hydra
0.43-0.50	0.51