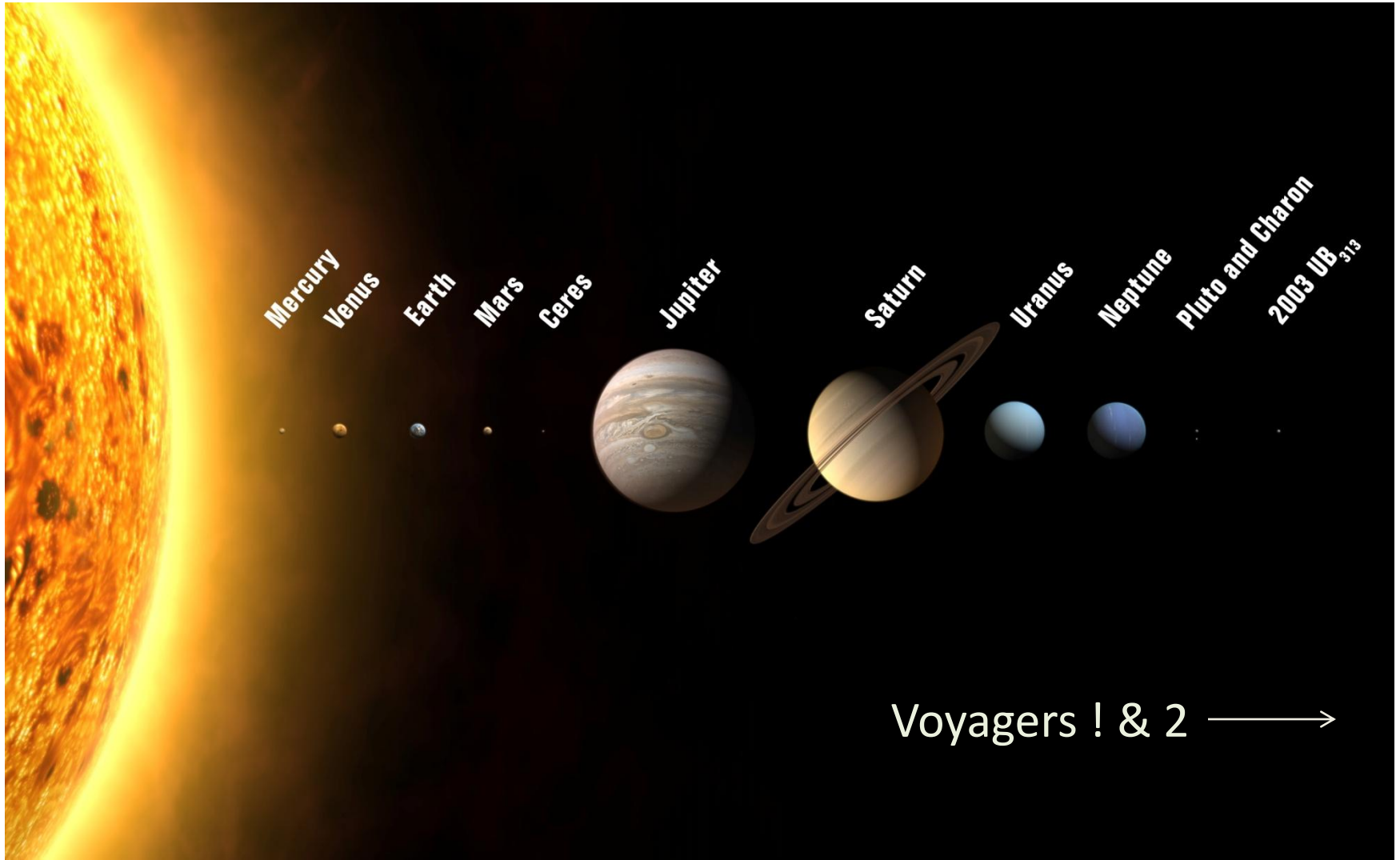


Space Odysseys in 2013

George Gamota



2013 was a Record Year for Space Science Accomplishments

- See video:
<https://www.youtube.com/watch?v=IRGSG6qaLqk>

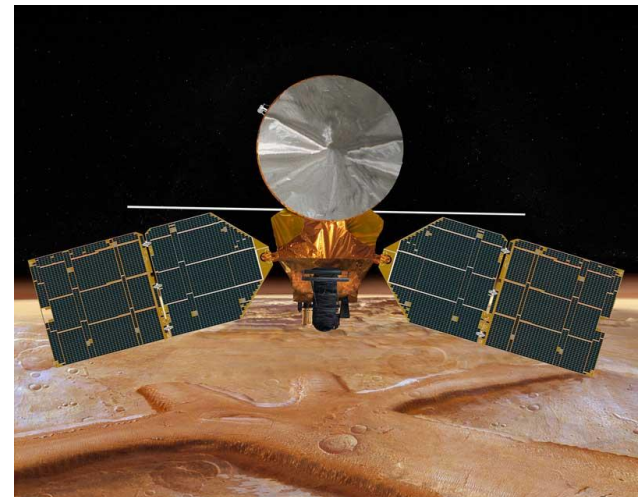
Outline

- Mars
 - Rovers
 - Orbiters
- Cassini
 - Saturn
 - Titan
- Juno
- Yoyagers
- GAI Telescope
- Beyond...

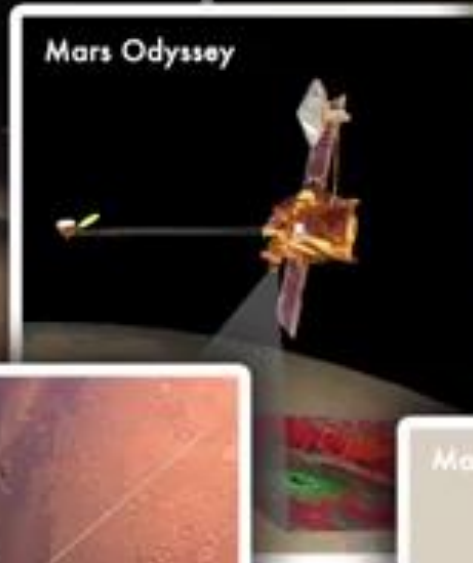


Mars

- Rovers
 - Spirit 2004-2010
 - Opportunity 2004 - ?
 - Curiosity 2011 - ?
- Orbiters
 - *Mars Global Surveyor 1996*
 - *Mars Odyssey 2001*
 - *Mars Express (ESA) 2004*
 - *Mars Reconnaissance Orbiter 2005*



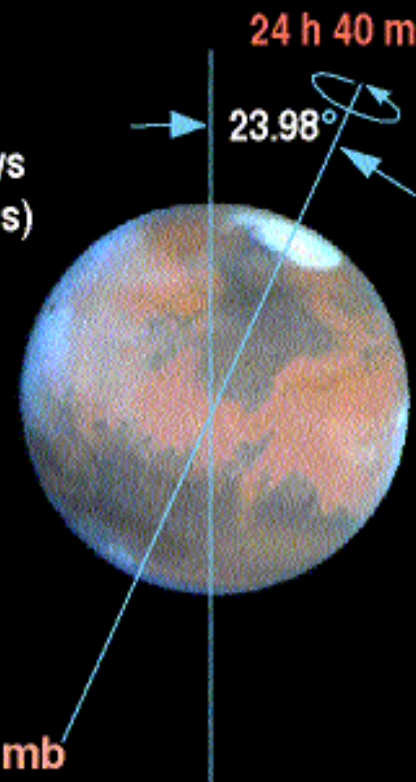
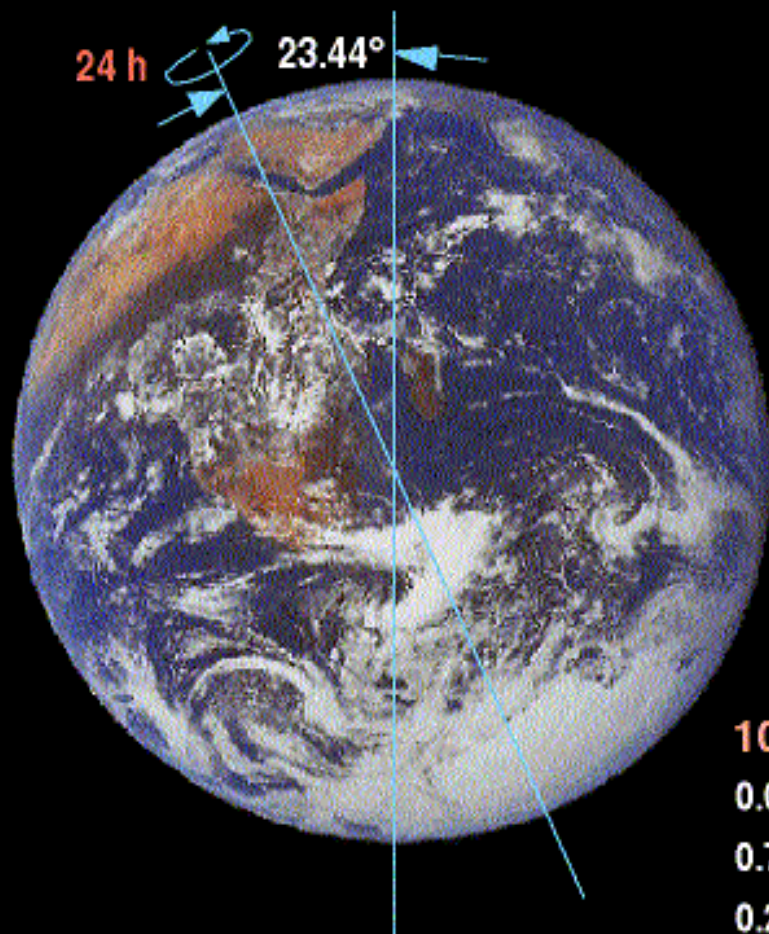
Snooping on Mars



EARTH

COMPARISON

MARS



YEAR

365 Days 686 Days
(667 Sols)

GRAVITY

38% of earth

SUNLIGHT

44% of earth

ATMOSPHERE

1013mb	Total	7.6 mb
0.00035	CO ₂	0.95
0.781	N ₂	0.027
0.210	O ₂	0.0013
0 to 0.04	H ₂ O	0 to 0.00021
0.0093	Ar	0.016

By Suman

Mars Rovers



Spirit/Opportunity (2004)

Sojourner (1997)

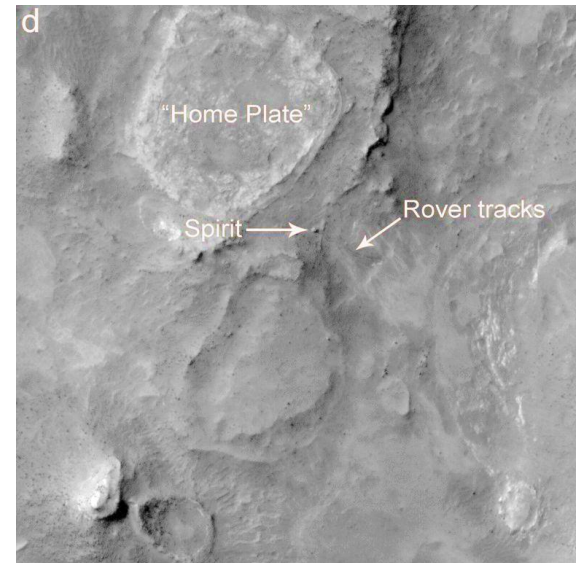
Curiosity (2011)

Major Finding

- In 2013, scientists announced results from the rover's analyses that revealed new secrets of the Red Planet's history.
- [Clay formations in Mars' Yellowknife Bay](#) indicate an environment that was once favorable to microbial life.
- The [soil contains about 2% water by weight.](#)

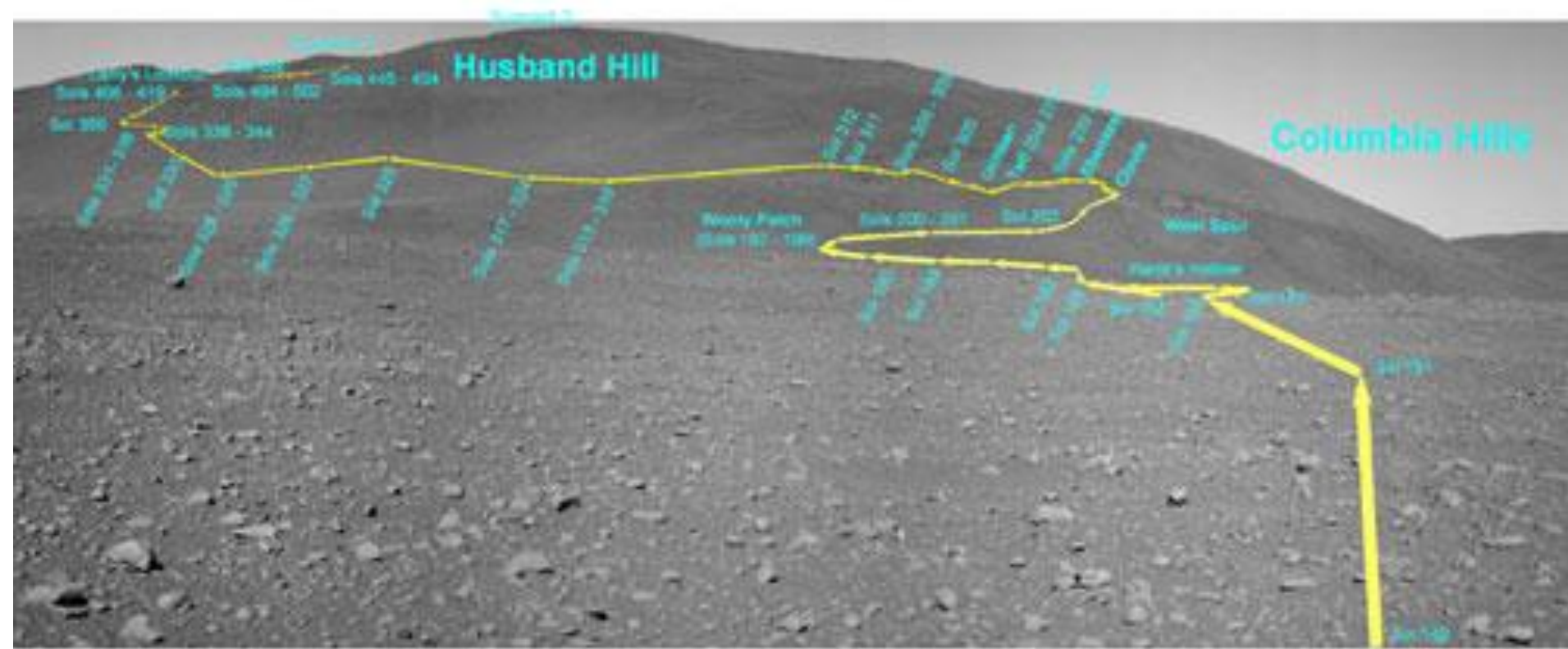
Lessons from Spirit

- Unexpected circumstances can lead to great outcomes.
 - Dragging a damaged tire exposed *silica*, a substance that forms when hot water reacts to rocks, e.g. like Old Faithful in Yellowstone
 - Spirit “died” in 2010 when
 - it became immobile

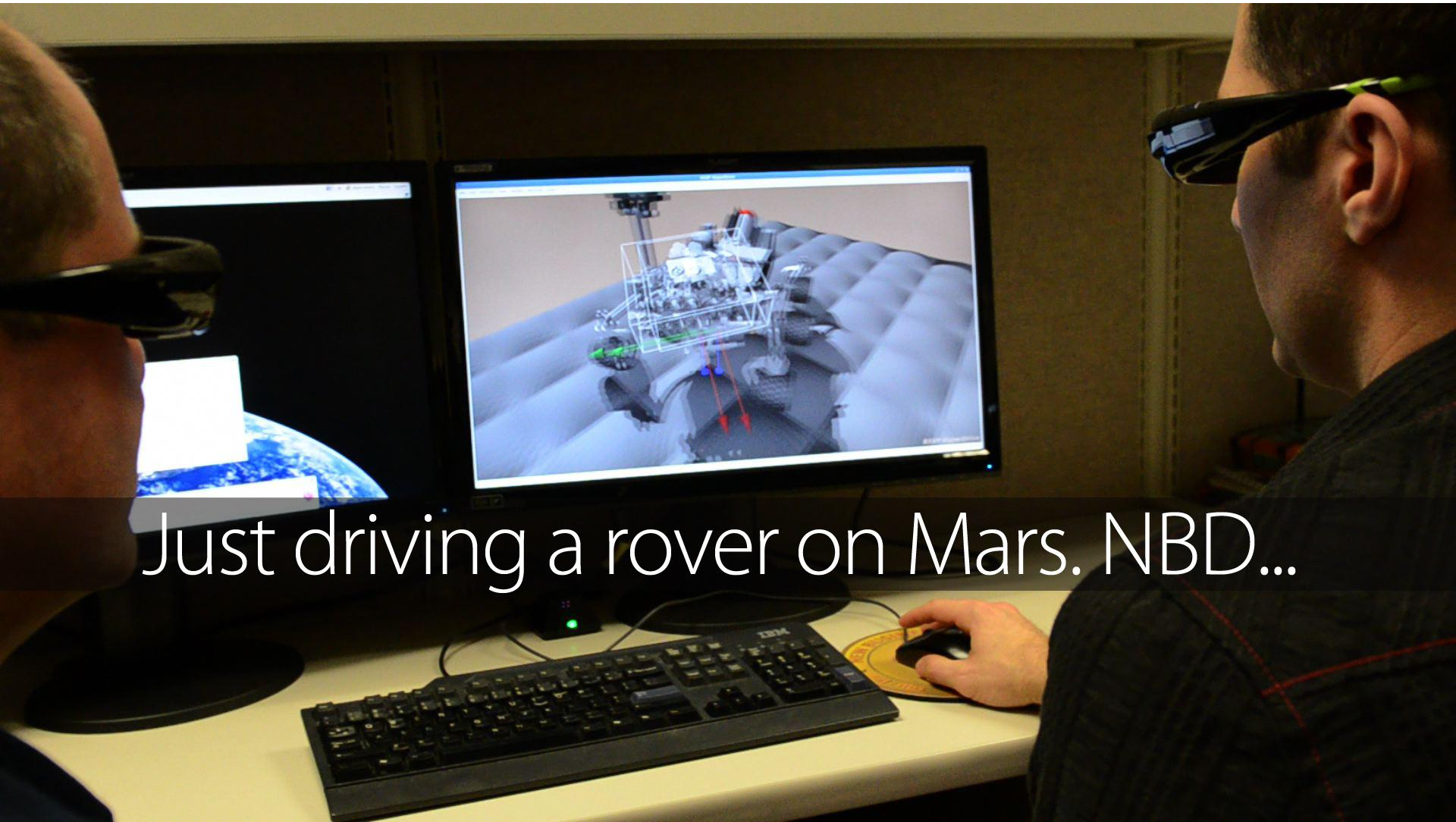


Spirit's Traverse 4.8 miles

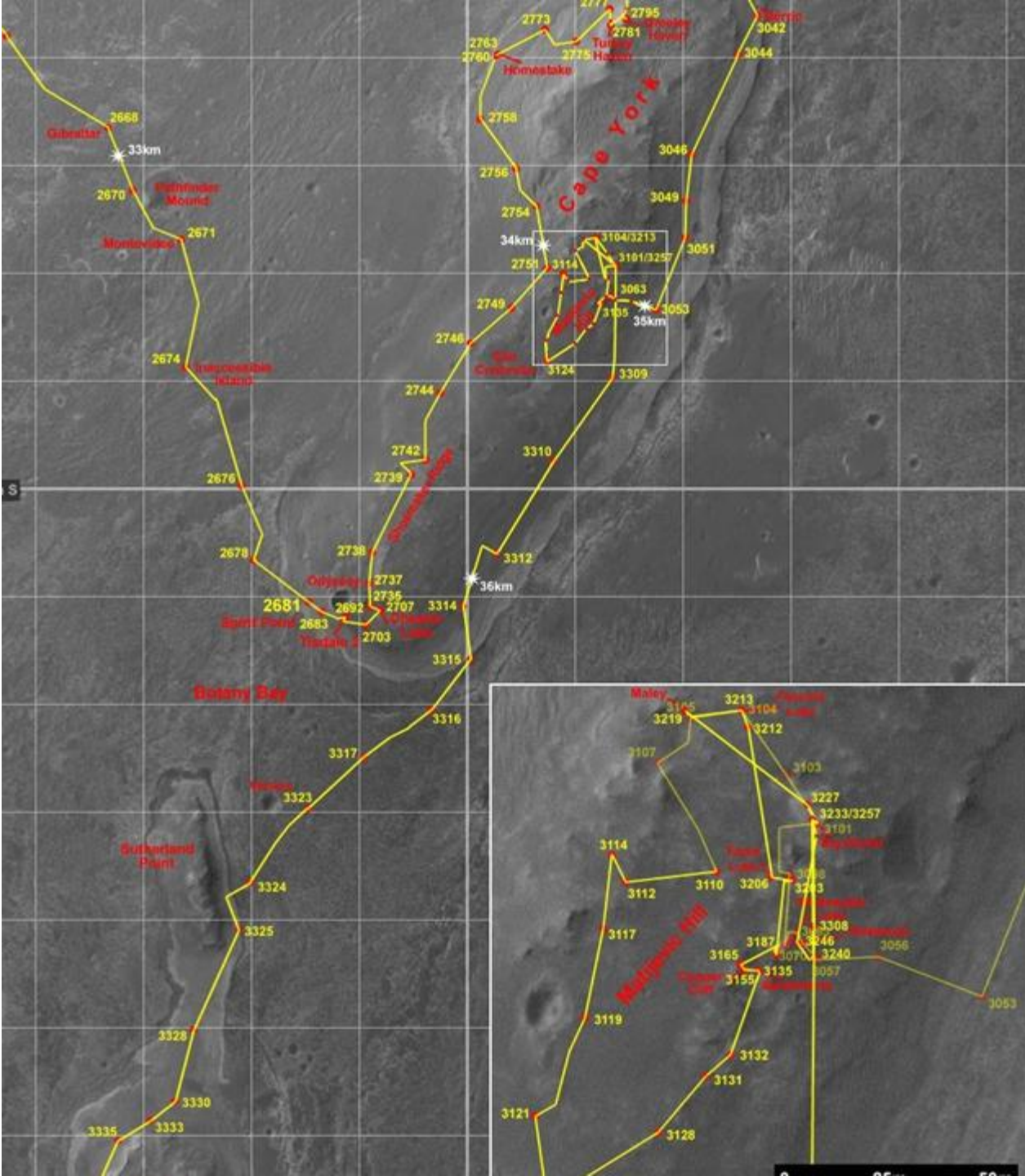
Spirit Rover Traverse (Sol 502)



How do you Drive on Mars



Just driving a rover on Mars. NBD...



Opportunity

Opportunity overlooking Endeavour Crater

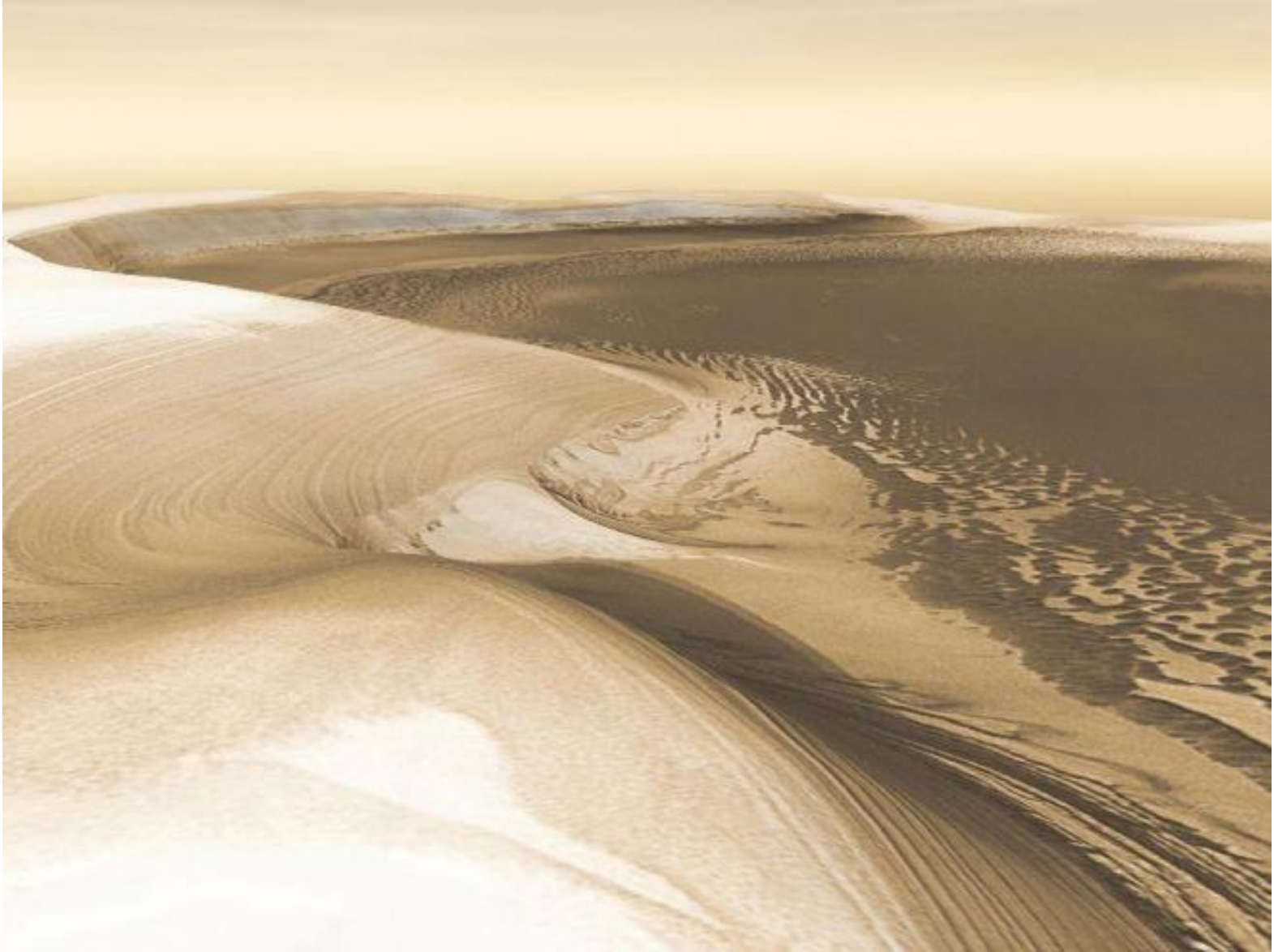
- On the 10th anniversary of its launch, Opportunity is also celebrating reaching the halfway point in its drive from one crater-rim segment to another



← ~14 miles →



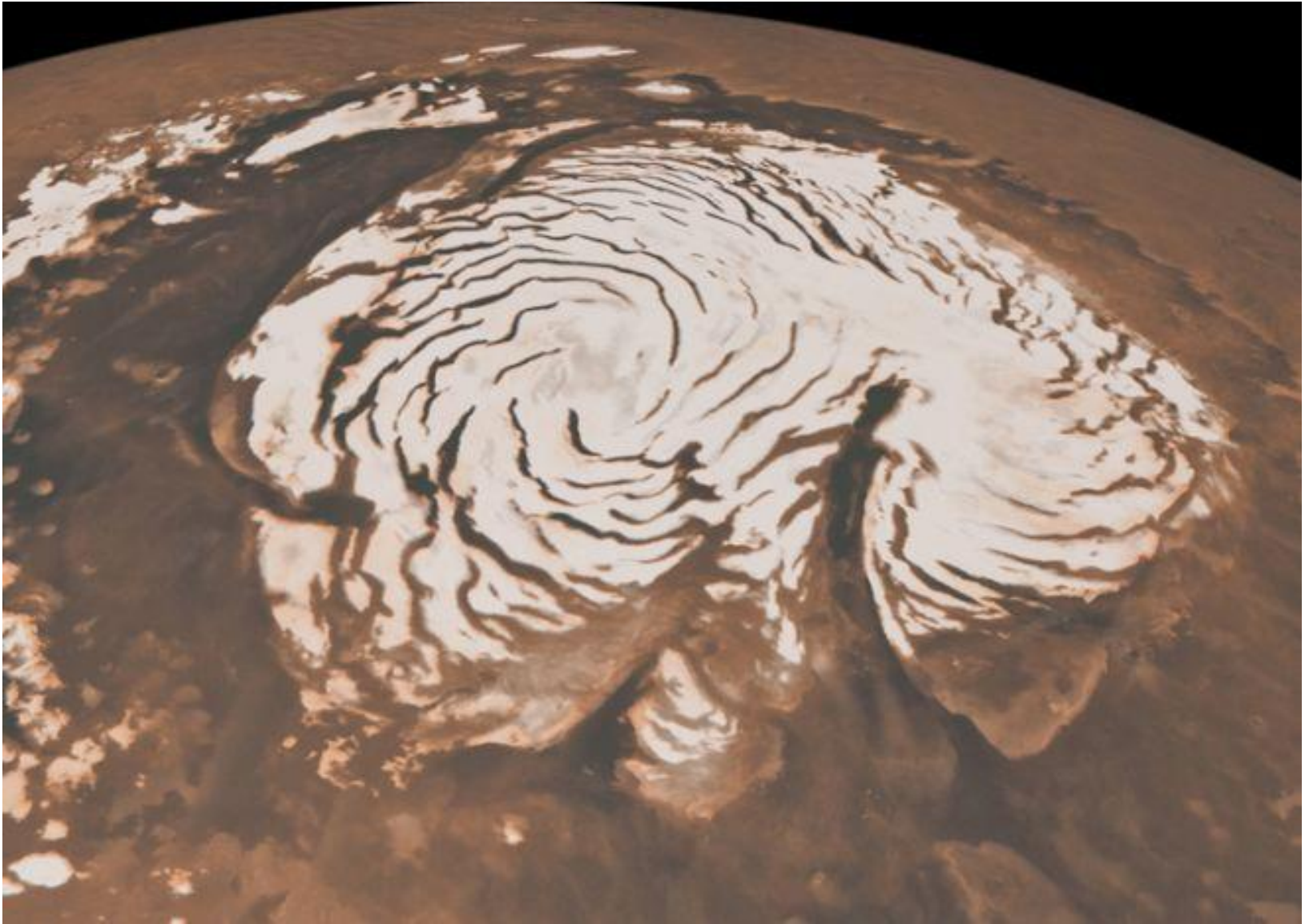
Chasma Boreale



Namib Desert, Namibia (Earth)



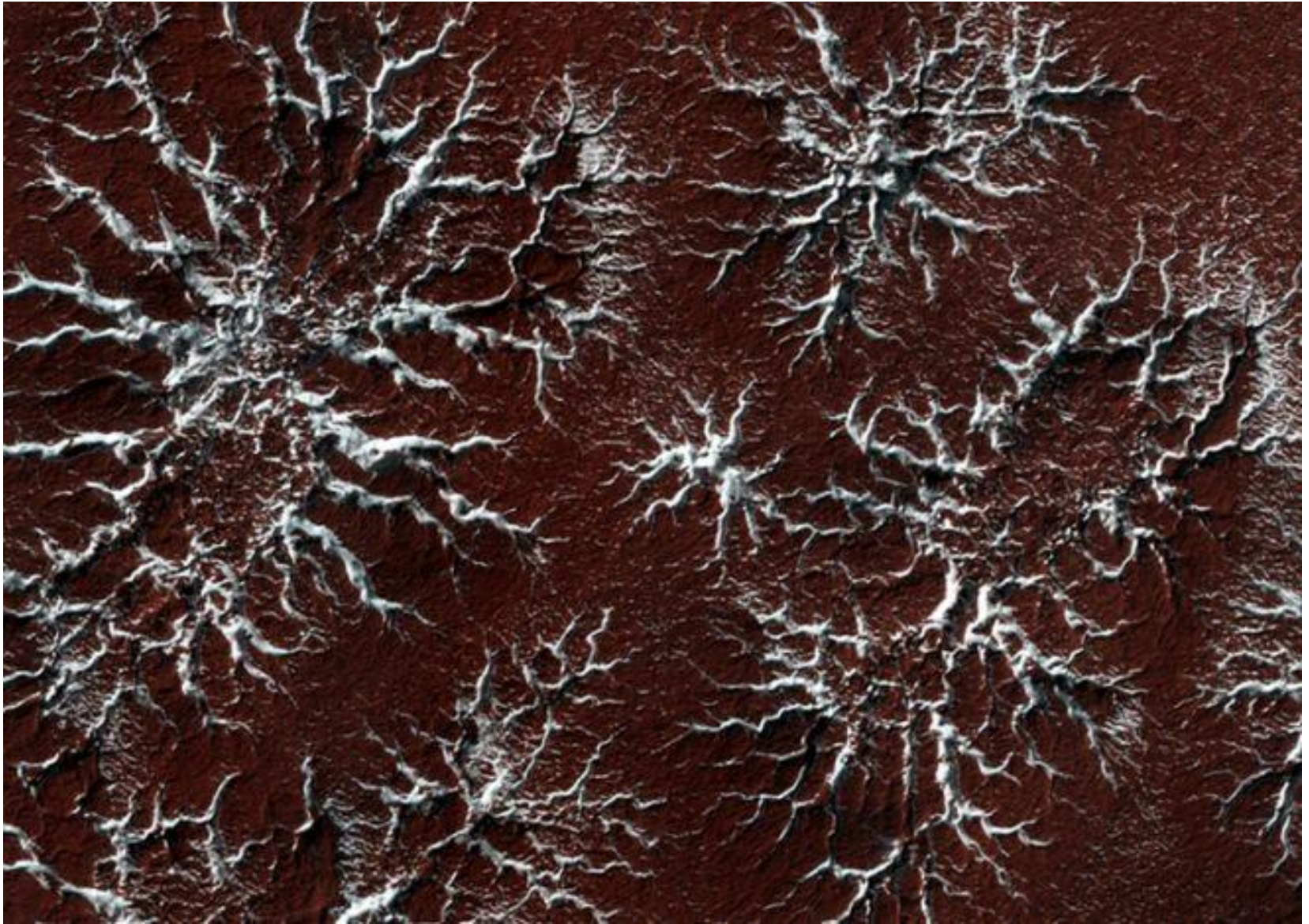
Summer on the Mars' South Pole



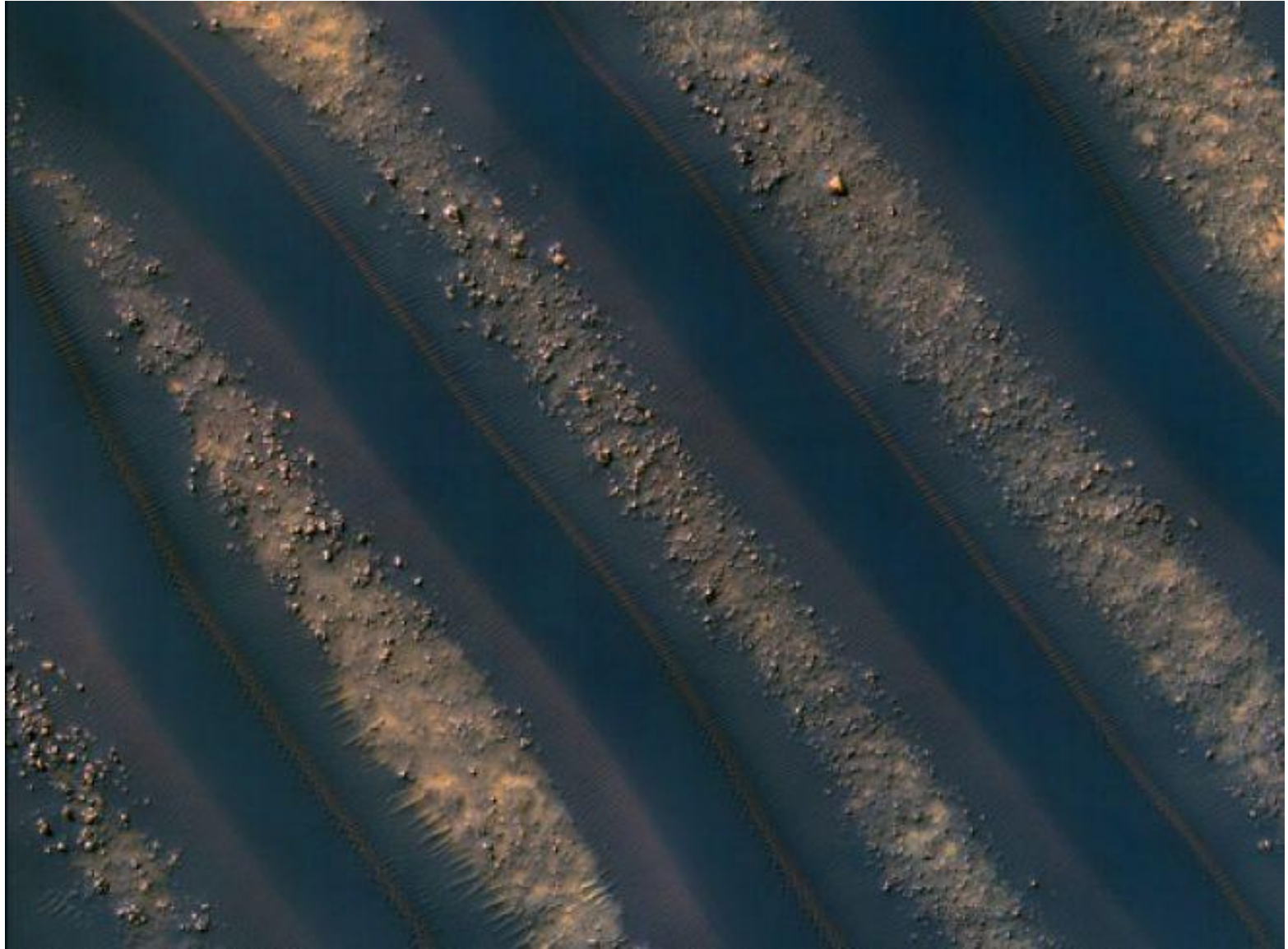
Summer in Antarctica



Dry Ice Spider Veins



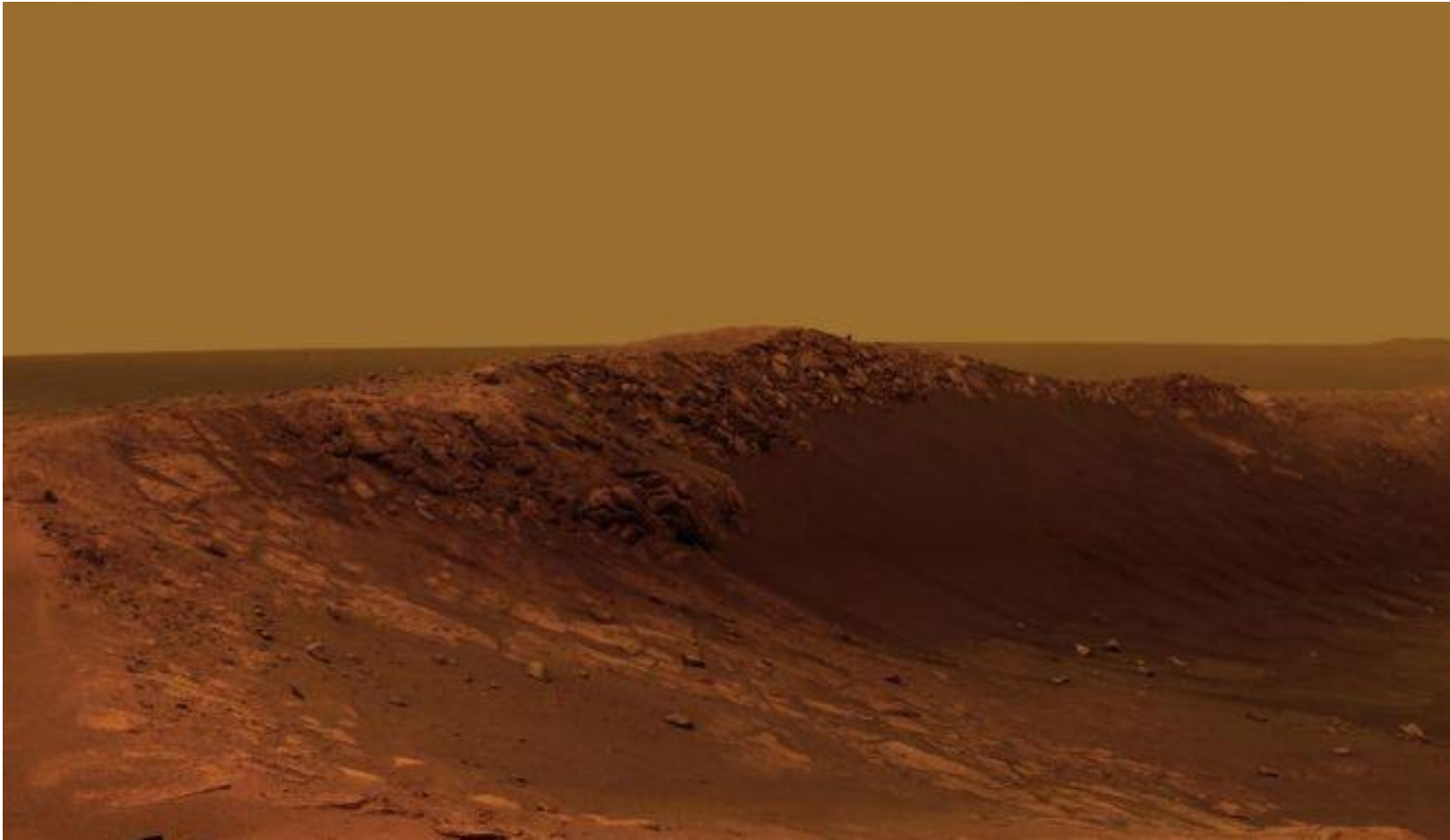
Dunes



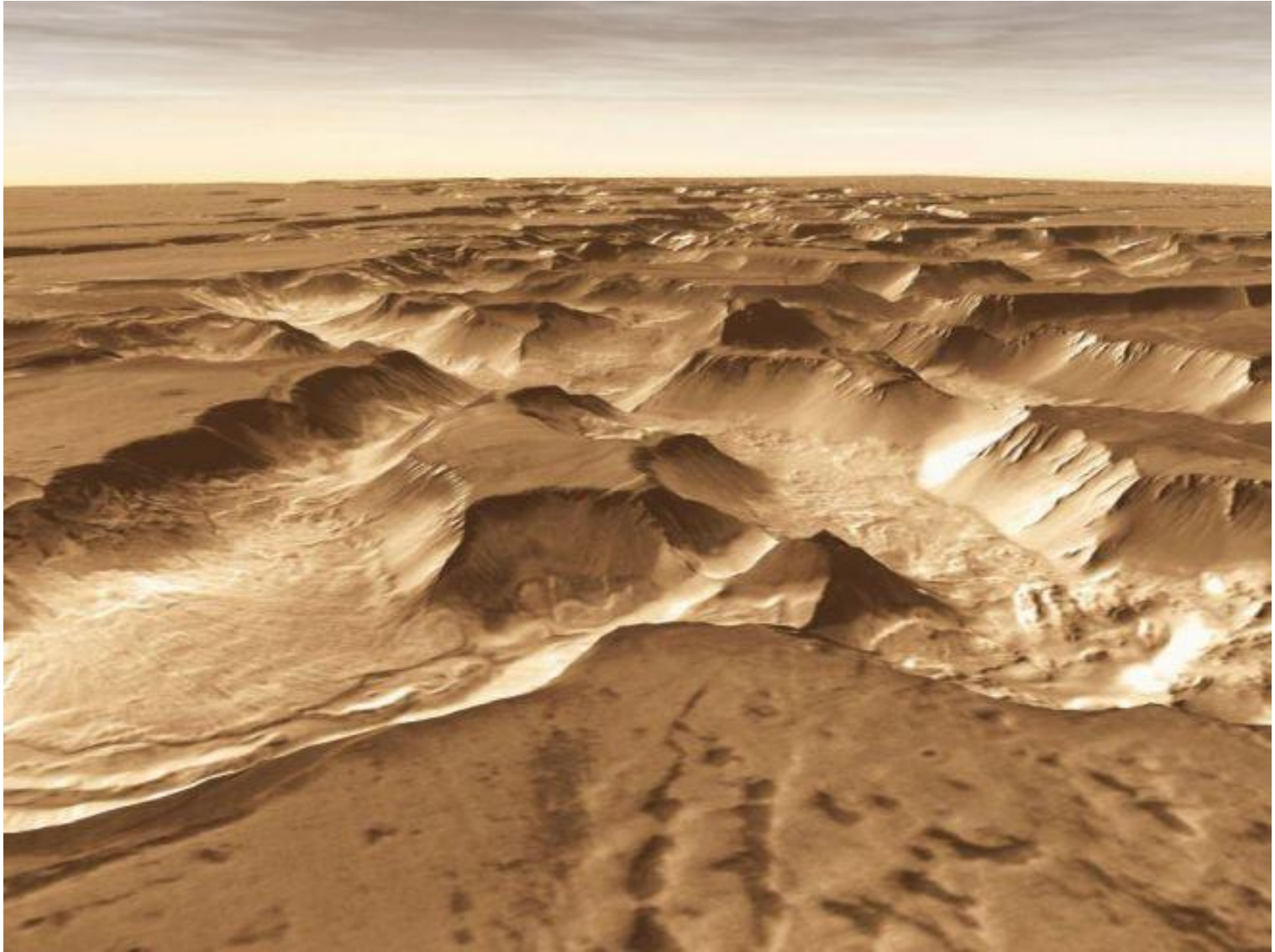
Earth – Moon from Mars



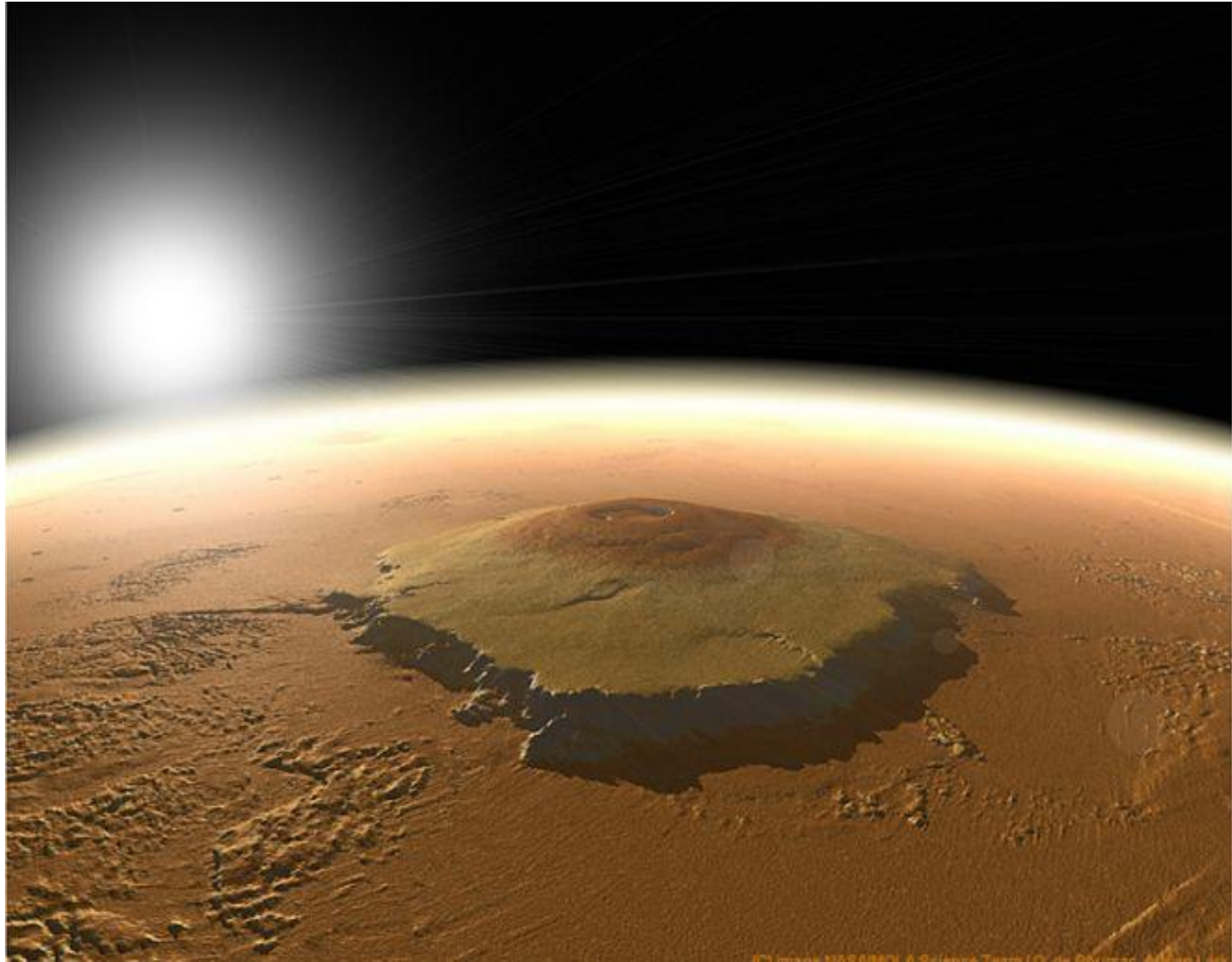
Santa Marina



Noctis Vista



Mount Olympus



Phobos & Deimos



Proctor Crater



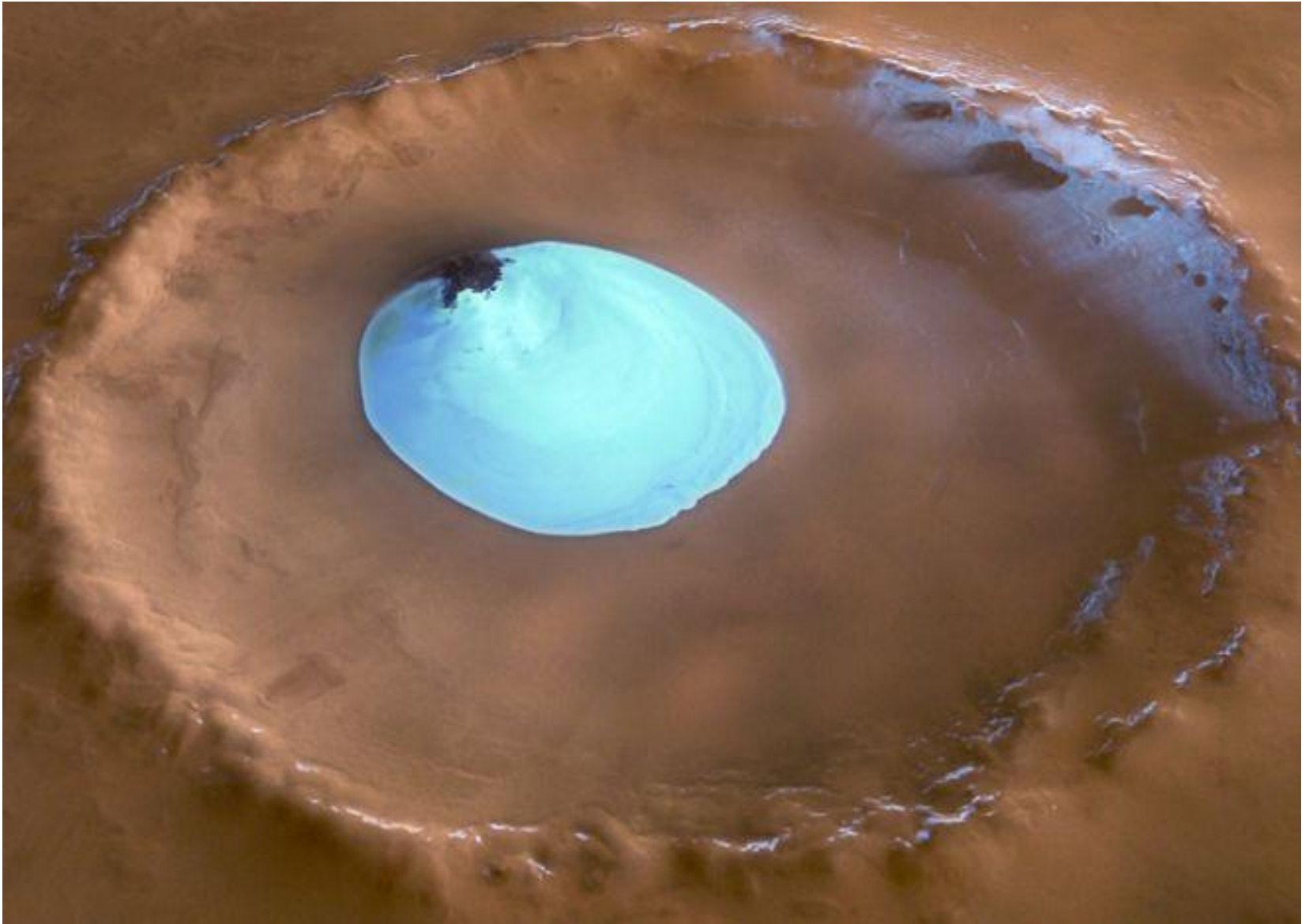
Serpent Dust Devil



Victoria Crater



Ice (water) on Mars



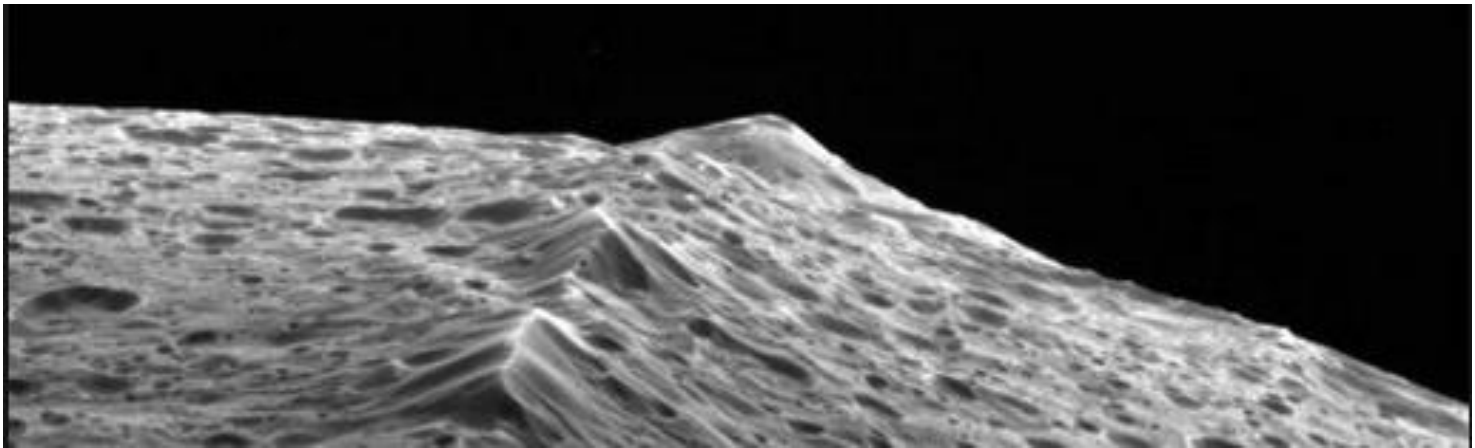
North Pole on Mars



500 x 500 pixels
10" per pixel

SPACE, the FINAL FRONTIER: These are the images from the star probe Cassini

Its 20-year mission: To boldly go where no robot of man has gone before

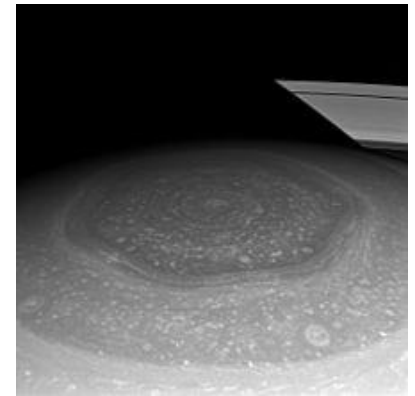
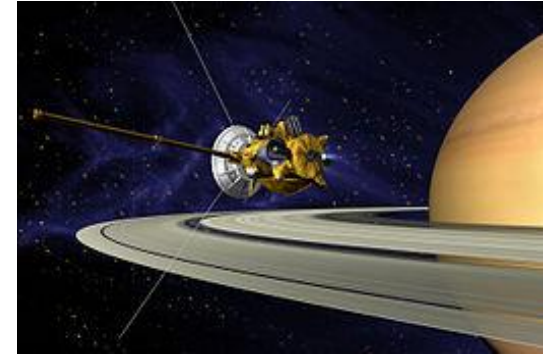


Mountains on Iapetus

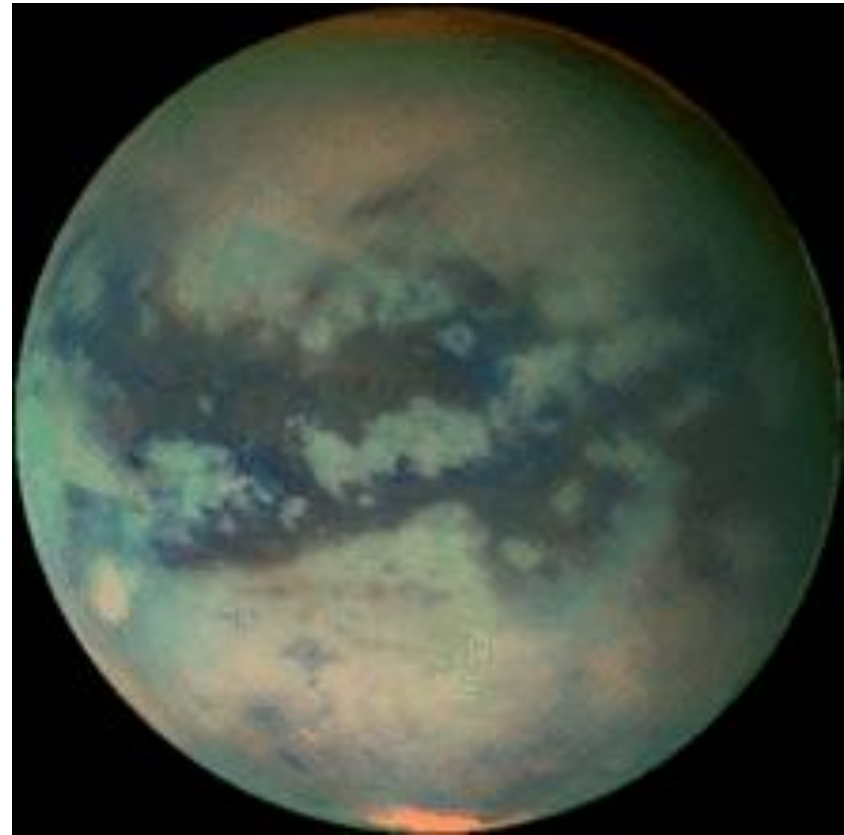
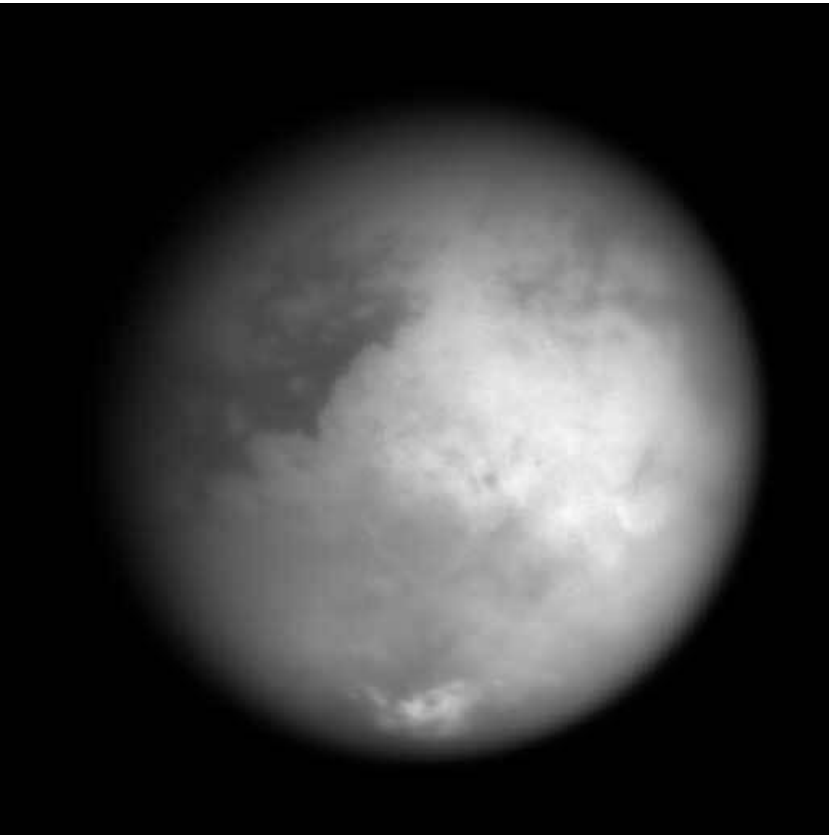
NINE YEARS INTO ITS MISSION

What is Cassini & Huygens

- Cassini is an orbiter & Huygens is a probe (lander)
- The pair was launched on October 15, 1997
- Joint NASA & European Space Agency project
- After an interplanetary voyage which included flybys of Earth, Venus, and Jupiter.
- It entered into orbit around Saturn on July 1, 2004,
- On December 25, 2004, *Huygens* separated from the orbiter.
- It reached Saturn's moon [Titan](#) on January 14, 2005, when it entered Titan's atmosphere and descended to the surface.
- It successfully returned data to Earth, using the orbiter as a relay.
- This was the first [landing](#) ever accomplished in the [outer Solar System](#).
- Since then Cassini orbiter has been exploring Saturn, its rings and moons

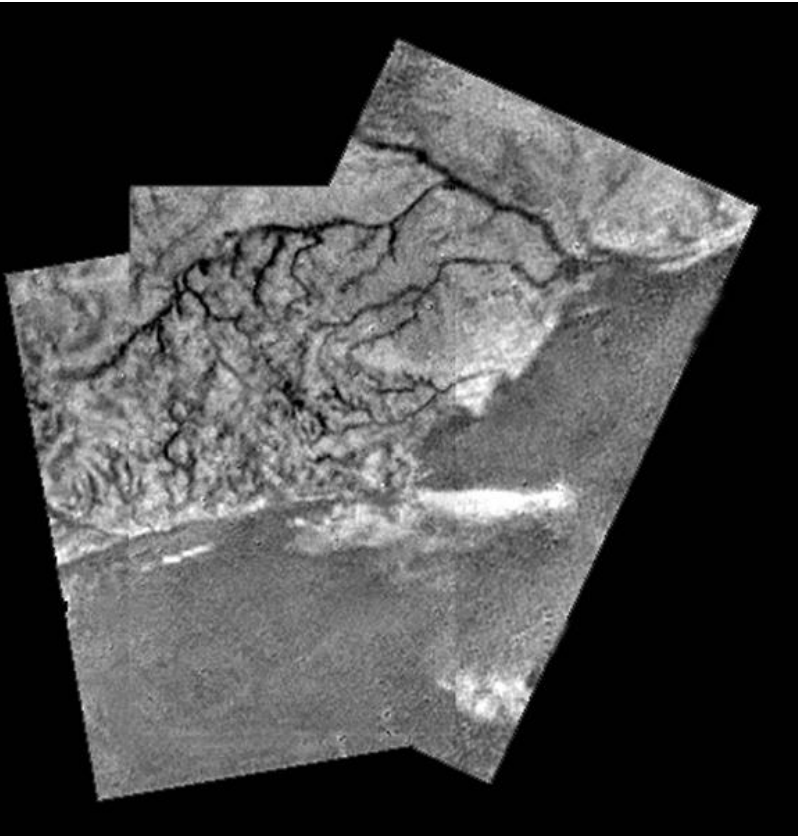


Titan in 2004 & 2013



Contrast Between Worlds

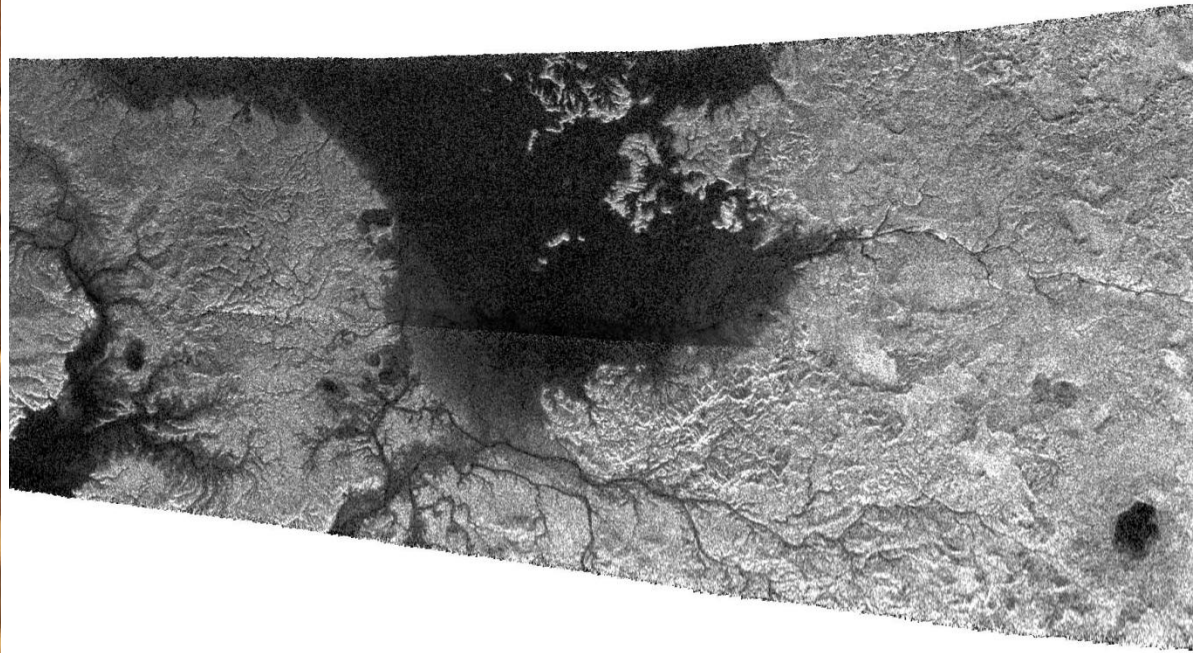
Titan



Earth – Long island

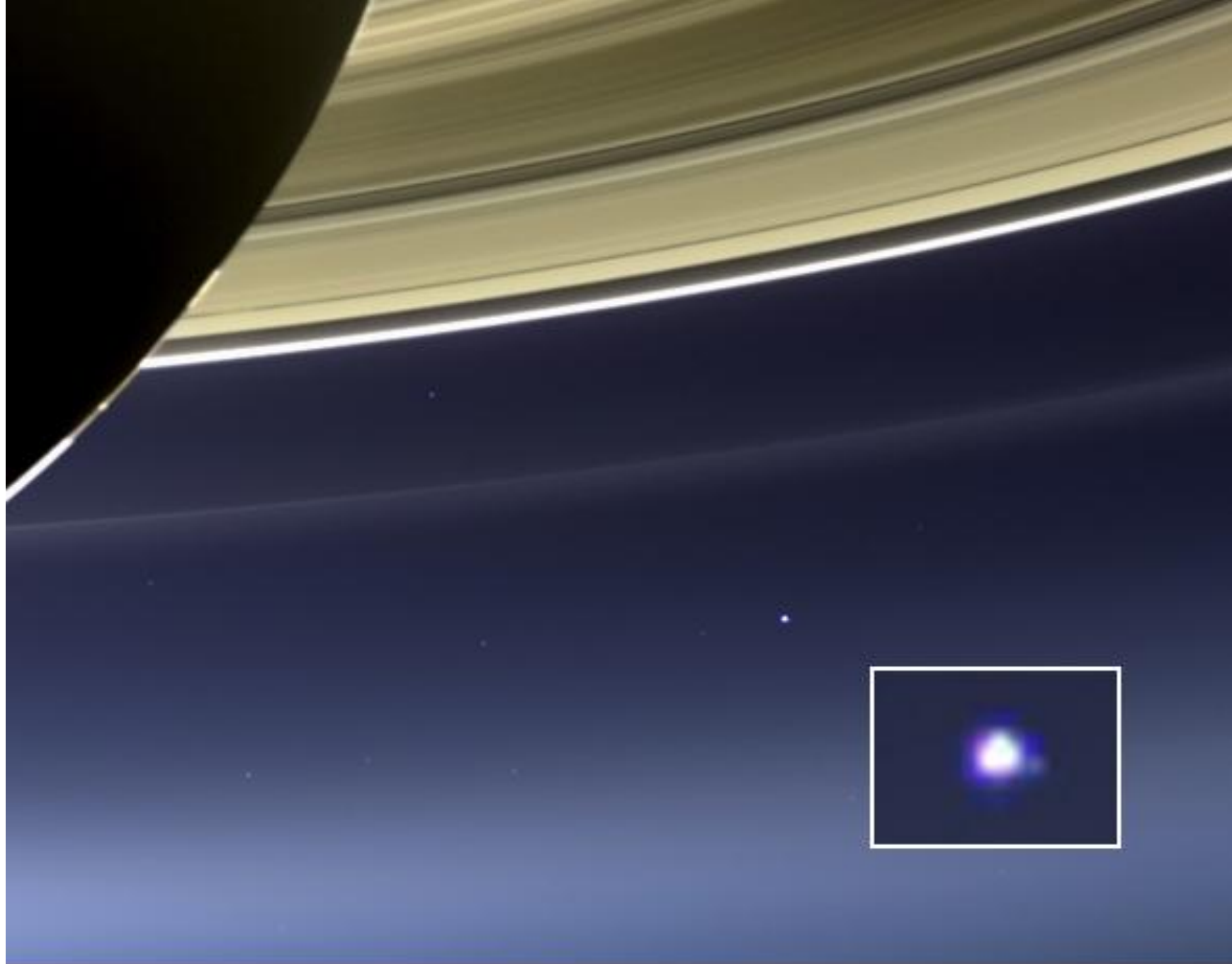


Surface of Titan



Saturn (from Cassini)





You are here.

Mission JUNO

- The JUNO mission will explore Jupiter
- Seek secrets about its origin
- Juno was launched on August 5, 2011
- On October 9th 2013 it did a slingshot around earth, gained 8,800 mph
- It will reach its destination Jupiter on July 4th 2016

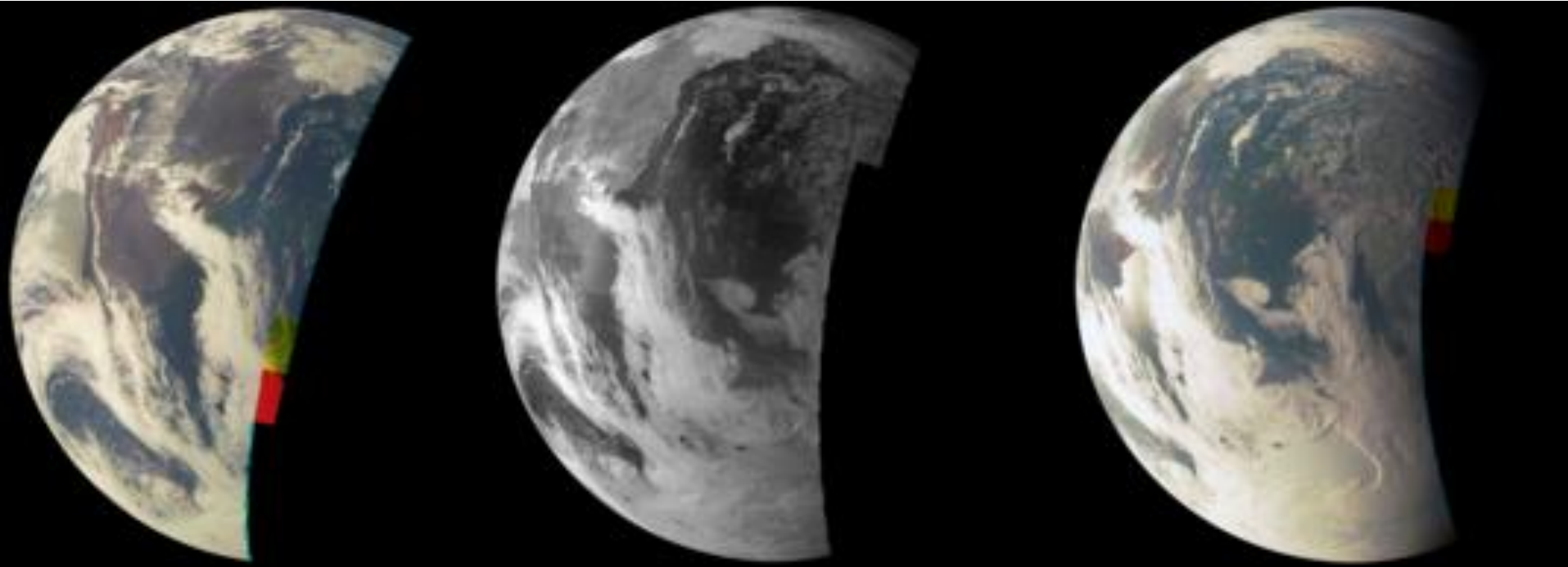
Earth and Moon Seen by Passing Juno Spacecraft

http://www.youtube.com/watch?feature=player_embedded&v=_CzBISXgzqI

<http://missionjuno.swri.edu/news/results-from-juno-earth-flyby>

Views of Earth from Juno 10/2013

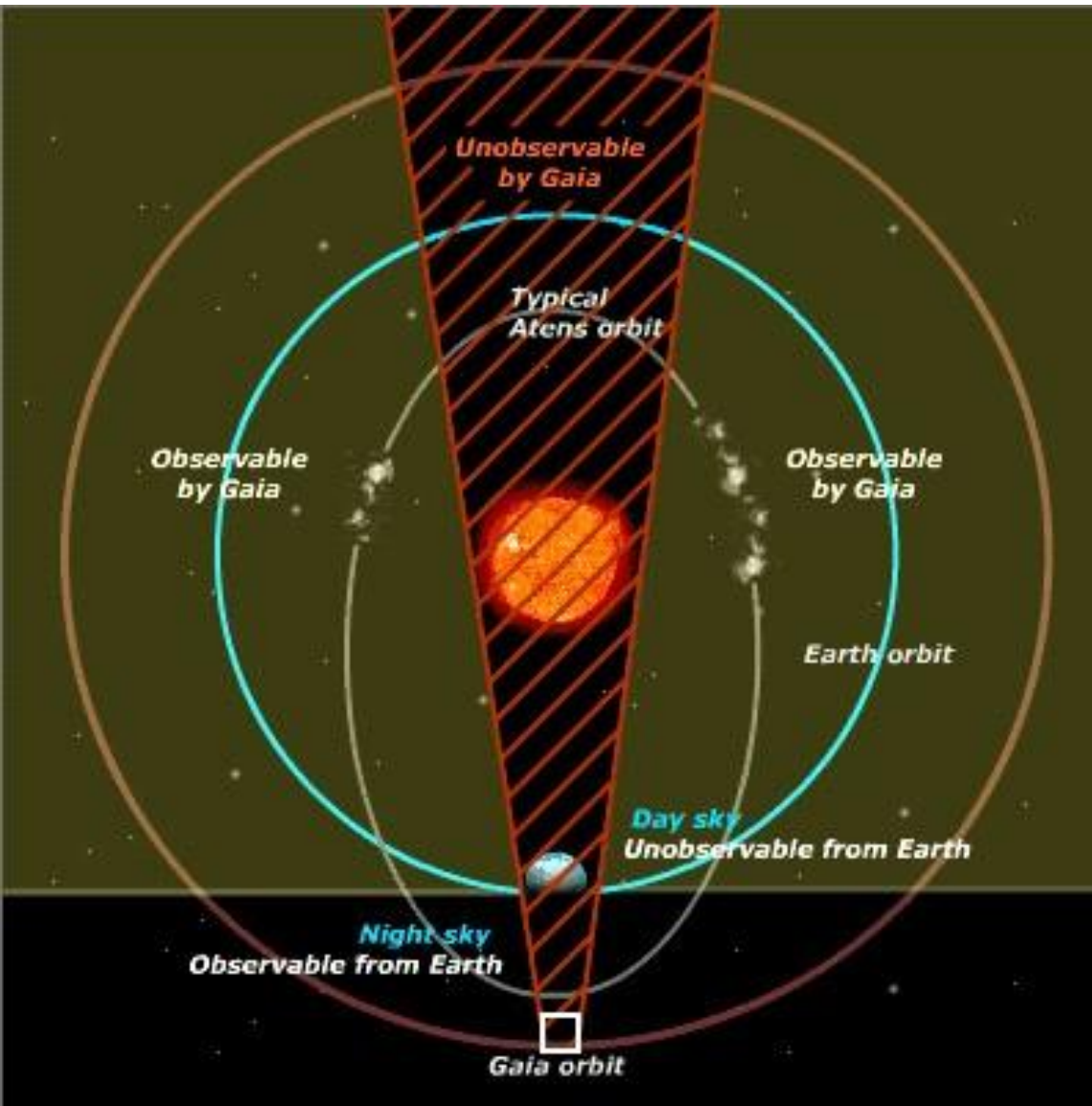
- if this flyby were of an alien planet, could we detect the presence of life down there?
Photos of the whole Earth are not terribly suggestive



What is GAIA?

- ESA's billion-star surveyor telescope GAIA is now in its operational orbit around a gravitationally stable virtual point in space called 'L2', 1.5 million km from Earth.
- The primary objective is to survey more than one billion stars in our Galaxy (Milky Way) and beyond.
- Gaia primary goal is to investigate the origin and subsequent evolution of our Galaxy, the Milky Way.

Sweep of the Milky Way - GAIA



Accuracy:

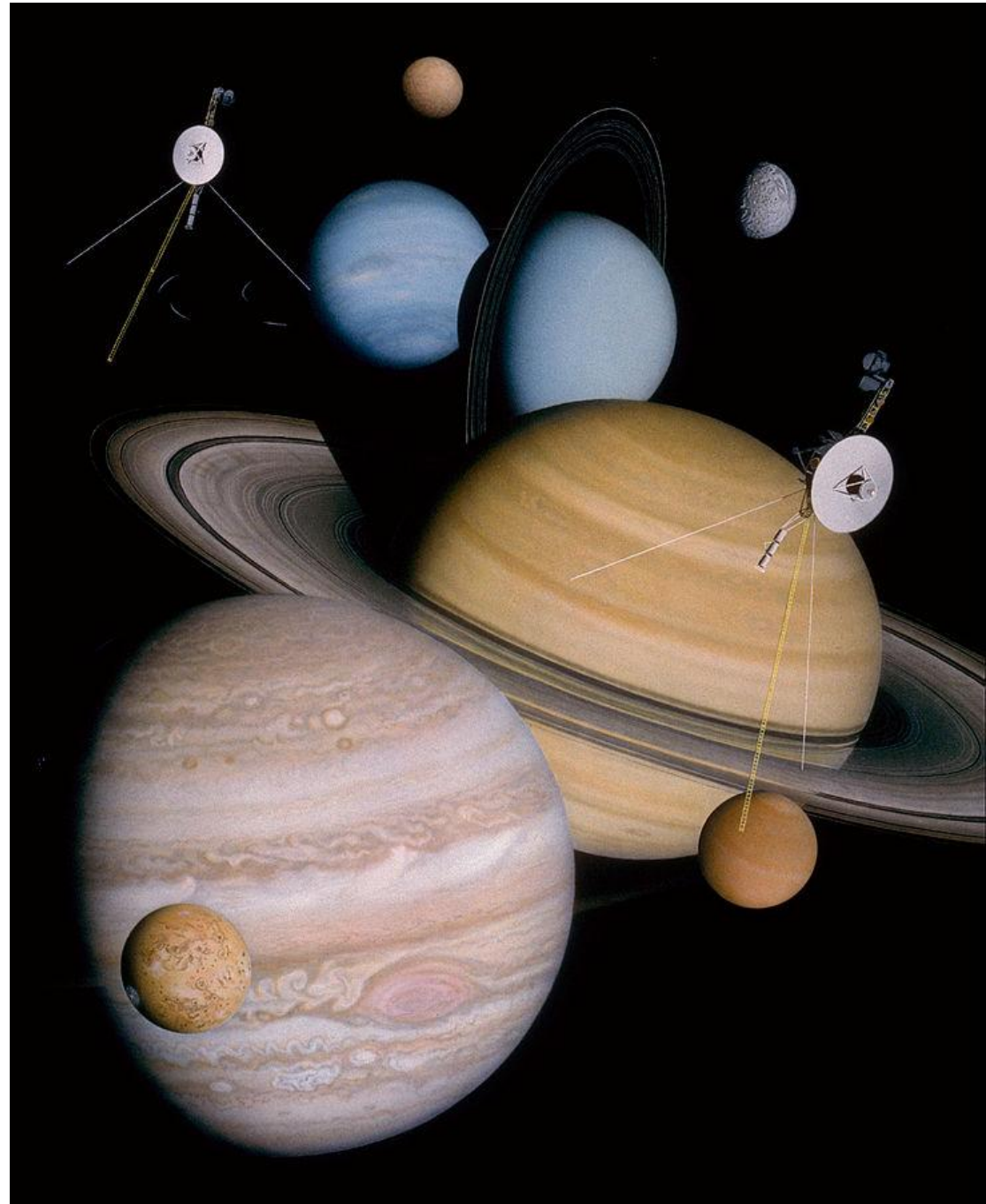
Equivalent to recognizing George Washington's face on a quarter on the moon from earth

Voyager 1 & 2



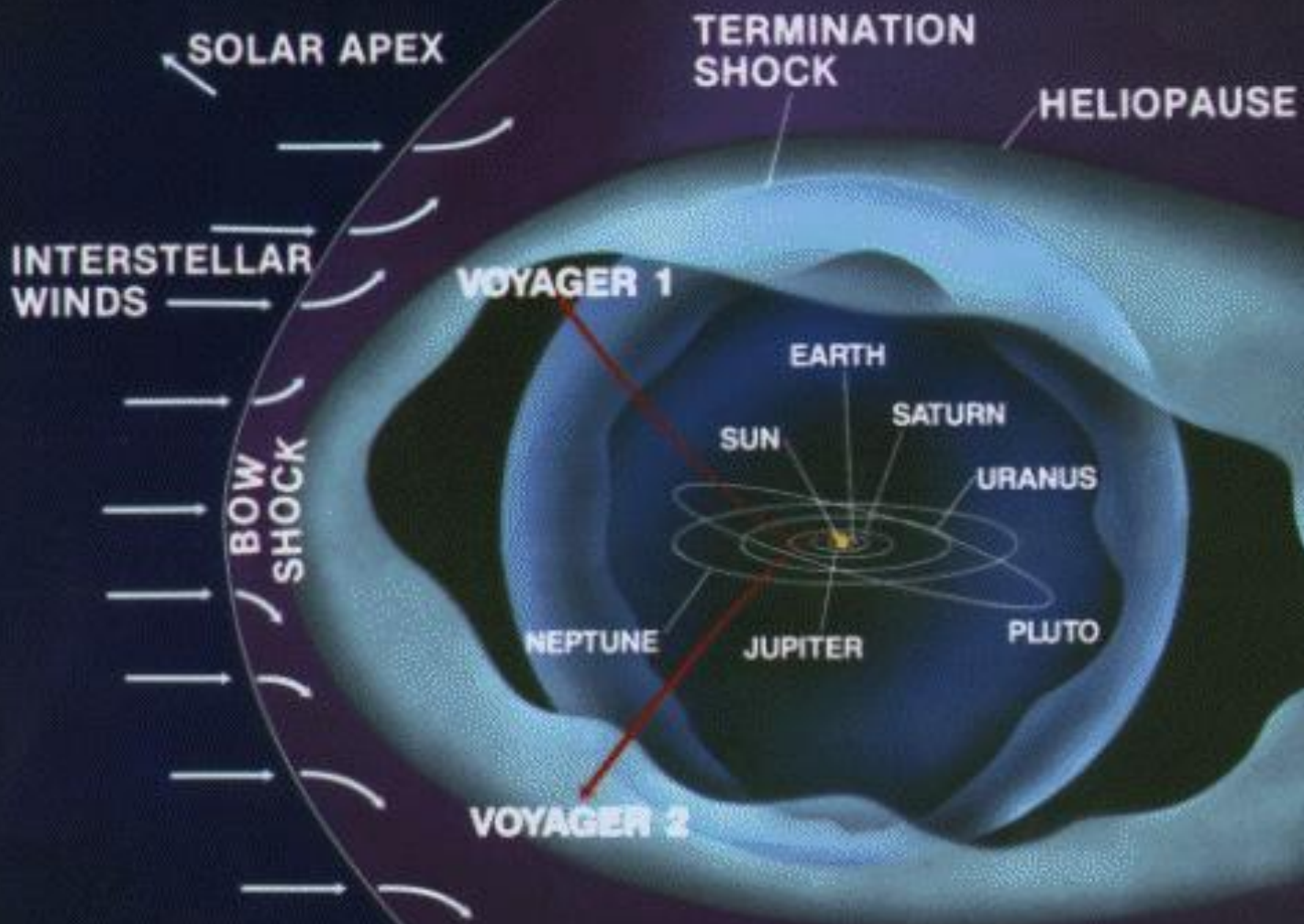
History

- Launched separately in 1977
- Took advantage of alignment of planets
- Visited: Jupiter, Saturn, Uranus & Neptune



Voyager Program

- On August 25 2012 Voyager 1 crossed into interstellar space
- Voyager 2 is expected to make the crossing in approx. 2016
- To gain speed and obtain “escape velocity” from our solar system, they used the slingshot effect around the gas giants

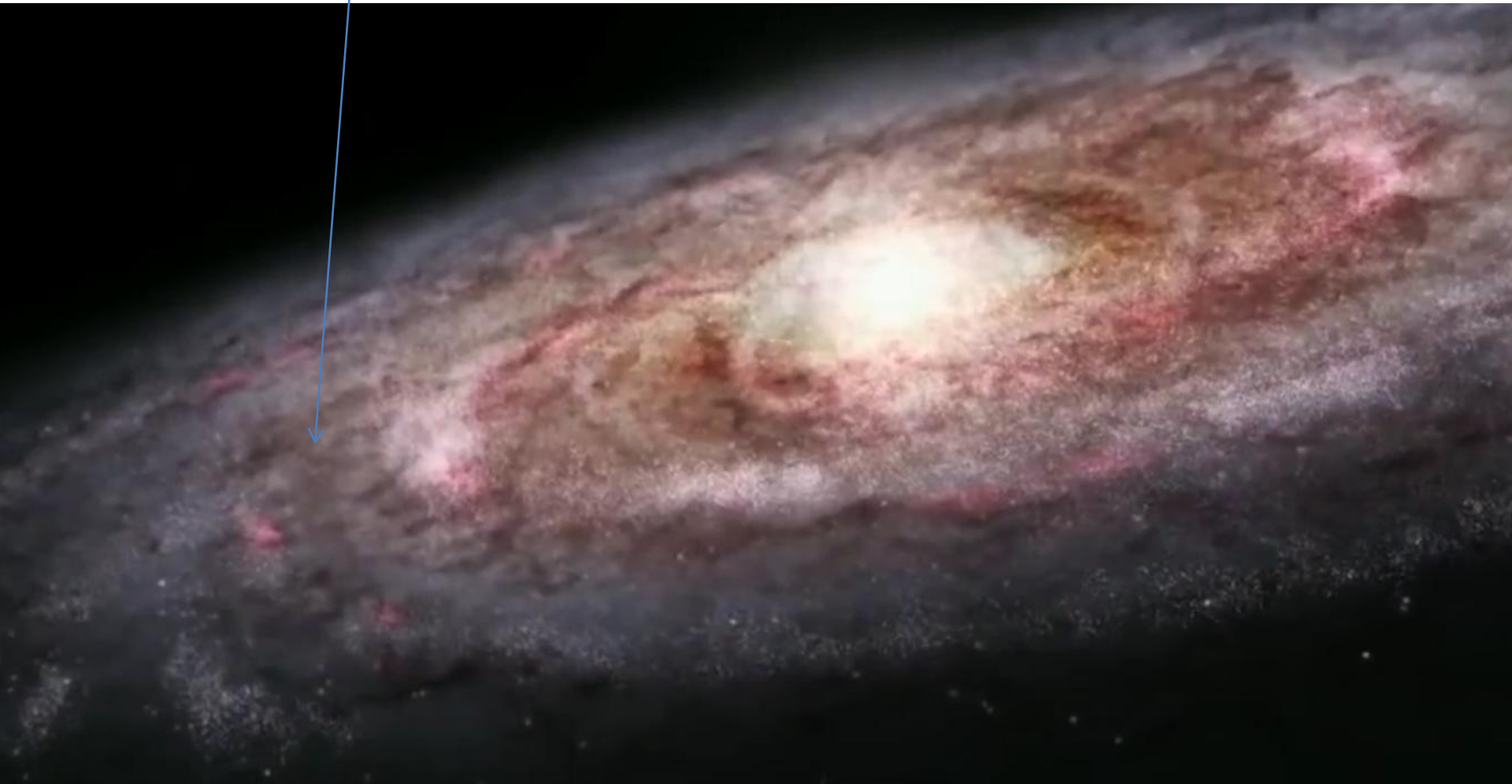


Beyond

100,000 light years

250 Million years/rotation

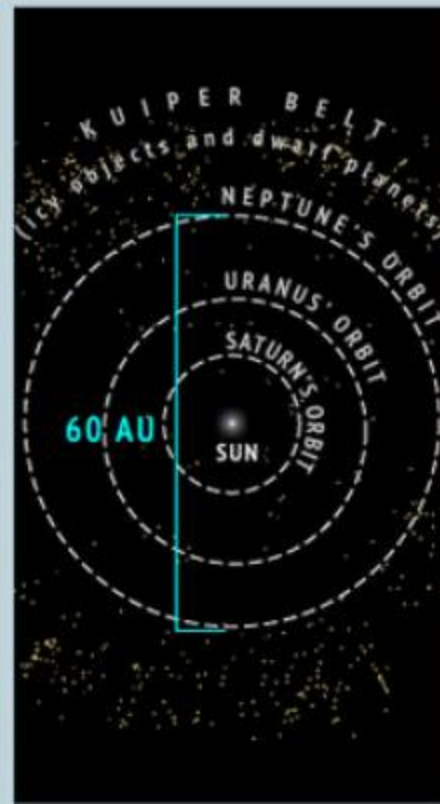
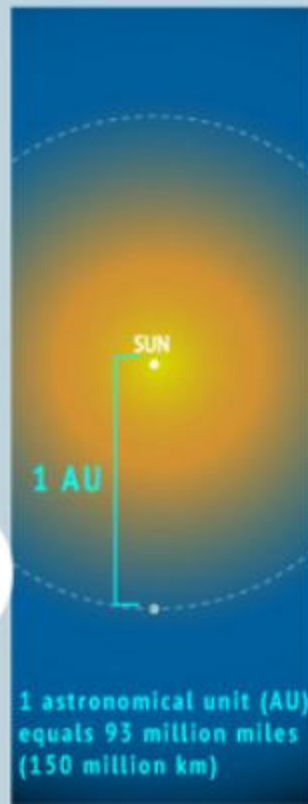
Our Solar System



Our Nearest Neighbor Star

HOW FAR TO ALPHA CENTAURI?

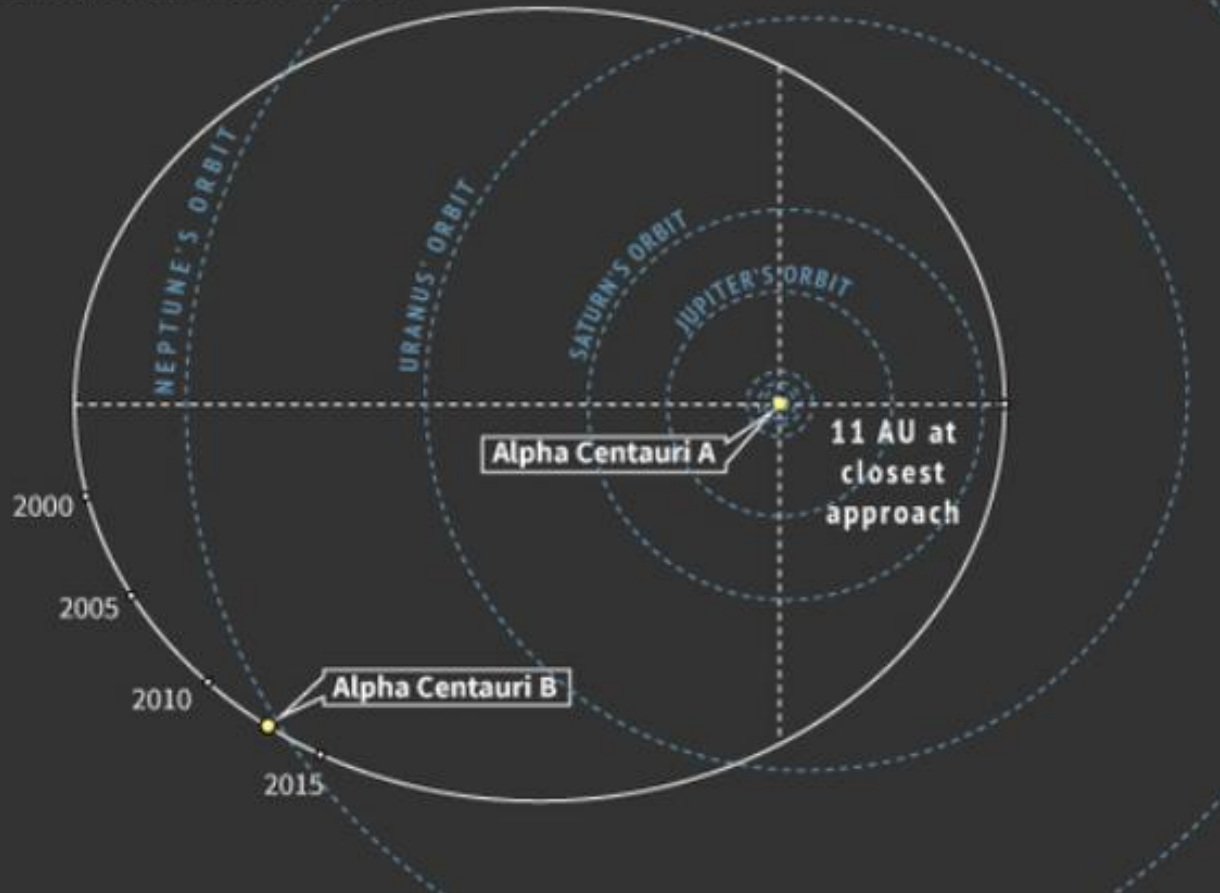
Even the closest star is more than 266,000 times farther away than our own sun. Light, the fastest thing known, takes only eight minutes to travel to us from the sun, but requires more than four years to get to the nearest star.



Nearest Star System

ALPHA CENTAURI: TWO STARS OR THREE?

Below, the Earth's solar system is overlaid on the Alpha Centauri A and B system. The B star is in an elliptical orbit that takes it to 11 astronomical units of star A every 80 Earth years. The third star, Proxima, is 15,000 AU, or nearly a quarter of a light-year, from the other two stars.



In The Beginning (almost)

