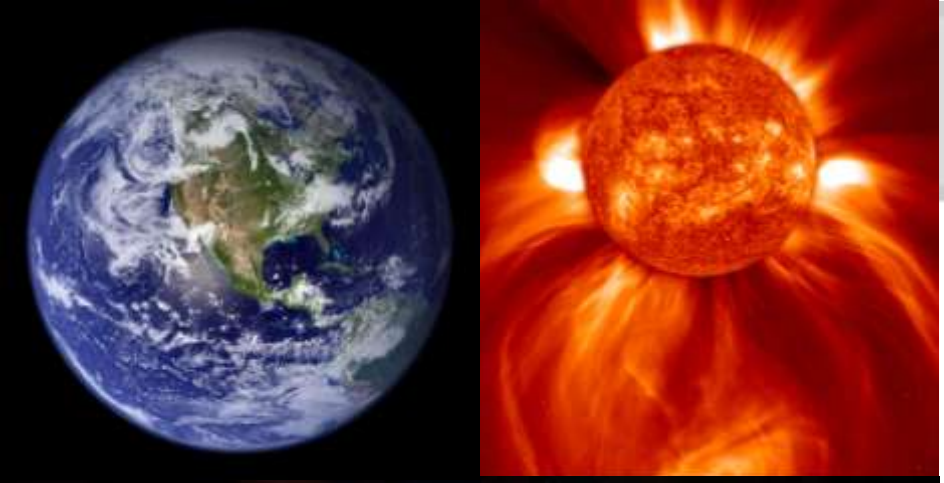
NASA's Science Missions and Student Internship/Fellowship Opportunities

For the NASA/FIU Hurricane and Remote Sensing Summer Education and Research Internship Program (HRSSERP)
Aug. 8-19, 2011

National Aeronautics and Space Administration

NASA Science:

Earth Science
Heliophysics
Planetary Science
Astrophysics




NASA Science

Answers science questions of compelling interest to all humanity.

Extends our nation's leadership in science while enabling partnerships that strengthen our international standing and relationships.

Inspires and trains the next generation of scientists, engineers, educators and citizens.

Provides information for use in response to national and international disasters.

Develops new technologies that drive innovation and impact the economy.

Provides objective research and observations to policy-makers and decision-makers in both the public and private sectors

NASA's Journey of Discovery

NASA's science program seeks answers to profound questions that touch or may affect us all:

- How and why are Earth's climate and the environment changing?
- How and why does the Sun vary and affect Earth and the rest of the solar system?
- How do planets and life originate?
- How does the universe work, and what are its origin and destiny?
- Are we alone?

NASA's Science Mission Directorate (SMD) At A Glance

98 spacecraft, 57 missions in operation, 28 more in development
- Plus aircraft, sounding rockets, balloons, and surface networks

Over 94% of every dollar NASA receives goes out the door to universities, commercial entities, and not-for-profits

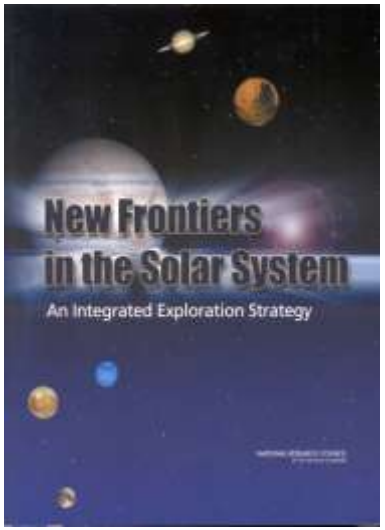
More than 10,000 U.S. scientists funded by 3,000 competitively selected research awards

Partnerships with a dozen Federal agencies and 60 other nations

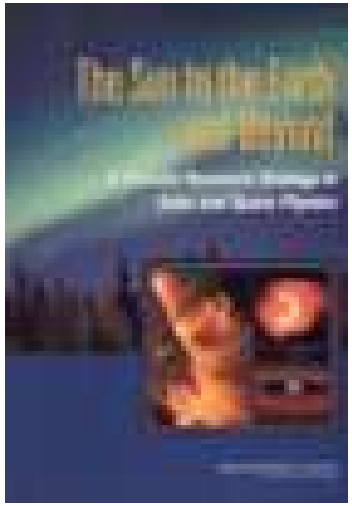
More than $500M of total SMD funds invested annually in technology development

Global impact on humanity's understanding of our place in the universe

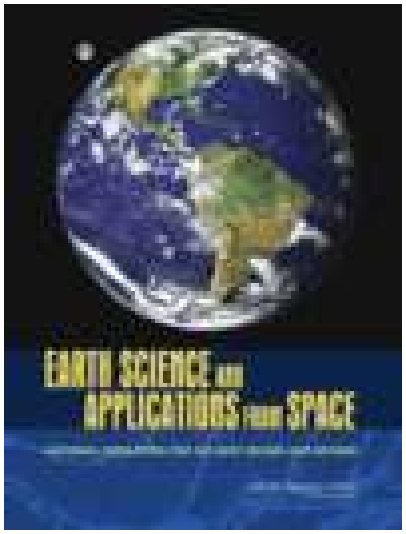
Recommendations from the U.S. Scientific Community Through NRC Decadal Surveys



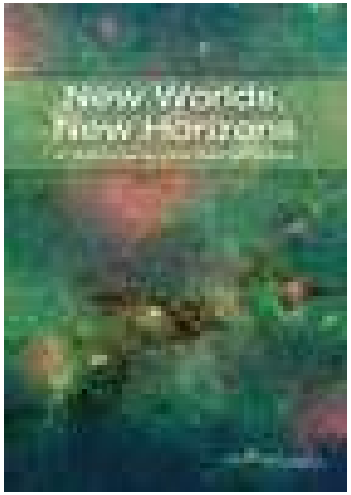
Planetary Science
2002
(2011)



Heliophysics
2003
(2012)



Earth Science
2007
(2017)

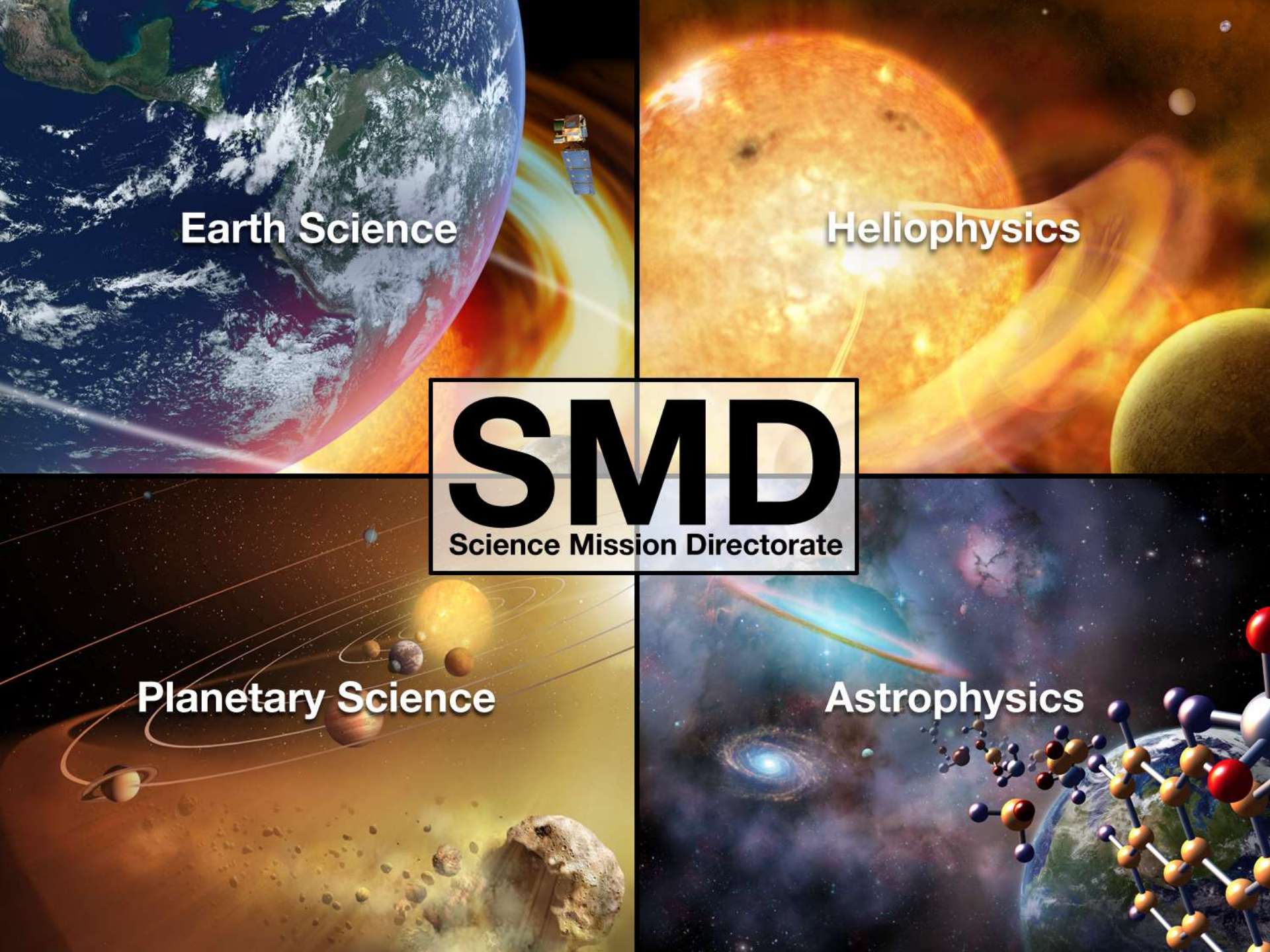


Astrophysics
2010
(2020)

Engaging the Next Generation

To share the story, the science, and the adventure of NASA's scientific explorations of our home planet, the solar system, and the universe beyond…

- SMD policy calls for each mission to allocate at least 1% of the mission budget for education and public outreach (E/PO activities
- SMD funds E/PO activities as elements proposed as part of competitively-selected research and research-enabling programs
- Each SMD Division has a Science Education and Public Outreach Forum (SEPOF) to help better connect NASA and the broad national education community
- SMD engages in collaborations with such organizations as:
  - NASA Museum Alliance for science centers, museums, and planetariums
  - Boys Scouts/Girl Scouts, 4-H clubs, and Boy's and Girl's Clubs of America
- SMD's E/PO programs are coordinated with the NASA Office of Education


Earth Science
Heliophysics
SMD
Science Mission Directorate
Planetary Science
Astrophysics

National Aeronautics and Space Administration

Astrophysics

Astrophysics

Discover how the universe works, explore how the universe began and evolved, and search for Earth-like planets

- How do matter, energy, space, and time behave under the extraordinarily diverse conditions of the cosmos?
- How did the universe originate and evolve to produce the galaxies, stars, and planets we see today?
- What are the characteristics of planetary systems orbiting other stars, and do they harbor life?


XMM-Newton (ESA)
1999 (10 year mission)
Swift
2004 (2 year mission)
Suzaku (JAXA)
2005 (5 year mission)
Fermi
2008 (5 year mission)
INTEGRAL (ESA)
2002 (2 year mission)
RXTE
1995 (2.5 year mission)
Herschel (ESA)
2009 (3 year mission)
Planck (ESA)
2009 (3–4 year mission)
GALEX
2003 (20–5 year mission)
WISE
2009 (10 month mission)
Hubble
1990 (15 year mission)
Kepler
2009 (3.5–6 year mission)
Chandra
1999 (5 year mission)
Spitzer
2003 (2.5 year mission)
SOFIA
2010 (20 year mission)
Astrophysics Missions in Operation

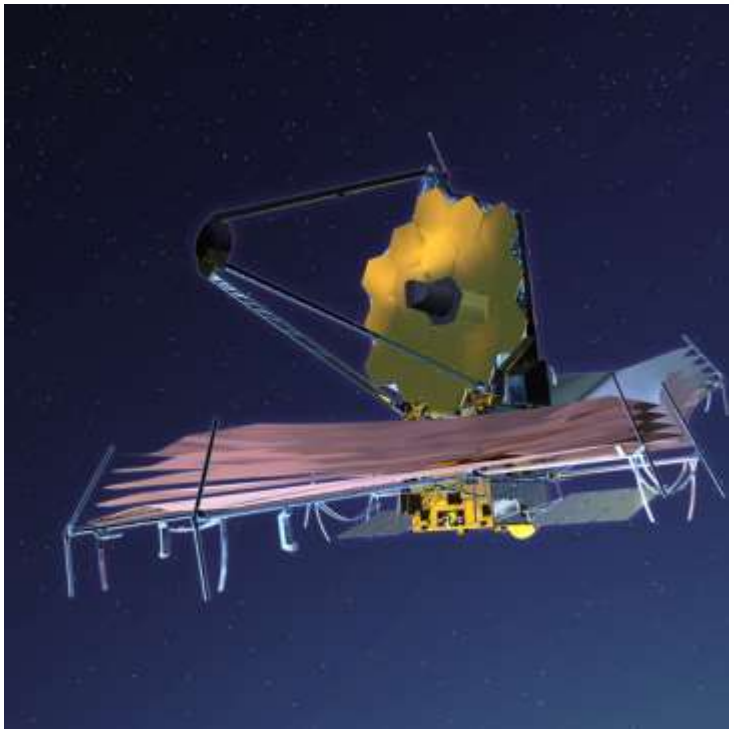
Stratospheric Observatory For Infrared Astronomy (SOFIA)

1st Flight (Aircraft Functional Checks)	December 2009
1st Open Door Flight	December 2009
First Light Opportunity	May 2010
Envelope Expansion #2	July 2010
Initiation of Science Flights with FORCAST (US-developed imager)	December 2010
Science Flights with GREAT begin	August 2011
Guest Observation Flights Begin	October 2011
Commissioning of HIPO & FLITECAM begins	February 2012
End of Development Segment 2; Start of Major System Upgrades	June 2012
Commissioning of Fourth Instrument begins	July 2013
Full Operational Capability (FOC)	December 2014


In-Flight Mission Control Operations


Crew Members with FORCAST Instrument

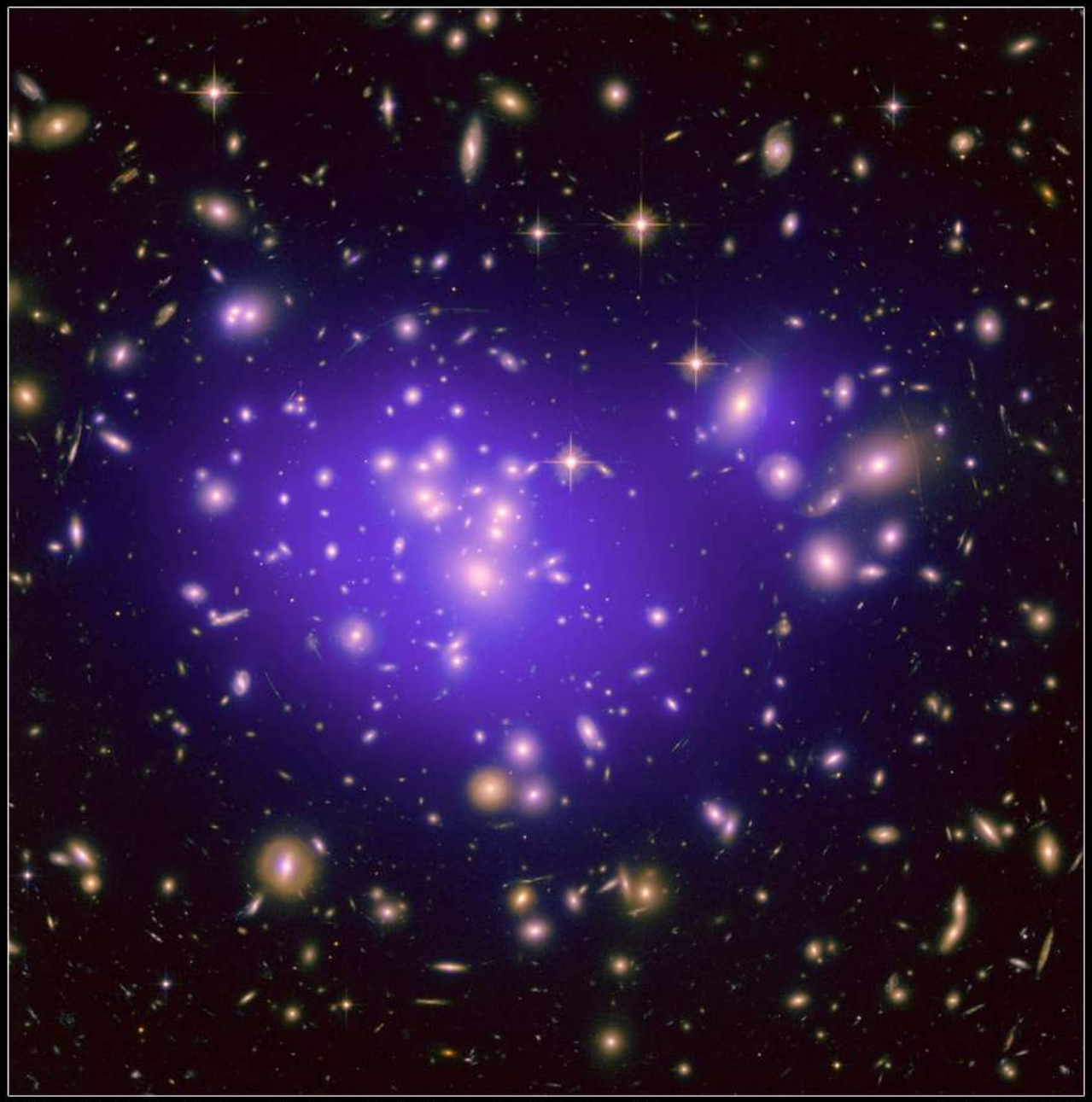
James Webb Space Telescope (JWST)



The James Webb Space Telescope (JWST) was the #1 priority from the NRC's 2001 Decadal Survey "Astronomy and Astrophysics in the New Millennium" and is the most complex spacecraft ever attempted. JWST is a large infrared space telescope that will look back in time to find the first galaxies that formed in the early Universe, connecting the Big Bang to our own Milky Way Galaxy. JWST will peer through dusty clouds to see stars forming planetary systems, connecting the Milky Way to our own Solar System.

The JWST Project at Goddard Space Flight Center is working with the contractors to establish a baseline budget, expected in late March. Once that work is complete, we will have a better idea of the launch date.

Dark Matter Map in Galaxy Cluster Abell 1689 *HST* ACS/WFC

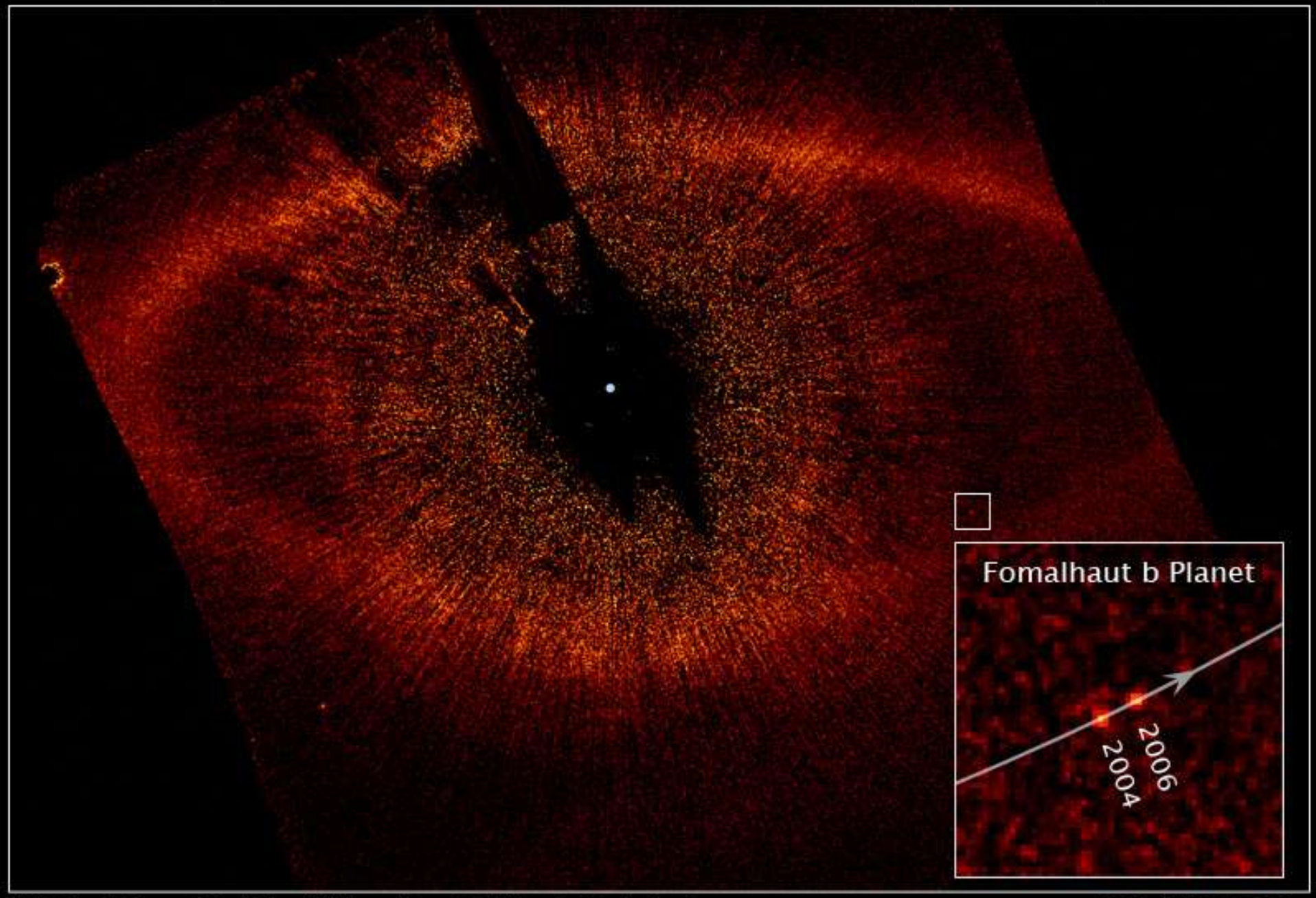


NASA, ESA, E. Jullo (Jet Propulsion Laboratory), P. Natarajan (Yale University), and J.-P. Kneib (Laboratoire d'Astrophysique de Marseille, CNRS, France)

STScI-PRC10-26

Fomalhaut System

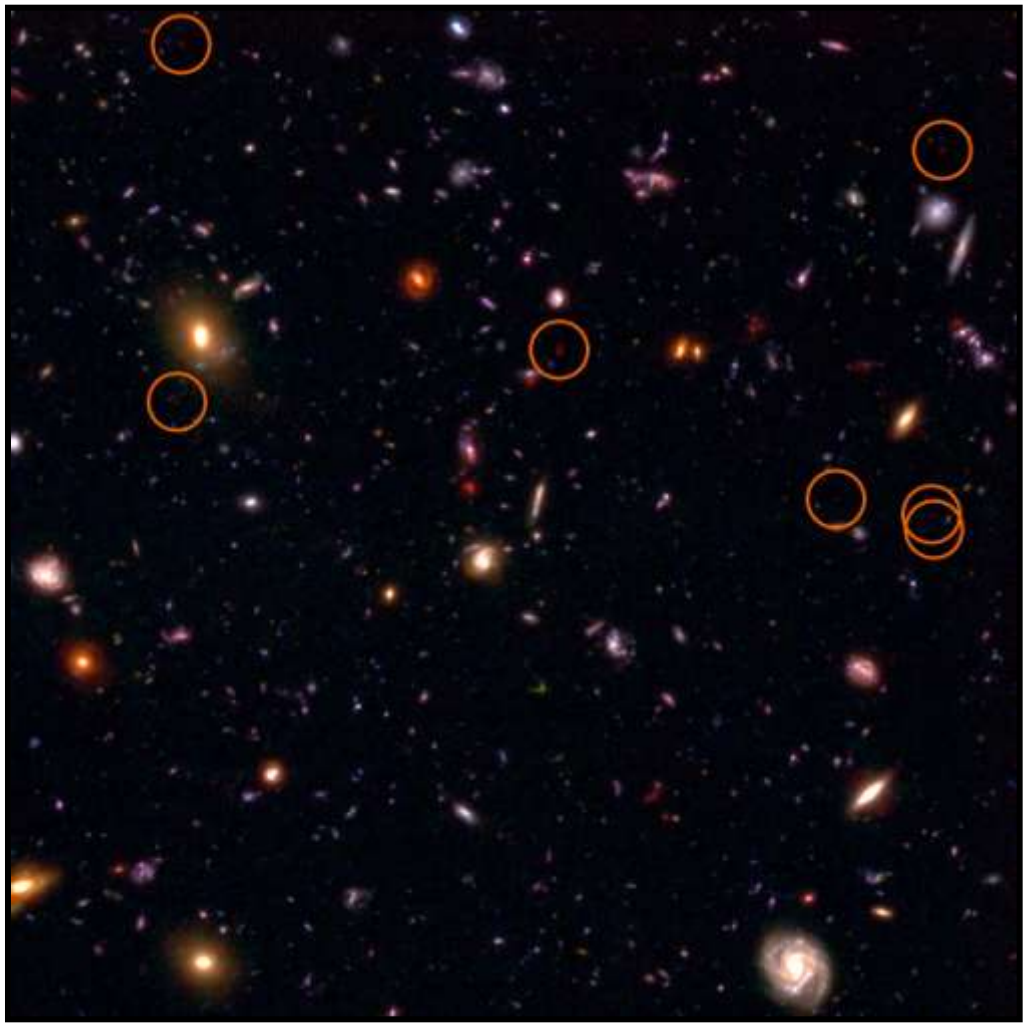
Hubble Space Telescope • ACS/HRC



NASA, ESA, and P. Kalas (University of California, Berkeley)

STScI-PRC08-39a

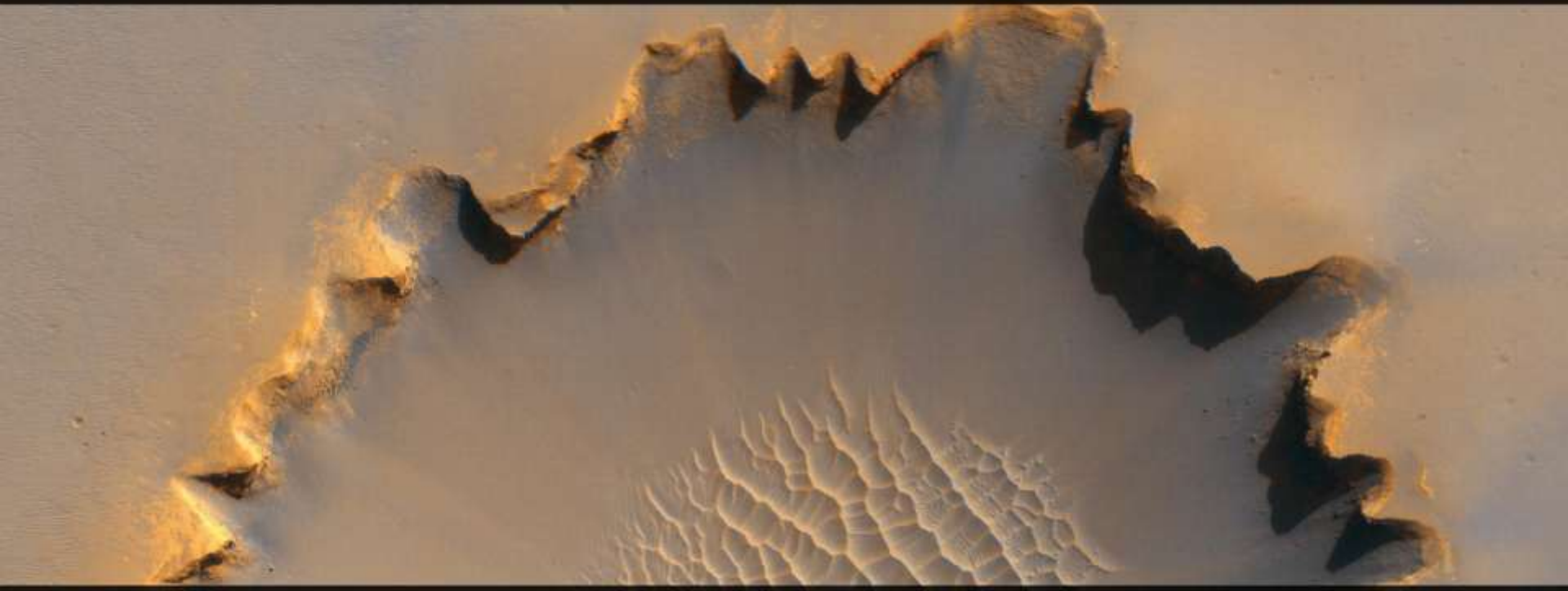
Hubble's Deepest View of the Universe



The Hubble Space Telescope has acquired the deepest image of the universe ever taken in near-infrared light using the newly installed Wide Field Camera 3.

2009 Infrared Ultra Deep Field

National Aeronautics and Space Administration



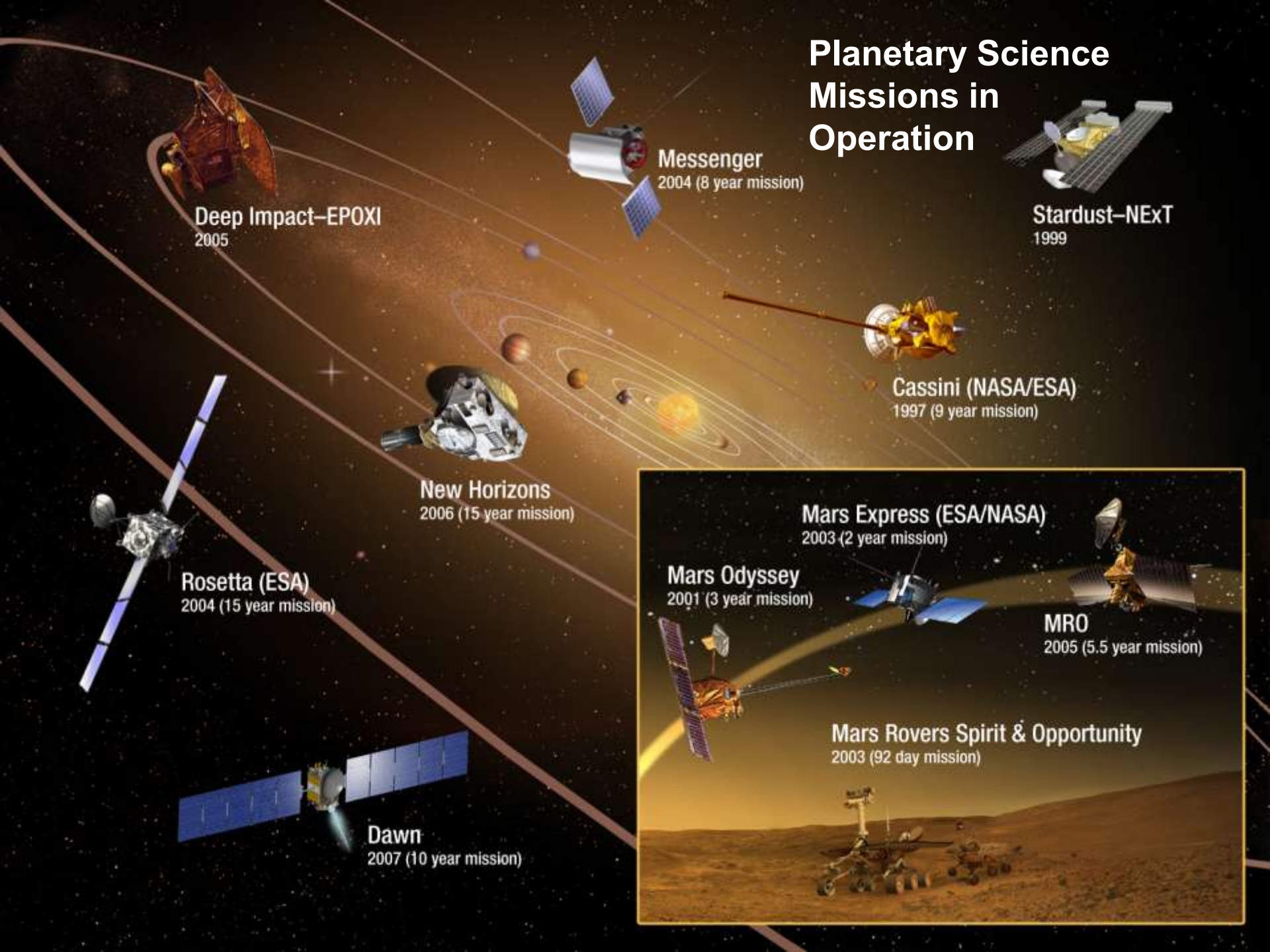
Planetary Science

Planetary Science

Ascertain the content, origin, and evolution of the solar system and the potential for life elsewhere

- What is the inventory of solar system objects and what processes are active in and among them?
- How did the Sun's family of planets, satellites, and minor bodies originate and evolve?
- What are the characteristics of the solar system that lead to habitable environments?
- How and where could life begin and evolve in the solar system?
- What are characteristics of small bodies and planetary environments that pose hazards and/or provide resources?

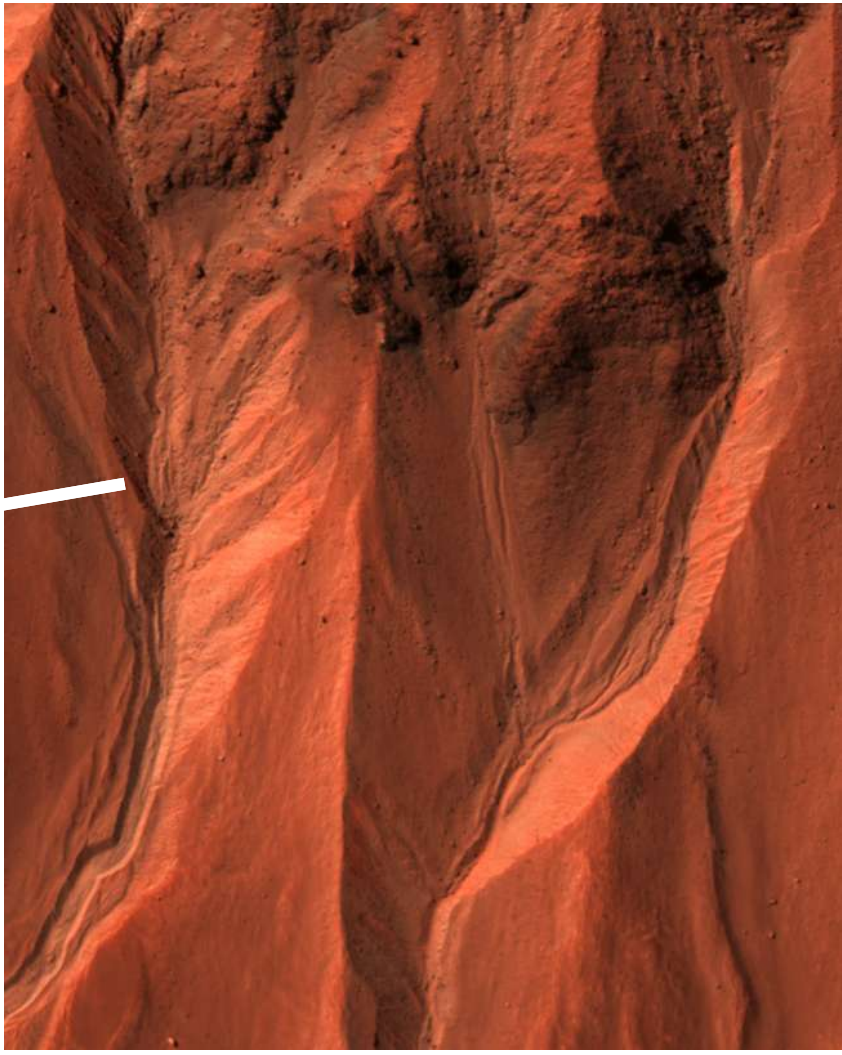
Planetary Science Missions in Operation

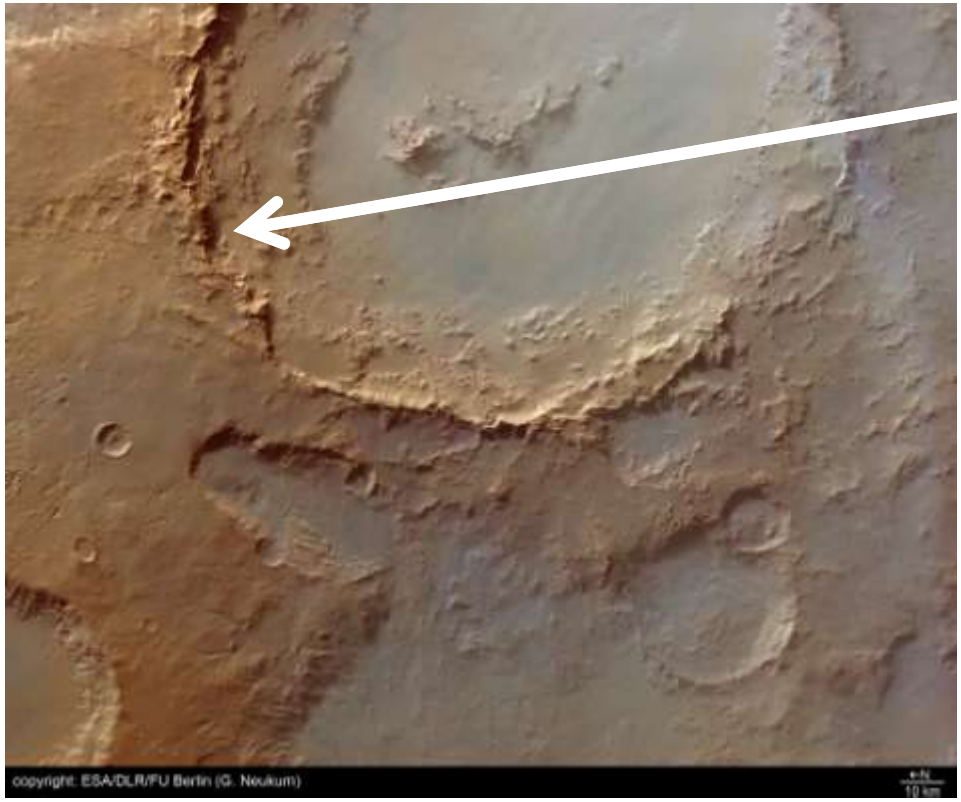


Gullies on Mars: Are the Flow Features from Water?

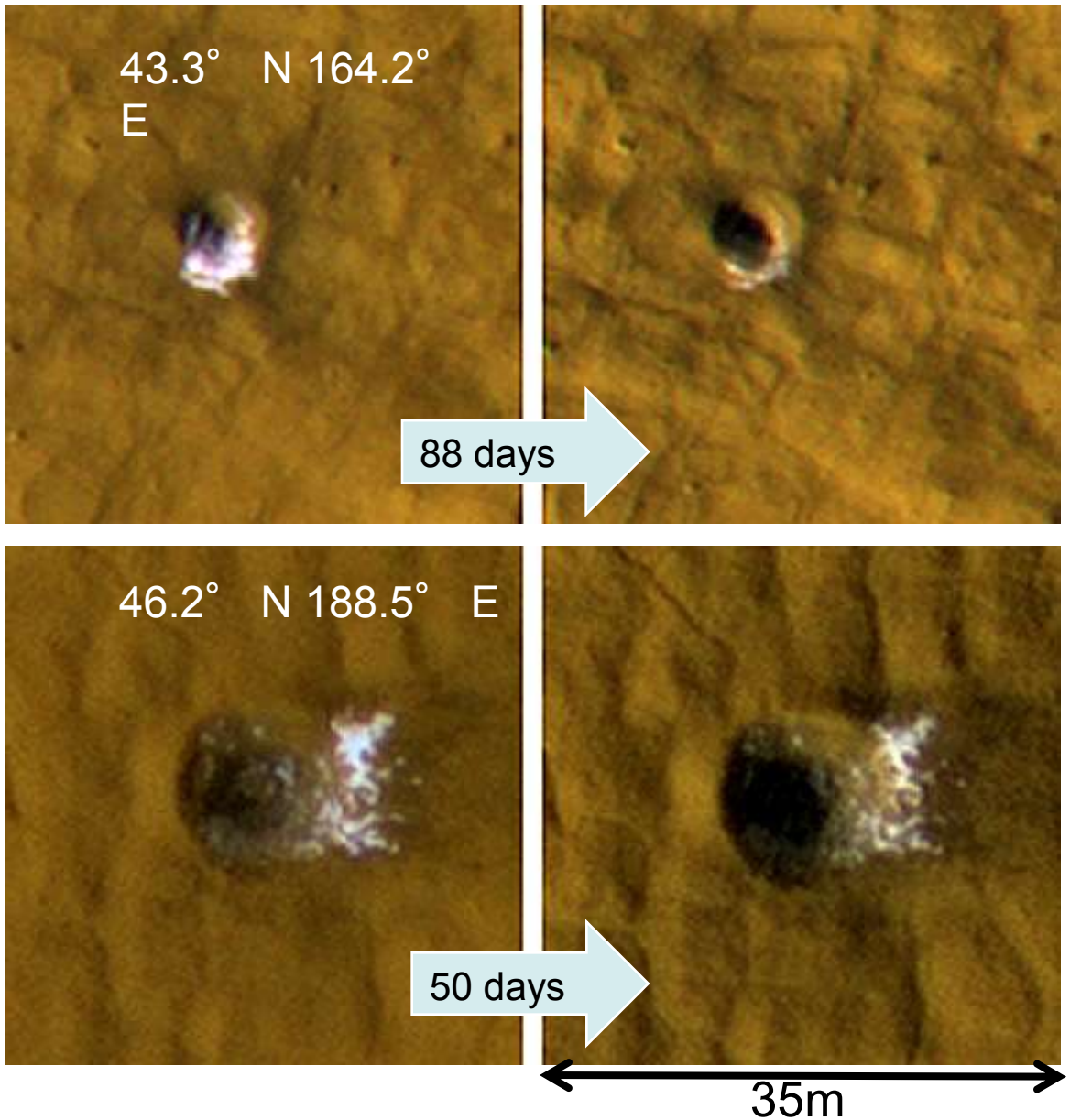
Hale Crater showing gullies on side of crater wall.

Crater is approximately 149km across, located in Argyre basin, 38.8°S, 36.5°W



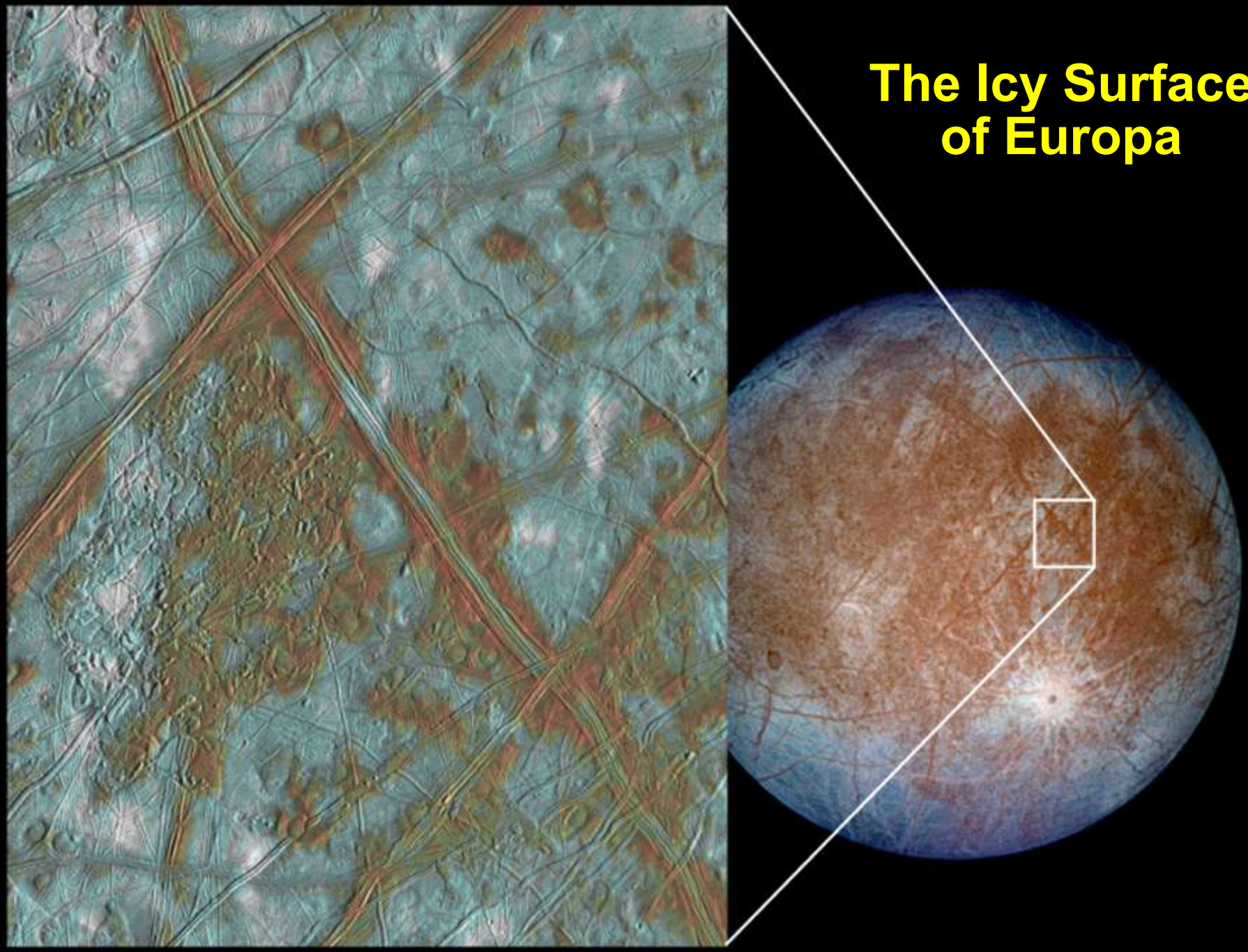


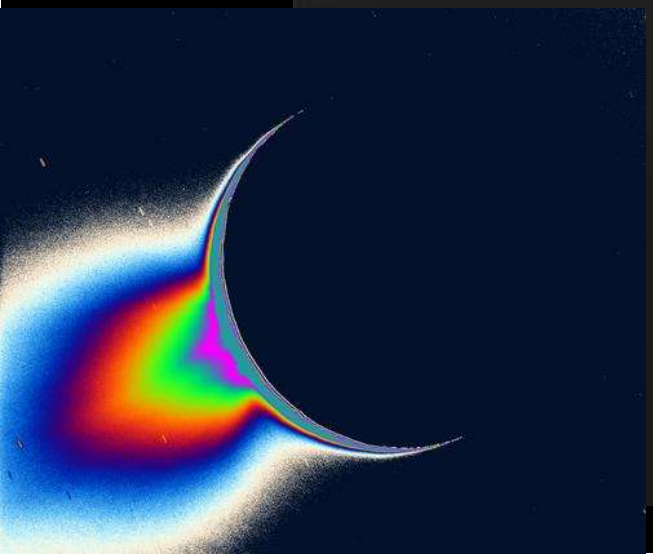
Martian Ice Found Just Below the Surface



- Fresh small impact craters show:
  - Ice layer ~0.5 – 1m below surface
  - Sublimates over several weeks
- Spectral analysis shows ~99% pure water
- Ice more extensive than expected from current climate
- Mars had a wet history

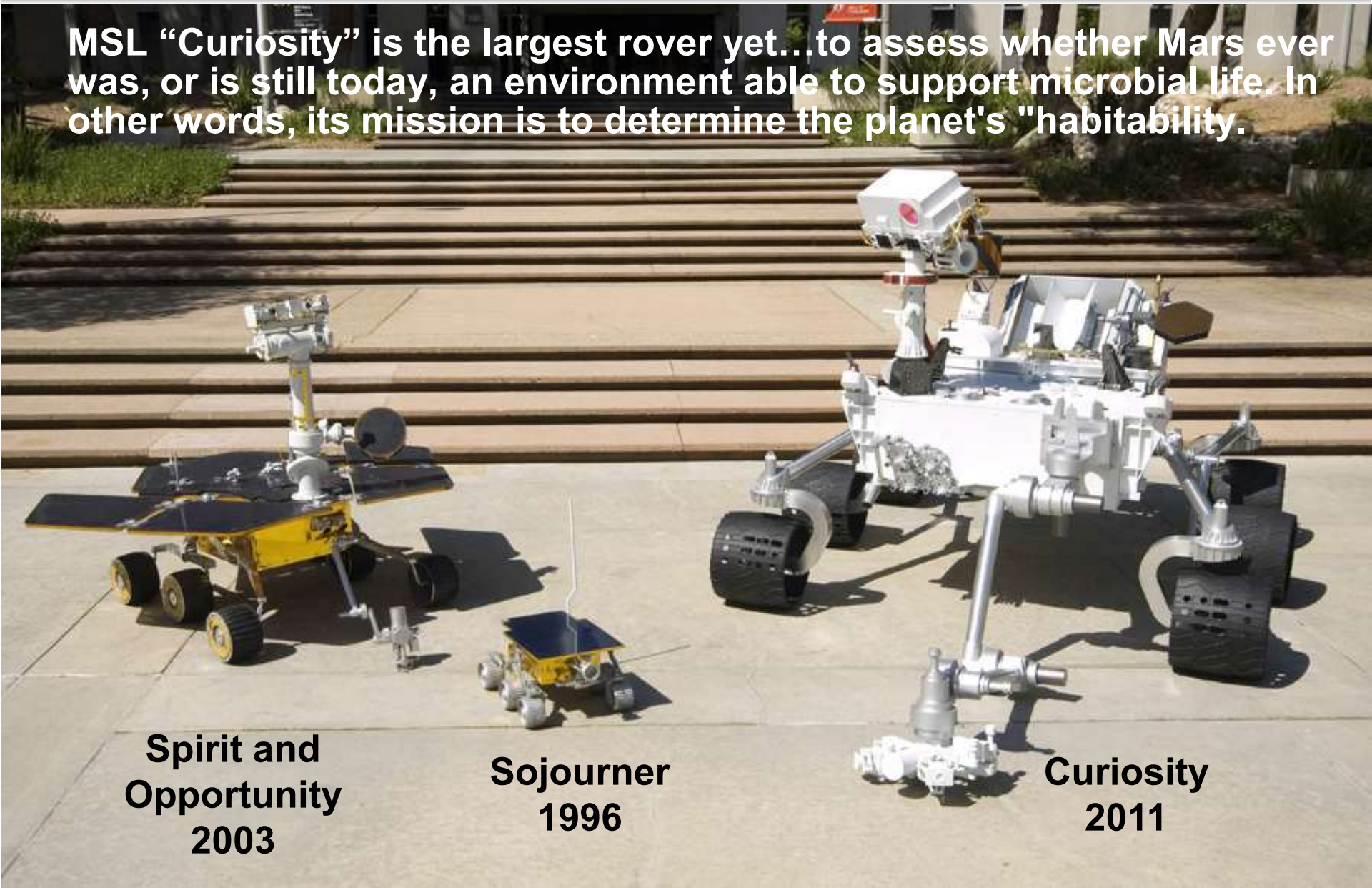
Life in Extreme Environments: Yellowstone N.P.


The Icy Surface
of Europa



Water Vapor in Geyser-like Jets on Saturn's Moon Enceladus

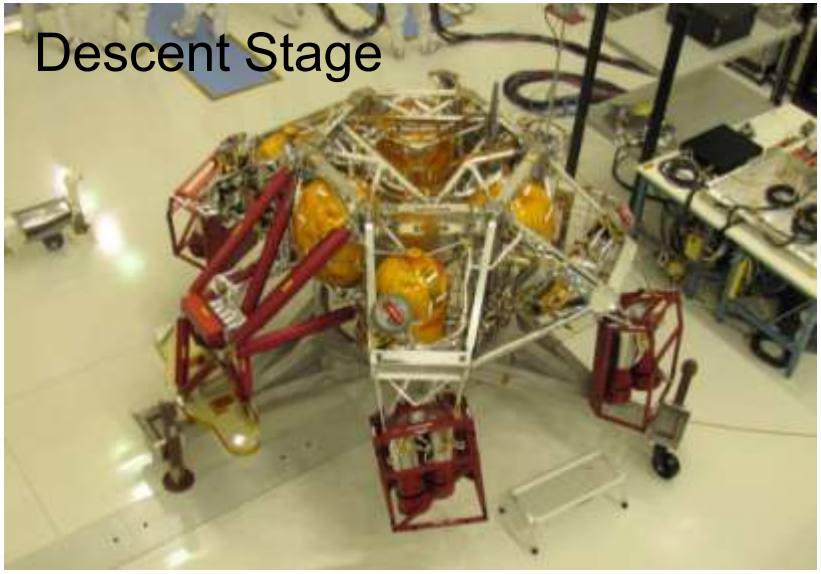
Mars Rover Family Portrait



Mars Science Laboratory

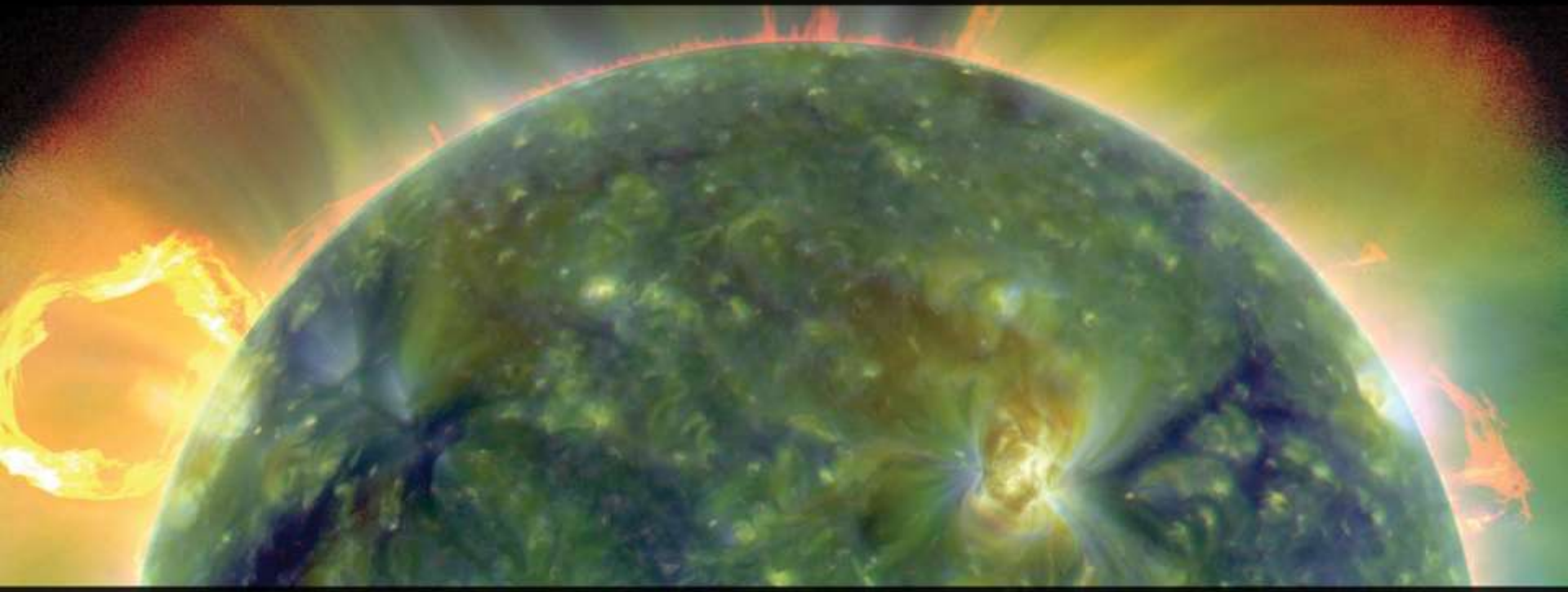

SAM Installation


Rover Driving Test


Descent Stage


Assembled Spacecraft

National Aeronautics and Space Administration

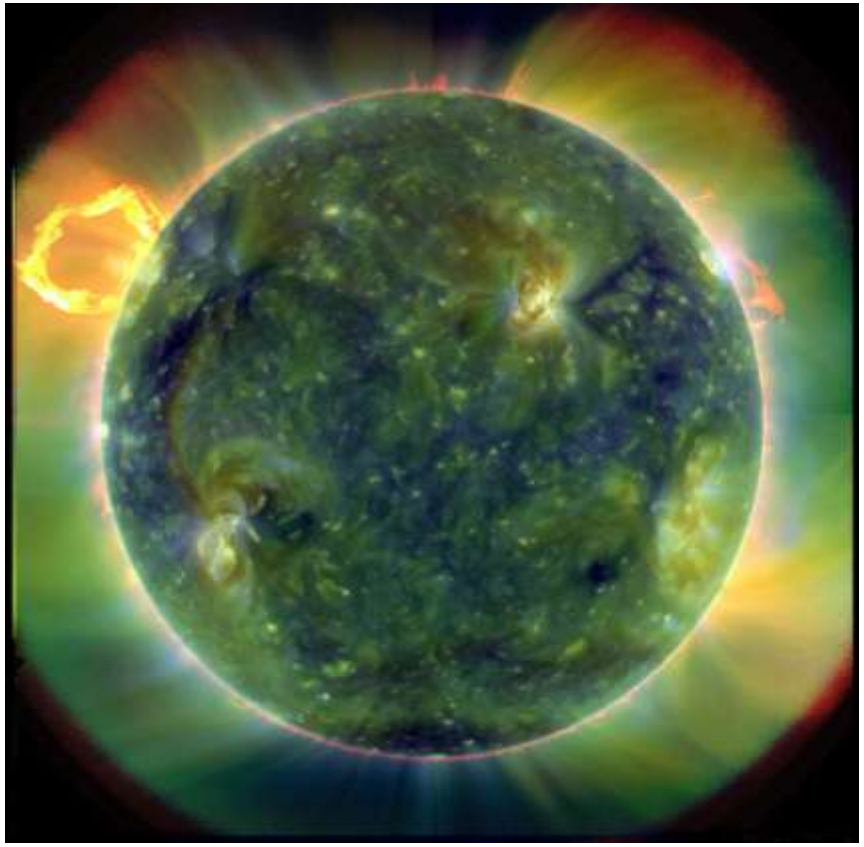


Heliophysics

Heliophysics

Understand the Sun and its interactions with the Earth and the solar system

- What causes the Sun to vary?
- How do the Earth and the heliosphere respond?
- What are the impacts on humanity?



Applications of Heliophysics Science

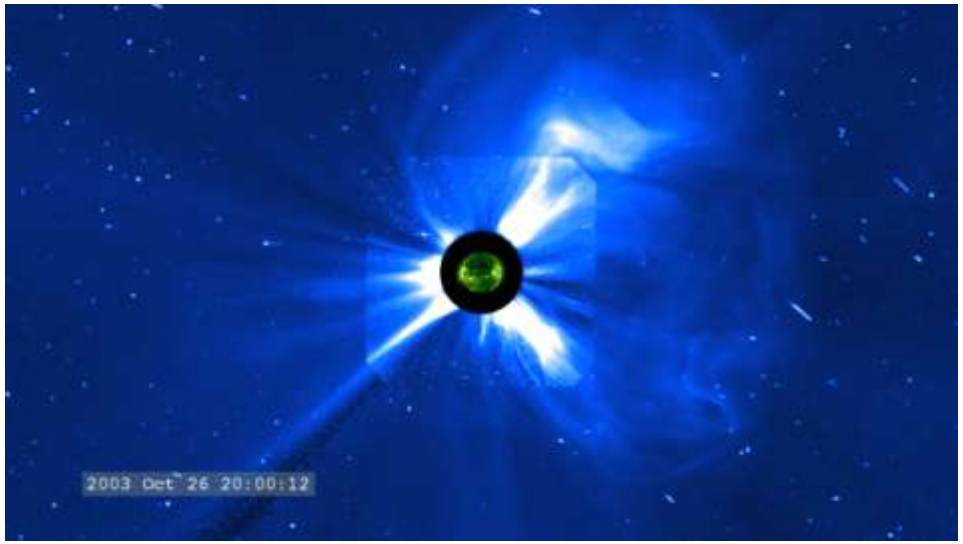
Modern society depends on a variety of technologies susceptible to the extremes of space weather

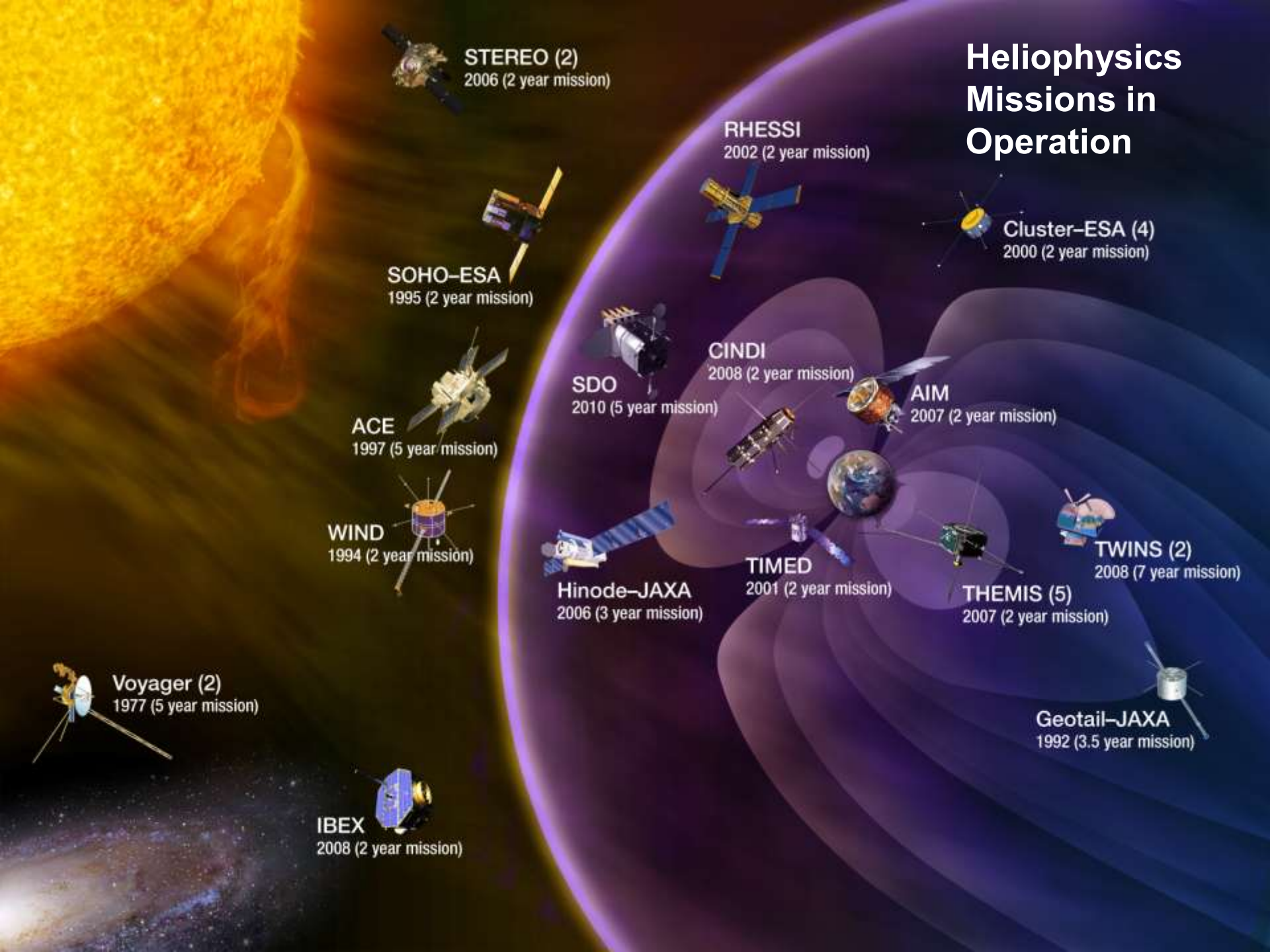
- Electric power grids and oil & gas pipelines
- High frequency radio communication and GPS navigation
- Satellites and spacecraft in Earth orbit

Human and robotic explorers across the solar system are also affected by solar activity

SMD makes its Heliophysics research data sets and models continuously available to all users via Internet sites, including:

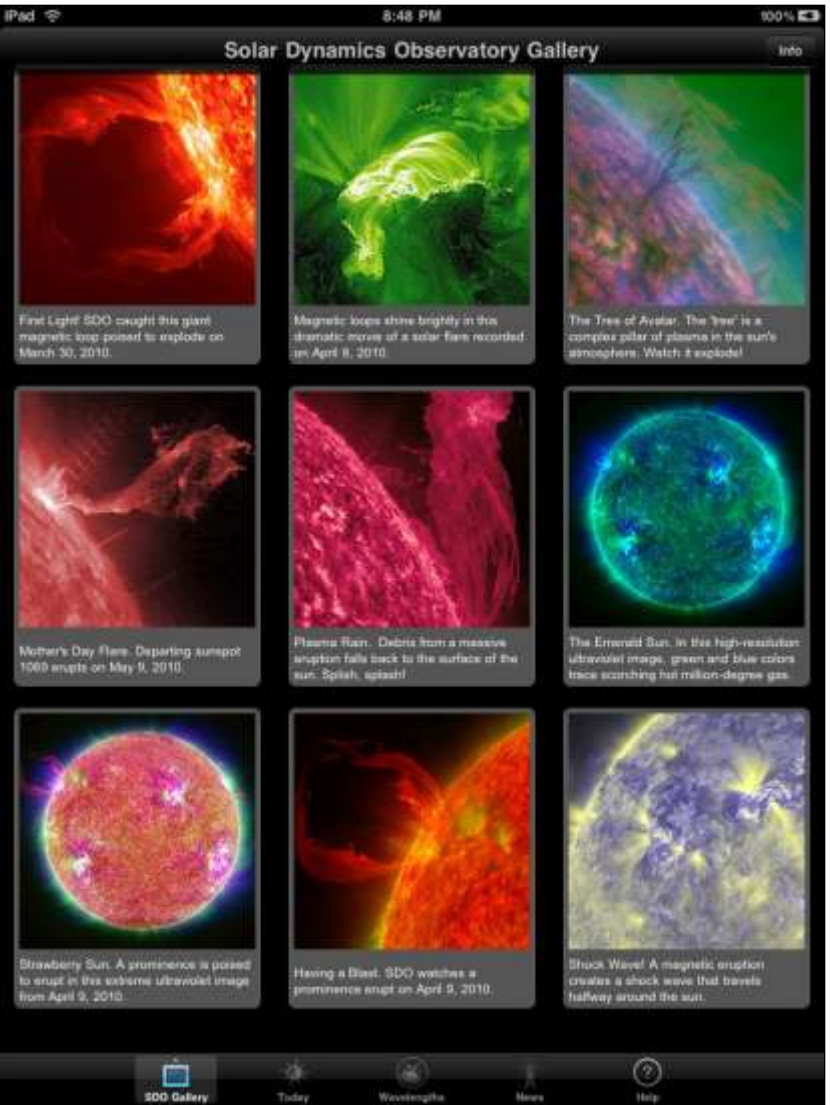
- Combined Community Modeling Center
- Integrated Space Weather Analysis System




Heliophysics Missions in Operation
STEREO (2)
2006 (2 year mission)
RHESSI
2002 (2 year mission)
Cluster–ESA (4)
2000 (2 year mission)
SOHO–ESA
1995 (2 year mission)
CINDI
2008 (2 year mission)
SDO
2010 (5 year mission)
AIM
2007 (2 year mission)
ACE
1997 (5 year mission)
WIND
1994 (2 year mission)
TWINS (2)
2008 (7 year mission)
Hinode–JAXA
2006 (3 year mission)
TIMED
2001 (2 year mission)
THEMIS (5)
2007 (2 year mission)
Voyager (2)
1977 (5 year mission)
Geotail–JAXA
1992 (3.5 year mission)
IBEX
2008 (2 year mission)

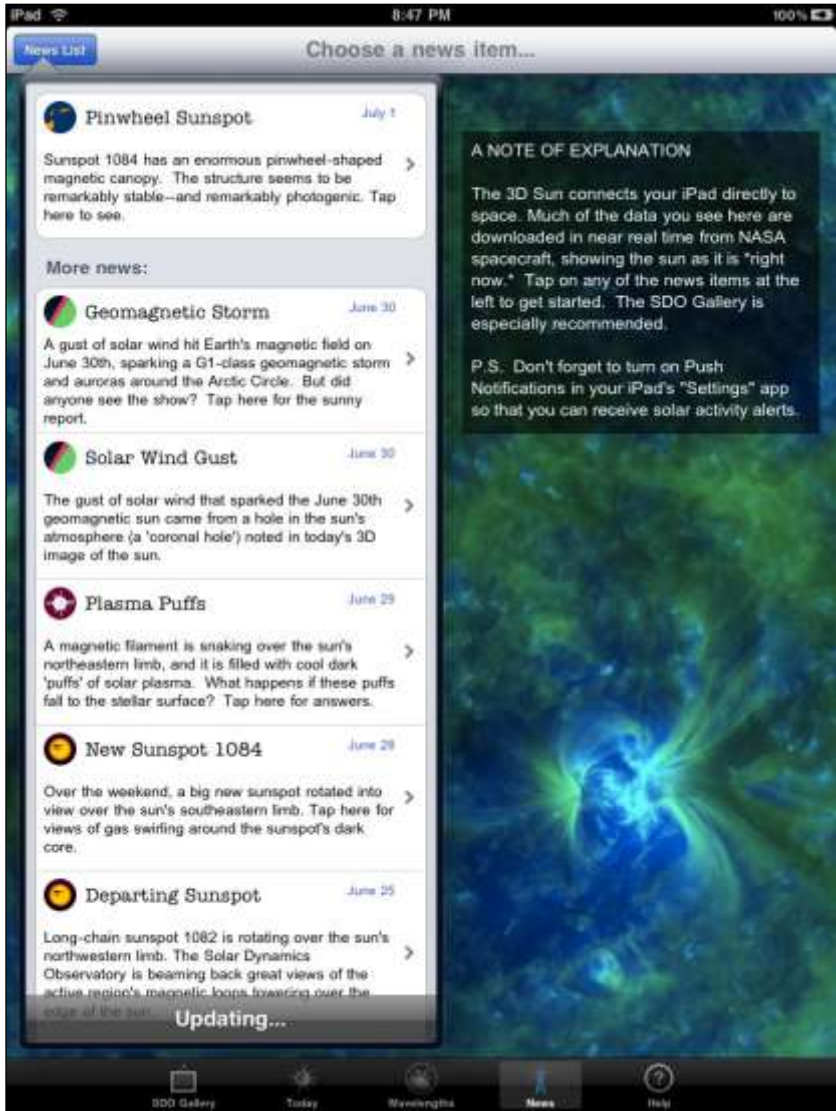
3D Sun App Allows Over A Million Users to Hold the Sun in the Palm of Their Hand

This free iPhone and iPad app can be downloaded from http://3dsun.org.



Left: Screenshot of SDO gallery

Right: iPad screenshot of recent news items



National Aeronautics and Space Administration

Earth Science

Earth Science

Advance Earth System Science to meet the challenges of climate and environmental change

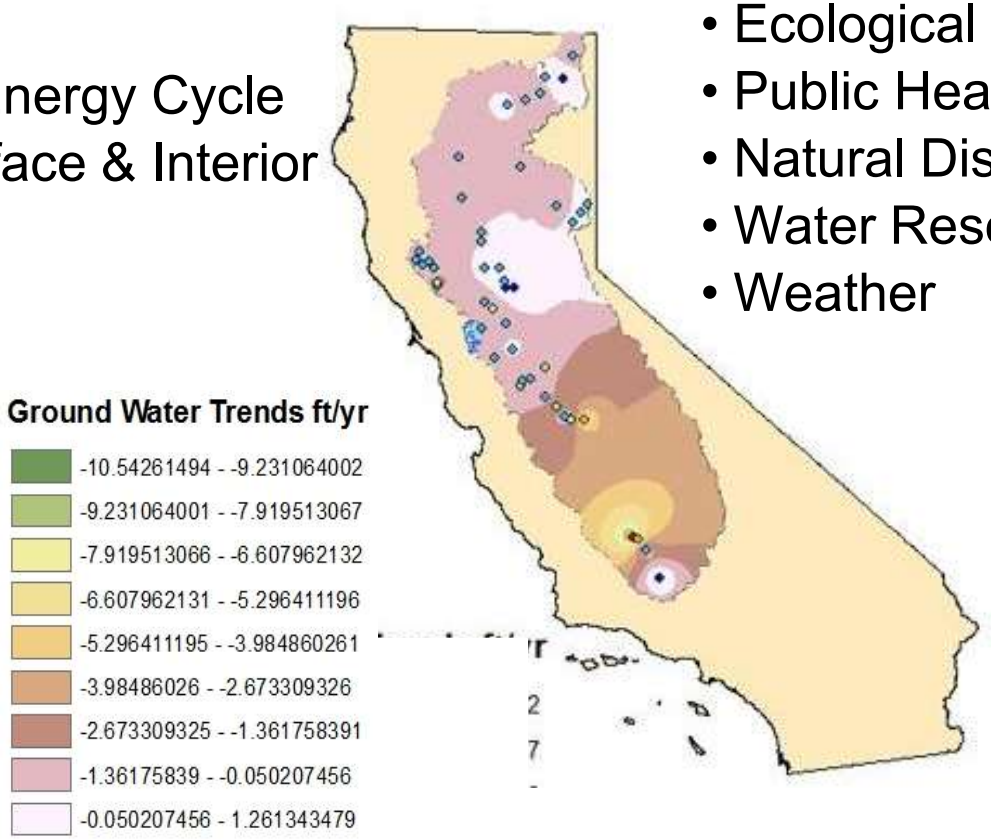
- **How is the global Earth system changing? (Characterize)**
- **What are the sources of change in the Earth system and their magnitudes and trends? (Understand)**
- **How will the Earth system change in the future? (Predict)**
- **How can Earth System Science improve mitigation of and adaptation to global change? (Apply)**

An end-to-end program encompassing space missions, suborbital platforms, data and information systems, fundamental research, data assimilation and modeling, applications research, and technology development.

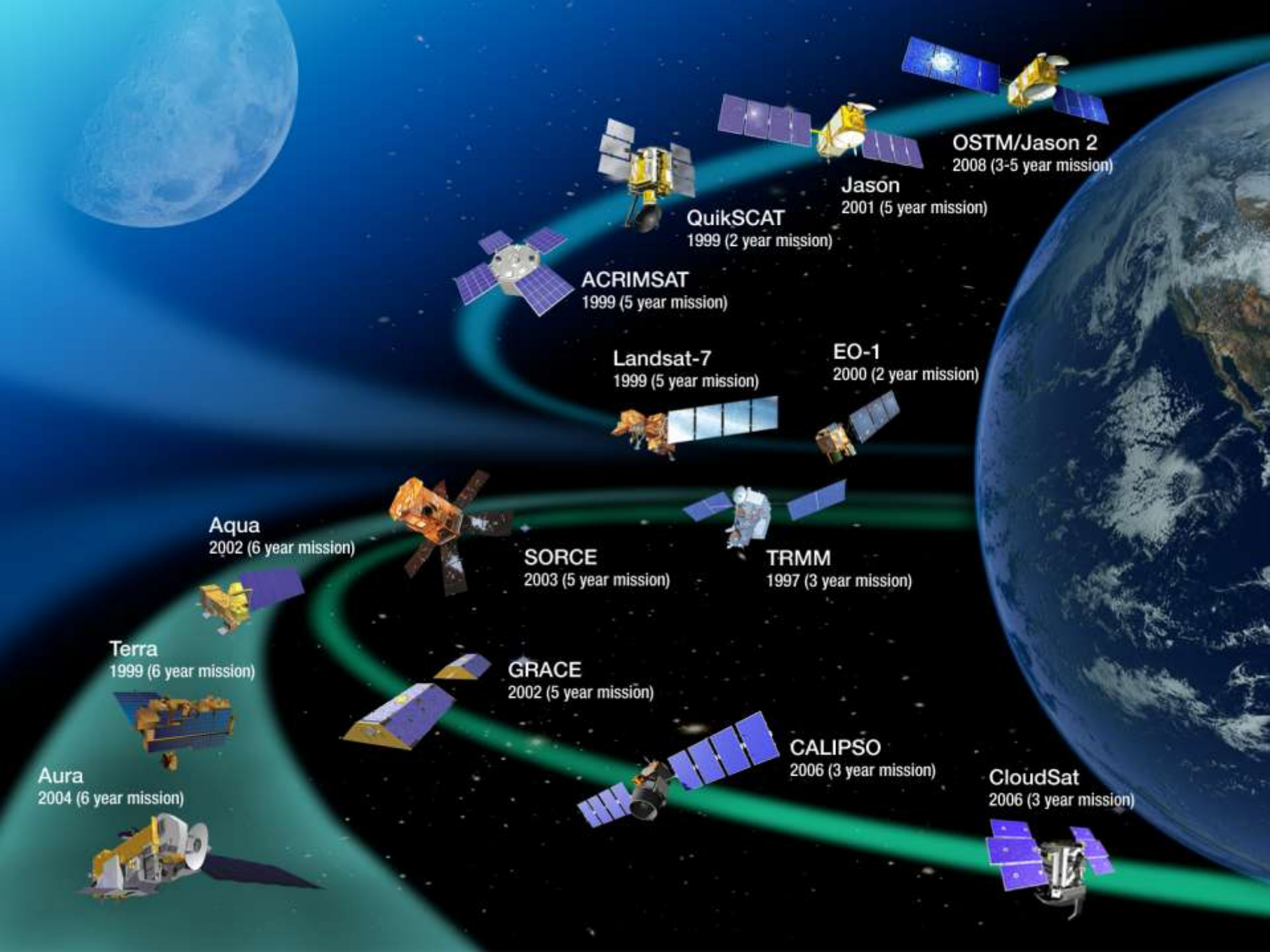
Earth Science Research and Applications

Science Focus Areas:
- Atmospheric Composition
- Carbon Cycle & Ecosystems
- Climate Variability & Change
- Weather
- Water & Energy Cycle
- Earth Surface & Interior

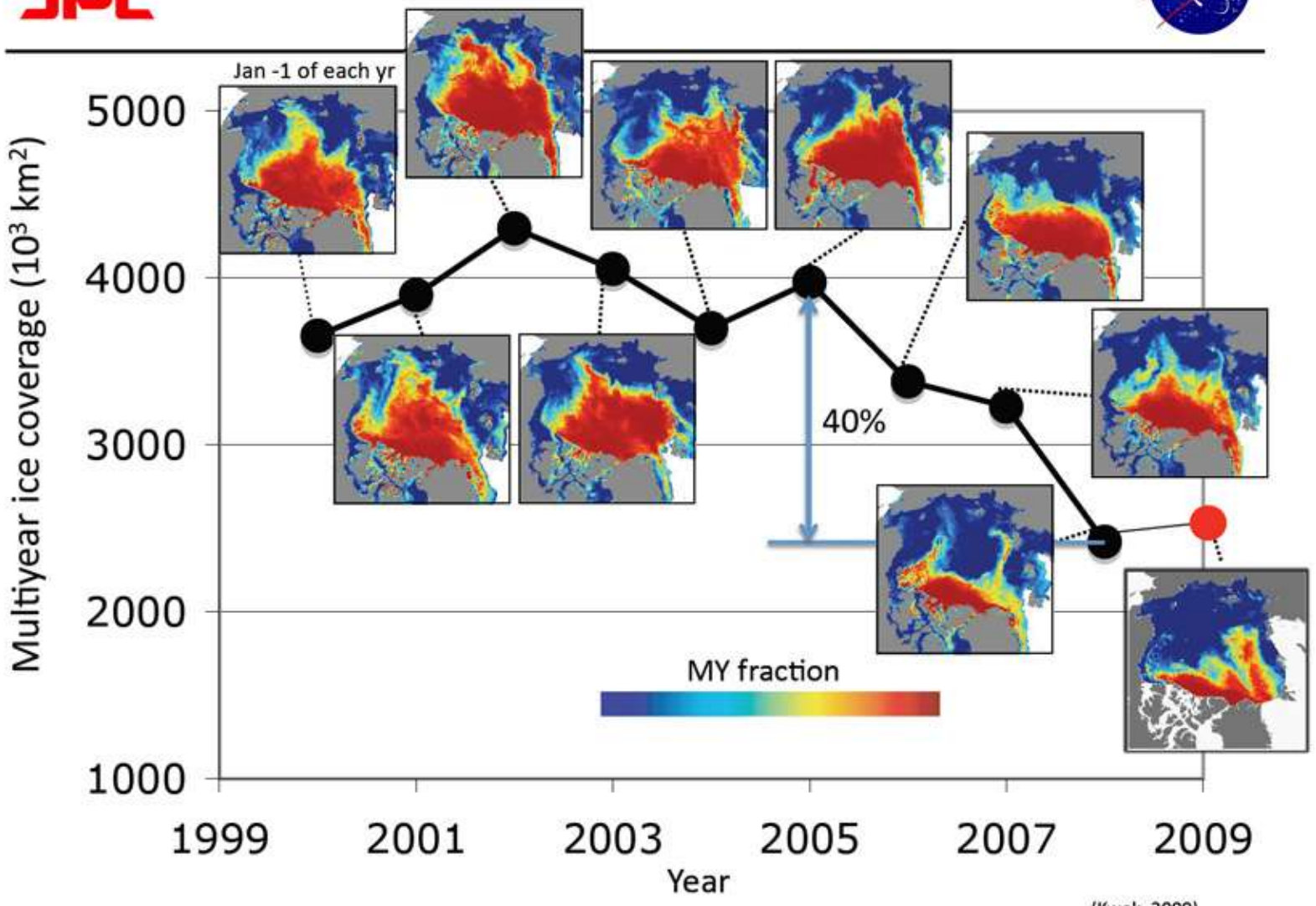
Applications Themes:
- Agriculture
- Air Quality
- Climate
- Ecological Forecasting
- Public Health
- Natural Disasters
- Water Resources
- Weather



Observed trends in groundwater levels from GRACE October 2003 – March 2009


OSTM/Jason 2
2008 (3-5 year mission)
Jason
2001 (5 year mission)
QuikSCAT
1999 (2 year mission)
ACRIMSAT
1999 (5 year mission)
Landsat-7
1999 (5 year mission)
EO-1
2000 (2 year mission)
Aqua
2002 (6 year mission)
SORCE
2003 (5 year mission)
TRMM
1997 (3 year mission)
Terra
1999 (6 year mission)
GRACE
2002 (5 year mission)
CALIPSO
2006 (3 year mission)
CloudSat
2006 (3 year mission)
Aura
2004 (6 year mission)

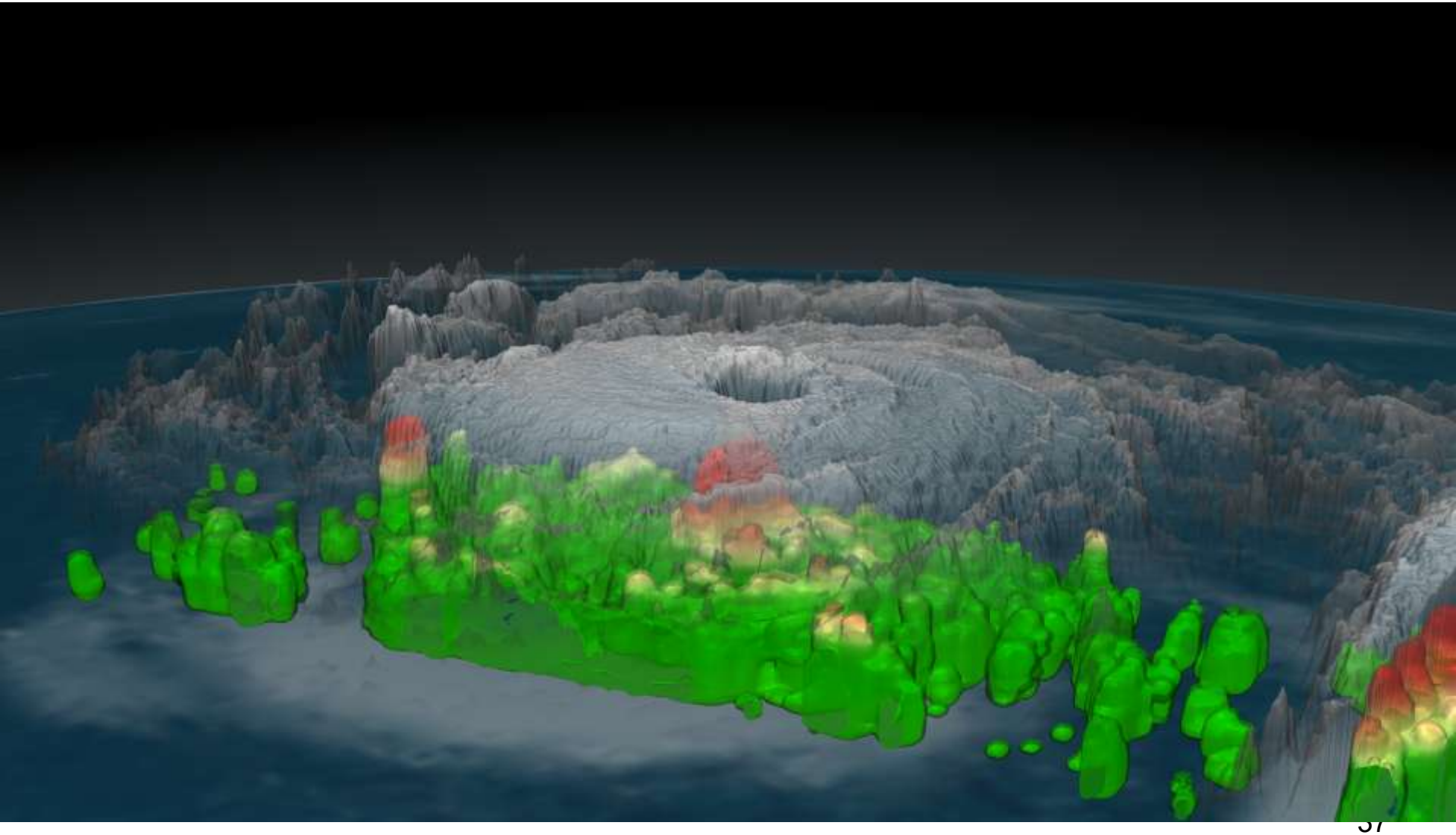
Decline in Arctic Ocean Multiyear Sea Ice Coverage (1999-2009)



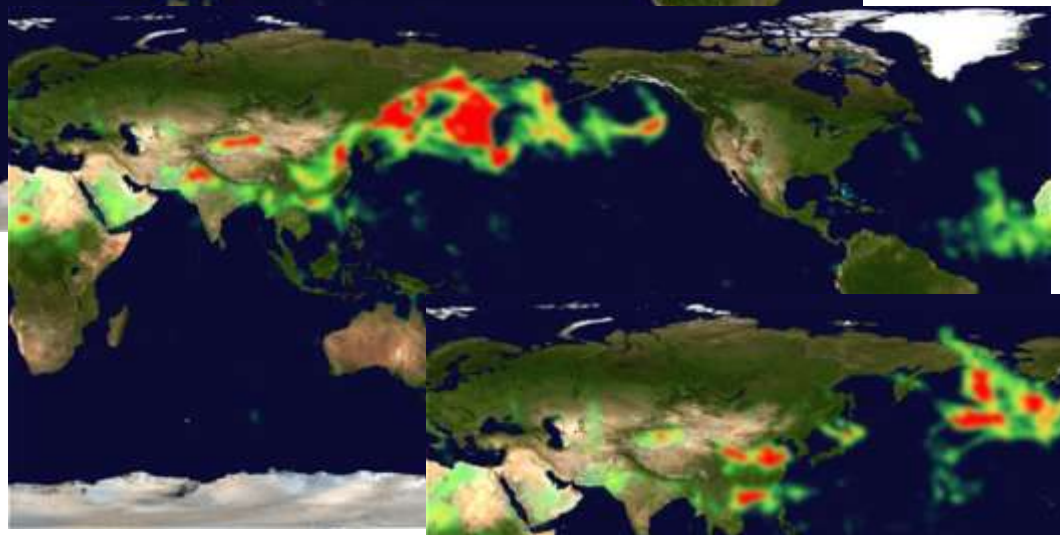
(Kwok, 2009)

Hurricane Danielle's Hot Towers from TRMM

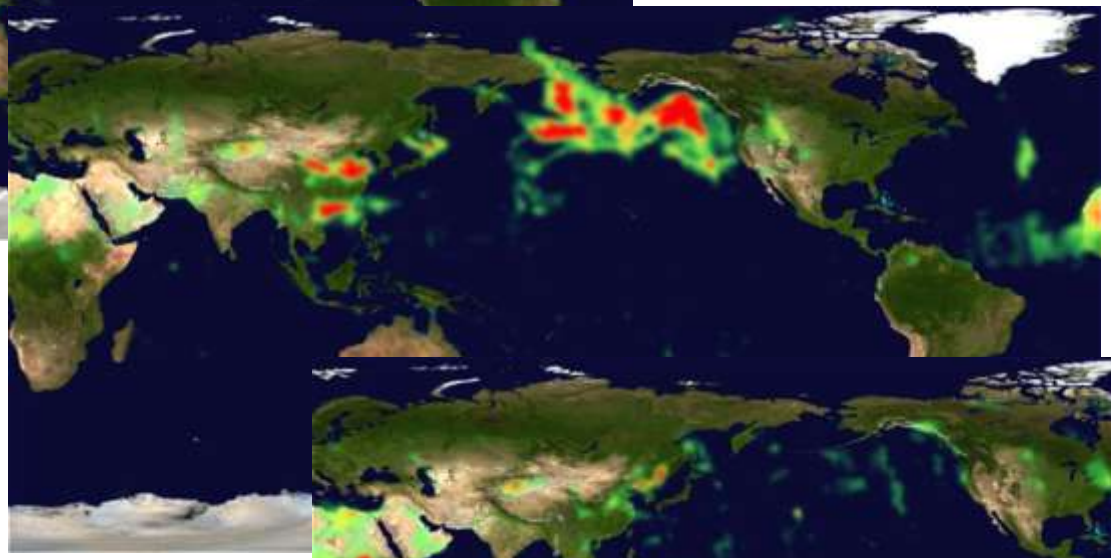
August 27, 2010



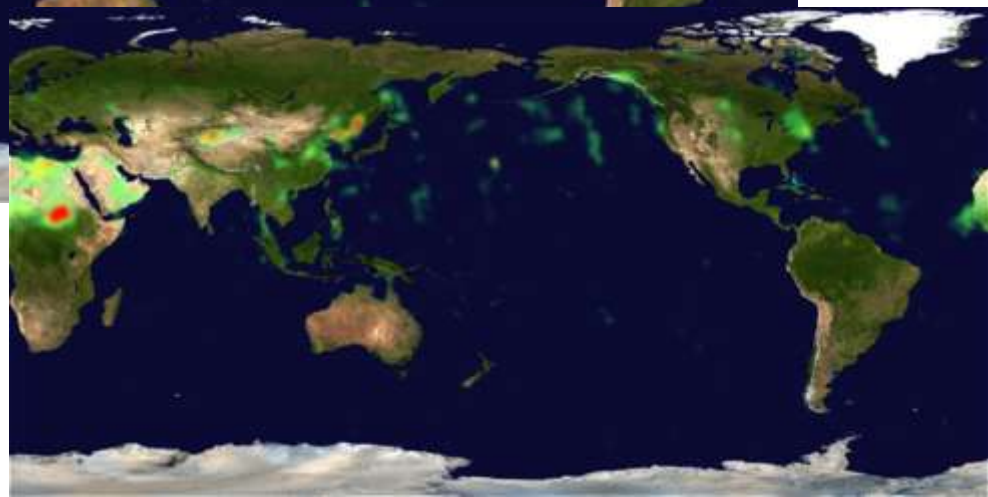
April 7, 2001



April 11, 2001



April 13, 2001

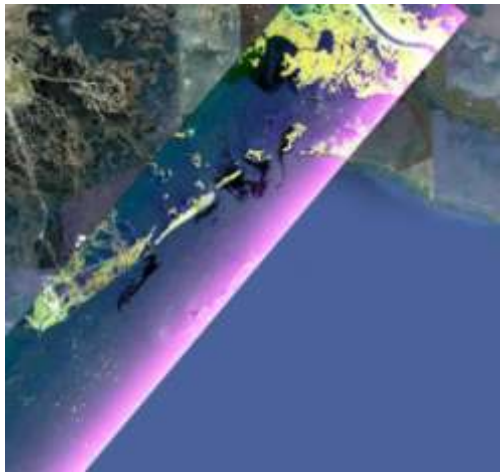


April 16, 2001

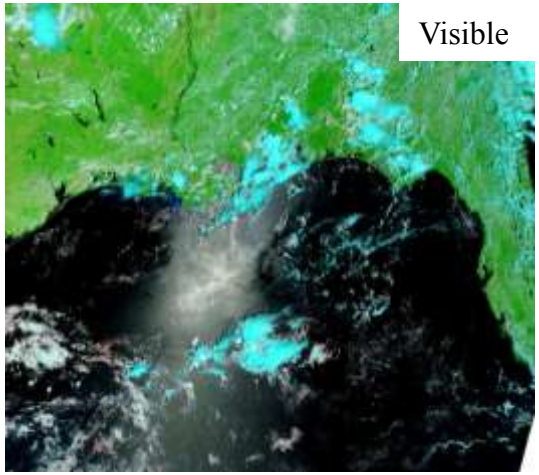
China Dust Storm Pollutes the Air in the Eastern US in April 2001

Response to Gulf Oil Spill

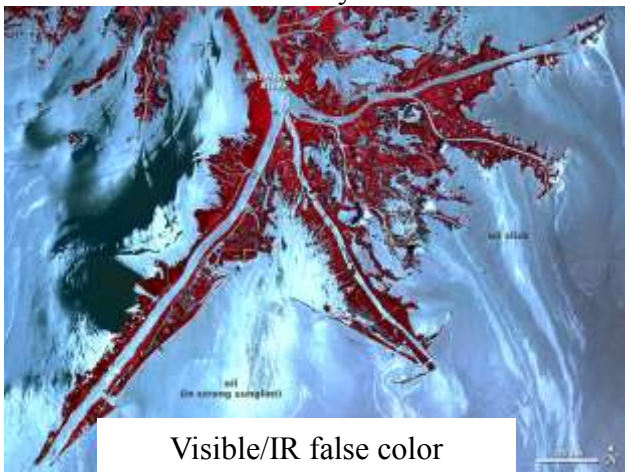
UAVSAR 23 June 2010



MODIS 31 May 2010



ASTER 24 May 2010

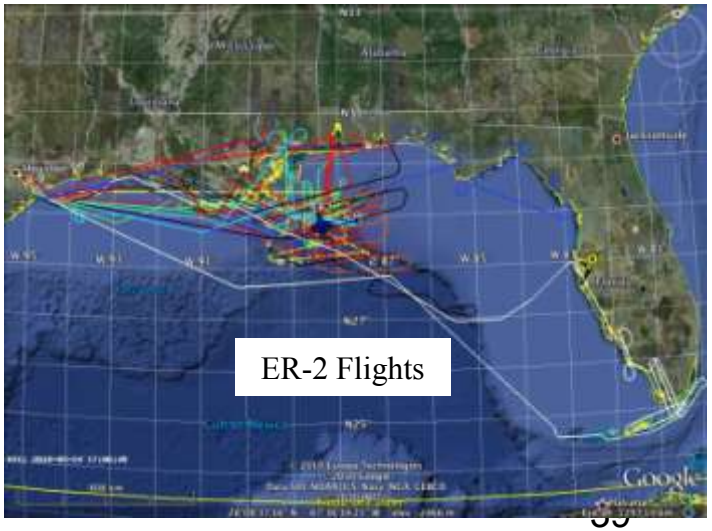


Satellite instruments: continually monitored the extent of the spill

- Terra & Aqua / MODIS – visible and infrared daily synoptic
- Terra / ASTER – visible, near IR and thermal IR high res
- EO-1 / Advanced Land Imager and Hyperion – highest res
- Terra / MISR
- CALIPSO / CALIOP

Airborne instruments: measured *surface* extent and volume

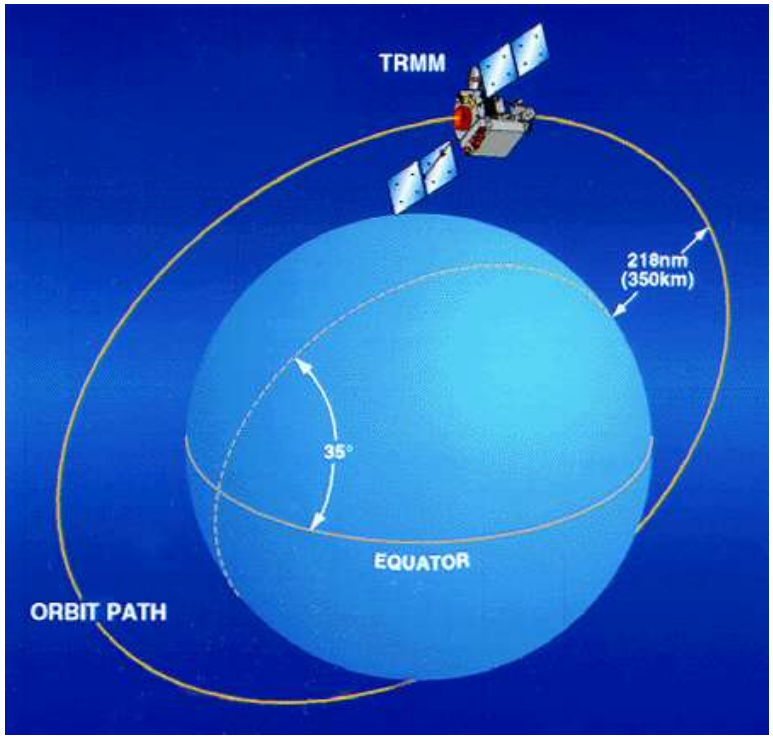
- ER2 / AVIRIS and DCS, MASTER – May, Jul, Aug, Sept
- Twin Otter / AVIRIS (July 1-12)
- B200 / HSRL– 10-11 May; two FOO; CALIOP studies
- UAVSAR– 22-24 June

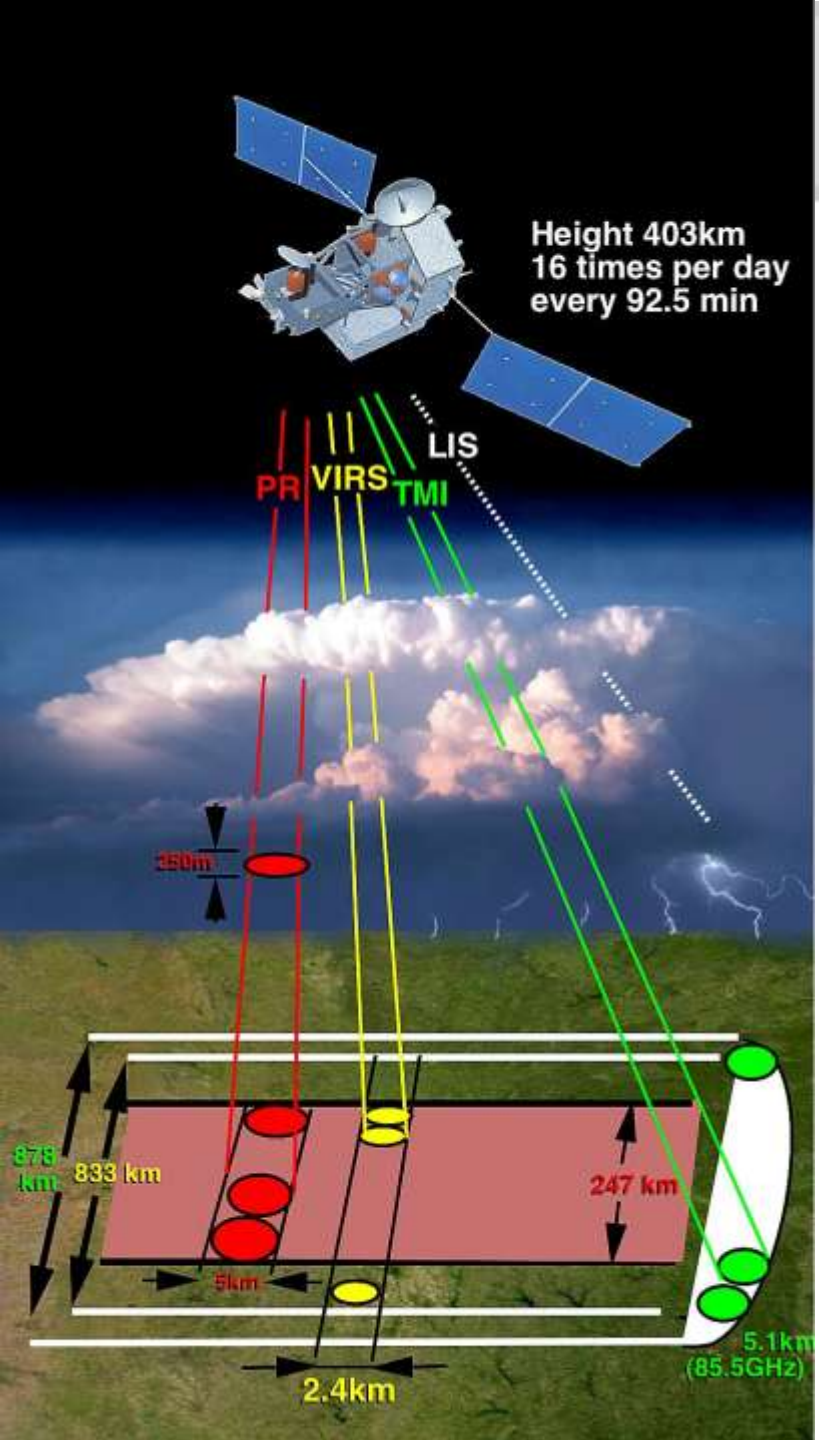


Data and provided to USGS for use by first responders;
NOAA using radiances to initialize trajectory model, USGS for oil concentration

Tropical Rainfall Measurement Mission (TRMM)

- Launched in Dec. 1997.
- TRMM's goal is to determining rainfall in the tropics and subtropics of the Earth.
- 13 years (1998-current) of data available, very unique dataset for precipitation and convection studies in tropical cyclones
- TRMM satellite orbit: circular (Non-Sun Synchronous)
- Observation frequency: 16 times per day.





Instruments on TRMM:

- Precipitation Radar (PR): 13.8 GHz (wavelength: 2.17 cm)
- TRMM Microwave Imager (TMI): 10, 19, 22, 37, and 85 GHz
- Visible and Infrared Scanner (VIRS):
- Lightning Imaging Sensor (LIS): detects total lightning--flash count & location

TERRA - Launch Date: December 18, 1999

Terra simultaneously studies clouds, water vapor, aerosol particles, trace gases, terrestrial and oceanic properties, the interaction between them and their effect on atmospheric radiation and climate. Moreover, Terra will observe changes in Earth's radiation budget (a measurement of all the inputs and outputs of the Earth's radiative energy), together with measurements of changes in land/ocean surface and interaction with the atmosphere through exchanges of energy, carbon, and water. Comprehending these interactive processes is essential to understanding global climate change.

Instruments on TERRA

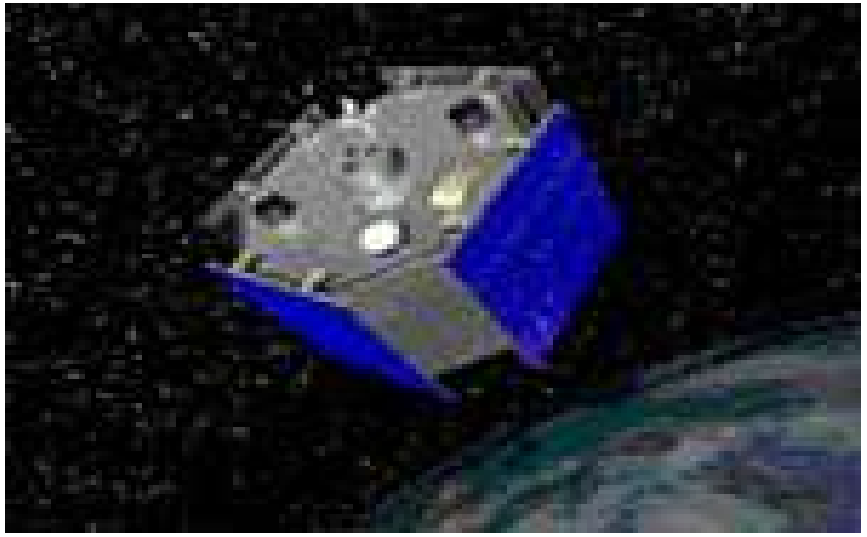
- **Clouds and the Earth's Radiant Energy System (CERES)**
- **Multi-angle Imaging SpectroRadiometer (MISR)**
- **Moderate- Resolution Imaging Spectroradiometer (MODIS)**
- **Measurements of Pollution in The Troposphere (MOPITT)**
- **Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER)**

Terra MODIS, 21 Octob
2005, 1625 UTC:
Hurricane Wilma

Terra MODIS, 28 October 2003, 1825 UTC: Fires in Southern California

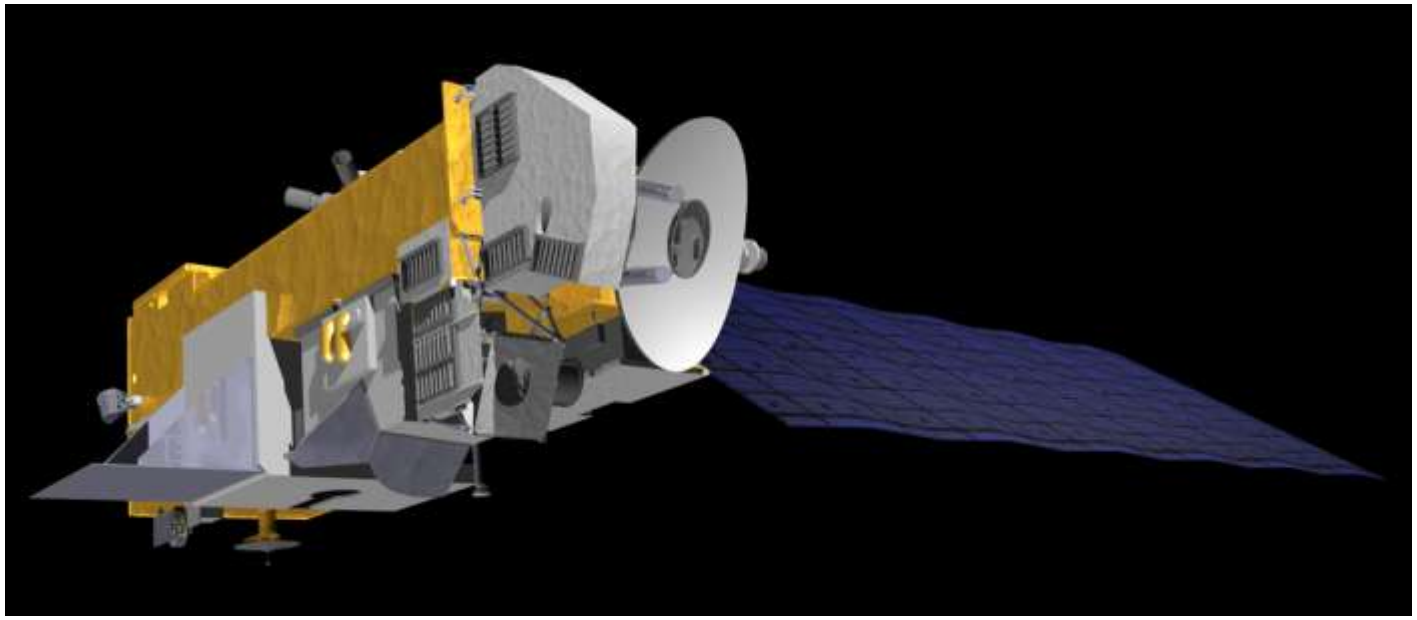
Active Cavity Radiometer Irradiance Monitor (ACRIMSAT)

Launch Date: December 20, 1999.



The purpose of the Active Cavity Radiometer Irradiance Monitor III (ACRIM III) instrument is To study total solar irradiance from the Sun

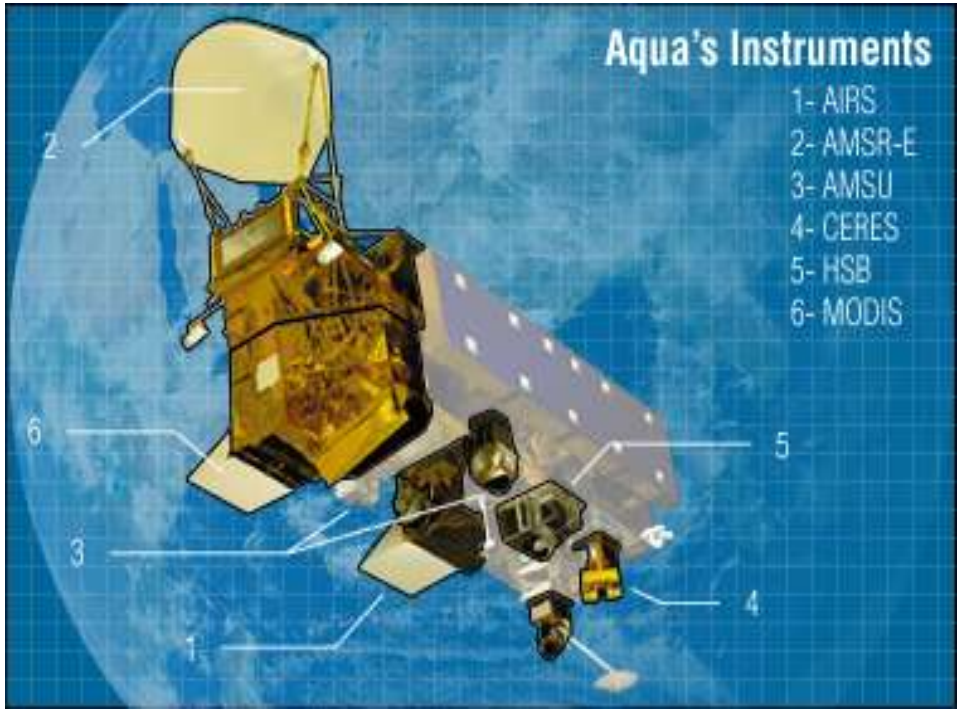
Arua-- Launch Date: July 15, 2004



Aura's objective is to study the chemistry and dynamics of the Earth's atmosphere with emphasis on the upper troposphere and lower stratosphere (0-30km) by employing multiple instruments on a single satellite. The satellite's measurements enable scientists to investigate questions about ozone trends, air quality changes and their linkages to climate change. These observations provide accurate data for predictive models and provide useful information for local and national government agencies.

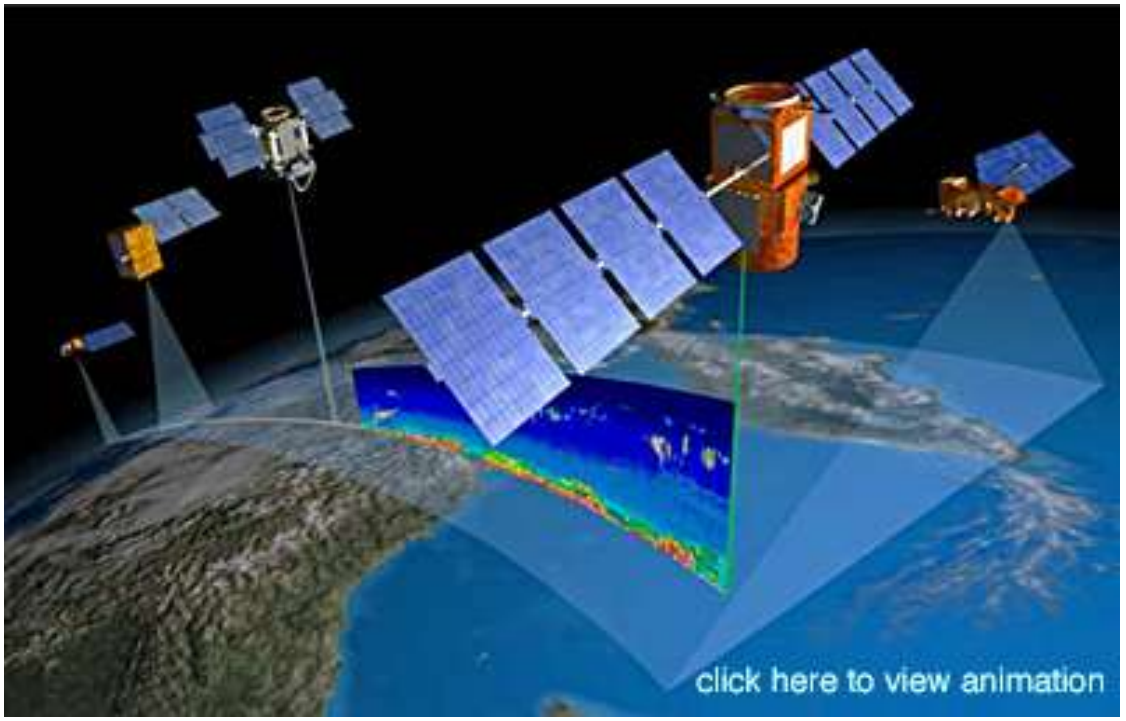
Aqua-- Launch Date: May 04, 2002

Aqua, Latin for "water," is named for the large amount of information that the Aqua spacecraft will collect about the Earth's water cycle. In particular, the Aqua data will include information on water vapor and clouds in the atmosphere, precipitation from the atmosphere, soil wetness on the land, glacial ice on the land, sea ice in the oceans, snow cover on both land and sea ice, and surface waters throughout the world's oceans, bays, and lakes.



Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observations (CALIPSO)

Launch Date:
April 28, 2006



The CALIPSO satellite was developed to help scientists answer significant questions and provide new information about the effects of clouds and aerosols (airborne particles) on changes in the Earth's climate.

CloudSat

Launch Date:
April 28, 2006

CloudSat is an experimental satellite that uses radar to observe clouds and precipitation from space. CloudSat orbits in formation as part of the A-Train constellation of satellites (Aqua, CloudSat, CALIPSO, PARASOL, and Aura).

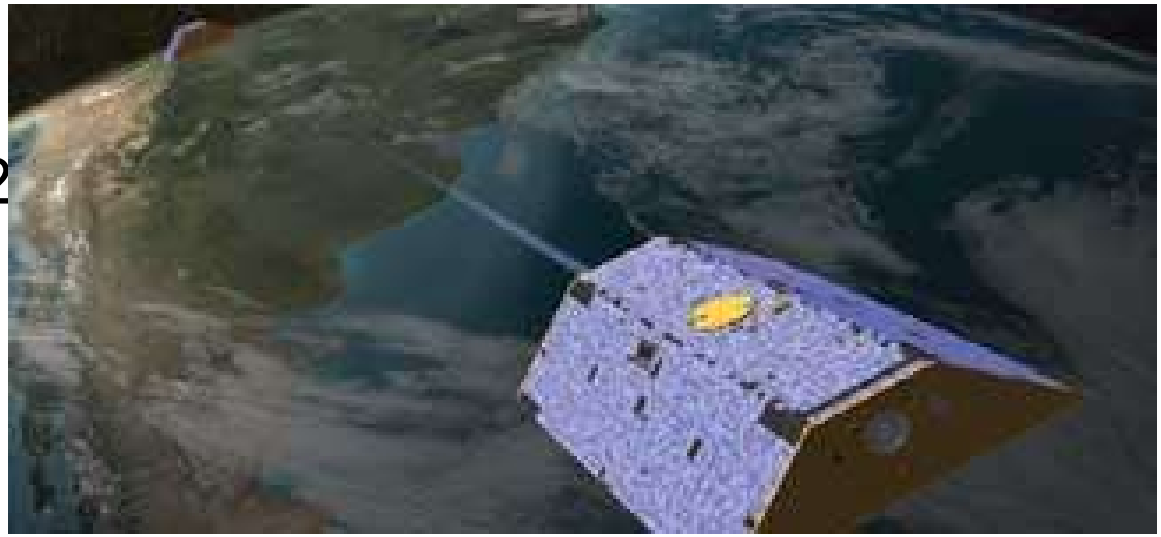
Geostationary Operational Environmental Satellite, I-M Series (GEOS I-M)

Launch Date:
April 13, 1994

The GOES I-M satellites are the primary element of U.S. weather monitoring and forecast operations and are a key component of NOAA's National Weather Service operations and modernization program. Spacecraft and ground-based systems work together to accomplish the mission of providing weather imagery and quantitative sounding data that form a continuous and reliable stream of environmental information used for weather forecasting and related services.

Gravity Recovery and Climate Experiment (GRACE)

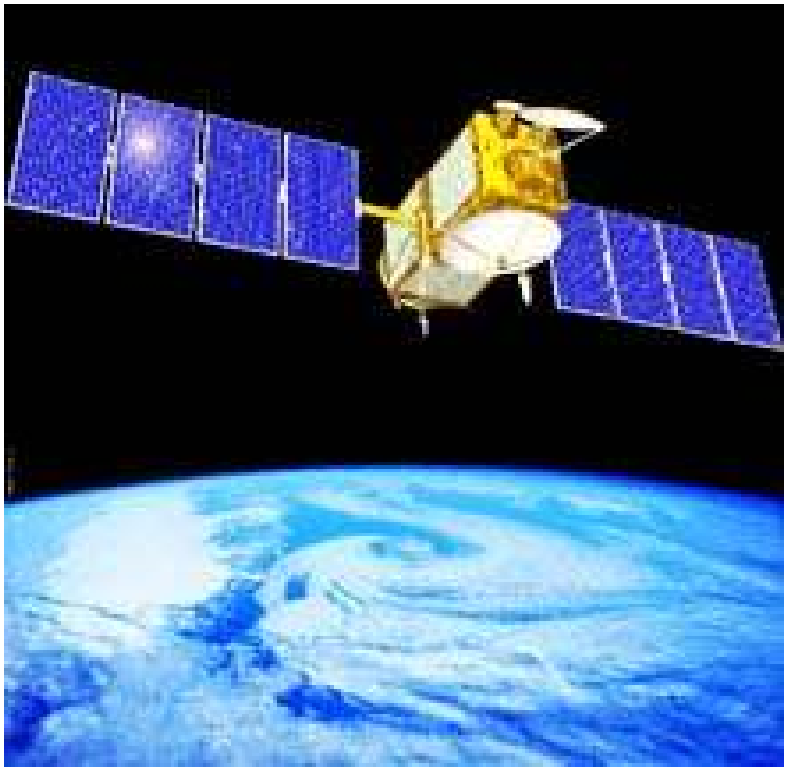
Launch Date:
March 17, 2002



GRACE, twin satellites launched in March 2002, are making detailed measurements of Earth's gravity field which will lead to discoveries about gravity and Earth's natural systems. These discoveries could have far-reaching benefits to society and the world's population.

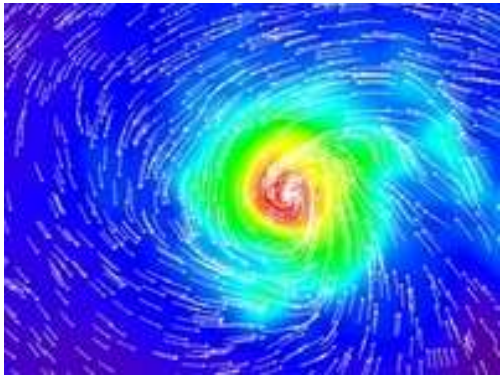
Jason-1: Launched on December 07, 2001

Jason is an oceanography mission to monitor global ocean circulation, improve global climate predictions, and monitor events such as El Nino conditions and ocean eddies. The Jason-1 satellite carries a radar altimeter, and it is a follow-on mission to the highly successful TOPEX/Poseidon mission, that measured ocean surface topography to an accuracy of 4.2 cm, enabled scientists to forecast the 1997-1998 El Niño, and improved understanding of ocean circulation and its effect of global climate.



Quick Scatterometer (QuickScat)

QuikSCAT mission is intended to record sea-surface wind speed and direction data under all weather and cloud conditions over Earth's oceans.



QuikSCAT image of Hurricane Dora in the eastern tropical Pacific Ocean on August 10, 1999

Launch Date:
June 19, 1999

Global Precipitation Measurement (GPM)

Launch Date:
July 01, 2013

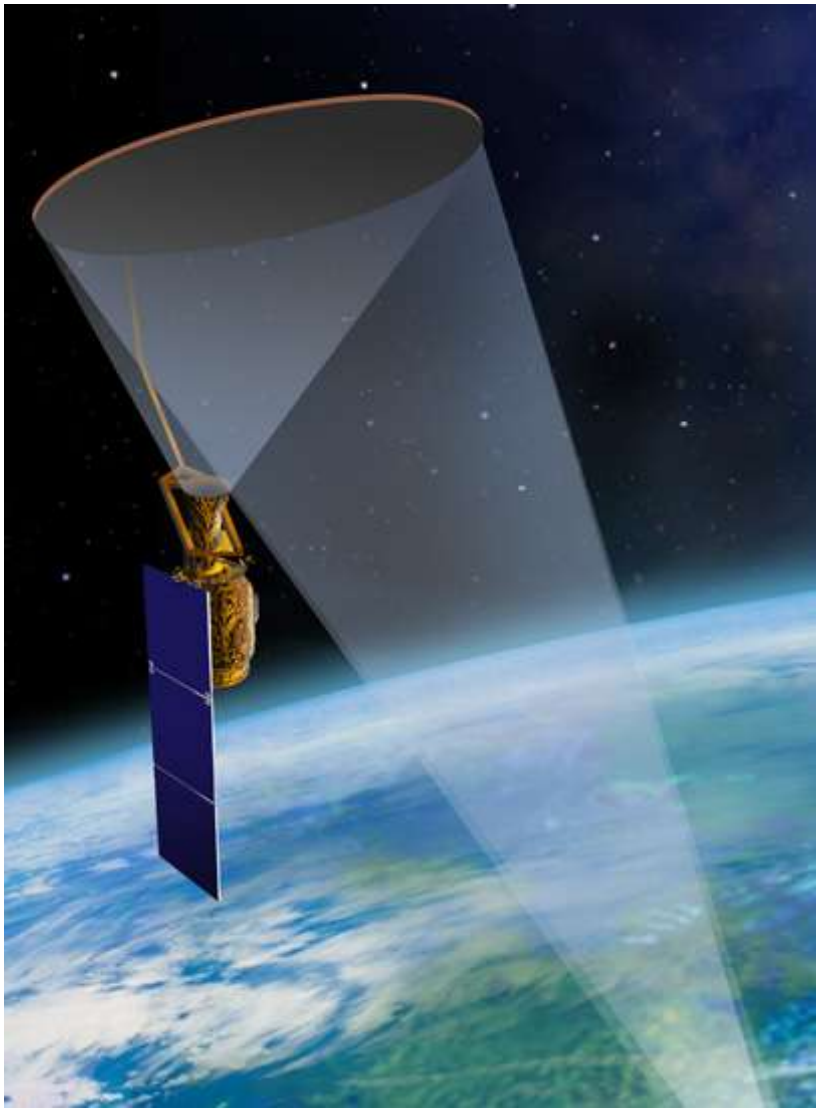
Building upon the success of the Tropical Rainfall Measuring Mission (TRMM), GPM will initiate the measurement of global precipitation, a key climate factor. Its science objectives are: to improve ongoing efforts to predict climate by providing near-global measurement of precipitation, its distribution, and physical processes; to improve the accuracy of weather and precipitation forecasts through more accurate measurement of rain rates and latent heating; and to provide more frequent and complete sampling of the Earth's precipitation.

NPOESS Preparatory Project (NPP)

Launch Date:
October 25, 2011

NPP is the bridge between the major Earth Observing System satellites(Terra, Aqua, and Aura) and the forthcoming series of Joint Polar Satellite System (JPSS) satellites which will compose the civilian polar-orbiting weather satellites. NPP data will be used for both climate research and operational weather prediction.

Soil Moisture Active/Passive (SMAP) - 2015



SMAP will provide the first global measurements of soil moisture, a key missing element in modeling the global water cycle.

NASA's Undergraduate and Graduate Internship/Fellowship Opportunities

NASA Undergraduate Student Research Program (USRP)

•NASA USRP is an internship program that offers NASA research and development opportunities to undergraduate students.

•**Spring 2012 NASA Undergraduate Student Research Project**
NASA's USRP offers U.S. undergraduate students with a minimum 3.0 grade point average mentored research experiences at NASA centers. Upcoming sophomores, juniors or seniors with a major or concentration in engineering, mathematics, computer science, or physical or life sciences may apply. Participants work practical problems to provide solutions that will be applied in aerospace or on future NASA missions. Applications for the 2012 spring session are due **Oct. 31, 2011**.

•Apply now and join NASA for the experience of a lifetime!
Now Accepting Applications in SOLAR
Spring 2012 Applications Being Accepted; Due on October 11, 2011
http://usrp.usra.edu/
http://intern.nasa.gov/

NASA Earth and Space Science Fellowship (NESSF)

•For students pursuing MS or PhD degree.
•Solicitation every year, due Feb. 1
•Very competitive.
• Application materials: a 6-page research proposal, Transcripts, recommendation letter from your advisor
• Award: $30,000 per year renewable up to 3 years

•Information: You can register in NSPIRES at http://nspires.nasaprs.com/.

•For further information contact Ming-Ying Wei, Program Administrator for NESSF Earth Science Research, Telephone: (202) 358-0771, E-mail: mwei@nasa.gov

NASA Graduate Student Researchers Project (GSRP)

•For students pursuing MS or PhD degree.
•Solicitation every year, due date: usually Feb. 1
•This twelve month award requires students to participate in a 10 week NASA Center or HQ-based research experience at the NASA Center/HQ extending the GSRP Fellowship award.
• Underrepresented groups in science, technology, engineering, and mathematics fields (STEM) are encouraged to apply.

•Application materials: a 6-page research proposal, Transcripts, recommendation letter from your advisor

•https://fellowships.nasaprs.com/gsrp/nav/

Other Opportunities at NASA:

http://www.nasa.gov/audience/forstudents/postsecondary/programs/index.html

- **Langley Aerospace Research Summer Scholars Project:** Participants spend 10 weeks conducting state-of-the-art research with other students from across the nation. They work with NASA researchers exploring an array of high-technology development projects and activities in pursuit of space exploration. http://www.nianet.org/larss/

- **Student Employment at NASA: http://nasajobs.nasa.gov/studentopps/employment/default.htm**

- **Jobs at NASA: http://nasajobs.nasa.gov/default.htm**