OpenSpace

Putting OpenSpace into use | ASTC 2019

Engaging high school interns

Mark SubbaRao, The Adler Planetarium & Astronomy Museum

Data to Dome

Data to Dome in an initiative of the International Planetarium Society designed to streamline the process of going from data to dome, increasing the potential for scientific communication and storytelling in the planetarium.

The task force will undertake initiatives (inclusive of Data to Dome) aimed at:

- Preparing planetaria for the big data streams that will come from next generation telescopes, satellites, experiments and computational simulations.
- Creating professional development opportunities aimed at developing more "data savvy" planetarians.
- Developing and promoting best practices for data visualization in the dome.
- Encouraging the visualization of a wide range of scientific data in the dome (moving beyond astronomy).

Find out more here: http://data2dome.org

OpenSpace Data to Dome Resources

We have developed a python-based GitHub repository contains libraries and example code for creating OpenSpace visualization modules. Generator routines will create a visualization module either from a data table, or directly from a CDSn (Strasbourg astronomical Data Center) http://cds.u-strasbg.fr/ catalog number. This enables the visualizations of tens of thousands of published astronomical catalogs with just one or two lines of python code. https://github.com/IPSScienceVisualization/OpenSpace

Galaxy Zoo in OpenSpace

Galaxy Zoo (https://www.zooniverse.org/projects/zookeeper/galaxy-zoo) is a decade-long citizen science project that has engaged millions of people in classifying galaxies from various astronomical surveys. Here we provide a python based Jupyter notebook that illustrates how to:

- download the data sets containing the Galaxy Zoo classifications
- explore that data
- build an OpenSpace visualization module.

https://github.com/archiekinnane/AdlerSummer/blob/master/JupyterNotebooks/adler1.ipynb

Informal interactive opportunities and videos for museums and teaching

Rachel Smith, North Carolina Museum of Natural Science

Astronomy & Astrophysics Research Lab

- "Digital narrative" for visual storytelling in display format, ongoing thematic displays visible in museum
- Special events, OpenSpace helps inspiring conversations on astronomy, research, and data visualization; OpenSpace can be worked into many types of special astronomy-related events
  - *Astronomy Days* and members' tours at NCMNS
  - Apollo 50th anniversary
- Internship opportunities for students
- Informal interactive opportunities for visitors in lab during special events

Videos for exhibits/displays

- Research screen, NCMNS
- Example: Museum of Life and Science, Lunar Lander exhibit

OpenSpace

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An expanding OpenSpace mp4 library

- Videos that enhance public outreach and teaching
- Example: undergraduate course, Astrobiology: Searching for Life in the Universe, Appalachian State University
- Example of using OpenSpace for research communication — Sci Tech Expo talk on meteorites and star formation research

Live, interactive presentation tool

Carter Emmart, American Museum of Natural History

150 YEARS | AMERICAN MUSEUM OF NATURAL HISTORY

Astronomical programs: The Tour of the Universe

- Local Stellar Neighborhood and Radio Sphere
- Milky Way Galaxy
- Extragalactic Structure
- Contextualizing the Cosmic Background Radiation
- Dynamic Scene Graph to seamlessly accommodate the true scale range of the universe

Dedicated to contextualizing the various datasets that comprise the Digital Universe, they not only show the extent of our knowledge, they also show our limitations imposed by distance, brightness, survey extent, uncertainty and understanding.

Space Mission programs: NASA SPICE and Image Projection

- New Horizons
- Rosetta
- OSIRIS-Rex
- Apollo 8 / Earthrise
- Apollo 11 50th Anniversary

Showing not just the results of planetary missions, such as carefully produced global maps, but how missions are actually conducted is made possible by visualizing the actual geometry of the missions. This is made possible by NASA's Navigation and Ancillary Information Facility (NAIF) and their space mission navigation codification structure called SPICE (for Spacecraft, Planets, Instruments, Cameras and Events). SPICE has become an international standard of use especially with nations that are tracked by the multi-national Deep Space Network. OpenSpace uses SPICE in order to depict missions as they are conceived or were actually flown.

Planetary Science programs: Globe Browsing with Multi-Scale Height Maps

- Earth Day
- Mars 2020 Site Candidates
- Apollo Landing Sites as imaged by the Lunar Reconnaissance Orbiter
- Mercury results of the MESSENGER mission

Like Google Earth, OpenSpace has developed use of remote serving of high-resolution maps for worlds that space missions have surveyed thus far. Built on the Geospatial Data Abstraction Language (GDAL), OpenSpace has developed multiple scale height map browsing allowing finest resolution of both imagery and terrain modeling. Adding regional and local close-up patches is also supported and has been used for specific programs of interest.

Apollo 16 astronaut, Charlie Duke, Lunar Module Pilot, was interviewed in a closed session in the Hayden Planetarium and a YouTube 360 recording was made as a record:
https://www.youtube.com/watch?v=MarfXBo8Et8&t=1217s

Planetary Surface programs: Surface scale overlay models

- Apollo EVA Photogrammetry
- Mars Curiosity Rover and Navcam terrain models

Models are geospatially located to show proper context to surrounding terrain. In the case of Apollo, historic EVA photography was used for photogrammetry reconstruction of boulders at several stations where samples were collected. The lunar module was constructed from photogrammetry of LM-2 at the Smithsonian National Air & Space Museum. In the case of Curiosity Rover, all action is visualized as SPICE playback of actual operations.

A YouTube record of the OpenSpace Apollo 11 50th Anniversary Recreation broadcast to NASA@MyLibrary was done as a live YouTube stream: https://www.youtube.com/watch?v=Xhh7mNUJ9Oo

Space Weather programs: Collaboration with NASA's Community Coordinated Modeling Center (CCMC)

- Sun-Earth Connection
- Sun-Earth Interaction

Starting in 2012, prior to NASA funding, early development work on OpenSpace was conducted by master thesis students from LiU stationed at NASA Goddard CCMC with the goal of creating interactive volumetric rendering and field and flow line tracing of simulation time series of solar events and interaction with earth's magnetosphere. Two major public programs were developed from this on-going work.

In 2017 and 2018, the Sun-Earth Connection was presented in the Hayden Planetarium and LeFrak Large Screen Theater venue at AMNH in collaboration Predictive Science Inc. A YouTube 360 recording was made:
https://www.youtube.com/watch?v=rDDjcxBP6ag
https://www.youtube.com/watch?v=VM_6XpLR3gw

OpenSpace w/ Teen Interns at the Adler Planetarium

Data Science . Astronomy . Science Communication

At the Apollo 50th Celebrations Adler Teens presented OpenSpace to over 1,000 visitors
Here w/ mentory (recent Astronomy graduates and Dr. Reatha Clark King who worked on rocket fuel for Apollo at the National Bureau of Standards.

1. Introduction to Python and Jupyter Notebook

Cells in Jupyter Notebook

There are two types of cells:

- **Text cell**: Texts are written (like this cell)
- **Code cell**: You can enter Python codes here and can run them. To run codes in a code cell, first select the cell and then press Shift-Enter key, click the 'play' button in the tool bar above, or select Cell | Run Cells in the menu bar. For code cells, input numbers are displayed at the left of the cell, for example '`In [1]`'. When running cell, the output is displayed below the cell.

In the following workshop, you basically first read explanations of a topic in a text cell, and then try it in a code cell next to the text cell.

Print function

The print function is useful to display the status of the running code. It can be used like

```
print ('text')
```

It can also display values of variables like

```
a = 1
print(a)
```

Enter the following code in the cell below and run it (Shift+Enter) to check this.

```
print ('text')
a = 1
print(a)
```

IPSScienceVisualization / OpenSpace

Unwatch 3 | Unstar 3 | Fork 0

Code | Issues 0 | Pull requests 0 | Projects 0 | Wiki | Security | Insights | Settings

No description, website, or topics provided.

Edit

Manage topics

49 commits | 1 branch | 0 releases | 2 contributors

Branch: master | New pull request | Create new file | Upload files | Find File | Clone or download

archiekinnane Update speck_creator.py — Latest commit a1b8ab2 on Aug 3, 2018

data2ops	Update speck_creator.py	10 months ago
EXAMPLE_files2ops.ipynb	Update EXAMPLE_files2ops.ipynb	10 months ago
EXAMPLE_viz2ops.ipynb	Update EXAMPLE_viz2ops.ipynb	10 months ago
README.md	Update README.md	10 months ago
tutorial.md	Update tutorial.md	10 months ago

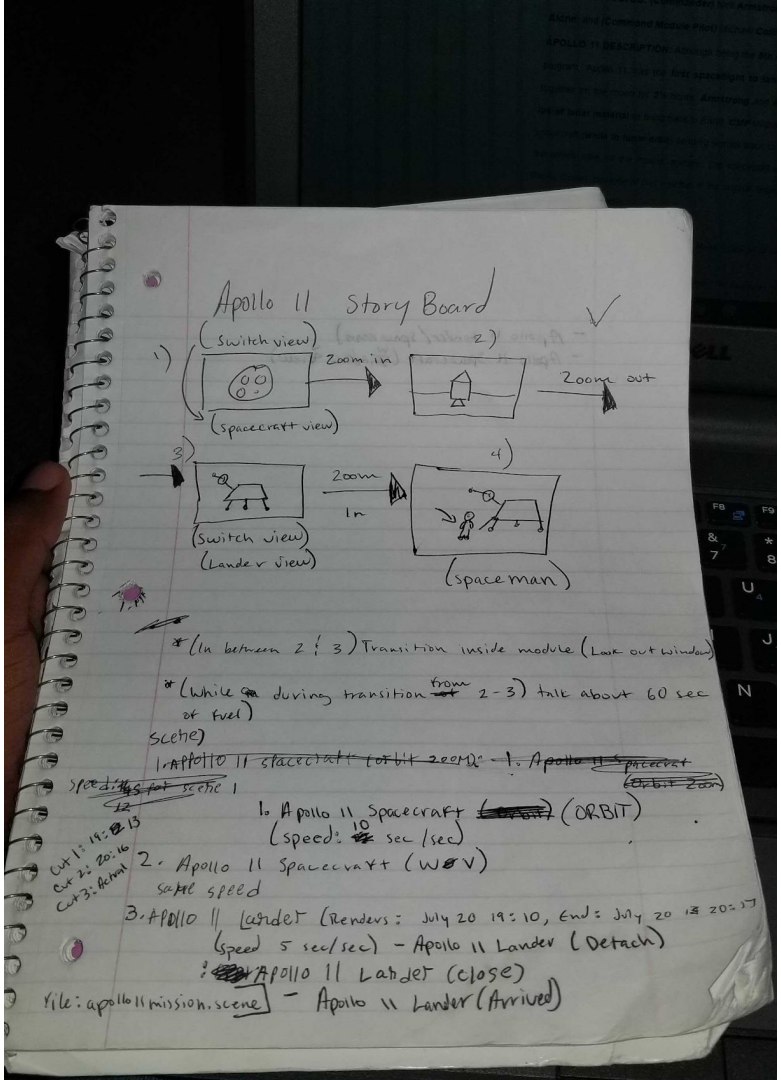
README.md

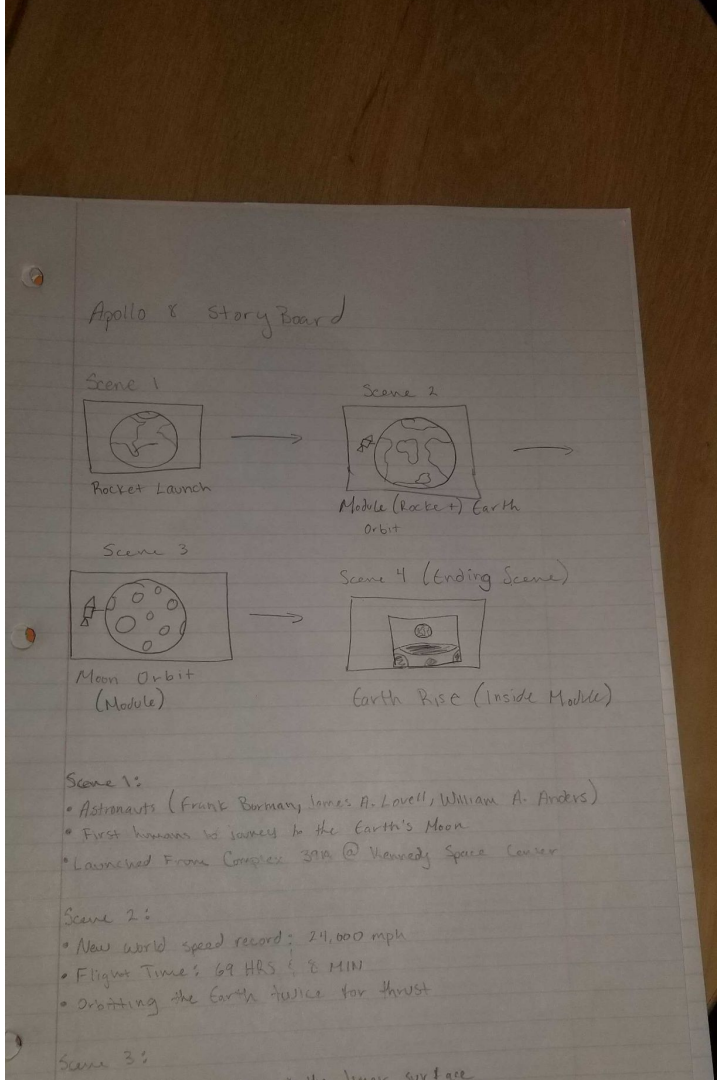
OpenSpace Python Resources

This repository contains libraries and example code for using python to create OpenSpace visualization modules. Generator routines will create a visualization module either from an Astropy Table, or directly from a CDS http://cds.u-strasbg.fr/ catalog number providing access to tens of thousands of published astronomical catalogs

Open Space Intern
Presentation Skills Activities

1. **Watch A Ted Talk (Deconstruct Mark & Jedidah)**
   - How do you think they did?
   - What could they improve on?
   - What did they do well?
   - What's one thing that stood out to you about their presentation?
   - What's one thing you can borrow from them while giving your presentation?
2. **Keep It Simple Stupid (K.I.S.S) & 10-20-30 Rule**
   - The Idea of K.I.S.S
   - 10-20-30 Rule Idea
3. **Speak Loud & Clear (Led by Reyhanneh)**
4. **Grab Attention & Tell Stories (Led by Reyhanneh)**
5. **Make Eye Contact & Use Body Language (Led by Reyhanneh)**
6. **Show Passion & Focus (Led by Reyhanneh)**
7. **Give Their Presentations Week 5 & 6 (8/14/19 Bash Event)**
8. **Present On Space Topics Throughout SVL Open Hours**


Apollo 11 Story Board
(switch view)
1)
Zoom in
2)
Zoom out
(spacecraft view)
3)
4)
Zoom
In
(switch view)
(Lander view)
(spaceman)
* (In between 2 & 3) Transition inside module (Look out window)
* (While during transition from 2-3) talk about 60 sec of fuel)
Scene)
1. Apollo 11 spacecraft orbit zoom
1. Apollo 11 Spacecraft (ORBIT)
(speed: 10 sec/sec)
2. Apollo 11 Spacecraft (WORV)
same speed
3. Apollo 11 Lander (Renders: July 20 19:10, End: July 20 20:17
(speed 5 sec/sec) - Apollo 11 Lander (Detach)
Apollo 11 Lander (close)
File: apollo11mission.scene - Apollo 11 Lander (Arrived)


Apollo 8 Story Board
Scene 1
Scene 2
Rocket Launch
Module (Rocket) Earth Orbit
Scene 3
Scene 4 (Ending Scene)
Moon Orbit (Module)
Earth Rise (Inside Module)
Scene 1:
• Astronauts (Frank Borman, James A. Lovell, William A. Anders)
• First humans to journey to the Earth's Moon
• Launched From Complex 39A @ Kennedy Space Center
Scene 2:
• New World speed record: 24,000 mph
• Flight Time: 69 HRS & 8 MIN
• Orbiting the Earth twice for thrust
Scene 3:


teeninte


EXIT


The Community Bash

North Carolina Museum of Natural Sciences

NORTH CAROLINA
Museum *of* Natural Sciences

Association of Science-Technology Centers annual conference
Toronto, Canada

September 20, 2019

Astronomy & Astrophysics Research Lab

Creating thematic visuals with OpenSpace

Digital Narrative

Mars

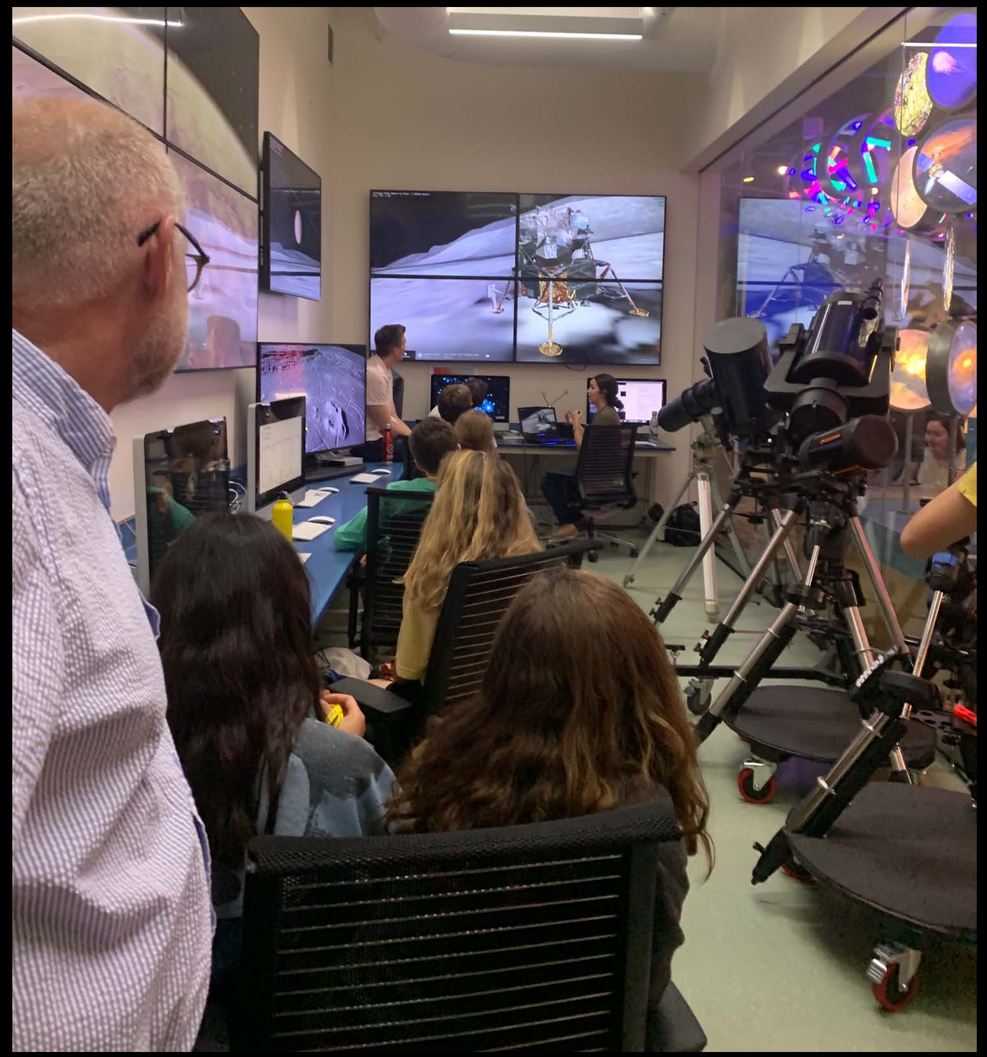
Digital Narrative

Earth

Special Events
Examples: Astronomy Days, members' tours

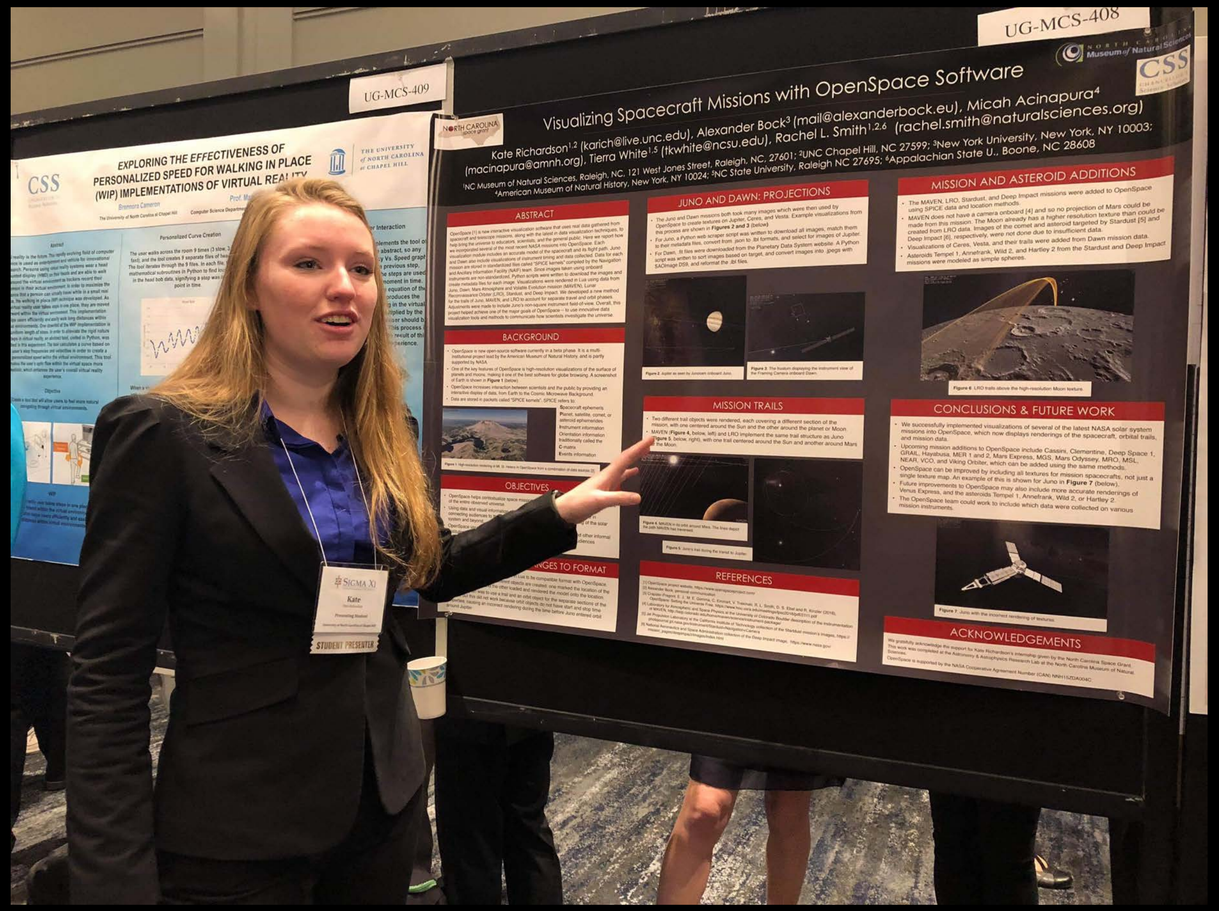
Weekend event during the last weekend in January
2019: 14,959 visitors experienced OpenSpace
through program and/or lab

Example: Apollo 11 50th anniversary



Students and Interns

Students and Interns



Sigma Xi Student Research Symposium
2018

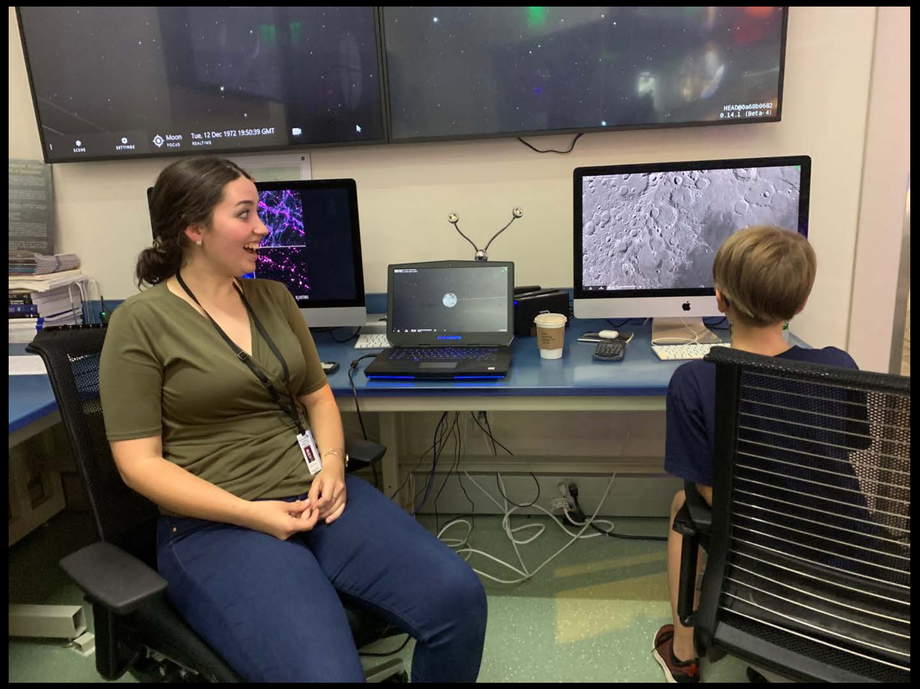
Kate Richardson
Physics & Astronomy/Computer Science
UNC- Chapel Hill

Best Poster Award, Math and Computer Science Division

Students and Interns

Appalachian State University, Dark Sky Observatory, Boone, NC

Interactive visitor opportunities

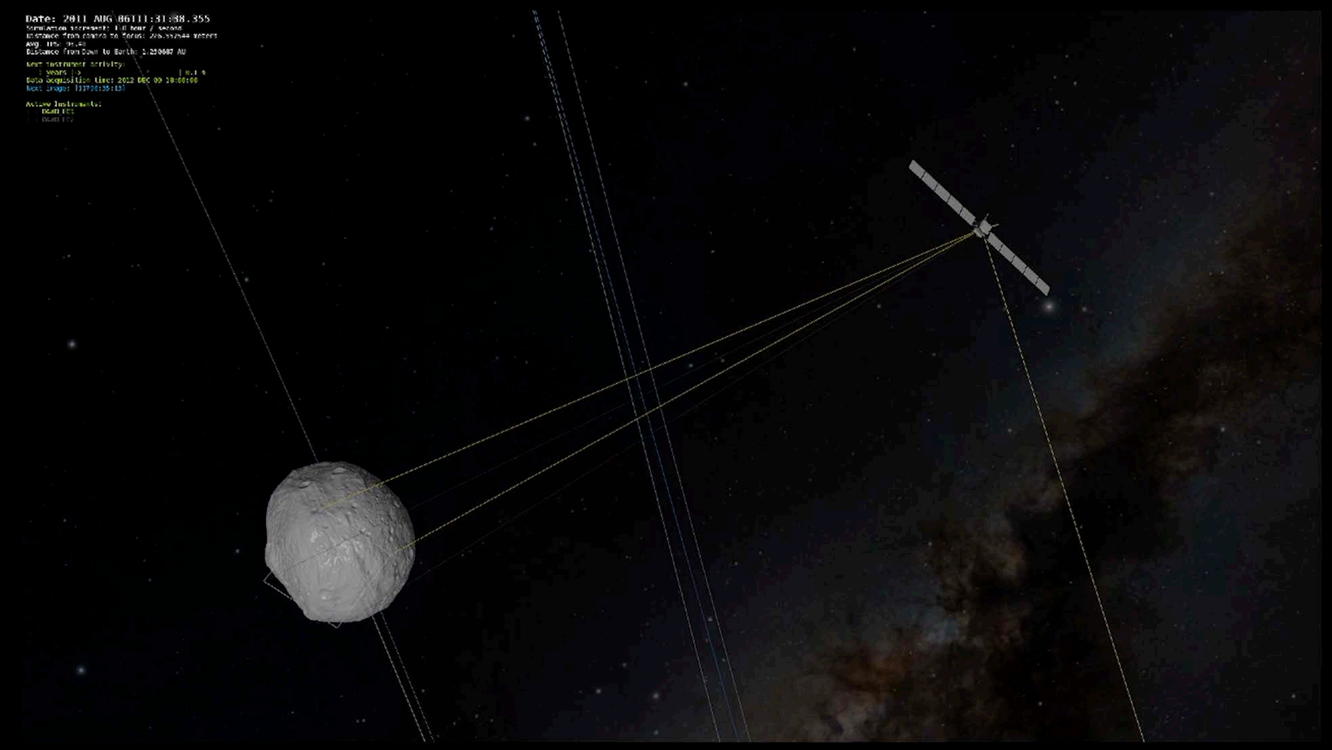


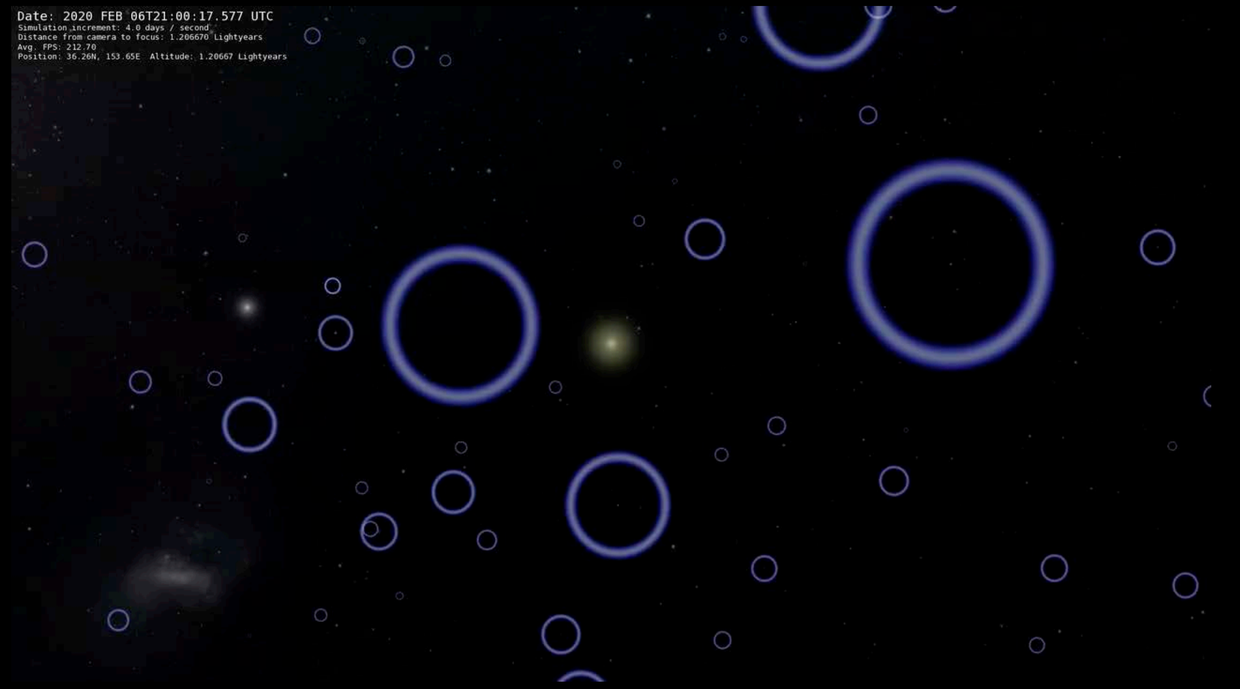
Museum Exhibits

Museum of Life and Science
Durham, NC
Lunar lander exhibit

Digital Library

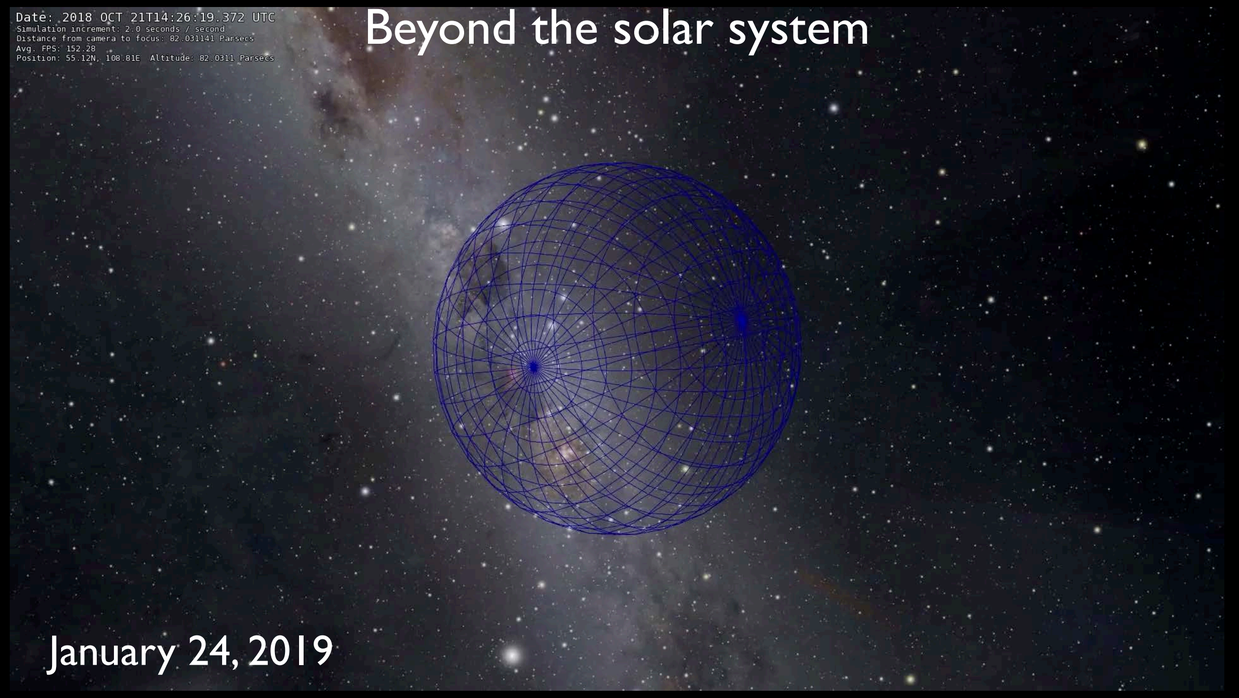
Ever-expanding *OpenSpace* mp4 video library





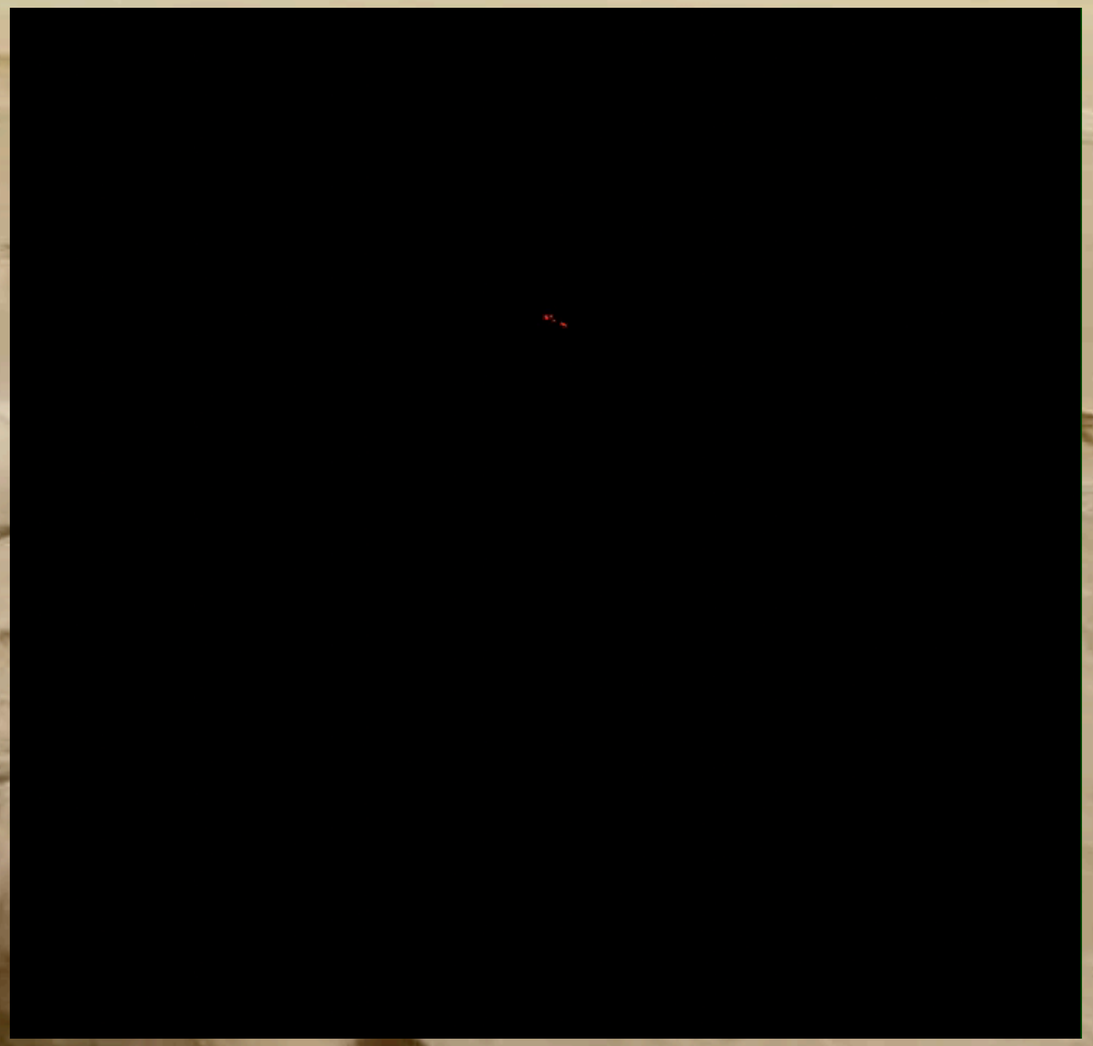
Undergraduate general education course: *Astrobiology: Searching for Life in the Universe*

Example lectures



Using *OpenSpace* for research communication

Example: Sci Tech Expo research presentation



Zagami
Mars

OpenSpace

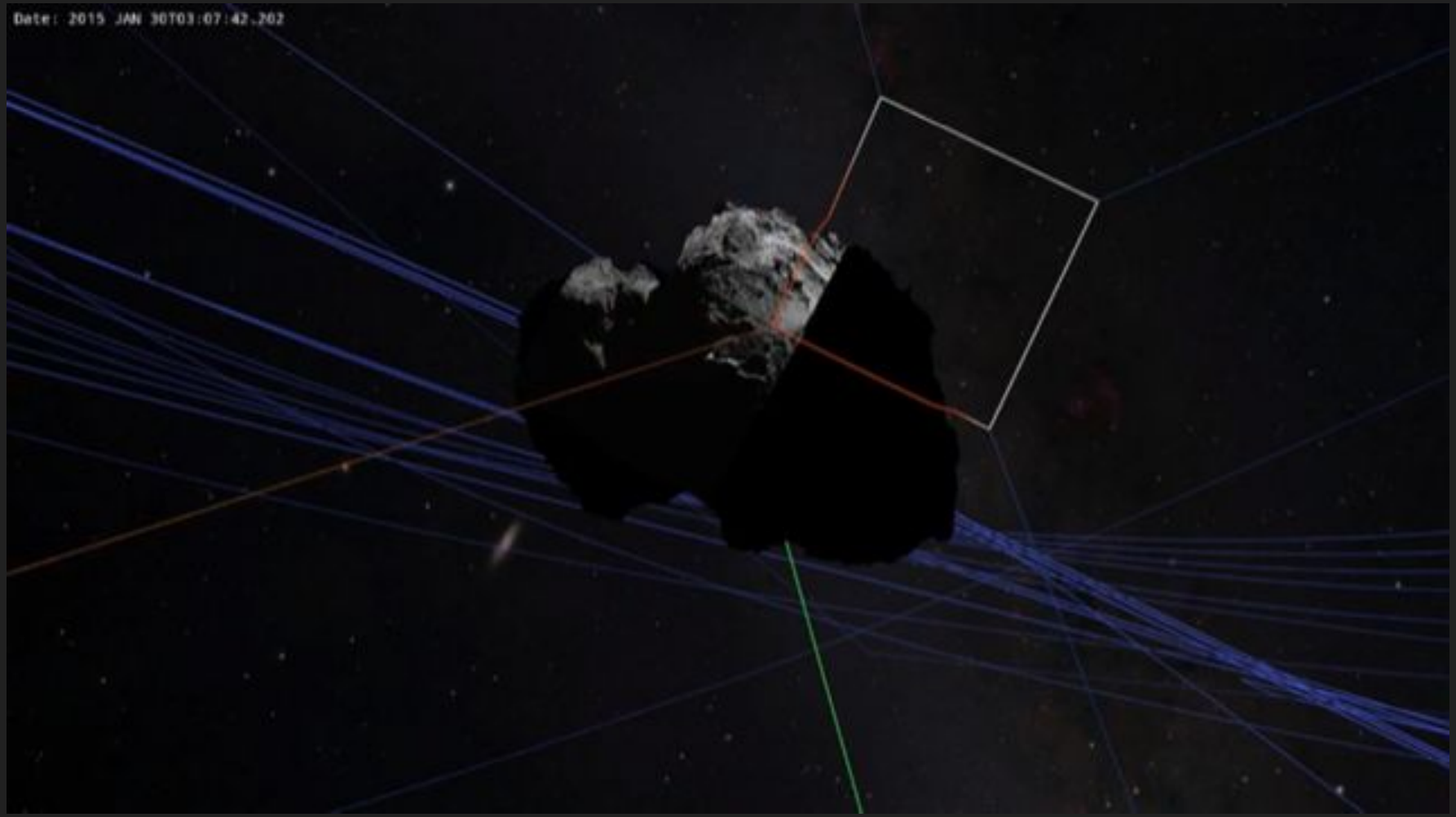
Live, interactive presentation tool

Carter Emmart, AMNH


Algol
Mothallah
NGC 1514
Hamal
Sheratan
Aldebaran


GAIA DR2 star catalog


Date: 2015 JUL 14T08:22:24.404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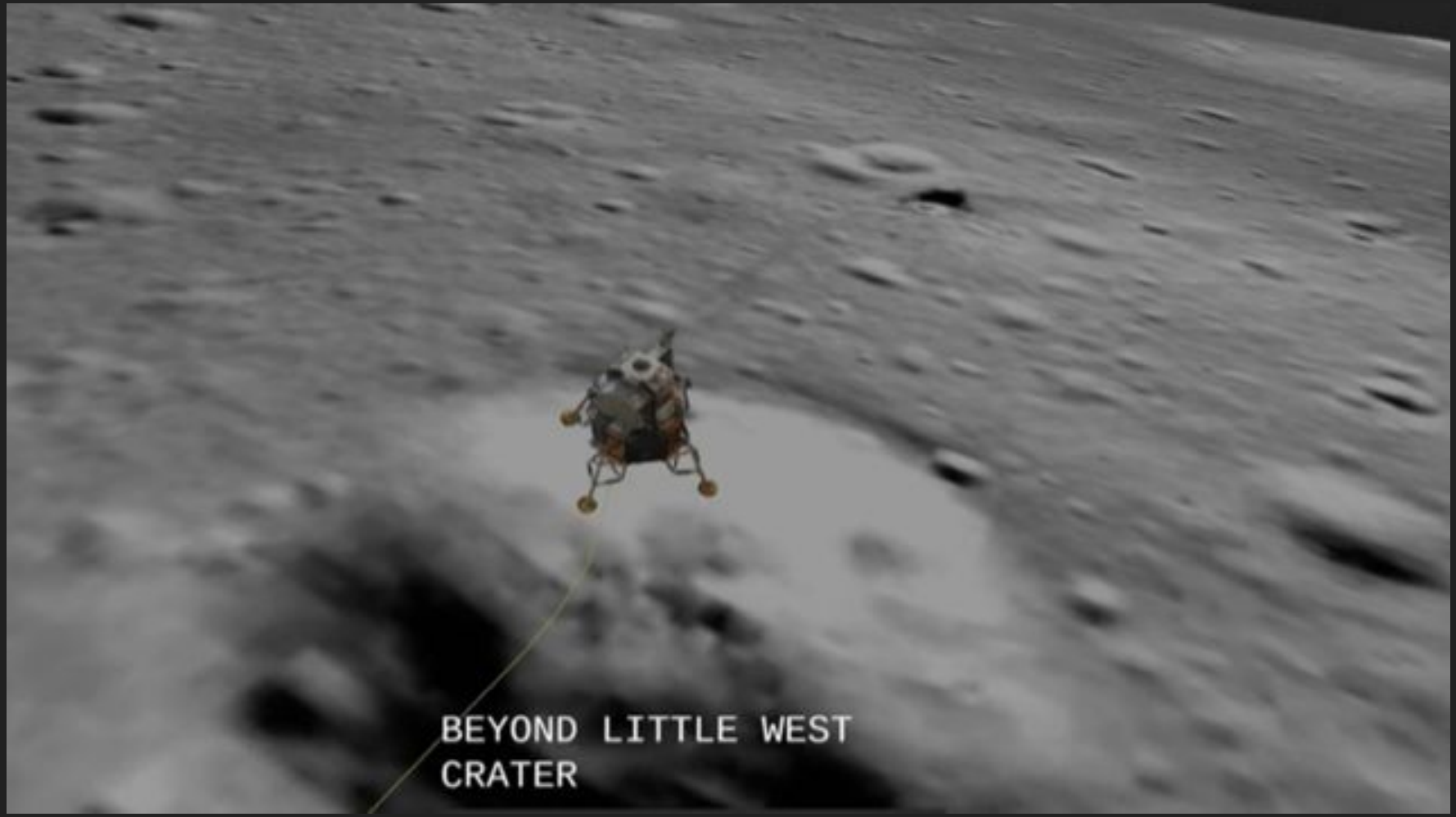
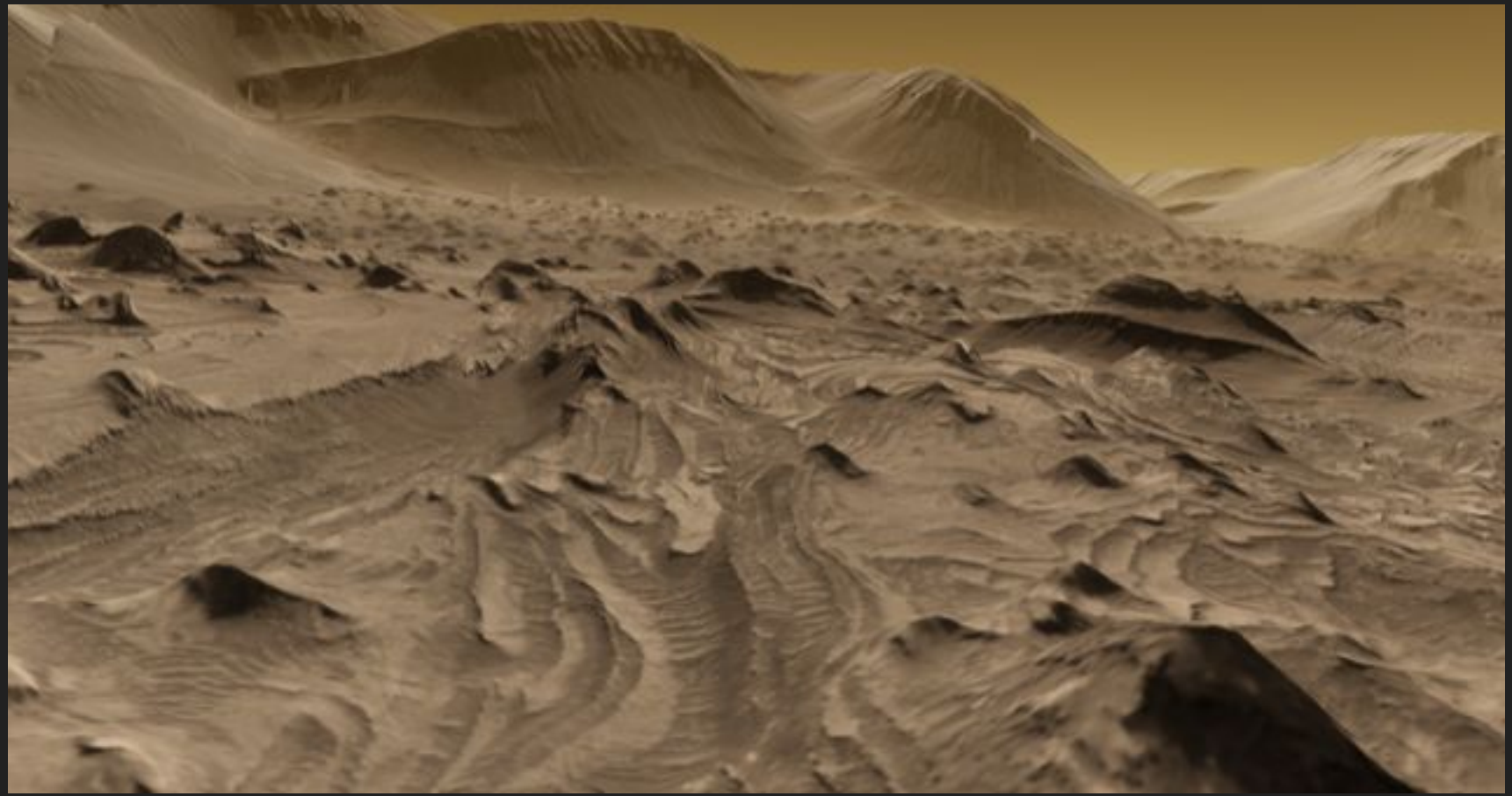
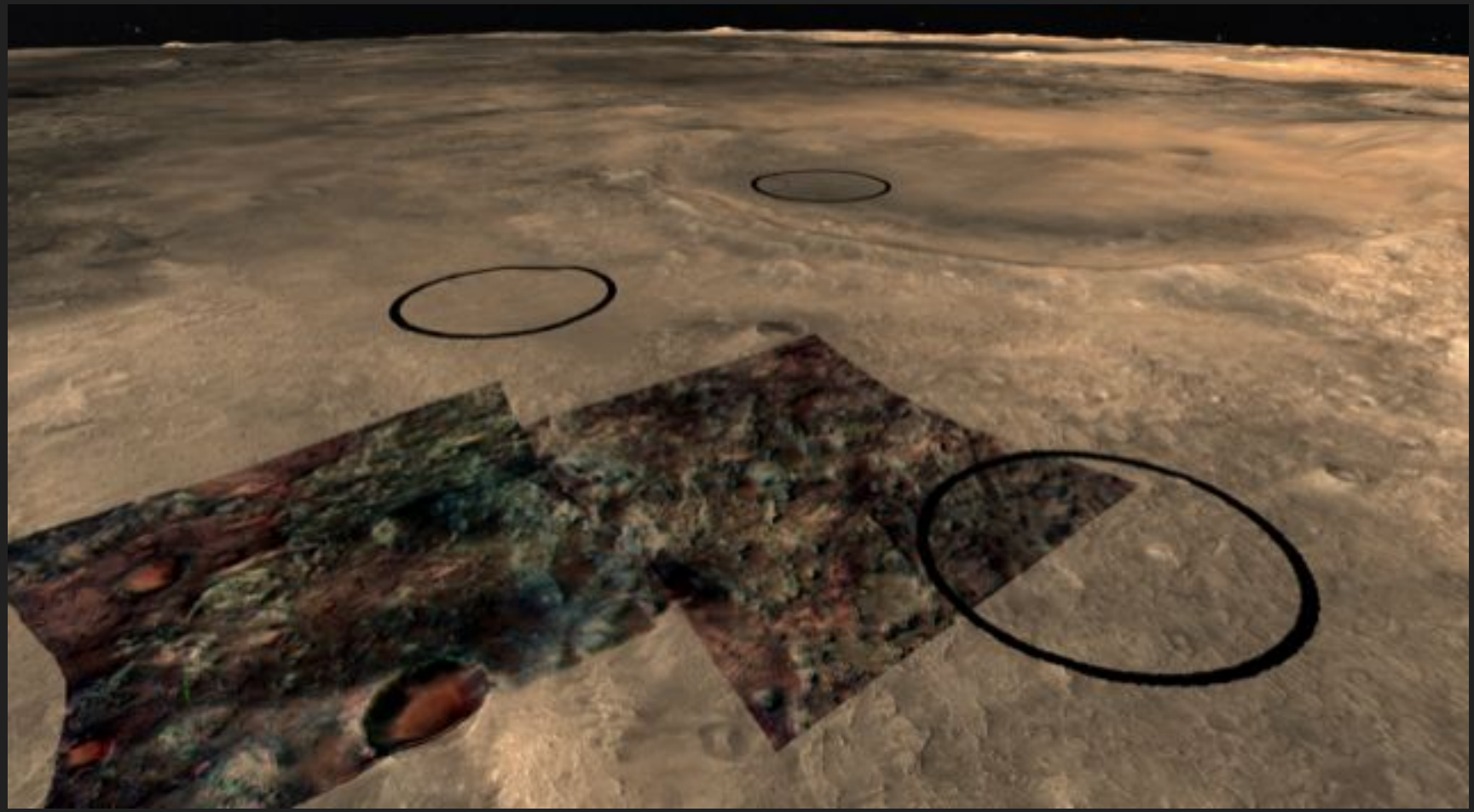
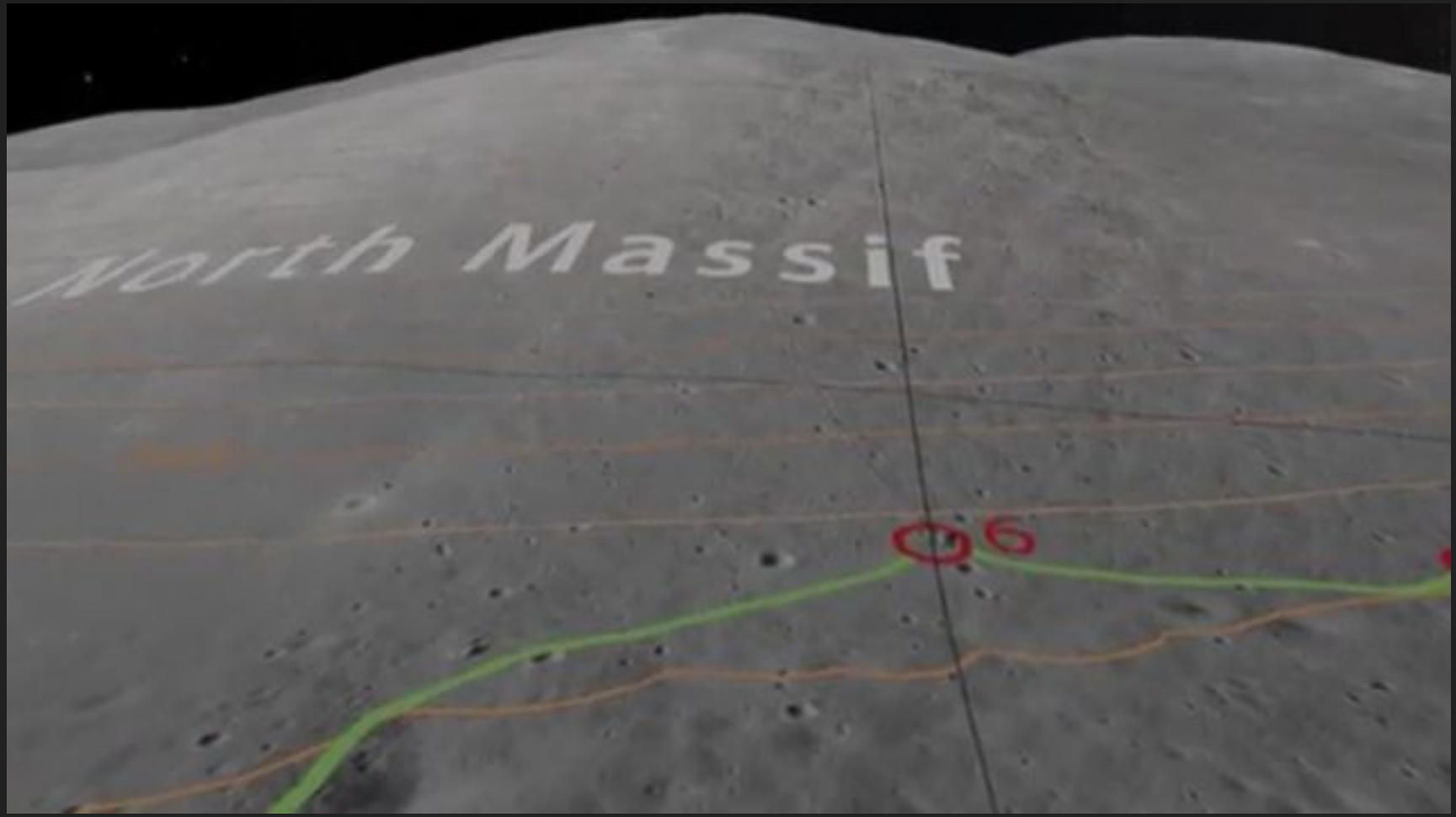

BEYOND LITTLE WEST
CRATER

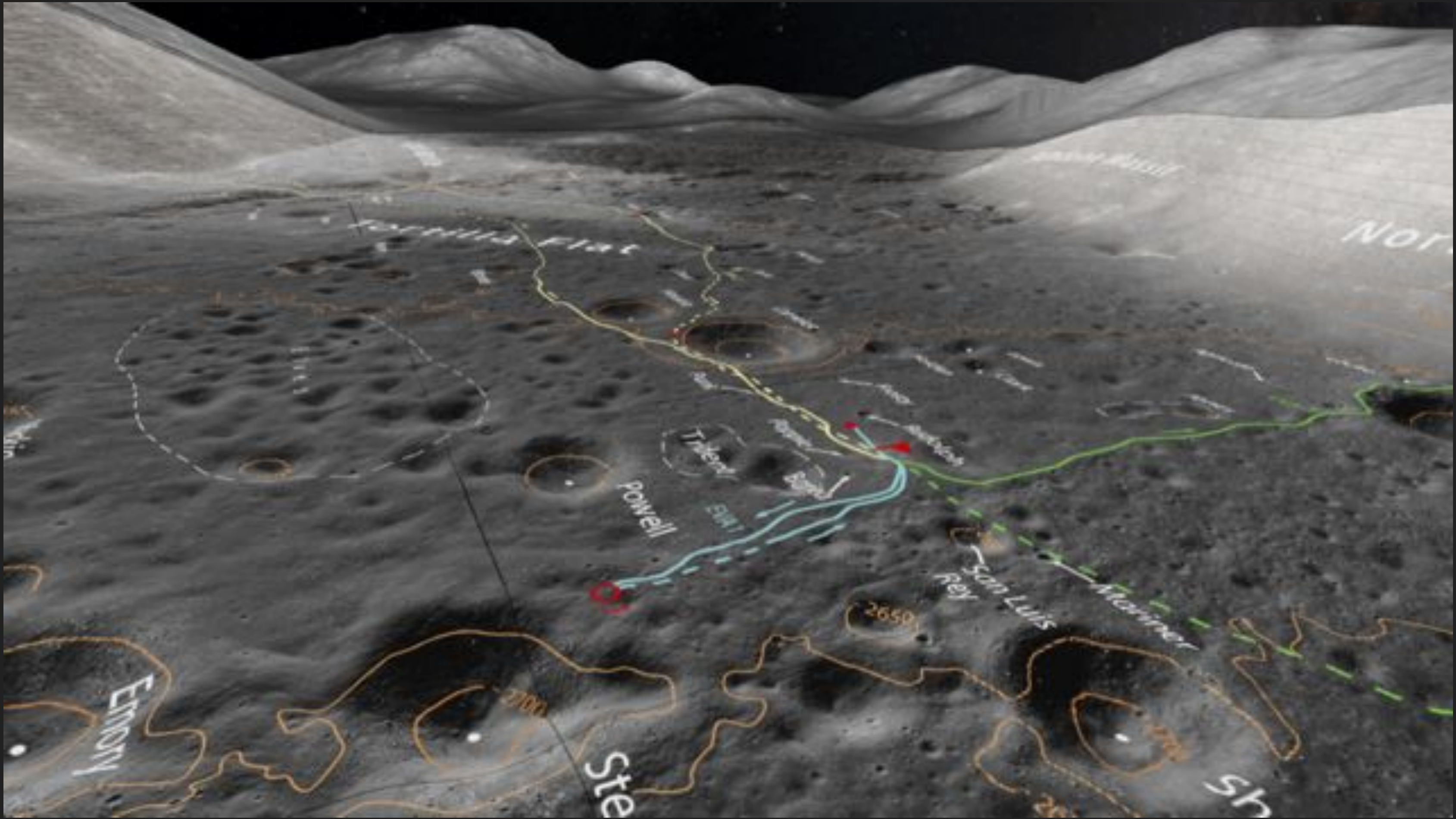

30 SECONDS OF FUEL
THEY GET THE WARNING

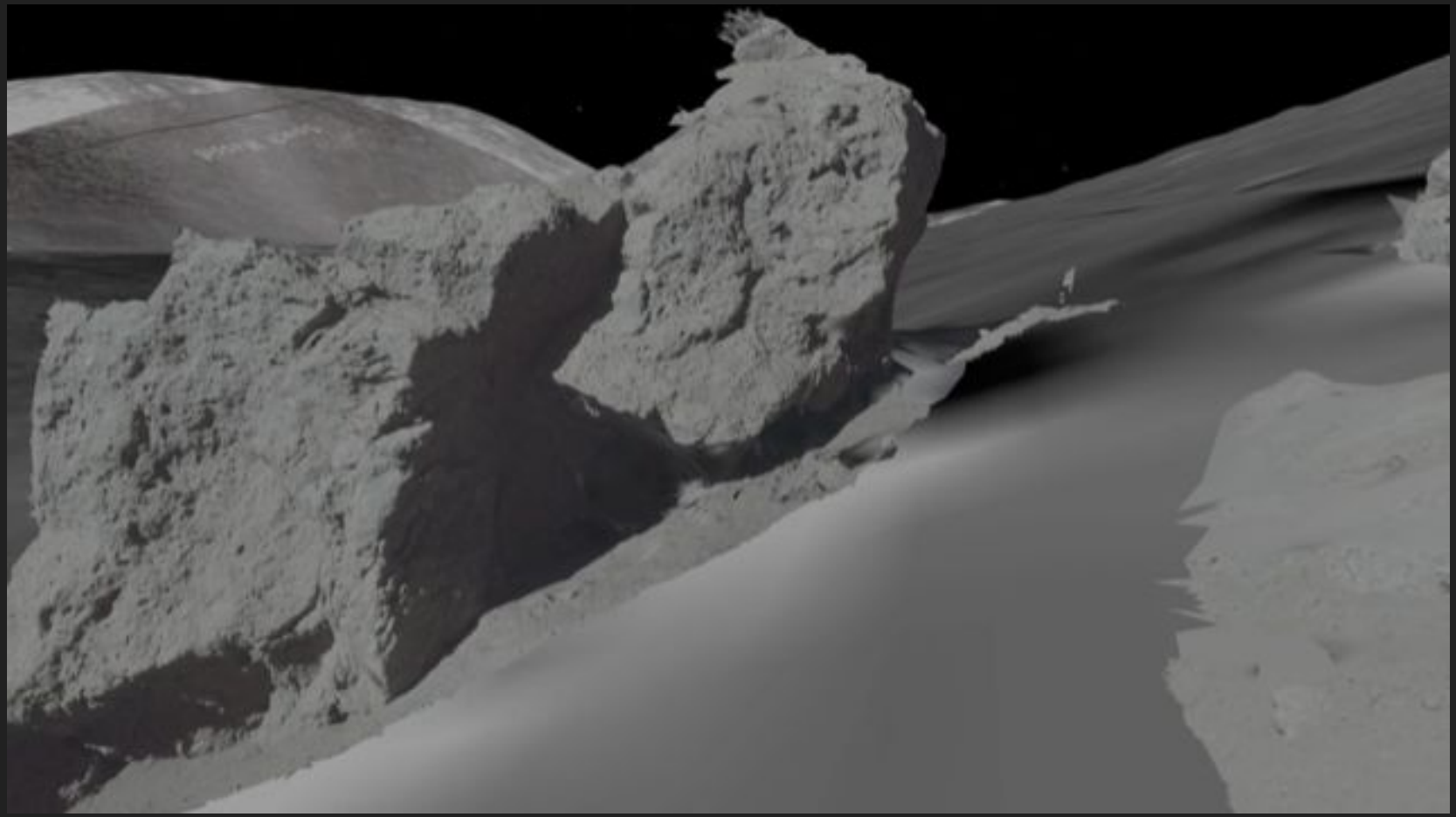

MRO HiRISE (0.25m) UA DTM



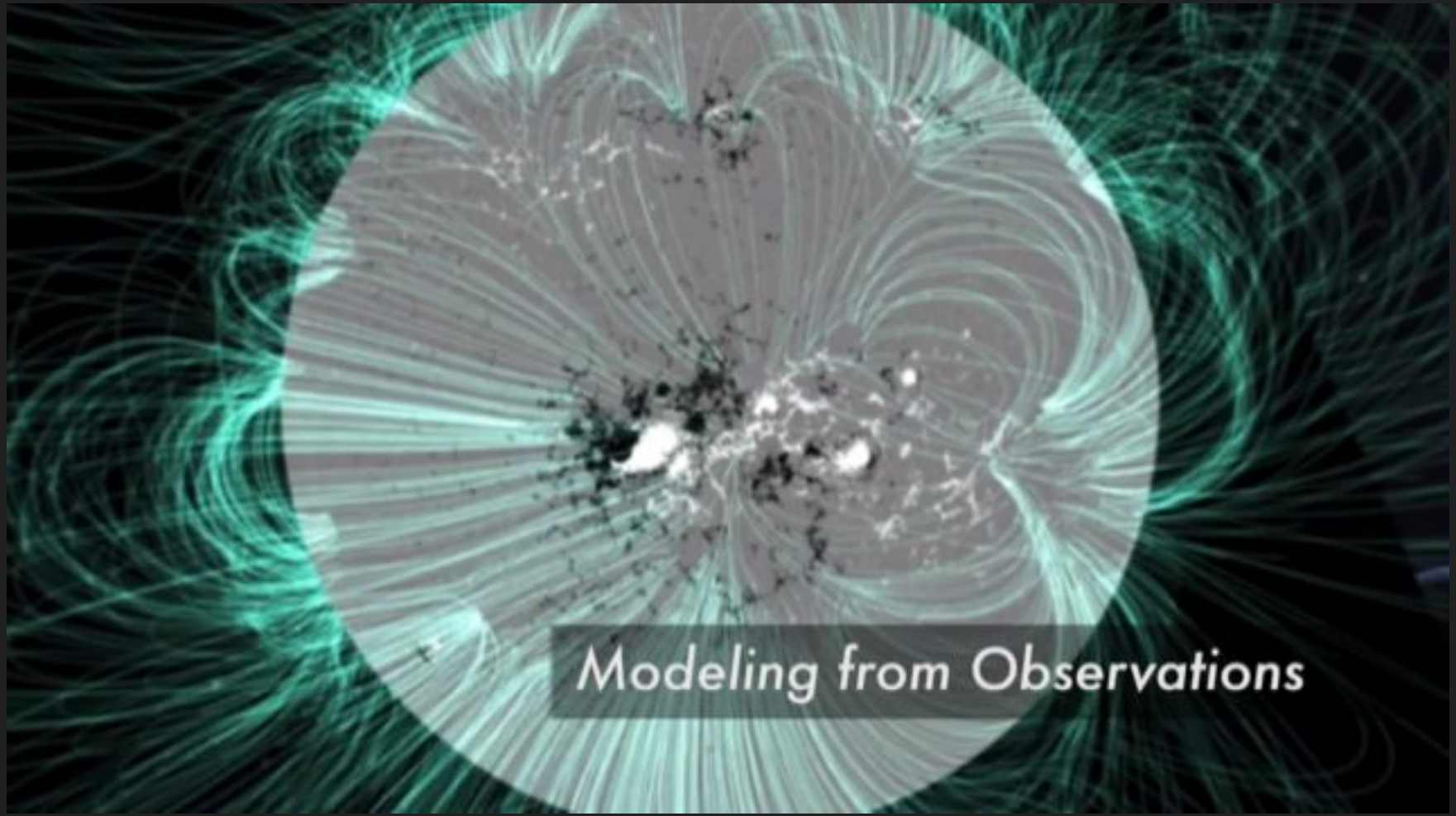


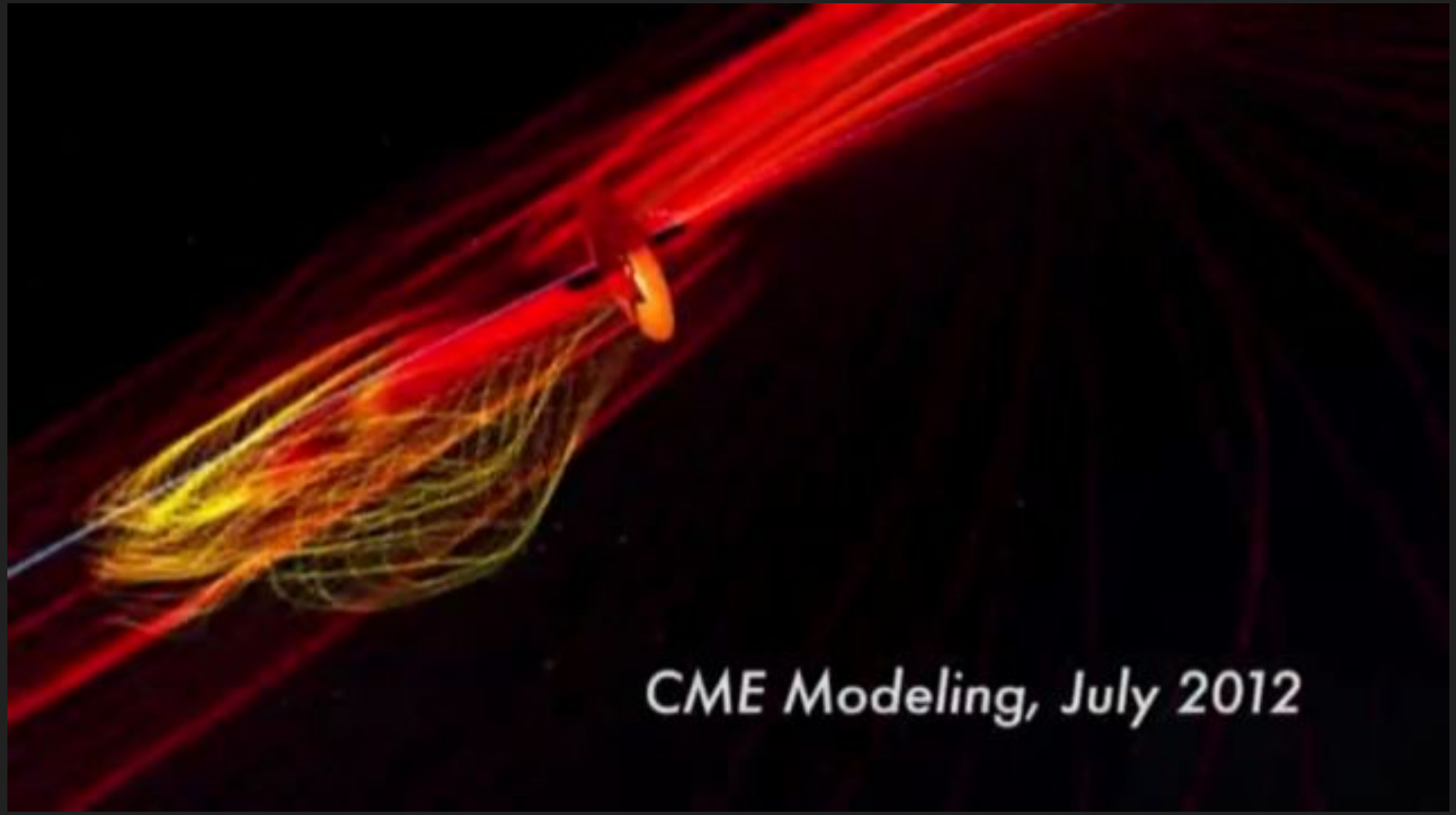

North Massif
6

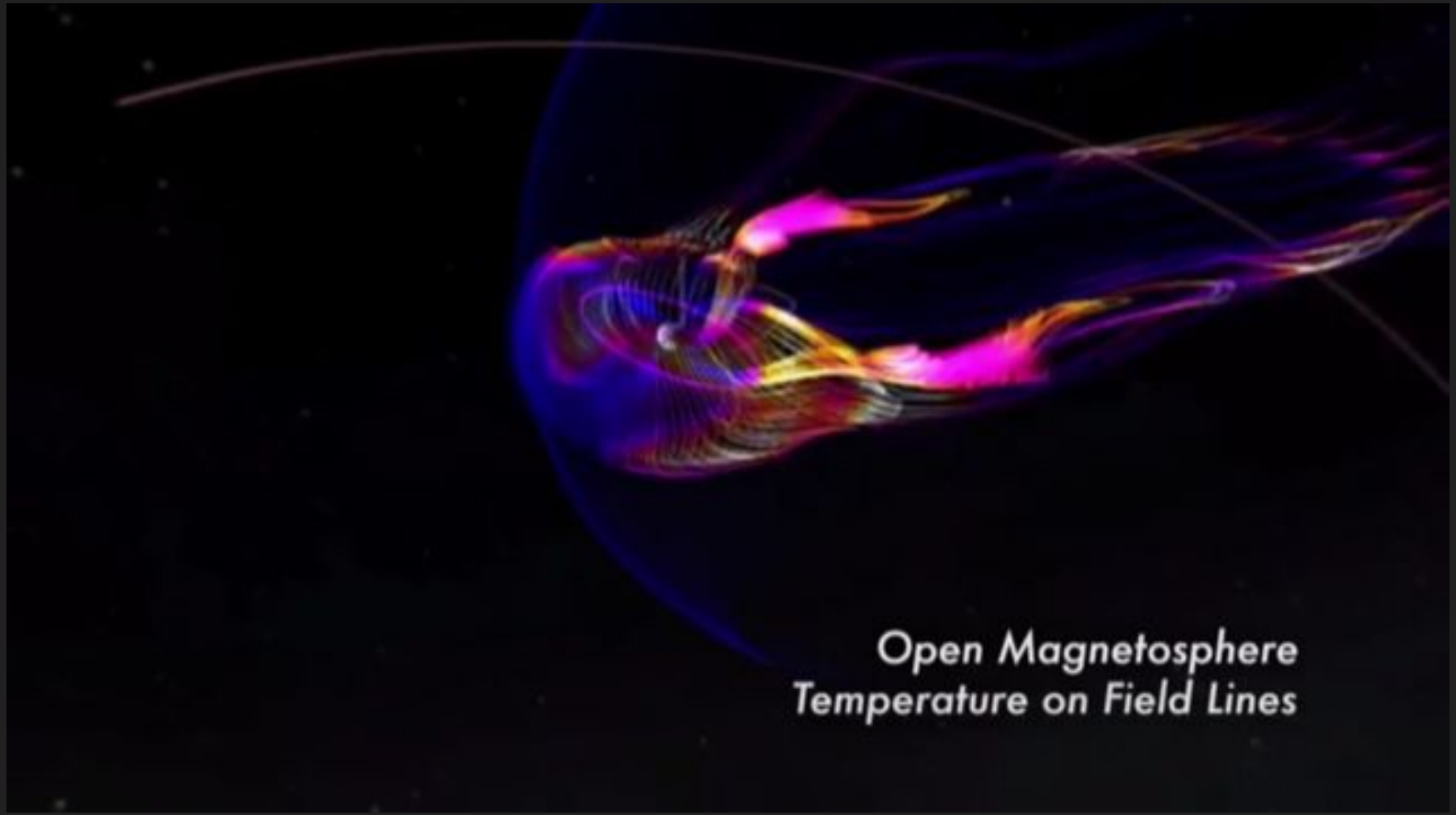

Powell
Emory
San Luis Rey
Mariner
2650




Navcam terrain with MSL articulation history


Modeling from Observations


CME Modeling, July 2012


Open Magnetosphere
Temperature on Field Lines