



# HOW WE MADE REWIND THE RED PLANET

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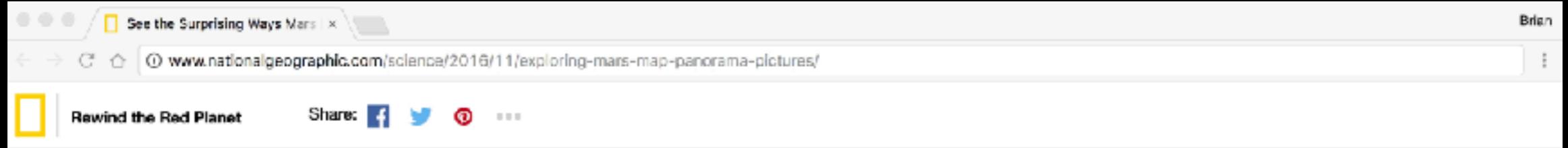
Slides here:  
<http://bit.ly/foss4mars>

DESIGN

DEVELOPMENT

EDITORIAL

DATA



# REWIND THE RED PLANET

Mars today is a chilly desert. But ancient landscapes reveal a time when water may have flowed freely. Scroll to see how the red planet has evolved.



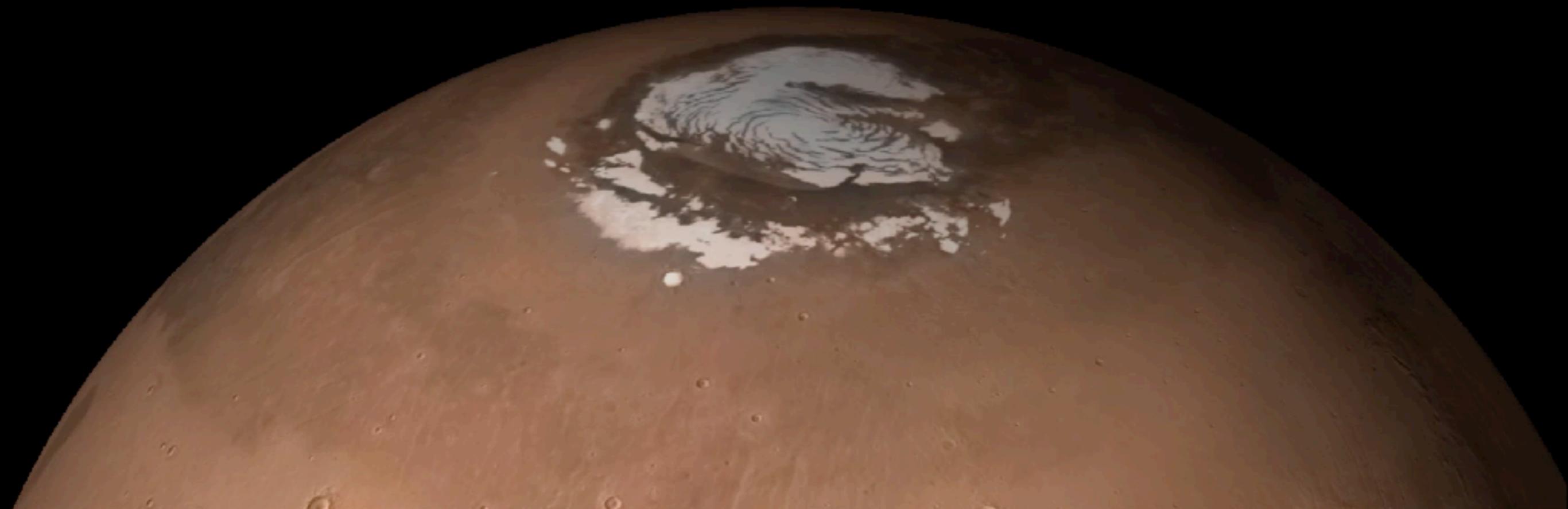


Rewind the Red Planet

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# REWIND THE RED PLANET

Mars today is a chilly desert. But ancient landscapes reveal a time when water may have flowed freely. Scroll to see how the red planet has evolved.

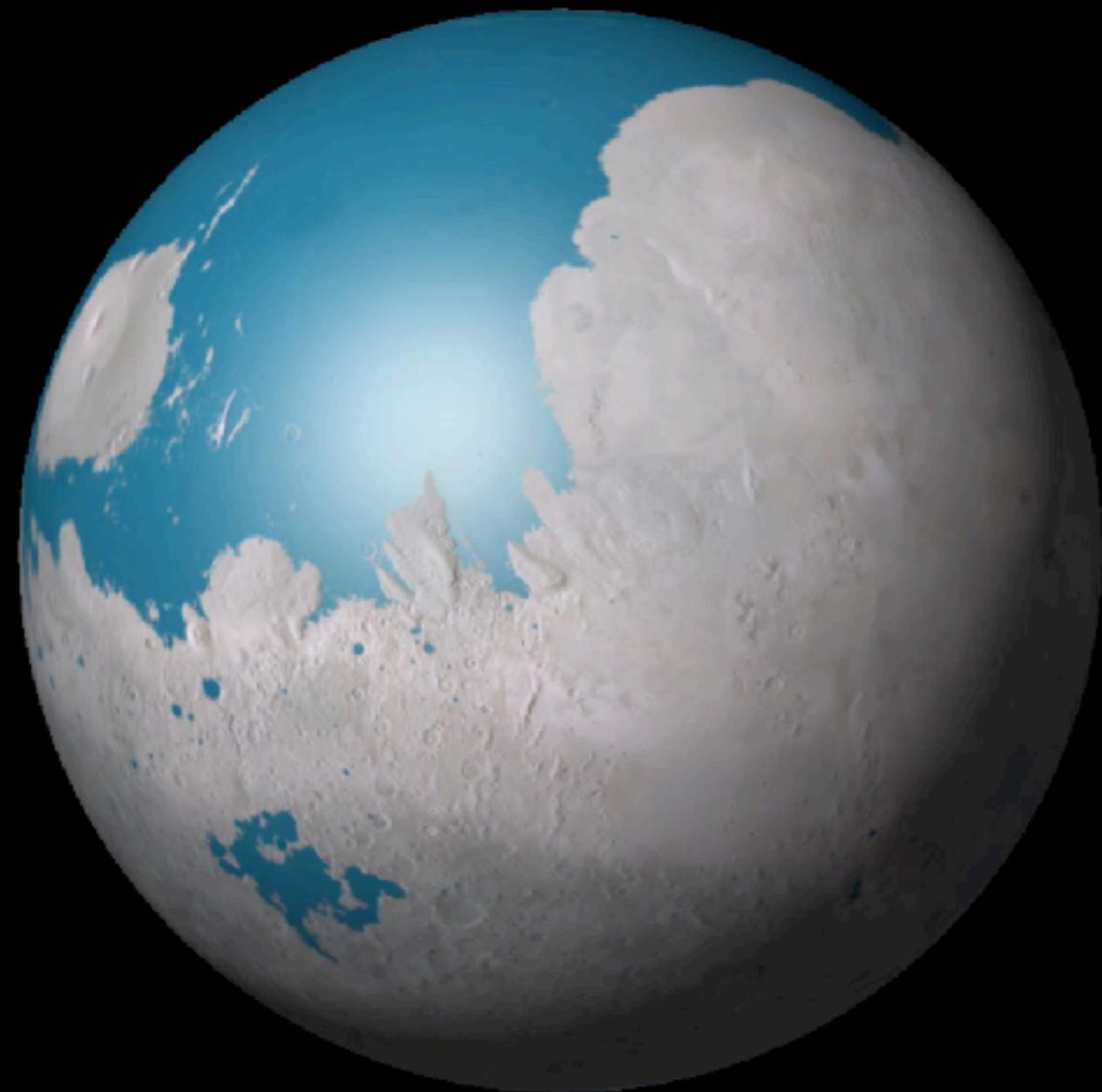




Rewind the Red Planet

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## A YOUNG WATER WORLD 3.8 BILLION YEARS AGO

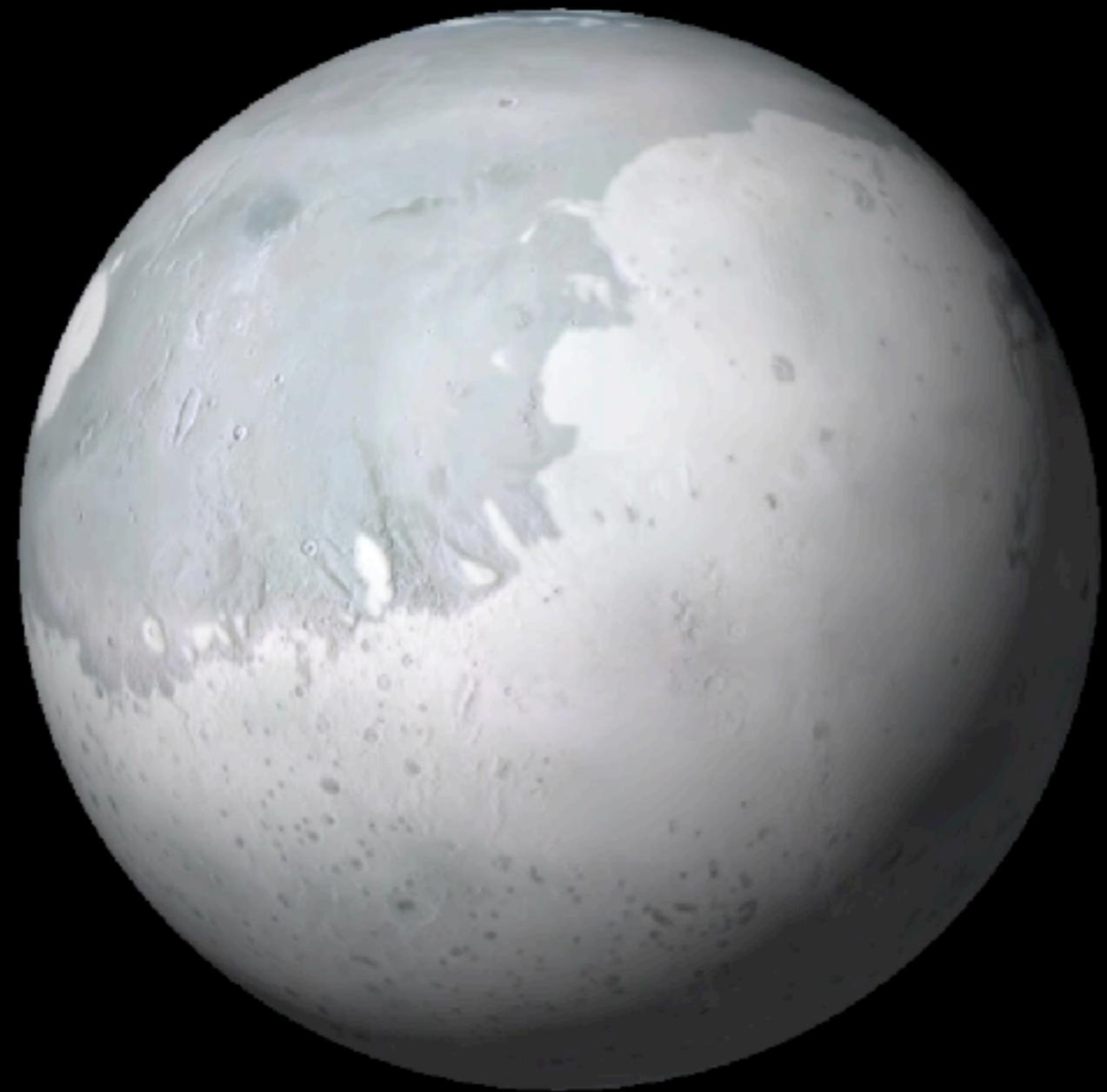




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## SNOW GLOBE HYPOTHESIS 3.8 BILLION YEARS AGO





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## BECOMING A RUSTED REALM

3.5 BILLION YEARS AGO



GALE CRATER



Rewind the Red Planet

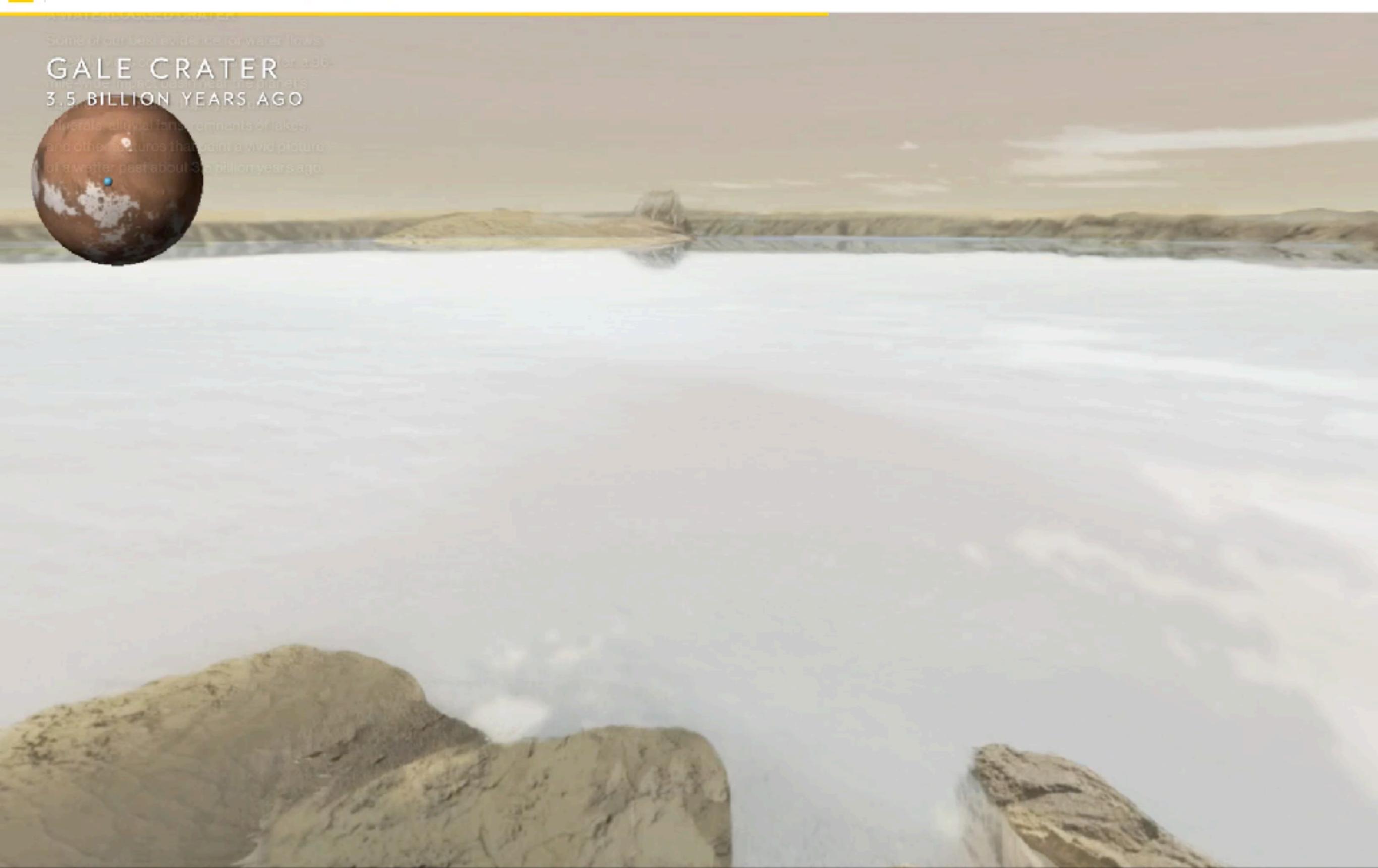
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Some of our best evidence of water flows

on Mars came from Gale Crater, or Aeolis

GALE CRATER  
3.5 BILLION YEARS AGO

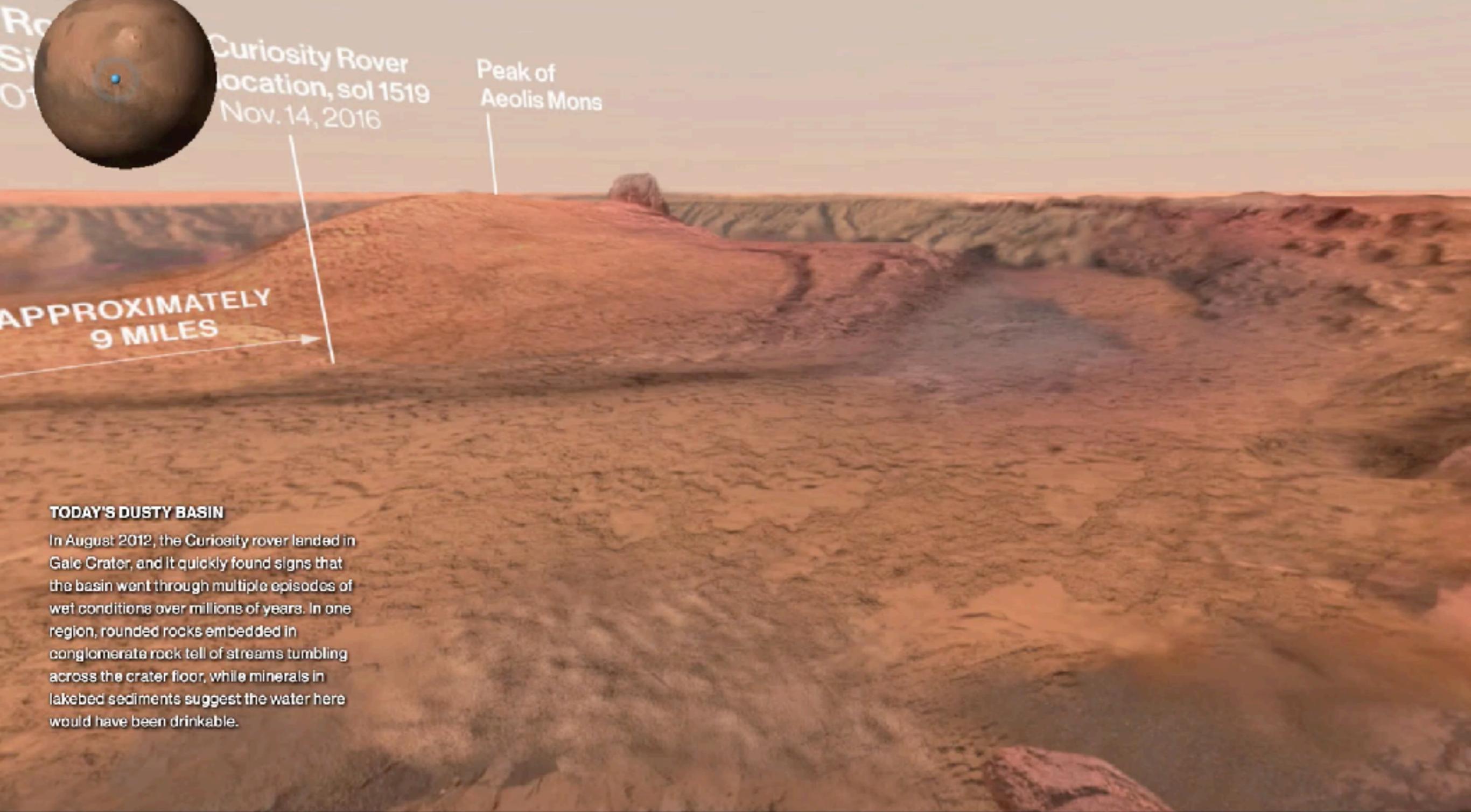
After a massive impact basin near the planet's equator, ancient rivers, canyons, and lakes, and other features that paint a vivid picture of a wetter past about 3.5 billion years ago.





## GALE CRATER

TODAY



## TODAY'S DUSTY BASIN

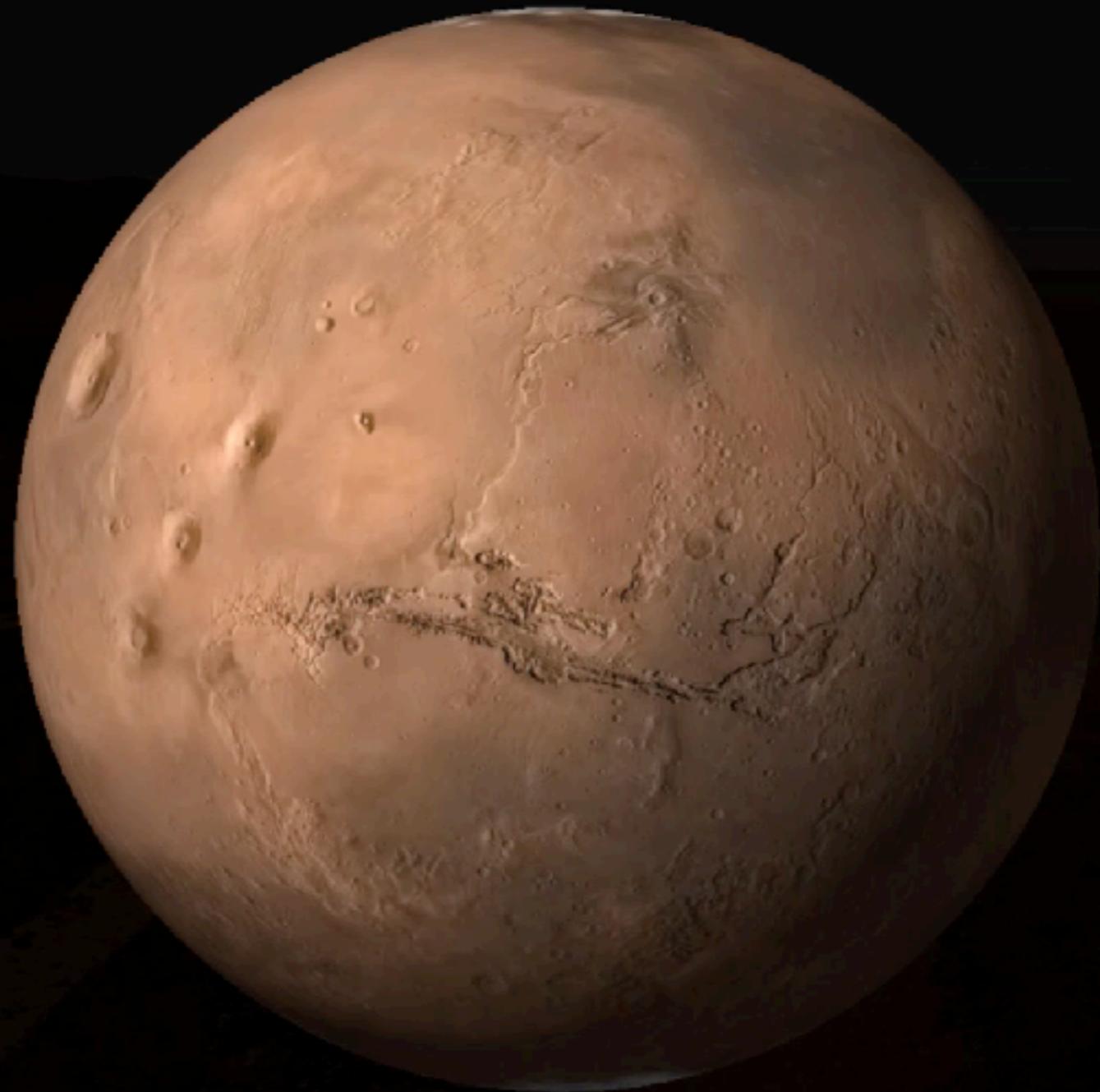
In August 2012, the Curiosity rover landed in Gale Crater, and it quickly found signs that the basin went through multiple episodes of wet conditions over millions of years. In one region, rounded rocks embedded in conglomerate rock tell of streams tumbling across the crater floor, while minerals in lakebed sediments suggest the water here would have been drinkable.



Rewind the Red Planet

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## THE RED PLANET TODAY



# **ACQUIRE KNOWLEDGE/DATA**

## **READING, REPORTING, RESEARCH**

Bethany Ehlmann, NASA JPL California Institute of Technology

Robin Wordsworth, Harvard University

Caleb Fassett, NASA Marshall Space Flight Center

Tim Goudge, The University of Texas at Austin

**CREATE A NARRATIVE**

**LOFI/HIFI DESIGNS**

**COMMISSION ILLUSTRATIONS**

**RESEARCH TECHNOLOGY**

**PROTOTYPE**

# TOOLS

## SCRAWLER

<https://github.com/cy-park/Scrawler>

## GREENSOCK ANIMATION PLATFORM

<https://greensock.com/gsap>

## THREE.JS

<https://threejs.org/>

1

Scrawler tracks box

40%

100%

0%

2

GSAP

TimelineLite  
tweens values

0%

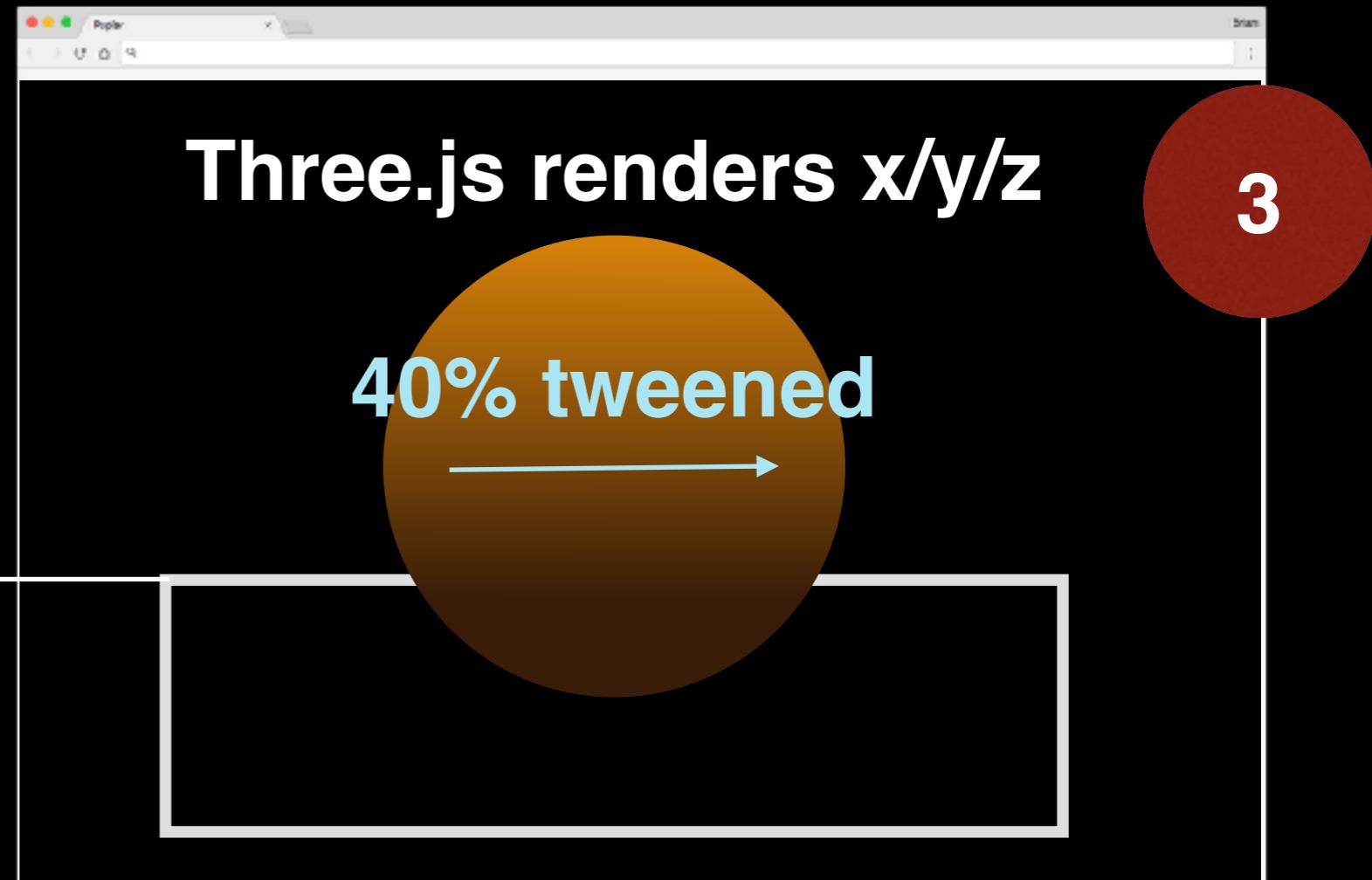
x: 0  
y: 0  
z: 0

40%

x: 0  
y: 40  
z: 40

100%

x: 0  
y: 100  
z: 100



## Western Hemisphere

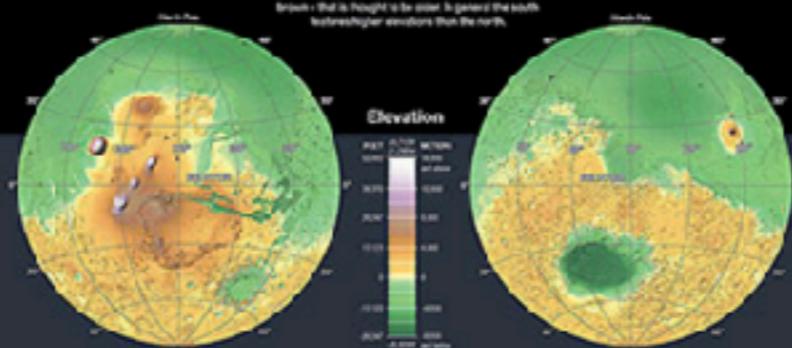
# MARS

## Eastern Hemisphere

For centuries Mars has stalked earthly imaginations, tantalizing storywriters and scientists with the prospect of extraterrestrial life. Before the space age the planet was thought to be Earthlike—a potential home to civilization. But as technology improved, a hot, dry world came into focus. Shrouded by a thin atmosphere of carbon dioxide, the inhospitable surface is one of the most rugged in the solar system.

## A Tale of Two Territories

## **Fourth Rock From the Sun**



Missed Opportunities



**Phobos**  
This irregularly shaped moon circles Mars three times a day, orbiting 3,700 miles, sometimes passing just outside its parent's equator as it moves at a remarkable speed of 12.8 miles per second.

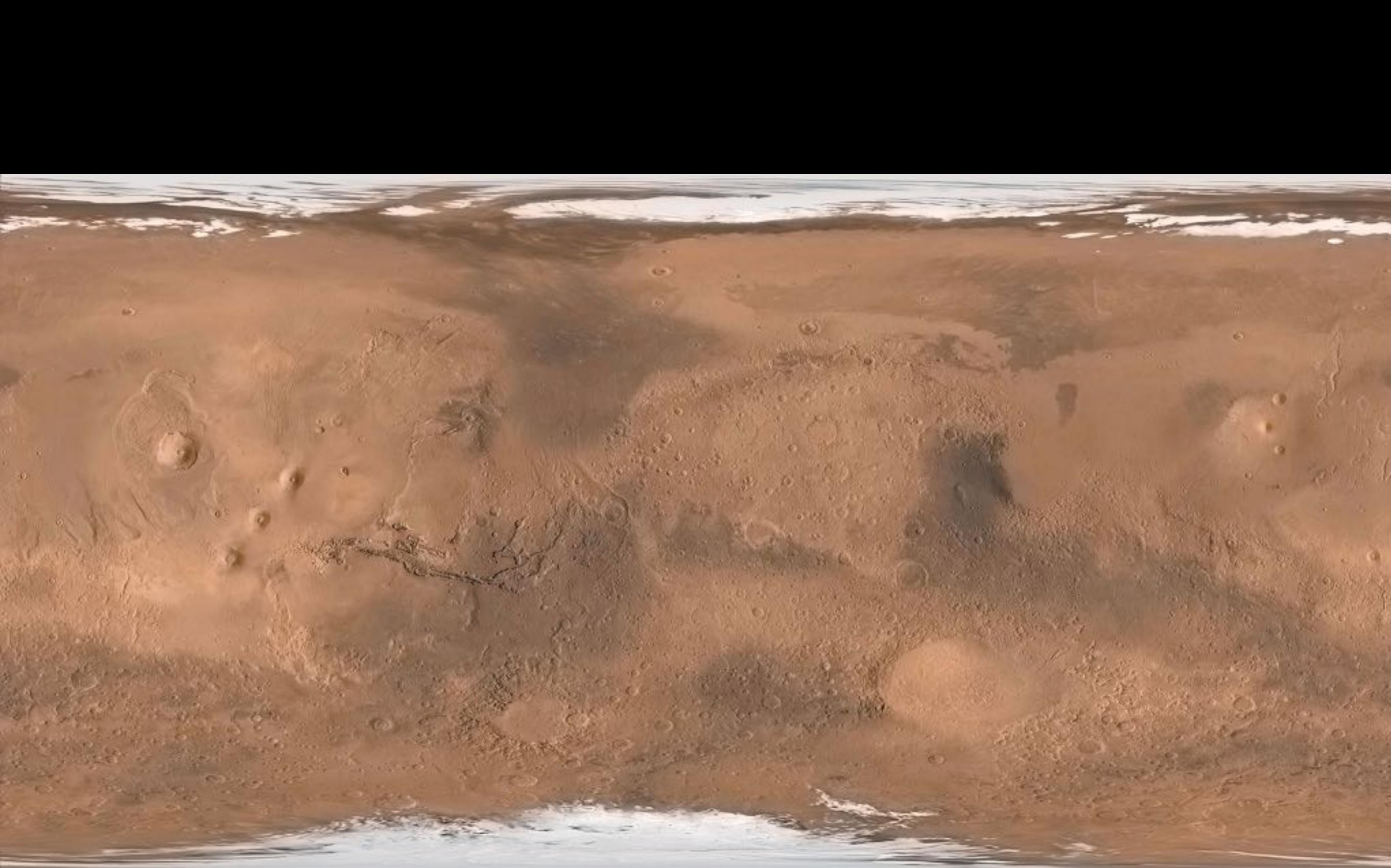


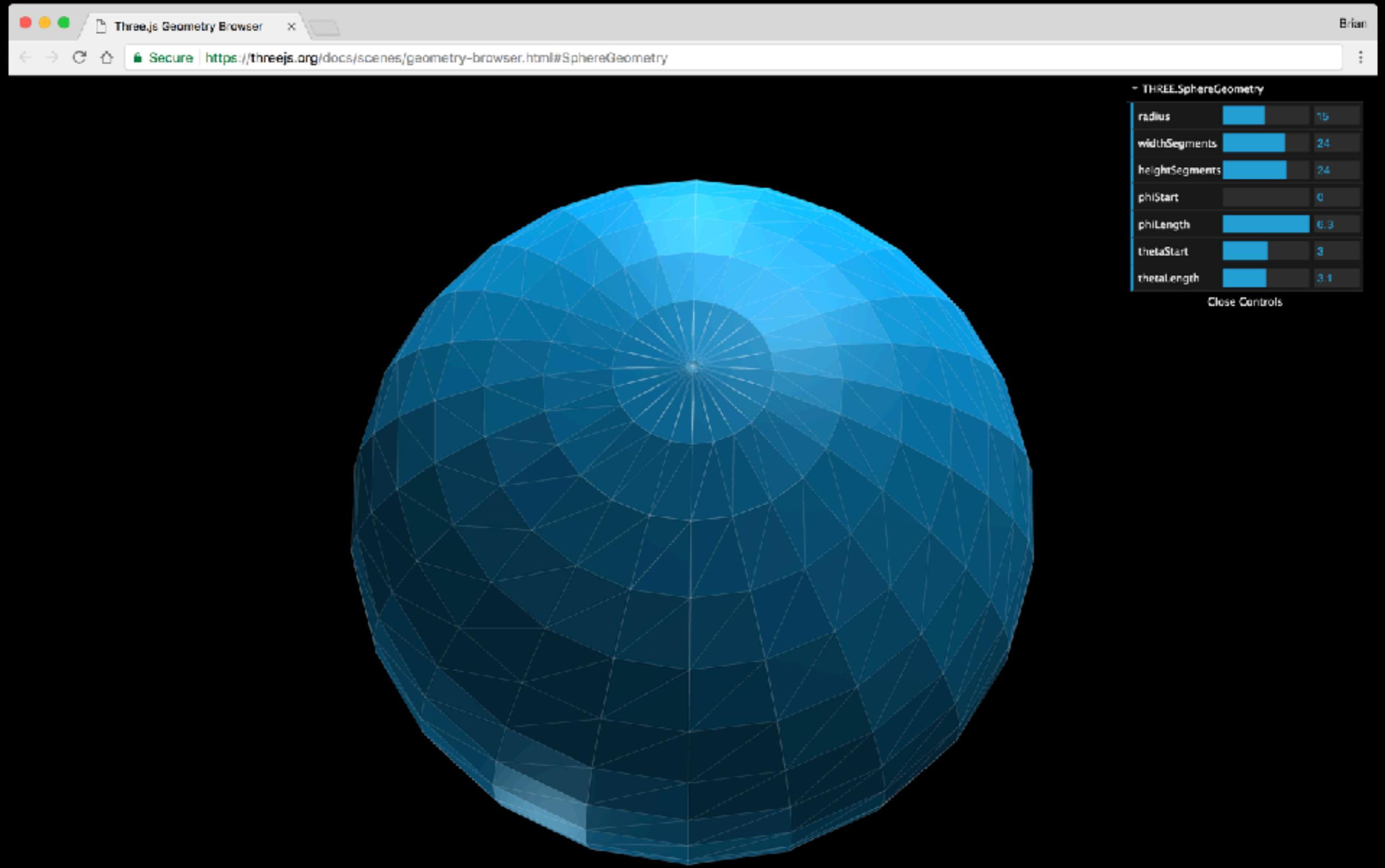
### **Business**

Average distance from the sun	101,435,750 mi (167,047,000 km)
(Spiral arm)	103,475,000 mi (166,500,000 km)
At the equator	100,000,000 mi (160,000,000 km)
At the poles	101,435,750 mi (167,047,000 km)
Length of year	365.256 days
Average orbital velocity	65,495 (10.7 km/sec)
Average temperature	57° F (13.9° C)
Diameter of the Sun	864,960 miles (1,391,000 km)
Distance from the Sun to the center of the galaxy	4,235 mi (6,800 km)
Mass of Earth	5.97 x 10 <sup>24</sup> kg
Gravity	34.4 m/s <sup>2</sup> (3.7 g-weight)
Surface gravity (Earth)	9.81 m/s <sup>2</sup> (1 g-weight)
Airline ticket	\$17
Around the world	\$17

NUTRITION  
GARCONNE







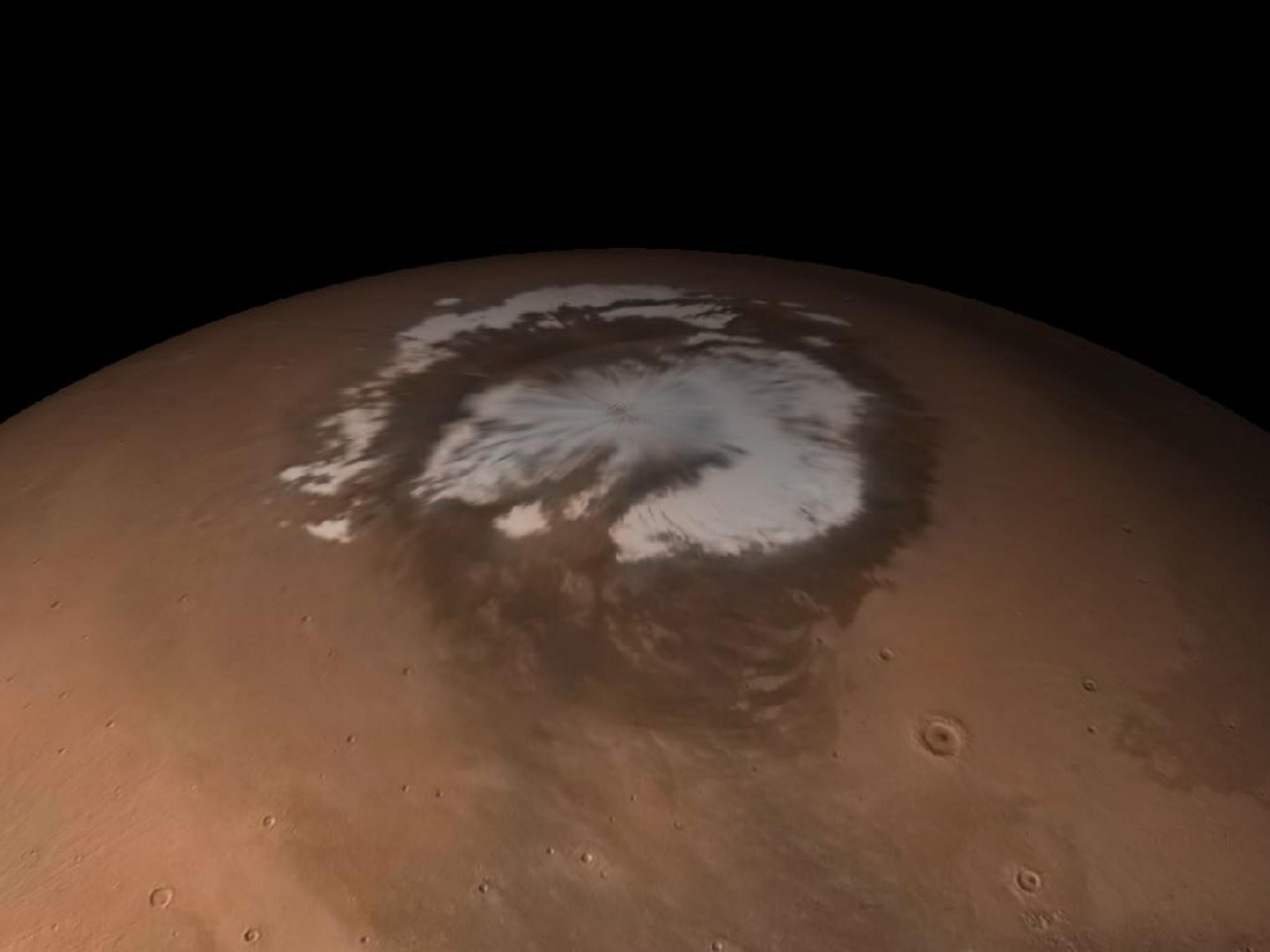
[Open in New Window](#)

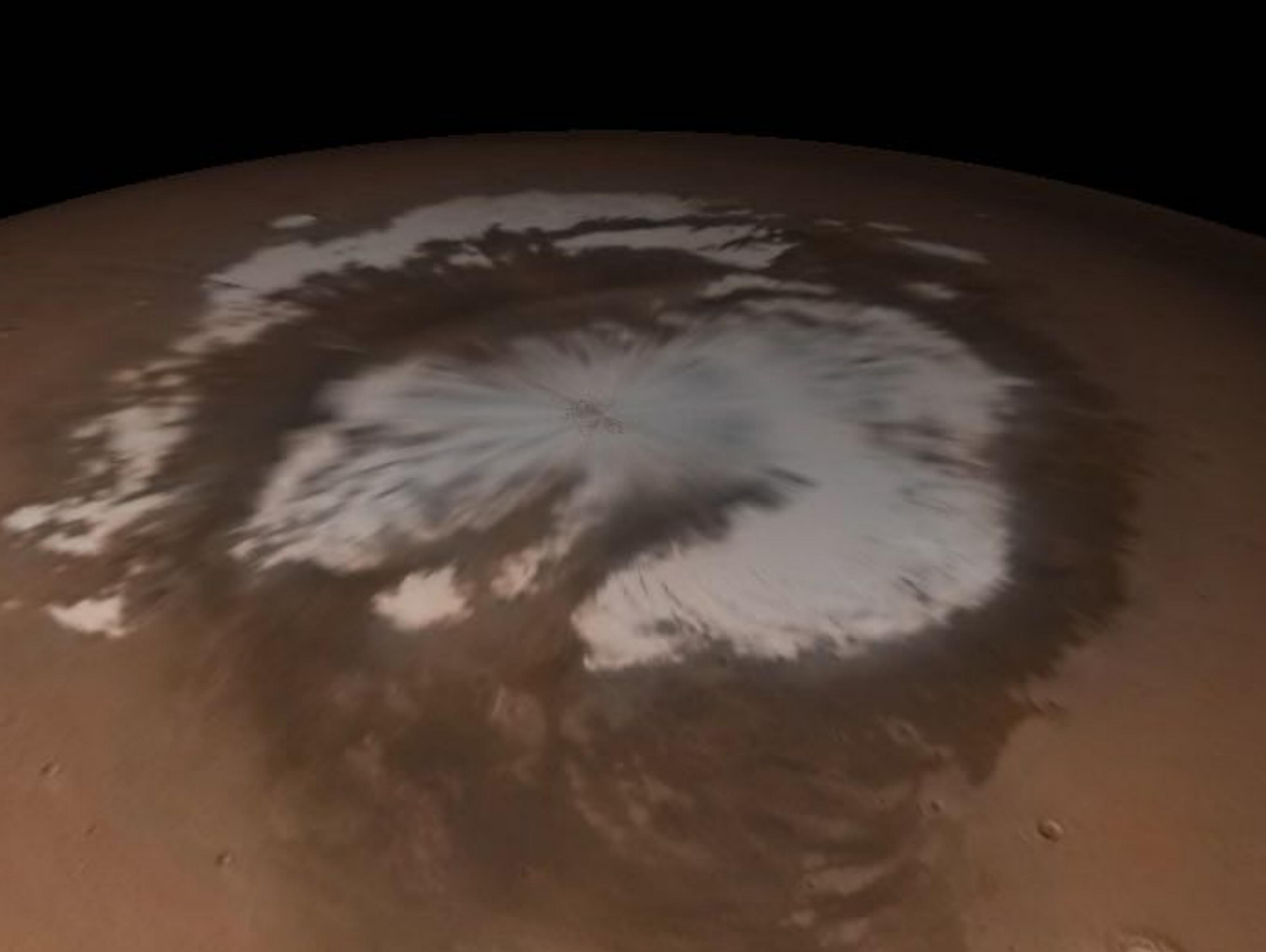
<https://threejs.org/docs/scenes/geometry-browser.html#SphereGeometry>

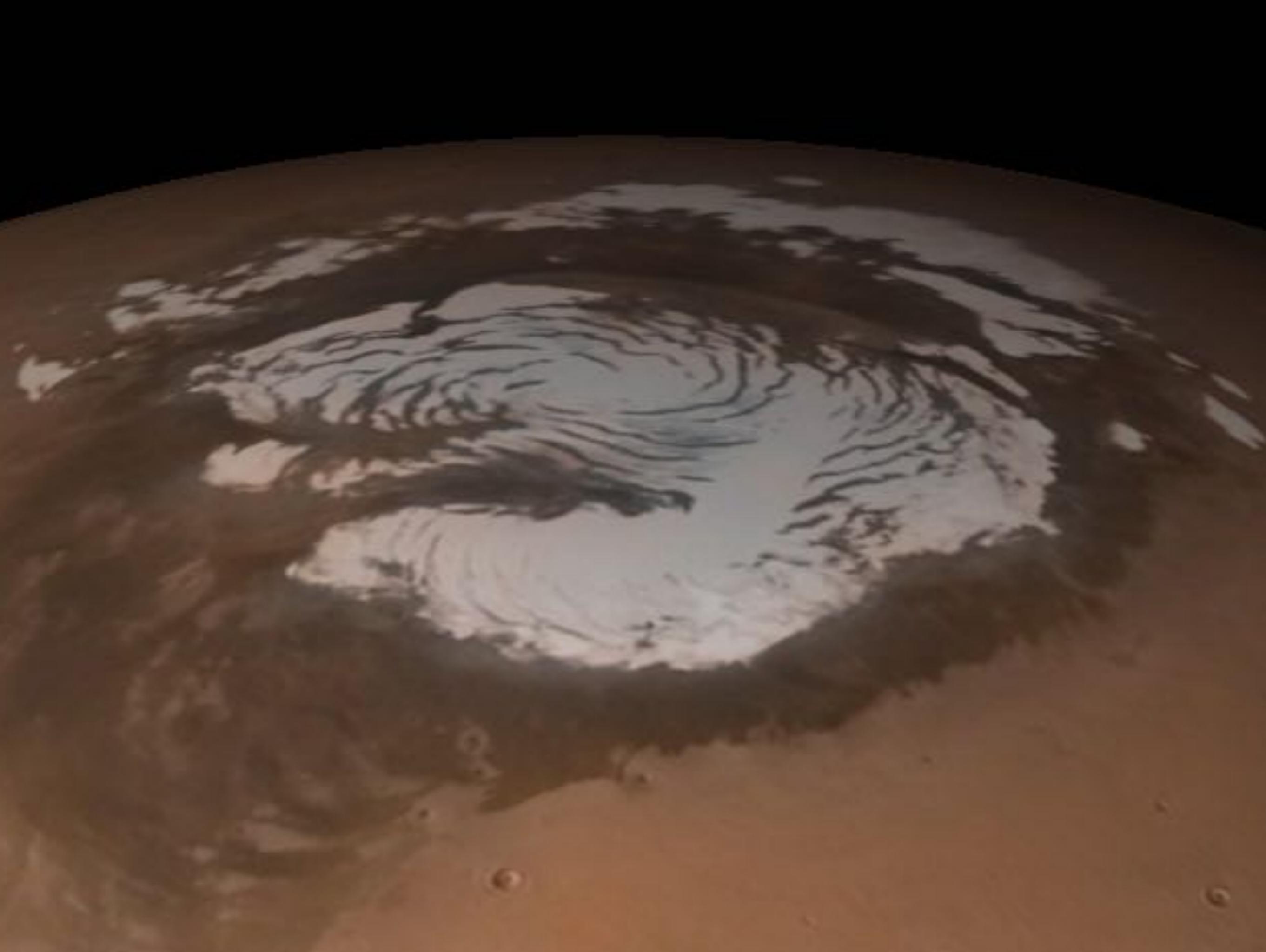
[WebGL](#) is a JavaScript API for rendering interactive 3D graphics in [modern web browsers](#) without the use of plug-ins. [Three.js](#) is built on top of WebGL, and allows you to create complex 3D scenes with a few lines of JavaScript.. If your browser supports WebGL you should see a rotating Earth below:

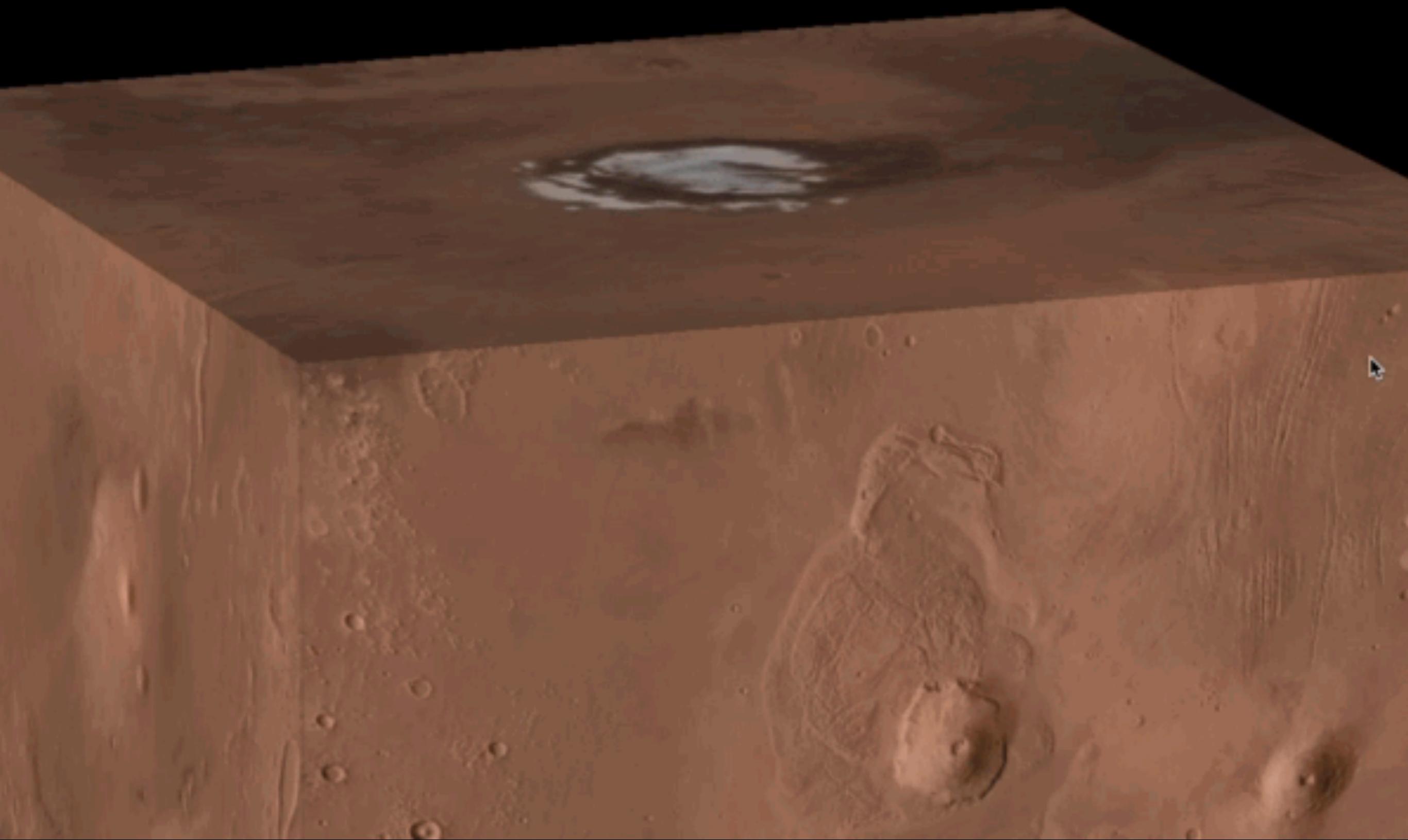


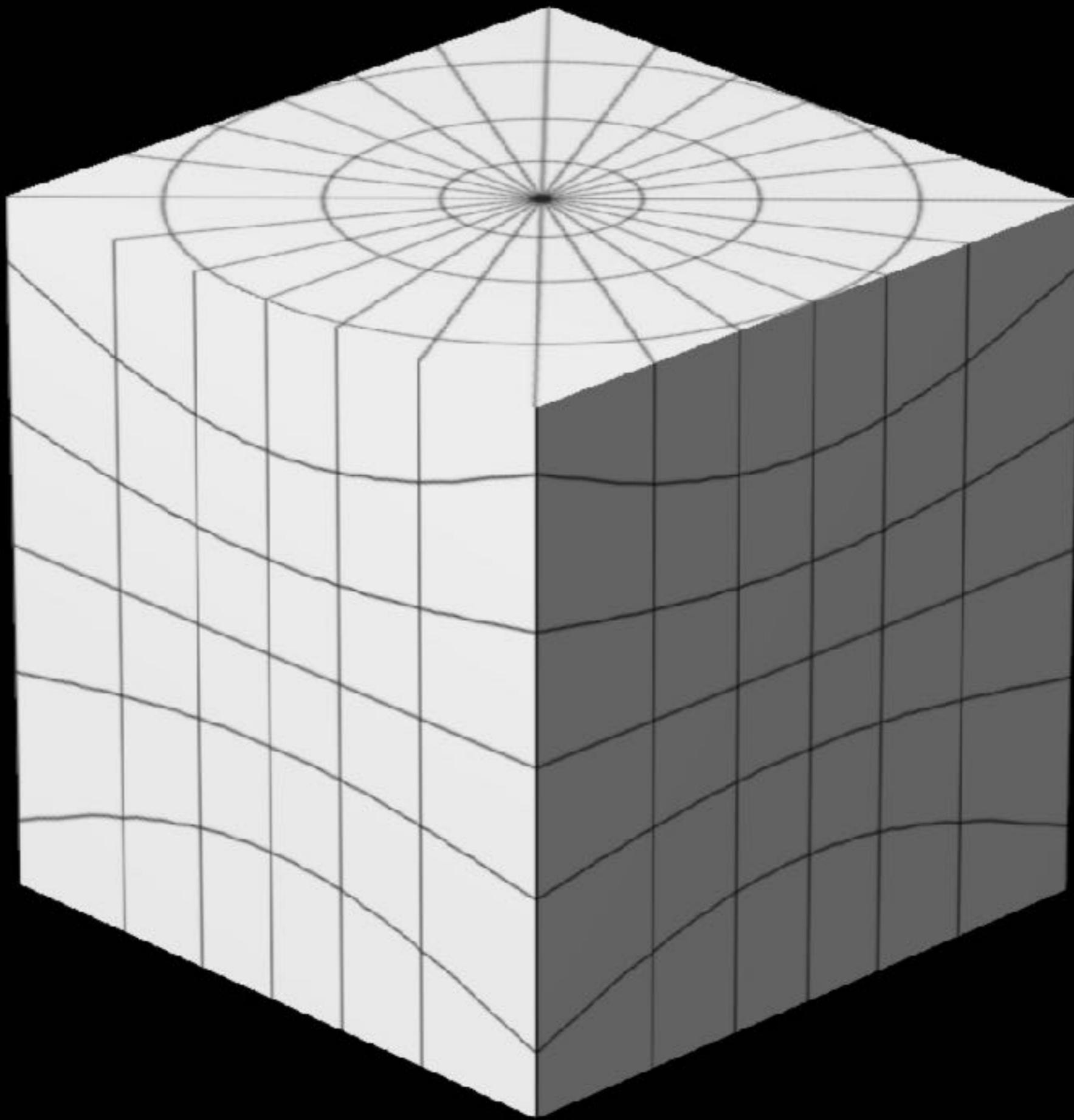
[ [Fullscreen](#) ]

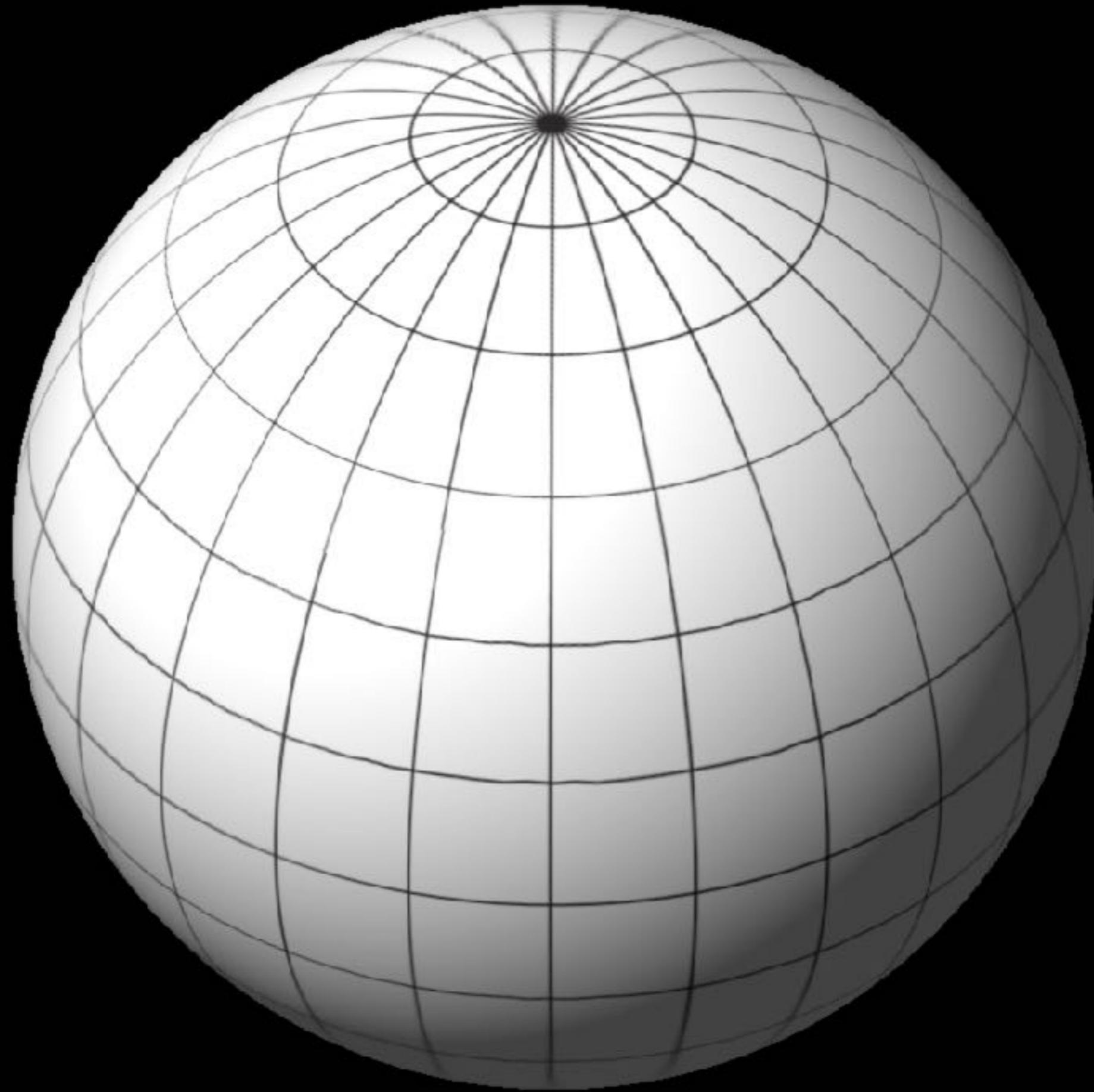




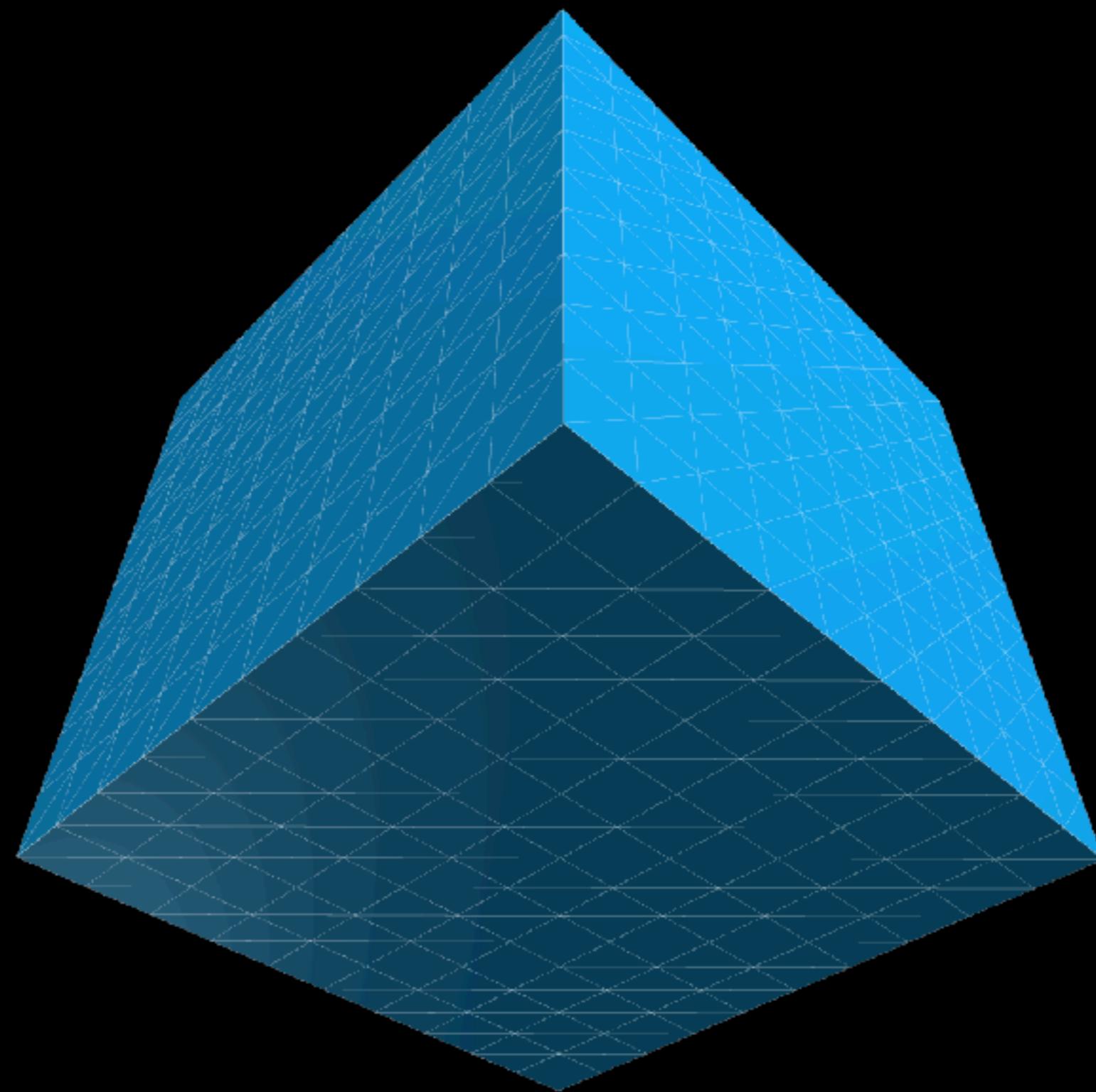


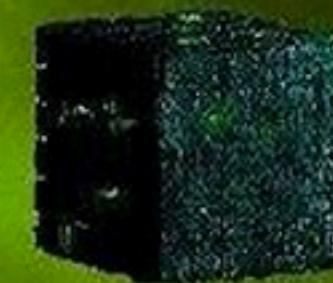
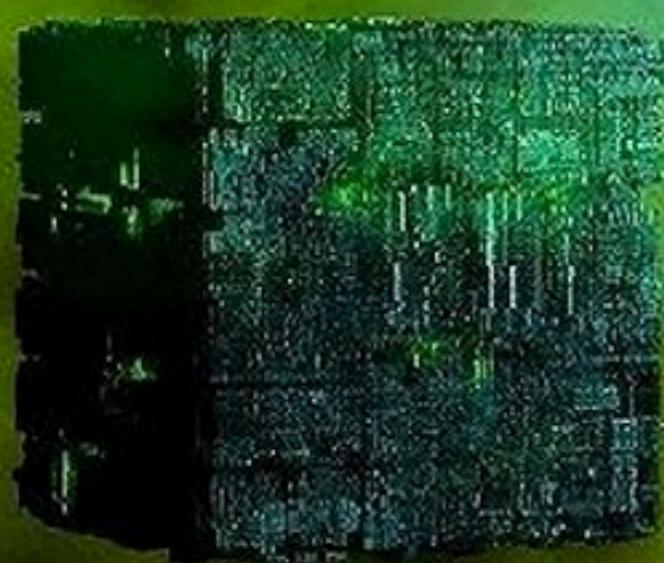
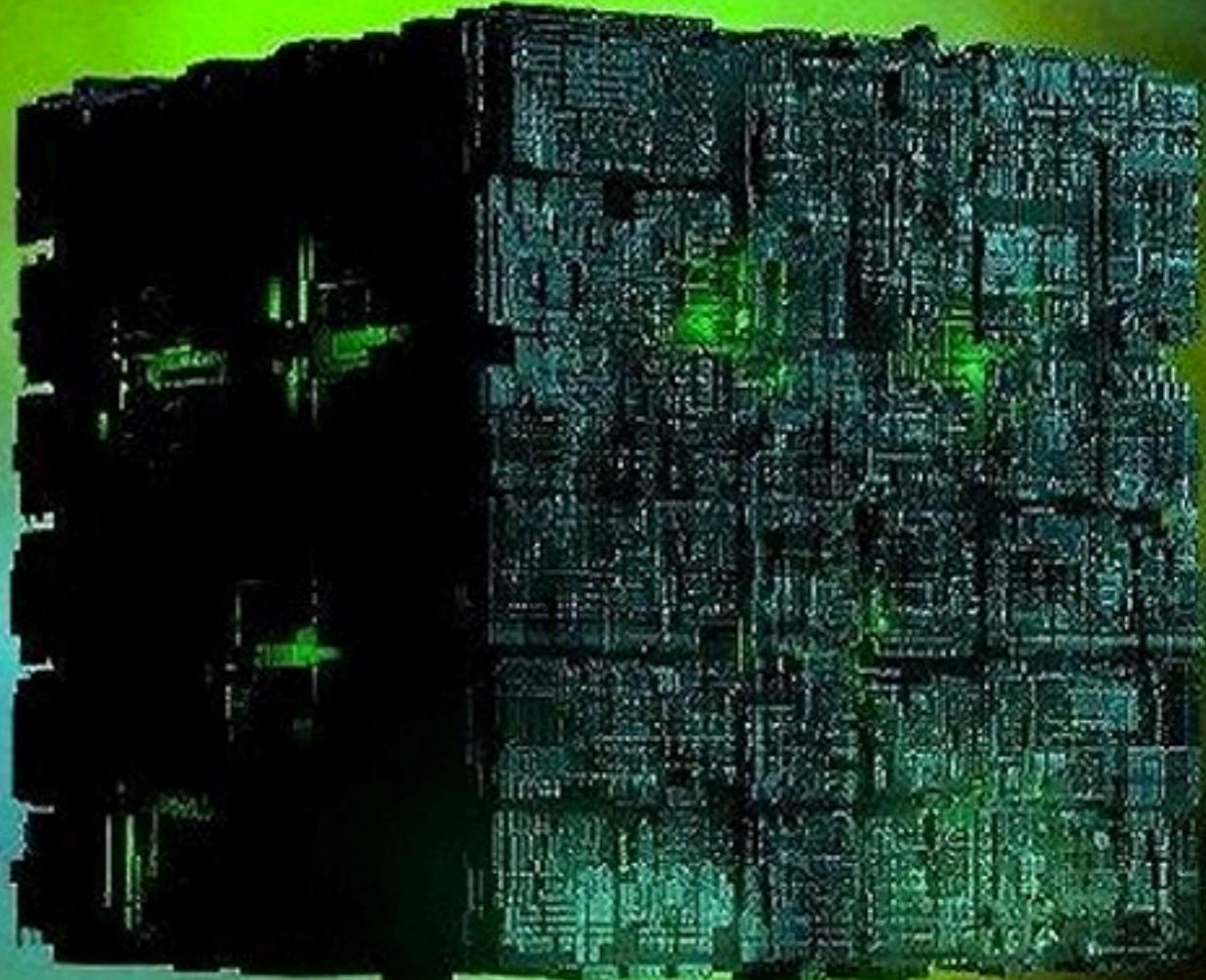
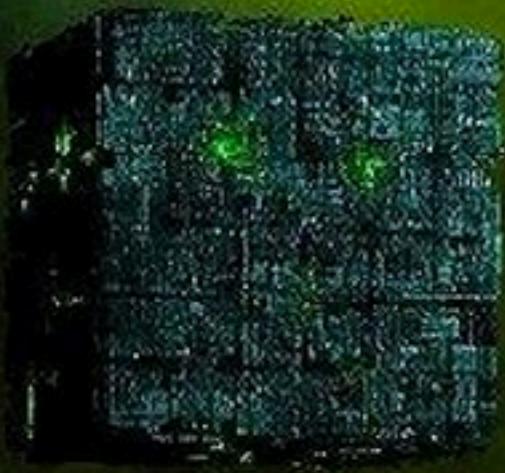


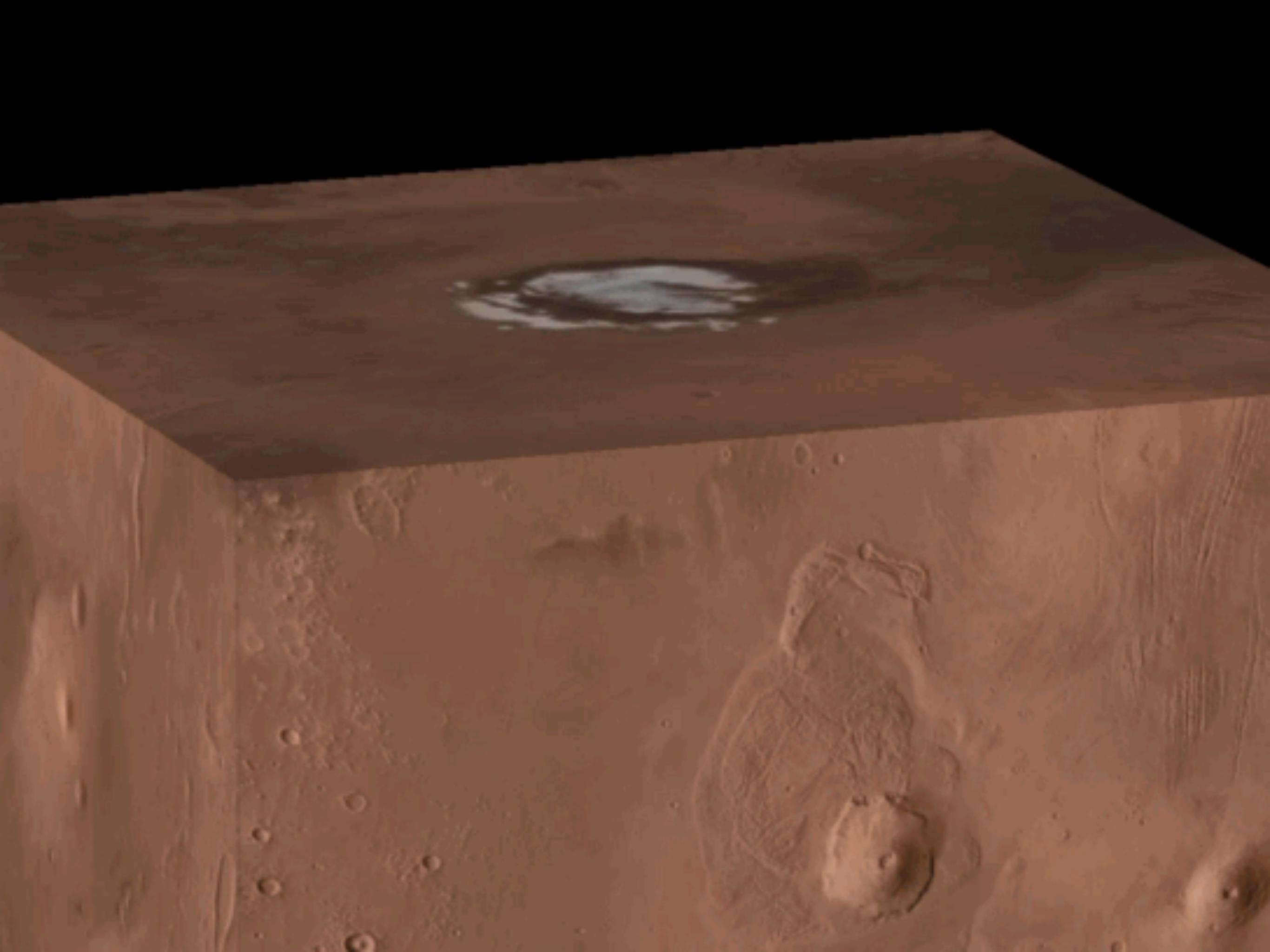


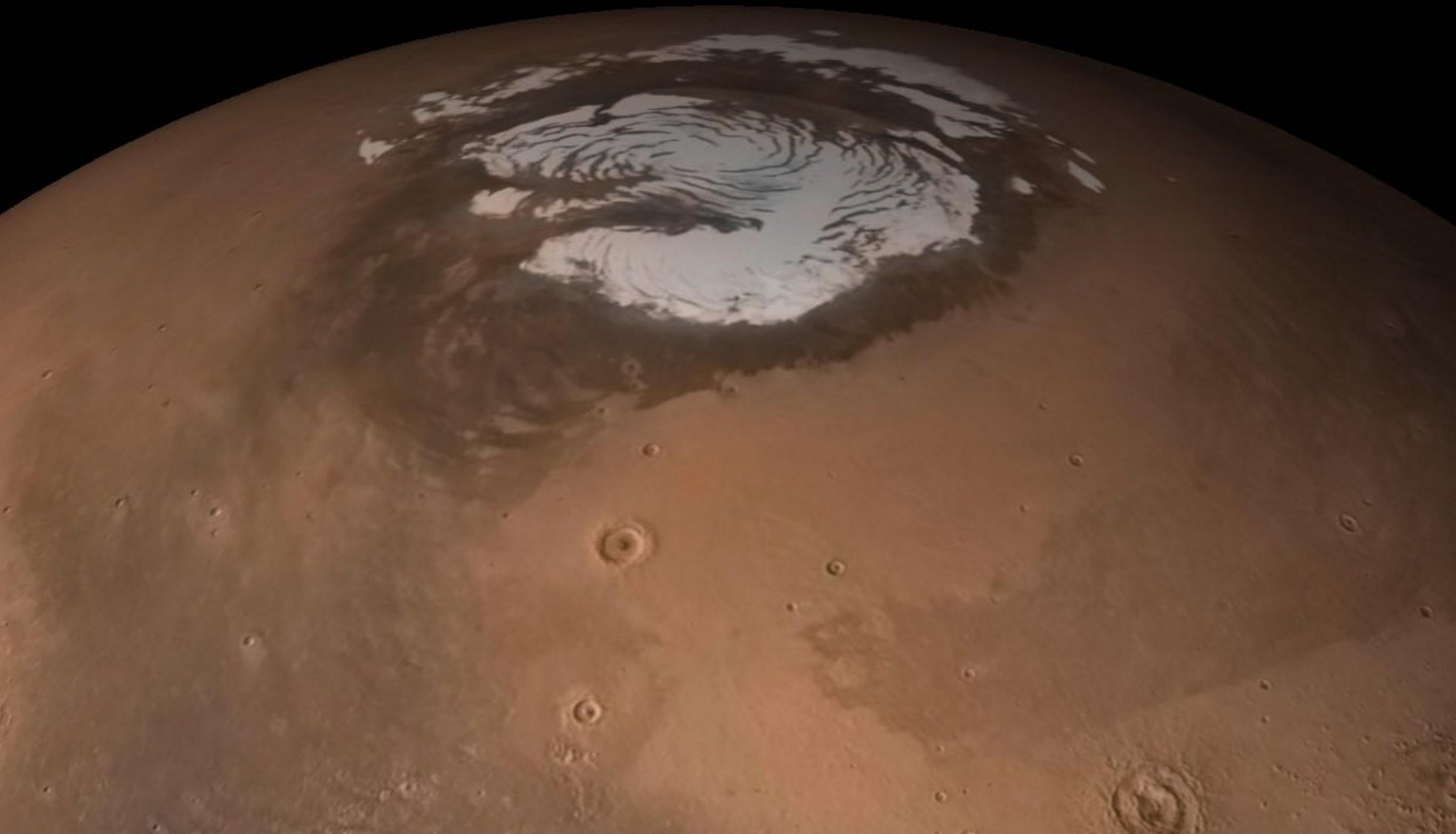




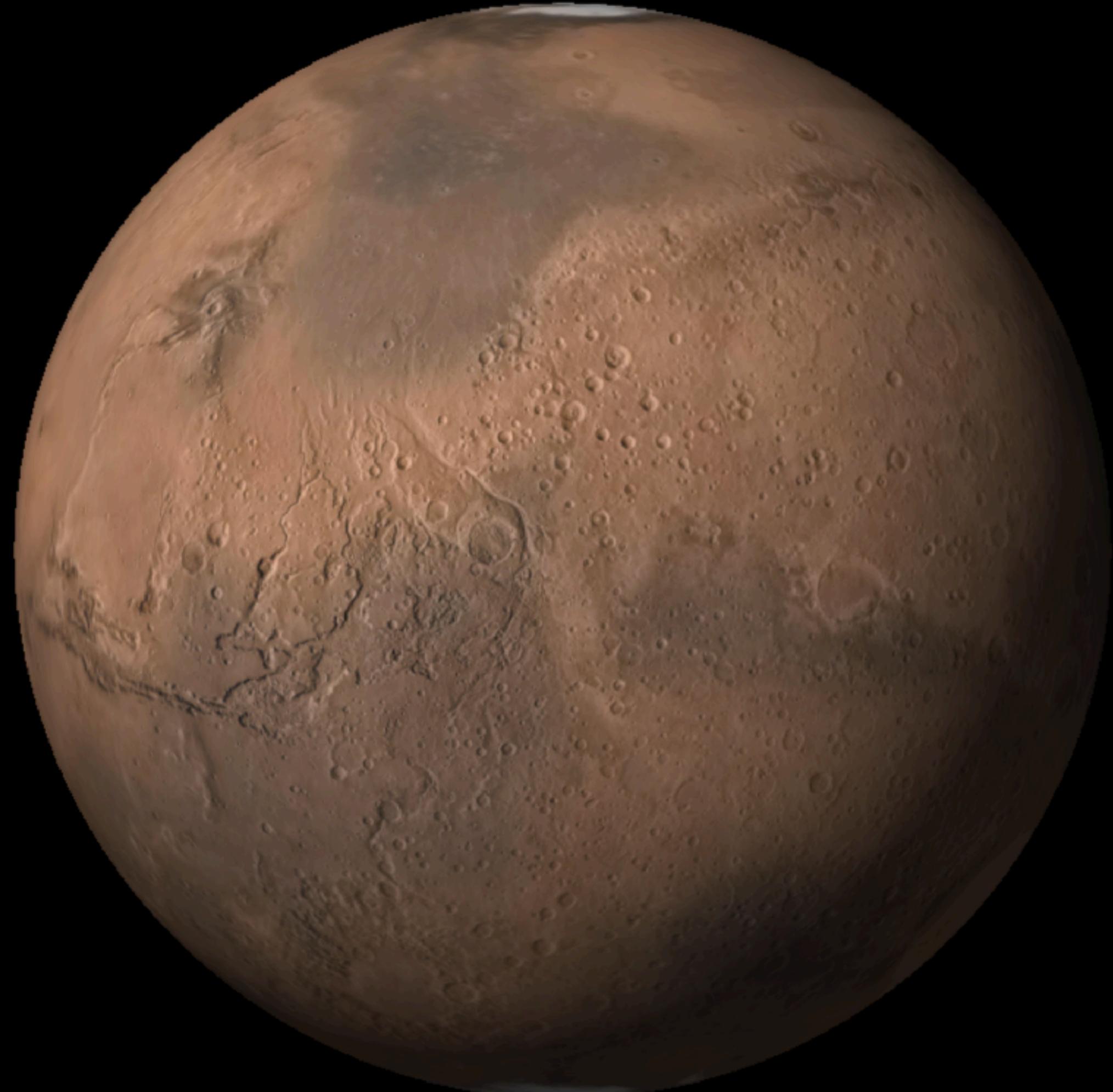








AGU





briantjacobs / cubeSphere-example.js

Last active 5 minutes ago

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0

[Code](#)[Revisions 5](#)[Embed](#) ▾

&lt;script src="https://gist.

[Download ZIP](#)

Create 6 gnomonic cube faces from a WGS84 input geotiff, render in three.js

# SCRIPTS TO DO THIS

[cubeSphere-example.js](#)[Raw](#)

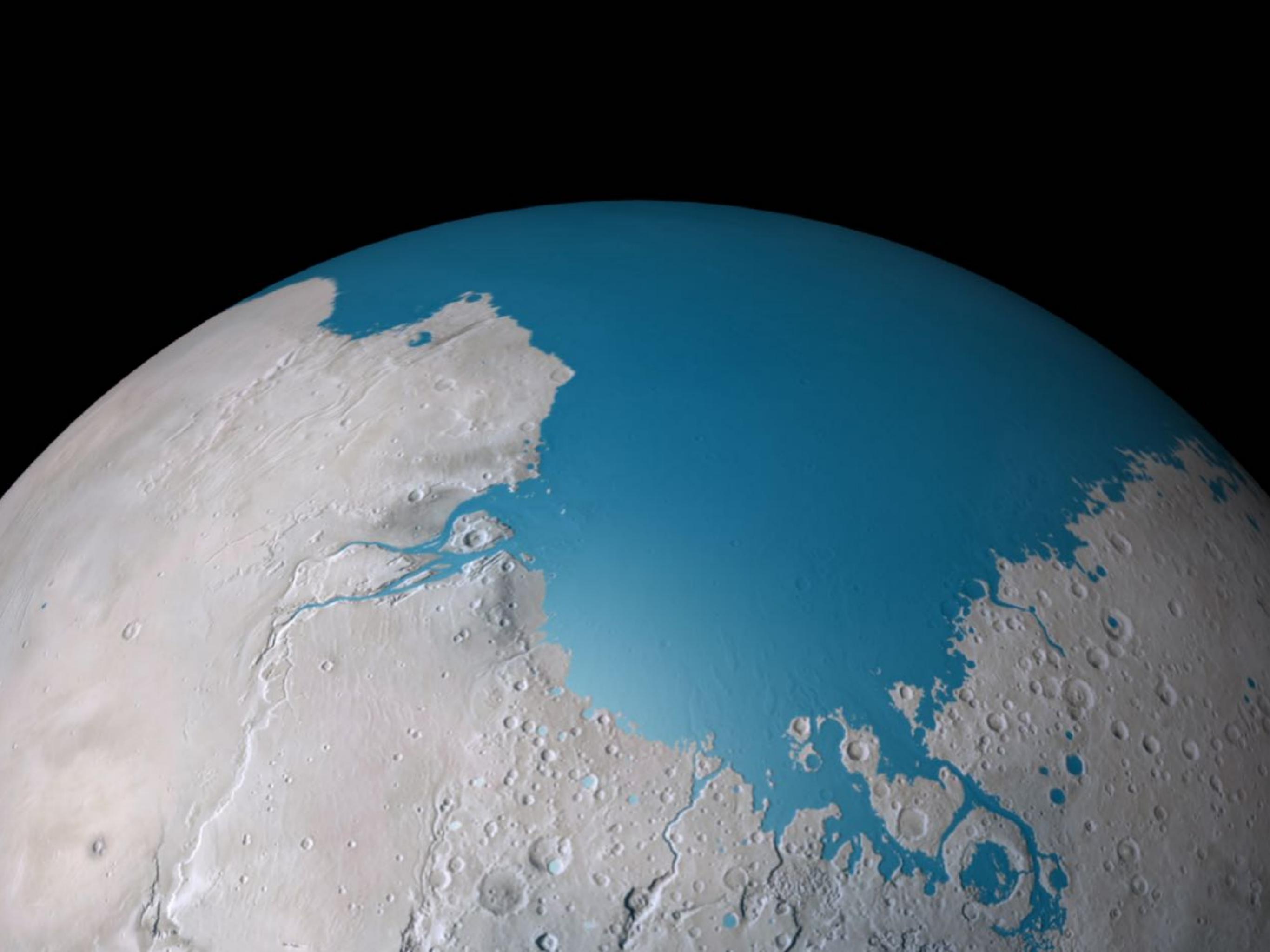
```
1 var cubeSphere = new CubeSphere({
2     parent: PARENT, // scene or Object3D
3     scale: 1, // in case scaling according to other objects in scene
4     radius: 5, // size of sphere
5     textureFace0: new THREE.TextureLoader().load('cubeFace0.jpg'),
6     textureFace1: new THREE.TextureLoader().load('cubeFace1.jpg'),
7     textureFace2: new THREE.TextureLoader().load('cubeFace2.jpg'),
8     textureFace3: new THREE.TextureLoader().load('cubeFace3.jpg'),
9     textureFace4: new THREE.TextureLoader().load('cubeFace4.jpg'),
10    textureFace5: new THREE.TextureLoader().load('cubeFace5.jpg'),
11    textureFace6: new THREE.TextureLoader().load('cubeFace6.jpg')
12 }
13 )
14 }
```

Python/GDAL script to automate face creation  
three.js snippets to render the faces and inflate

<https://github.com/briantjacobs/foss4g-2017-talk/>

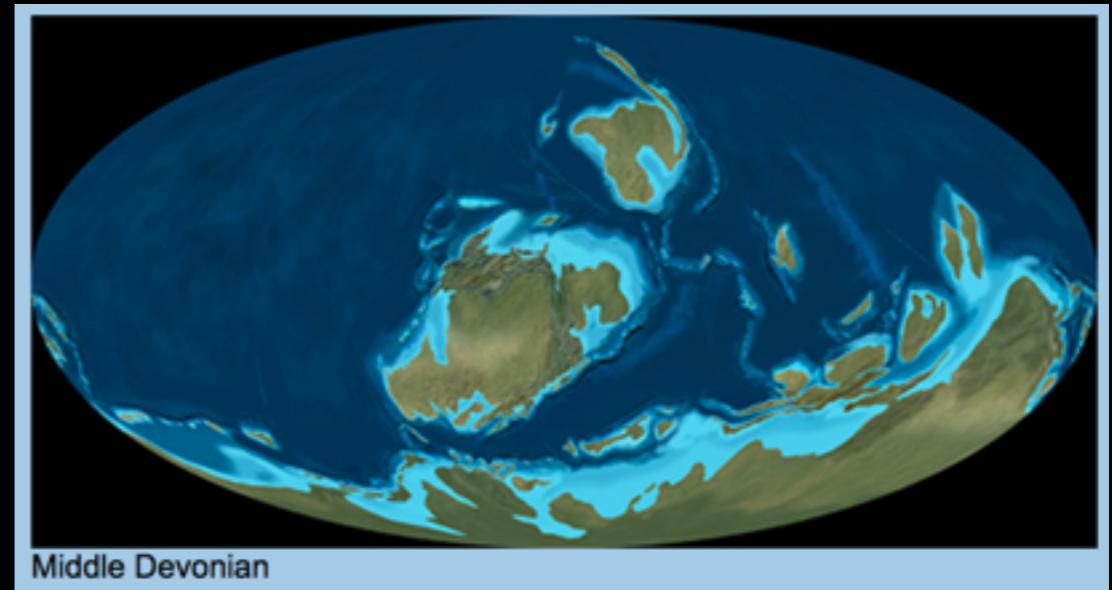
[processWGS84intoGnomonicFaces.py](#)[Raw](#)

```
1 # requires gdal cli installed
2 # run like this:
3 # python processWGS84intoGnomonicFaces.py input-geotiff.tif
4
5 import subprocess
6 import sys
7 inputFile = sys.argv[-1]
8 outputPath = "/path/to/faces/"
9
```

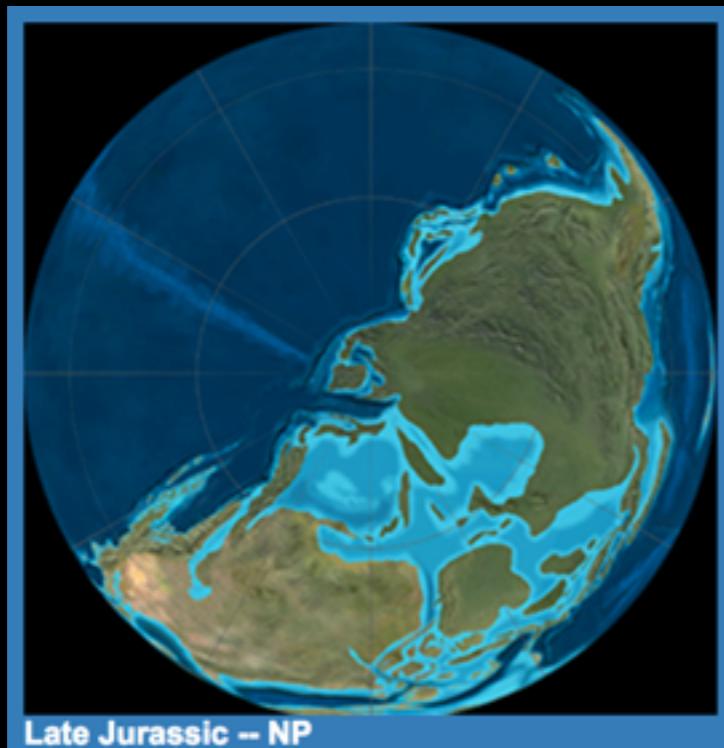




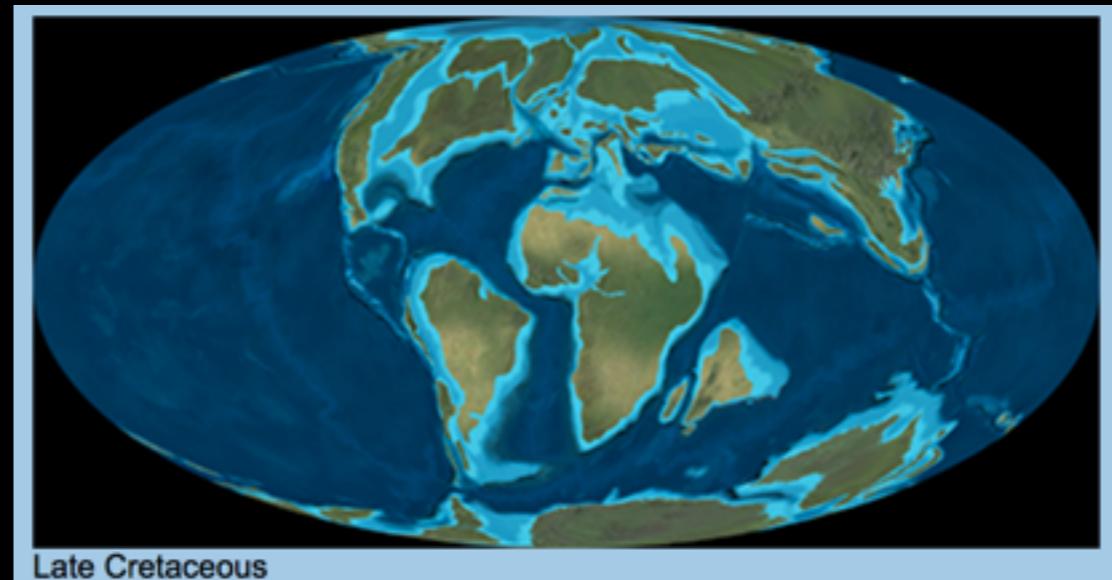
Early Jurassic



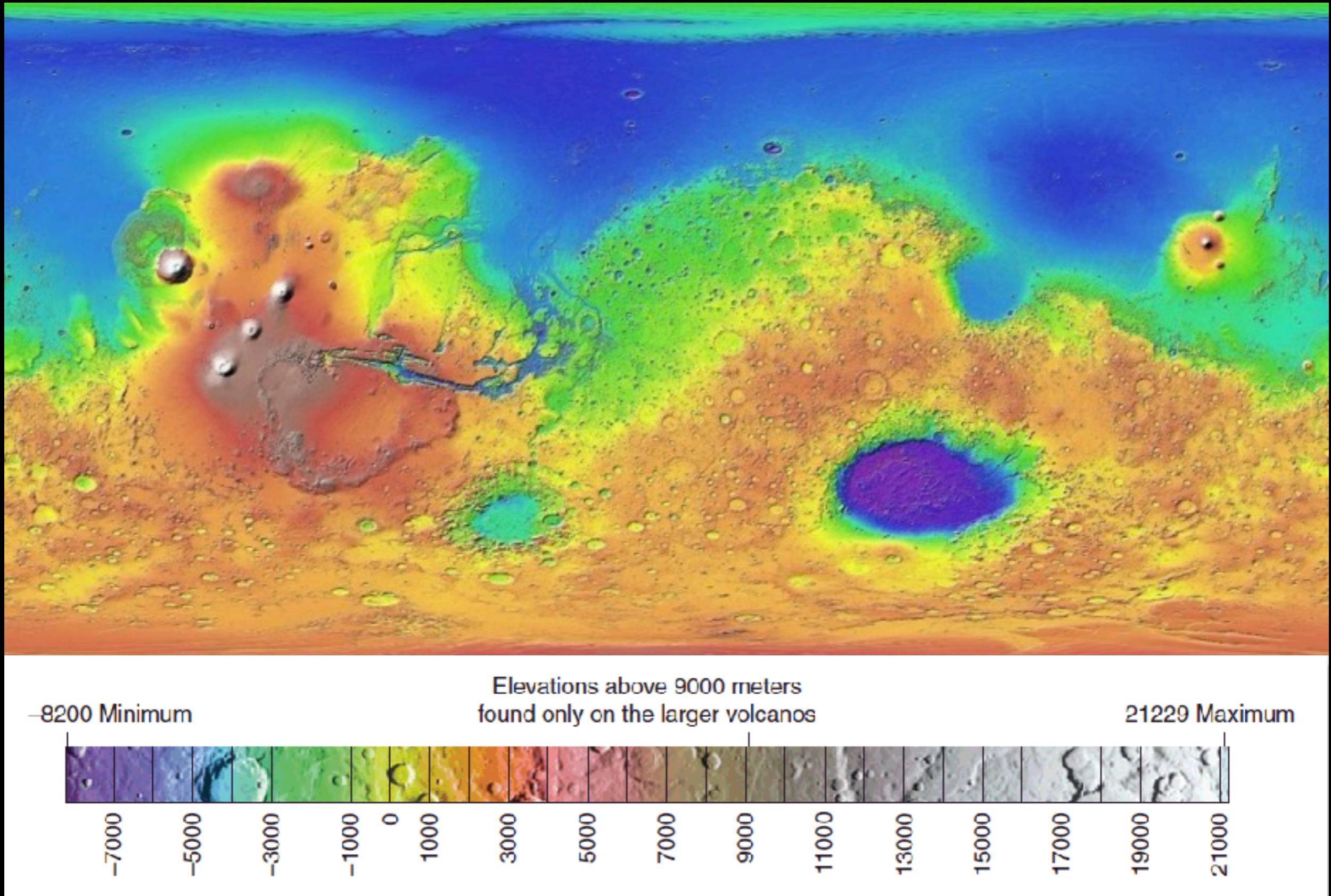
Middle Devonian



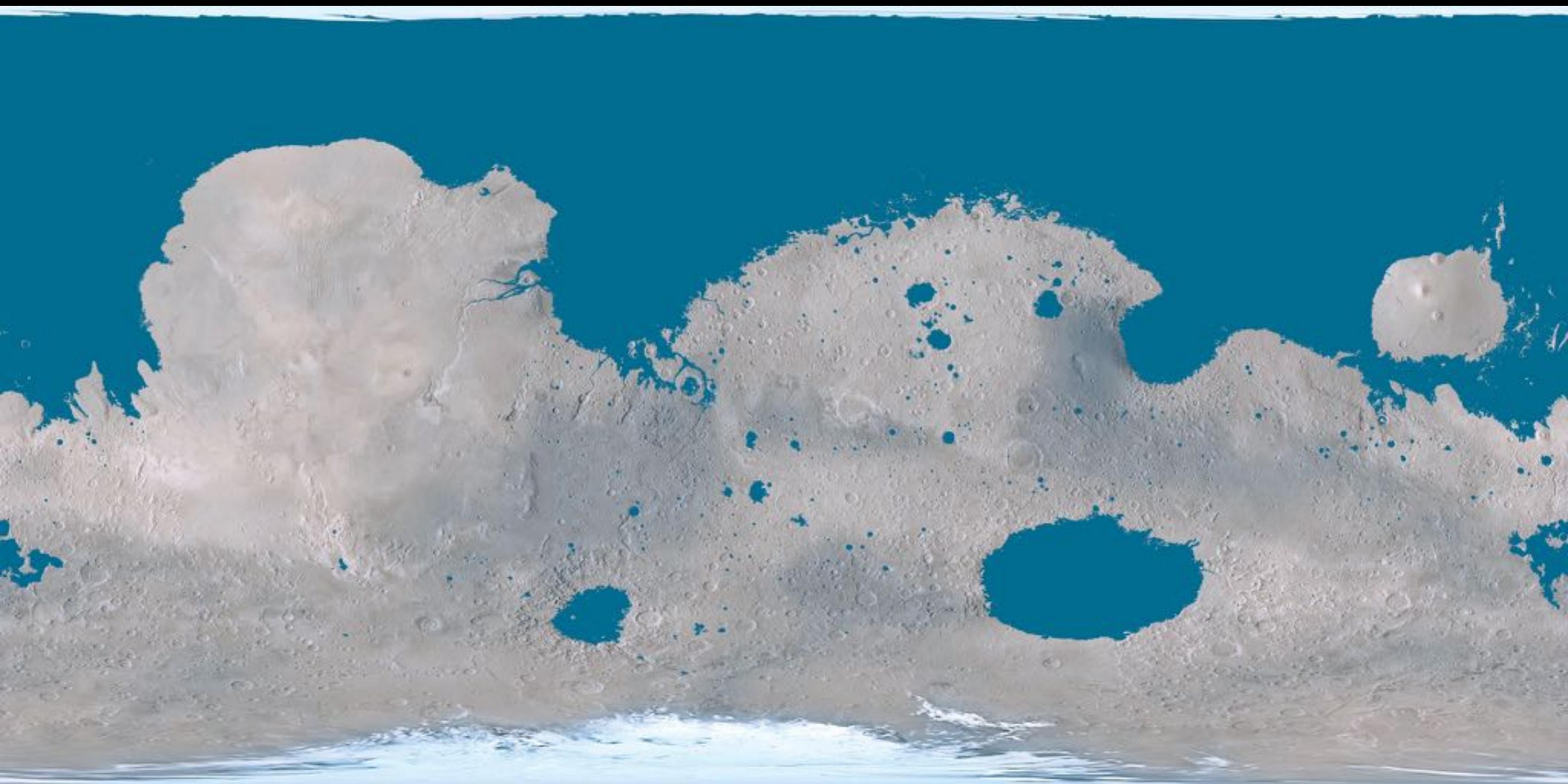
Late Jurassic -- NP



Late Cretaceous

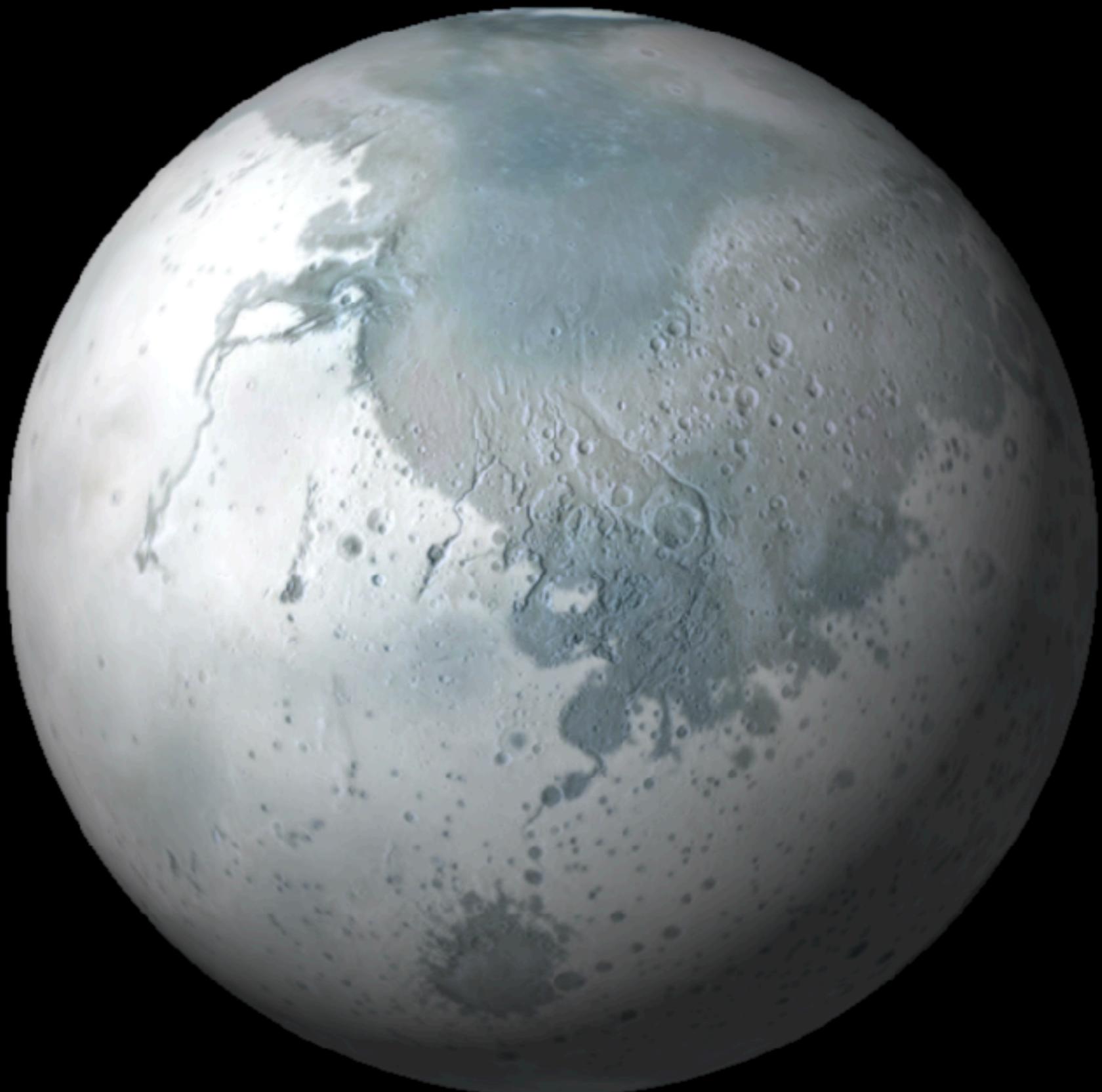


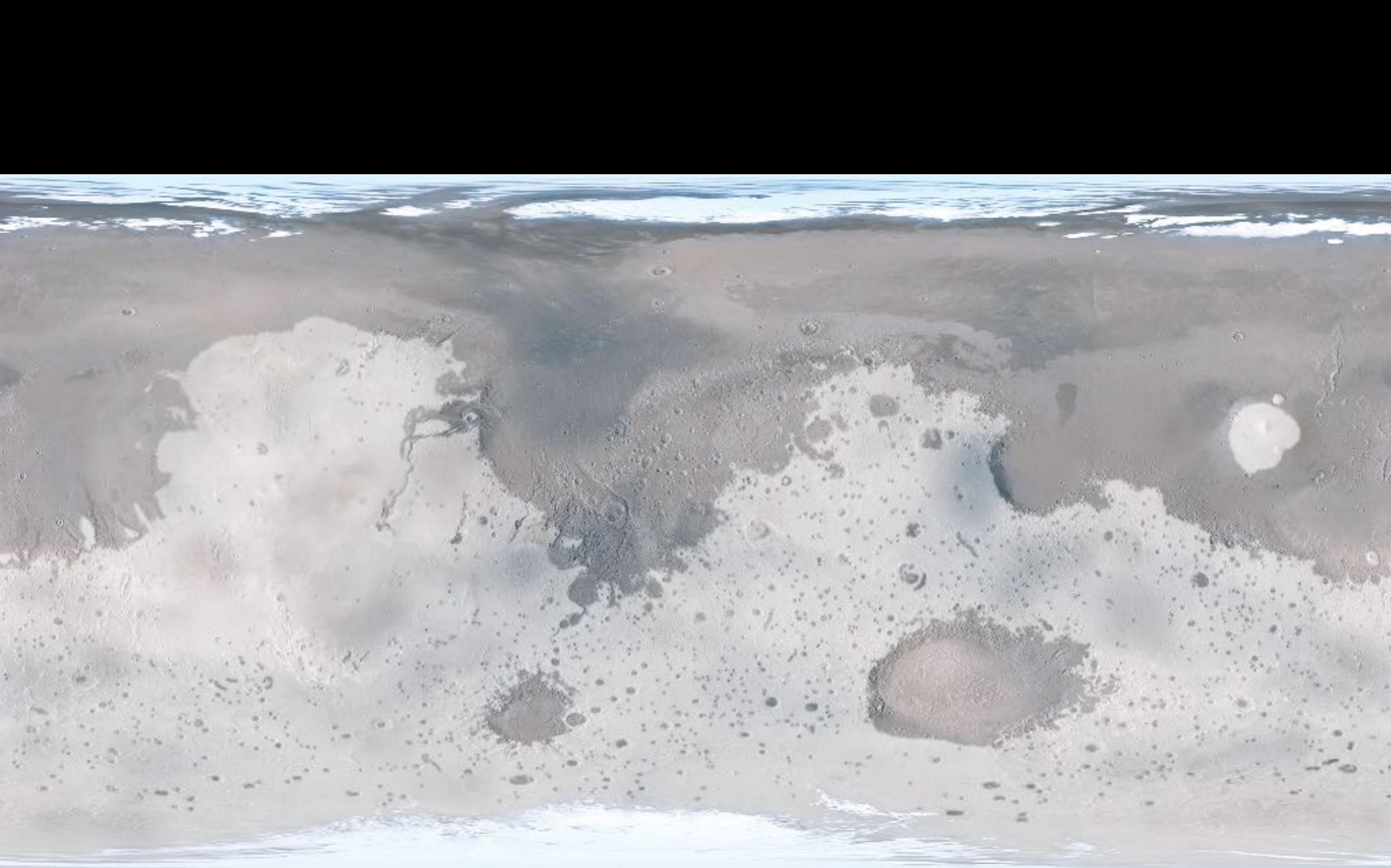
[https://astrogeology.usgs.gov/search/map/Mars/GlobalSurveyor/MOLA/  
Mars\\_MGS\\_MOLA\\_DEM\\_mosaic\\_global\\_463m](https://astrogeology.usgs.gov/search/map/Mars/GlobalSurveyor/MOLA/Mars_MGS_MOLA_DEM_mosaic_global_463m)

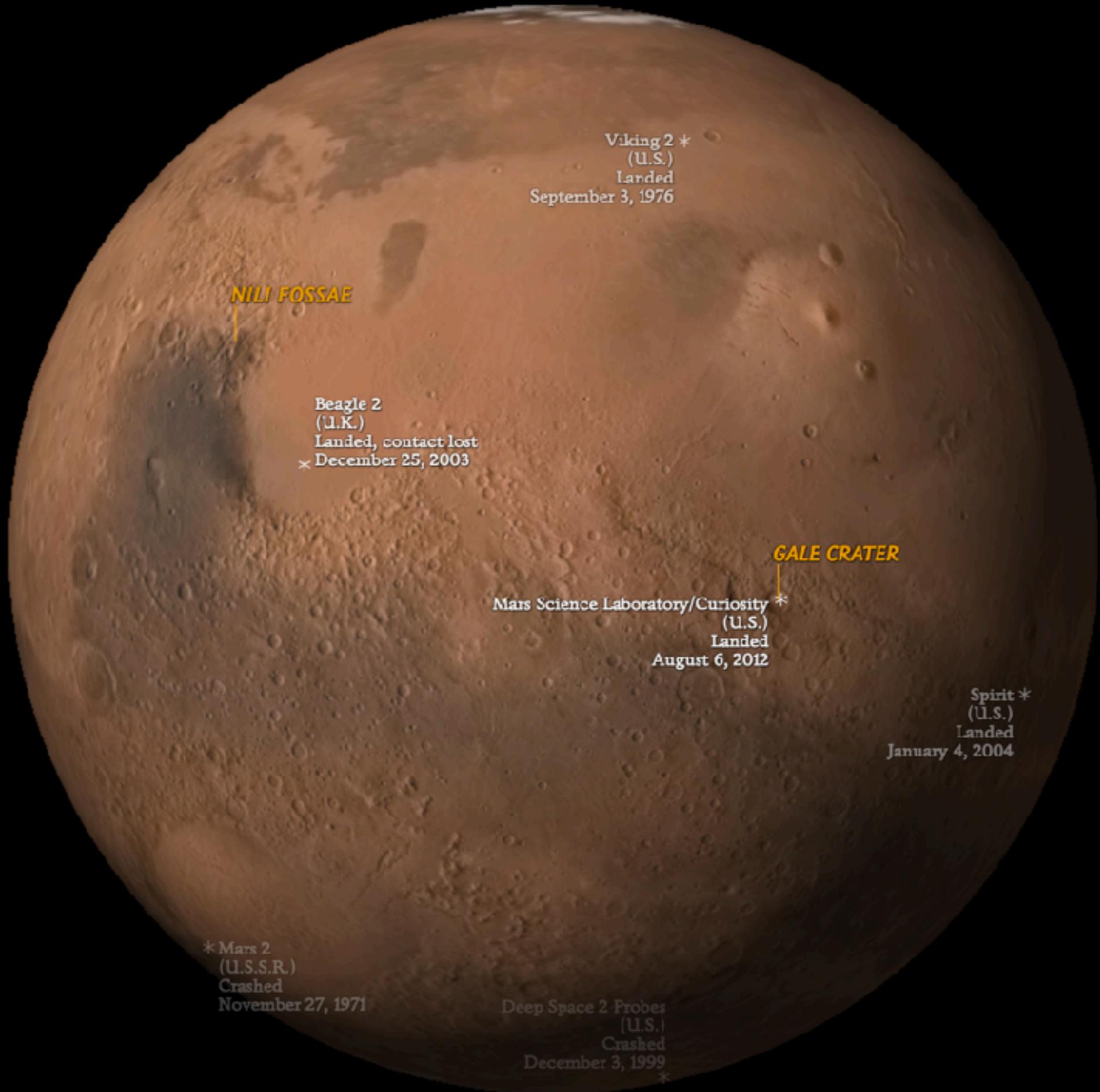


# SNOW GLOBE HYPOTHESIS

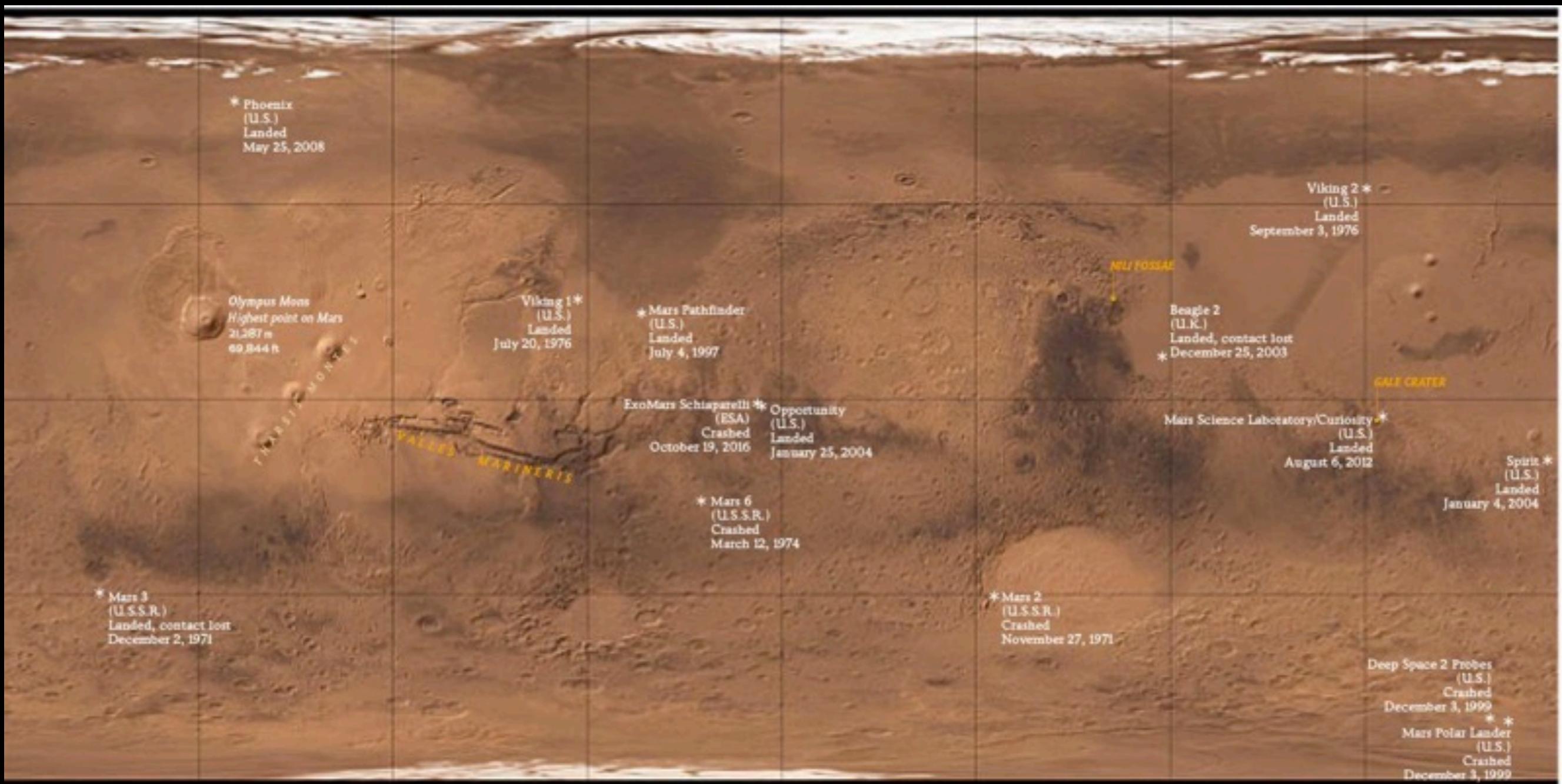
3.8 BILLION YEARS AGO







# Text in SVG, not AI2HTML



(<http://ai2html.org/>)

# 2D SVG X/Y to 3D XYZ

```
var longitude = (xSVGPos * (360 / widthSVG))  
var latitude = (ySVGPos * (180 / heightSVG))
```

```
var latitudeRadians = latitude * (Math.PI / 180.0);  
var longitudeRadians = longitude * (Math.PI / 180.0);  
  
var x = sphereRadius * Math.sin(latRadians) * Math.cos(lngRadians);  
var y = sphereRadius * Math.cos(latRadians);  
var z = sphereRadius * Math.sin(latRadians) * Math.sin(lngRadians);
```

# PERFORMANCE

## **requestAnimationFrame**

<https://developer.mozilla.org/en-US/docs/Web/API/window/requestAnimationFrame>

<http://creativejs.com/resources/requestanimationframe/index.html>

## **Texture sizes**

ifMobile ? 512x512.jpg : 1024x1024.jpg

## **Antialiasing**

`new THREE.WebGLRenderer({ antialias: ifMobile ? false : true });`





Curiosity Rover  
Landing Site  
Aug 6 2012

Curiosity Rover  
location, sol 1519  
NASA/JPL 2014

Destination  
peak of  
Aeolis Mons

APPROXIMATELY  
9 MILES

# **360 PANORAMA**

## **three.js 360**

[https://threejs.org/examples/webgl\\_panorama\\_equirectangular.html](https://threejs.org/examples/webgl_panorama_equirectangular.html)

## **Nice Writeup**

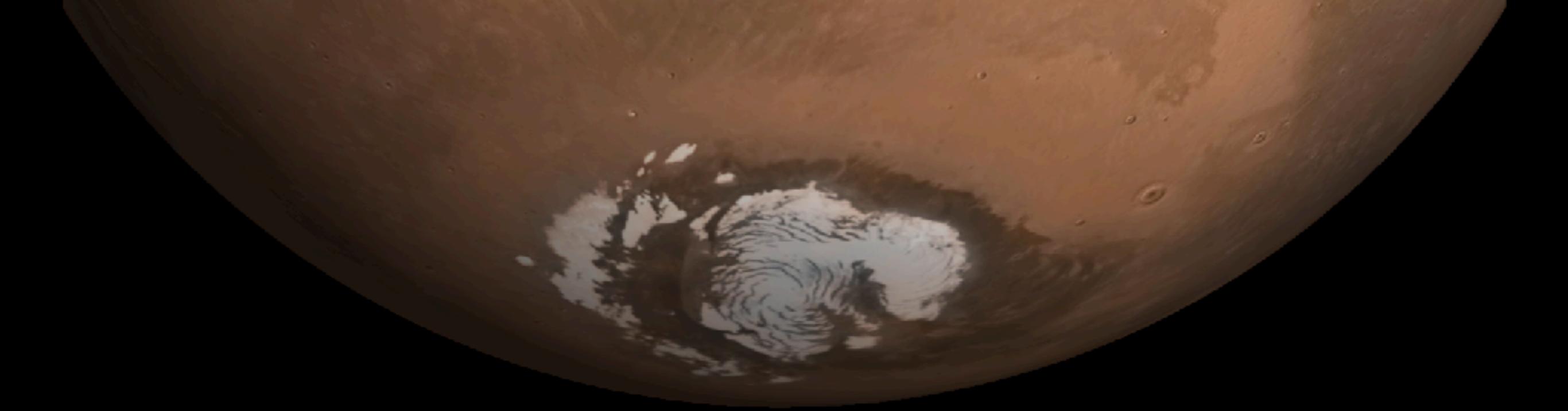
<https://open.blogs.nytimes.com/2016/11/11/building-a-cross-platform-360-degree-video-experience-at-the-new-york-times/>

## **Enter the Sphere**

<https://codepen.io/thiagopnts/pen/RRQVpa>

## **Dependency free library**

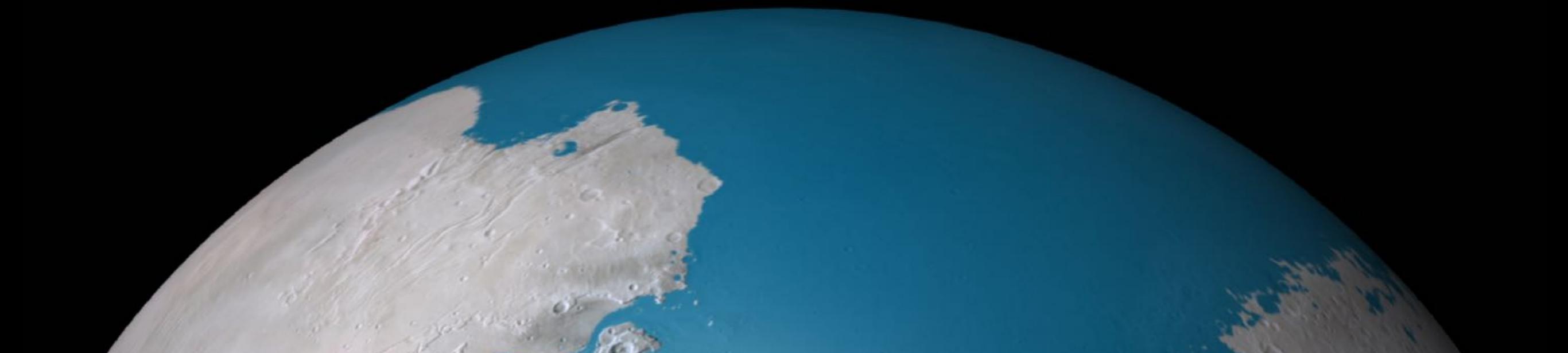
<https://github.com/thiagopnts/kaleidoscope>

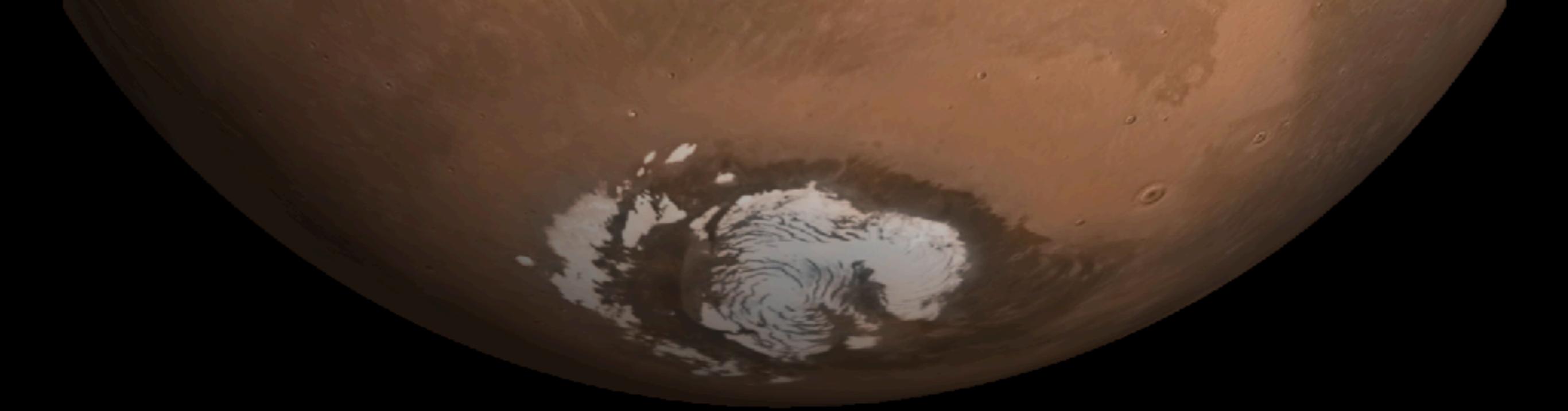


# "How We Made a Rewind the Red Planet"

<https://source.opennews.org/articles/how-we-made-rewind-red-planet/>

**Scroll to bottom for resources section on 3D globes/maps**





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# ARTICLE RESOURCES

<https://source.opennews.org/articles/how-we-made-rewind-red-planet/#resources>

**Scroll to bottom for resources section on 3D globes/maps**

THREE.JS resources and examples

3D Globes

3D Maps

3D Object Manipulation

# CUBESPHERE SCRIPT+CODE

<https://github.com/briantjacobs/foss4g-2017-talk/>

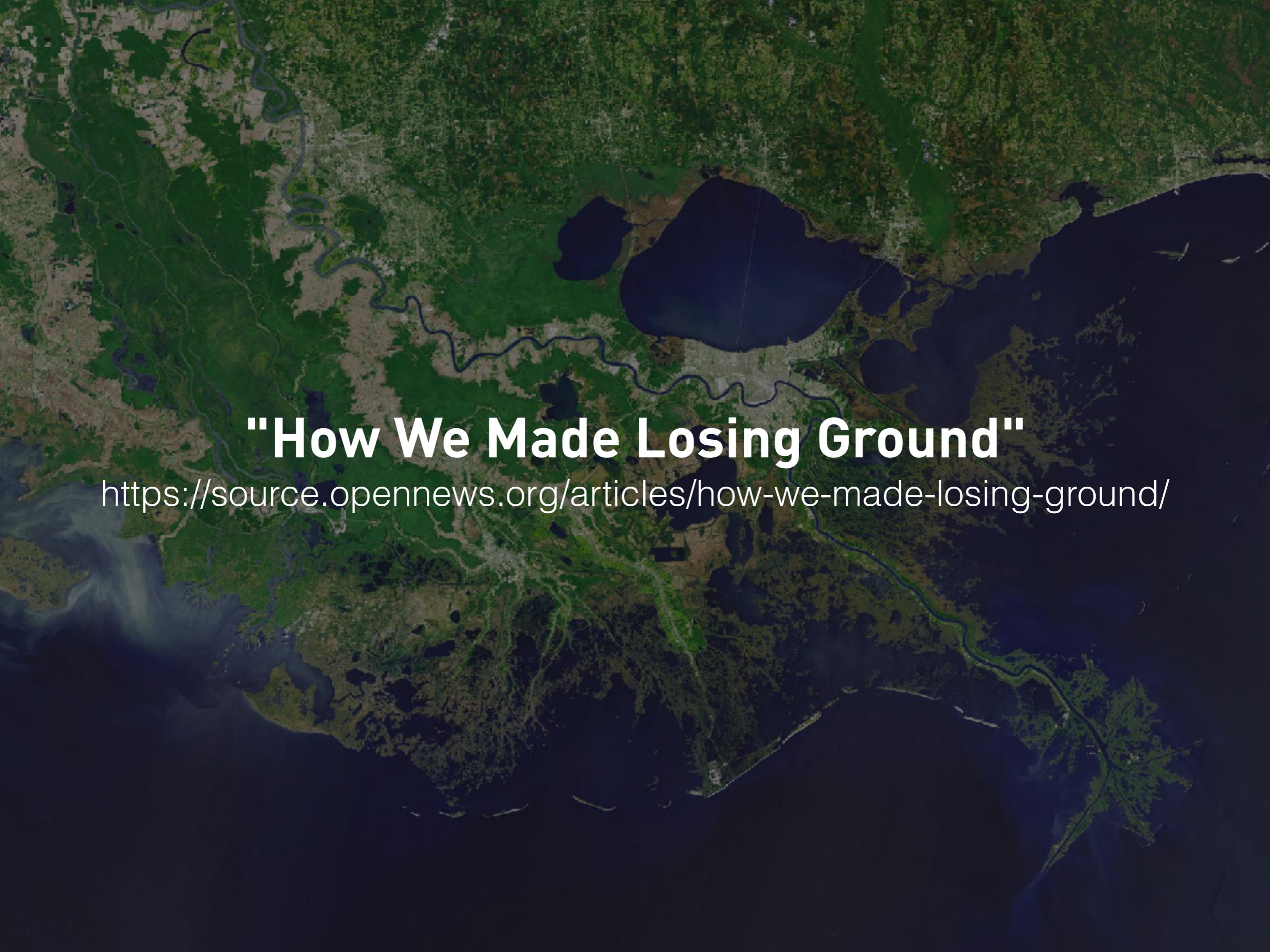
# SEARCH "REWIND THE RED PLANET"

<http://www.nationalgeographic.com/science/2016/11/exploring-mars-map-panorama-pictures/>



# "How We Resurrected a Dragon"

<https://source.opennews.org/articles/resurrecting-dragon/>

The background image is a detailed aerial satellite map of a coastal region, likely the Mississippi River delta. It shows a complex network of water bodies, including the Gulf of Mexico to the west and several large lakes and river systems to the east. The terrain is predominantly green and brown, indicating various types of vegetation and soil. In many areas, particularly along the coast and in the interior basins, there are significant areas of dark blue, representing water or areas of land that have been lost or are in a state of transition. The overall scene illustrates the scale of coastal land loss and environmental change.

# "How We Made Losing Ground"

<https://source.opennews.org/articles/how-we-made-losing-ground/>

# THANK YOU!

**Brian T. Jacobs**  
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