Science @NASA

John Mace Grunsfeld PhD
Associate Administrator Science
National Aeronautics and Space Administration

Our Mission:

Innovate
Explore
Discover
Inspire

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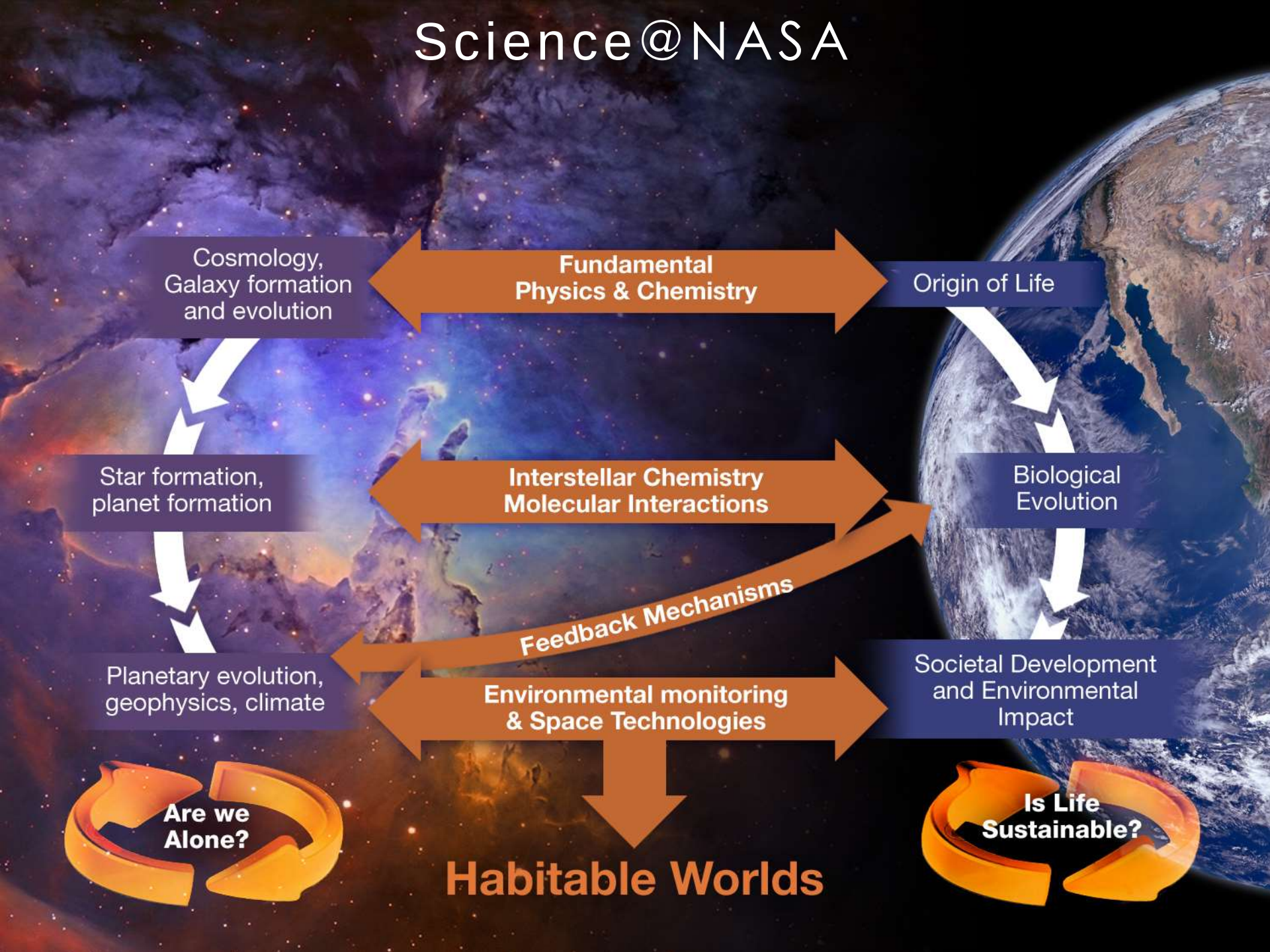
Science@NASA

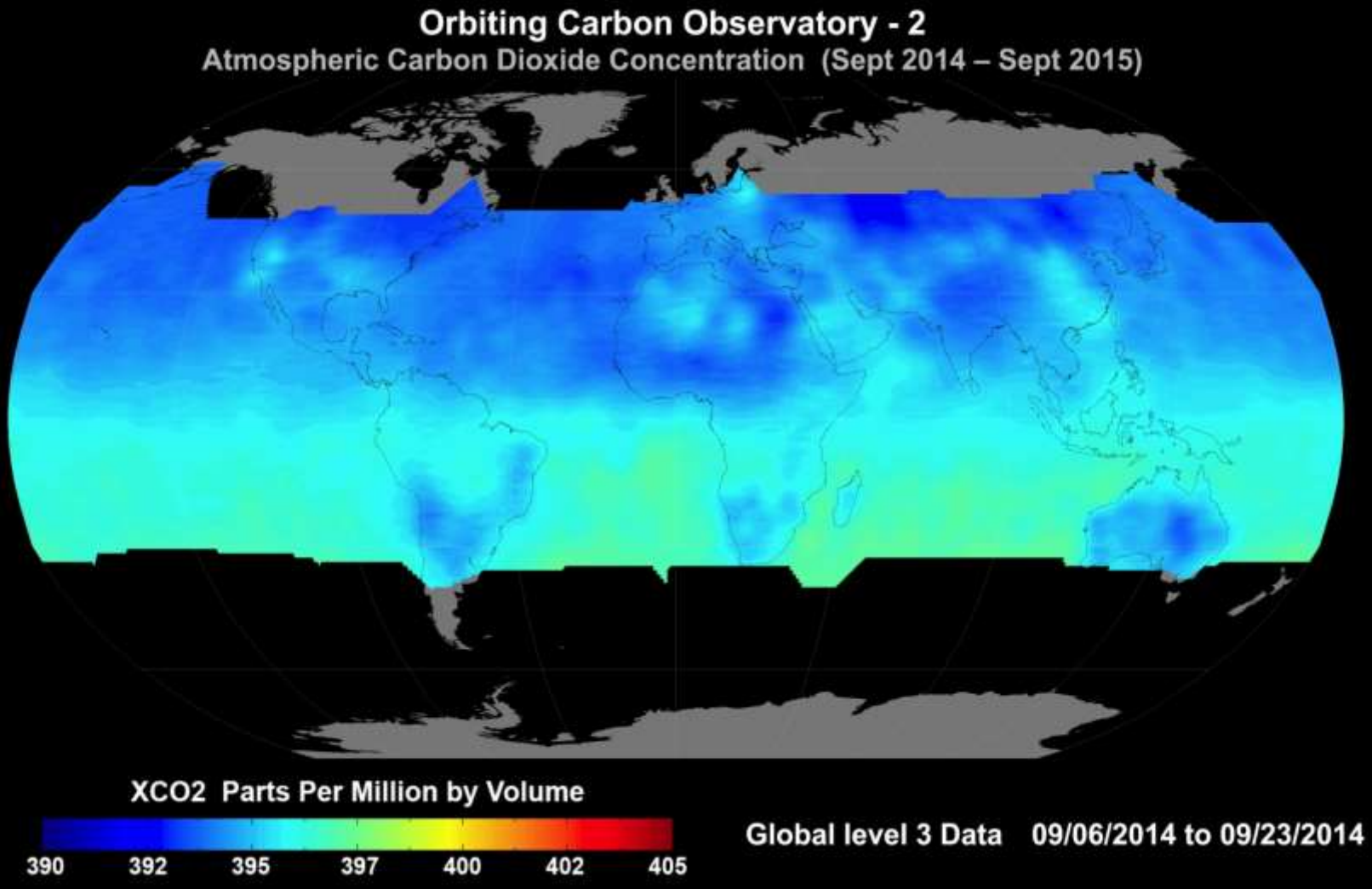


Science @ NASA executes:

- 95 missions
- 121 spacecraft
- 12 Balloon launches (FY 2015)
- 20 Sounding rockets (FY 2015)
- 4,200 Airborne hours (FY 2015)

Daily EPIC Imagery: http://epic.gsfc.nasa.gov

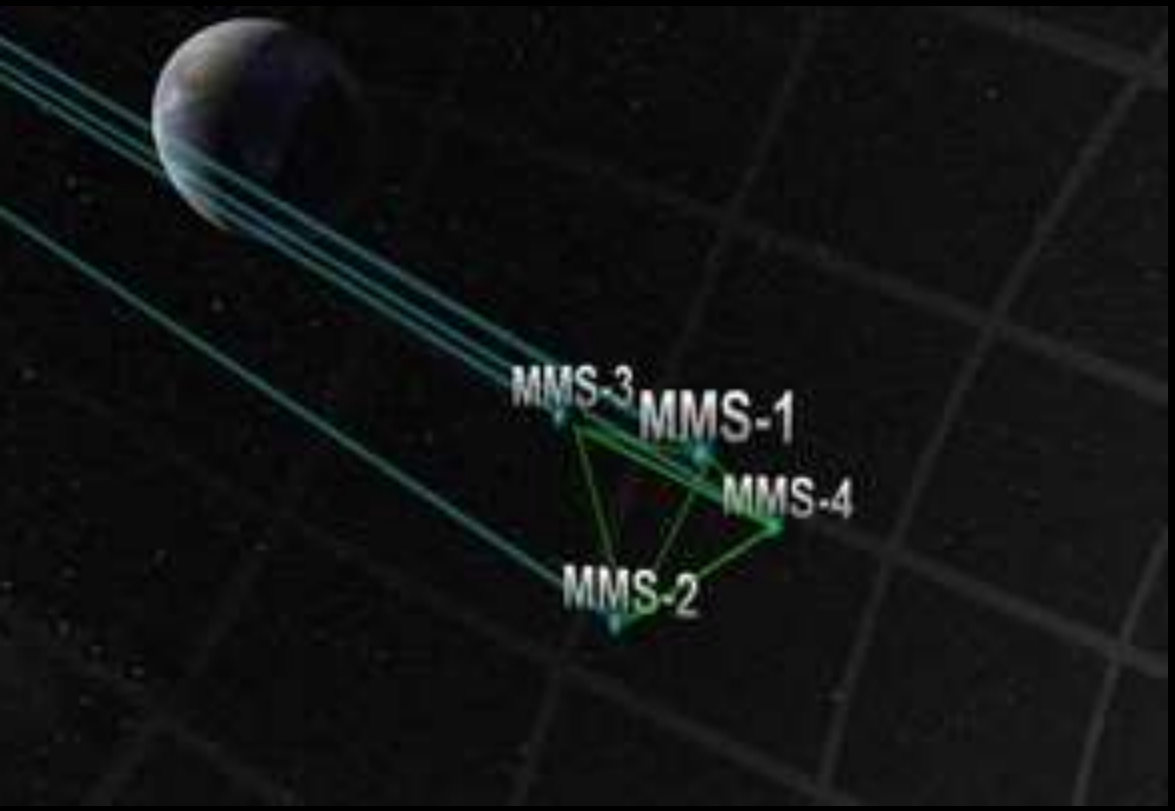
OCO-2's First Year of Measurements



Heliophysics Science Highlights

October 2015

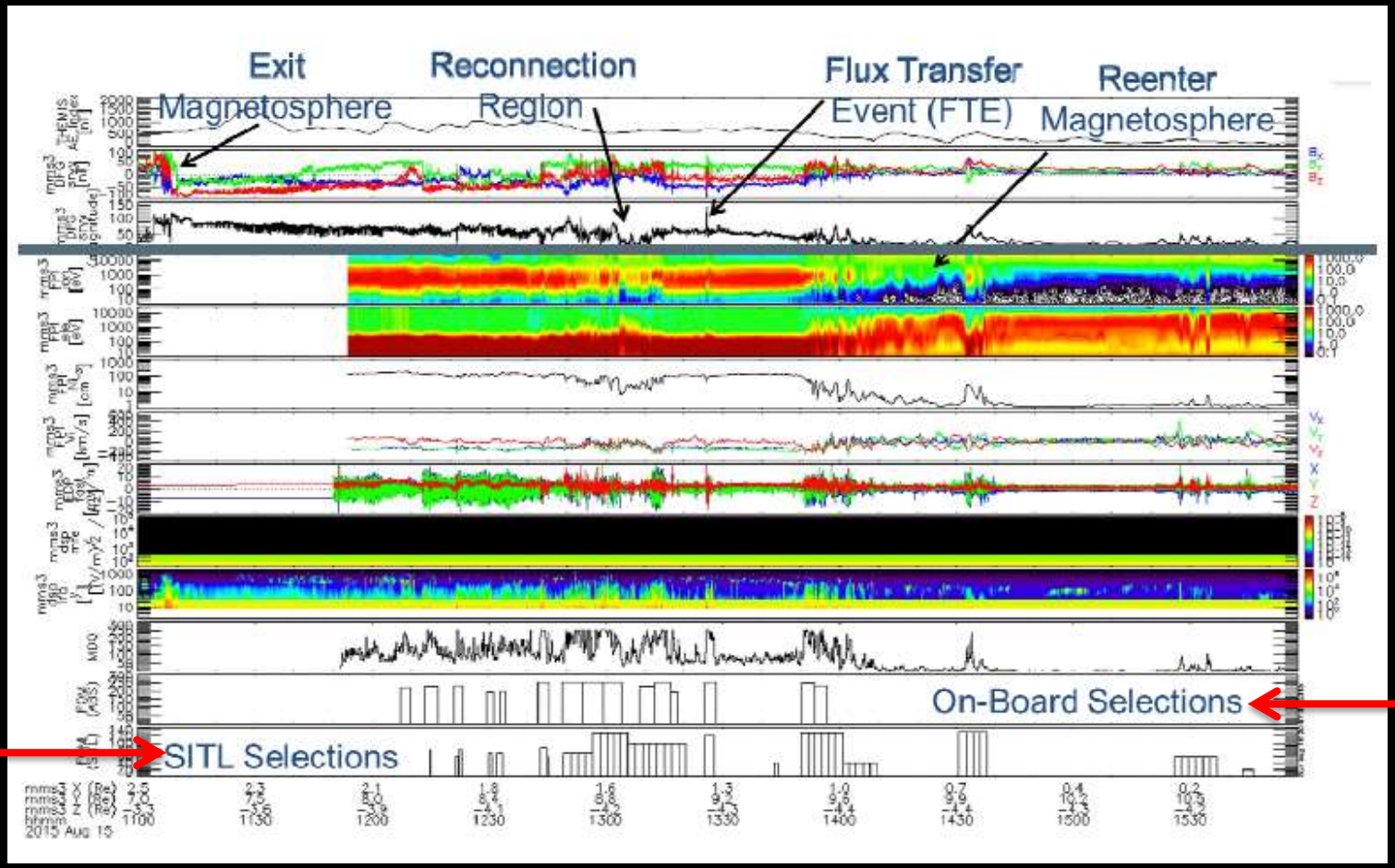
MMS Spacecraft Achieve Tightest Flying Formation Ever!



- On Oct. 15, 2015 the four satellites of its Magnetospheric Multiscale (MMS) mission are now flying at their smallest separation, the tightest multi-spacecraft formation ever flown in orbit. The four spacecraft are just six miles apart, flying in a tetrahedral formation.

Heliophysics Science Highlights

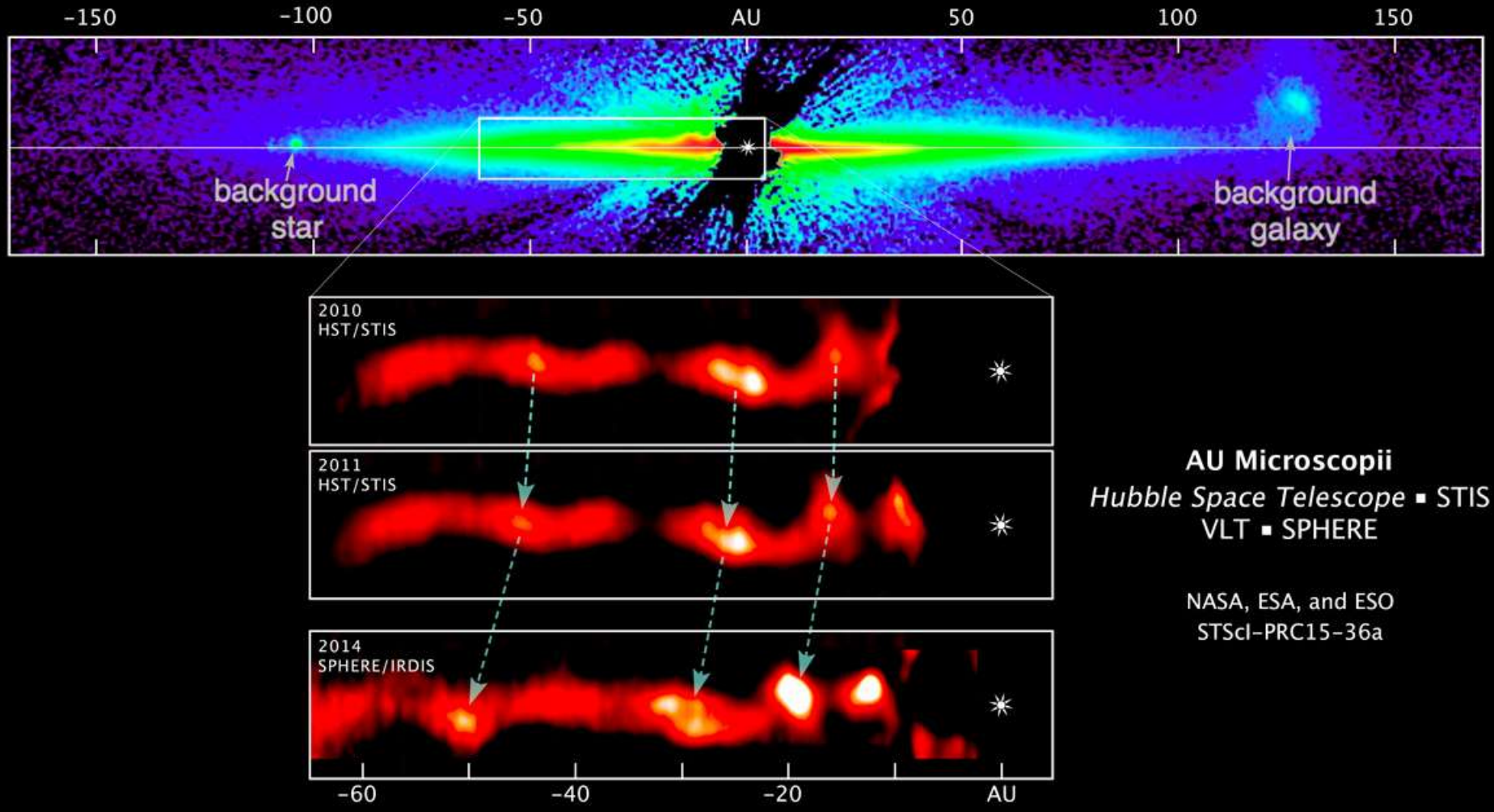
MMS First Passage Through the Magnetopause



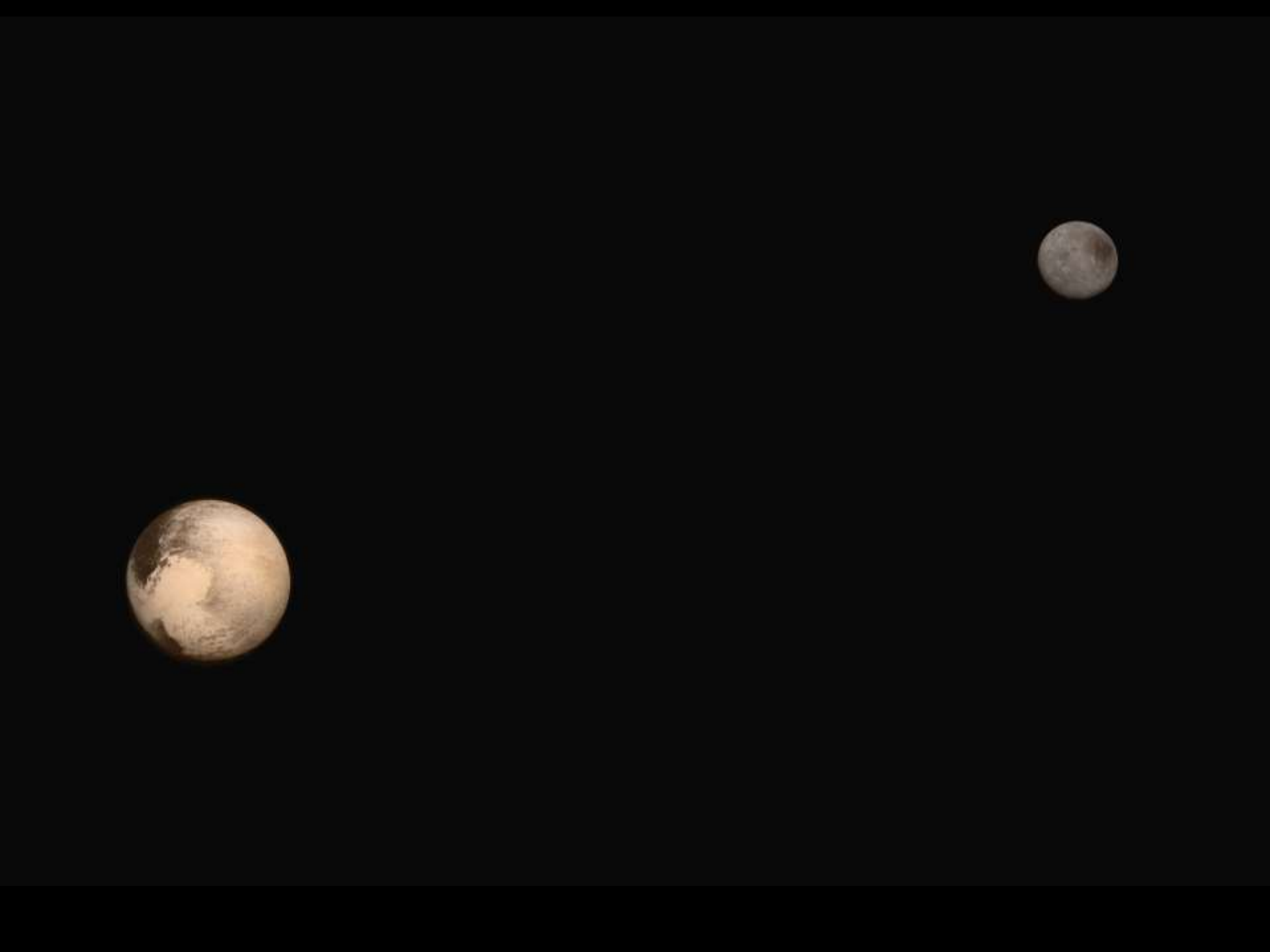
EXOPLANETS 20/20

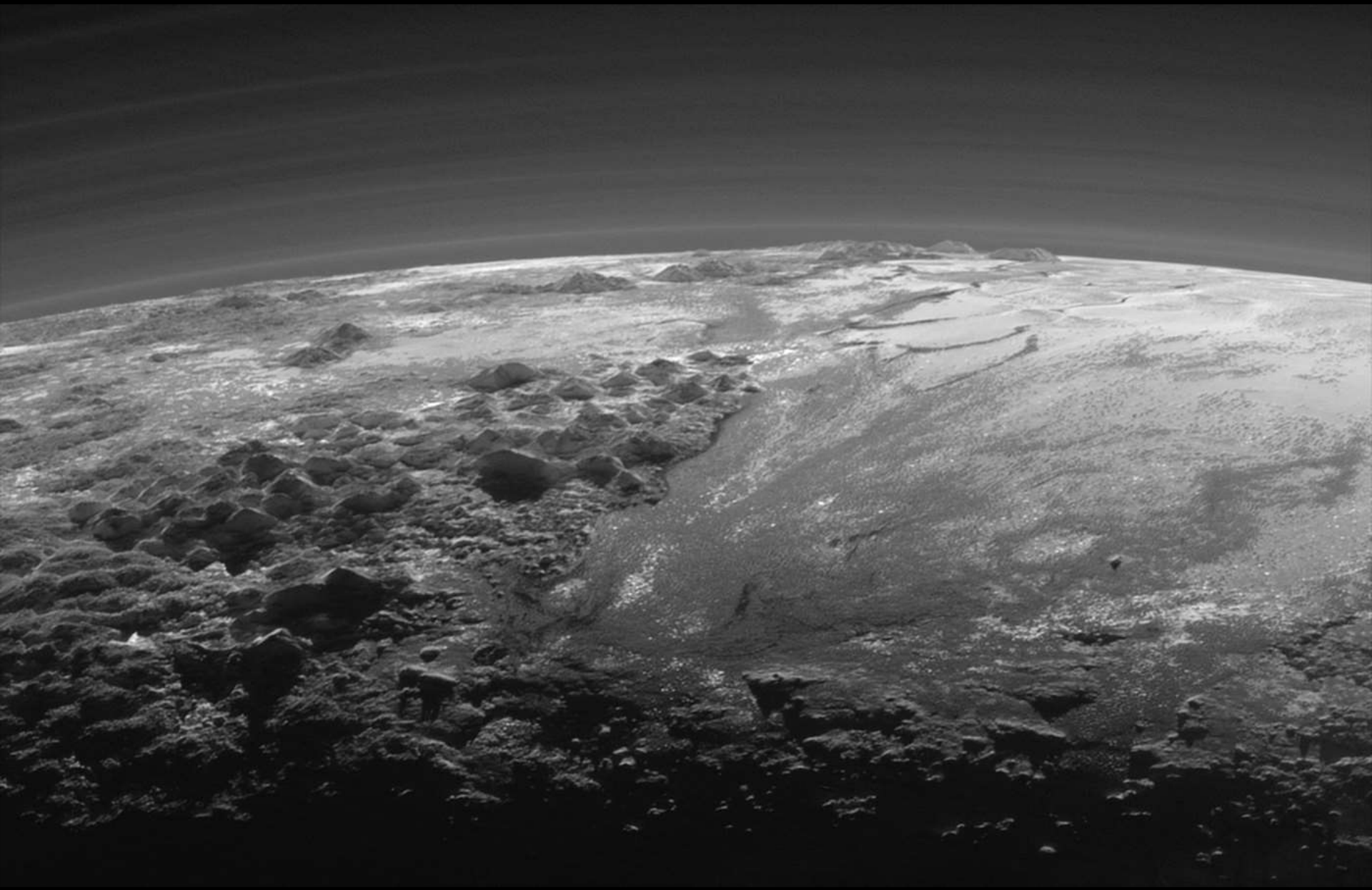
Celebrating the last 20 years–and imagining the next 20 years–of exoplanet exploration

October 10-11, JPL Open House with Exoplanet Theme
October 19, NASM What's New in Aerospace Forum: "Exploring Alien Atmospheres."
October 20, Congressional Staffers Lunch and Learn: "The Search for Planets, Habitability, Life in Our Galaxy."
October 20, NASM Exoplanets 20/20–Celebrating 20 Years of Exoplanet Exploration, Imagining the Next 20 Years
October 21, Carnegie Capital Science, "Hunting Planets: Celebrating 20 Years of Exoplanets."
October 22, Reditt "Ask Me Anything" on Exoplanets
October 22-23, Thursday-Friday, Astrophysics Subcommittee Meeting at GSFC

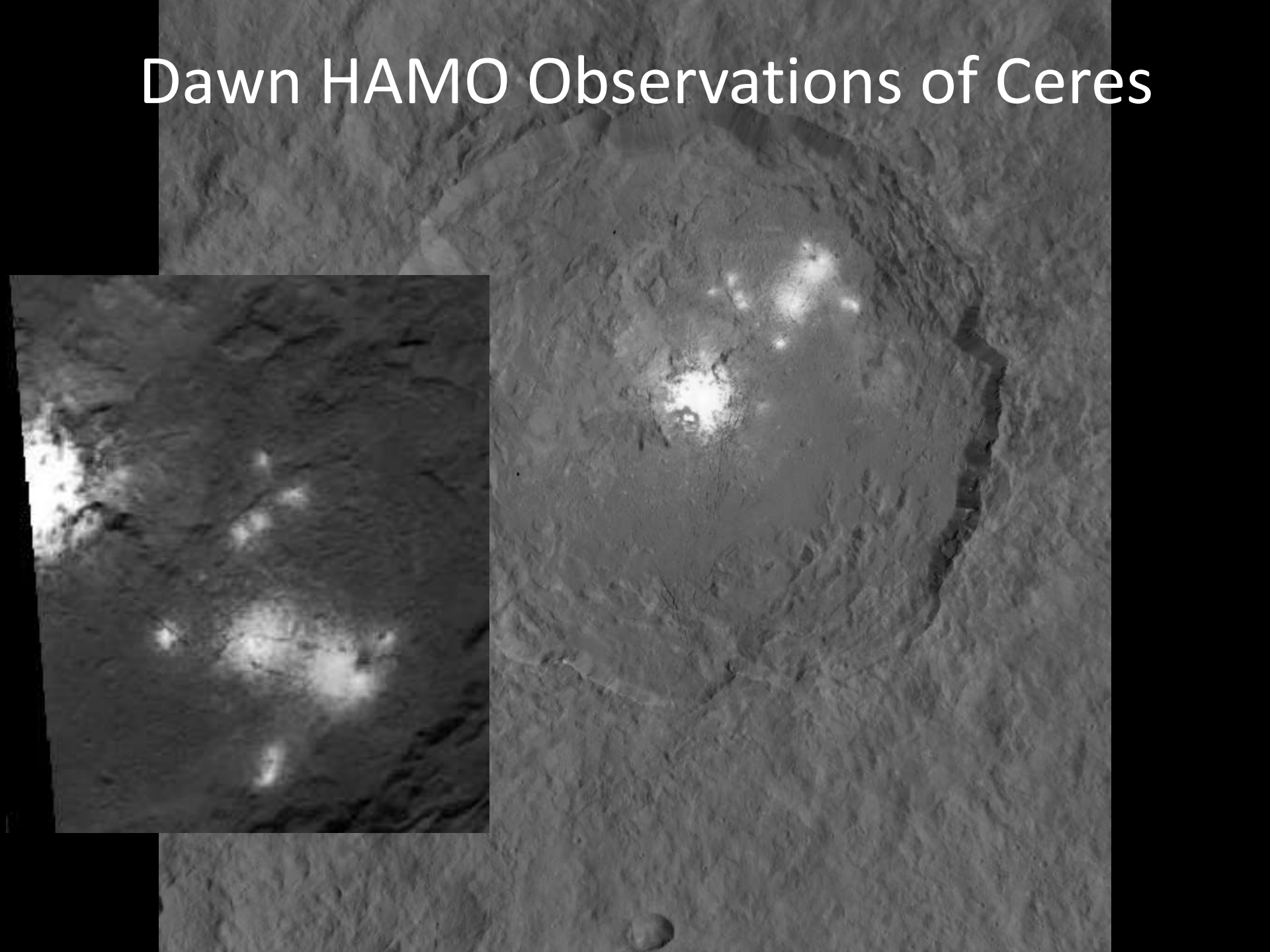


Credit for Top Panel: NASA, ESA, G. Schneider (Steward Observatory), and the HST GO 12228 team
Credit for Bottom Panels: NASA, ESA, ESO, and A. Boccaletti (Paris Observatory)

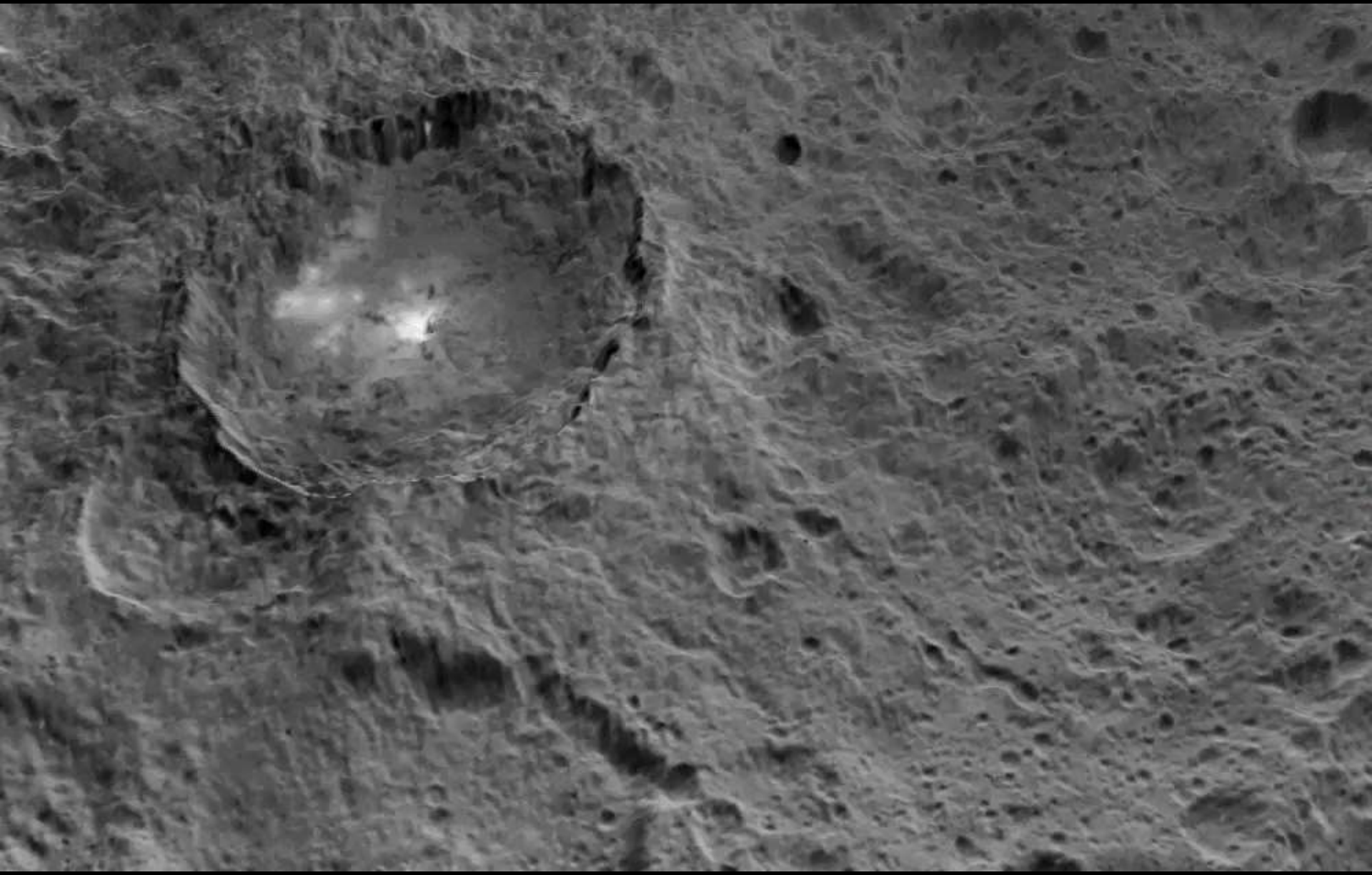




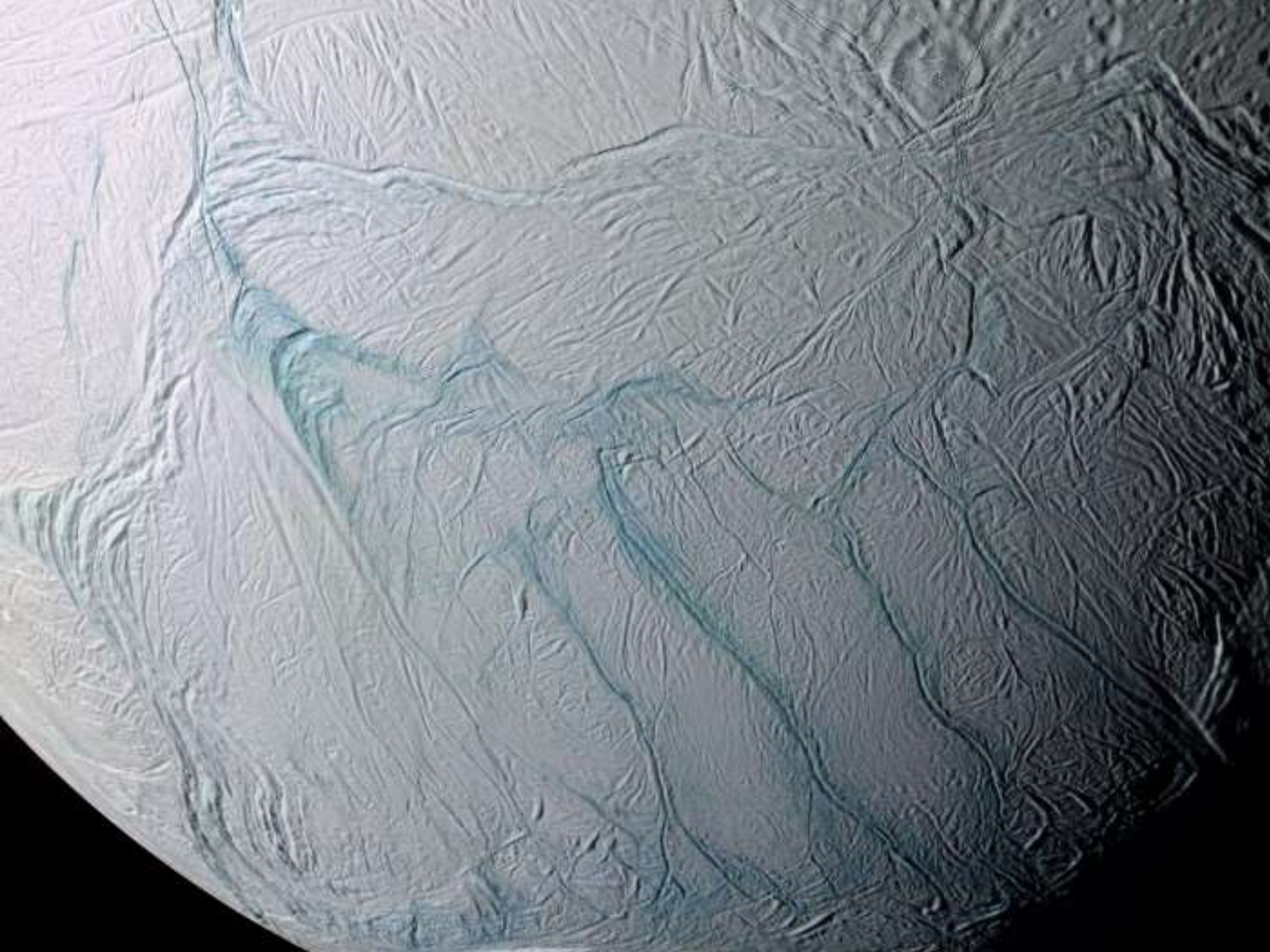
Dawn HAMO Observations of Ceres



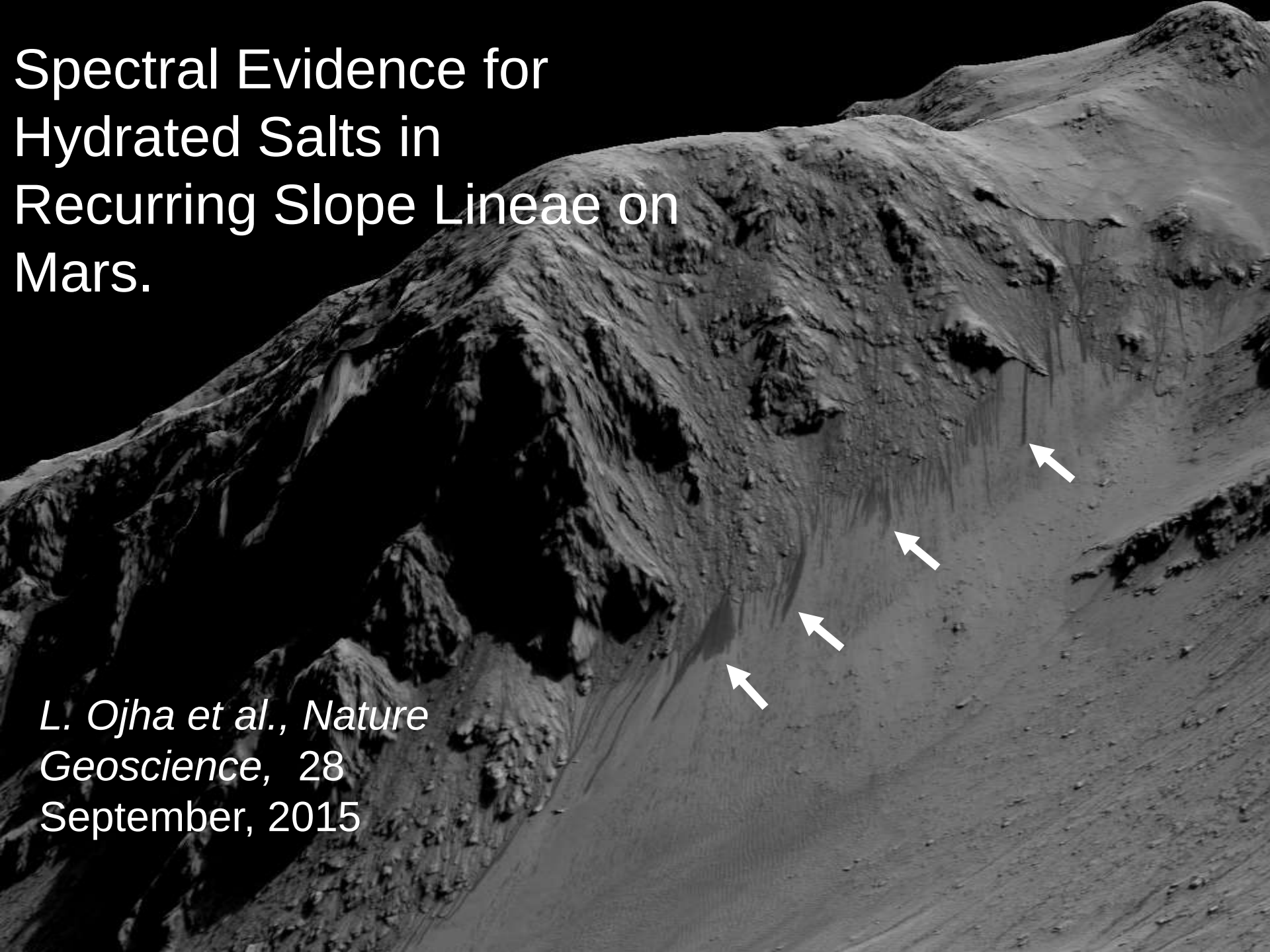
Dawn at Ceres: Bright Spots Crater (Ogmios)



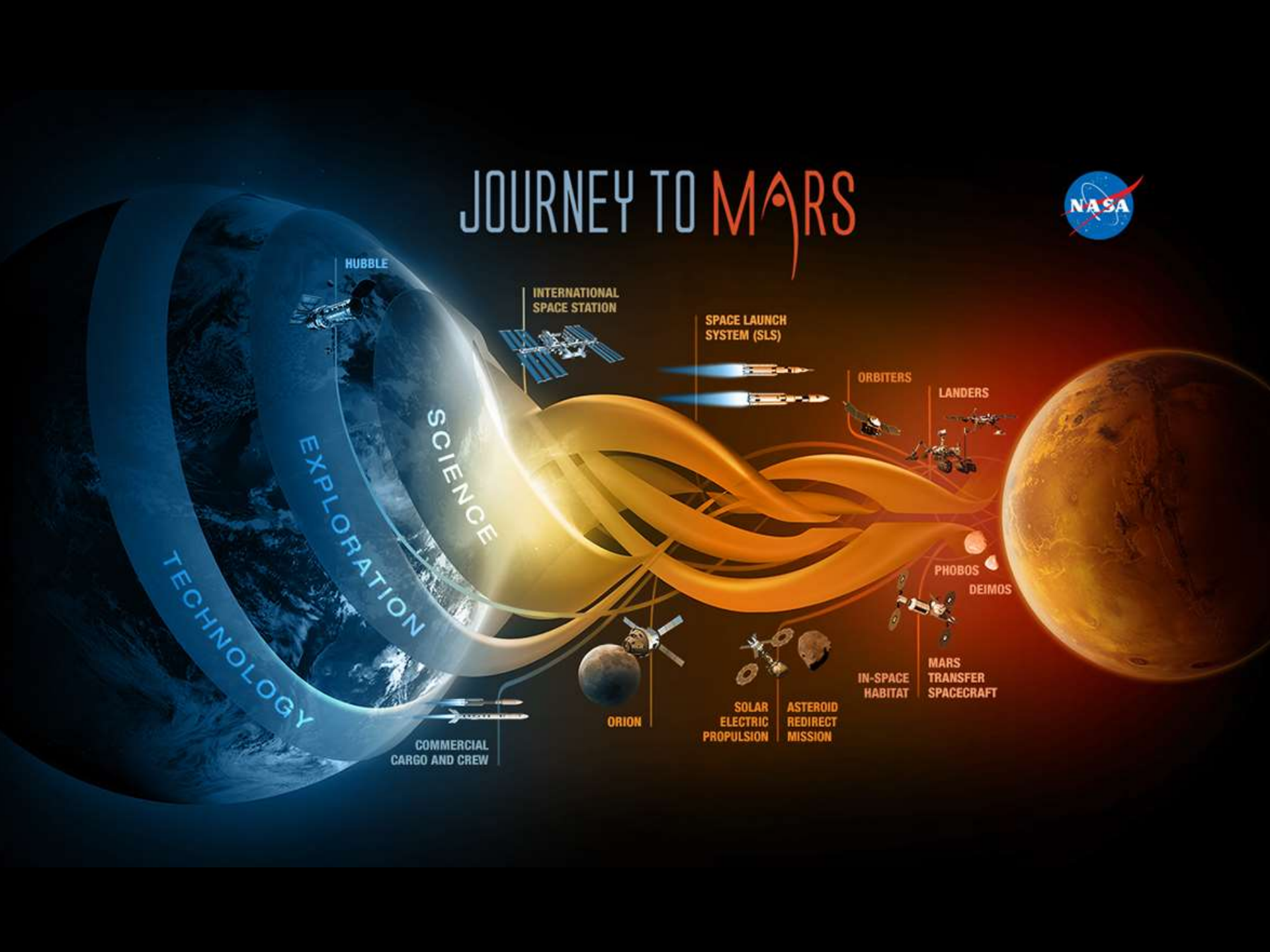
P. Schenk, LPI



Spectral Evidence for Hydrated Salts in Recurring Slope Lineae on Mars.



L. Ojha et al., Nature Geoscience, 28 September, 2015


JOURNEY TO MARS
NASA
HUBBLE
INTERNATIONAL SPACE STATION
SPACE LAUNCH SYSTEM (SLS)
ORBITERS
LANDERS
SCIENCE
EXPLORATION
TECHNOLOGY
PHOBOS
DEIMOS
IN-SPACE HABITAT
MARS TRANSFER SPACECRAFT
ORION
SOLAR ELECTRIC PROPULSION
ASTEROID REDIRECT MISSION
COMMERCIAL CARGO AND CREW

Strategic Principles for Space Exploration

Implementable in the **near term with the buying power of current budgets** and in the longer term with budgets commensurate with economic growth

Exploration enables science and science enables exploration, leveraging scientific expertise for human exploration of the solar system

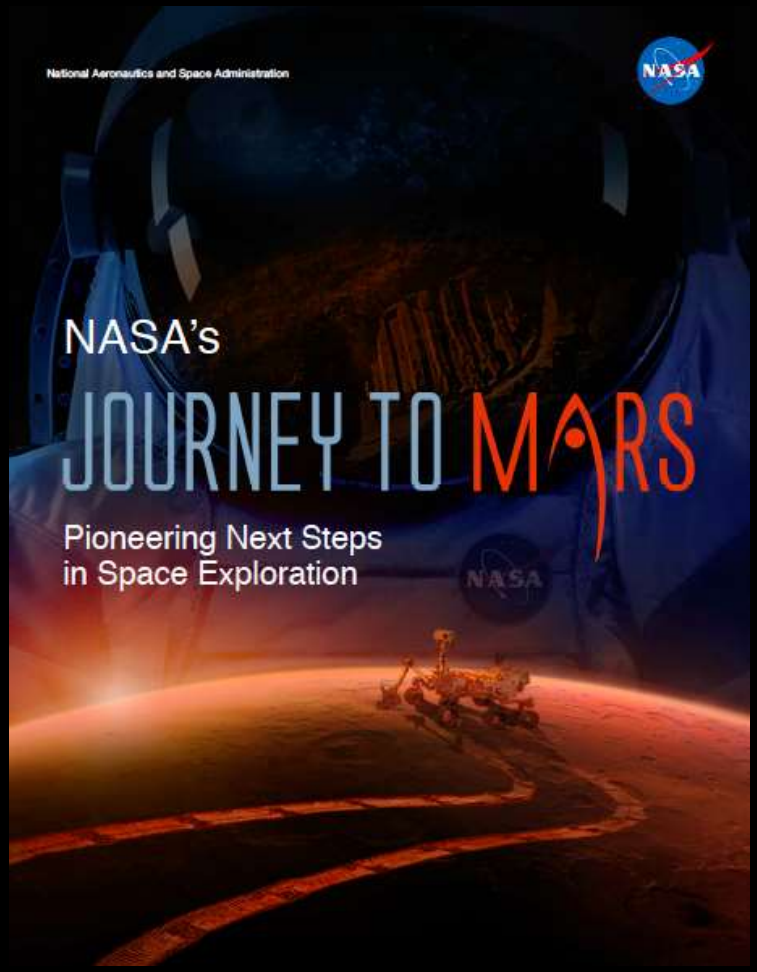
Application of **high Technology Readiness Level (TRL)** technologies for near-term missions, while focusing sustained investments on **technologies and capabilities** to address challenges of future missions

Near-term mission opportunities with a defined cadence of compelling and integrated human and robotic missions, providing for an incremental buildup of capabilities for more complex missions over time

Opportunities for **U.S. commercial business** to further enhance the experience and business base

Resilient architecture featuring multi-use, evolvable space infrastructure, minimizing unique major developments, with each mission leaving something behind to support subsequent missions

Substantial **new international and commercial partnerships**, leveraging current International Space Station partnerships and building new cooperative ventures for exploration



Earth Reliant

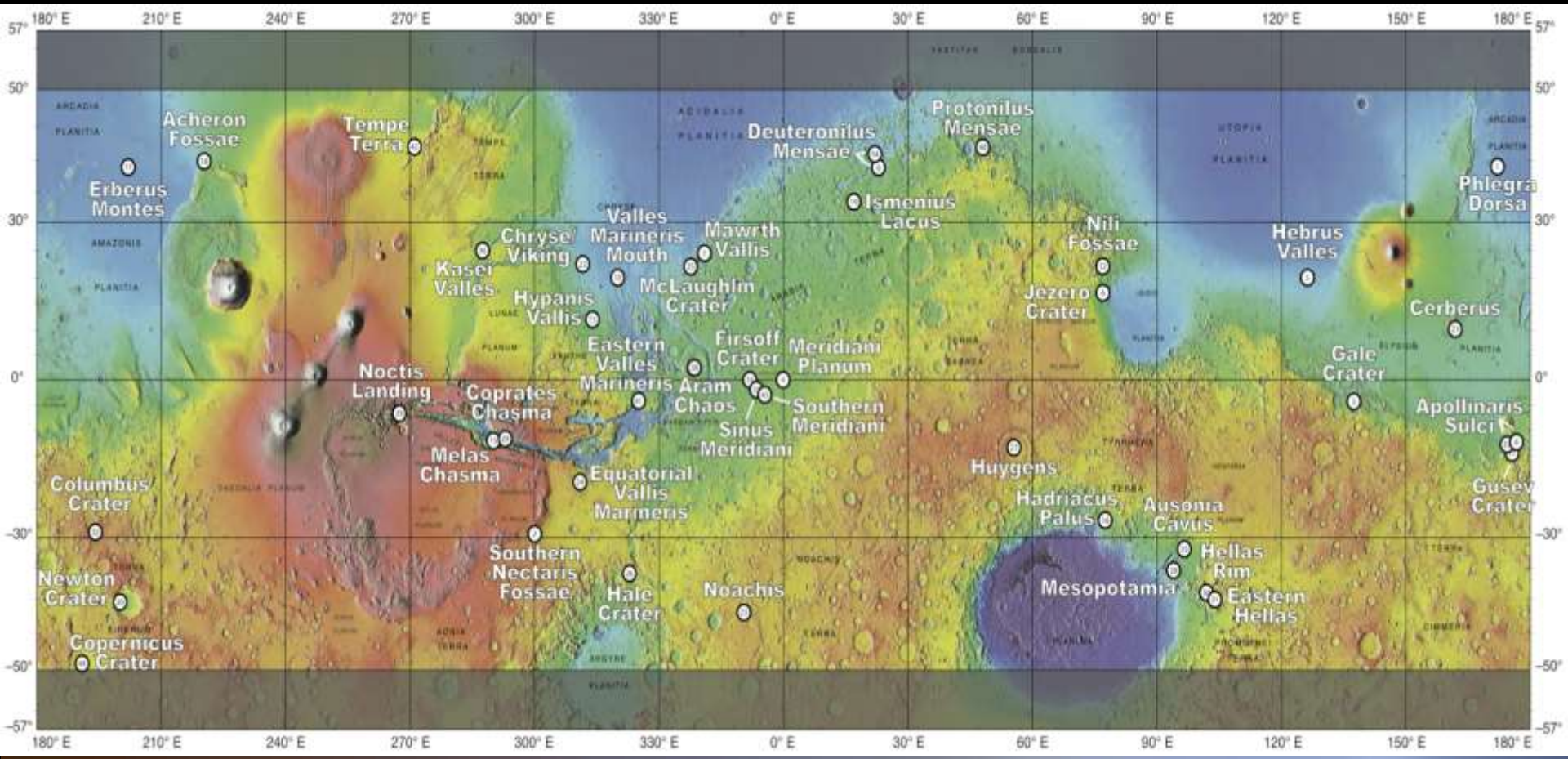
- Focused on ISS research
- Human health and behavior
- Communications
- Materials
- Extravehicular operations
- Advanced life support

Proving Ground

- SLS and Orion
- ARM mission
- Deep space habitation
- Autonomous operation
- Minimized re-supply

- Earth Independent
  - Living and working independent of Earth
  - Harvesting Martian resources
  - Advanced communications

Potential Exploration Zones



1st Human Landing Site Workshop
October 27-30 at Lunar & Planetary Institute

#JOURNEYTOMARS

What’s Next?

LISA Pathfinder - Status

- ✓ 2012 - ST7 delivered to ESA, integrated later in the year
- ✓ ESA thrusters changed to GAIA cold gas thrusters
- ✓ Final ground testing met or exceeded all requirements.
- ✓ Sep 3, 2015 - spacecraft, propulsion module and launch I&T complete, ready for shipping
- ✓ Numerous operations exercises completed.
- ✓ Oct 8, 2015 - Flown to Guiana Space Port, Kourou, French Guiana.
- ✓ Oct 26, 2015 - Spacecraft walkdown of hardware in launch configuration
- **Dec 1, 2015 11:15 pm EST - LAUNCH on Vega 6**
- L+74 d - LISA Pathfinder operations start
- L+186 d - ST-7 operations start (for 2 months)
- L+288 d - Nominal mission ends.
- Extended mission under consideration.

Opening Transport Container at Kourou
Credit: ESA-CNES-Arianespace / Optique Vidéo du CSG - G. Barbaste

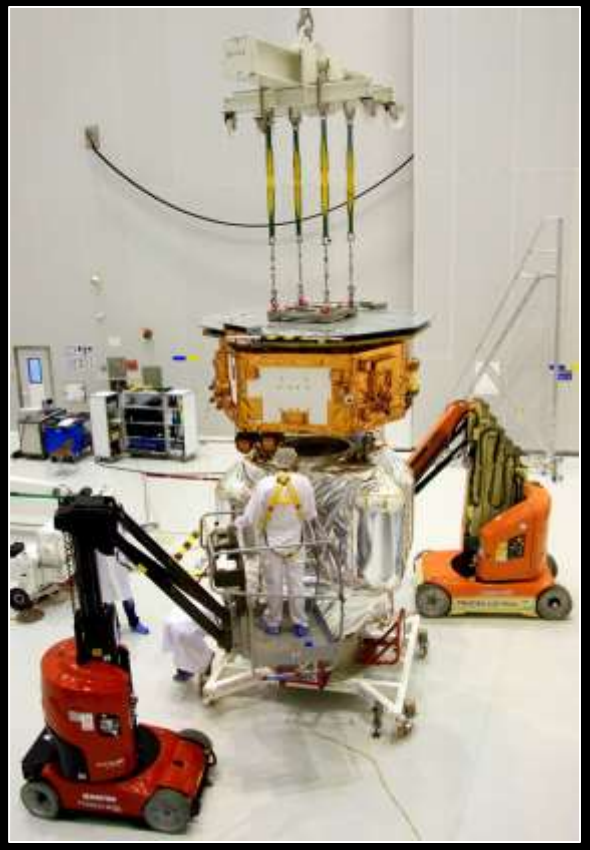
http://sci.esa.int/lisa-pathfinder/

ST-7/LISA Pathfinder
ST-7/Disturbance Reduction System (DRS)

CURRENT STATUS:

- LISA Pathfinder shipped to Guiana Space Port, Kourou, French Guiana-on October 8
- Spacecraft final closeouts are ongoing
- Launch December 2, 2015 (UT)
- Extended mission being discussed

- ESA Mission with NASA Collaborating
- Project Category: 3 Risk Class: C
- DRS flies on the ESA LISA Pathfinder spacecraft
- Sun-Earth L1 halo orbit
- Drag-free satellite to offset solar pressure
- Payload delivery: July 2009 – COMPLETE
- Launch date: December 2, 2015
- LPF prime mission: 7 months
- Data Analysis: 12 months



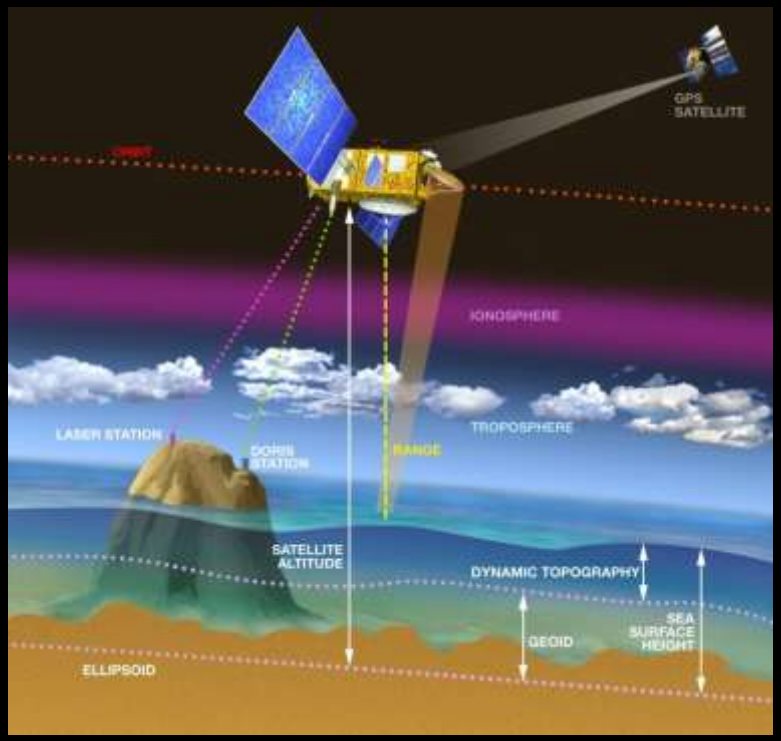
Jason-3 Mission

Science Measurements

Global sea surface height to an accuracy of ≤ 4 cm every 10 days, for determining ocean circulation, climate change and sea level rise

Mission Objectives

- Provide continuity of ocean topography measurements beyond TOPEX/Poseidon, Jason-1 and OSTM/Jason-2
- Operational ocean altimetry mission to enable the continuation of multi-decadal ocean topography measurements
- NOAA and EUMETSAT are lead agencies with CNES and NASA/JPL providing implementation support



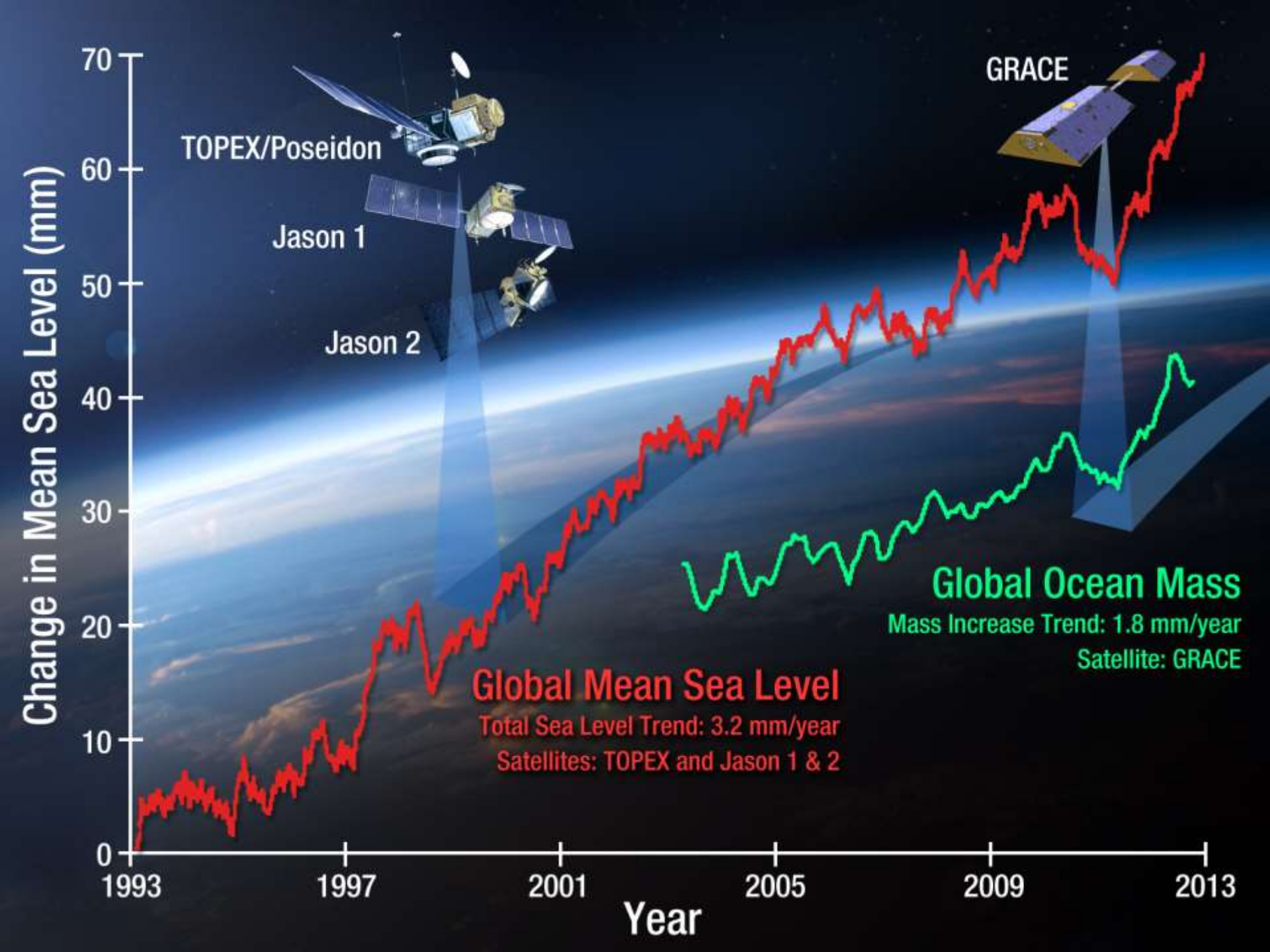
Instruments

- Core Mission:
  - Poseidon-3B Altimeter
  - DORIS (Precise Orbit Determination System)
  - **Advanced Microwave Radiometer (AMR)**
  - **GPS Payload (GPSP)**
  - **Laser Retro-reflector Array (LRA)**
- Passengers (Experiments):
  - JRE (Carmen3 + LPT)

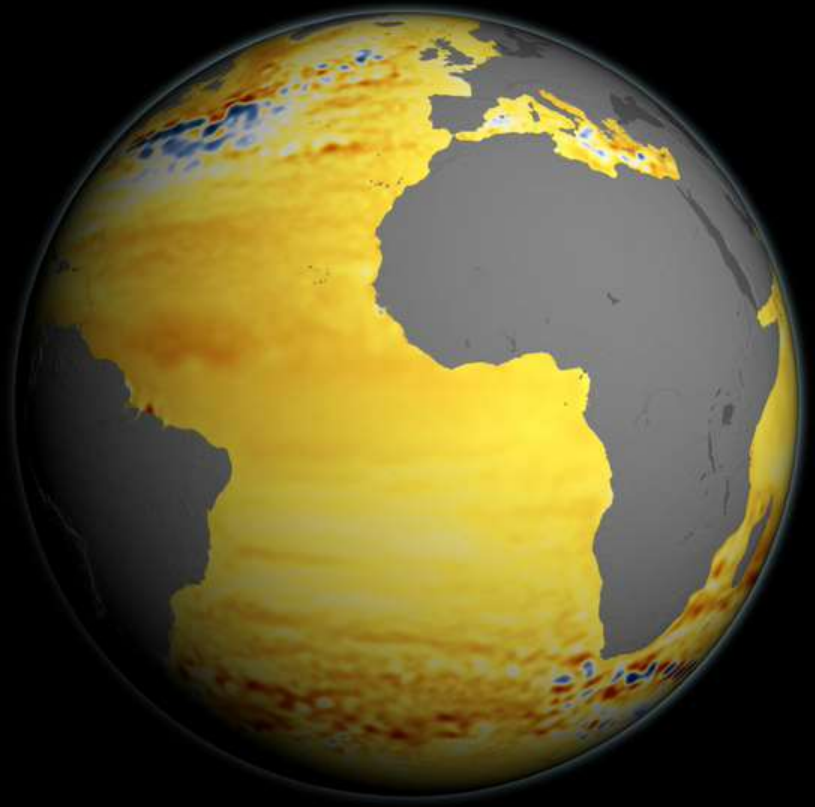
Mission Overview

- Launch Date: December 2015
- **Launch Vehicle: Falcon 9**
- 7120.5 Project Category: II
- Risk Classification: B
- Proteus Spacecraft Bus provided by CNES
- Mission life of 3 years (goal of 5 years)
- 1336 km Orbit, 66° Inclination

NASA responsible for items in BLUE (on behalf of NOAA)


Change in Mean Sea Level (mm)
70
60
50
40
30
20
10
0
1993
1997
2001
2005
2009
2013
Year
TOPEX/Poseidon
Jason 1
Jason 2
GRACE
Global Mean Sea Level
Total Sea Level Trend: 3.2 mm/year
Satellites: TOPEX and Jason 1 & 2
Global Ocean Mass
Mass Increase Trend: 1.8 mm/year
Satellite: GRACE

A 22-Year Record of Global Sea Change



Credit: NASA's Scientific Visualization Studio/JPL

Jason 3 Project

Project

- Activities are progressing towards supporting December 15 launch opportunity

Spacecraft

- In storage in temperature and humidity controlled SpaceX Payload Processing Facility (PPF) at Vandenberg Air Force Base
- CNES confirmed fueling personnel will be available for mid-November fueling operation

Launch Vehicle (SpaceX Falcon 9)

- SpaceX investigation drawing to conclusion; draft written report expected to be submitted to FAA by NET end of October
- SpaceX presented investigation results in Launch Services Program Engineering Review Board (ERB) on October 15
- Failure Investigation Status:
  - Rod end strut component failure remains SpaceX most credible failure cause; rod end struts on the Jason-3 launch vehicle 1st and 2nd stages are in process of being replaced
  - LSP's independent assessment of the data and events expected first week Nov.
    - Several Engineering Review Board (ERBs) have been completed to rule out a number of potential causes such as avionics, GN&C, Dragon capsule, and Stage 1propulsion system
    - LSP has developed additional plausible scenarios besides failed strut; in process of analysis and testing
- Upcoming launch vehicle reviews will assess readiness of launch vehicle for launch

Program Update – ASTRO-H

- All spacecraft level environment testing successfully completed.
- Preparing for shipment of spacecraft Nov 30.
- Progress remains good and there are no major technical issues with NASA hardware.
- JAXA team working towards a Launch Readiness Date NET Jan 28, 2016.

Upcoming Events

- Nov 10 & 12 - Functional Test - Detailed prior to the Document Conformance Review
- Nov 19 - ASTRO-H Spacecraft Pre-ship Review
- Nov 30 - Spacecraft shipment to Tanegashima launch site
- Mid-Jan 2016 (TBC) - KDP-E
- Jan 28 - Launch Readiness Date

https://heasarc.gsfc.nasa.gov/docs/astroh/

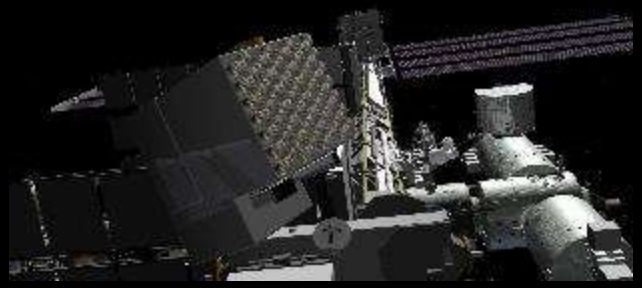
Explorers for Astrophysics

ASTRO-H
(JAXA-led mission)

- NASA to supply the Soft X-ray Spectrometer (SXS) instrument only

Nov. 2015

NICER
Neutron Star Interior Composition Explorer



Aug. 2016

TESS
Transiting Exoplanet Survey Satellite

Aug. 2017

New Frontiers Program

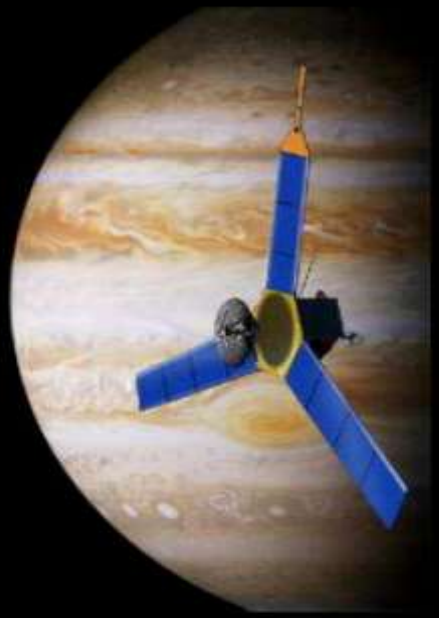
1st NF mission
New Horizons:

Pluto-Kuiper Belt

Launched January 2006
Arrives July 2015
PI: Alan Stern (SwRI-CO)

2nd NF mission
JUNO:

Jupiter Polar Orbiter



Launched August 2011
Arrives July 2016
PI: Scott Bolton (SwRI-TX)

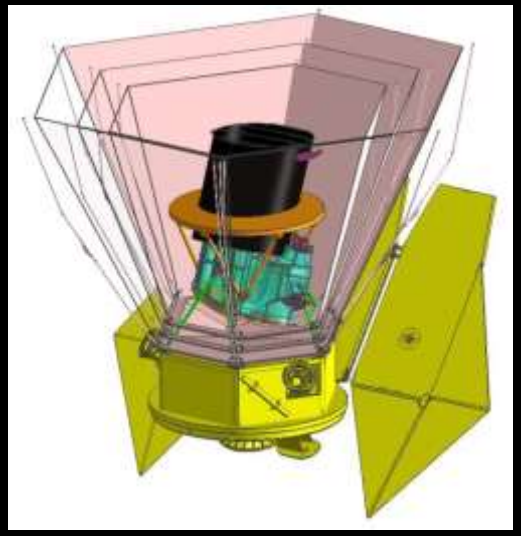
3rd NF mission
OSIRIS-REx:

Asteroid Sample Return

To be launched: Sept. 2016
PI: Dante Lauretta (UA)

What’s New?

Astrophysics SMEX/MO Mission Selections



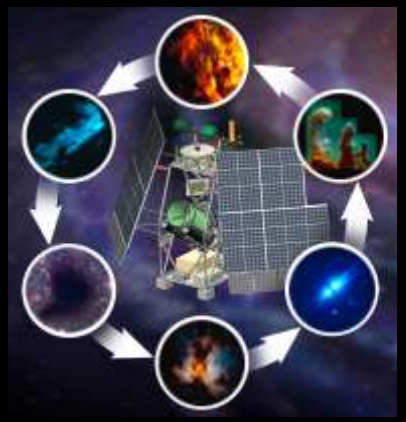
SPHEREx
PI: J. Bock, Caltech
An All-Sky Near-IR
Spectral Survey

PRAXyS
PI: K. Jahoda, GSFC
Polarimeter for
Relativistic Astrophysical
X-ray Sources

IXPE
PI: M. Weisskopf, MSFC
Imaging X-ray Polarimetry
Explorer

PI: A. Lee, UC Berkeley
US Participation in JAXA's
LiteBIRD CMB Polarization Survey

PI: C. Walker, U. Arizona
GUSTO: Gal/Xgal U/LDB Spectroscopic
- Stratospheric Terahertz Observatory



Status of Discovery Program

Discovery 2014 – Selections announced September 30

- About 3-year mission cadence for future opportunities

Missions in Development

- *InSight*: Launch window opens March 4, 2016 (Vandenberg)
- Strofio: Delivered to SERENA Suite (ASI) for BepiColombo

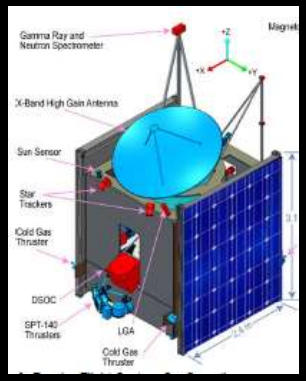
Missions in Operation

- *Dawn*: Science observations now in HAMO

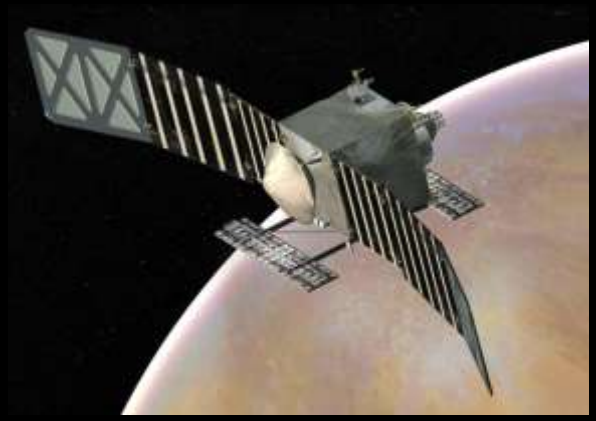
Missions in Extended Operations

- *MESSENGER*: Completed low altitude science operations before impact with Mercury
- *LRO*: In stable elliptical orbit, passing low over the lunar south pole

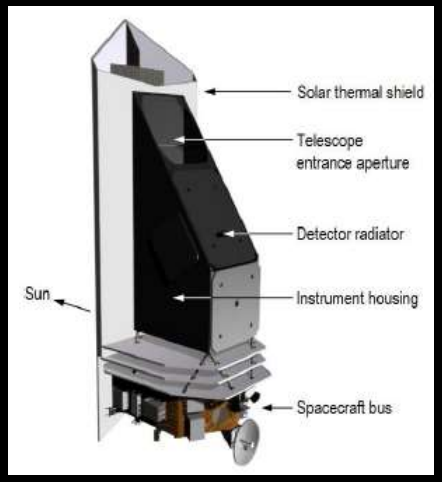
Discovery Selections



Psyche: Journey to a Metal World
PI: Linda Elkins-Tanton, ASU
Deep-Space Optical Comm (DSOC)

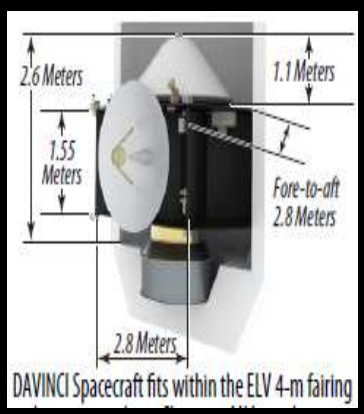


VERITAS: Venus Emissivity, Radio Science, InSAR, Topography, And Spectroscopy
PI: Suzanne Smrekar, JPL
Deep-Space Optical Comm (DSOC)



NEOCam:
Near-Earth Object Camera
PI: Amy Mainzer, JPL
Deep-Space Optical Comm (DSOC)

Lucy: Surveying the Diversity of Trojan Asteroids
PI: Harold Levison, Southwest Research Institute (SwRI)
Advanced Solar Arrays



DAVINCI: Deep Atmosphere Venus Investigations of Noble gases, Chemistry, and Imaging
PI: Lori Glaze, GSFC

Anticipated Future Mission Opportunities
(Based on Notional Out Year Budgets)

EARTH: Venture Class 2015 AO EVI-3 Instruments

EARTH: Venture Class 2015 AO EVM-2 Mission

HELIOPHYSICS: Explorer Mission AO NET 2016 for Mission and Mission of Opportunity

PLANETARY: New Frontiers 4 Mission AO in 2016 for launch ~2024

EARTH: Venture Class 2017 AO EVI-4 Instruments

EARTH: Venture Class 2017 ROSES PEA EVS-3 Suborbital

PLANETARY: Discovery Mission AO in 2017 for launch ~2023

HELIOPHYSICS: Solar Terrestrial Probes Mission AO NET 2017

ASTROPHYSICS: Medium-class Explorer (MIDEX) Mission FY2017 AO for Mission and Mission of Opportunity

National Space Weather Strategy

- National Space Weather Strategy & Space Weather Action Plan released on October 29
- The Office of Science Technology Policy (OSTP), Executive Office of the President, led the multi-agency effort to develop a National Space Weather Strategy (NSWS)
  - The NSWS articulates strategic goals for improving forecasting, impact evaluation, and enhancing National Preparedness (protection, mitigation, response and recovery) to a severe space weather event
- A Space Weather Action Plan (SWAP) establishes cross-Agency actions, timelines and milestones for the implementation of the NSWS
- The Action Plan will:
  - Enhance the transition of research to operations for space weather observations, modeling tools, advance warning capabilities and mitigation approaches
  - Incorporate severe space weather events in Federal emergency preparedness, planning, scenarios, training, and exercises
  - Establish Federal and non-Federal stakeholder collaborations to enhance observing systems and networks and data management activities

Progress on Decadal Science

Heliophysics Decadal Survey Progress

The NASA FY15 Appropriation and the FY16 President's Budget Request, including the notional out-year budget estimates, support the following:	
0.0 Complete the current program	Extended operations of current operating missions as recommended by the 2015 Senior Review; 5 missions currently in development (SET, ICON, GOLD, SOC and SPP)
1.0 Implement DRIVE (Diversify, Realize, Integrate, Venture, Educate)	Implementing DRIVE initiative wedge in FY15; fully funded in FY18
2.0 Accelerate and expand Heliophysics Explorer program	Release of next Explorer mission AO planned for 2016 (~3.5-year average historical cadence) vs. Decadal recommendation of every 2-3 years; strategy to increase cadence under assessment; notional mission cadence increases to Decadal recommendation by the early-2020s.
3.0 Restructure STP as a moderate scale, PI-led flight program	Assessing trade space for STP-5; next STP mission AO planned for 2017 with a LRD ~2023
4.0 Implement a large LWS mission and launch by 2024	Release of next LWS mission AO NET 2018 as recommended by Decadal Survey

Earth Science Decadal Survey Status

- 2007 Earth Science and Applications from Space is most recent Decadal Survey (Jan 2007); NRC mid-term assessment May 2012
  - "NASA responded favorably and aggressively to the decadal survey, embracing its overall recommendations for Earth observations, missions, technology investments, and priorities for the underlying science. As a consequence, the scientific and applications communities have made significant progress over the past 5 years." (Mid-Term Report overarching Finding)
  - **All Legacy Missions launched**: OSTM (2008), OCO-1 (2009*), Aquarius (2011), Glory (2011*), Suomi NPP (2011), LDCM (2013), GPM (2014), *OCO-2 (2015)*
  - 31 July 2017 completion date for 2nd ESAS Decadal Survey

- Main 2007 Decadal Survey ***New Mission*** recommendations/status
  - Tier I
    - Venture Class: 3 strands, multiple solicitations in each strand, on-schedule, fully funded
      - EV-S 1: all 5 investigations completed data acquisition 2015; EV-S 2: 6 investigations selected 2015
      - EV-Instrument 1: TEMPO in Phase C for Sept 2017 instrument delivery, NLT Dec 2021 launch on host
      - EV-Mission 1 CYGNSS in Phase D for Oct 2016 launch
      - EV-Instrument 2: GEDI in Phase B for May 2018 launch to ISS;
        ECOSTRESS in Phase B (24 Sept KDP-C) for May 2017 delivery, Aug 2017 launch to ISS
      - EV-Instrument 3: Proposals in-hand, under review
    - SMAP: **Launched 31 January 2015**
    - ICESat-2: In Phase C for June 2018 [Oct 2017 MA] launch
    - NI-SAR: In Phase B for Dec 2020-Sept 2021 launch; NI-SAR is radar component of DESDynI; GEDI (EVI-2) contributes substantially to DESDynI lidar/ecosystem
    - CLARREO-Pathfinder: Proposed 2-instrument initiation in FY16 budget, flight to ISS, Sept 2019 launch

Earth Science Decadal Survey Status

- Main 2007 Dec. Survey ***Mission*** recommendations/status (cont.)
  - Tier II, III
    - SWOT: In Phase B for Oct 2020 launch (joint with CNES)
    - *GRACE-FO*: In Phase D for Feb 2018 [Aug 2017 MA] launch (GFZ partner)
    - Pre-formulation: GEO-CAPE, ASCENDS, ACE, HySpIRI, [CLARREO if CLARREO-PF is not approved by Congress for FY16 start]
    - *PACE*: In pre-Phase A Design-to-Cost study, for development and launch by 2022; PACE substantially covers ocean color component of Decadal ACE mission

- Climate Architecture Missions (not included in Decadal Survey)
  - RBI, TSIS-1, TSIS-2, OMPS-L: Covered separately below
  - Altimeter Follow-On: **FY16** budget request included funding for NASA contribution (radiometer, GPS, Laser Retroreflectors, LV) to Jason-CS/Sentinel-6A (w/ESA/EUMETSAT/EU), 2020 LRD
  - OCO-3: **FY16** budget request restarted OCO-3 development (awaits Congressional approval)

Planetary Program Architecture Recommended by the Planetary Decadal Survey

Large Missions ("Flagship"-scale)

"Recommended Program" (budget increase for JEO new start)	*"Cost Constrained Program"* (based on FY11 Request)	*"Less favorable" budget picture than assumed* (e.g., outyears in FY12 request)
1) Mars Astrobiology Explorer-Cacher – descoped	1) Mars Astrobiology Explorer-Cacher – descoped	Descope or delay Flagship mission
2) Jupiter Europa Orbiter (JEO) – descoped	2) Uranus Orbiter & Probe (UOP)	
3) Uranus Orbiter & Probe (UOP)		
4/5) Enceladus Orbiter & Venus Climate Mission		

Discovery

$500M (FY15) cap per mission (exclusive of launch vehicle) and 24 month cadence for selection

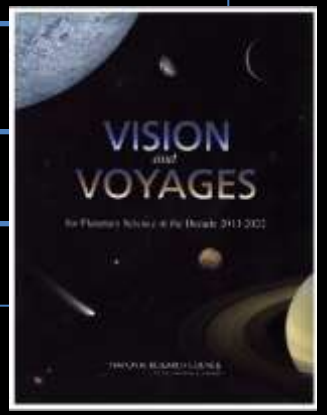
New Frontiers

$1B (FY15) cap per mission (exclusive of launch vehicle) with two selections during 2013-22

Research & Analysis (5% above final FY11 amount then ~1.5%/yr)

Technology Development (6-8%)

Current Commitments (ie: Operating Missions)



Astronomy & Astrophysics Decadal Survey Progress

The NASA FY15 Appropriation, the President's FY16 Budget Request, and the notional out year budget planning guidance in the President's FY16 Budget Request, support:	
Complete JWST	JWST remains within budget guidelines and on track for an October 2018 launch.
Large-scale 1. WFIRST	Preformulation and focused technology development for WFIRST-AFTA (a 2.4m version of WFIRST with a coronagraph) are underway to enable a new start. Budget line established for an Astrophysics Decadal Strategic Mission.
Large-scale 2. Augmentation to Explorer Program	Astrophysics Explorers planned budget increased to support cadence of four AOs per decade including SMEX AO in Fall 2014 and MIDEX AO in late 2016/early 2017.
Large-scale 3. LISA	Discussing partnership on ESA's L3 gravitational wave observatory and participating in ESA-led assessments in 2014-2015. Strategic astrophysics technology (SAT) investments plus support of LISA Pathfinder.
Large-scale 4. IXO	Pursuing a partnership on ESA's L2 Athena X-ray observatory; the Athena study phase, with U.S. participation, is underway. Strategic astrophysics technology (SAT) investments.
Medium-scale 2. Inflation Probe Technology Development Prog	Balloon-borne investigations plus strategic astrophysics technology (SAT) investments. Studying partnership on JAXA's LiteBIRD.

Astronomy & Astrophysics Decadal Survey Progress

The NASA FY15 Appropriation, the President's FY16 Budget Request, and the notional out year budget planning guidance in the President's FY16 Budget Request, support:	
Medium-scale 1. New Worlds Technology Development Program	Focused technology development for a coronagraph on WFIRST, strategic astrophysics technology (SAT) investments, and exoplanet probe mission concept studies. Established partnership with NSF to develop extreme precision Doppler spectrometer as facility instrument. Exozodi survey using LBTI.
Small-scale. Research Program Augmentations	Increased annual R&A budget by 10% from FY10 to FY12 and another 10% from FY14 to FY16. Within R&A: established Theoretical and Computational Astrophysics Networks (TCAN) program with NSF; funding available for astrophysics theory; funding available for lab astrophysics; funding available for suborbital payloads.
Small-scale. Intermediate Technology development Augmentation	Established competed Strategic Astrophysics Technology (SAT) program element; directed technology funding for WFIRST and other large-scale decadal priorities (e.g., WFIRST coronagraph, Athena).
Small-scale. Future Ultraviolet-Visible Space Capability	Strategic Astrophysics Technology (SAT) and Astrophysics R&A (APRA) investments; mission concept studies.
Small-scale. SPICA (U.S. contribution to JAXA-led)	Not supported as a strategic contribution; candidate for Explorer Mission of Opportunity.

How Can the SSB Help?

How Can the SSB Help?

- NRC Study on Extended Missions and Senior Reviews
- NRC Study on achieving science goals with cubesats
- Joint NRC-European Science Foundation review of the MEPAG SAG2 (Special Regions Assessment Group) Report
- Astro 5-yr midterm performance assessment
- Planning for Earth Science & Applications from space Decadal Survey
- NRC Study on role of Large Missions
- NRC Study on review of Astrobiology program
- NRC Workshop on the readiness for the search for life beyond earth
- Open source software

Recent SSB Studies & Workshops

Project Title	NASA POC	Req Date	Req Del Date	Act Del Date	Comments	Request Letter or SOT/SOW
Earth science data continuity	Freilich	6/14/13	6/30/14	10/12/15	Public Release date was 10/26/15	Request letter
AFTA Study	Benford	8/29/13	2/28/14			Request Letter
Study on Survey of Surveys	Allen	2/6/14	5/15/15	7/28/15	req and actual delivery dates are for prepub.	Request letter and SOT
Education workshop	Allen	3/11/14	5/31/15		Report due date is approximate from SOT.	SOT
Planetary protection NRC-ESF joint review of MEPAG SR-SAG2	Conley	10/3/14	11/30/15		Prepub report req by late summer.	Request letter
Planetary protection Mtg of Experts #2 - FY15	Pugel	10/3/14	11/30/15		Report delivery date is expiration date set in SOT; No report.	SOT
Astro 5-yr midterm performance assessment	Hertz	11/20/14	4/1/16			Request letter
Achieving science goals with cubesats	Pierce	12/10/14			No delivery date stipulated	Letter and SOT
Earth Science (ESAS) decadal survey	Freilich	4/21/15	7/31/17		Requested delivery date is for prepub of steering cttee report. Task initiated in Aug 2015.	SOW
Extended Missions	Allen	4/30/15	5/31/16		Prepub report due 12 months after initiation, estimate 5/31/16.	Request letter
Review of restructured planetary R&A Pgrm	Statler	8/13/15	12/31/16			Request letter

What about the Budget?

FY16 Program Highlights

- Support Mars 2020 mission and formulation of a potential Europa mission
- Pre-formulation of WFIRST/AFTA
- Provide for a sustained land imaging capability beyond Landsat 8
- Increase efforts to detect and study NEOs
- Increase collaboration with NASA's Space Technology Mission Directorate
- Implement the revised and competed STEM education program to ensure that the most meritorious activities within SMD are supported

FY 2016 Program/Budget Strategy

- Provide the most productive Earth & space science program for the available resources
  - Guided by national priorities
  - Informed by NRC Decadal Surveys recommendations
  - Incorporating new ideas and partnerships
  - Increase NASA-wide collaboration on strategic projects (ISS, Mars 2020, NEOs…)
- Responsibly manage the national investment in robotic space missions
  - Confirm new missions only after sufficient technology maturation, and budget at an appropriate confidence level
  - Take aggressive steps with missions that do not stay within budget
  - Proactively manage JWST to the cost and schedule baseline
- Increase cadence of competed PI-led flight missions

Questions/Comments