Jet Propulsion Laboratory
California Institute of Technology

Emerging Information Technologies for Earth and Space Studies

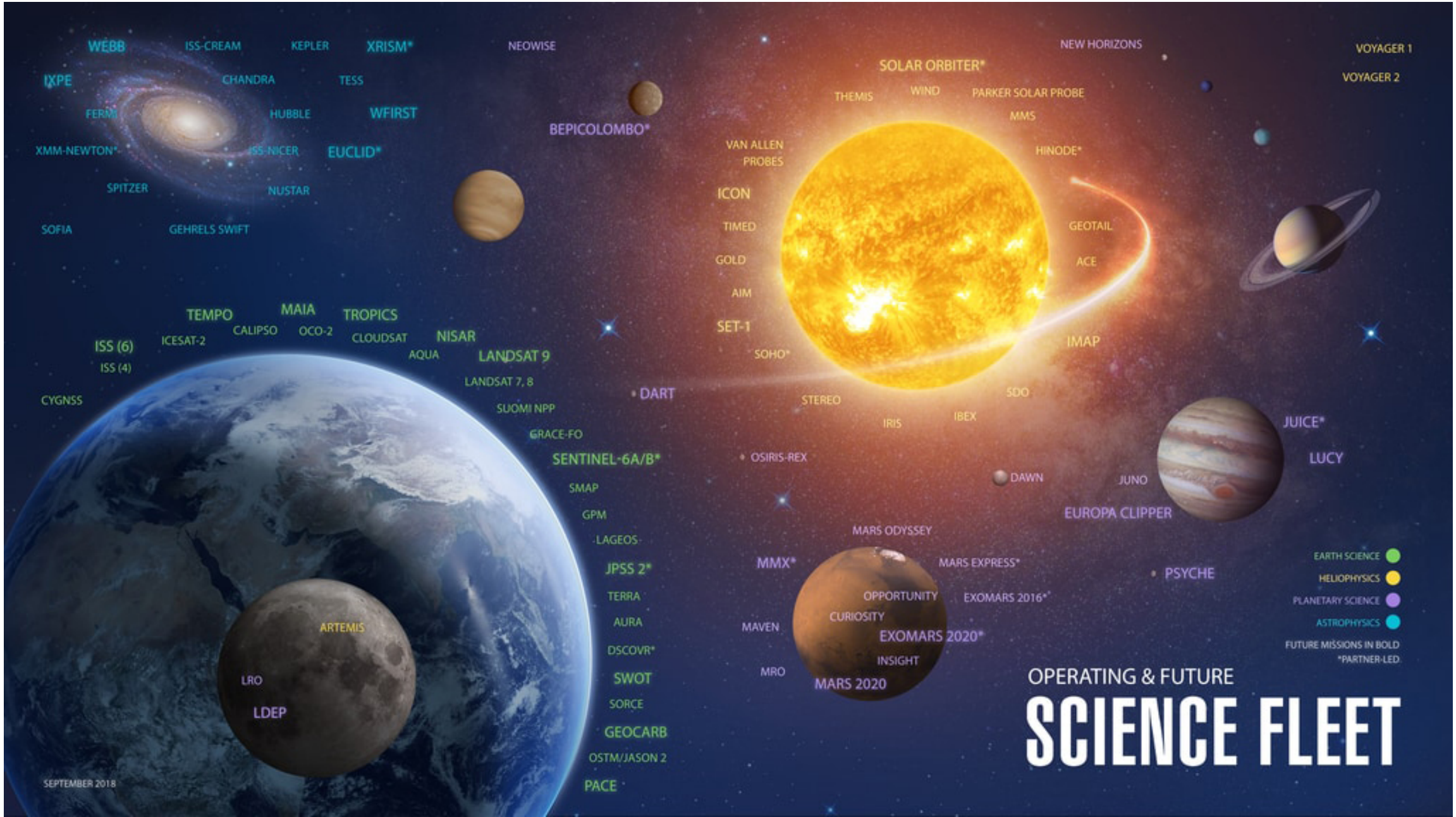
Tom Soderstrom, JPL IT Chief Technology and Innovation Officer
Stephanie Granger, JPL Applied Science System Engineering

December 2018

The Birth of U. S. Space Exploration

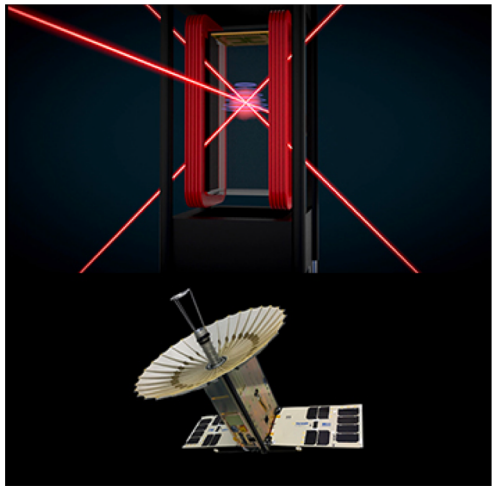
January 31, 1958

Exploring new worlds and advancing understanding of our home planet



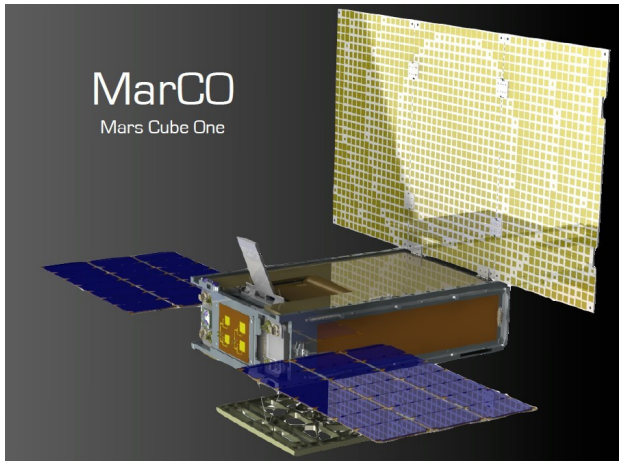
Why? To help us answer the BIG questions
How do we protect Mother Earth?
How do we divert an asteroid?
Are we alone?
How did the Universe form and where is it going?
Can we find Earth 2.0?
Is/was there life on Mars?

Seven new mission launched in May 2018 (a JPL record)

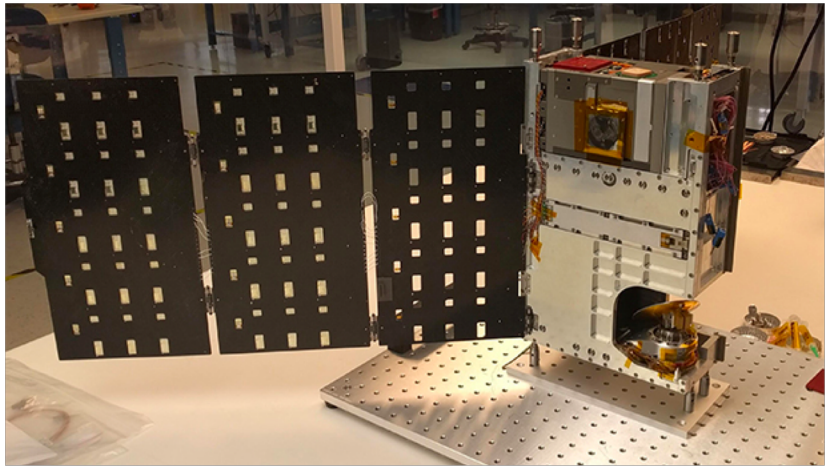


Cold Atom Lab and Raincube

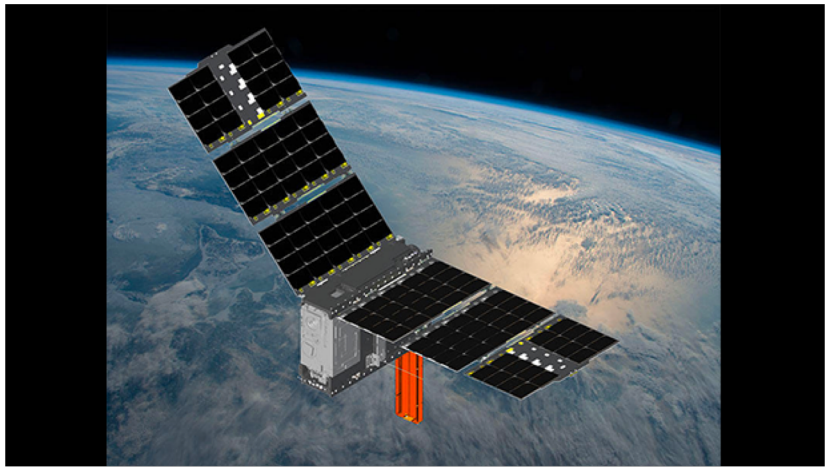
InSight lander



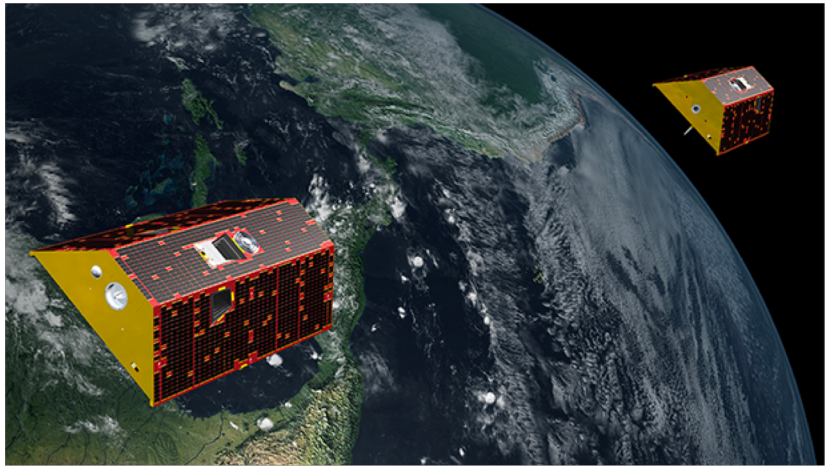
Two Mars CubeSat Ones



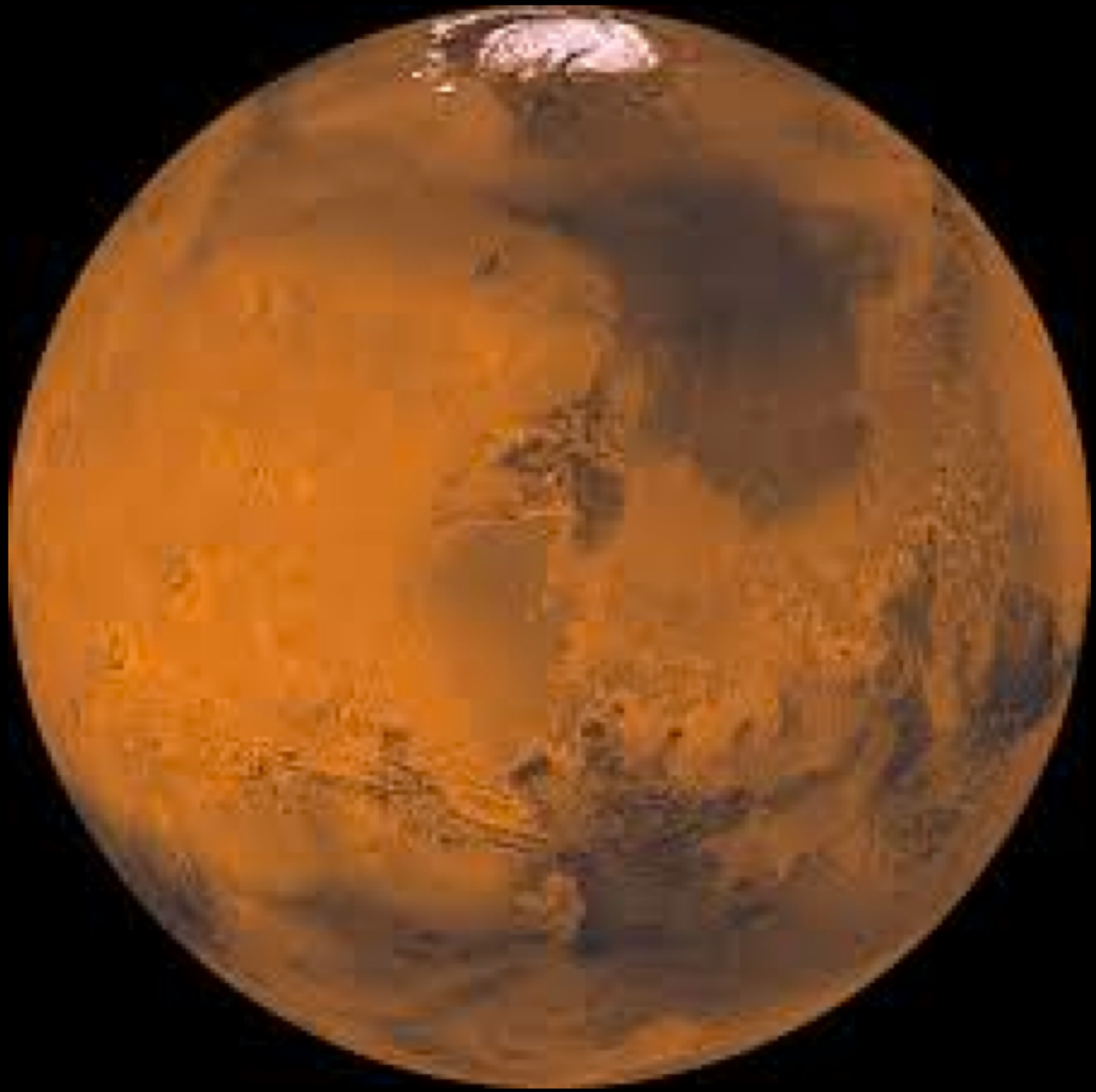
TEMPEST-D CubeSat



CubeRRT CubeSat

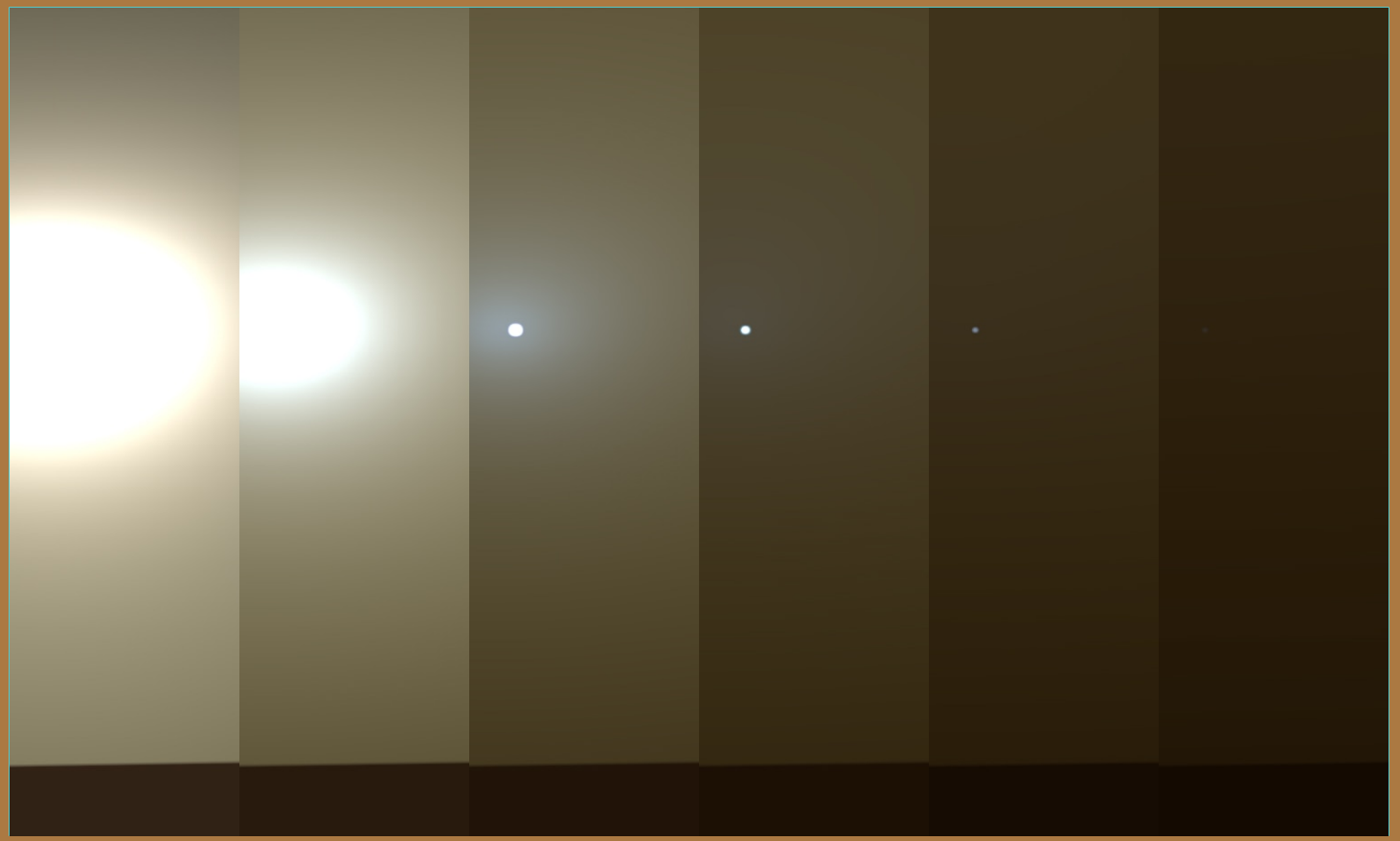


GRACE-FO

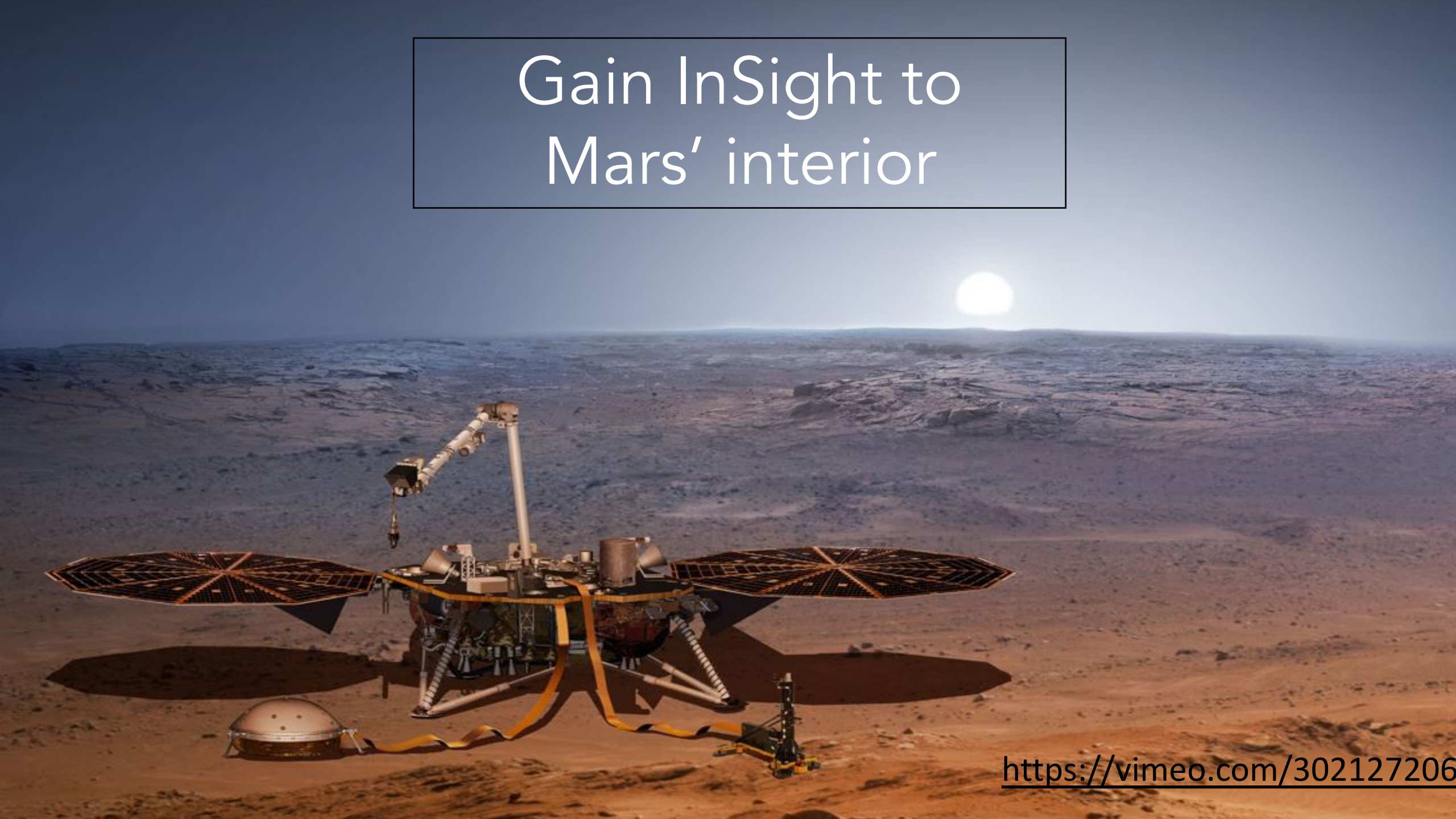


Curiosity: Did/does Mars house life?

Opportunity Hunkers Down During Dust Storm



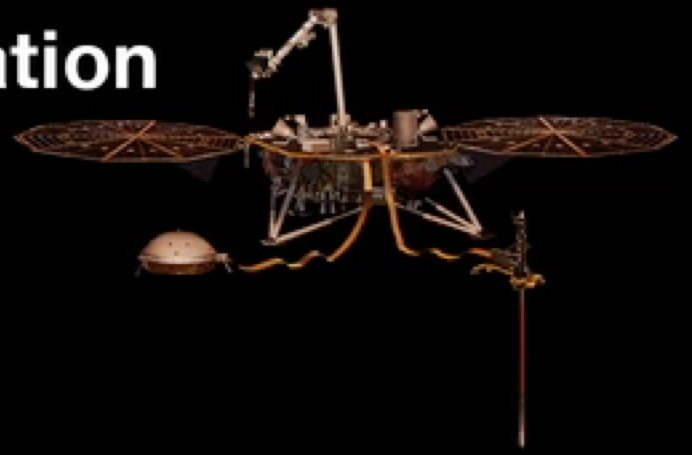
Gain InSight to Mars' interior



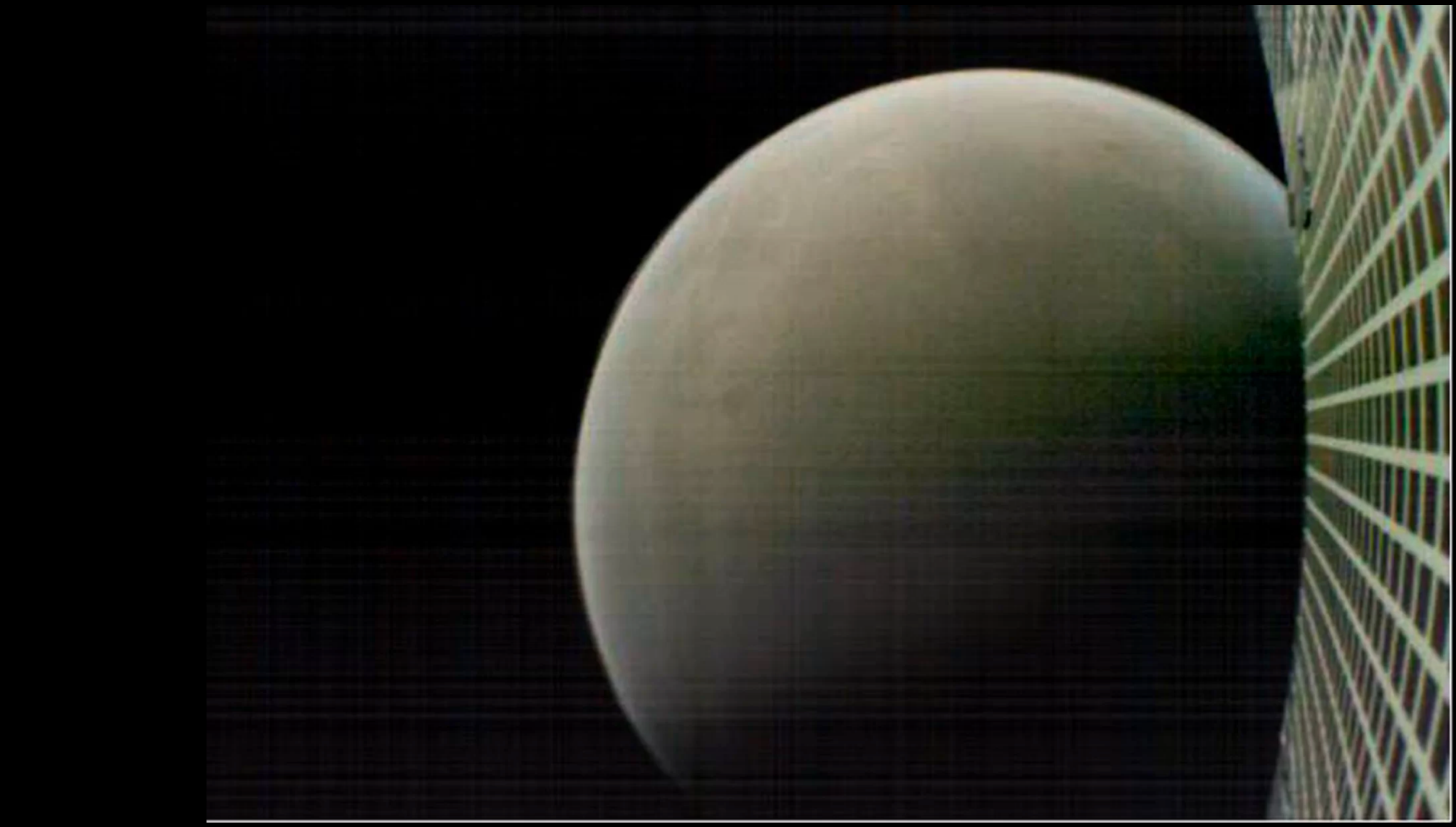
https://vimeo.com/302127206

InSight Media Reel 3 - Animation

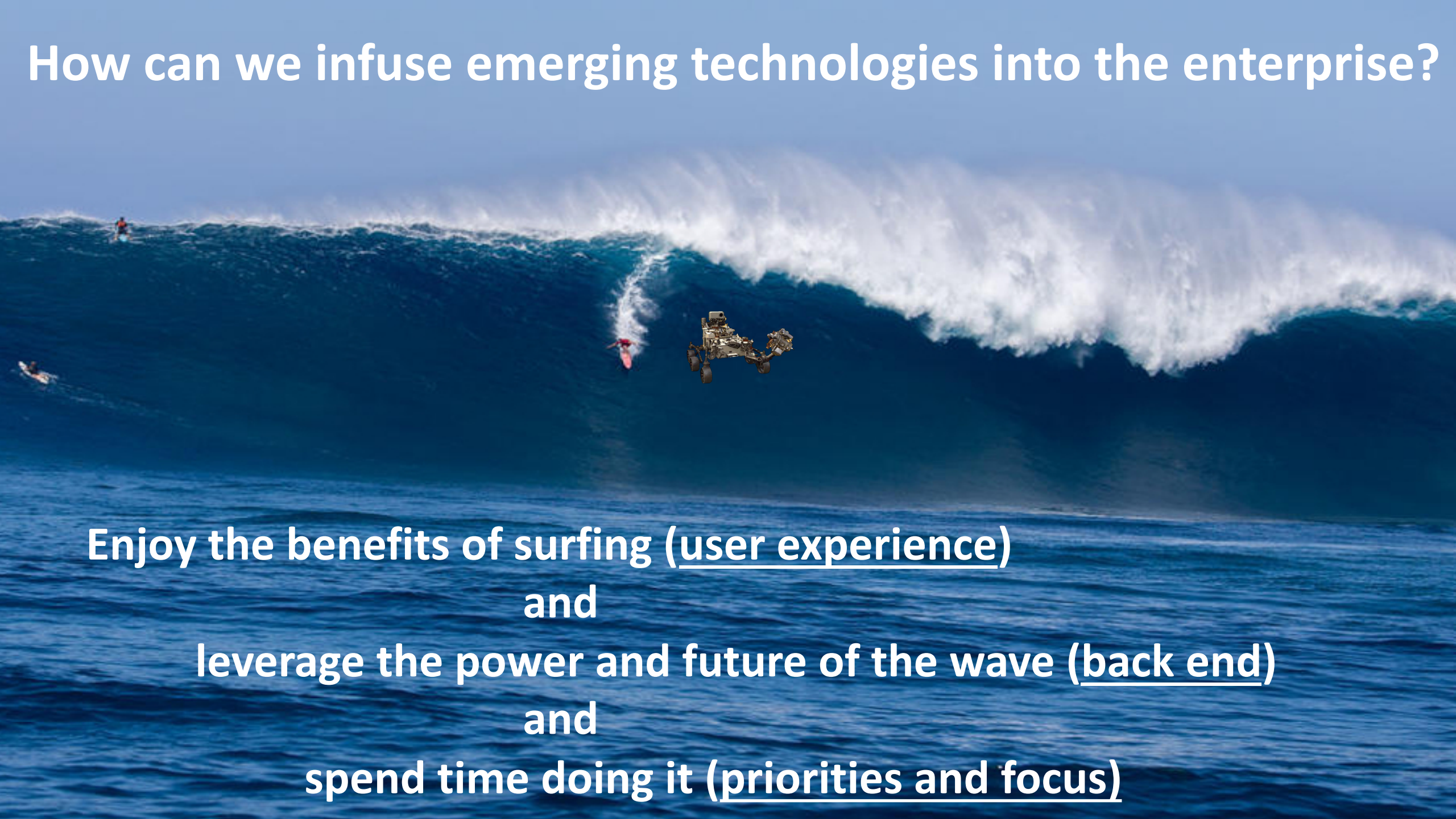
November 21, 2018 4:00



LOCATION	DURATION	
00:07	1:13	InSight Entry, Descent, and Landing (EDL) Animation
01:21	2:13	InSight Instrument Deployment Animation
03:35	0:20	Mars Cube One (MarCO) Relaying EDL Data to Earth in Near Real-time



How can we infuse emerging technologies into the enterprise?



Enjoy the benefits of surfing (user experience)
and
leverage the power and future of the wave (back end)
and
spend time doing it (priorities and focus)

T

WHAT ARE THE EMERGING TECHNOLOGY WAVES?

New Habits

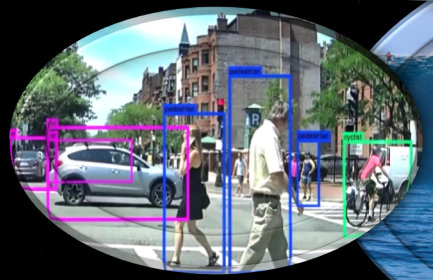
Work from anywhere, always connected, gaming, sharing, open source, reduced footprint, cord-cutting

Cyber Security Challenges

At scale, authentication, encryption by default, role-based training, BlockChain

Applied AI

Deep Learning, Machine Learning, IA, Intelligent Digital Assistants, NLP, automation, data-driven, APIs, analytics, combinations



Accelerated Computing

Serverless, edge computing, HPC, GPUs, Neuromorphic, Quantum

Ubiquitous Computing

Mobile, smart devices, AR, IoT, NUI

Software Defined Everything

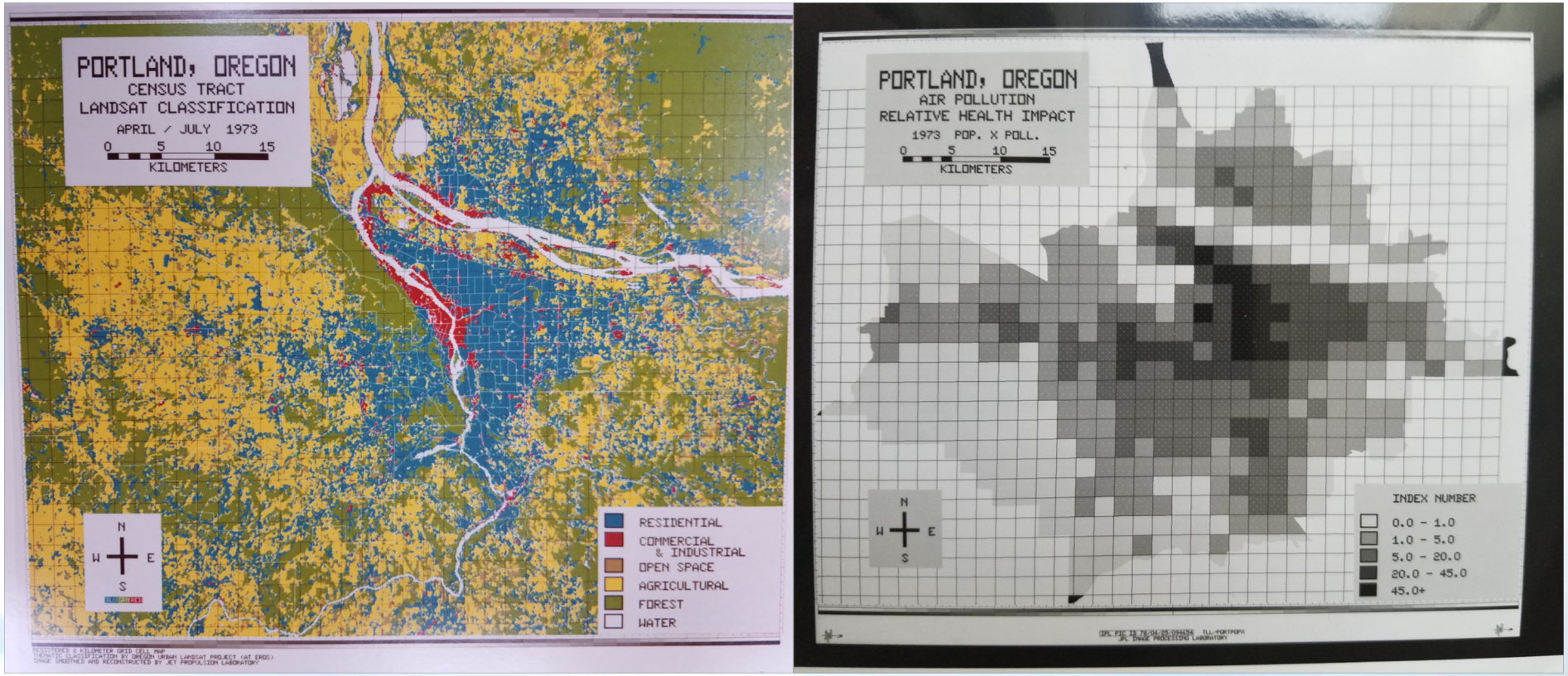
Programming everything, APIs, Software Defined Networks, containers, DevOps, Open Source, self-healing, everything distributed

HOW CAN YOU BENEFIT?

Participate at: techwaves@jpl.nasa.gov

IBIS: Image-Based Information System

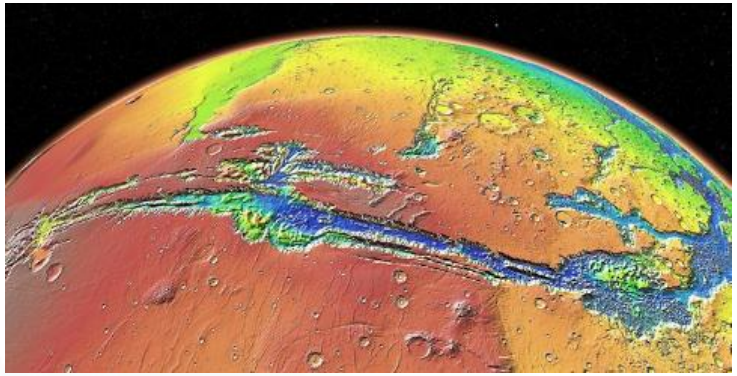
1978: Digital Image Processing meets Cartography

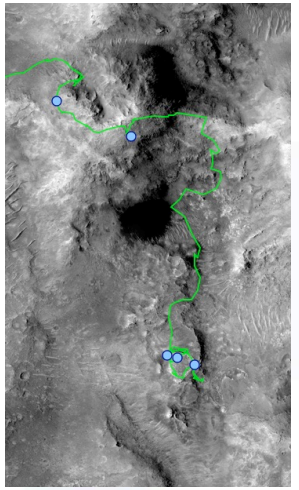


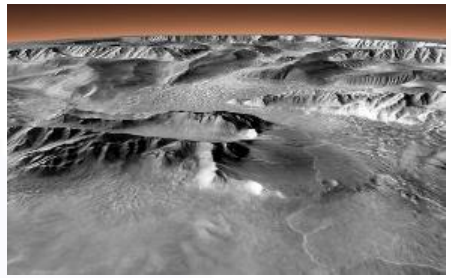
Credit: T. Logan, NASA/JPL-Caltech

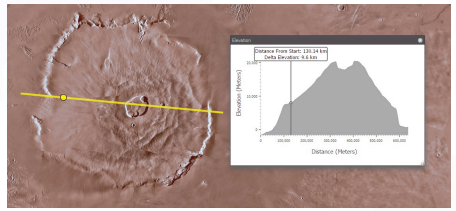
Solar System Trek Project

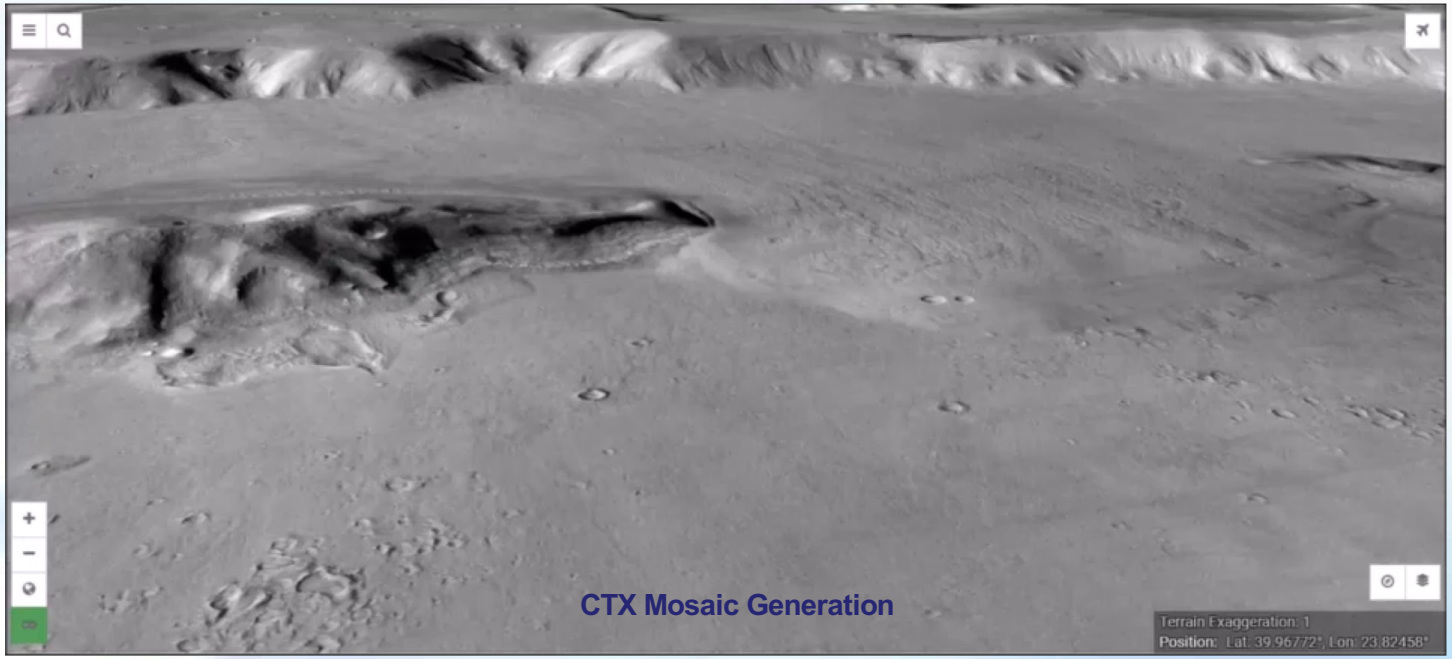
Mars Trek





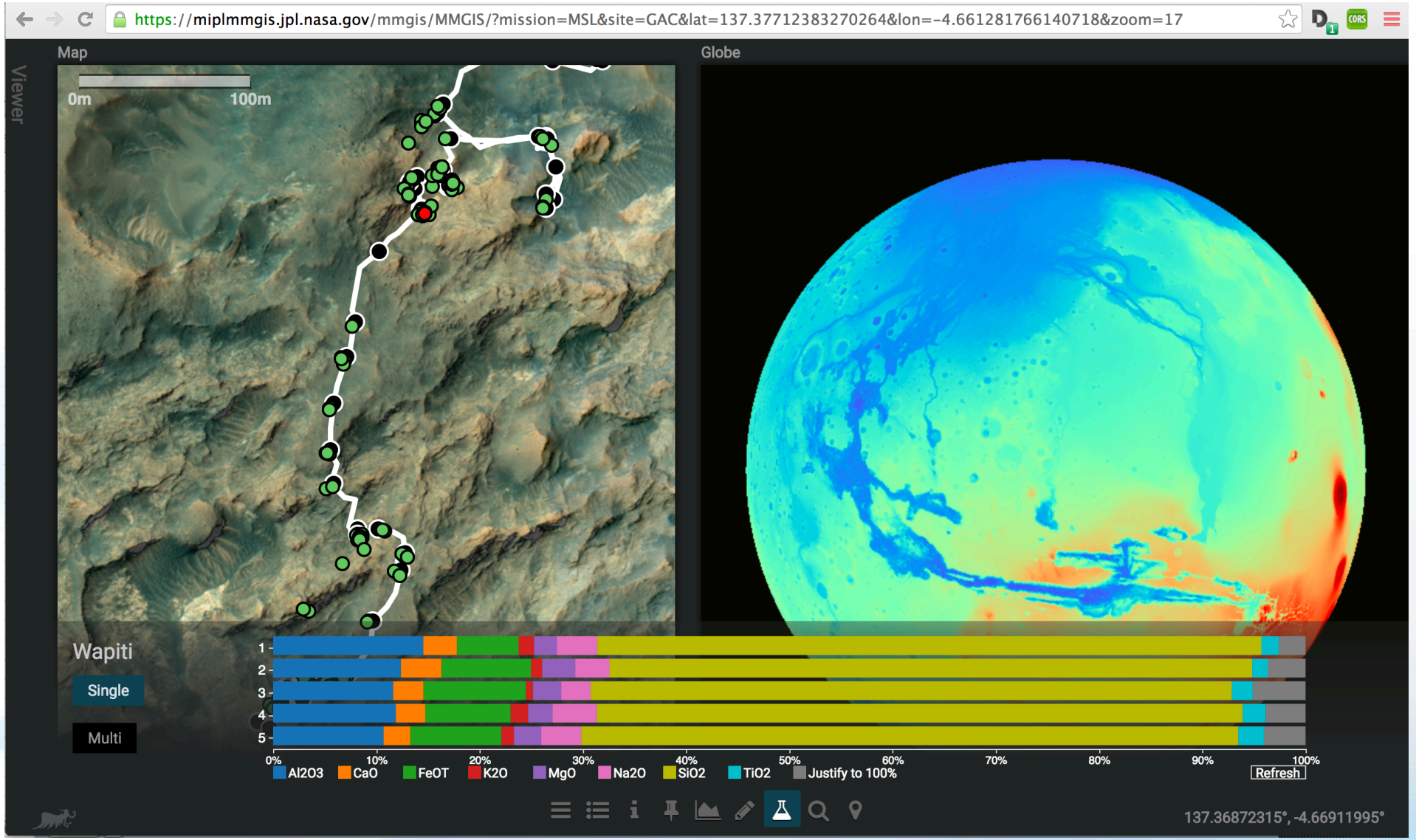




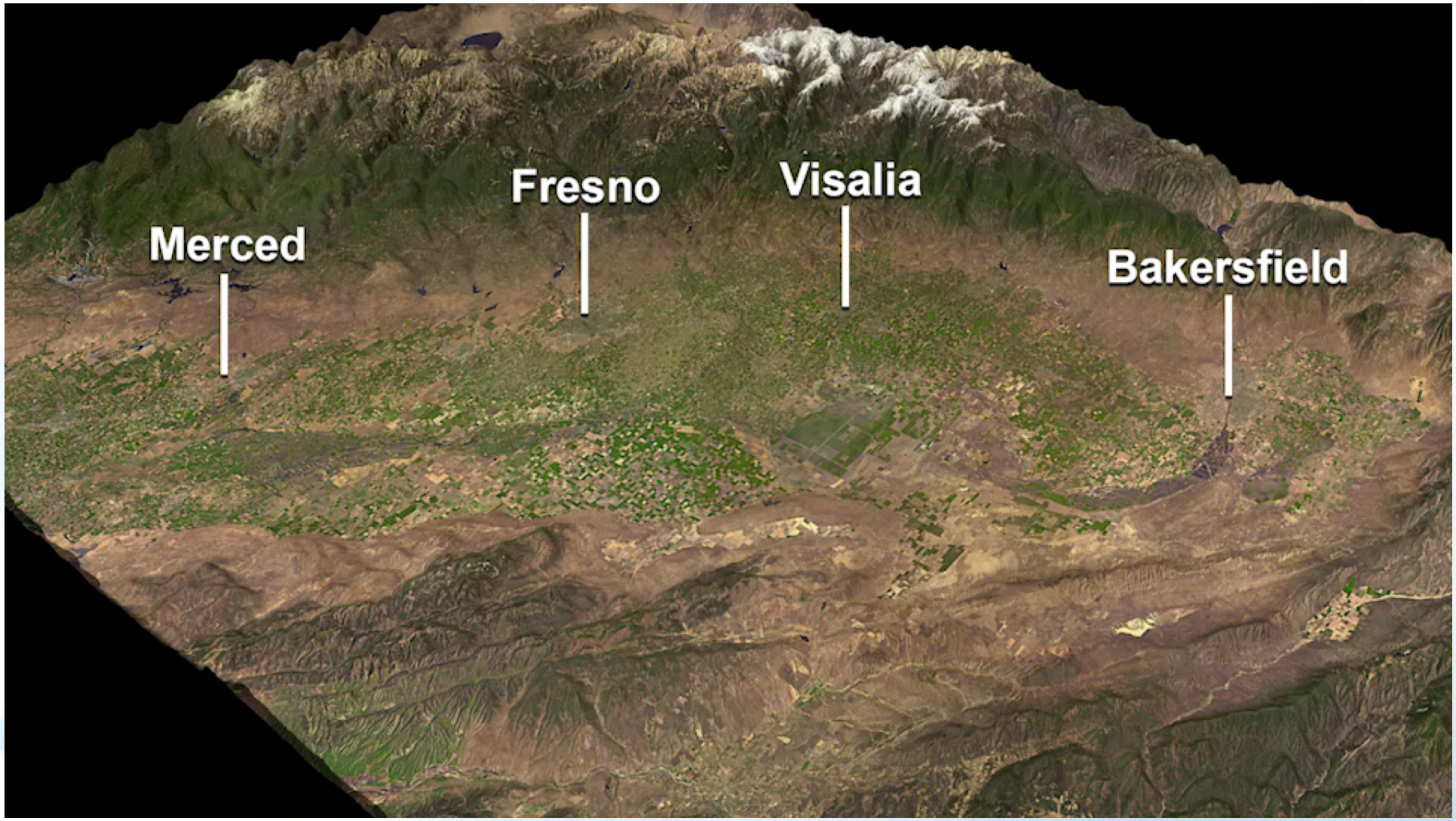


Credit: E. Law, et al., NASA/JPL-Caltech

MMGIS - Multi-Mission Geographic Information System for Mars Operations

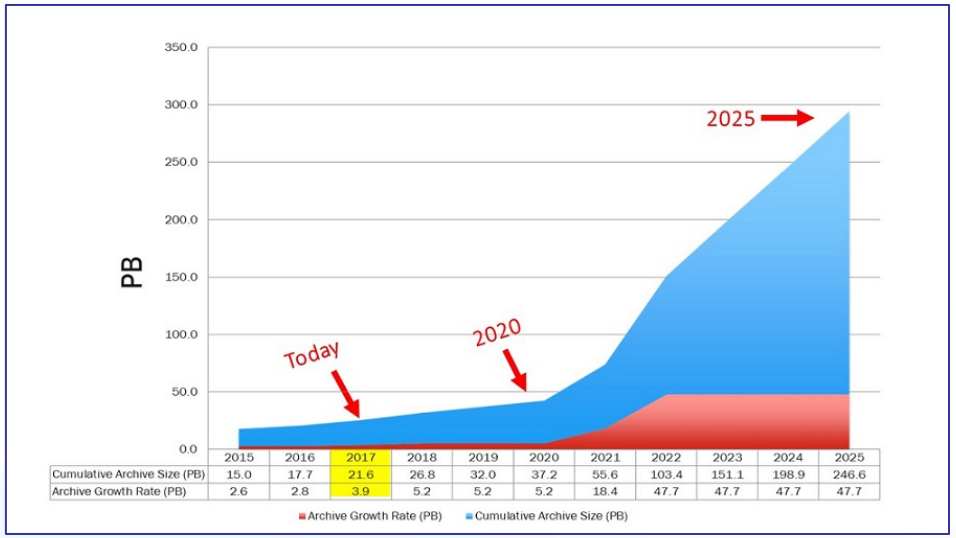


Subsidence in the San Joaquin Valley
Sentinel-1 May 2015 – Jan. 2017



Credit: T. Farr, C. Jones, V. Realmuto; NASA/JPL-Caltech

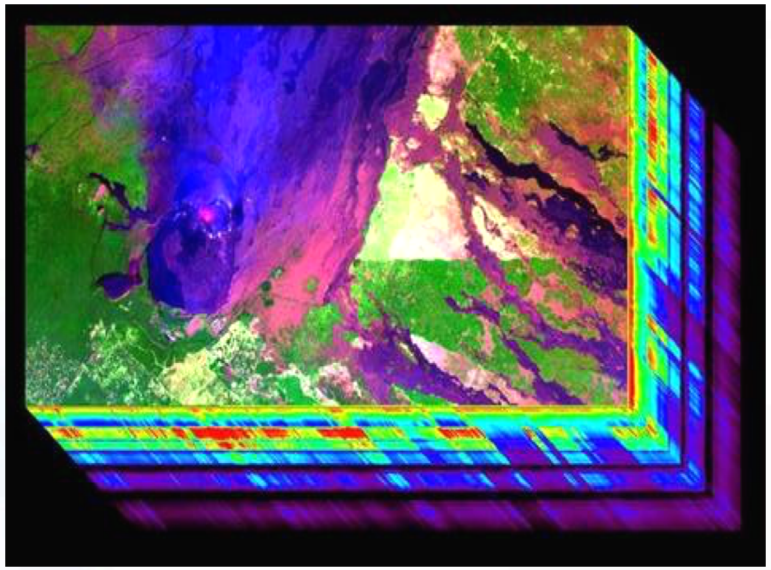
Increasing Volume and Complexity of Data and Analyses



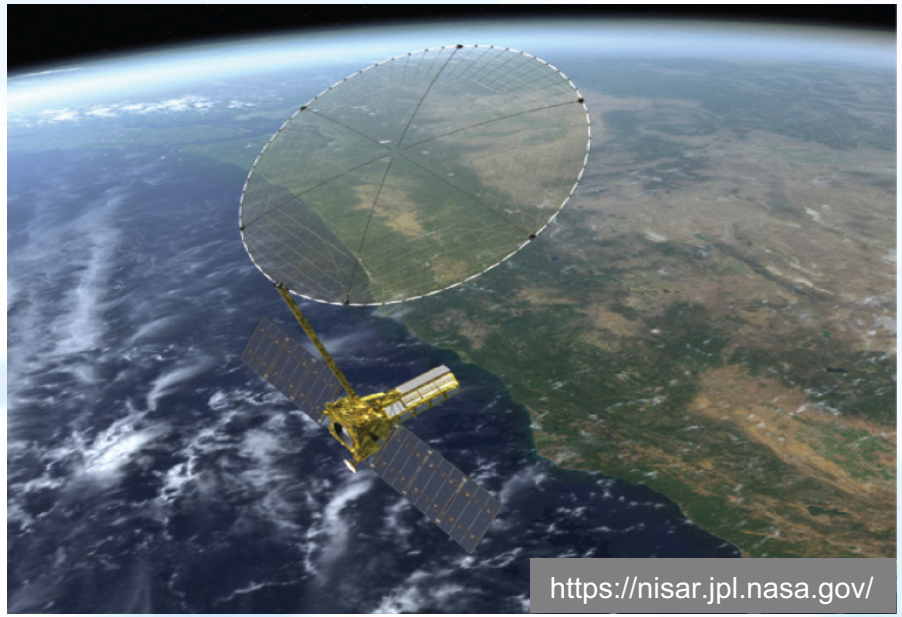
	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Cumulative Archive Size (PB)	15.0	17.7	21.6	26.8	32.0	37.2	55.6	103.4	151.1	198.9	246.6
Archive Growth Rate (PB)	2.6	2.8	3.9	5.2	5.2	5.2	18.4	47.7	47.7	47.7	47.7

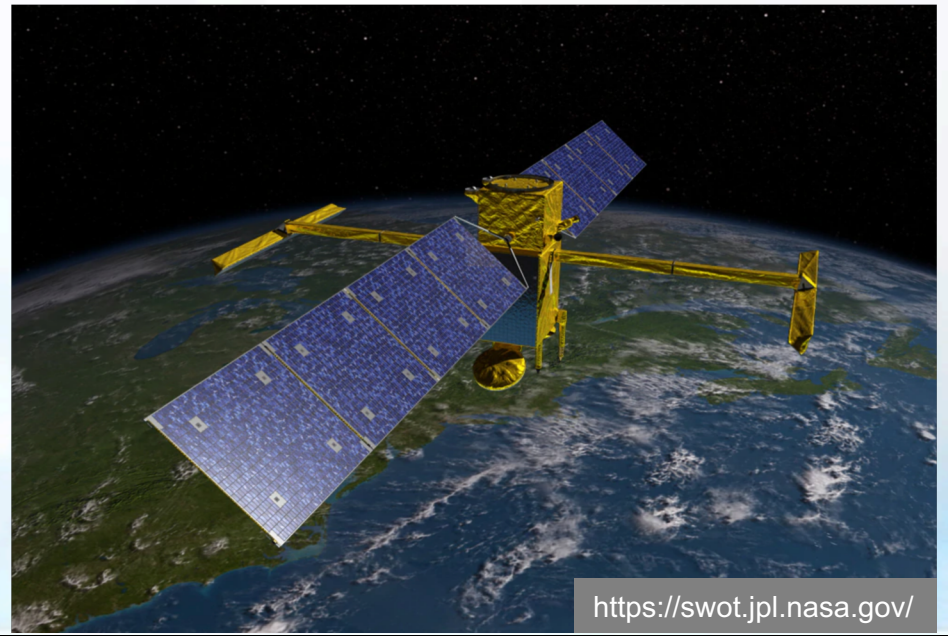
Archive Growth Rate (PB) Cumulative Archive Size (PB)

Credit: Nasa
https://earthdata.nasa.gov/about/eosdis-cloud-evolution

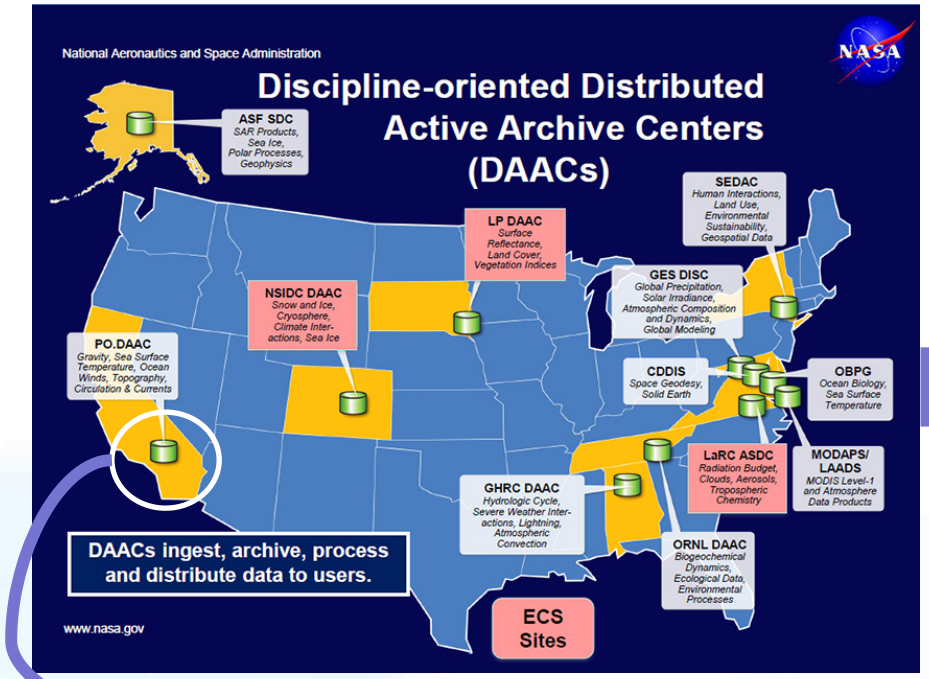


Credit: NASA/JPL-Caltech

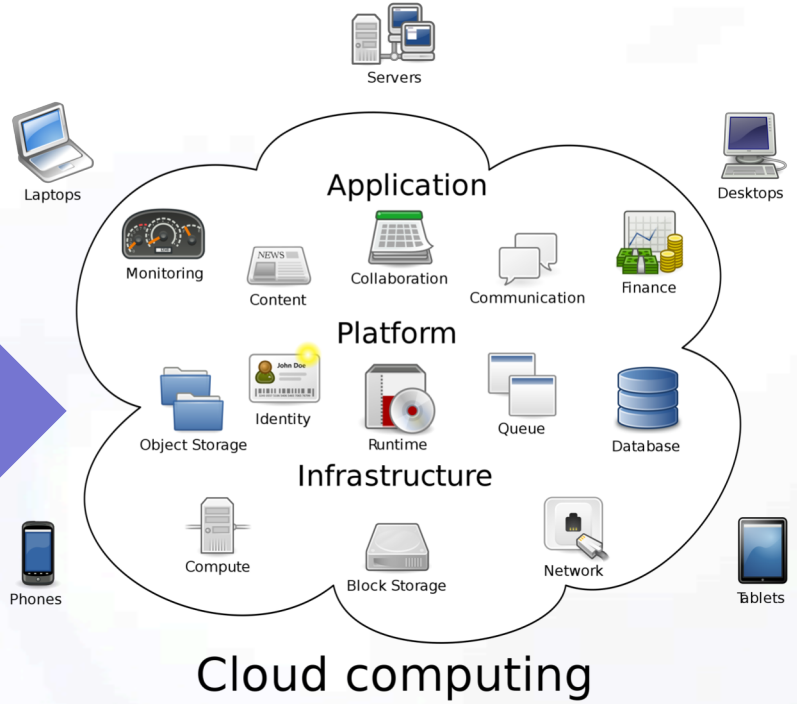




Migration to the Cloud



Credit: NASA



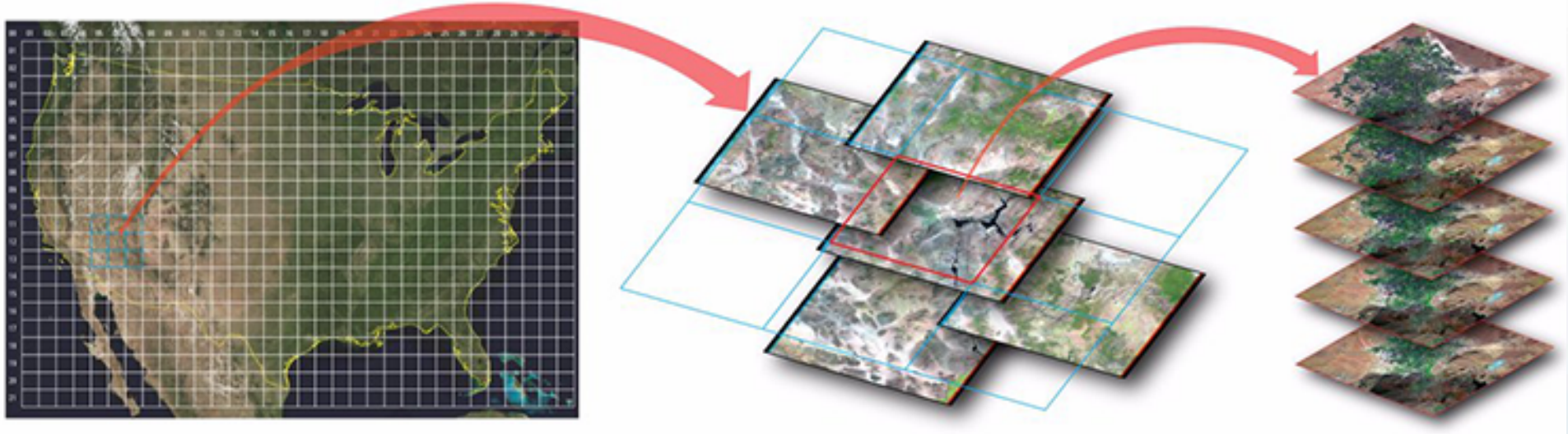
Credit: Sam Johnston for Wikipedia

NASA/JPL's Physical Oceanography DAAC is one of the first DAAC to migrate to the cloud.

On-Demand Analysis Ready Data

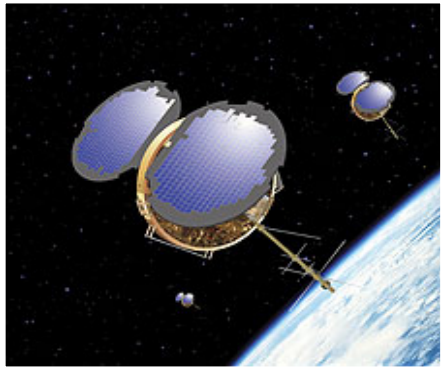
“Satellite data that have been processed …and organized into a form that allows immediate analysis without additional user effort and interoperability with other datasets both through time and space.”

- CEOS (Committee on Earth Observation Satellites)



Credit: USGS Landsat

Upcoming Launches

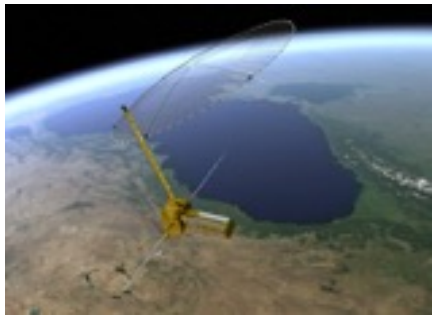


COSMIC-2
April – June 2018

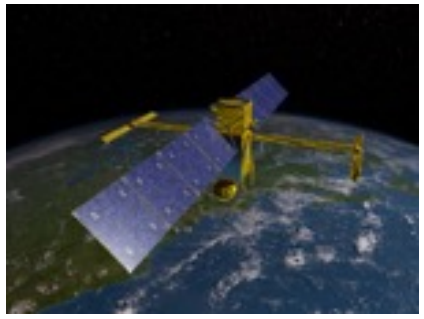
ECOSTRESS
June 2018

Mars 2020

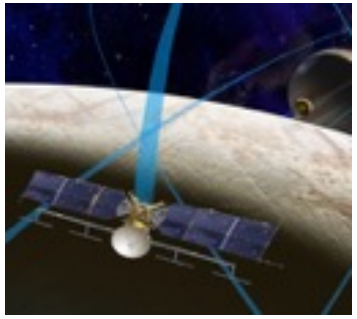
Mars Helicopter



NISAR 2021



SWOT 2021

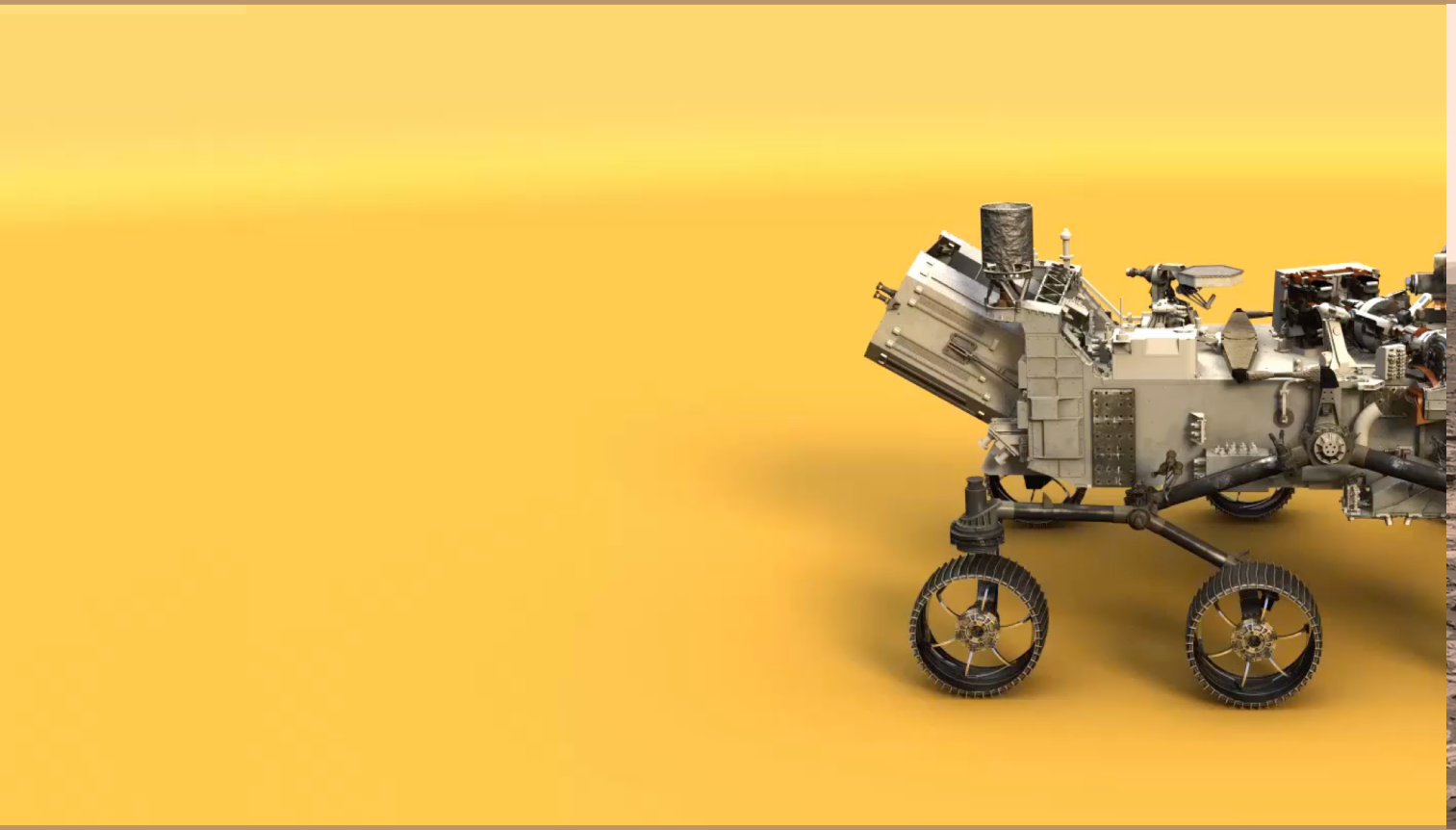


Europa Clipper 2022

PSYCHE 2022

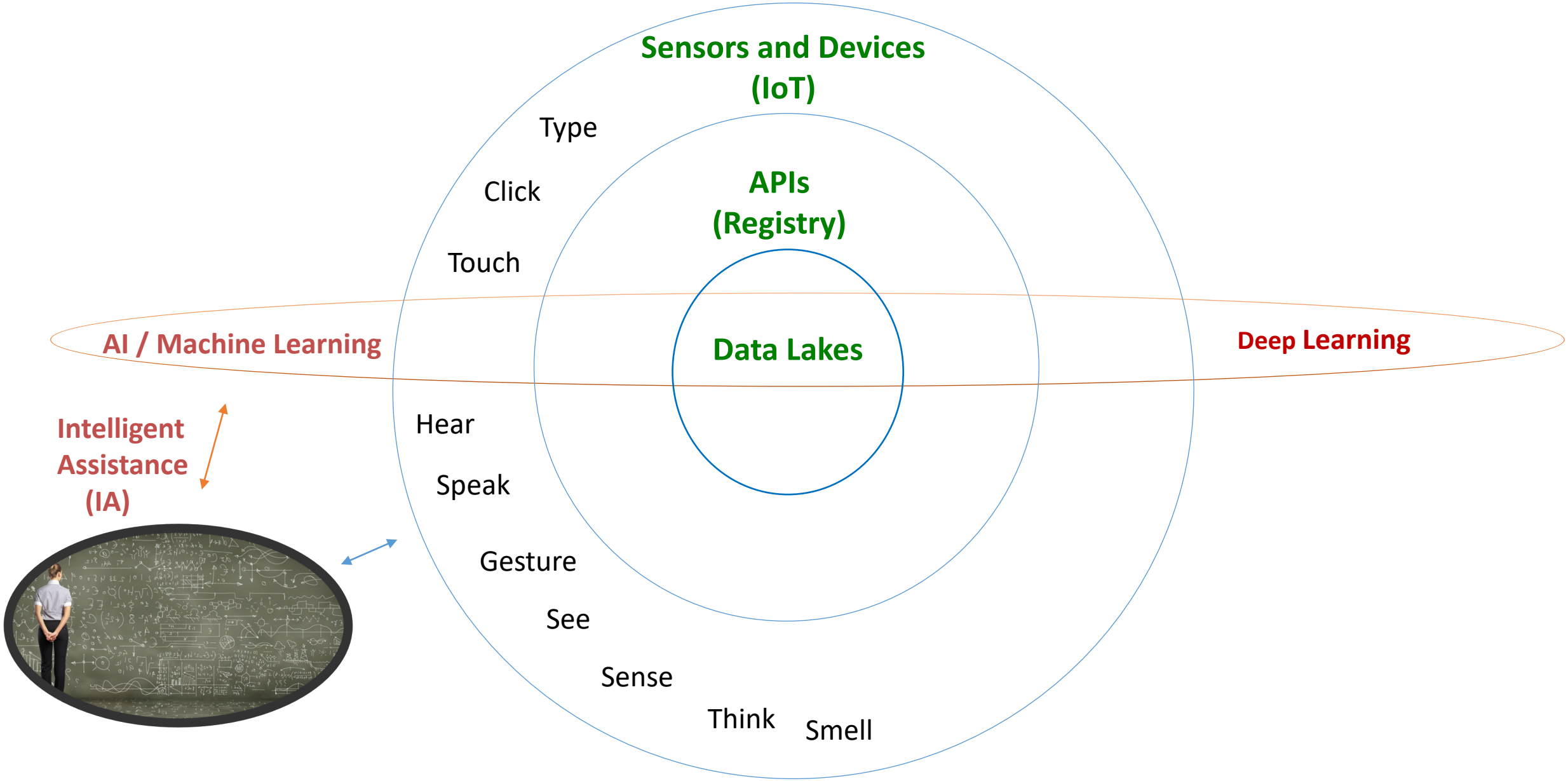
W E ’ R E G O I N G B A C K !

Mars 2020: Our next rover on Mars



Our Vision of How We Will Work

Leverages IOT, Programming, Smart Data, Cloud, and Artificial Intelligence, which can evolve at different cadences



Prepare for next generation of explorers’ ways of working

Augmented and Virtual Reality

"Alexa, enable NASA Mars"
"How cold is Mars?"
"Can people live on Mars?"
...

- Separate IoT Network
- Serverless - safer and cheaper
- Natural user interfaces
- Using multiple senses
- Handles huge scale

Opportunities

Small Business Innovative Research (SBIR)

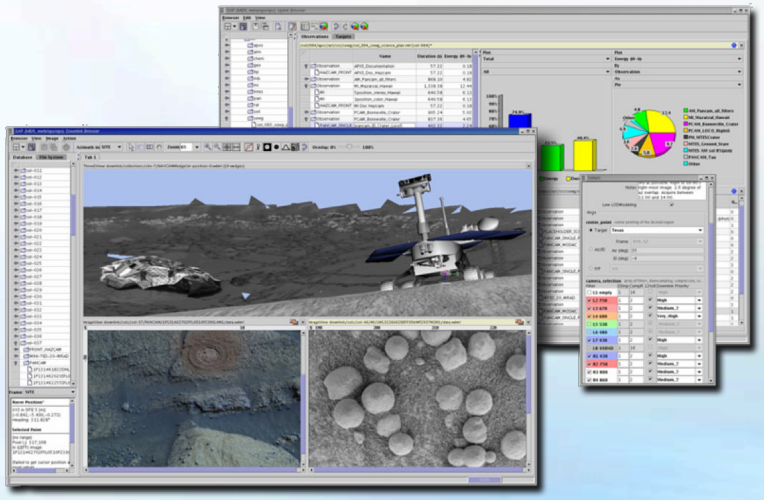
- Funds research, development, and demonstration of innovative technologies that fulfill NASA needs and have significant potential for successful commercialization. https://sbir.jpl.nasa.gov/

NASA Western Water Applications Office (headquartered at JPL)

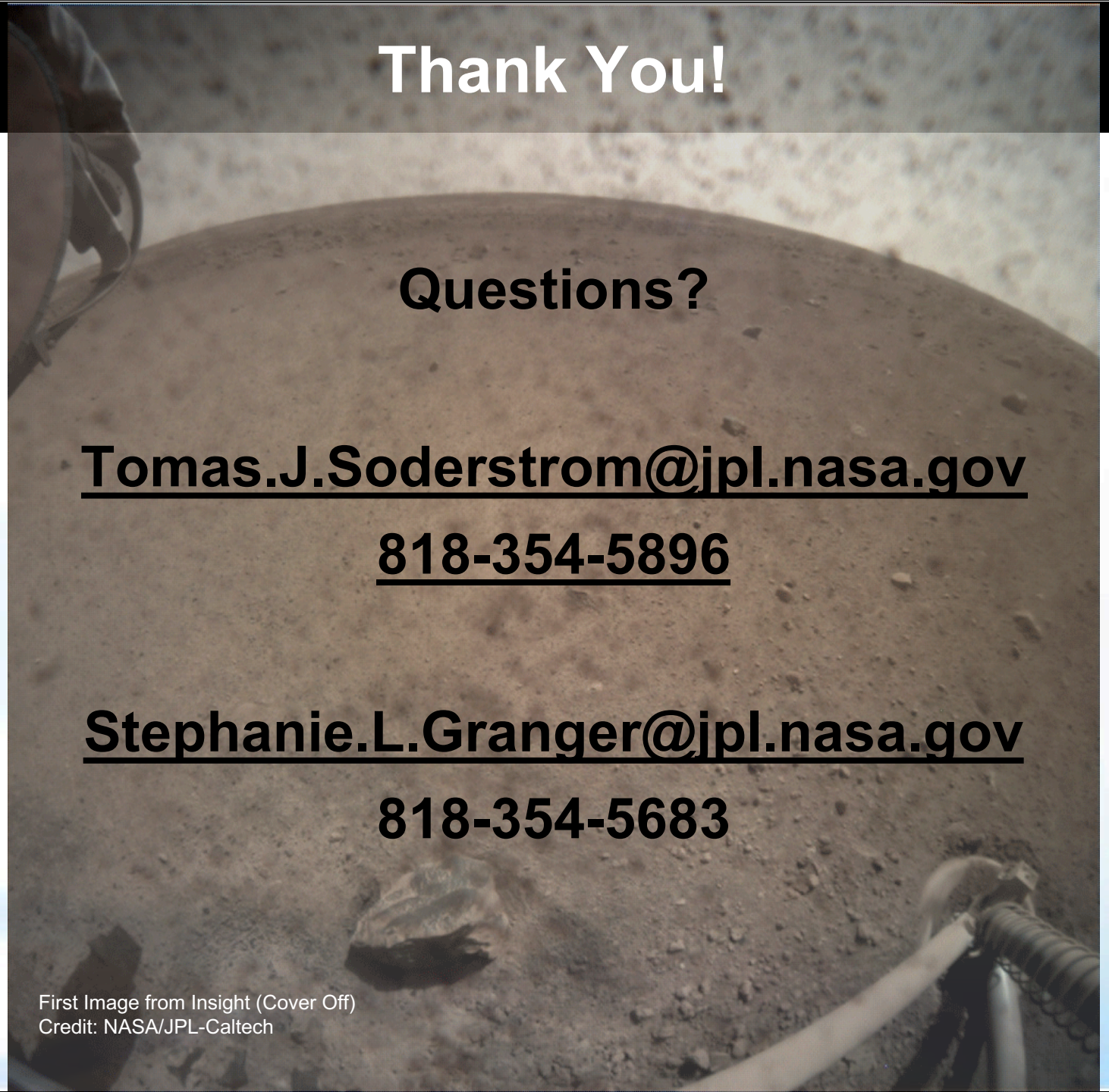
- Accelerates the application of NASA observations and analysis to timely water management problems. https://water.jpl.nasa.gov/

JPL Office of Technology Transfer

- Facilitates the transfer of technologies to the commercial sector so that the public can directly benefit from outstanding researchers. https://ott.jpl.nasa.gov/



Thank You!



Questions?

Tomas.J.Soderstrom@jpl.nasa.gov

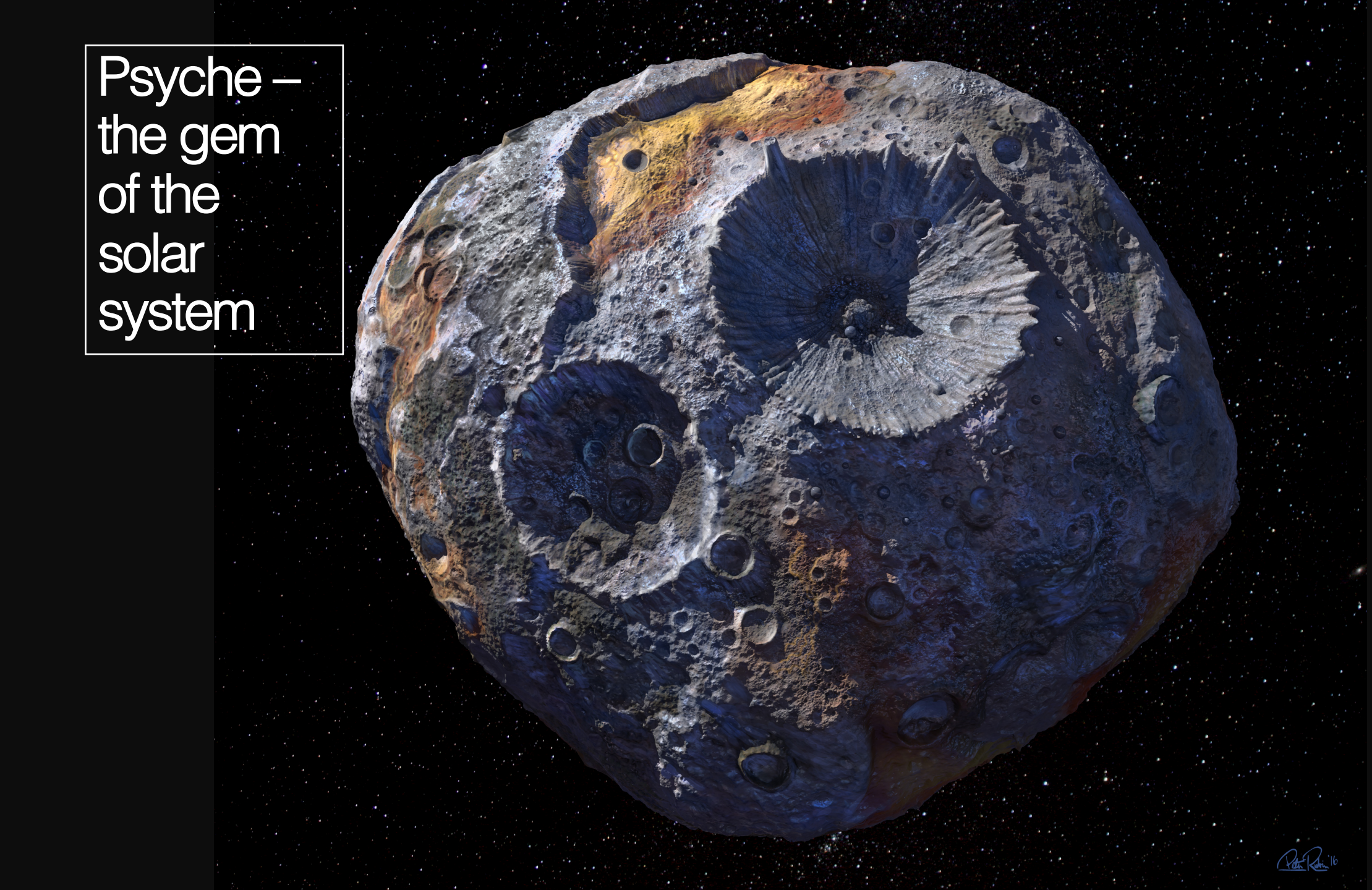
818-354-5896

Stephanie.L.Granger@jpl.nasa.gov

818-354-5683

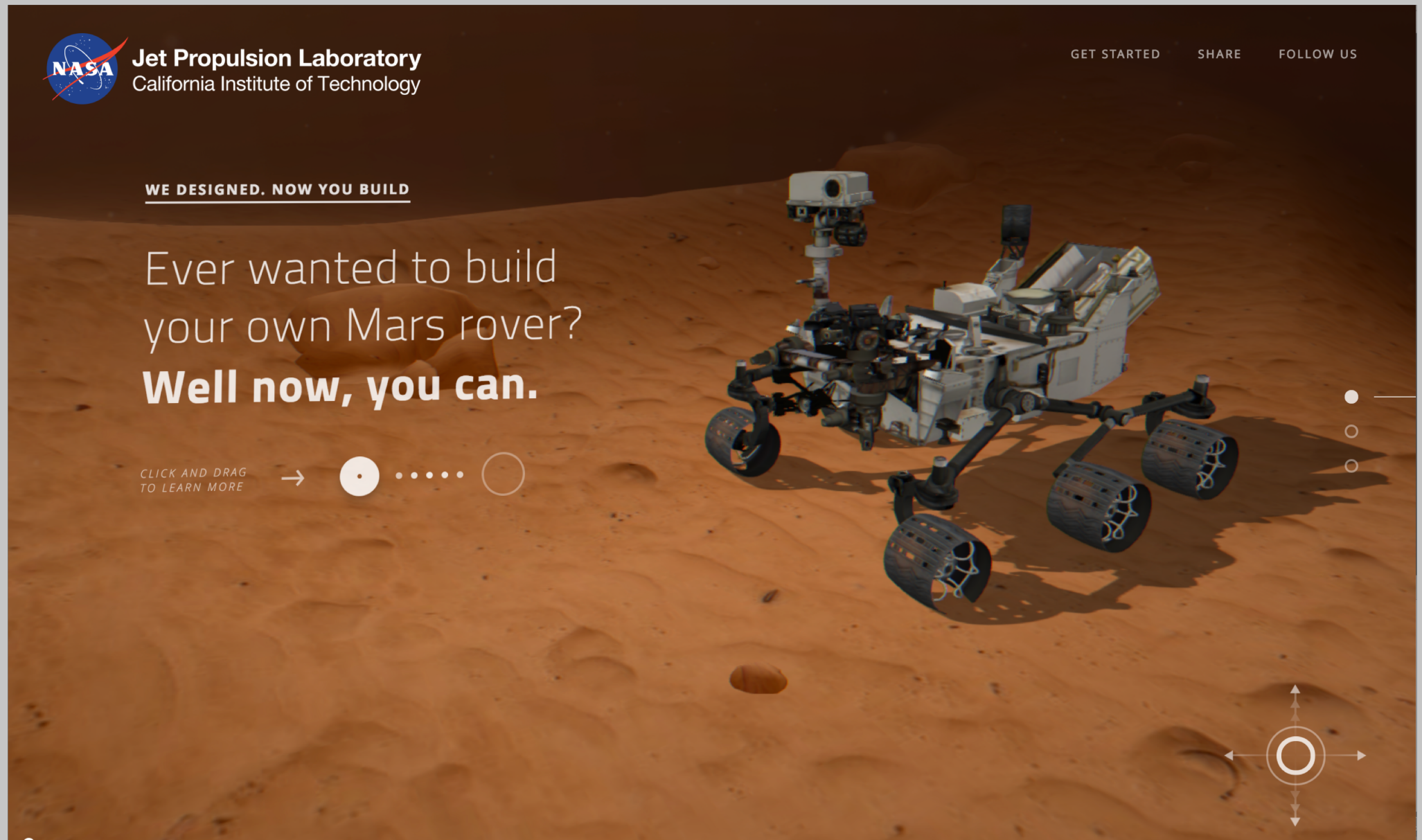
First Image from Insight (Cover Off)
Credit: NASA/JPL-Caltech

Psyche – the gem of the solar system



Preparing for the next generation of explorers with hands-on

JPL Open Source Rover site - https://opensourcerover.jpl.nasa.gov

Learn Robotics with the JPL Open Source Rover

https://opensourcerover.jpl.nasa.gov