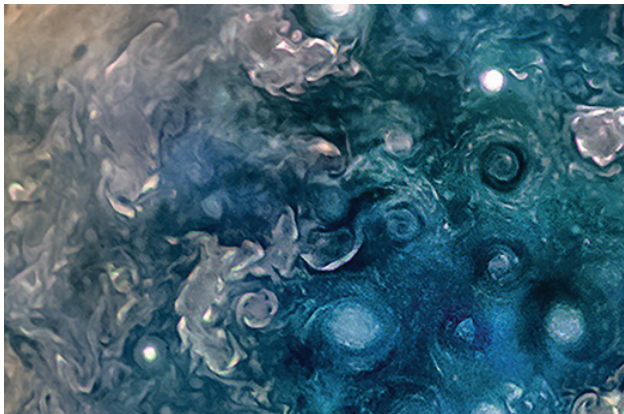


SCIENCE

National Aeronautics and
Space Administration



SPACE STUDIES BOARD MEETING

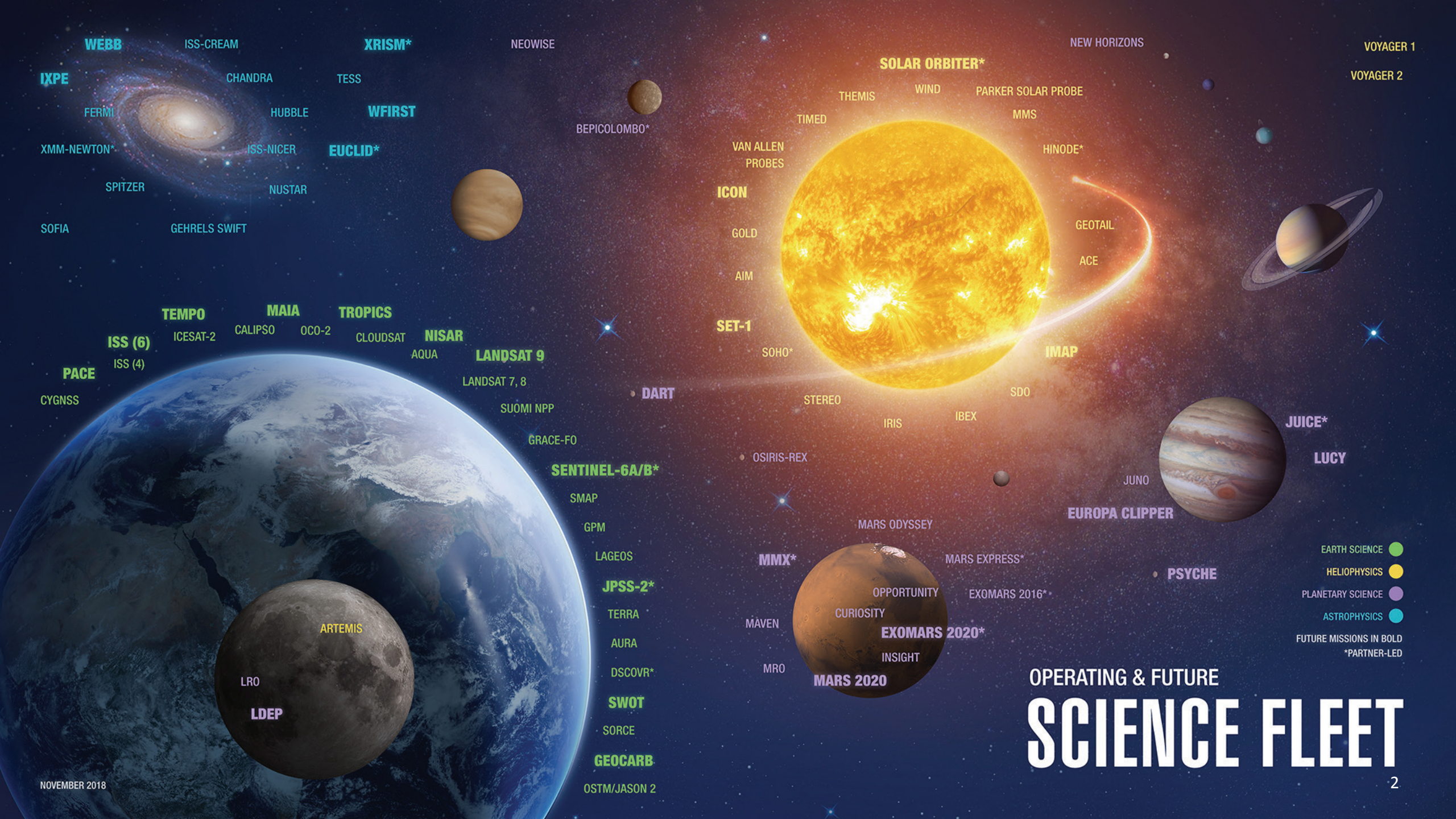
NASA Science Overview

Thomas H. Zurbuchen

Associate Administrator
Science Mission Directorate, NASA

 @Dr_ThomasZ

November 7, 2018



WEBB **ISS-CREAM** **XRISM*** **NEOWISE** **NEW HORIZONS** **VOYAGER 1**
IXPE **CHANDRA** **TESS** **VOYAGER 2**
FERMI **HUBBLE** **WFIRST**
XMM-NEWTON* **ISS-NICER** **EUCLID***
SPITZER **NUSTAR**
SOFIA **GEHRELS SWIFT**

TEMPO **MAIA** **TROPICS** **NISAR** **LANDSAT 9**
ISS (6) **ICESAT-2** **CALIPSO** **OCO-2** **CLOUDSAT** **AQUA** **LANDSAT 7, 8**
PACE **ISS (4)** **LANDSAT 9** **LANDSAT 7, 8** **SUOMI NPP** **GRACE-FO** **SENTINEL-6A/B*** **SMAP** **GPM** **LAGEOS** **JPSS-2*** **TERRA** **AURA** **DSCOVR*** **SWOT** **SORCE** **GEOCARB** **OSTM/JASON 2**

BEPICOLOMBO* **SOLAR ORBITER*** **THEMIS** **WIND** **PARKER SOLAR PROBE** **MMS** **HINODE*** **GEOTAIL** **ACE** **IMAP** **SDO** **IBEX** **IRIS** **STEREO** **SOHO*** **SET-1** **GOLD** **AIM** **VAN ALLEN PROBES** **TIMED**

DART **OSIRIS-REX** **MARS ODYSSEY** **MARS EXPRESS*** **EXOMARS 2016*** **EXOMARS 2020*** **INSIGHT** **MARS 2020** **MAVEN** **MRO** **MMX*** **OPPORTUNITY** **CURIOSITY**

JUNO **EUROPA CLIPPER** **PSYCHE** **JUICE*** **LUCY**

ARTEMIS **LRO** **LDEP**

- EARTH SCIENCE ●
- HELIOPHYSICS ●
- PLANETARY SCIENCE ●
- ASTROPHYSICS ●
- FUTURE MISSIONS IN BOLD
- *PARTNER-LED

OPERATING & FUTURE SCIENCE FLEET



NASA Science Overview

SMD HIGHLIGHTS

Recent mission highlights, future missions and Cislunar activities

OPERATIONAL UPDATES

Astro2020 decadal survey, SMD strategic data management, excellent teams and diversity

NEW AO TEMPLATE

Classified heritage, alternative access to space



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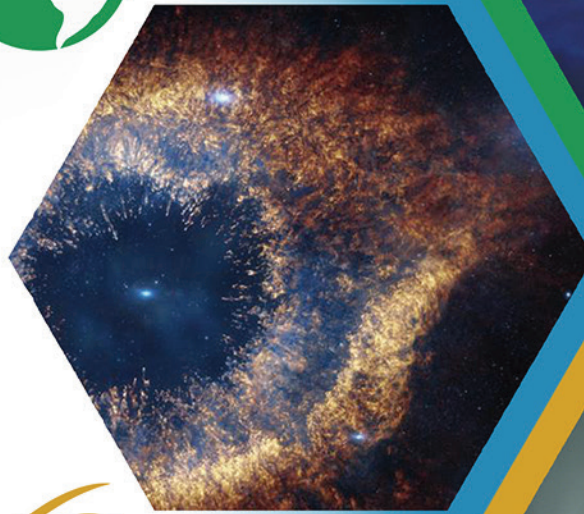
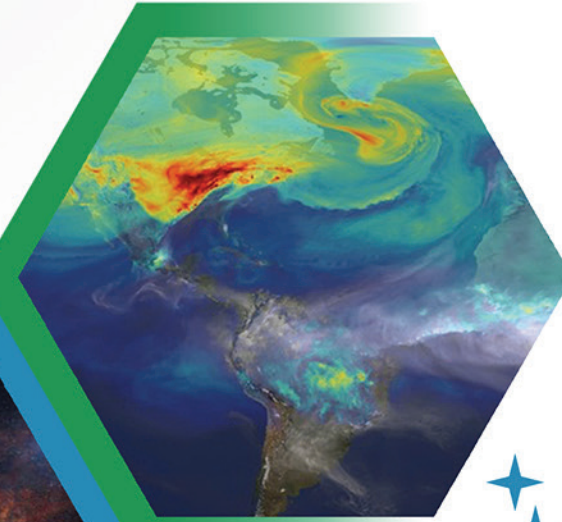
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Key Science THEMES

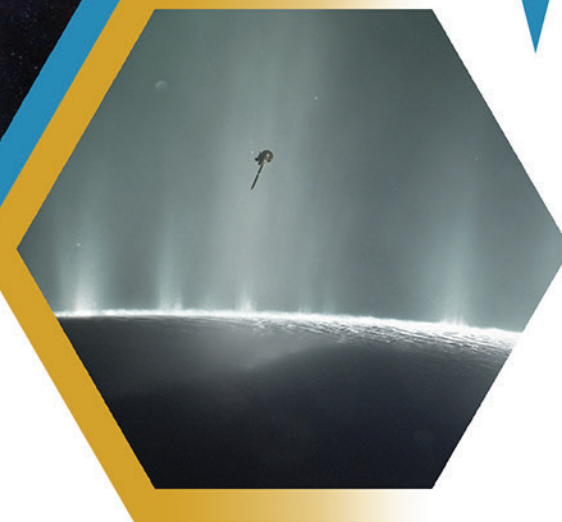
Protect & Improve
Life on Earth



Discover Secrets
of the Universe

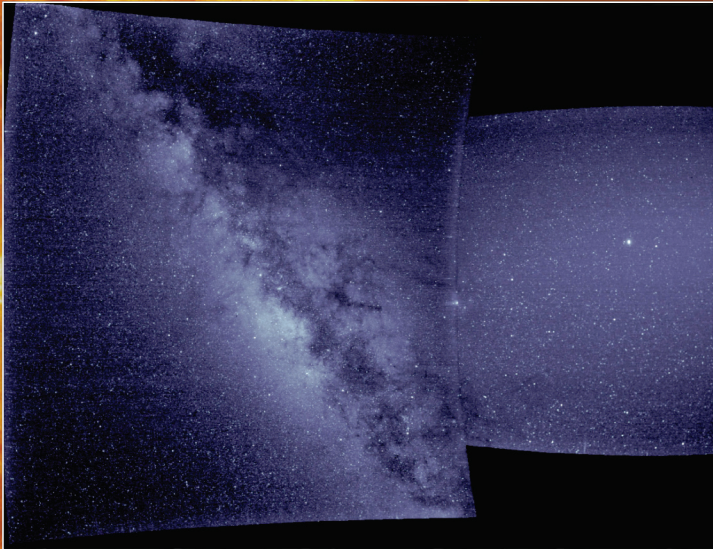


Search for
Life Elsewhere





Discover the Secrets
of the Universe



*Sept. 19, 2018 - Parker Solar Probe returned first-light
data from each of its four instrument suites*

PARKER SOLAR PROBE

A Mission to Touch the Sun





SOLAR ORBITER

Observing the Sun from Mercury,
Distance and Higher Inclination

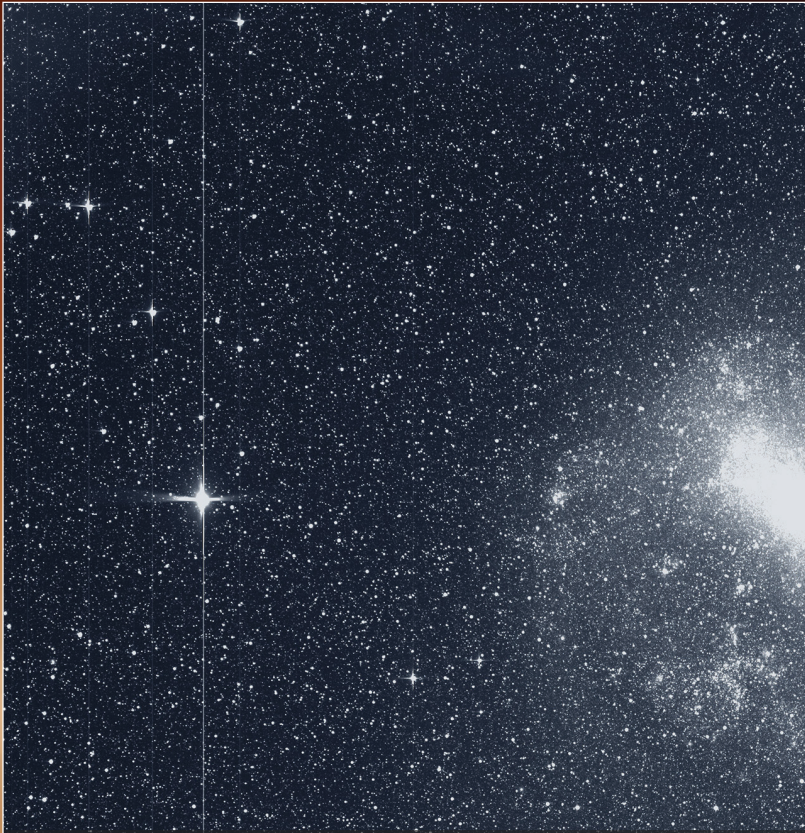
Protect & Improve
Life on Earth



TESS

Transiting Exoplanet Survey Satellite

Search for
Life Elsewhere

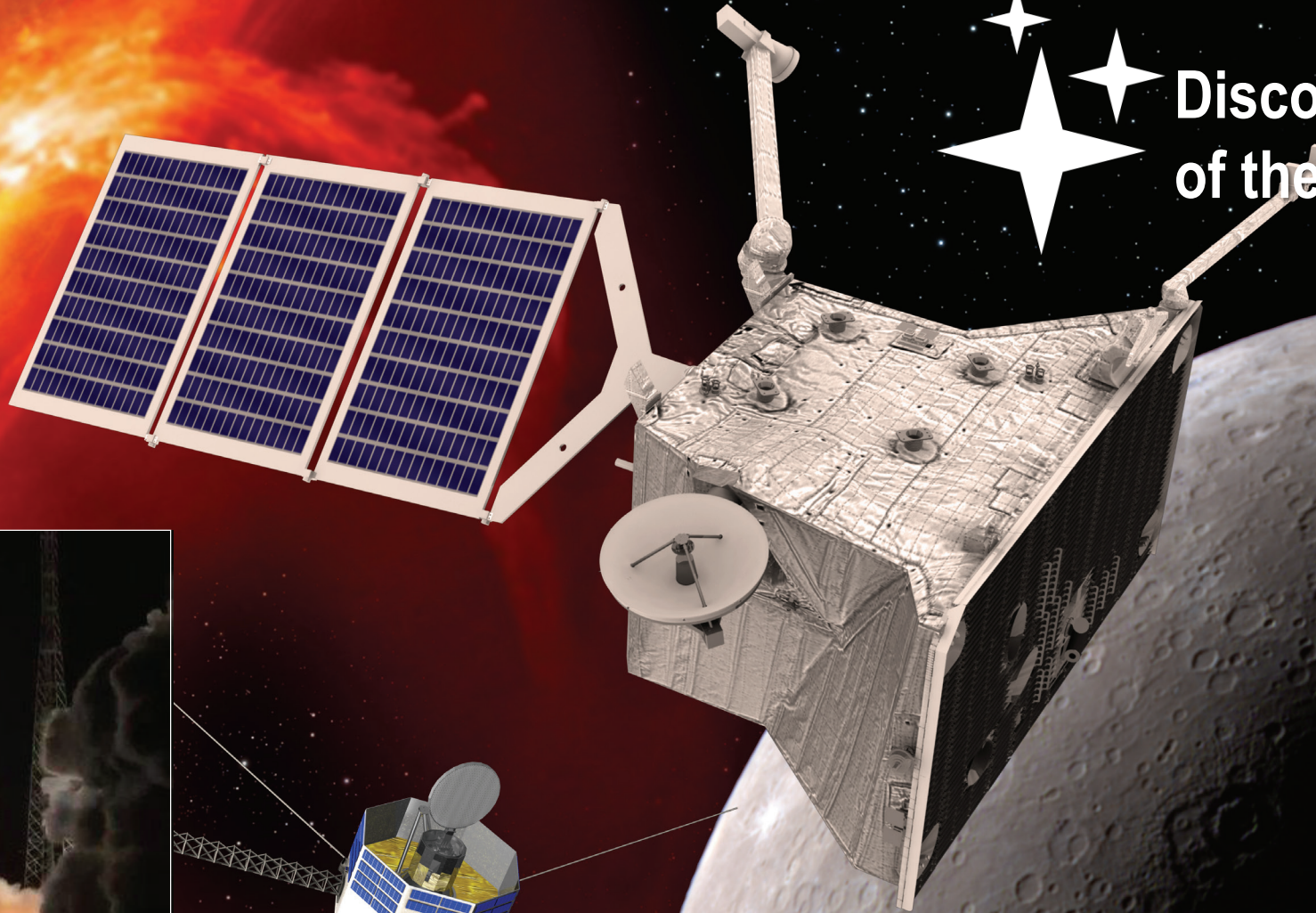


Sept. 17, 2018 - TESS shares its 1st science image of the Large Magellanic Cloud (right) and the bright star R Doradus (left)





Discover the Secrets
of the Universe



Oct. 20, 2018 - ESA's BepiColombo launches
from Kourou, French Guiana on Ariane 5 rocket

BepiColombo

Studying Mercury from unique vantage points

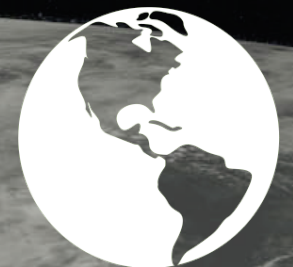
ICESat-2

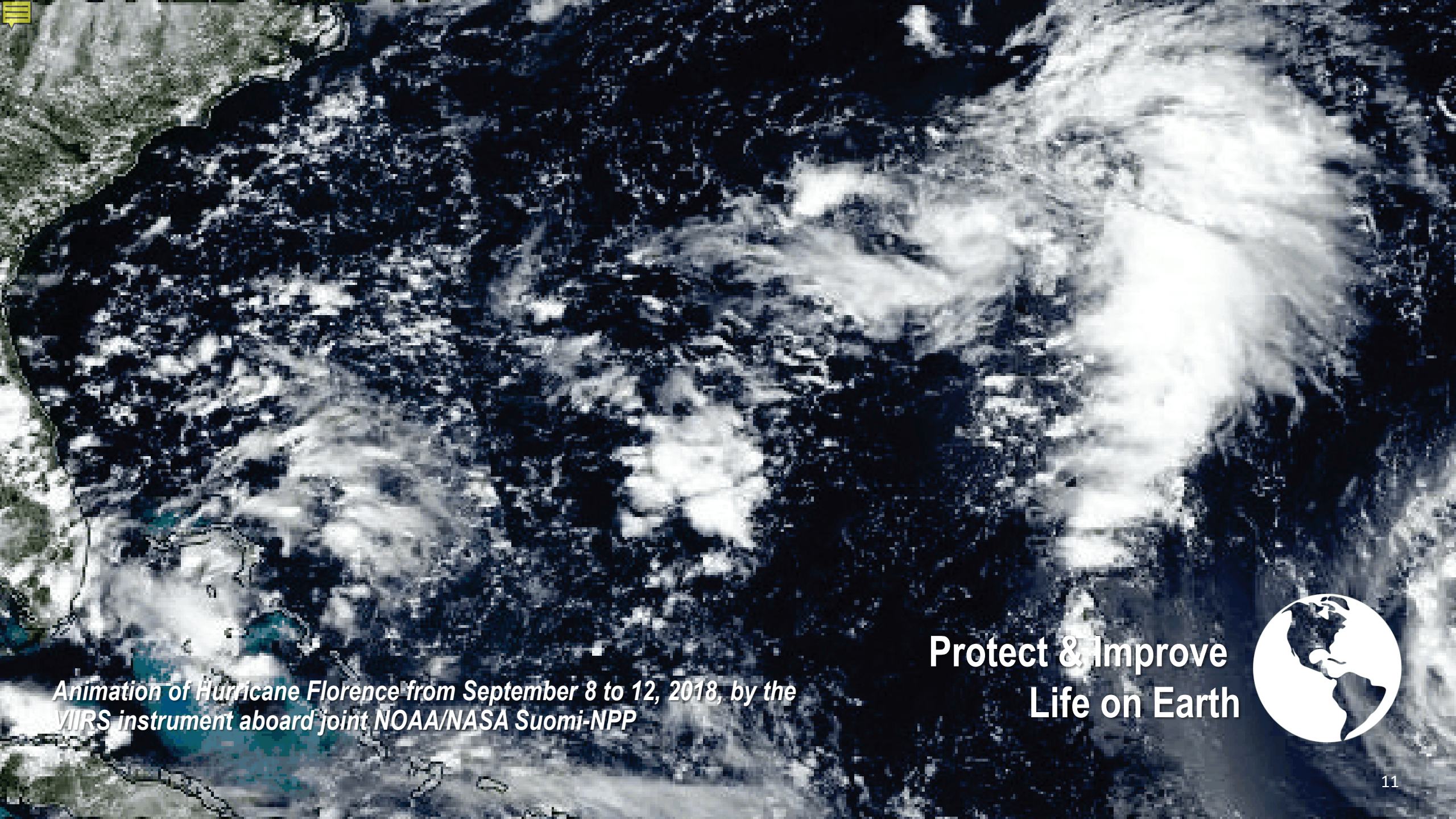


Sept. 15, 2018 - A United Launch Alliance Delta II rocket launches with ICESat-2 onboard, Vandenberg Air Force Base, California



Protect & Improve
Life on Earth





Animation of Hurricane Florence from September 8 to 12, 2018, by the VIIRS instrument aboard joint NOAA/NASA Suomi-NPP

**Protect & Improve
Life on Earth**



ICON Launching

Protect & Improve
Life on Earth



Oct. 14, 2018 - Pegasus XL vehicle preparing for move to hot pad at Vandenberg Air Force Base, California, with ICON inside the payload



InSight Landing

November 26, 2018

Discover the Secrets
of the Universe

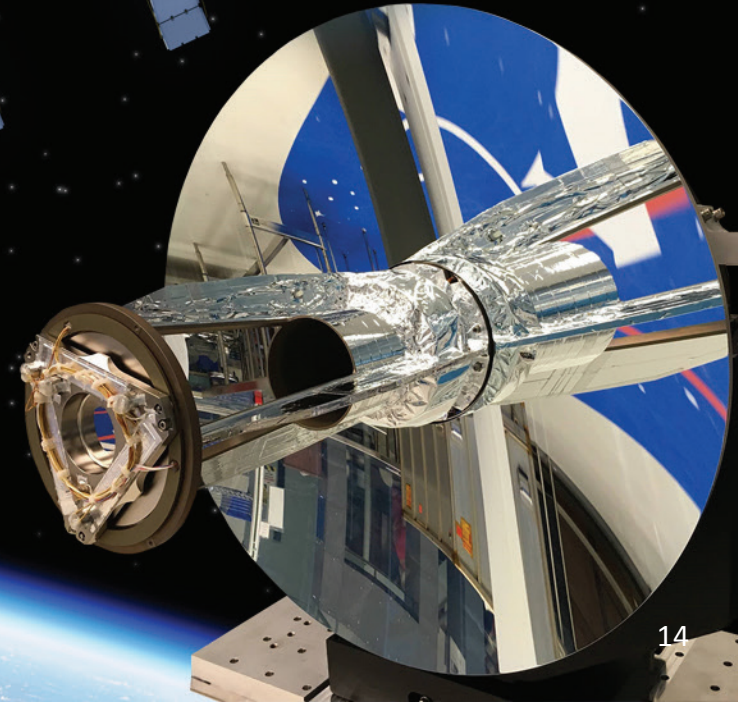


May 5, 2018 - NASA's InSight to Mars lifts off at Vandenberg Air Force Base, California

GEDI Launching

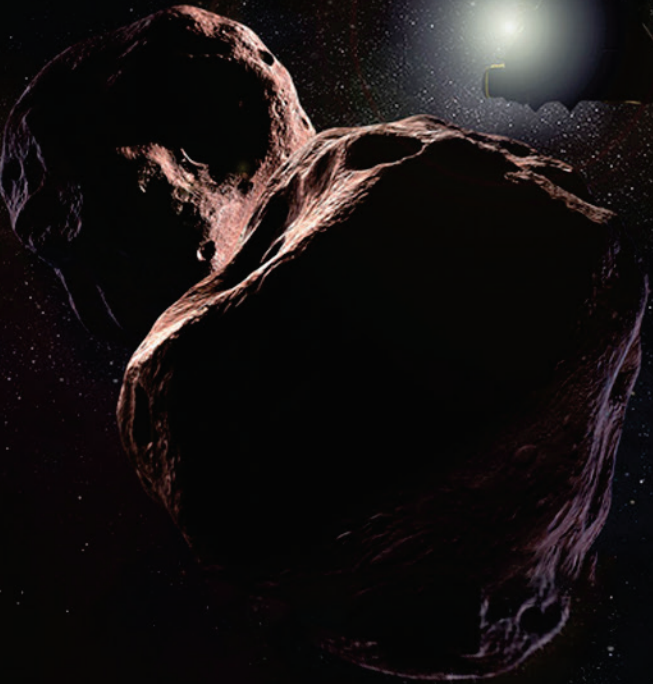
December 2018

Protect & Improve
Life on Earth

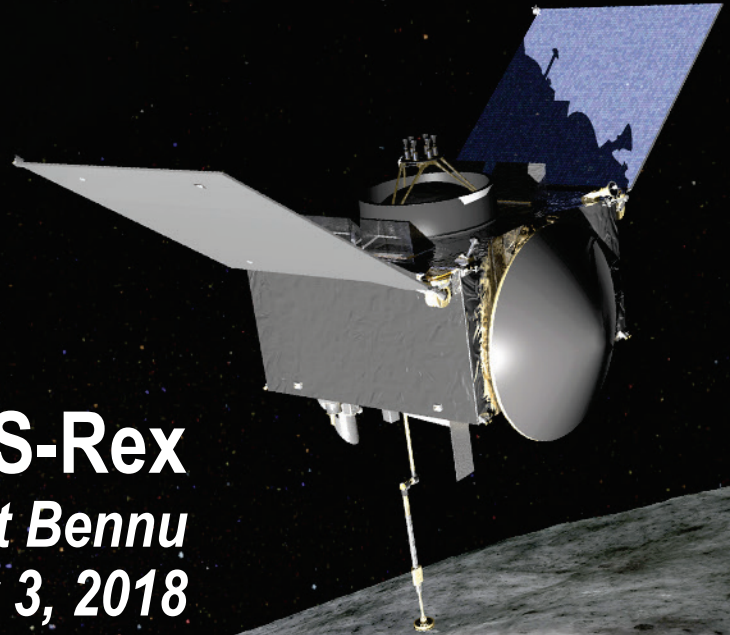




**Discover the Secrets
of the Universe**



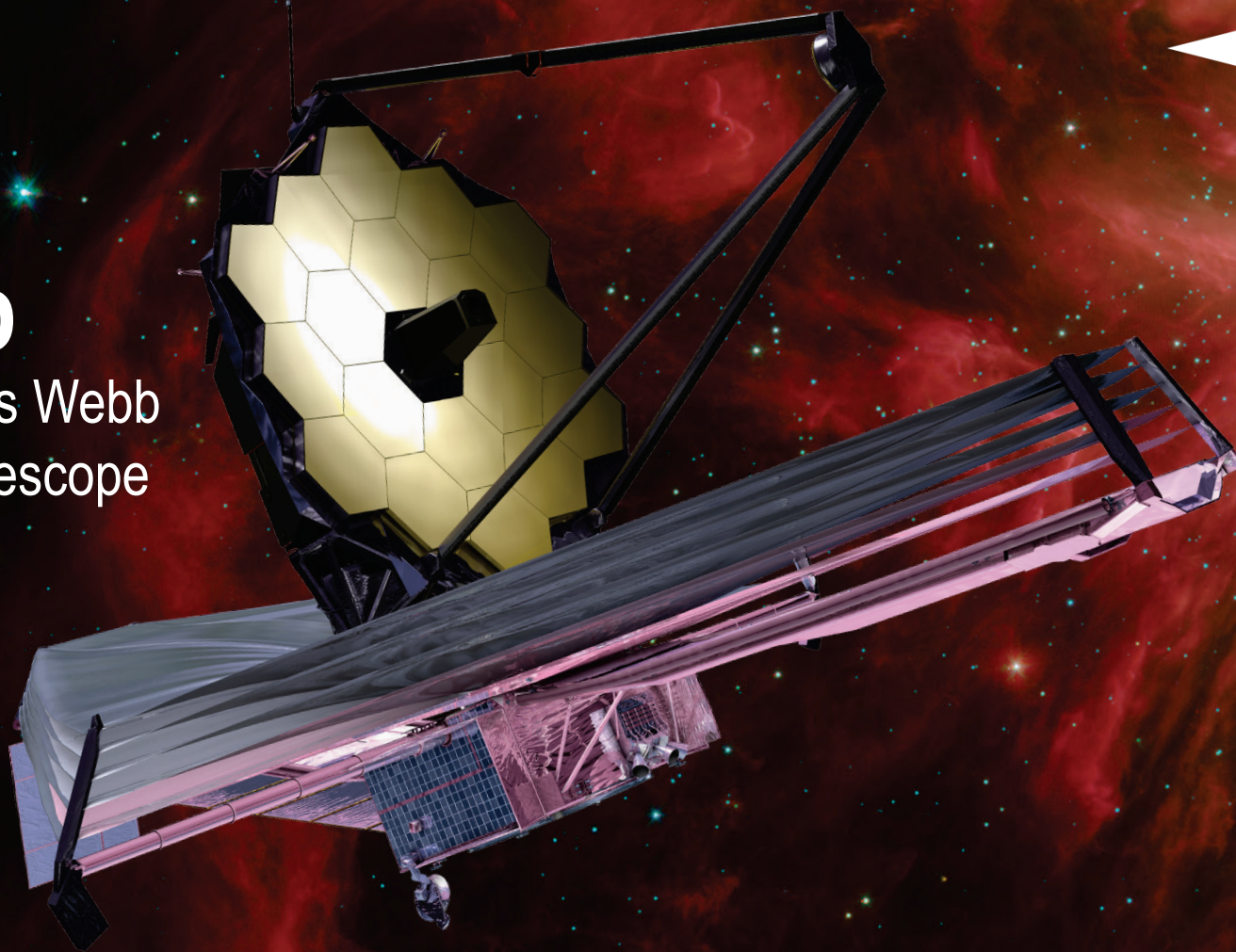
New Horizons
Arrival at Ultima Thule
January 1, 2019



OSIRIS-Rex
Arrival at Bennu
December 3, 2018

Webb

The James Webb
Space Telescope



Discover the Secrets
of the Universe



*Sept. 24, 2018 - Technicians ready
sunshield/spacecraft element for assembly at
Northrop Grumman, Redondo Beach, California*

Commercial Lunar Payload Services (CLPS)

- Competition open to US commercial providers of space transportation services, consistent with National Space Transportation Policy
- 10-year multi-vendor catalog for specific payload missions
- Structured for NASA as one of several buyers of a commercial service
- **Proposals received October 9, 2018**
- **First vendor selection by December 2018; future on-ramps as more capabilities are developed**





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Astro2020 Decadal Survey Status

- Statement of Task finalized between Agencies (NASA, NSF, DOE) and NASEM
- NASEM proposal to the Agencies received, reviewed and accepted
- Funding to implement Astro2020 sent to NASEM
- Start by late 2018, planned public roll out January 2019 AAS meeting
- White papers from the community on Decadal due January 18, 2019
- Final Decadal Survey report should be delivered by early 2021

Strategic Plan for Scientific Data and Computing

- Development of 5-year SMD strategic data management strategy underway; core principles are:
 - Continued free and open access to scientific data
 - Improved ease of use and discoverability
 - Enhanced science applications and new use cases
 - Incorporates best practices and “state of the art” through partnerships
- Strategy development being informed by a range of stakeholder inputs, including:
 - NAC, SC, and Ad Hoc Task Force on Big Data recommendations, findings and analyses (2016-2018)
 - Science archives community workshop held August 2018
 - Interagency, international, and industry workshop held October 30 & 31, 2018
 - RFI extended to close November 2, 2018
- SMD working group, comprised of representatives from each division, will use inputs to draft SMD overarching strategy, expected to be completed in early 2019
 - Implementation plans will be developed by each division to meet their specific needs



Building Excellent Teams

- Excellent teams require diverse opinions and perspectives
- Teams must foster a community where everyone feels safe
- Encouraging healthy behavior through actions is paramount
- SMD is building excellent teams by:
 - Promoting diversity for both grants and PI-led missions
 - Providing resources to report concerns
 - Partnering with the Office of Diversity and Equal Opportunity
 - Examining barriers to diversity and inclusion within NASA and the broader science community





Pathways to Mission Leadership: Mission Principal Investigator (PI) Diversity Workshop

- November 27-28, NASA Science will bring together current principal investigators (PIs), academia, industry, and government to discuss strategies for broadening participation in NASA's missions to:
 - Promote diversity among current mission principal investigators
 - Encourage inclusive behavior within the science community
 - Examine barriers to participation
 - Identify best practices and lessons learned for success
 - Foster new partnerships
- Contact Ellen Gertsen at ellen.gertsen@nasa.gov to nominate participants!



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New AO Template – Version 5 Changes

- Classified Heritage Information
 - Added two new methods for provision of a classified heritage appendix in response to requests from industry
 - Added inclusion of classified Basis of Estimate data
- Encouraging Excellent Teams
 - Added statements on diversity and inclusion, and harassment and discrimination
- Technology Demonstration and Infusion
 - Reorganized approach to technology infusion/demonstration
- Alternative Access to Space
 - Completely rewrote “Access to Space” sections splitting it into “AO-Provided Access to Space” and “Alternative Access to Space,” with clarifications of requirements based on 2016 Heliophysics Explorer evaluation lessons learned
- Increasing Access to NASA’s Science Results
 - Integrated requirements from the NASA Plan for Increasing Access to the Results of Scientific Research into new Section 4.4.2 “Increasing Access to the Results of Federally Funded Research”
- Numerous small clarifications and edits



New ESPA-Class Rideshare Policy

- Actively soliciting ESPA-class rideshare scientific payloads
- Directly supports NASA, government, academic, commercial, and international partnerships
- Recognizes future importance of constellation systems and economies of scale enabled by ESPA-class rideshare

Technology Flight Opportunities

Incentivize, expand and incorporate advanced technology demonstration or infusion in all missions

- Stimulate growth of commercial space flight industry with innovative space technologies
- Support capability development in suborbital and orbital small satellite launch vehicle market
- Include NASA Centers, government agencies, academia, industry, international participation
- Increase focus on potentially transformational technologies, improved metrics



Focused Technology Investment

Technology	Potential Benefits
INTEGRATED PHOTONICS	Substantial improvement in performance of sensors and science instruments; reduction in size and cost. Possible emergence of an optical computer
SMALL SATELLITE – ENABLED SCIENCE	Significant savings in mission costs; “democratization” of science through larger numbers of small missions from Agency & partner institutions
INTELLIGENT SYSTEMS / HIGH-LEVEL AUTONOMY	Increase capabilities or enable wide range of SMD missions (e.g., targeted Earth Science observations, enhanced planetary rover capabilities, rapid response to solar events in Heliophysics)
NEXT GENERATION HIGH-END COMPUTING	Allows continued scaling of SMD modeling & simulation applications beyond the end of Moore’s Law
BIG DATA / DEEP LEARNING	Significant opportunity to better understand scientific processes from voluminous data stores

EXPLORE AS
ONE



EXPLORER 1



INSIGHT



PARKER



ICESAT-2



WEBB