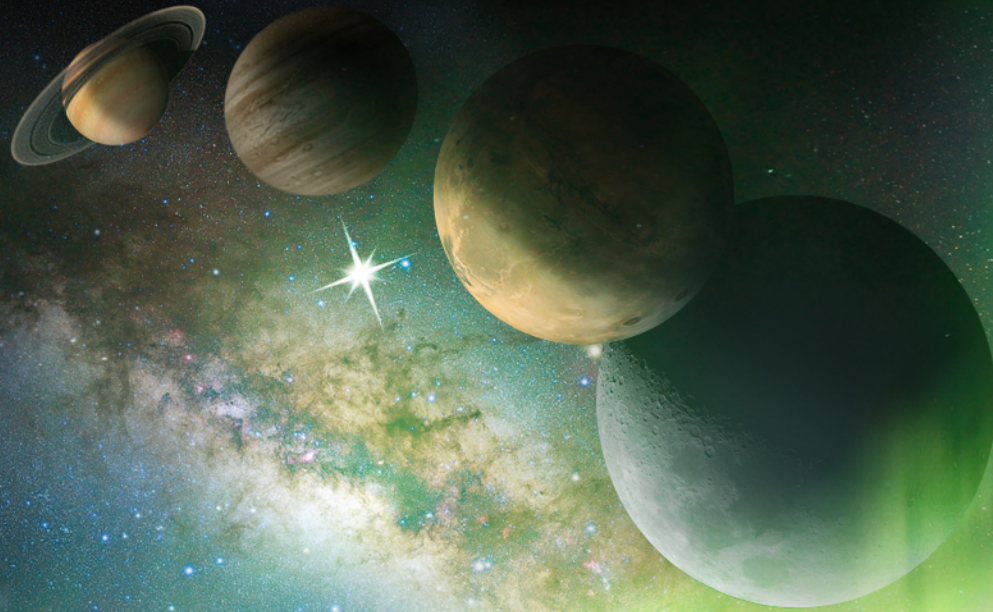


National Aeronautics and
Space Administration



Science Committee Report

Dr. Bradley M. Peterson
Chair, Science Committee

Science Committee Members

Dr. Brad Peterson, Chair, The Ohio State University and Space Telescope Science Institute

Dr. Scott Gaudi, The Ohio State University, Chair, Astrophysics Advisory Cmte (APAC)

Dr. Jill Dahlburg, Naval Research Laboratory, Chair, Heliophysics Advisory Cmte (HPAC)

Dr. Anne Verbiscer, Chair, Planetary Science Advisory Cmte (PAC)

Dr. J. Marshall Shepherd, Chair, Earth Science Advisory Cmte (ESAC)

Dr. Doug Duncan, University of Colorado

Dr. Susan Avery, Woods Hole Oceanographic Institute

Dr. Tamara Jernigan, Lawrence Livermore National Laboratory

Dr. Walter Secada, University of Miami

Dr. Mihir Desai, Southwest Research Institute

Dr. Kathryn Flanagan, Space Telescope Science Institute

Dr. Jeffrey A. Hoffman, Massachusetts Institute of Technology

Dr. Pat Patterson, Space Dynamics Laboratory

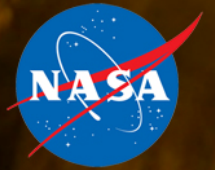
Dr. Meenakshi Wadhwa, Arizona State University



Outline

- **Science Results**
- Programmatic Status
- Committee Work

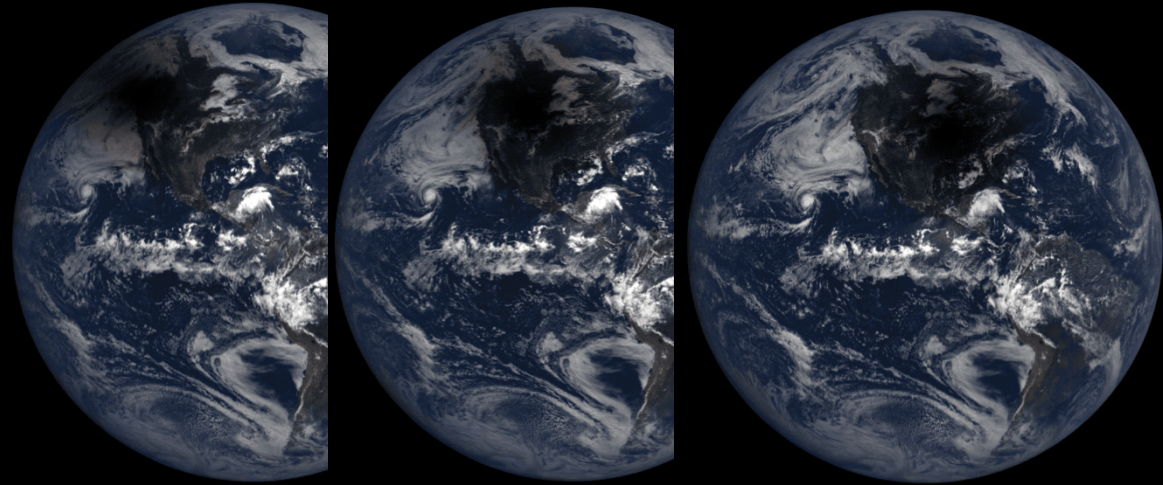
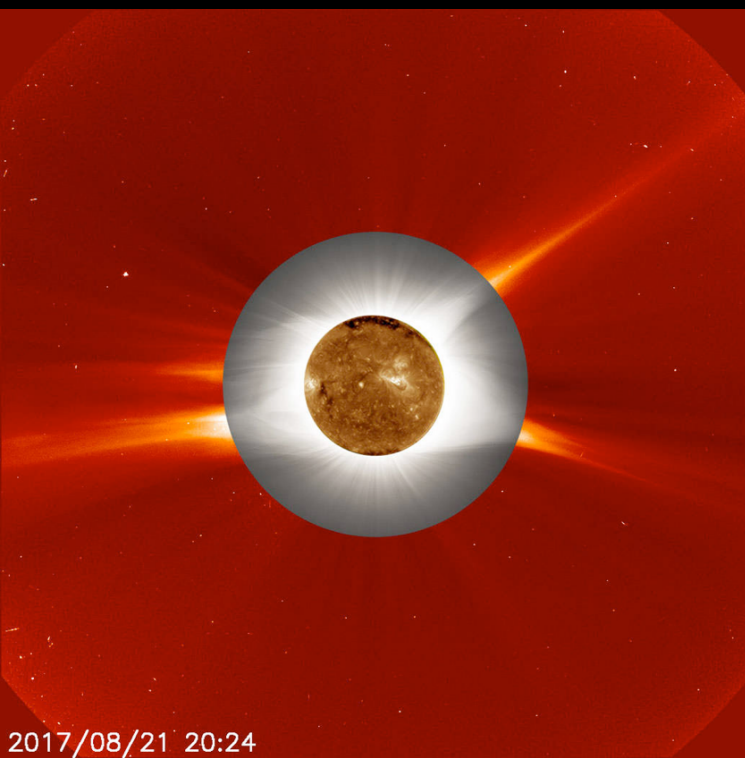
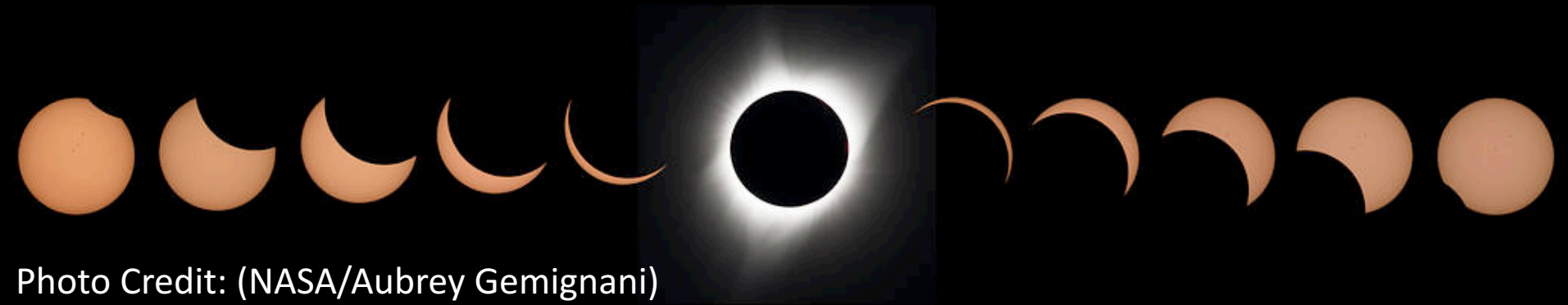
National Aeronautics and Space Administration



Heliophysics



Total Solar Eclipse - Aug. 21, 2017



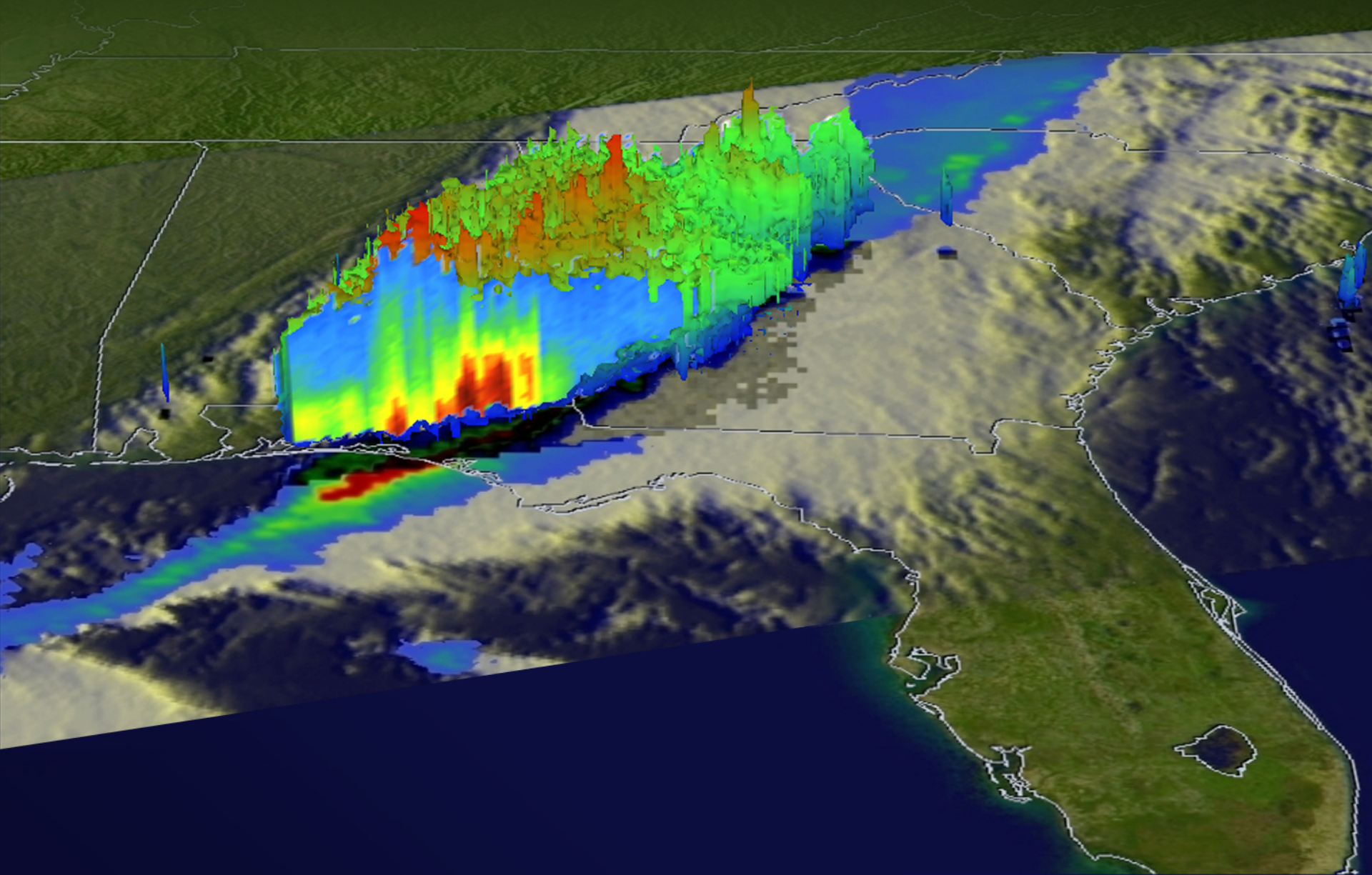
Moon's shadow moving across North America as seen by EPIC on DISCOVER.
Credit: NASA EPIC Team

Credits: Innermost image: NASA/SDO.

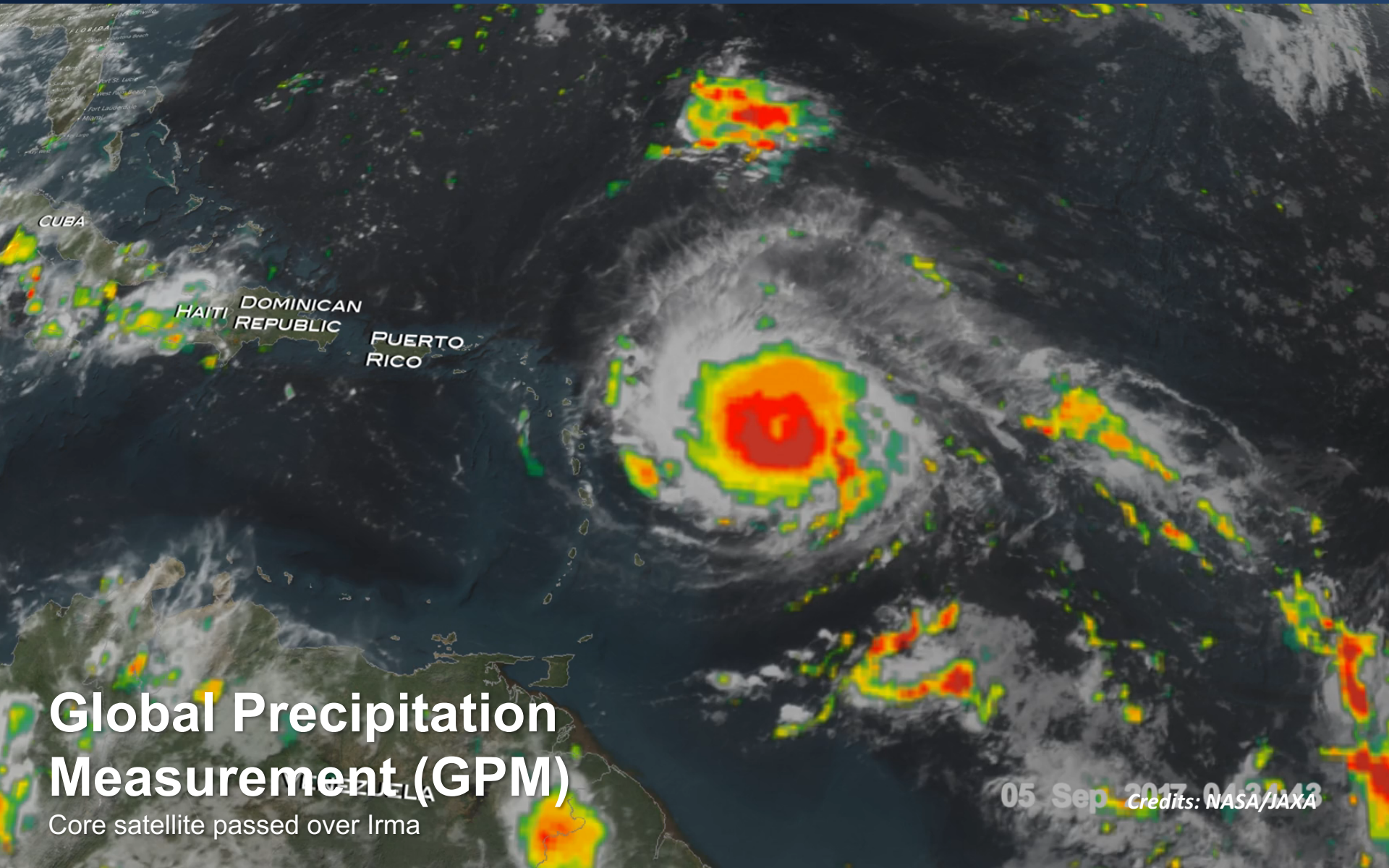
Ground-based eclipse image: Jay Pasachoff, Ron Dantowitz, Christian Lockwood and the Williams College Eclipse Expedition/NSF/National Geographic

Outer image: ESA/NASA/SOHO

EARTH SCIENCE



EARTH SCIENCE APPLIED SCIENCE HAS IMPACT



Global Precipitation Measurement (GPM)

Core satellite passed over Irma

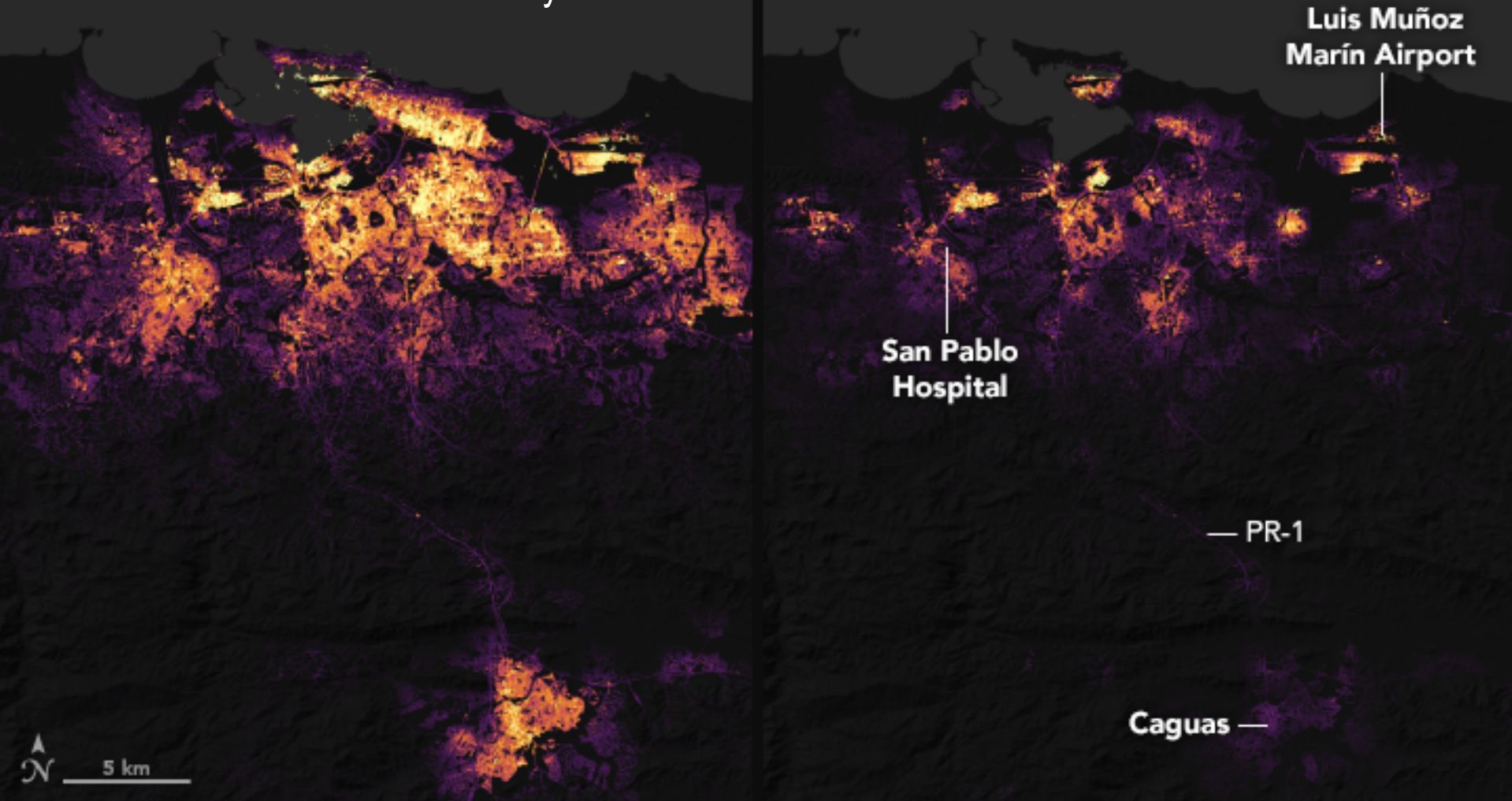
05 Sep 2017 04:27:43 Credits: NASA/JAXA

Baseline

September 27-28

Suomi NPP

NOAA - NASA's disaster recovery in Puerto Rico



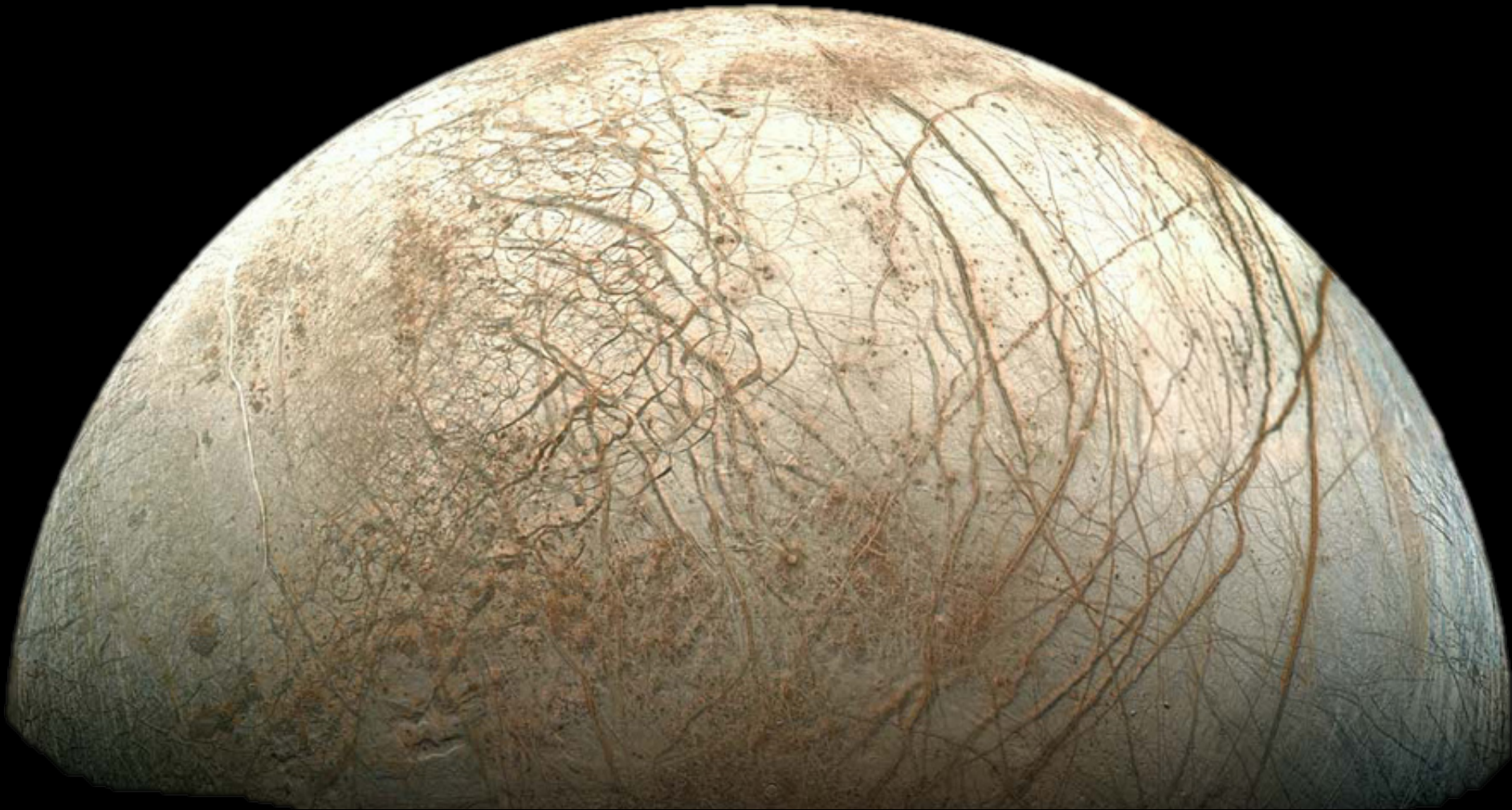
Nighttime Lights

Less

More



Planetary Science



Discovery of the First Interstellar Object

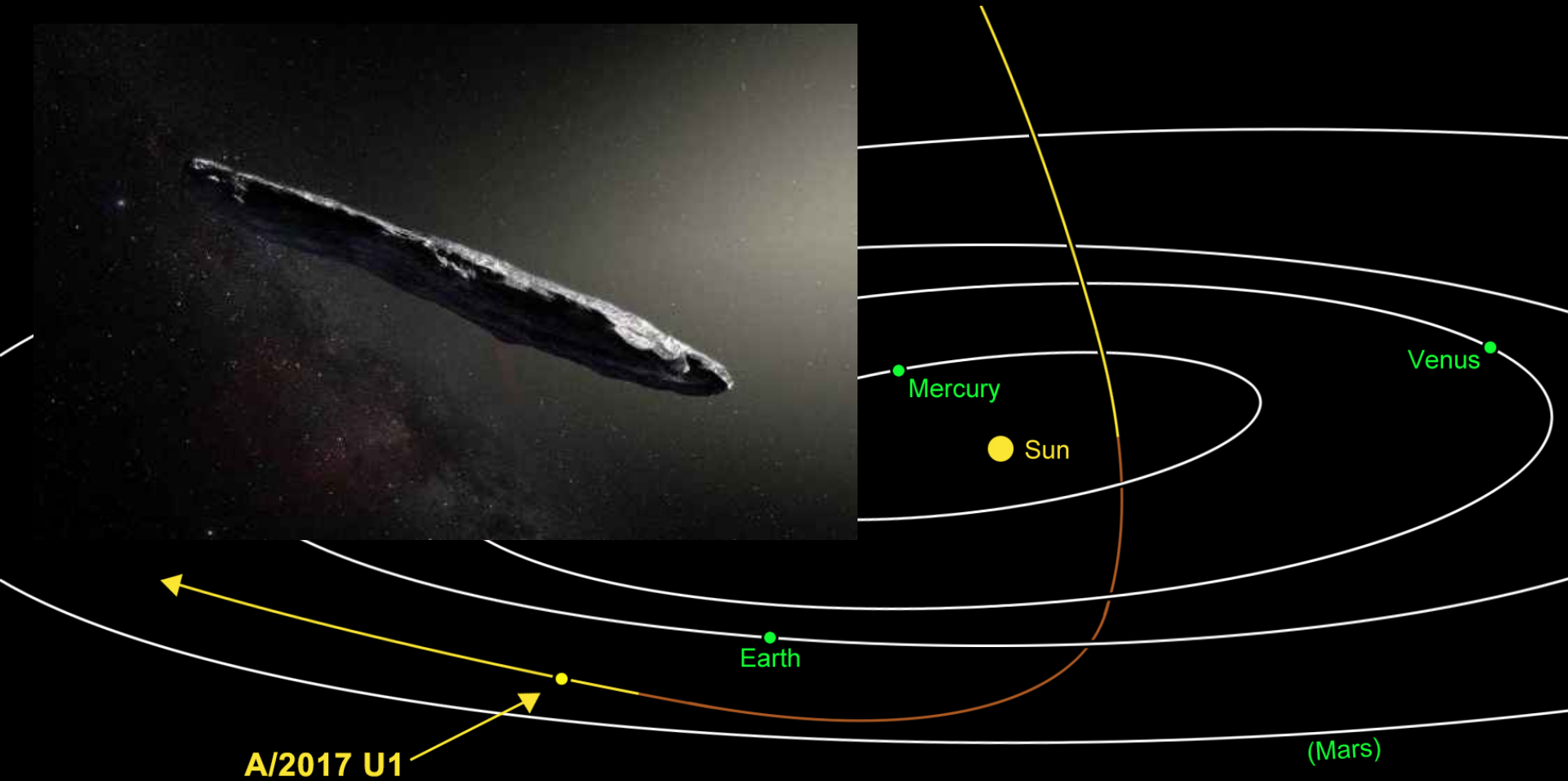
- 1I/2017 U1 ('Oumuamua)
- Discovered on October 19, 2017 by the Pan-STARRS1 telescope during near-Earth object survey operations
- Speed and trajectory indicate it originated outside of and is not bound to our solar system

- Object is asteroidal in nature (no coma observed)
- Object is highly elongated, with an axis ratio of $\sim 10:1$ (Meech *et al.* 2017, *Nature*)
- Observations suggest a surface reddened due to irradiation by cosmic rays over its history



Artist concept credits: European Southern Observatory/
M. Kornmesser

MESSENGER FROM DEEP SPACE



A/2017 U1: 'Oumuamua

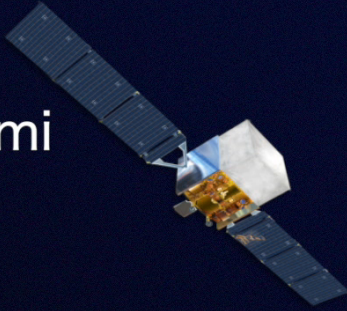
National Aeronautics and Space Administration



Astrophysics

GW170817 / GRB170817a

Fermi



Gamma rays, 50 to 300 keV

GRB 170817A

Counts per second

1,500
1,000
500



LIGO

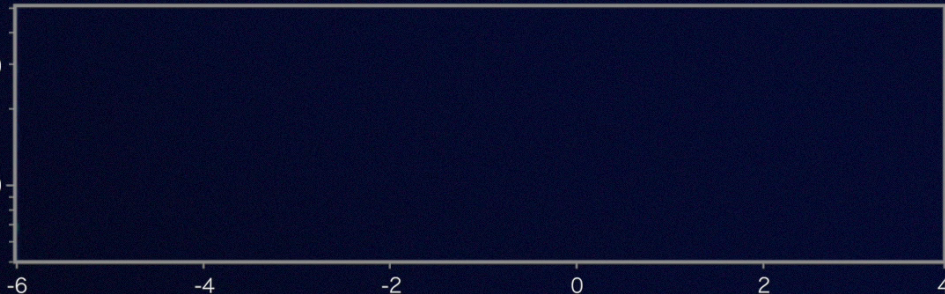


Gravitational-wave strain

GW170817

Frequency (Hz)

300
100

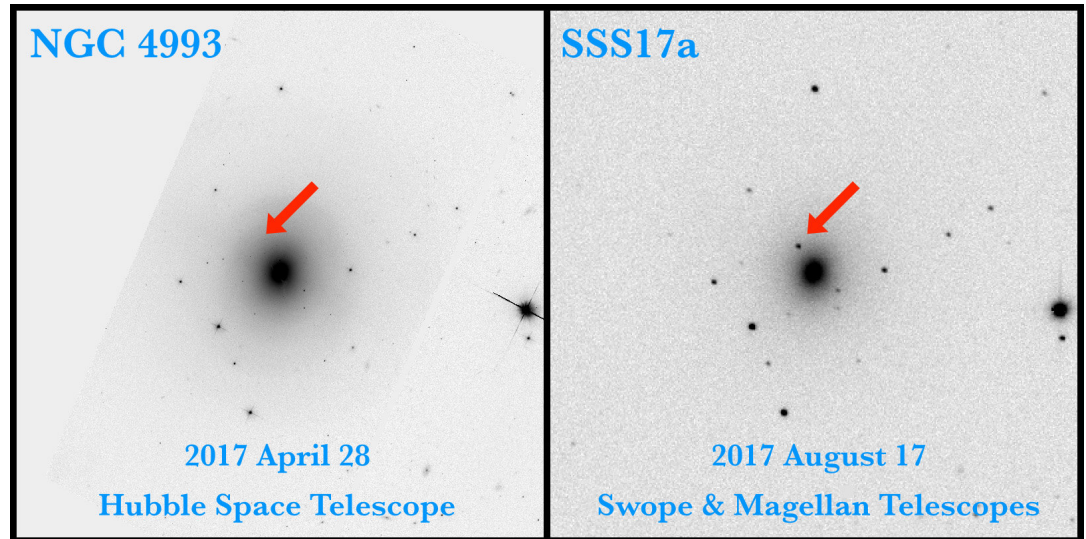


Time from merger (seconds)

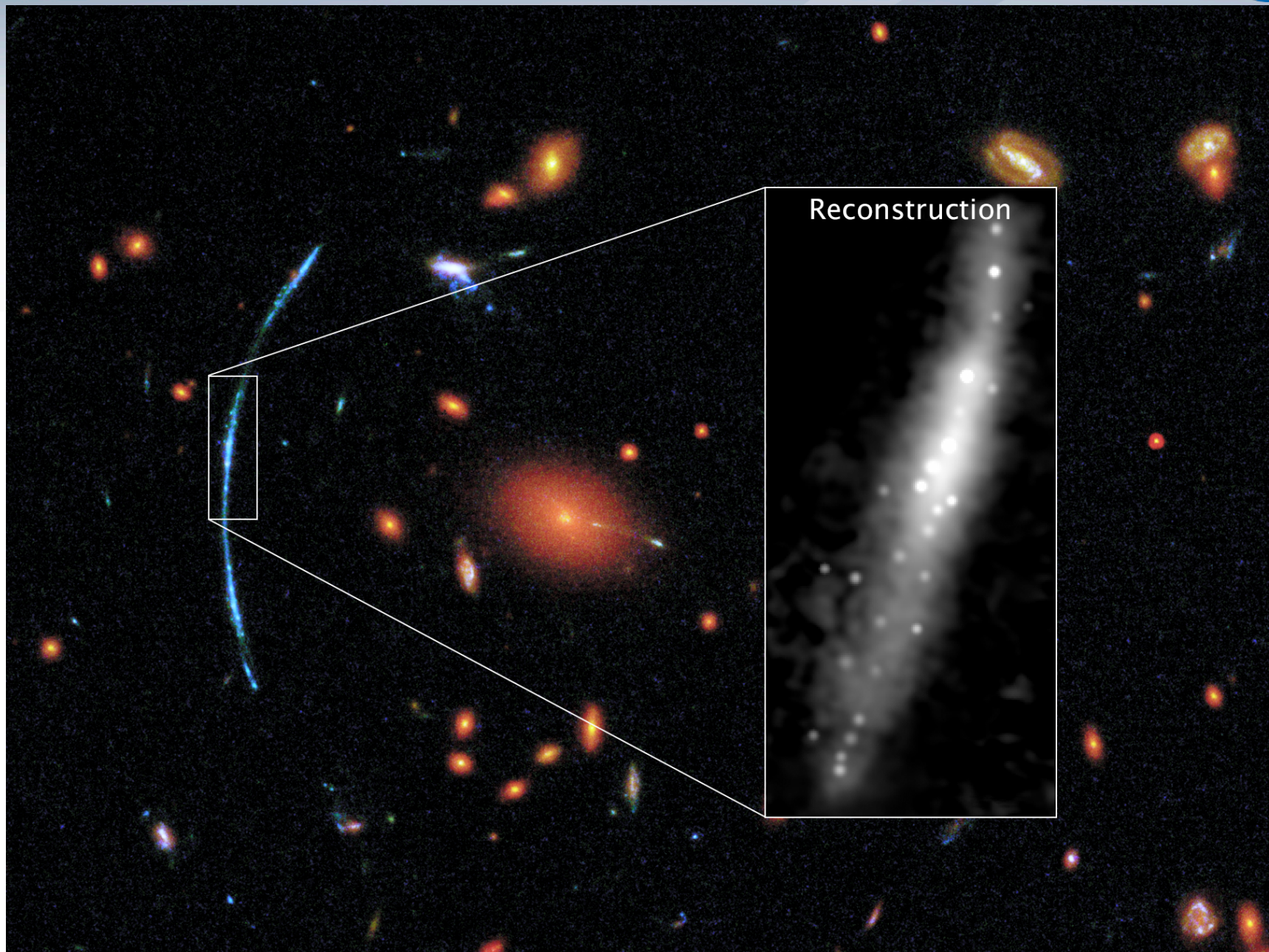
Merger of two neutron stars

Occurred on 2017
August 17.

Confirmed long-held suspicions that short gamma-ray bursts are due to neutron star mergers.



Hubble sees Star Forming Regions at $z=2.5$



Chandra informs 3D Model of Nova V745 Sco Outburst

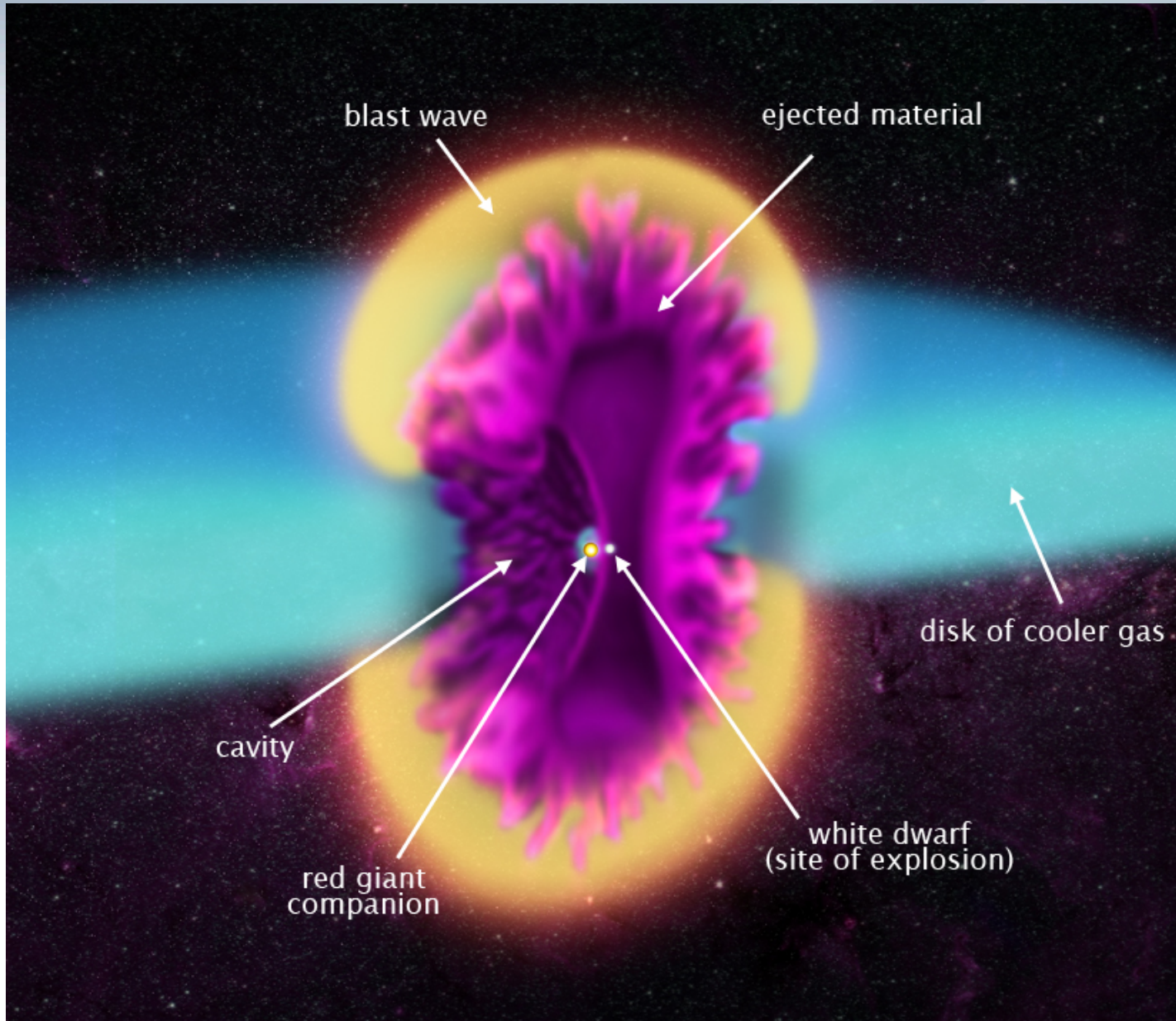
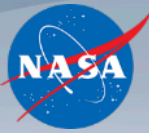


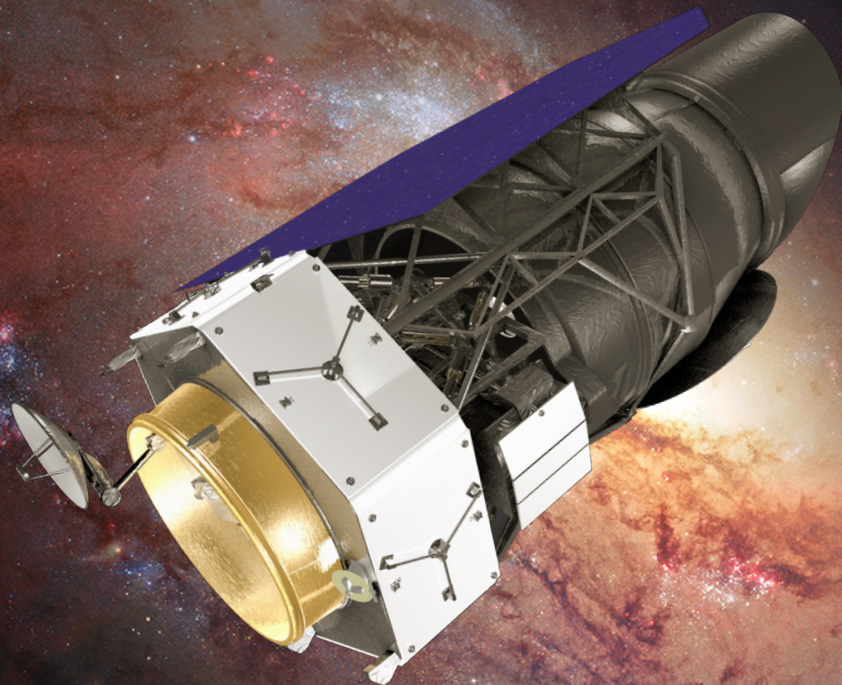
Illustration: NASA/CXC/M.Weiss)

Outline



- Science Results
- **Programmatic Status**
- Committee Work

NASA Science Overview by SMD Associate Administrator Dr. Thomas Zurbuchen



SCIENCE AND MISSION HIGHLIGHTS

Overview of SMD's high impact, integrated and multi-faceted portfolio

SMD UPDATES

Personnel and schedule updates, and public/private partnership activities

NEWS AND AWARENESS

JPSS Launch, TSIS Launch Ready
Class D Strategy Released at AGU
New Selection for MMX
WIETR Report Release

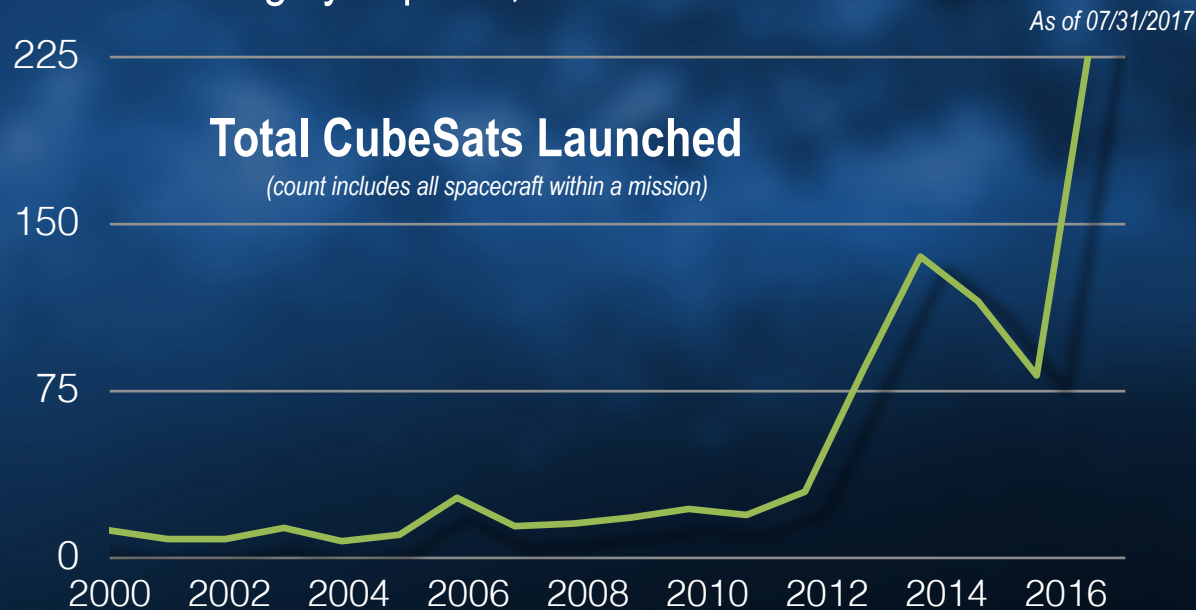
JPSS-1 HAS A NEW NAME: NOAA-20

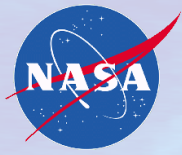


NEW CAPABILITIES FOR SCIENCE

Significant increase in the capabilities of SmallSats/CubeSats over the past 5 years

- Science instruments have been miniaturized
- New, potentially disruptive small satellite platform technologies have advanced
- Industry and academia have exploited these trends to craft highly capable, low cost-missions





Eugene Parker Honored



On May 31, the Solar Probe Plus was renamed the Parker Solar Probe in honor of the discovery of the solar wind by Eugene Parker. During the ceremony he received the NASA Distinguished Public Service Award.



Science Mission Directorate



**Lawrence Friedl,
NASA Earth Science**

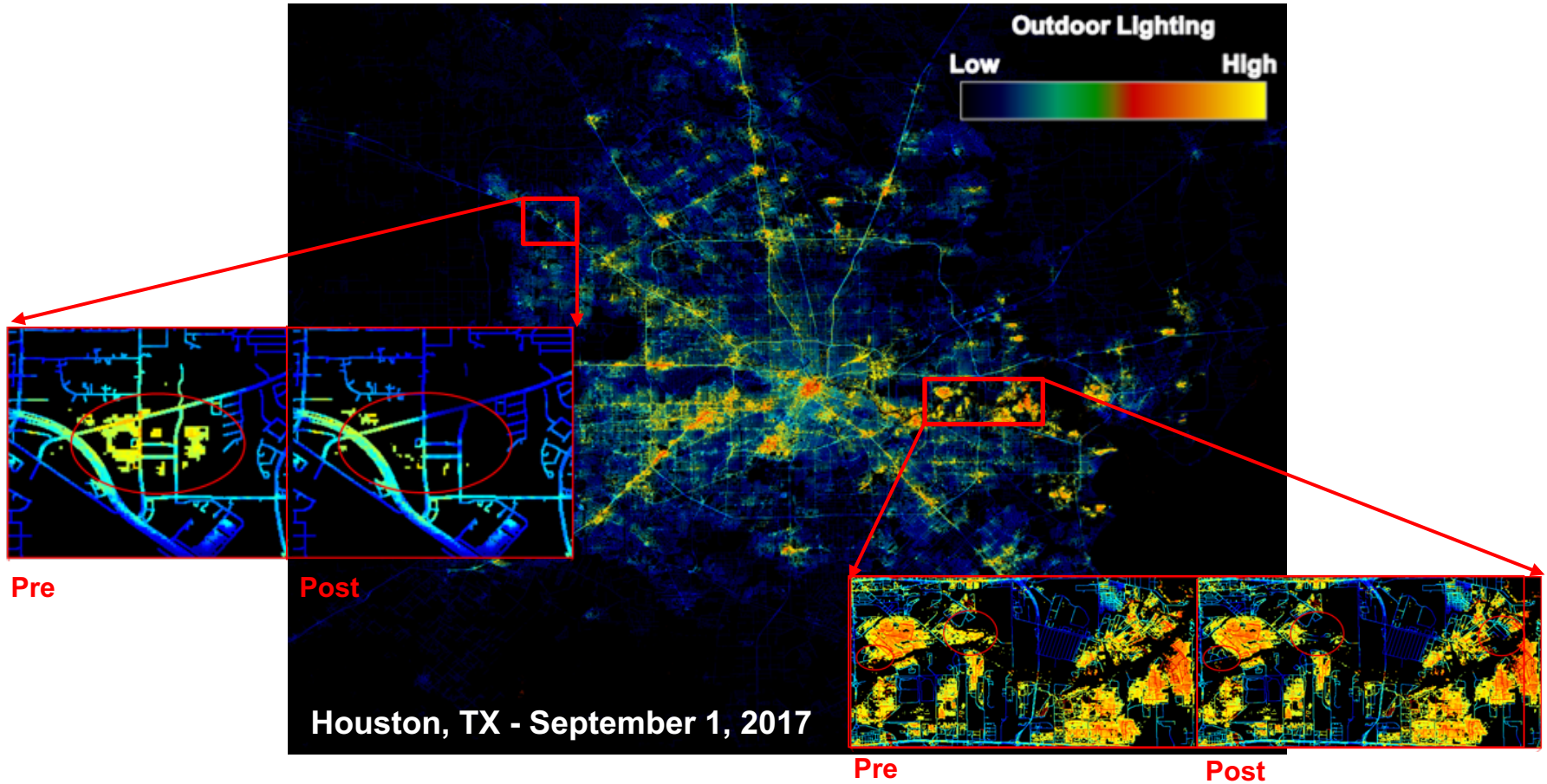
**Discussion with NAC Science
29.Nov.2017**

Earth Science Societal Benefits

Hurricane Harvey



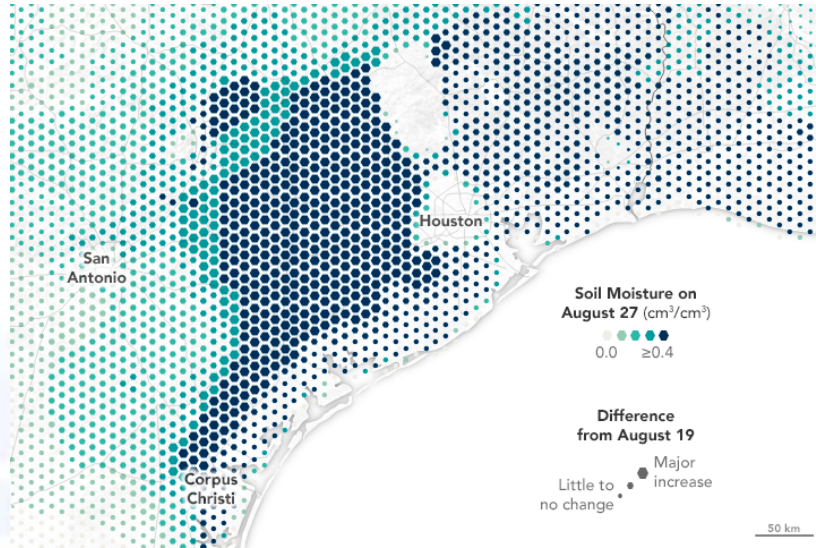
Power Outage Knowledge Supports Search and Rescue and Situational Awareness



Houston, TX - September 1, 2017

Night-time maps combine data from multiple satellites: Suomi-NPP, Landsat-8, Sentinel 2A & 2B, TerraSAR-X/TanDEM-X to enable first-ever daily monitoring of affected areas at neighborhood scales (< 30 meters).

Hurricane Harvey



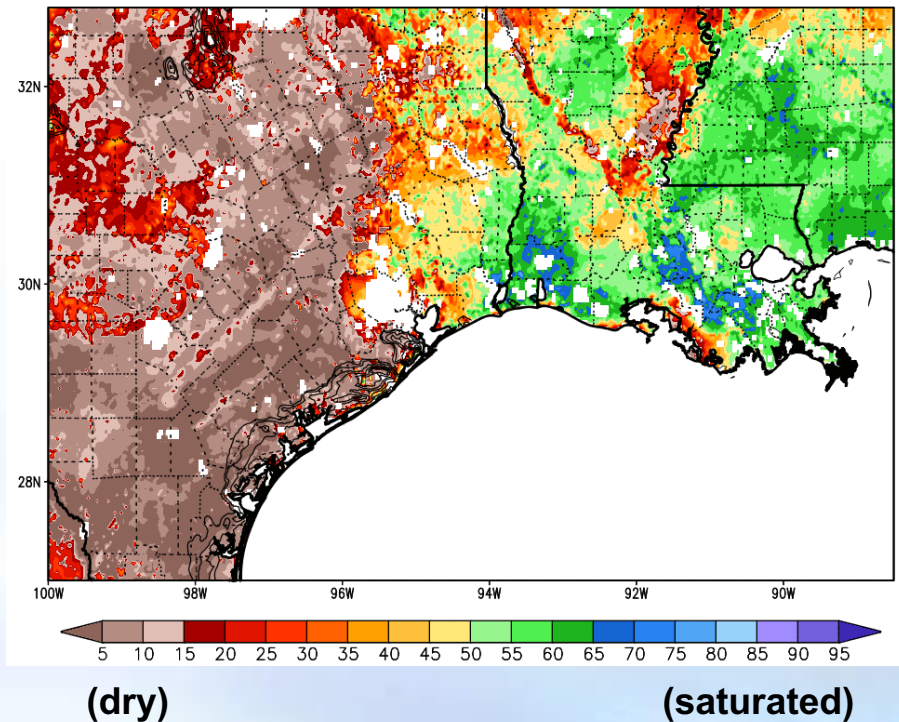
^ Changes in soil moisture in areas affected by Harvey; based on observations from SMAP mission

FEMA uses these information products for situational awareness to highlight flood-prone areas.

Soil Moisture Active Passive

Combination of SMAP observations with atmospheric forcing data from the NASA Land Information System for maps of soil moisture during Harvey

0–100 cm Relative Soil Moisture (available water; %) valid 10z 25 Aug 2017
Precipitation in previous hour (1,2,5,10,15,20,25 mm contours)



SERVIR: Preventing Glacial Lake Outburst Flood



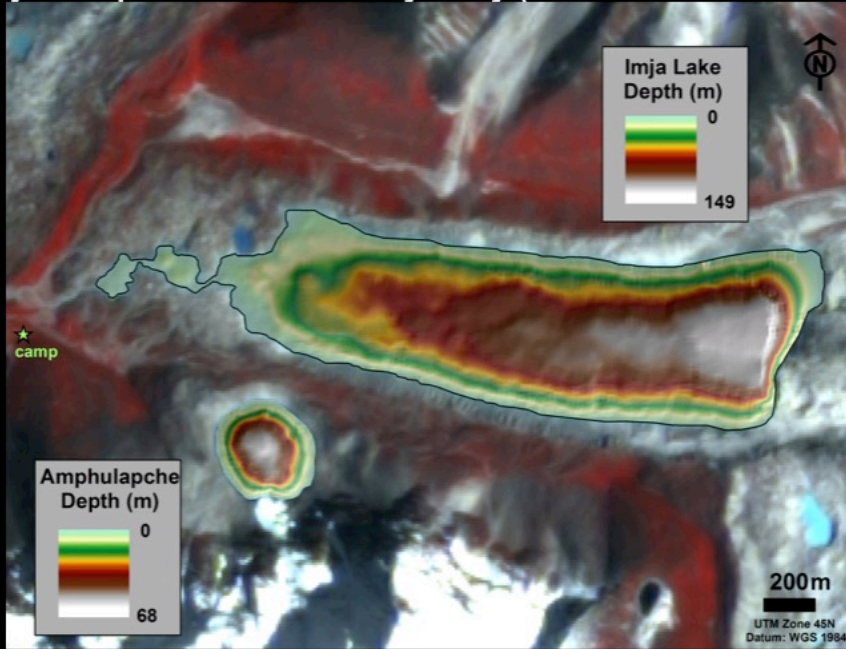
Issue: Nepal has a heightened concern about mountain hazards – landslides and GLOFs – following the 2015 earthquake.

Officials in Nepal needed to determine the risk of an Imja Lake outburst flood, which was a potential threat to villages below.

Approach: Data and imagery provided by SERVIR PI Jeffrey Kargel guided a UN Development Program-funded project to inform the government's decision to lower the lake.

Used EO-1 ALI, ASTER, Landsat, SRTM

Imja / Amphu: Modeled Bathymetry (smoothed on hillshade)



Bathymetric (lake depth) map superposed on EO-1 ALI image

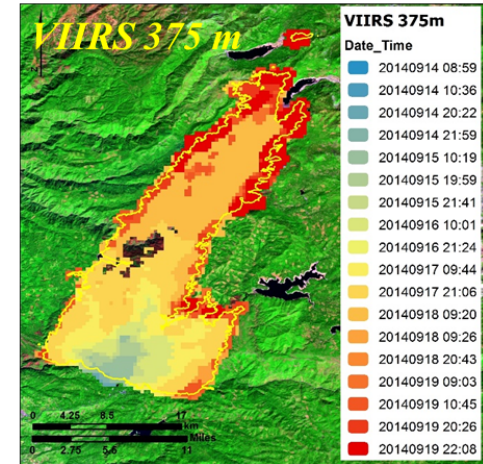
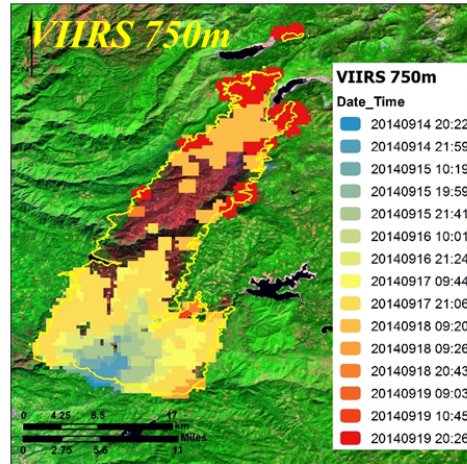
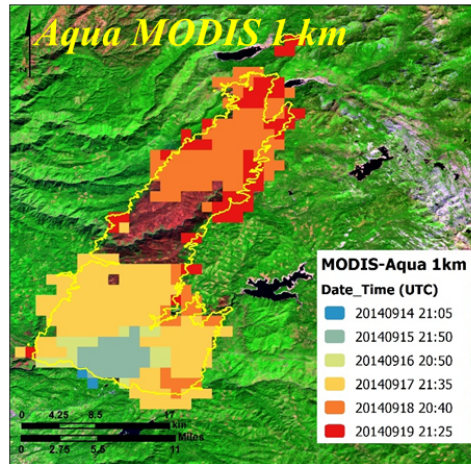
Significance: Based on project findings, the Department of Hydrology and Meteorology in Nepal signed a letter of agreement with the Engineering Department of Nepal Army to lower the water level by 3.5 meters.

The Kathmandu Post stated that over 96,500 vulnerable people in Solukhumbu and the downstream Tarai and Churia districts of Mahottari, Siraha, Saptari and Udaypur are expected to directly benefit.

USFS & Active Fire Detection Products



Recent Suomi NPP VIIRS 375 m active fire detection product enables early detection of small fires and improved mapping of large wildfires.



Fire information products and maps are served by USFS Active Fire Mapping Program >>

Active Fire Mapping Program

Current Large Incidents (Here)

New Large Incidents

Fire Detection Maps

MODIS Satellite Imagery

VIIRS Satellite Imagery

Fire Detection GIS Data

Fire Data in Google Earth

Fire Data Web Services

Latest Detected Fire Activity

Other Near Real Time Products

Frequently Asked Questions

About Active Fire Maps

BTAC
Geospatial Technology and Applications Center

2222 West 22nd South
Salt Lake City, UT 84119
Voice: (801) 975-3737
Fax: (801) 975-3478

Current Large Incidents
November 28, 2017

Fire locations are based on data provided by the National Interagency Coordination Center and are subject to change.
Large Incident map currently updated on Fridays or as fire conditions warrant.

INRS Summary
November 28th, 2017

National Preparedness Level
Level 1
National Fire Activity (NFA) - Nov. 23
National Interagency Coordination Center (NICC) has been
Downgraded from Level 2 to Level 1
Large Fire Incidents: 7
Large Fire Containment: 4
Area Contained Status (Estimated): 0
Type 1 (NFA) committed: 0
Type 2 (NFA) committed: 0
Source: [Incident Management Situation Report](#)

Active Fire Mapping News
August 16, 2017

FIRE MAPPING

Canada Wildfire for British Columbia and
Northwest Territories Alert for
contingency of wildfire activity in the
wildland area in BC, Yukon, Alberta,
ONCA for British Columbia and the
Northwest Territories are being provided
due to the ongoing threat of fire
activity in those geographic areas.
For more information, please contact:
USFS and GISRS 2738

“These refined data further improve the situational awareness of fire managers and are also ingested into operational modeling, analysis and visualization applications that support fire management decision-making at a landscape scale.”



Brad Quayle
U.S. Forest Service

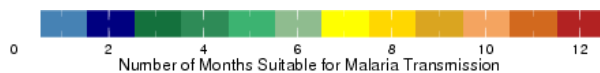
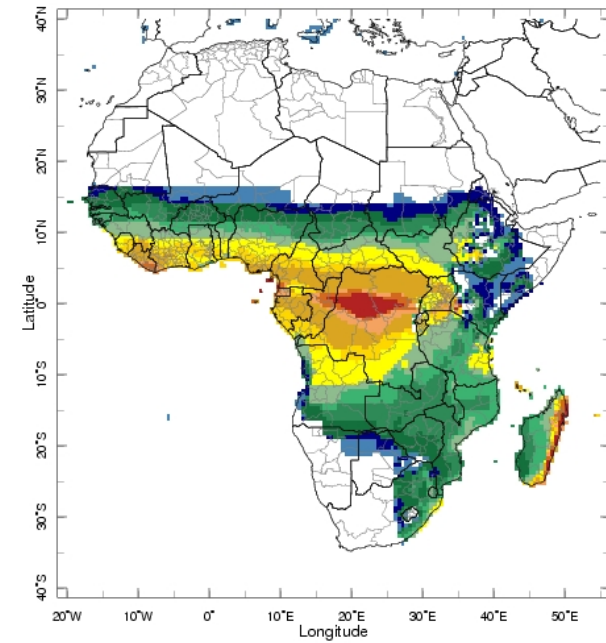
Malaria Map Rooms

<http://iridl.ldeo.columbia.edu/maproom/>



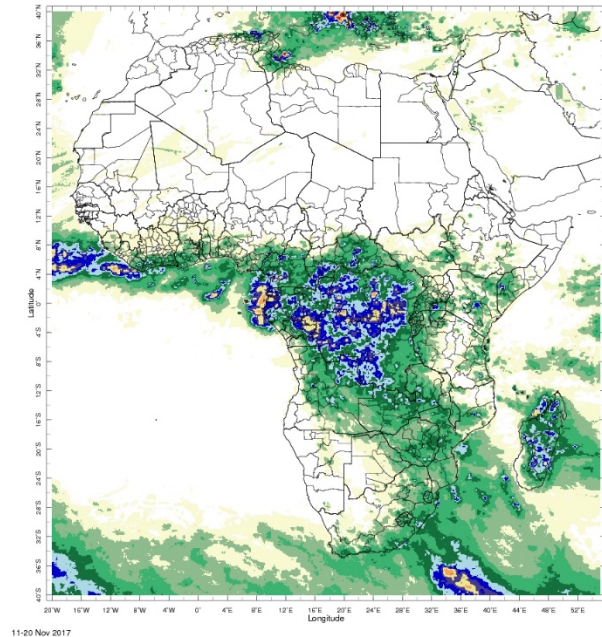
Suitability. Number of months suitable for malaria transmission, based on monthly climatological averages: Conditions suitable for both the development of the parasite and the life cycle of the mosquito vector.

**Climate Suitability \equiv Coincidence of
18-32°C + 80mm + RH>60%**

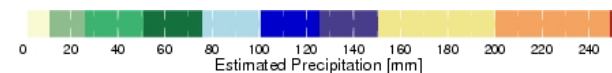


Malaria Early Warning. Precipitation is factor related to sufficient surface water and moisture for mosquito breeding sites: Precipitation on short time scales aids in determining location and timing of potential outbreaks.

**Dekadal (10-day) Precipitation
11-20 Nov 2017**



11-20 Nov 2017



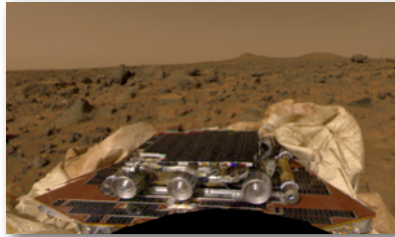
Note: Masked to exclude malaria-absent or endemic areas.

Planetary Science - Discovery Program

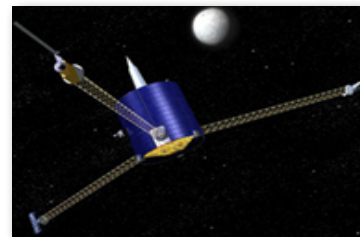
NEO characteristics:
NEAR (1996-1999)



Mars evolution:
Mars Pathfinder (1996-1997)



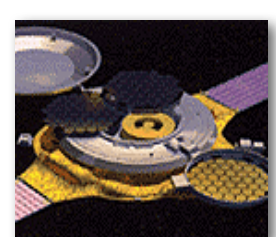
Lunar formation:
Lunar Prospector (1998-1999)



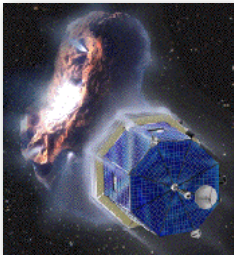
Nature of dust/coma:
Stardust (1999-2011)



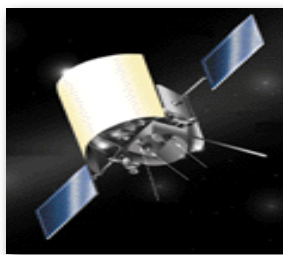
Solar wind sampling:
Genesis (2001-2004)



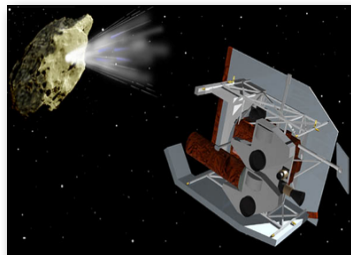
Comet diversity:
CONTOUR (2002)



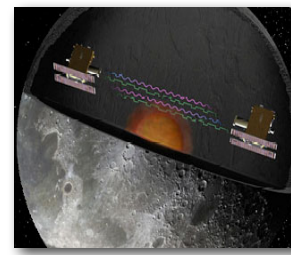
Mercury environment:
MESSENGER (2004-2015)



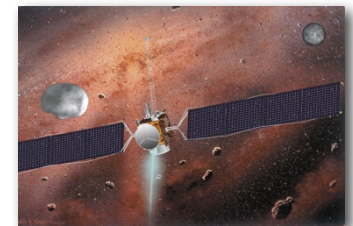
Comet internal structure:
Deep Impact (2005-2012)



Lunar Internal Structure
GRAIL (2011-2012)



Main-belt asteroids:
Dawn (2007-TBD)



Exoplanets
Kepler (2009-TBD)



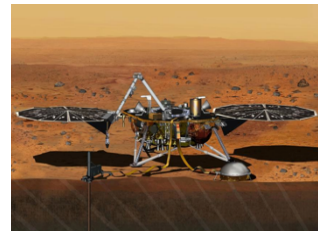
Lunar surface:
LRO (2009-TBD)



ESA/Mercury Surface:
Strofio (2017-TBD)



Mars Interior:
InSight (2018)



Trojan Asteroids:
Lucy (2021)

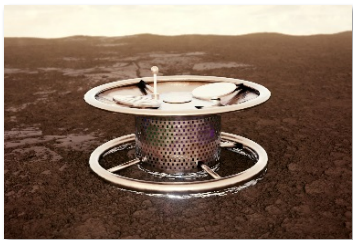


Metal Asteroids:
Psyche (2022)

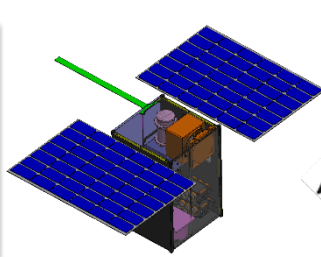


Planetary Science Deep Space SmallSat Studies

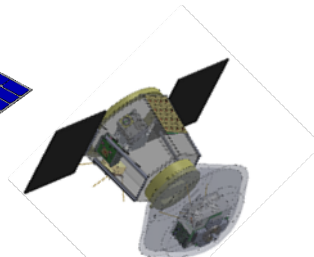
- A National Academies Report (2016) concluded that CubeSats have proven their ability to produce high-value science. In particular, CubeSats are useful as targeted investigations to augment the capabilities of larger missions or to make a highly-specific measurement.
- SMD is developing a directorate-wide approach on CubeSats/SmallSats
- Unique challenges for SmallSats at planetary destinations
- PSD solicited concept studies for SmallSat missions
 - Concepts sought for 1U to ESPA-class missions
 - Up to \$100M mission concept studies considered
 - Not constrained to fly with an existing mission
- Objectives:
 - What Planetary Science investigations can be done with SmallSats?
 - What technology development is needed to enable them?
 - What's the anticipated cost range?
- Received 102 proposals
- Awarded 19 studies



SAEVe
T. Kremic



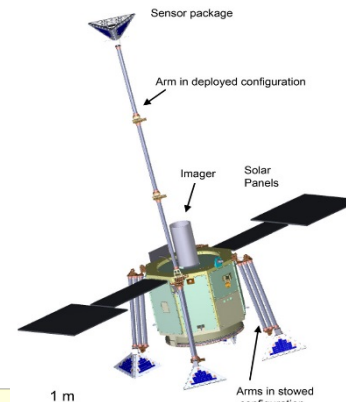
MISEN
R. Lillis



Cupid's Arrow
C. Sotine



MAT
L. Montabone



APEX
J. Plescia



CAESAR
B. Clark

PDCO Status

- Over **17,000 near-Earth objects (NEOs)** discovered and confirmed to date
- Successful **exercise of the planetary defense system** through the campaign to recover and observe asteroid 2012 TC4 (close approach was on Oct. 12, 2017 at <8 Earth radii)
- Recently released **2017 NEO Science Definition Team Report** reassesses NEO search and characterization given current technology and understanding of the NEO population. Of the estimated 25,000 NEOs 140 meters or larger in size (that can cause regional damage), 1/3 have been found. Space-based assets will be needed to find the rest.
- Working on the **White House National Near-Earth Object Preparedness Action Plan** through Detecting and Mitigating the Impact of Earth-Bound Near-Earth Objects (DAMIEN) Interagency Working Group



Astrophysics Missions in Development

ISS-CREAM 8/2017
NASA Mission



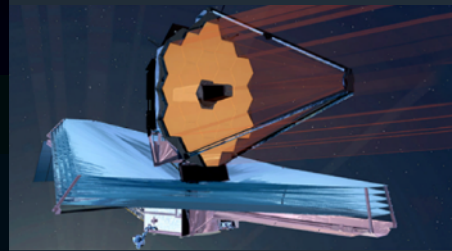
Cosmic Ray Energetics
And Mass

TESS 3/2018
NASA Mission



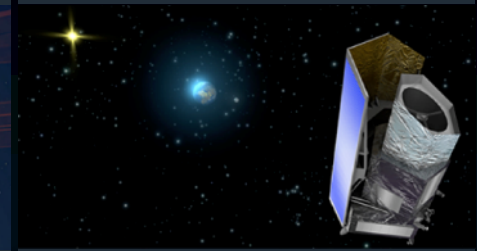
Transiting Exoplanet
Survey Satellite

Webb 2019
NASA Mission



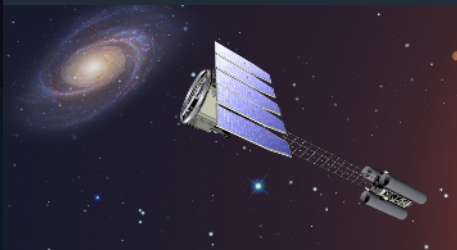
James Webb
Space Telescope

Euclid 2020
ESA-led Mission



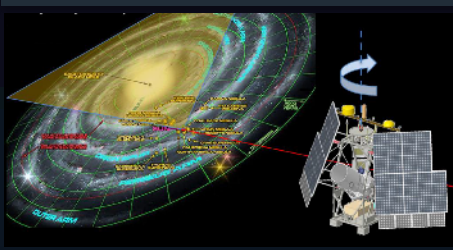
NASA is supplying the NISP
Sensor Chip System (SCS)

IXPE 2021
NASA Mission



Imaging X-ray
Polarimetry Explorer

GUSTO 2021
NASA Mission



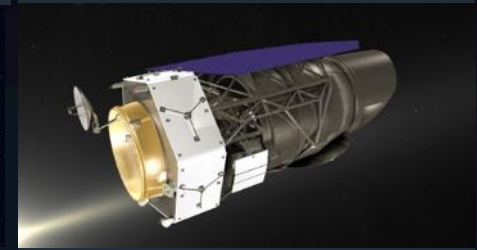
Galactic/ Extragalactic ULDB
Spectroscopic Terahertz Observatory

XARM 2021
JAXA-led Mission



NASA is supplying the SXS
Detectors, ADRs, and SXTs

WFIRST Mid
2020s
NASA Mission

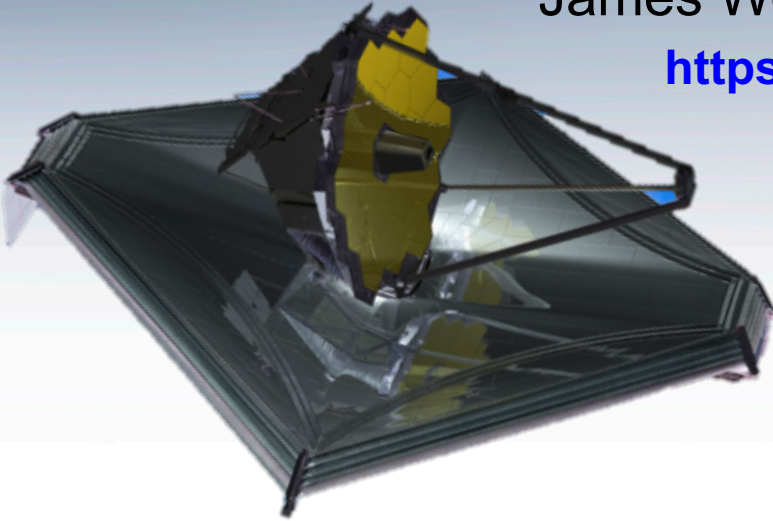


Wide-Field Infrared
Survey Telescope

Webb

James Webb Space Telescope

<https://jwst.nasa.gov/>



Large Infrared Space Observatory

Top priority of 2000 Decadal Survey

Science themes: First Light; Assembly of Galaxies; Birth of Stars and Planetary Systems; Planetary Systems and the Origins of Life

Mission: 6.5m deployable, segmented telescope at L2, passively cooled to <50K behind a large, deployable sunshield

Instruments: Near IR Camera, Near IR Spectrograph, Mid IR Instrument, Near IR Imager and Slitless Spectrograph

Operations: 2019 launch for a 5-year prime mission

Partners: ESA, CSA

RECENT ACCOMPLISHMENTS:

- Completed spacecraft bus integration with sunshield forming the spacecraft element (SCE)
- Conducted first avionics driven sunshield deployment and tensioning
- Completed cryovacuum test of science payload
- Selected 13 proposals for Early Release Science

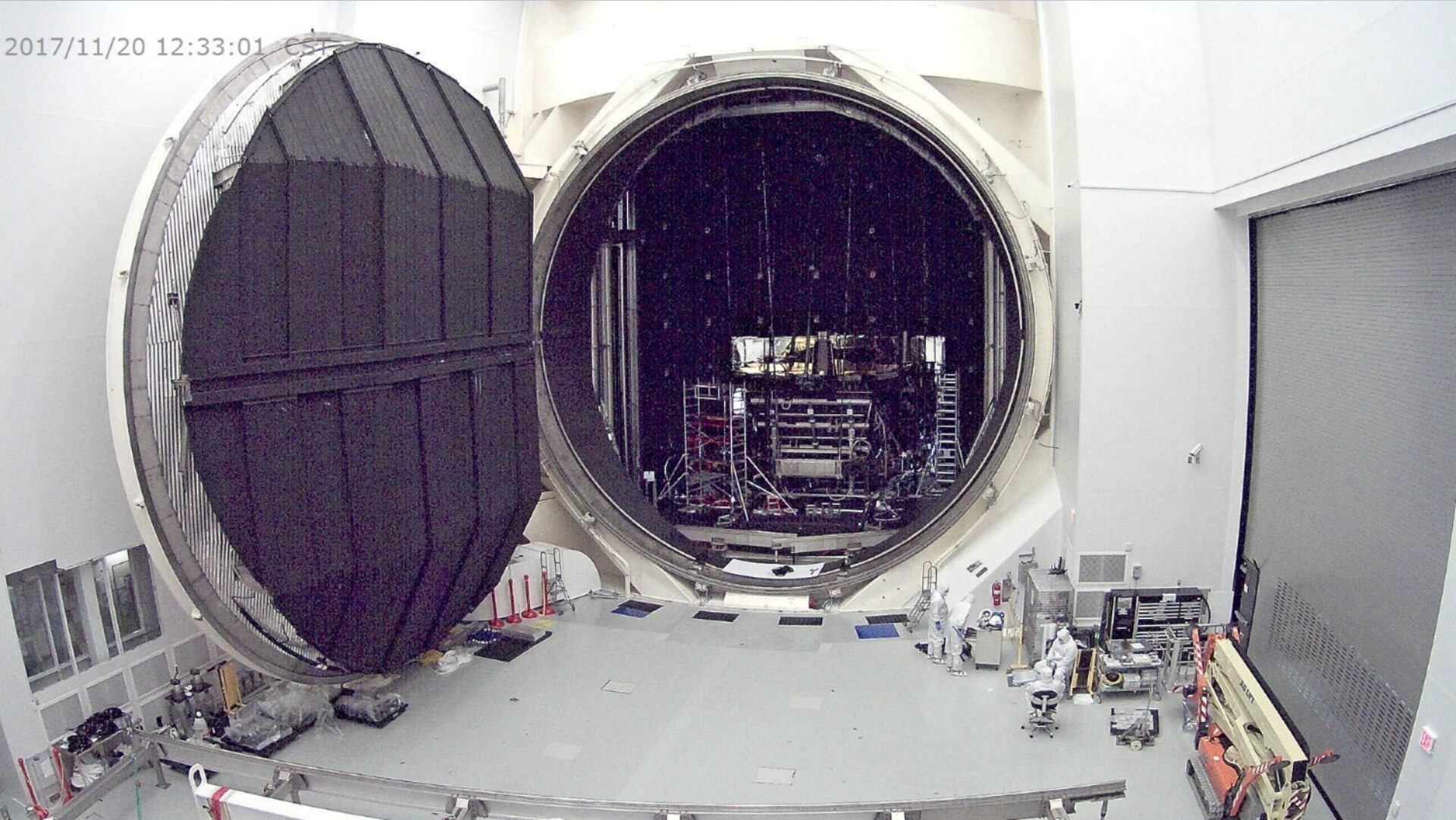
2017- early 2018 Plans:

- Ship science payload to Northrop-Grumman
- Environmental testing of SCE
- Integration of SCE and science payload
- Observatory level deployment and environmental testing

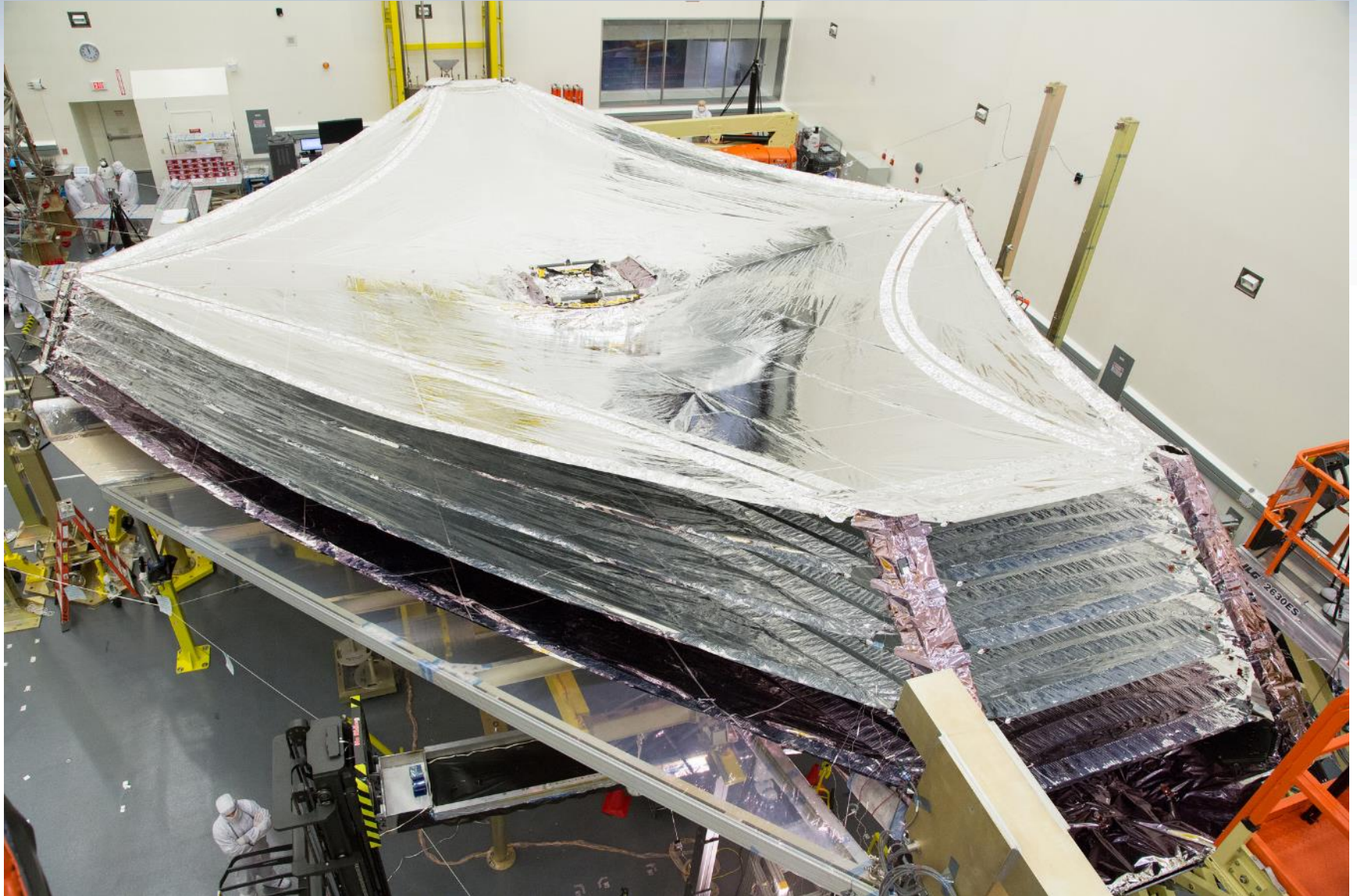
Webb OTIS after Thermal Vacuum test



2017/11/20 12:33:01 CST



Webb Sunshield Deployed

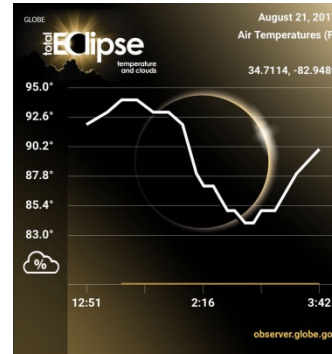
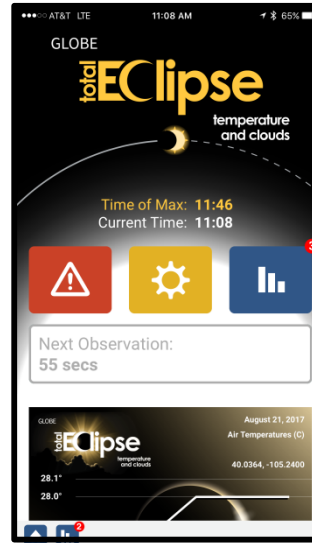
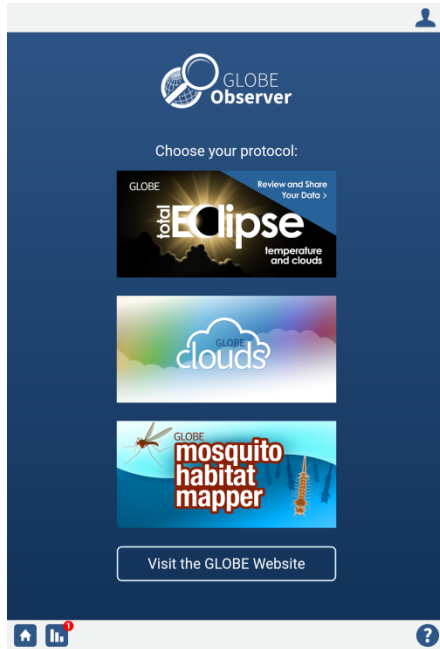


NASA SMD Science Activation Showcase

Kristen Erickson, Director, Science Engagement & Partnerships

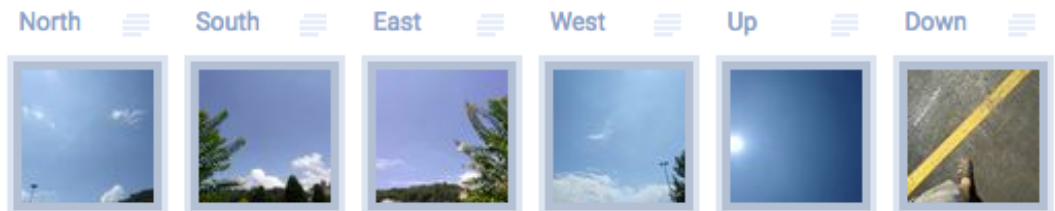
- **GLOBE**
Kristen Weaver, Goddard Space Flight Center
- **NASA Space Science Education Consortium**
PI/C. Alex Young, Goddard Space Flight Center
- **Universe of Learning**
PI/Denise Smith, Space Telescope Science Institute
- **Bringing the Universe to America's Classrooms**
PI/Rachel Connolly, WGBH/PBS LearningMedia
- **OpenSpace**
PI/Rosamond Kinzler, American Museum of Natural History

GLOBE Observer Eclipse App



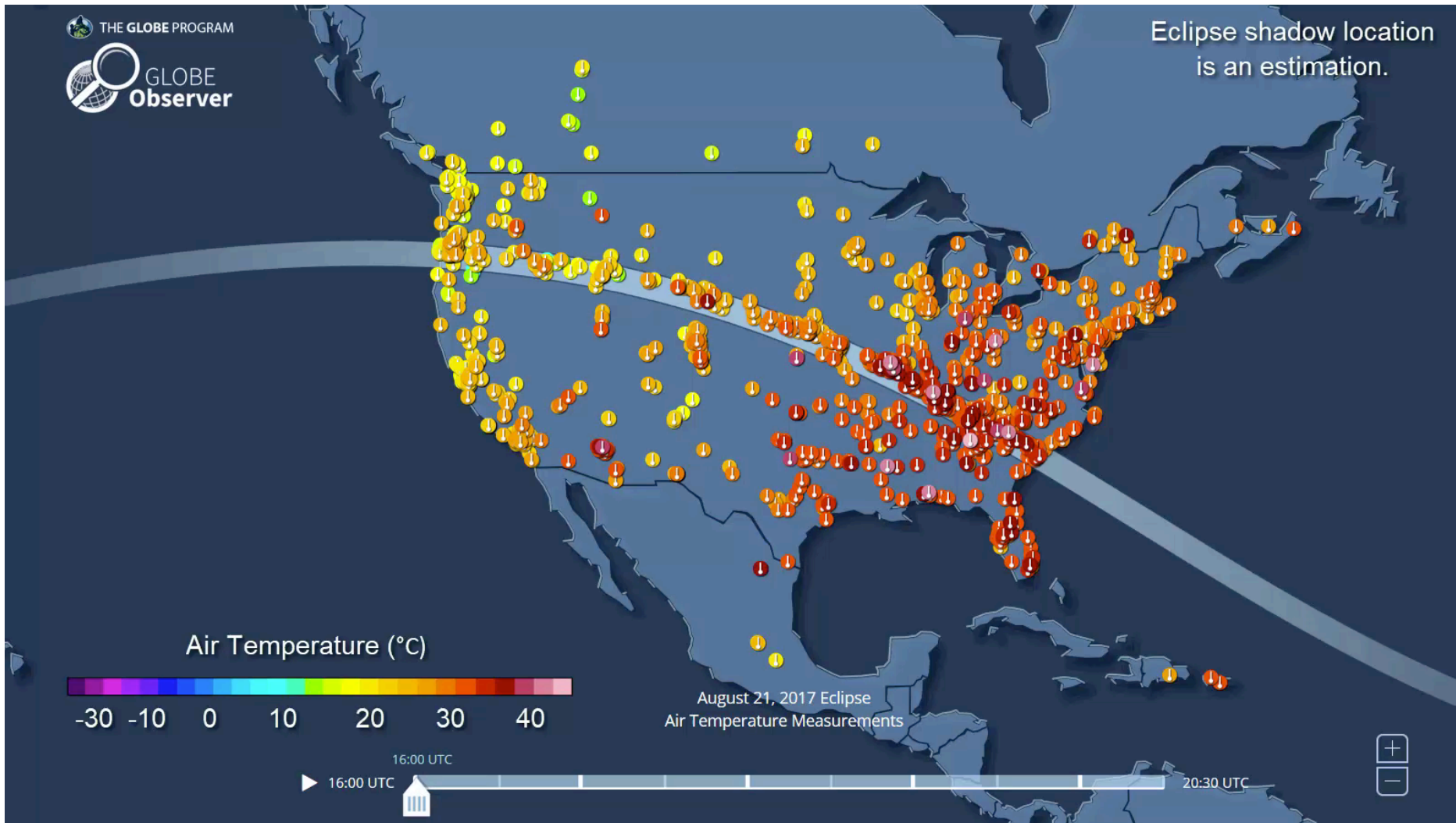
*Example graph from South Carolina
~10F drop in air temp*

- Air temperature and cloud observations (including cloud photos)
- Timer to alert users of next observation time



- Total Observations: >110,000 (as of 11/17)
- Total GLOBE Observers: >10,000
- Participating Countries: USA, Canada, Mexico, Dominican Republic, Puerto Rico, Guatemala, Honduras, Colombia, Panama, Costa Rica
- Also distributed 28,000 eclipse glasses to 85 different GLOBE members hosting eclipse events across the United States

Air Temperature



Over 76,000 air temperature measurements reported on 8/21

The background of the slide is a composite image. The top portion shows a dark space scene with several planets, including Saturn with its rings, Jupiter, and a large, pale, hazy planet. The bottom portion shows a bright, hazy landscape with a body of water, trees, and a couple standing on a rocky shore in the foreground, looking out at the water. The overall color palette is soft and ethereal, with a mix of dark blues, greys, and bright, hazy whites and greens.

Outline

- Science Results
- Programmatic Status
- **Committee Work**

Big Data Task Force

BDTF delivered final products of white papers, findings and recommendations in these areas:

- Data Accessibility
- Statistical and Computational Methodologies
- Modeling Workflows
- Server-side Analytics
- Are the Science Data Archives Ready to Meet Future Challenges?
- Frontier Development Labs
- Organizing SMD's Data Science and high-performance computing programs
- Data science and computing
- DOE's Exascale Computer Program
- National Data Superhighway
- NSF Big Data Innovation Regional Hubs and Spokes
- SMD Data Science Applications Program



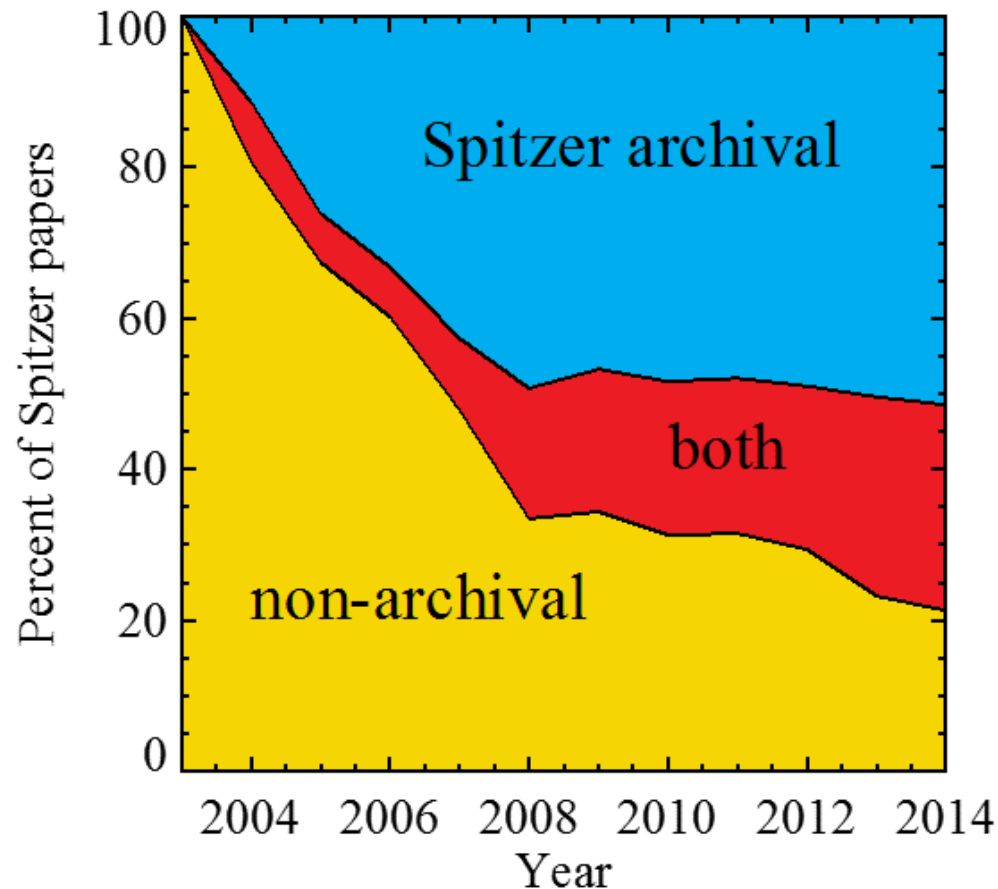
BDTF at JPL, November 2017

NAC Science Committee and the four SMD division advisory committees will weigh these results over next several months. Thanks go to the BDTF Chair and Members!

Big Data Task Force

On the importance of big data, from November BDTF Meeting at JPL:

The use of data in NASA archives can **double the science** of the original mission. This is the trend in **all** of SMD's science data archives.



Credit: Infrared Processing & Analysis Center (IPAC) presentation to the BDTF, November 2, 2017.



Update From the Earth Science Advisory Committee (ESAC) Dr. Marshall Shepherd, Chair

ESAC accepted and approved the report of the Earth Science Senior Review Subcommittee on October 2, 2017. This was the first such review done under SMD's new division advisory committees.

Conclusions:



2017 Senior Review – Missions Seeking Extension

- Science merit is generally very high across missions
- Flagships continue to excel
- Several newer missions scored lower on data-related metrics
- No obvious underperformer





Earth Science Advisory Committee (ESAC) Annual Performance Review of the NASA Earth Science Division

- **Science Mission Directorate (SMD) criteria for GPRAMA voting:**
 - Green – Expectations for the research program fully met in context of resources invested.
 - Yellow – Some notable or significant shortfalls, but some worthy scientific advancements achieved.
 - Red – Major disappointments or shortfalls in scientific outcomes, uncompensated by other unusually positive results.
- **ESD Science Annual Performance Indicators are related to the following six Focus Areas:** Atmospheric composition, Weather, Carbon Cycle, Water Cycle, Climate, and Earth Surface & Interior.
- **After reviewing and discussing pertinent documentation every API was unanimously voted **Green** on October 30, 2017**, indicating that the committee found science objectives fully met for 2017.
 - The committee was particularly pleased to see improved formatting and consistency with the report, which emerged from prior teleconferences with program managers.
 - Earth science continues to be a vital part of NASA's mission and the committee is very pleased with the progress and trajectory of the Earth Science Division.

Astrophysics Advisory Committee (APAC)

Common Themes and Important Topics that Cross SMD Divisions

- **R&A Funding and Selection Rates (as examples, the Astrophysics Theory Program funding cycle change, the change in the internal civil servant funding model, and the reduction in the NASA named fellows, proposed cancelation of the ROSES-17 Strategic Astrophysics Technology call).**
- **Portfolio balance and the role of flagship missions.**
- **NASA support for ground-based research and facilities.**
- **Diversity and equal representation issues in general.**
- **Other issues that arise occasionally that cross SMD division lines:**
 - **Example: Is the internal civil servant scientist funding model being applied consistently across SMD? Can it be?**

Tracked Progress on Completion of the SMD Research and Analysis (R&A) Charge

It is good practice to periodically step back and review processes to gain insight and spot new opportunities.

The R&A charge was formulated in July, 2017 by SMD and the NAC Science Committee (SC) and currently is in work by the four division advisory committees and NAC SC.

Two Questions:

1. Does the SMD R&A program have effective processes in place to solicit, review and select high-impact/high-risk projects?
2. Does the SMD R&A program have effective processes in place to solicit, review and select focused, interdisciplinary, and interdivisional projects?



Community Technical Interchange Meeting on Future Capabilities in Space Servicing and Assembly: *Opportunities for Future Astrophysics Missions*

NASA GSFC November 1 – 3, 2017



70+ participants from government, industry, and academia

SC Finding: Esteemed NASA Civil Servant Workforce

The Science Committee (SC) wishes to acknowledge the community's great esteem for its civil servant colleagues. NASA civil servants have worked tirelessly in many roles – as project scientists, mission planners, analysts, archivists, project managers, engineers, and more – to enable the breakthrough science of NASA's missions. The TI&E Committee would like to also emphasize the value of NASA civil service technologists and researchers that invent, acquire, and adapt advanced technologies and capabilities (e.g., engineering methods) to the needs of NASA's science and exploration projects.

The commitment, professionalism, and dedication of NASA's civil servants have earned the respect and gratitude of the science and engineering community. The community considers its civil servant colleagues – along with the missions they support – a national treasure.