

National Aeronautics and
Space Administration



Science Committee Report

Dave McComas
Chair, Science Committee



Science Committee Members

Dave McComas, Southwest Research Institute, Chair

Carle Pieters, (Vice Chair), Brown University

Maura Hagan, NCAR, Chair of Heliophysics

Eugene Levy, Rice University, Chair of Planetary Protection

Janet Luhmann, UC Berkeley, Chair of Planetary Science

Brad Peterson, Ohio State, Chair of Astrophysics (rotating off)

Steve Running, University of Montana, Chair of Earth Science

Doug Duncan, University of Colorado

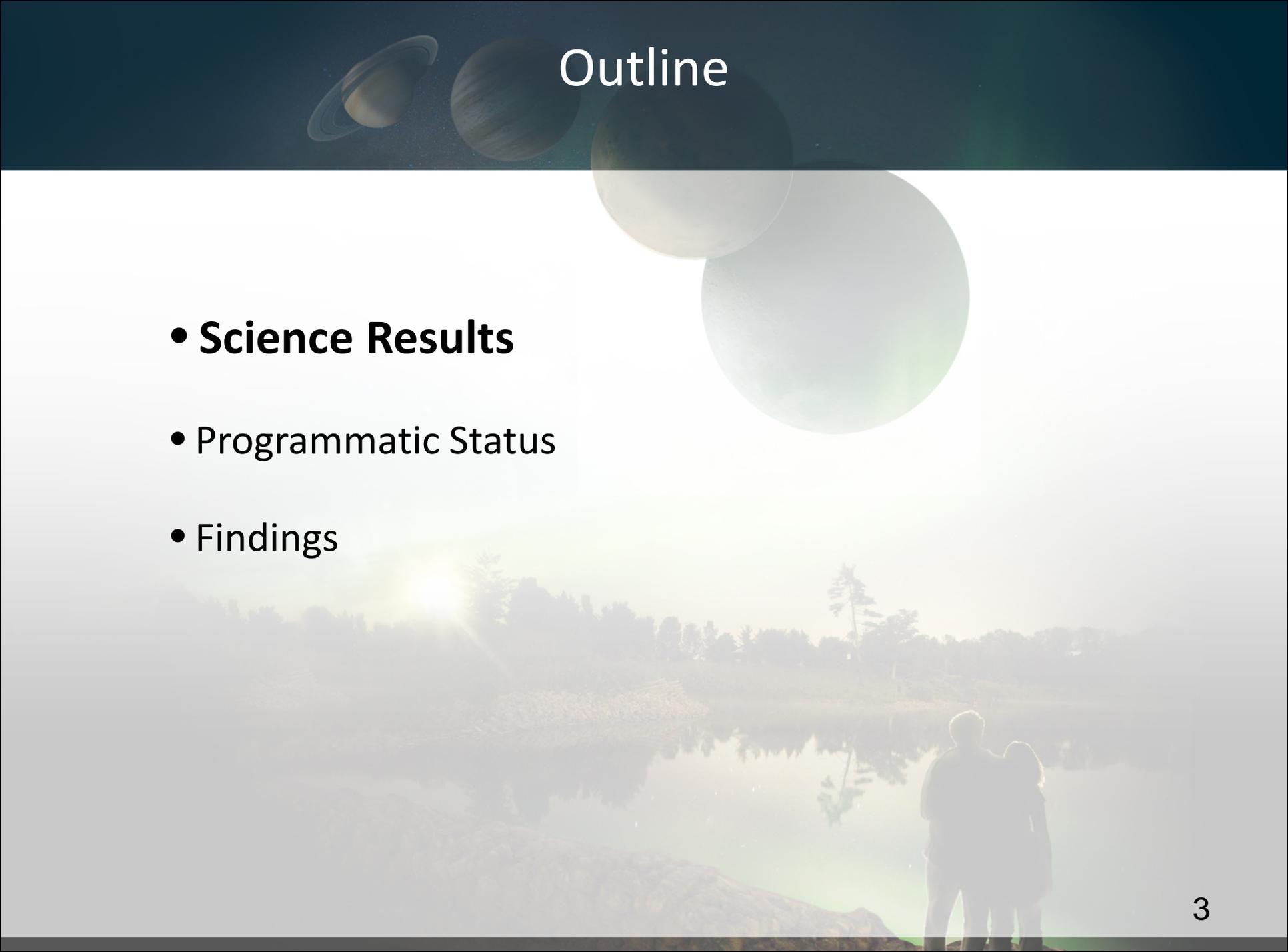
Mark Robinson, Arizona State University

Harlan Spence, University of New Hampshire

James Green, University of Colorado at Boulder (new member)

David Spergel, Chair of Space Studies Board (*ex officio* member)

Noel Hinners (1935-2014)



Outline

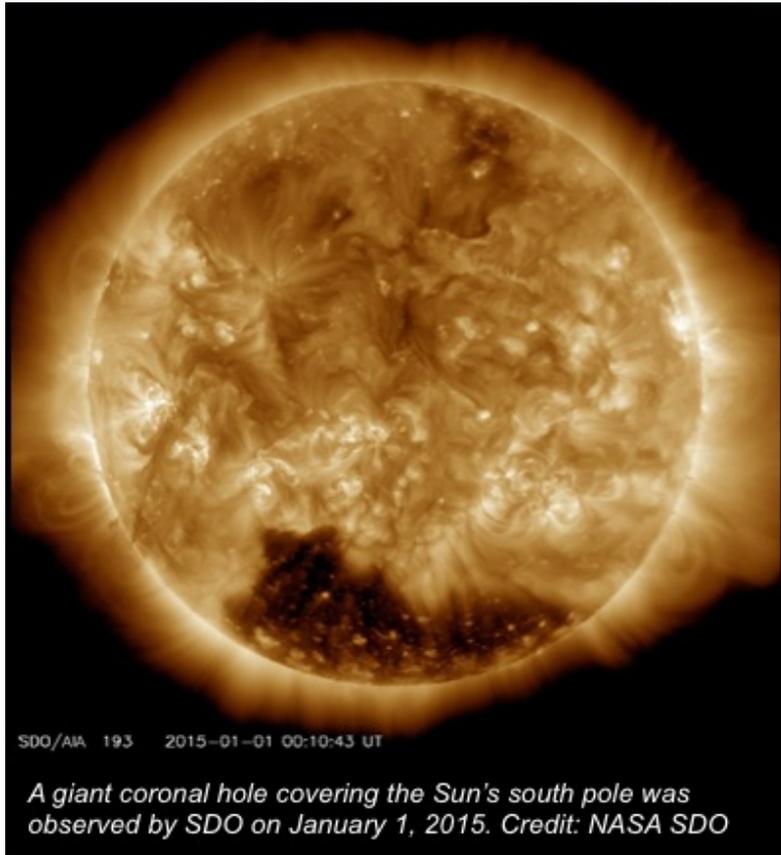
- **Science Results**
- Programmatic Status
- Findings

National Aeronautics and Space Administration



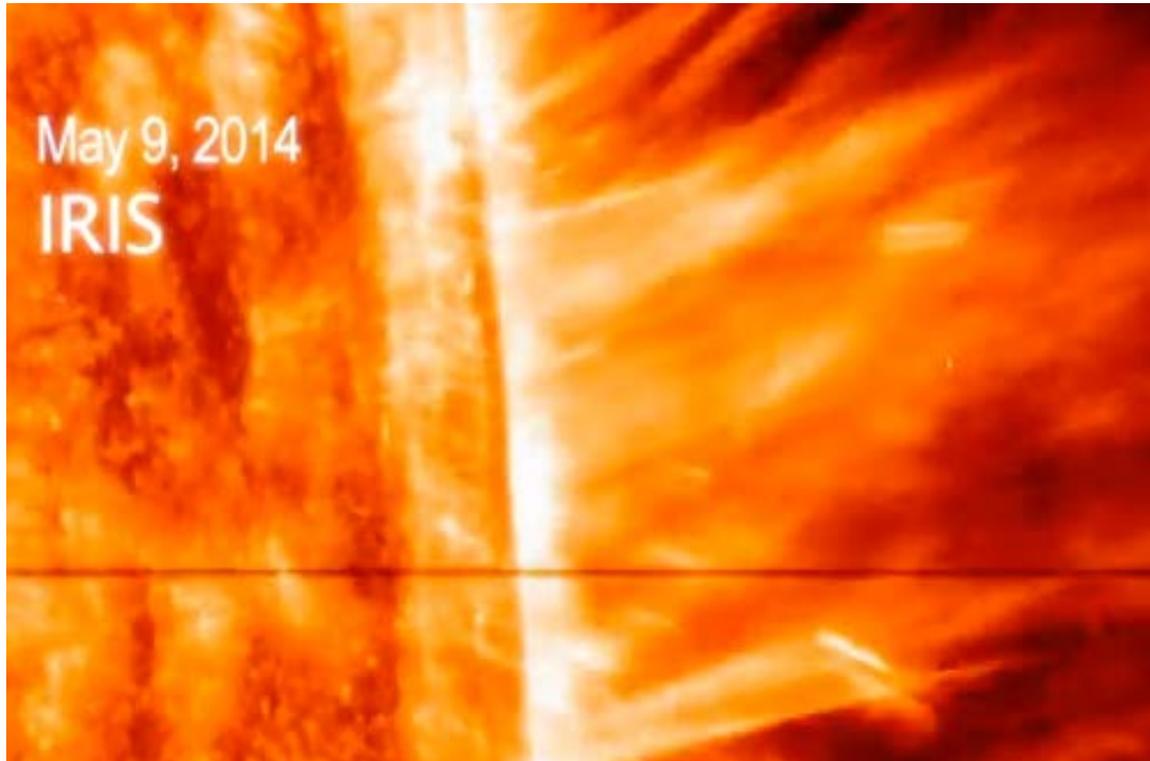
Heliophysics





- Solar Dynamics Observatory (SDO) captured an enormous coronal hole near the Sun's southern pole.
- Coronal holes are associated with open magnetic field lines, allowing particles orbiting along those field lines to escape the solar atmosphere.
- These particles, known as high-speed streams, can produce space weather events with potential impacts on Earth.
- Trapped particles associated with closed magnetic field lines on the Sun can heat up and glow producing the bright spots in the AIA image.

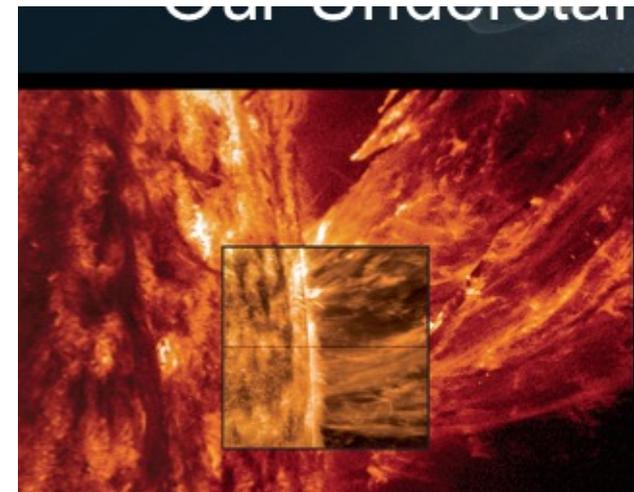
SDO Observes Giant Coronal Hole January 1, 2015



IRIS - After 1 Year in Space

- The Interface Region Imaging Spectrograph (IRIS) observes the low level of the Sun's atmosphere, a constantly moving area called the interface region.

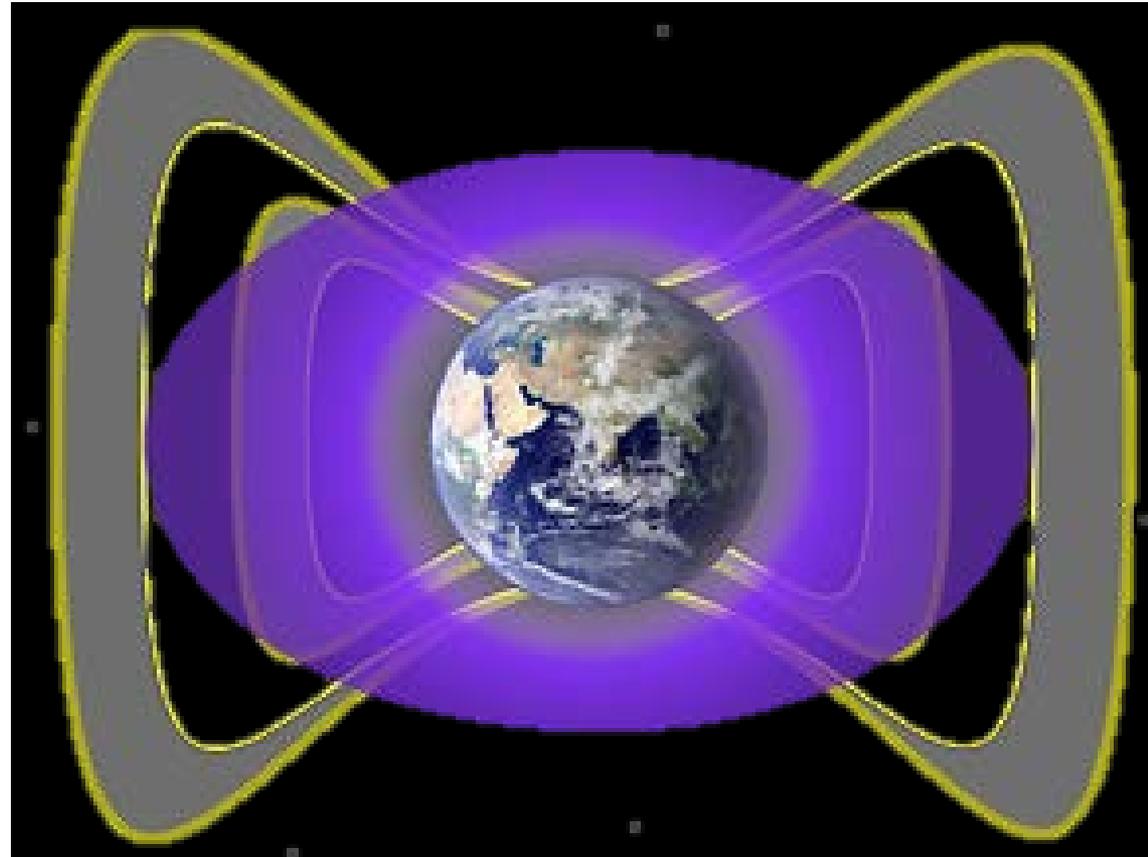
- IRIS measurements showed structures resembling mini-tornadoes in active regions for the first time
- Possible mechanism for transferring energy to power the million-degree coronal temperatures



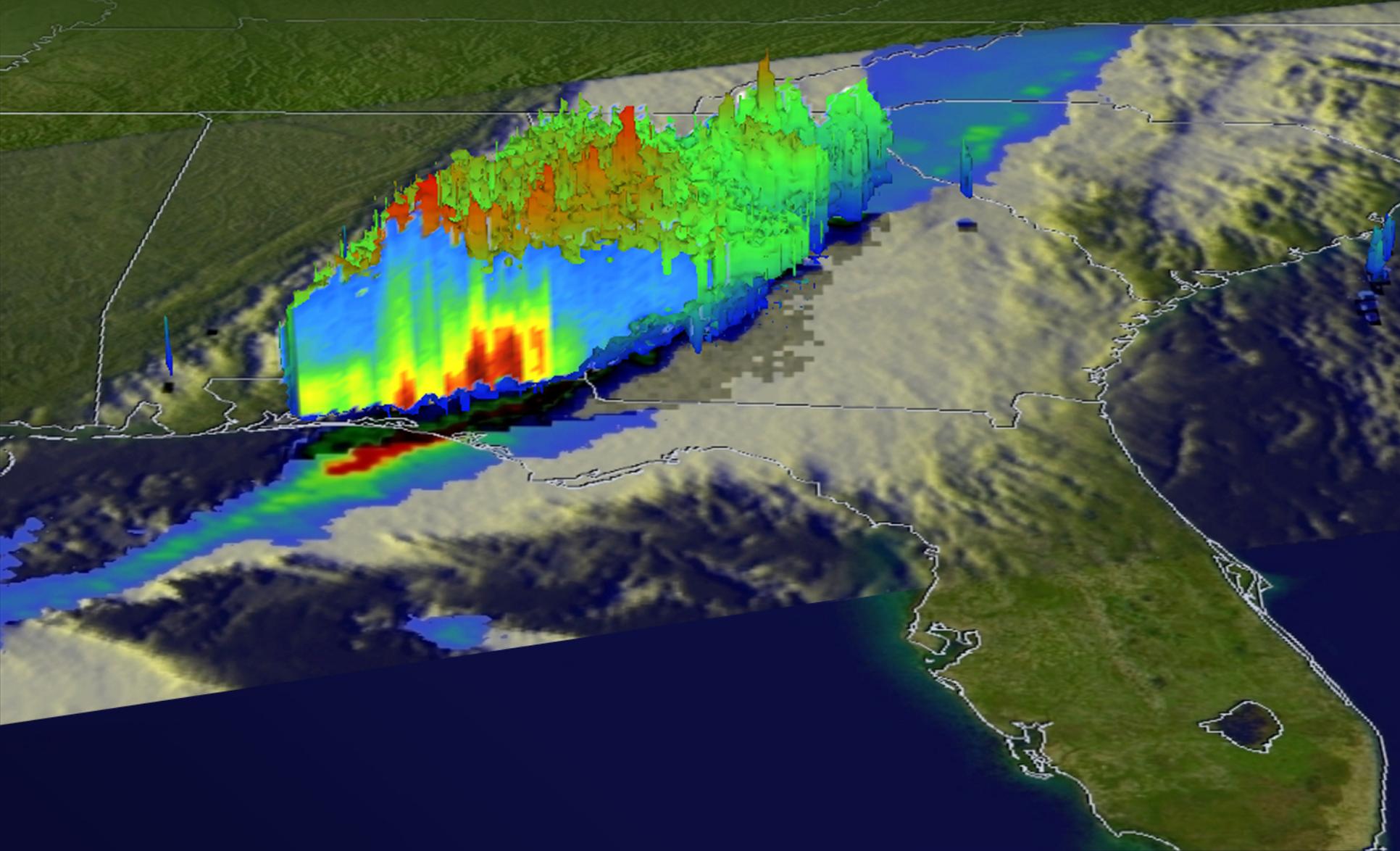


Van Allen Probes Spot an Impenetrable Barrier in Space

- Data show that the inner edge of Earth's outer radiation belt is highly pronounced.
- Particles at the outer boundary of the Earth's plasmasphere cause the particles in the outer belt to scatter, removing them from the belt.
- For the fastest, highest-energy electrons, this edge is a sharp boundary that the electrons cannot penetrate.
- The discovery of this barrier improves understanding of what gives the radiation belts their shape and what can affect the way they swell or shrink to help predict the conditions within the belts.



EARTH SCIENCE

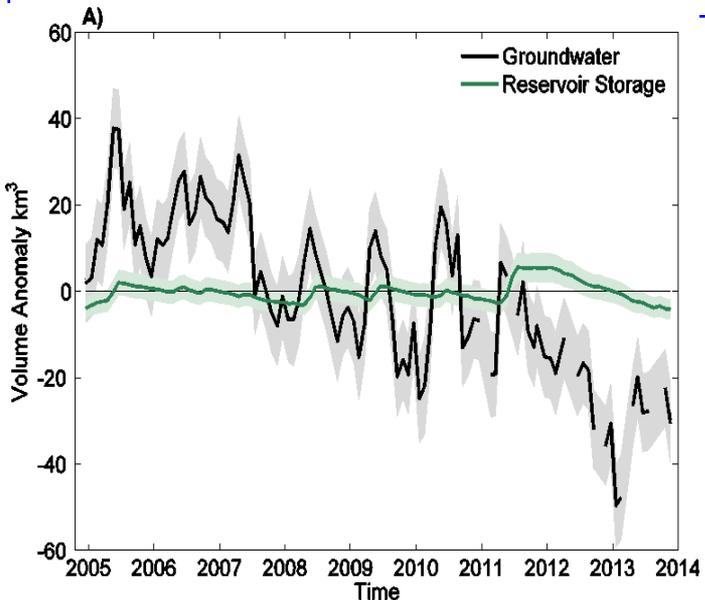
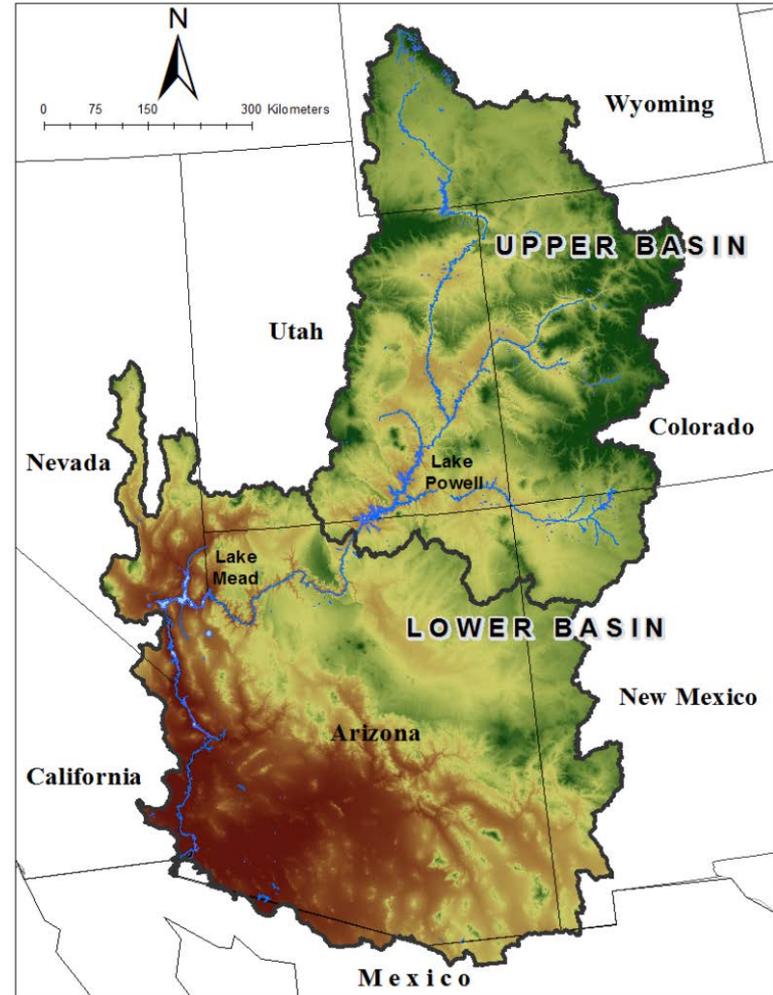




Groundwater Depletion During Drought Threatens Future Water Security of the Colorado River Basin

Stephanie L. Castle, Brian F. Thomas, John T. Reager, Matthew Rodell, Sean C. Swenson and James S. Famiglietti, *Geophysical Research Letters*, 2014 AGU, DOI: 10.1002/2014GL061055

Scientists analyzed nine years (December 2004 to November 2013) of observations from NASA's GRACE mission and found that during this period of sustained drought, groundwater accounted for 50.1 km³ of the total 64.8 km³ of freshwater loss. *The rapid rate of depletion of groundwater storage ($-5.6 \pm 0.4 \text{ km}^3 \text{ yr}^{-1}$) far exceeded the rate of depletion of Lakes Powell and Mead. Results indicate that groundwater may comprise a far greater fraction of Basin water use than previously recognized, in particular during drought, and that its disappearance may threaten the long-term ability to meet future allocations to the seven Basin states. Streamflow of the Colorado River Basin is the most over-allocated in the world. Demand for this renewable resource will soon outstrip supply.*



Left: Monthly anomalies (km³) of groundwater storage (black) and of surface reservoir storage (green) for (A) the entire Basin (trend: $-5.6 \pm 0.4 \text{ km}^3 \text{ yr}^{-1}$) and Lakes Powell and Mead combined (trend: $-0.9 \pm 0.6 \text{ km}^3 \text{ yr}^{-1}$).

Above: The Colorado River Basin of the western United States. State and international boundaries in light gray. Green and brown colors represent high and low elevations, respectively. The Upper Basin is that portion of the Basin upstream of Lake Powell. The Lower Basin is the remainder of the basin downstream of Lake Powell. Basin outlines are in dark gray. The river, its main tributaries and Lakes Powell and Mead are shown in blue.



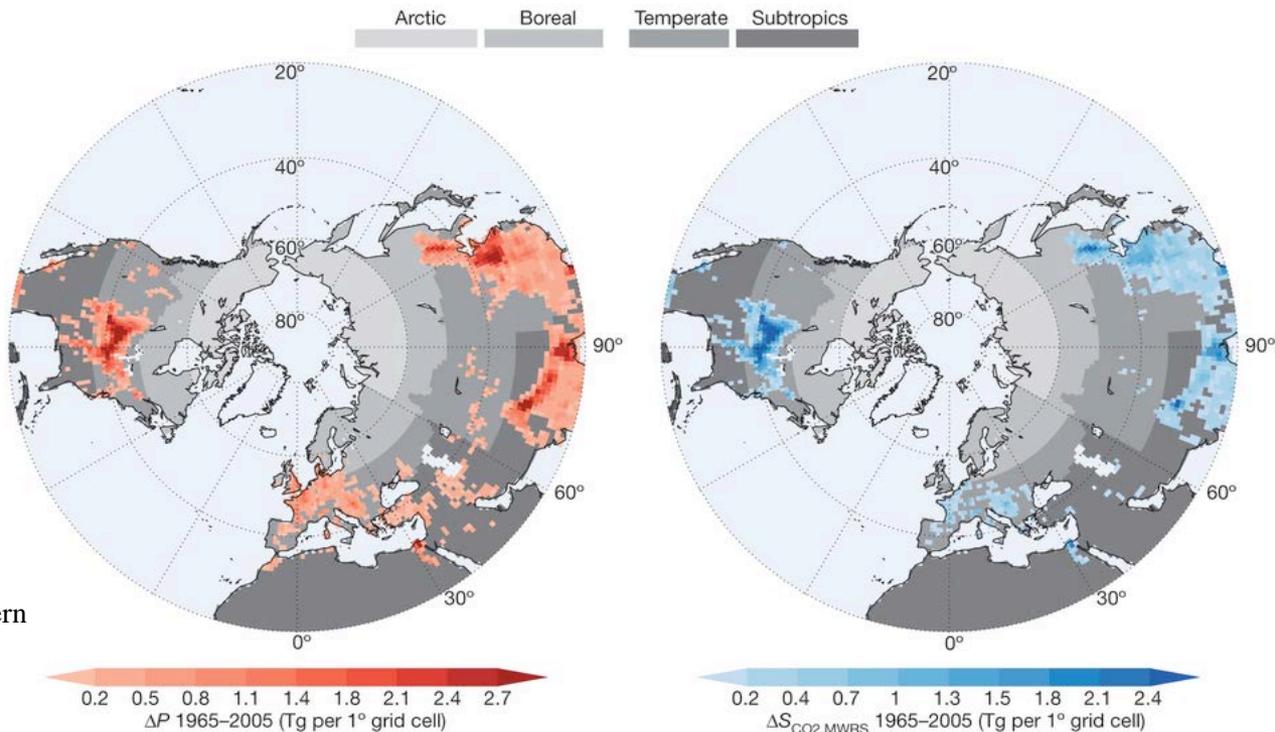
Direct human influence on atmospheric CO₂ seasonality from increased cropland productivity

Josh M. Gray, Steve Frolking, Eric A. Kort, Deepak Ray, Christopher J. Kucharik, Navin Ranakutty, and Mark A. Friedl
Nature | NOVEMBER 2014 | <http://www.nature.com/>, doi: 10.1038/nature13957

Scientists used production statistics (from NASA’s MODIS sensor and agricultural data) and a carbon accounting model to show that increases in agricultural productivity, explain as much as a quarter of the observed changes in atmospheric CO₂ seasonality. Specifically, Northern Hemisphere extratropical maize (corn), wheat, rice, and soybean production grew by 240 % between 1961 and 2008, thereby increasing the amount of net carbon uptake by croplands during the Northern Hemisphere growing season by 0.33 petagrams. Maize, wheat, rice, and soybeans account for about 68% of extratropical dry biomass production, so it is likely that the total impact of increased agricultural production exceeds the amount quantified here.

The seasonal amplitude of Northern Hemisphere atmospheric carbon dioxide (CO₂) concentrations has increased by as much as 50% over the past 50 years. This increase has been linked to changes in photosynthesis, increased heterotrophic respiration, and expansion of woody vegetation.

Right: Geographic patterns of increases in Northern Hemisphere extratropical MWRS agricultural production (*P*) from 1961–2008 (left), and the resulting increase in forcing to atmospheric CO₂ seasonality (right).

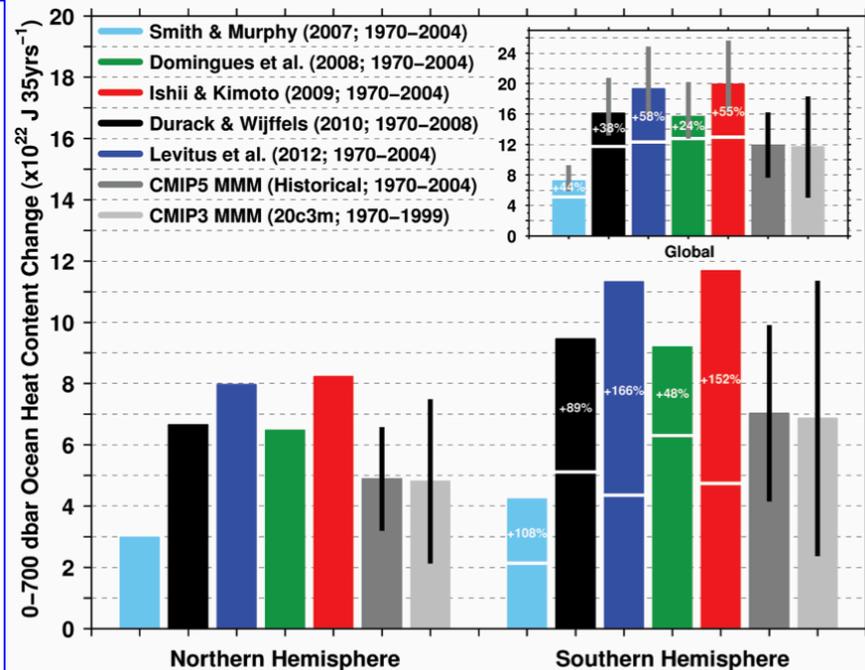




Quantifying underestimates of long-term upper-ocean warming

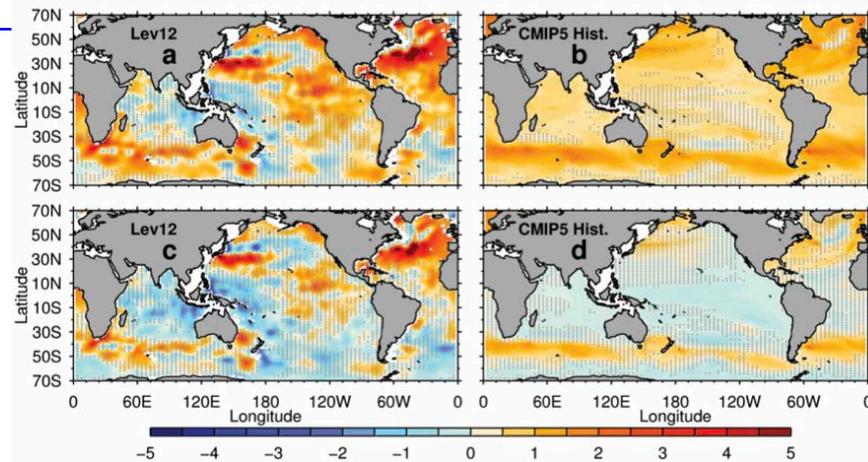
Paul J. Durack, Peter J. Gleckler, Felix W. Landerer and Karl E. Taylor, NATURE CLIMATE CHANGE | VOL 4 | OCTOBER 2014
<http://www.nature.com/natureclimatechange>, DOI: 10.1038/nclimate2389

A study used satellite altimetry observations and a large suite of climate models and concluded that observed estimates of the top 2200 feet of the global ocean warming since 1970 are likely biased low. The study found that the partitioning of Northern and Southern Hemispheric simulated sea surface *height* changes consistently with precise altimeter observations, whereas the hemispheric partitioning of simulated upper-ocean *warming* is inconsistent with temperature observations. They adjust the poorly constrained Southern Hemisphere observed warming estimates so that hemispheric ratios are now consistent. These adjustments yield large increases to current global upper-ocean heat content, and have important implications for sea-level and climate sensitivity assessments. The global ocean stores more than 90% of the heat associated with observed greenhouse-gas- attributed global warming.



Top: Observed and simulated hemispheric and global upper-ocean (0-700 dbar) heat content change for 1970-2004. For the SH and global results horizontal white lines indicate the original unadjusted changes. Full bars indicate the adjusted values, which are revised so that hemispheric ratios of heat uptake match the historical Multi Model Mean (MMM). Color bars are estimates from observed data, grey bars are modeled estimates.

Right: Upper-ocean (0-700 dbar) heat content trends for 1970-2004. Left panels (a and c) show observations while right panels (b and d) show the multi-model mean (MMM). Lower panels (c and d) show maps with the global mean trends removed. All trends are reported in units of J x 10³ per (kg 35yrs). (4 ≈ 1° C per 35yrs depth averaged warming).

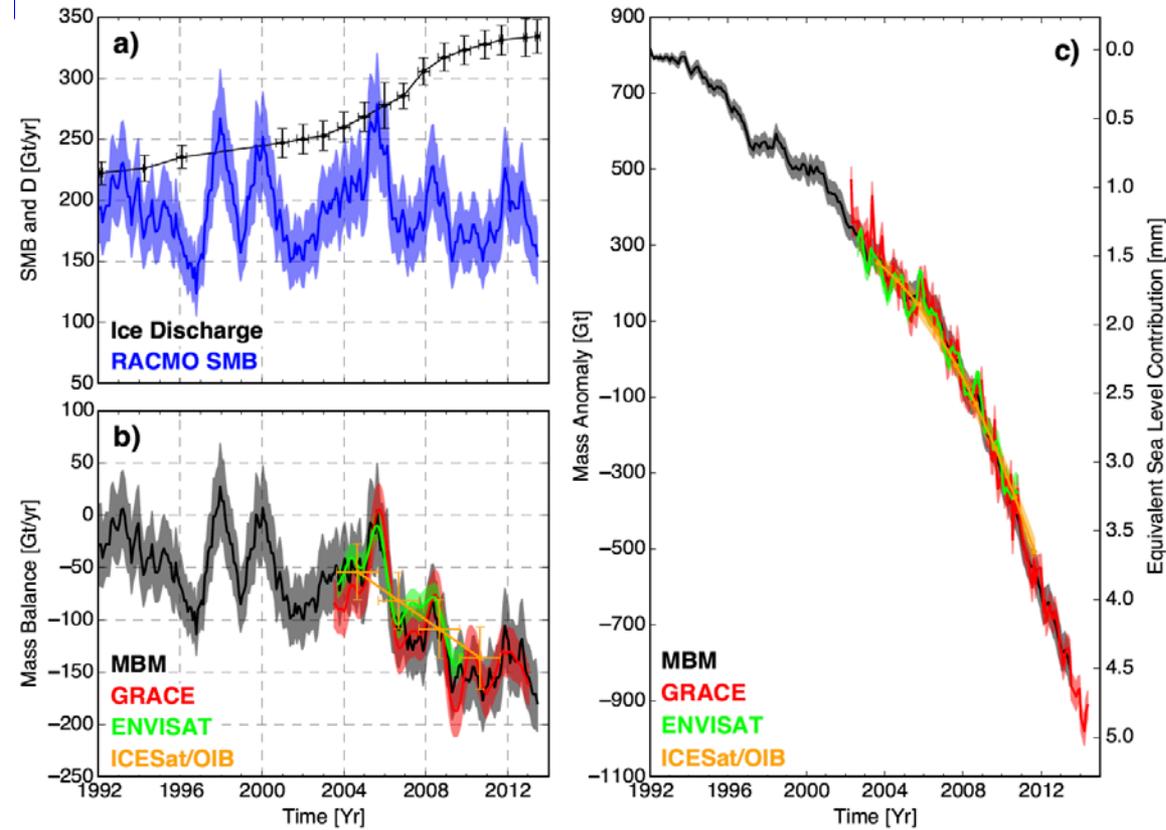




Mass loss of the Amundsen Sea Embayment of West Antarctica from four independent techniques

Tyler C. Sutterley, Isabella Velicogna, Eric Rignot, Jeremie Mouginot, Thomas Flament, Michiel R. van den Broeke, Jan M. van Wessem, and Carleen H. Reijme | Geophysical Research Letters | DECEMBER 2014 | doi: 10.1002/2014GL061940

NASA funded scientists conducted a 21-year analysis of the mass balance of the Amundsen Sea Embayment of West Antarctica. This area is experiencing rapid retreat and mass loss to the sea, and the study showed that the *acceleration of mass loss there has nearly tripled during the last decade*. The team compared four independent estimates: 1) satellite time-variable gravity, 2) mass budget method (MBM), 3) satellite radar altimetry, and 4) satellite and airborne laser altimetry. These methods include data from ICESat and Operation IceBridge laser altimetry, Envisat radar altimetry, GRACE time-variable gravity, the University of Utrecht's Regional Atmospheric Climate Model (RACMO2.3) surface mass balance, ice velocity from imaging radars and ice thickness from radar sounders.



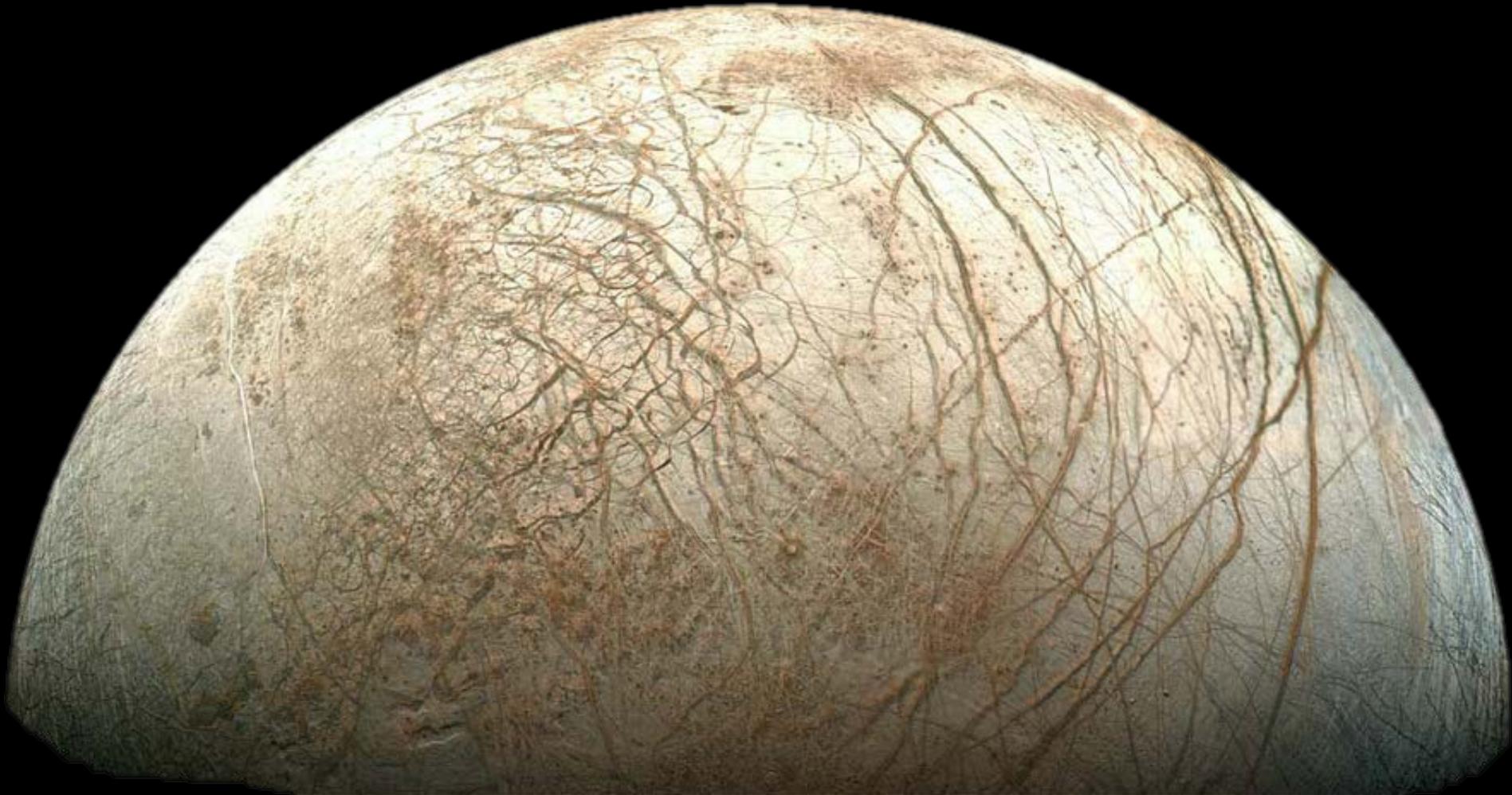
The total amount of loss averaged 83 gigatons per year (91.5 billion U.S. tons). By comparison, Mt. Everest weighs about 161 gigatons (177 billion U.S. tons), meaning the Antarctic glaciers lost an amount of water weight equivalent to Mt. Everest every two years over the last 21 years.

<http://news.agu.org/press-release/west-antarctic-melt-rate-has-tripled/>

Left: (a) Rates of Regional Atmospheric Climate Model (RACMO) surface mass balance, Surface Mass Balance (SMB, blue) and ice discharge, D, from Mouginot et al. [2014] (black). (b) Mass balance estimates, $dM(t)=dt$, and (c) Cumulative mass anomalies, $M(t)$, for the Amundsen Sea Embayment of Antarctica from the Mass Budget Method, MBM, (black), GRACE time-variable gravity (red), Envisat radar altimetry (green) and ICESat/IceBridge laser altimetry (orange).

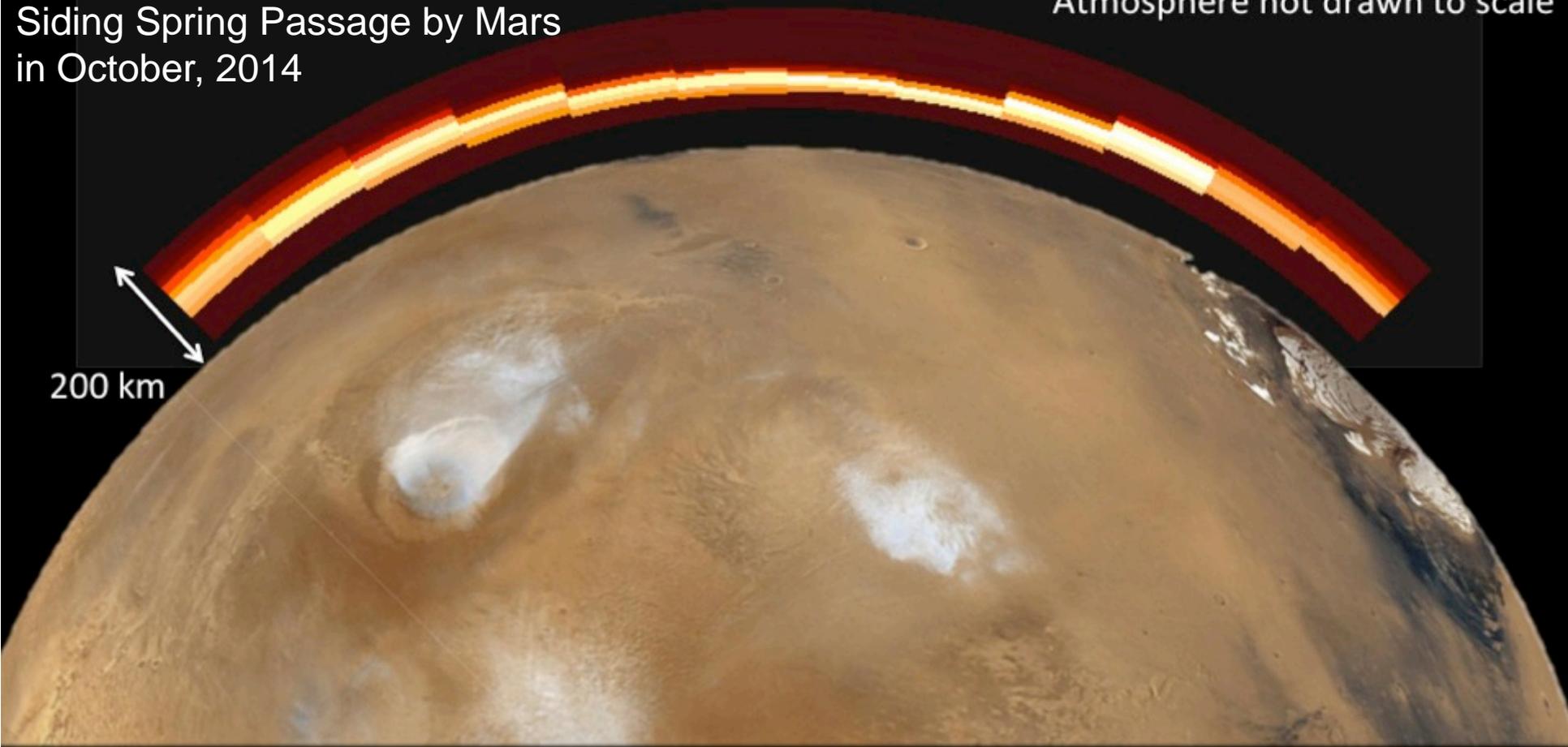


Planetary Science



MAVEN Results from Comet
Siding Spring Passage by Mars
in October, 2014

Geographic representation is conceptual
Atmosphere not drawn to scale

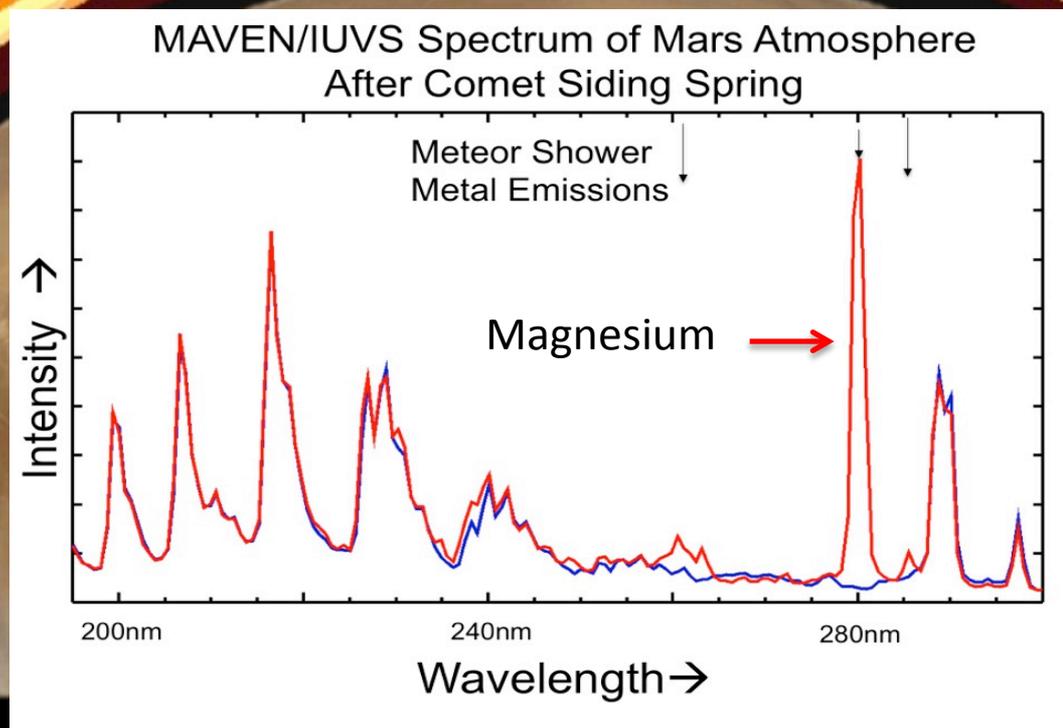


Emission from ionized magnesium in Mars' atmosphere following the Siding Spring Meteor Shower, imaged by MAVEN's Imaging Ultraviolet Spectrograph

MAVEN Results from Comet Siding Spring Passage by Mars in October, 2014

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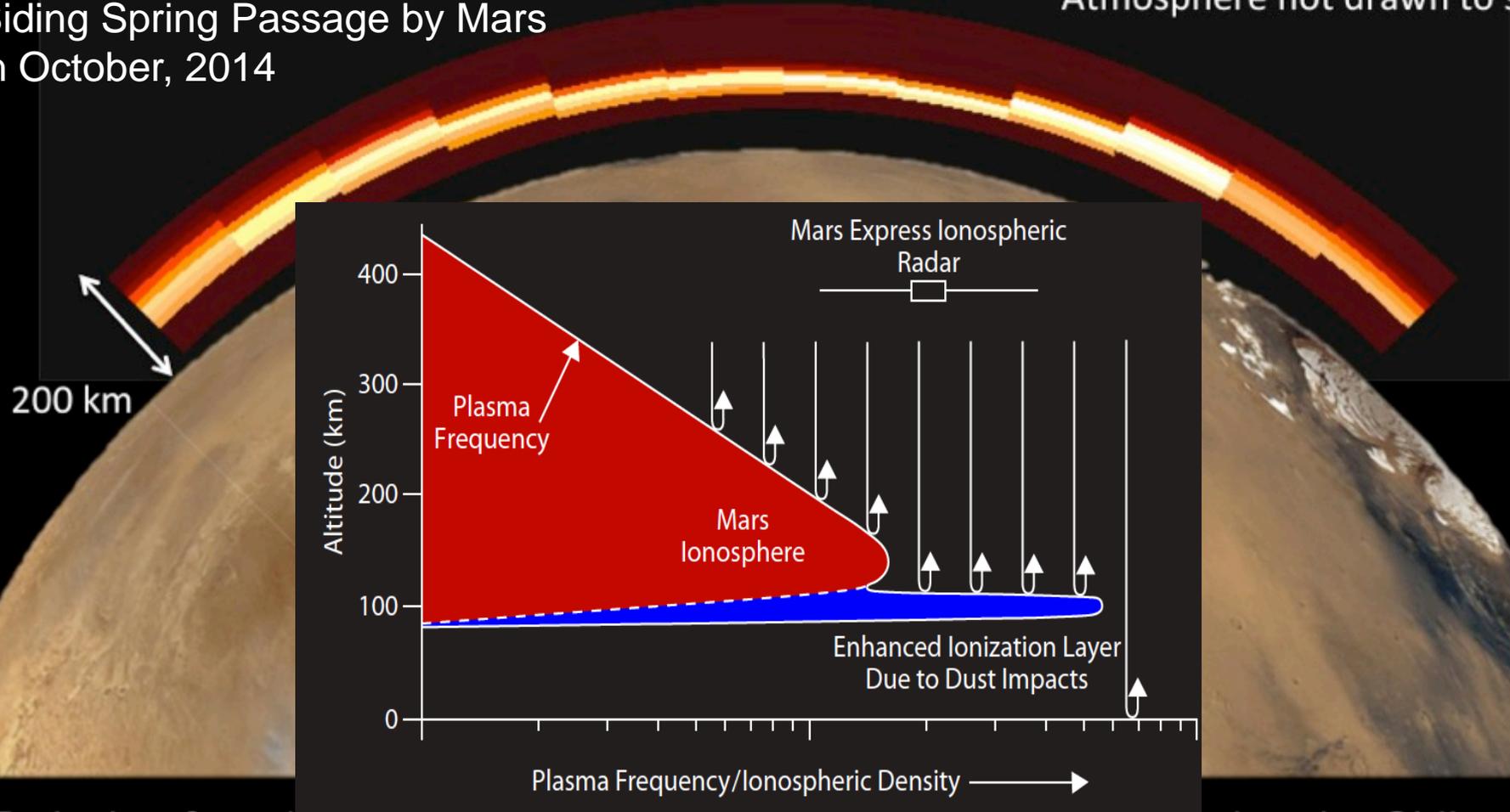
200 km



Emission from ionized magnesium in Mars' atmosphere following the Siding Spring Meteor Shower, imaged by MAVEN's Imaging Ultraviolet Spectrograph

MAVEN Results from Comet Siding Spring Passage by Mars in October, 2014

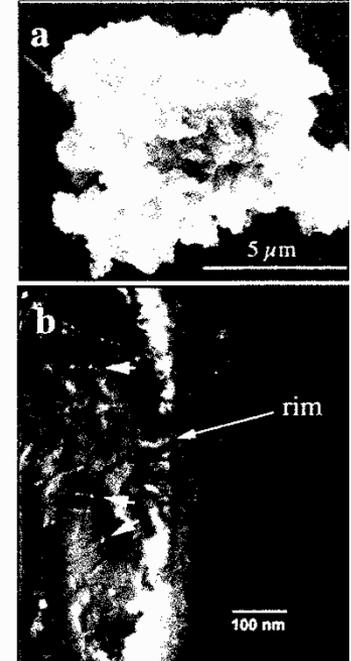
Geographic representation is conceptual
Atmosphere not drawn to scale



Emission from ionized magnesium in Mars' atmosphere following the Siding Spring Meteor Shower, imaged by MAVEN's Imaging Ultraviolet Spectrograph

- **J. P. Bradley et al. (2014) Detection of solar wind produced water in irradiated rims on silicate minerals. *Proc. Nat. Acad. of Sci.*, 47(4), 525-549.**

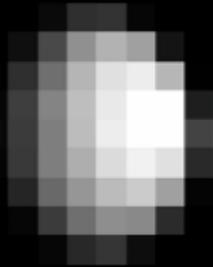
The group answered a four decade old question by showing that hydrogen ions in the solar wind, react with oxygen in the silicate minerals of interplanetary dust particles (IDPs) to form water. Some of these IDPs, collected by NASA high-altitude research aircraft, are the most primitive samples of early Solar System material available for laboratory examination (Ishii et al., *Science*, 2008). The water was detected in the ~100 nanometer thick rims, roughly one-thousandth the width of a human hair, produced on the surfaces of these IDPs by solar wind irradiation. The rims were analyzed by valence electron energy-loss spectroscopy, a technique that probes the 0 to 50 eV region of the energy loss spectrum, where features from -O-H and H₂O can be detected. This result demonstrates that the solar wind can produce water in the silicate surface materials of airless bodies including the Moon and asteroids, and that the high flux of IDPs early in Solar System history could add water to the Earth and to other planets and moons.



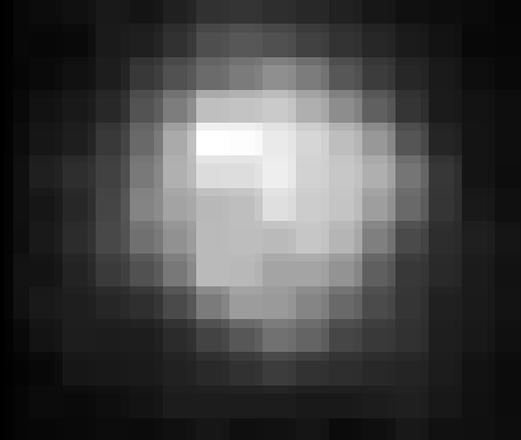
U220A19 (top) and TEM image (bottom) of the ~100 nm solar wind irradiated rim that was analyzed for H₂O.

Upcoming: Dawn and New Horizons

Dec 1: Dawn's first image of Ceres



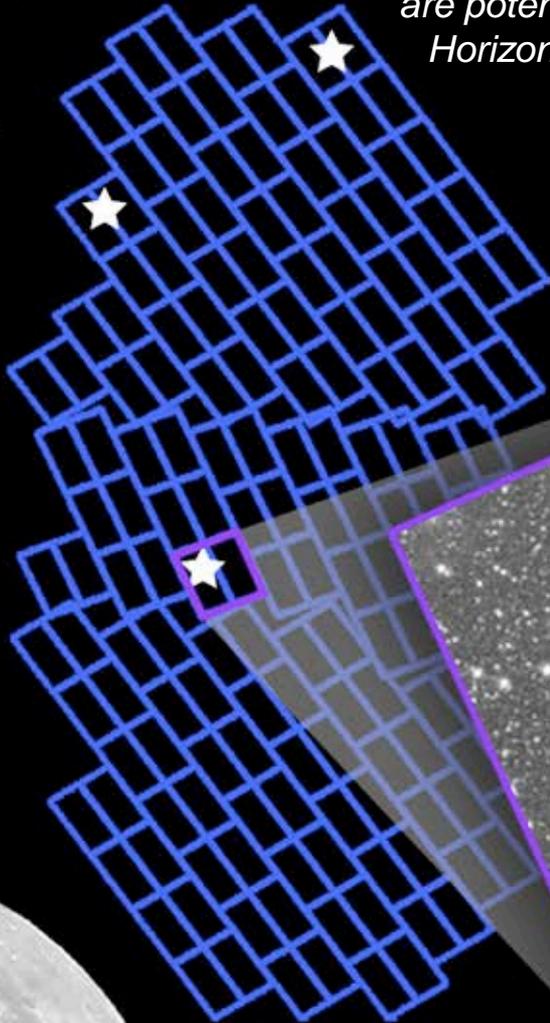
HST's best image of Pluto



- Dec 26: Start of approach phase
- Jan 13: Next set of Ceres images (26 pixels but still less than HST)
- Jan 26: Images Better than Hubble (BTH) resolution
- Mid-Feb – 7x better than Hubble
- Mar 6: Arrival – Dawn gently captured by Ceres
- Early May: BTH images of Pluto
- July 14: Pluto system flyby; close approach to Pluto at 7:49 a.m. EDT
- July 15, 2015: First-post flyby data returned; Departure Phase begins

NASA's Hubble Telescope Finds Potential Kuiper Belt Targets for New Horizons Pluto Mission

Search area:
83 Hubble
WFC3 fields
Locations of
potentially
targetable
discoveries
shown

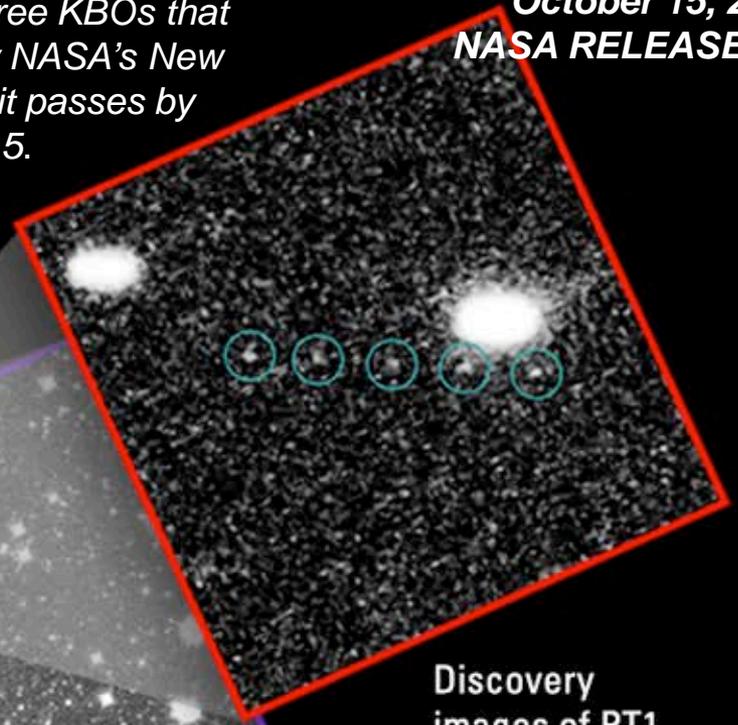


Full moon,
at same
scale

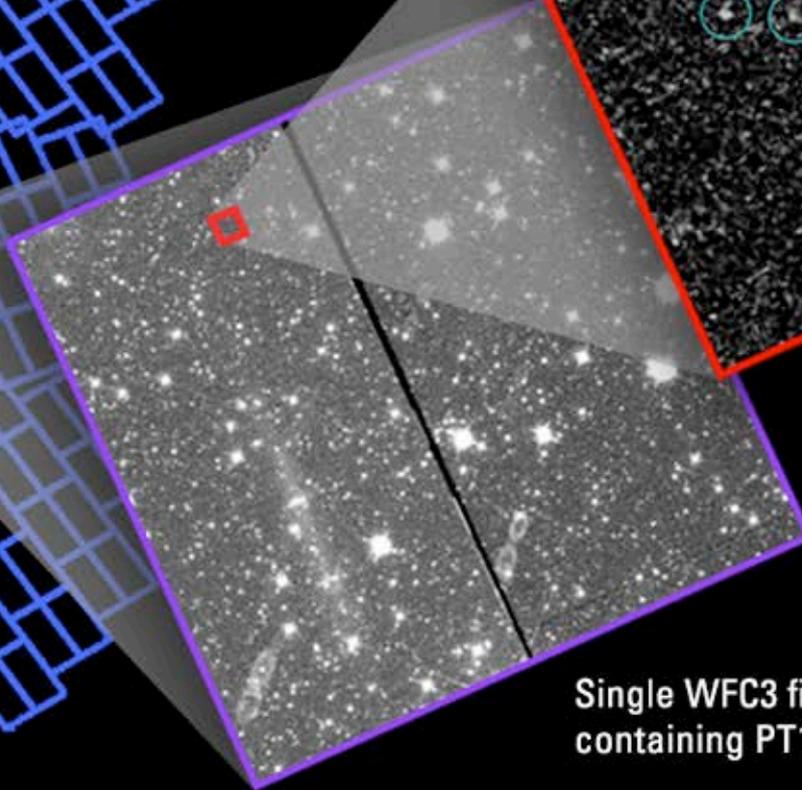


A HST survey uncovered three KBOs that are potentially reachable by NASA's New Horizons spacecraft after it passes by Pluto in mid-2015.

October 15, 2014
NASA RELEASE 14-281



Discovery
images of PT1



Single WFC3 field,
containing PT1

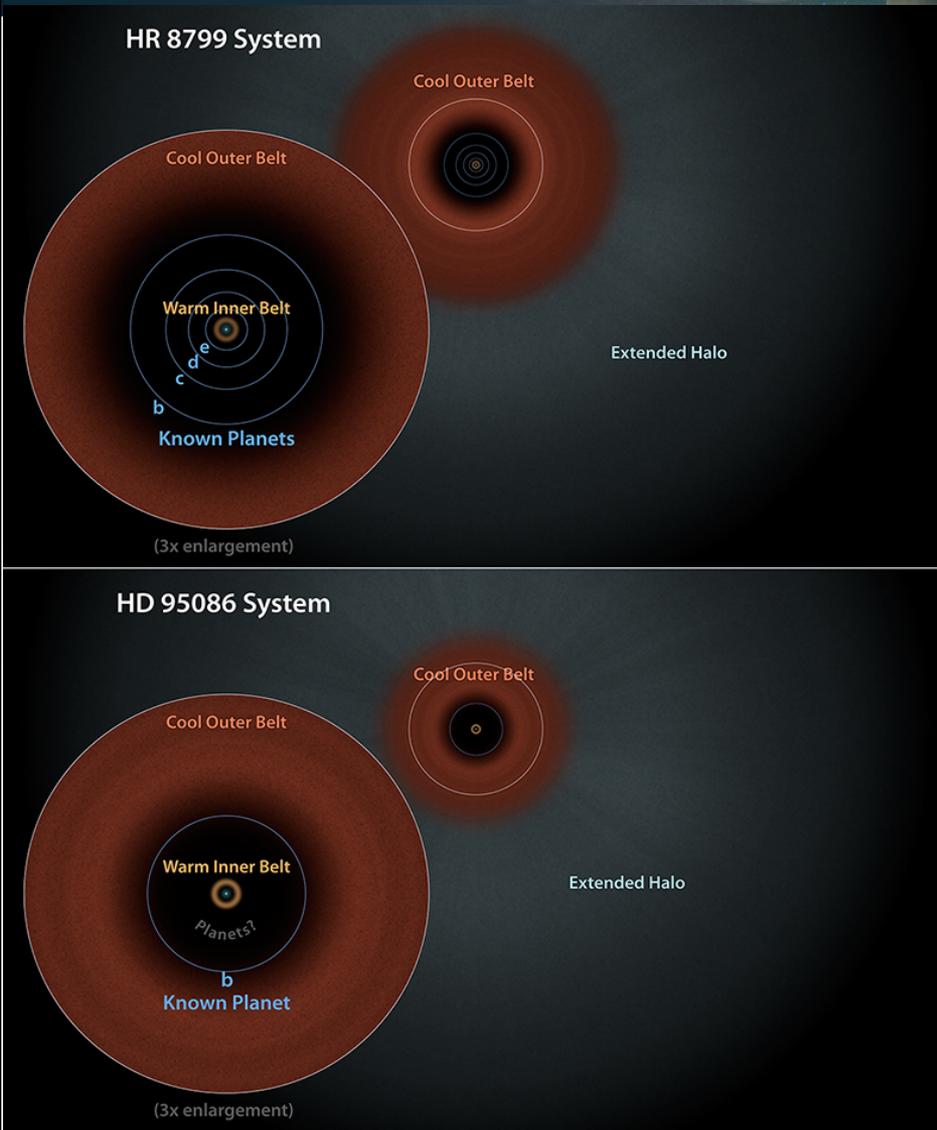
The three KBOs identified each are ~1 billion miles beyond Pluto. Two are estimated to be as large as 55 km; the third perhaps as small as 25 km.

National Aeronautics and Space Administration



Astrophysics

Follow the Dust to Find Planets



- Beefed-up version of our solar system is encased in a halo of fine dust. The findings are based on infrared data from NASA's Spitzer Space Telescope and ESA's Herschel Space Observatory, in which NASA is a partner.
- The dusty star system, located 295 light-years from Earth in the constellation Carina. It is thought to include two belts of dust, which lie within the newfound outer dust halo. One of these belts is warm and closer to its star, as is the case with our solar system's asteroid belt, while the second belt is cooler and farther out, similar to our own Kuiper belt of icy comets.
- Within our solar system, the planets Jupiter, Saturn, Uranus and Neptune are sandwiched between the two dust belts. Scientists think something similar is happening in the star system HD 95086, only on larger scales. One planet, about five times the mass of Jupiter, is already known to sit right inside HD 95086's cooler belt. Other massive planets may be lurking between the two dust belts, waiting to be discovered.
- Studies like this from Spitzer and Herschel point the way for ground-based telescopes to snap pictures of hiding planets
- Comparing data from the two star systems hints that HD95086, like its cousin HR 8799, is a possible home to multiple planets that have yet to be seen. Ground-based telescopes might be able to take pictures of the family of planets.
- Both HD 95086 and HR 8799 are much younger and dustier than our solar system. When planetary systems are young and still forming, collisions between growing planetary bodies, asteroids and comets kick up dust. Some of the dust coagulates into planets, some winds up in the belts, and the rest is either blown out into a halo, or funneled onto the star.

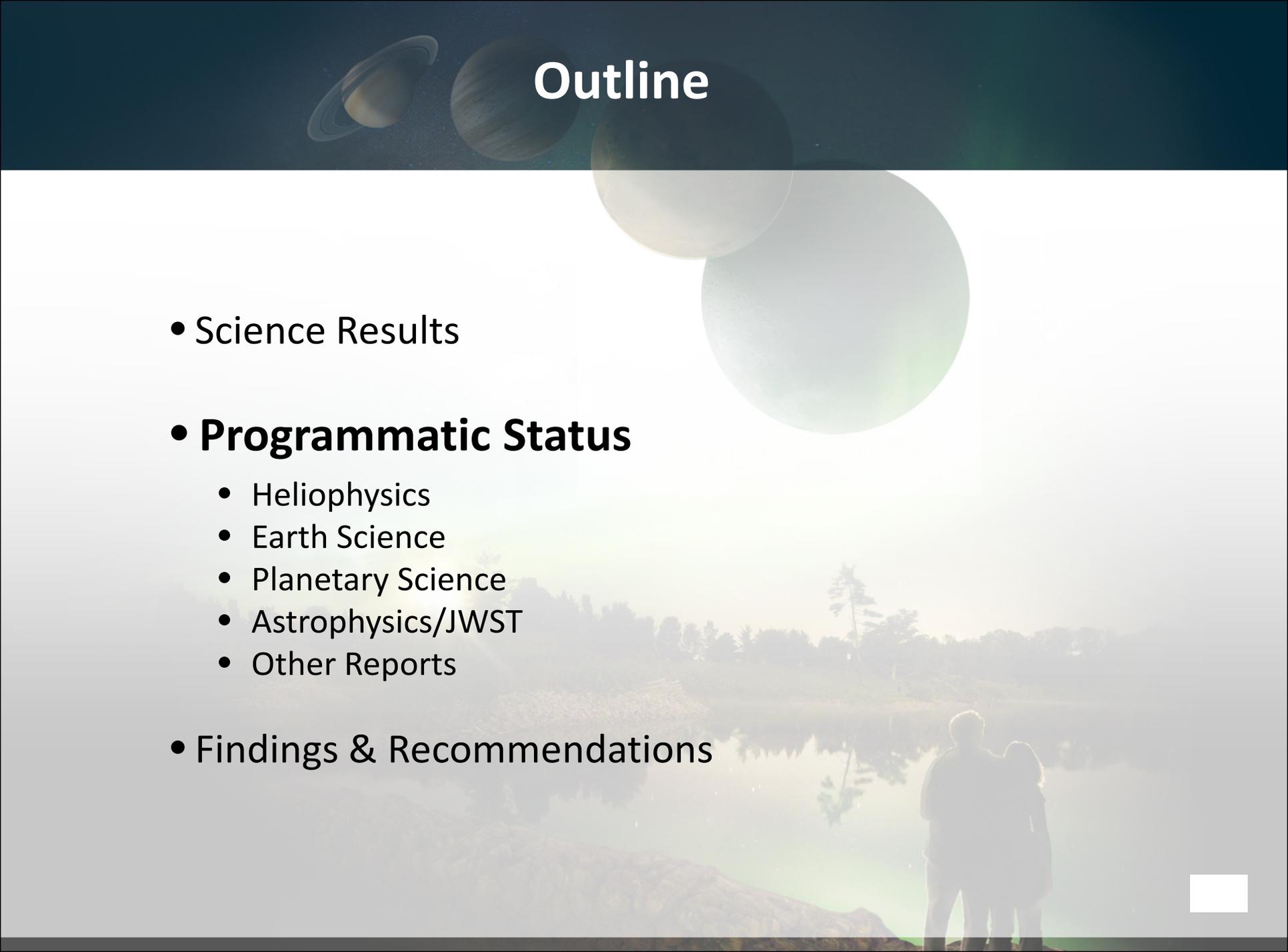
NASA Telescopes Find Black Hole May be Neutrino Factory



- The supermassive black hole at the center of the Milky Way, seen in this image from NASA's Chandra X-ray Observatory, may be producing mysterious particles called neutrinos. Neutrinos are tiny particles that have virtually no mass and carry no electric charge. Unlike light or charged particles, neutrinos can emerge from deep within their sources and travel across the Universe without being absorbed by intervening matter or, in the case of charged particles, deflected by magnetic fields.
- Scientists have proposed that these higher-energy neutrinos are created in the most powerful events in the Universe like galaxy mergers, material falling onto supermassive black holes, and the winds around dense rotating stars called pulsars.
- Using three NASA X-ray telescopes, Chandra, Swift, and NuSTAR, scientists have found evidence for one such cosmic source for high-energy neutrinos: the 4-million-solar-mass black hole at the center of our galaxy called Sagittarius A* (Sgr A*, for short). After comparing the arrival of high-energy neutrinos at the underground facility in Antarctica, called IceCube, with outbursts from Sgr A*, a team of researchers found a correlation. In

particular, a high-energy neutrino was detected by IceCube less than three hours after astronomers witnessed the largest flare ever from Sgr A* using Chandra. Several flares from neutrino detections at IceCube also appeared within a few days of flares from the supermassive black hole that were observed with Swift and NuSTAR.

- This Chandra image shows the region around Sgr A* in low, medium, and high-energy X-rays that have been colored red, green, and blue respectively. Sgr A* is located within the white area in the center of the image. The blue and orange plumes around that area may be the remains of outbursts from Sgr A* that occurred millions of years ago. The flares that are possibly associated with the IceCube neutrinos involve just the Sgr A* X-ray source.
- This latest result may also contribute to the understanding of another major puzzle in astrophysics: the source of high-energy cosmic rays. Since the charged particles that make up cosmic rays are deflected by magnetic fields in our galaxy, scientists have been unable to pinpoint their origin. The charged particles accelerated by a shock wave near Sgr A* may be a significant source of very energetic cosmic rays.

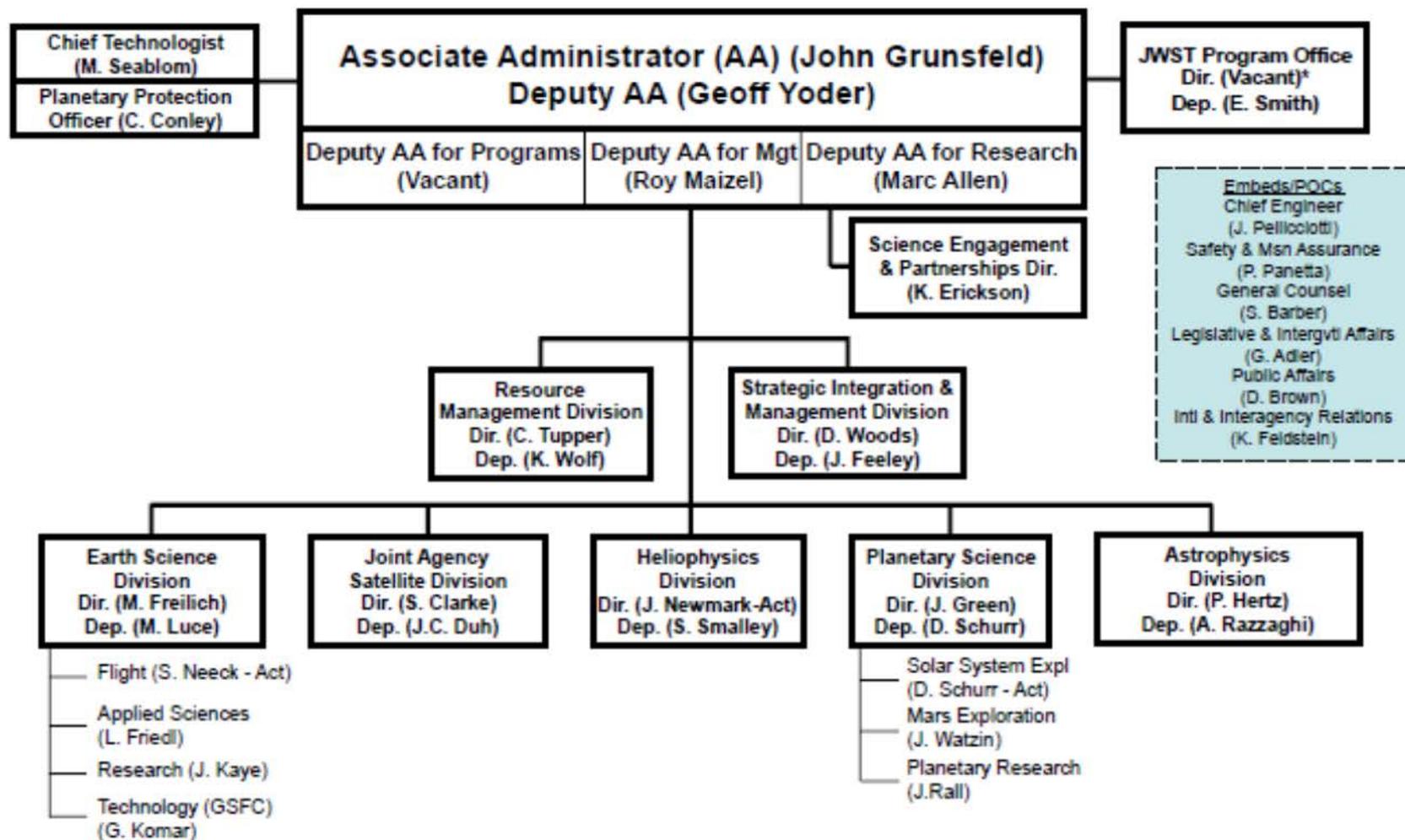


Outline

- Science Results
- **Programmatic Status**
 - Heliophysics
 - Earth Science
 - Planetary Science
 - Astrophysics/JWST
 - Other Reports
- Findings & Recommendations



SMD Organization



* Direct report to NASA Associate Administrator

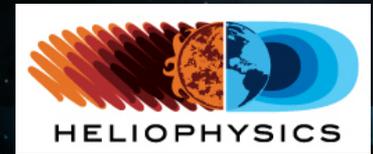
National Aeronautics and Space Administration



Heliophysics



Heliophysics Key Milestones



Key Decision Points

October 2014	ICON KDP-C
February 2015	GOLD KDP-C
March 2015	MMS Launch Readiness Date
March 2015	SPP Critical Design Review
July 2018	SPP Launch Readiness Date
October 2018	SOC Launch (Jul 2017 LRD)

Solicitations

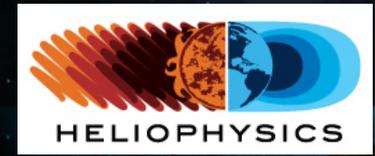
NET December 2014	Education CAN
February 2015	ROSES NRA
February 2016	ROSES NRA

The next Heliophysics Explorer solicitation anticipated no earlier than FY2017. (6 years minimum since last AO)

The next Solar Terrestrial Probes solicitation anticipated no earlier than FY2017. (15 years minimum since last AO)

Senior Review – April 2015

Heliophysics Roadmap

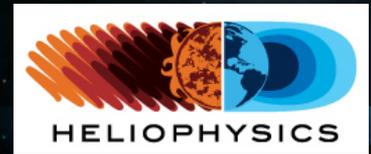


- Goal is to implement the Decadal Survey recommendations
- Primary constraint is the current budget forecast
- Planned Actions
 - Complete the existing program
 - Implement the NASA components of DRIVE*
 - Grow the Explorer program as recommended by Decadal Survey
 - Evolve the Heliophysics budget distributions to increase emphasis on the grants program and Explorer/MoOs

*Diversify, Realize, Integrate, Venture, Educate

Near-final Roadmap: http://sec.gsfc.nasa.gov/roadmap_2014_oct_draft.pdf
(No substance changes – final formatting and checking only)

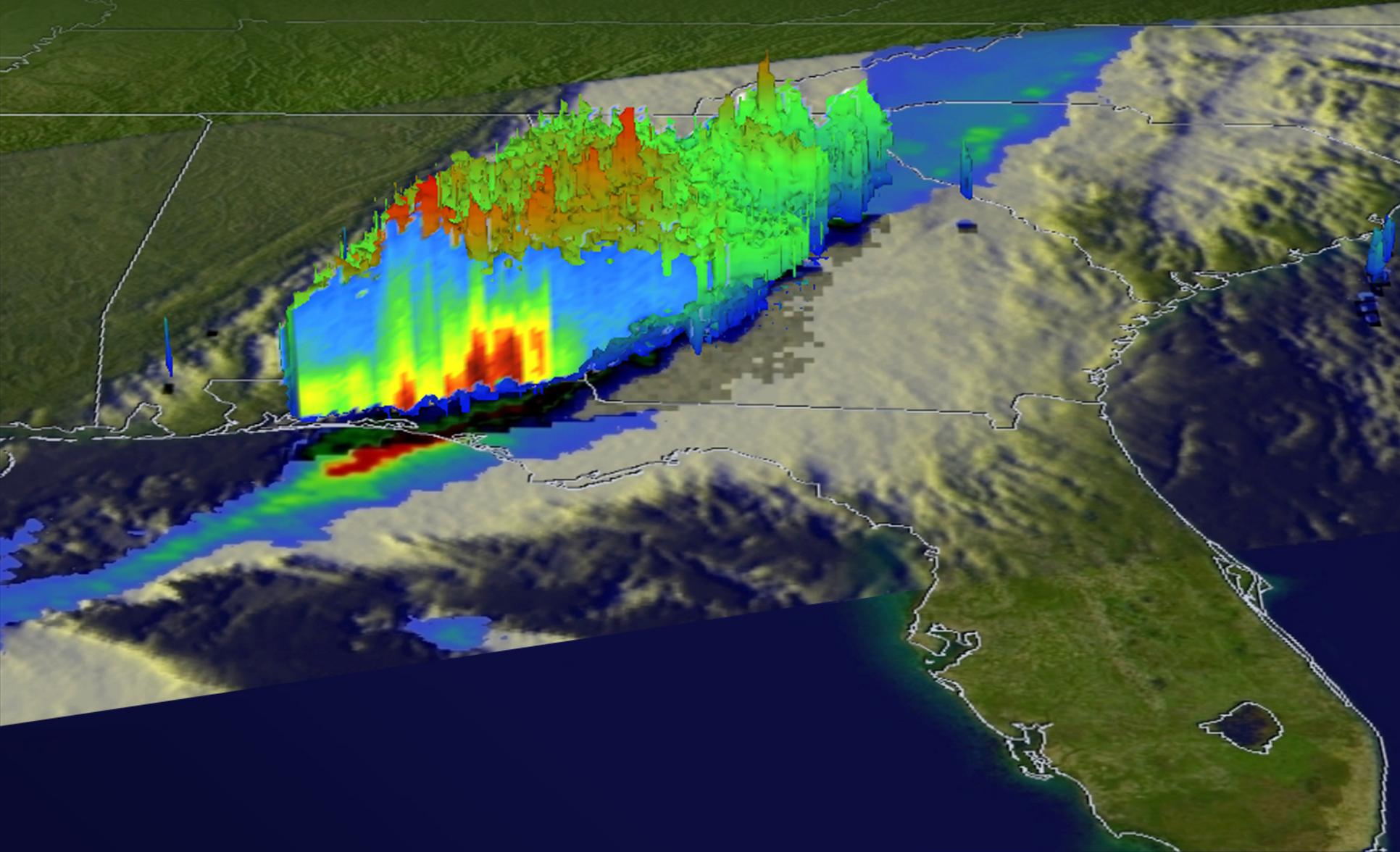
NASA's CubeSat Initiative



- Heliophysics is administering SMD's CubeSat budget, \$5M/yr
- Management approach
 - CubeSat proposals will be solicited via ROSES and selected by each SMD Division
- Science CubeSat Integration Panel:
 - Establish policy, incorporate lessons learned, and conduct outreach
 - Integrate management and implementation as needed
 - Recommend awards following review by Divisions
- CubeSat proposals received and selected for 2014 awards

NASA CubeSat proposals will be solicited and selected on the basis of science merit and technology value.

EARTH SCIENCE



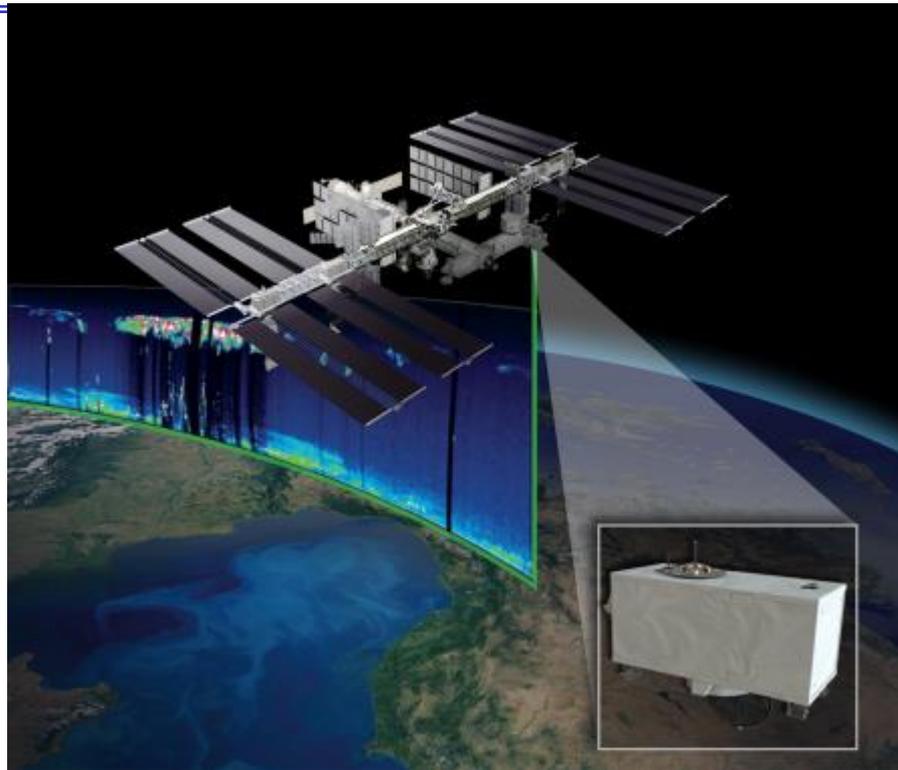
3 ESD-developed EO missions launch in CY 2014
2 ISS-developed EO instruments in 2014, 1 in 2016
11+ more ESD EO launches before 2022





Cloud-Aerosol Transport System (CATS)

Launched January 10, 2015



- The Cloud-Aerosol Transport System (CATS) is a lidar remote sensing payload.
- CATS launched from KSC.
- Science goals of the CATS project
 - Improve understanding of aerosol and cloud properties and interactions
 - Improve strategic and hazard warning capabilities of events in near real-time
 - Improve model-based estimates of climate forcing and predictions of future climate change
- The CATS instrument is a directed opportunity funded by the ISS Program (HEOMD).
- Algorithms and data processing is funded by ESD, and is a joint effort with the LaRC/CALIPSO team.
- Programmatic aspects of CATS include
 - Utilizing ISS as an affordable Earth Science observing platform
 - Providing in-space demonstration of technologies for future satellite missions
 - Demonstrating build-to-cost project development with streamlined management structure





Soil Moisture
Active Passive
Mission

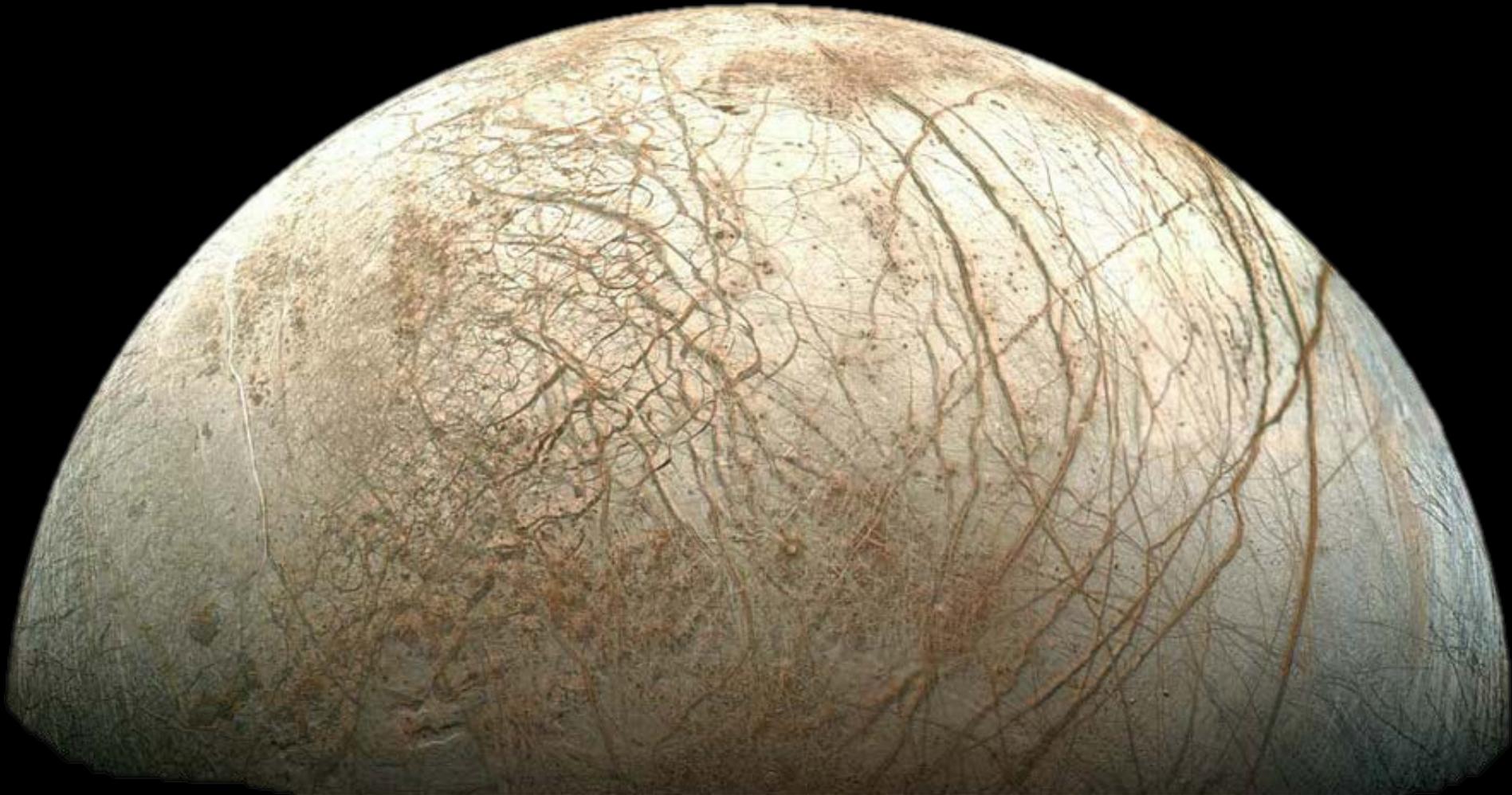
SMAP

SMAP measurements of soil moisture and freeze/thaw state address a wide range of water cycle research and science applications, such as weather predictions, drought/flood monitoring, and food production.

**SMAP to Launch
29 January 2015**



Planetary Science



Planetary Science Missions Events

2014

- July – *Mars 2020* Rover instrument selection announcement * Completed
- August 6 – 2nd Year Anniversary of *Curiosity* Landing on Mars
- September 21 – *MAVEN* inserted in Mars orbit
- October 19 – Comet Siding Spring encountered Mars
- September – *Curiosity* arrives at Mt. Sharp
- November 12 – ESA's *Rosetta* mission lands on Comet Churyumov–Gerasimenko
- December 2/3 – Launch of *Hayabusa-2* to asteroid 1999 JU₃

2015

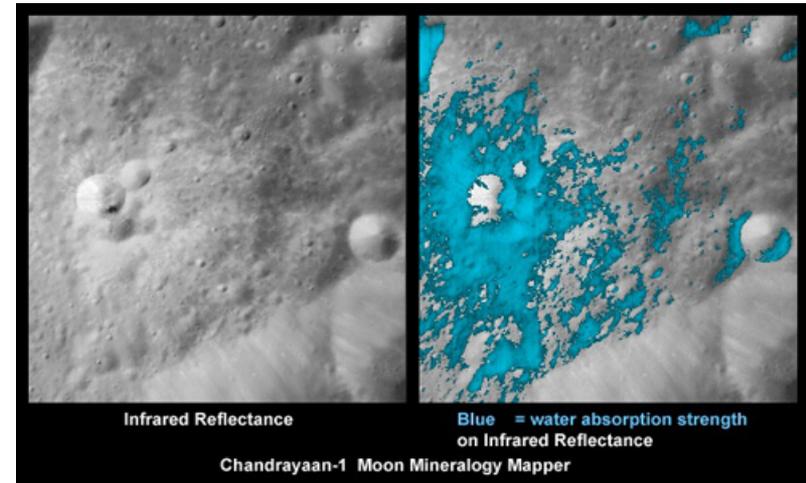
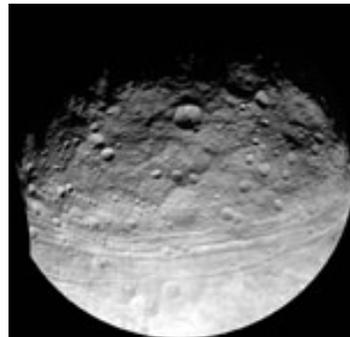
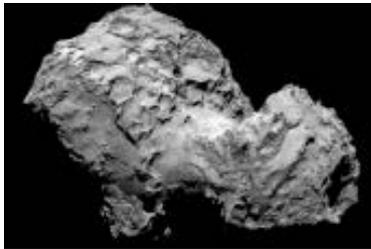
- January – Discussions with Indian Space Research Organization (ISRO)
- March 6 – *Dawn* inserted into orbit at dwarf planet Ceres
- Early April– *MESSENGER* spacecraft impacts Mercury
- April – Europa instrument Step 1 selection
- May – Discovery 2014 Step 1 selection
- July 14 – *New Horizons* flies through the Pluto system

2016

- March – Launch of Mars missions *InSight* and ESA's *ExoMars Trace Gas Orbiter*
- March – Europa instrument Step 2 selection
- July – *Juno* inserted in Jupiter orbit
- July – ESA's *Bepi Colombo* launch to Mercury
- August – Discovery 2014 Step 2 selection
- September – *InSight* Mars landing
- September – Launch of Asteroid mission *OSIRIS – REx* to asteroid Benu
- September – *Cassini* begins to orbit between Saturn's rings & planet

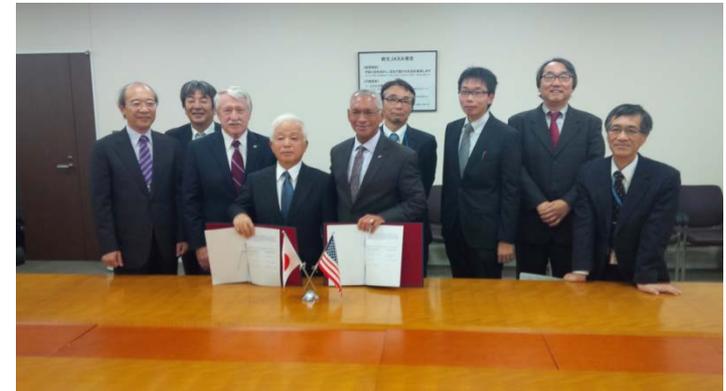
International Collaboration Successes

Having the M3 spectrometer on the Indian Chandrayaan-1 lunar mission has proven most successful - this instrument was the first to detect lunar "frost" on the surface during the night, which dissipated shortly after dawn. That mission also carried the US Mini-SAR - a radar experiment that noted potential for water-ice in the lunar poles.

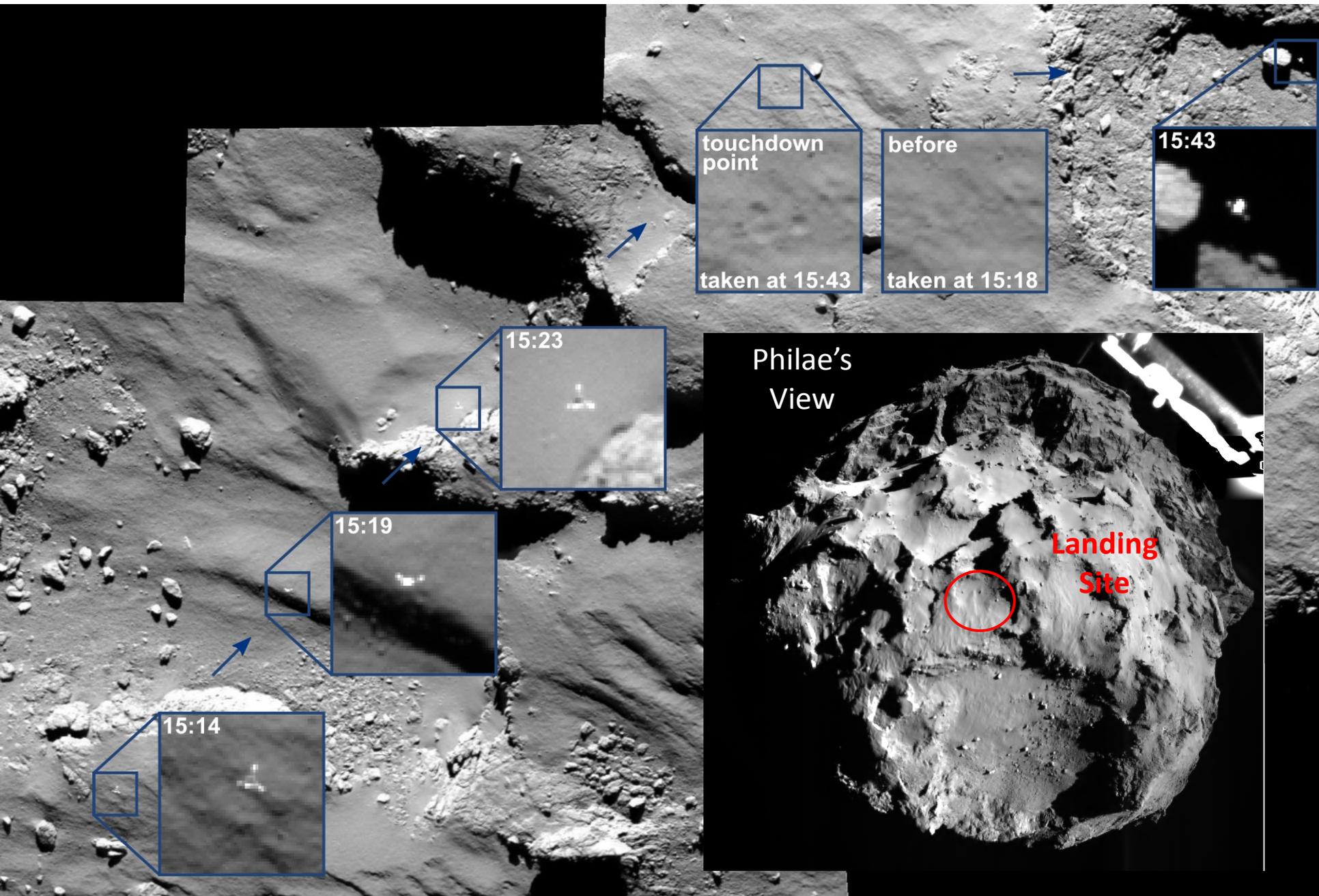


NASA collaboration with ESA on Rosetta through instruments and science team, Also instruments on DAWN.

- Japanese investigators to participate in the **OSIRIS-REx** asteroid encounter and sample-analysis phases of the mission
- Accommodating NASA-funded investigators on the **Hayabusa2** instrument teams and mission operations team
- Developing a mutually agreed upon Joint Sample Exchange Curation and Analysis Plan
- Developing a mutually agreed Data Access Plan



Rosetta's Images of Philae's Landing/Bounce



National Aeronautics and Space Administration



Astrophysics

■	Formulation
■	Implementation
■	Primary Ops
■	Extended Ops



XMM-Newton (ESA)
12/10/1999



Swift
11/20/2004



Suzaku (JAXA)
7/10/2005



Fermi
6/11/2008



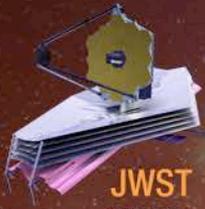
Euclid (ESA)
2020



Hubble
4/24/1990



Kepler
3/6/2009



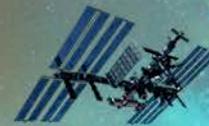
JWST
2018



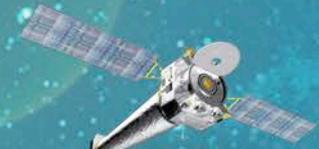
Spitzer
8/25/2003



ASTRO-H (JAXA)
2015

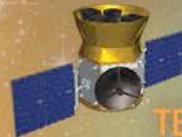
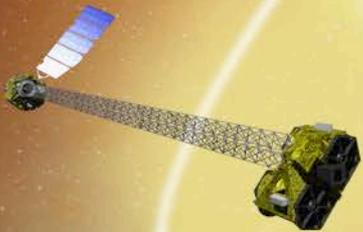


NICER (on ISS)
2016



Chandra
7/23/1999

NuSTAR
6/13/2012



TESS
2017



LISA Pathfinder (ESA)
2015



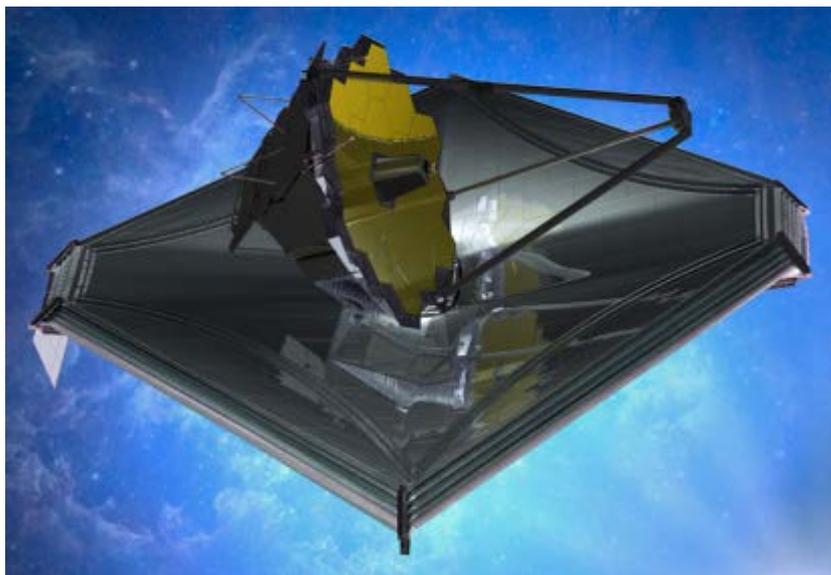
SOFIA
Full Ops 2014

NASA Astrophysics Programs



JWST

James Webb Space Telescope



2014 Accomplishments

- Highly successful second cryovacuum test of ISIM
- Deployment testing of full-scale engineering unit sunshield
- Spacecraft manufacturing initiated
- Telescope Pathfinder completed
- Telescope Flight Backplane completed

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: 2018 launch for a 5-year prime mission

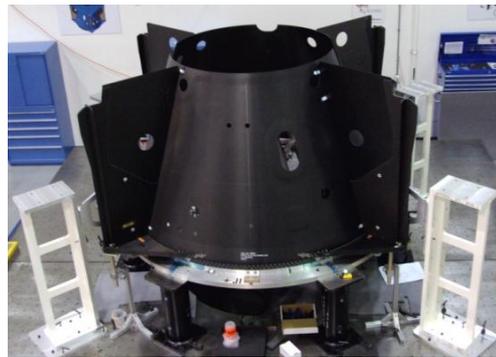
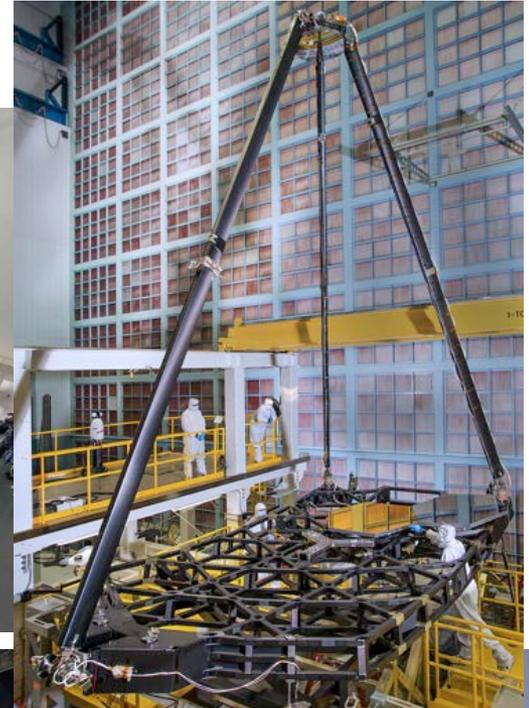
Partners: ESA, CSA

2015 Plans

- Complete Instrument hardware replacements, and test ISIM for the final time before integration into observatory
- Conducts tests at JSC in preparation for 2016 full telescope and instrument test
- Complete MIRI cryocooler
- Start Assembly of the Primary mirror



JWST Hardware Progress

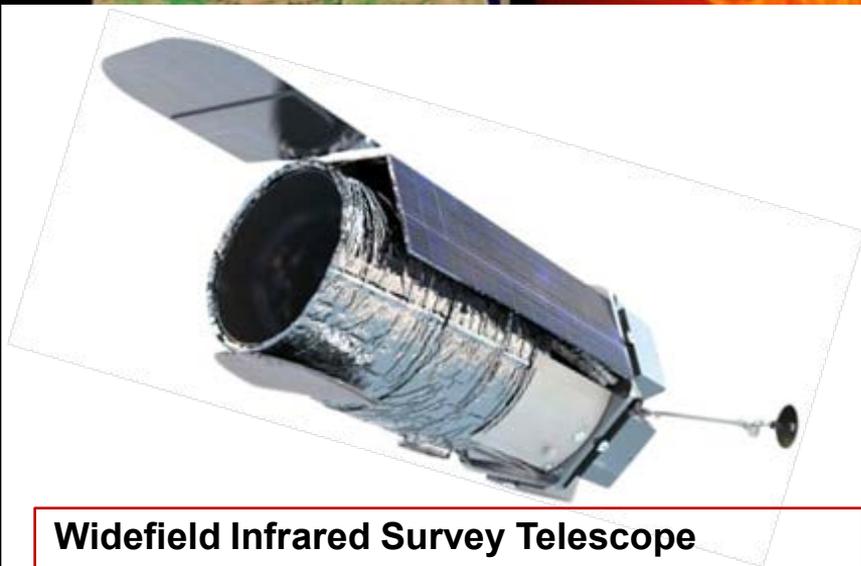


Astro Subcommittee: JWST remains on track for an October 2018 launch within its replan budget guidelines



WFIRST / AFTA

Widefield Infrared Survey Telescope with Astrophysics Focused Telescope Assets



Widefield Infrared Survey Telescope

Top priority of 2010 Decadal Survey

Science themes: Dark Energy, Exoplanets, Large Area Near Infrared Surveys

Mission: 2.4m widefield telescope at GEO, uses existing AFTA hardware to image 0.28 deg^2 at $0.8\text{-}2.0 \mu\text{m}$

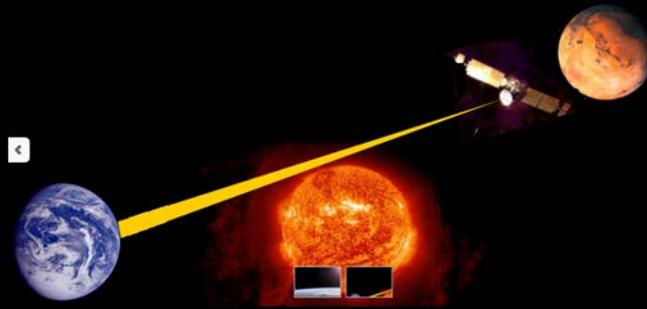
Instruments (design reference mission):
Wide Field Instrument, Coronagraph Instrument

- FY15 Budget Request and Appropriation support pre-formulation of WFIRST/AFTA
- Plans support Agency/Administration decision for formulation to begin NET FY 2017, should funding be available.

<http://wfirst.gsfc.nasa.gov/>

CURRENT STATUS:

- May 2013, NASA Administrator Bolden directed study of WFIRST/AFTA and preserve option for FY17 new start if budget is available.
 - No decision expected before early CY 2016.
- Currently in pre-formulation phase.
 - Activities include technology development for detectors and coronagraph (with STMD), assessment of the 2.4m telescopes including risk mitigation, mission design trades, payload accommodation studies, and observatory performance simulations.
- Maturing key technologies by FY19.
 - H4RG infrared detectors for widefield imager.
 - Internal coronagraph for exoplanet characterization (two architectures identified December 2013; occulting mask coronagraph and phased induced amplitude apodization complex mask coronagraph).
- March 2014 NRC study on WFIRST/AFTA offers positive view of AFTA, with concerns about technology and cost risks.
- WFIRST Preparatory Science (WPS) funds ROSES proposals that are relevant to WFIRST's goals and WFIRST-specific simulations and models.
- SDT final report due January 31, 2015.



NASA
SCIENCE | FOR RESEARCHERS



Selected Other
Reports



Joint Session with HEO Committee

Science and
Human Exploration
and Operations
Joint Activities

National Aeronautics and Space Administration

Evolvable Mars Campaign

Status Update to NASA Advisory Council HEO
& Science Committees

January 12, 2015

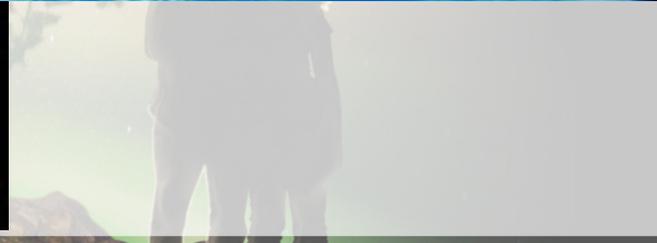
Jason Crusan

Director, Advanced Exploration Systems
Human Exploration and Operations Mission Directorate

**John M. Grunsfeld, Associate Administrator
Science Mission Directorate**

Joint Meeting of the NASA Advisory Council
Science/Human Exploration and Operations Committees

January 12, 2015



Present Day HEOMD and SMD Joint Activity Areas

- **Science Instruments on the International Space Station (ISS)**
- **Mars Exploration Program**
 - Mars 2020 Partnership – borne out of current Mars strategy discussions
 - Mars Science Laboratory (Curiosity)
 - Partnership on HEO/Space Technology Mission Directorate (STMD) instrumentation - Mars EDL Instrumentation (MEDLI-2), Mars Oxygen ISRU Experiment (MOXIE), and Mars Environmental Dynamics Analyzer (MEDA)
- **Planetary Protection**
- **Space Communications and Navigation (SCaN)**
- **Asteroid Redirect Mission**
 - improve detection/characterization of Near Earth Objects (NEOs)
 - interplanetary radar capabilities
- **Space Radiation**
 - Space Radiation Working Group
- **Launch Services**
- **Joint Robotic Precursor**
- **In discussions regarding potential collaboration on satellite servicing**

Planetary Protection Subcommittee Outer Space Treaty (OST) Compliance Issue

How will the U.S. Government ensure compliance by non-governmental US entities with the Outer Space Treaty (OST) requirements for planetary protection?

Problem:

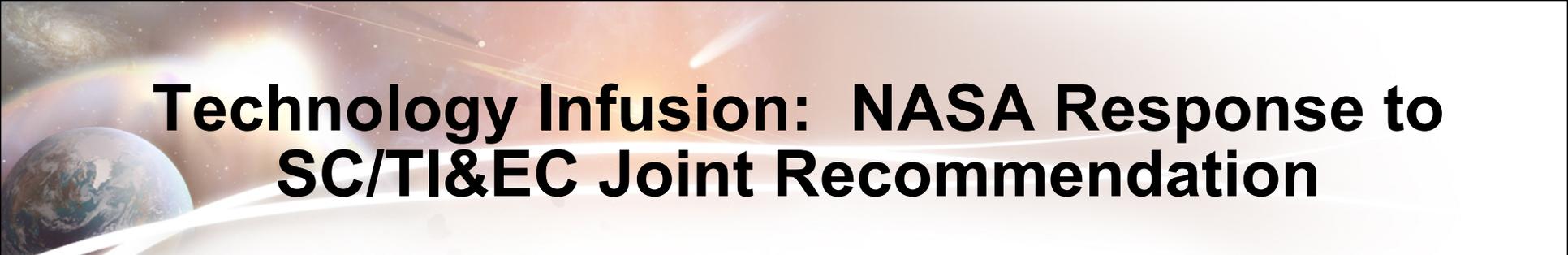
- Space exploration by non-governmental U.S. entities has the potential to jeopardize NASA's scientific interests if missions are not compliant with current planetary protection requirements
- Already, several planned U.S. non-governmental space exploration activities¹ have planetary protection implications and the potential to interfere with future scientific exploration
- There is currently no U.S. Governmental process by which compliance of non-governmental entities with planetary protection requirements is monitored or ensured

¹ The Google Lunar X-Prize and Lockheed Martin's role in the Mars One mission

OST Compliance Issue

Possible Solution

- FAA is responsible for reviewing and authorizing licenses permitting U.S. non-governmental entities to launch vehicles to space, and to have vehicles return to Earth from space. In exercising that responsibility, the FAA consults with NASA, which conducts an internal review of each proposed launch and reentry.
- NASA is the only U.S. Government organization with expertise in planetary protection, and is authorized through the Space Act to coordinate related activities with U.S. public and private organizations
- Compliance with the OST and international planetary protection requirements could be ensured by designating NASA as the provider of expert advice on planetary protection to parts of the USG that regulate and/or license non-governmental US activities in space
- The NASA Administrator could engage with appropriate counterparts at the State Department and the Dept. of Transportation (FAA) to offer NASA expertise in assuring that non-governmental US entities comply with international planetary protection requirements



Technology Infusion: NASA Response to SC/TI&EC Joint Recommendation

Briefing provided to the SC on both technology infusion and development processes and specific examples across SMD

Recommendation:

The Council recommends that the STMD AA & SMD AA engage with each other and their communities to determine how policies and procedures could be modified to allow the infusion of new mission-enabling and mission-enhancing technologies developed by Principal Investigators, STMD or others in small to medium class missions.

Response:

Although we understand and agree with its intent, NASA **does not concur with the specificity of this recommendation**. We believe the current policies plans, and implementation strategies provide deliberate pathways for the inclusion of new and innovative technology for all mission classes. SMD and STMD work closely on technology investments for future missions through both competitive and strategic initiatives. In addition, SMD has specific technology programs in each of its science divisions that are funded through competitive solicitations to advance technology for future missions . . .

Committee didn't really understand reason for non-concurrence

Ad Hoc Task Force on Big Data

Drivers: Providing interoperable data sets facilitates potentially new science, better use of data for decision support and potentially actionable science information, and can result in use in completely new areas. However, large data sets demand understanding of architecture and tools for current and future needs.

Ad hoc Big Data Task Force – formed in part 13.1.vi of NAC science Committee Charter (April 2014)

Complete SMD review of nominees by end of January, 2015

SC provided informal feedback on need for inclusion of cutting edge industry participation/input

Goal is to hold the first Ad Hoc Big Data Task Force meeting and report at next SC meeting (April 6-7 2015)



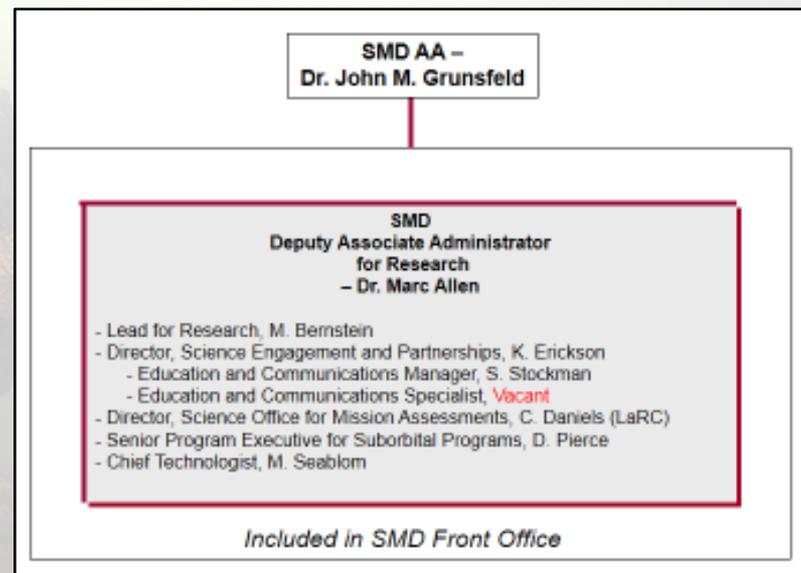


Objectives:



**SMD Organization
Reflects Increased
Focus**

**SC delighted to see
\$42M in budget and
strong focus**



NASA Travel Rules that Affect the Science Community

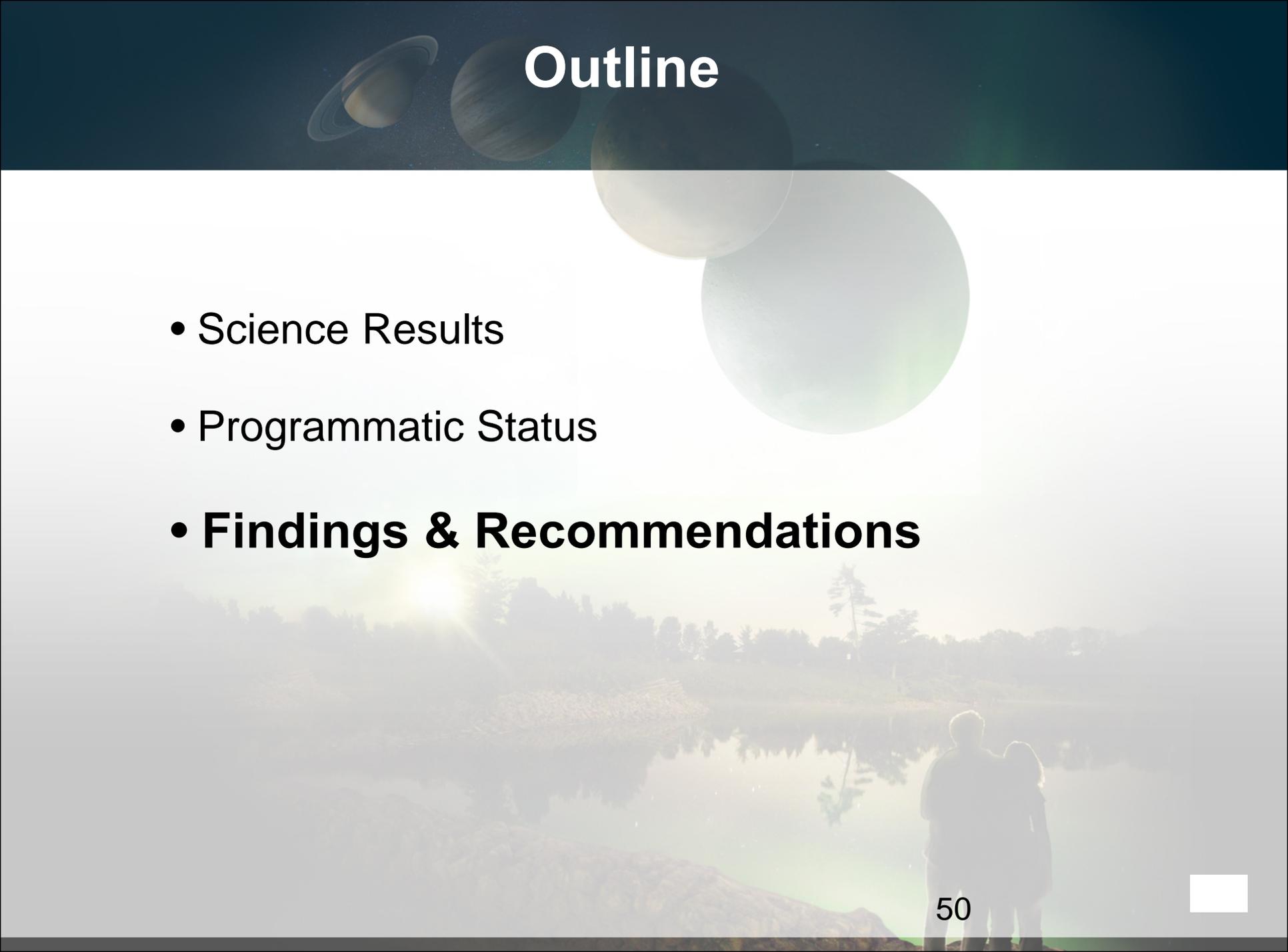
SMD Stated Position:

- Our main objective is for scientists to do science.
- We fully endorse participation at science meetings and consider it a critical part of the science process.
- Within the framework of current regulations, NASA/SMD are making every effort possible to allow scientists to attend science meetings.

Current Status

- Conference spending limits remain in place
 - Conference spending over \$100K must be approved
 - Conference spending over \$500K is prohibited unless approved by the NASA Administrator
- Conference spending reporting requirements remain in place
 - NASA rules define any large offsite meeting as a conference for reporting purposes
 - Requires extra work by support staff (NASA Conference Tracking System (NCTS), accounting codes) to enable internal controls and reporting
- Because it's the law, foreign conference attendance limit of 50 remains in place
 - **Currently includes civil servants and contractors in count (NASA option)**
- Reduced travel spending budgets remain in place – but situation is manageable.

Big disconnect with science community: SC disagrees that this self inflicted wound is working for the community – since it was an internal NASA decision, NASA can fix it... Please!



Outline

- Science Results
- Programmatic Status
- **Findings & Recommendations**

Recommendation: Reduce loss of efficiency and scientific productivity from over-application of travel restrictions

- **Recommendation:** The committee recommends that NASA change its definition of the class of persons (specifically, “contractors”) who are subject to the travel restrictions externally mandated for Civil Servants. This definition could continue to provide travel controls on those personnel that NASA considers appropriate (for example, scientists at specific institutions), but should not include others, such as those at most universities, non-profits, and private companies funded through mission contracts.
- **Major reasons for the recommendation:** The committee finds that the broad definition of “contractor” with respect to the application of travel restrictions using NASA funds has resulted in significant loss of efficiency and scientific productivity across the science community. This broad loss of efficiency and productivity is unnecessary and solely driven by NASA’s internal choice to expand the group included in the mandated travel restrictions.
- Regular and open communication between scientists and technologists is essential for healthy and productive research. Although electronic and virtual means of communication play an increasing role in interacting with colleagues and can accommodate much routine project activity, they cannot replace face-to-face interactions. Specific examples include the much valued give-and-take of vibrant (sometimes heated) discussions, insight derived from multiple ideas being discussed spontaneously, informal (often unplanned) interactions and brainstorming that occurs before or after a presentation. These in-person contacts are extremely cost-effective and are key components in productive scientific interactions.
- **Consequence of not implementing the recommendation:** Scientists not normally considered as NASA employees, and not required by external mandates, will continue to be included in the travel restrictions, which will continue to lead to significant loss of efficiency and scientific productivity for NASA.