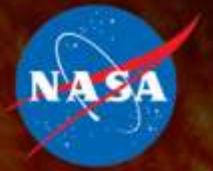




NASA's Science Missions and Student Internship/Fellowship Opportunities

*For the NASA/FIU Hurricane and Remote Sensing Summer
Education and Research Internship Program (HRSSERP)
Aug. 6-17, 2011*



NASA Science:

Earth Science
Heliophysics
Planetary Science
Astrophysics



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

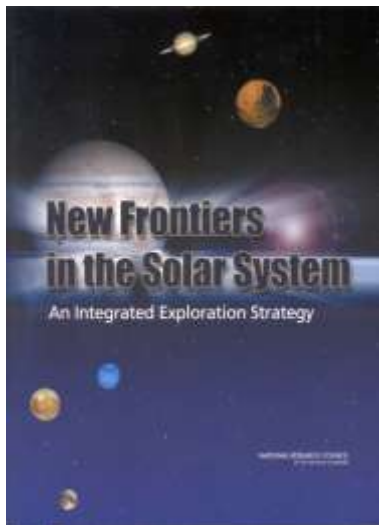
Partnerships with a dozen Federal agencies and 60 other nations

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

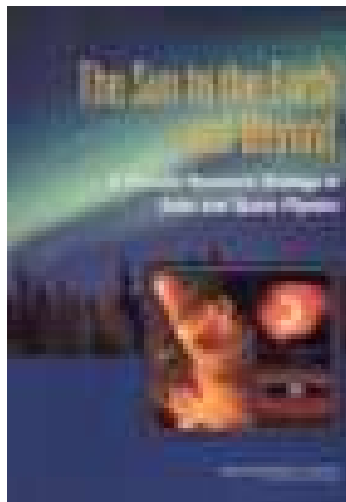
Global impact on humanity's understanding of our place in the universe



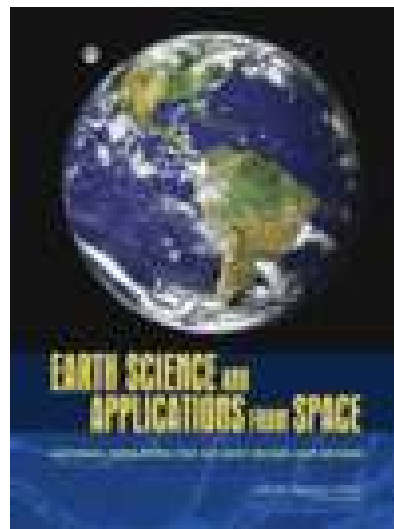
Recommendations from the U.S. Scientific Community Through NRC Decadal Surveys



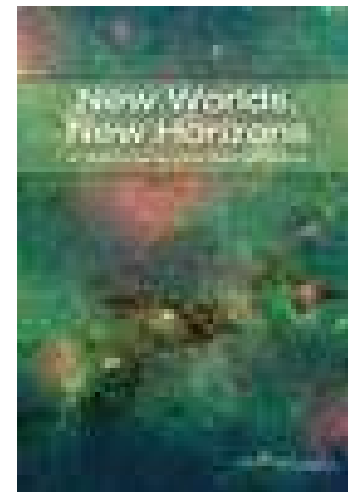
Planetary Science
2002
(2011)



Heliophysics
2003
(2012)



Earth Science
2007
(2017)



Astrophysics
2010
(2020)



Engaging the Next Generation

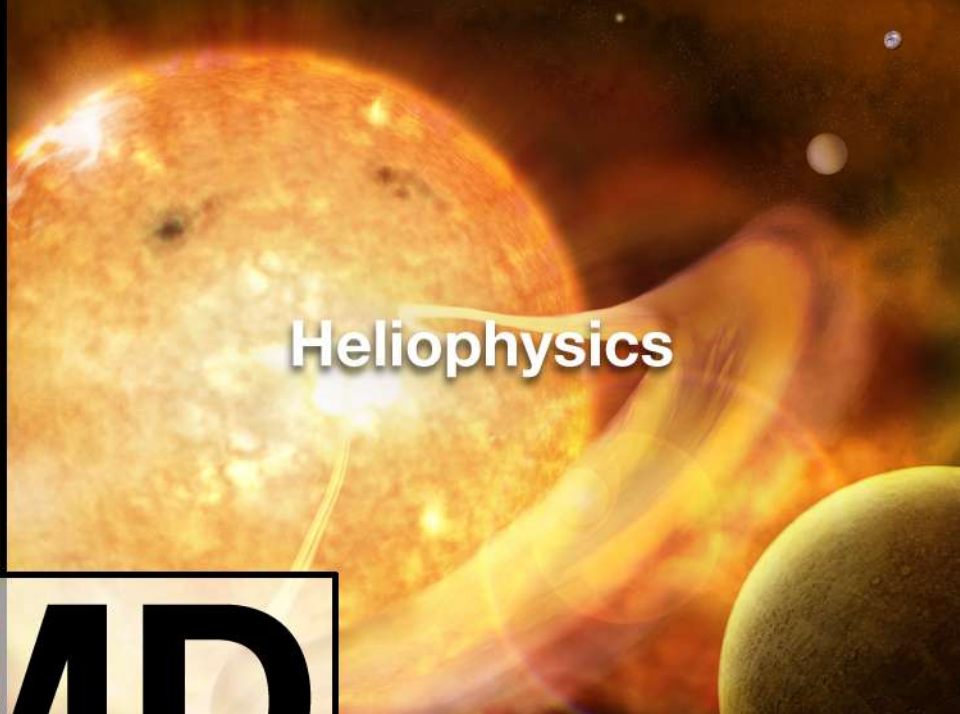
To share the story, the science, and the adventure of NASA's scientific explorations of our home planet, the solar system, and the universe beyond...

- 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

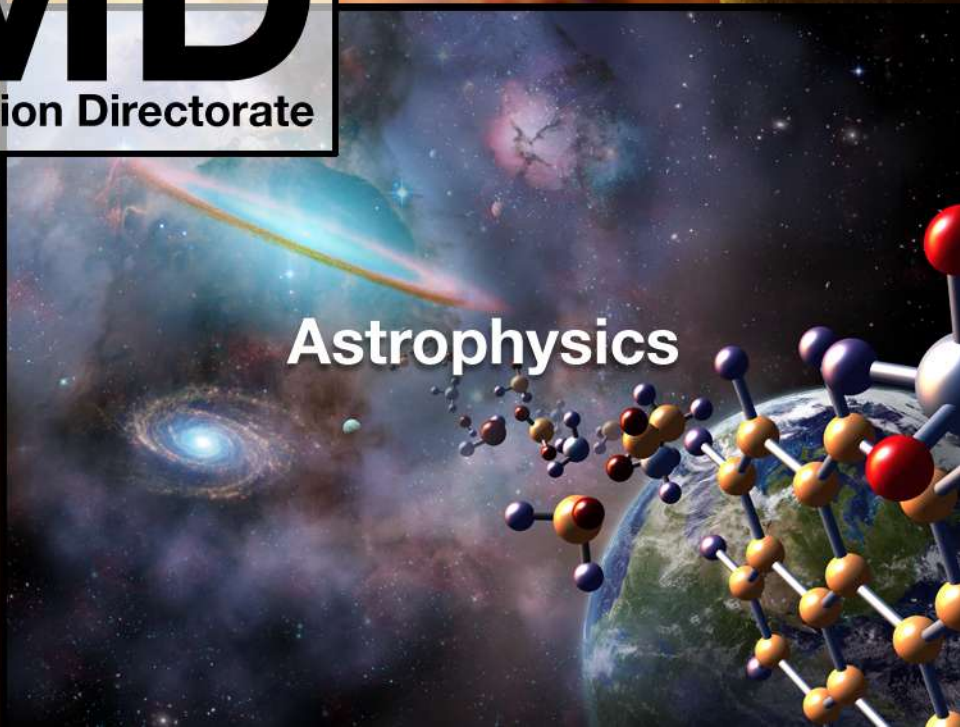


Heliophysics

SMD
Science Mission Directorate



Planetary Science



Astrophysics



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)

Suzaku (JAXA)
2005 (5 year mission)

Fermi
2008 (5 year mission)

Swift
2004 (2 year mission)

INTEGRAL (ESA)
2002 (2 year mission)

RXTE
1995 (2.5 year mission)

Planck (ESA)
2009 (3-4 year mission)

GALEX
2003 (20-5 year mission)

Herschel (ESA)
2009 (3 year mission)

Kepler
2009 (3.5-6 year mission)

WISE
2009 (10 month mission)

Hubble
1990 (15 year mission)

Chandra
1999 (5 year mission)

Spitzer
2003 (2.5 year mission)

Astrophysics Missions in Operation

SOFIA
2010 (20 year mission)



Stratospheric Observatory For Infrared Astronomy (SOFIA)

Open Door Flight
December 18, 2009



| | |
|--|---------------|
| 1 st Flight (Aircraft Functional Checks) | December 2009 |
| 1 st 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



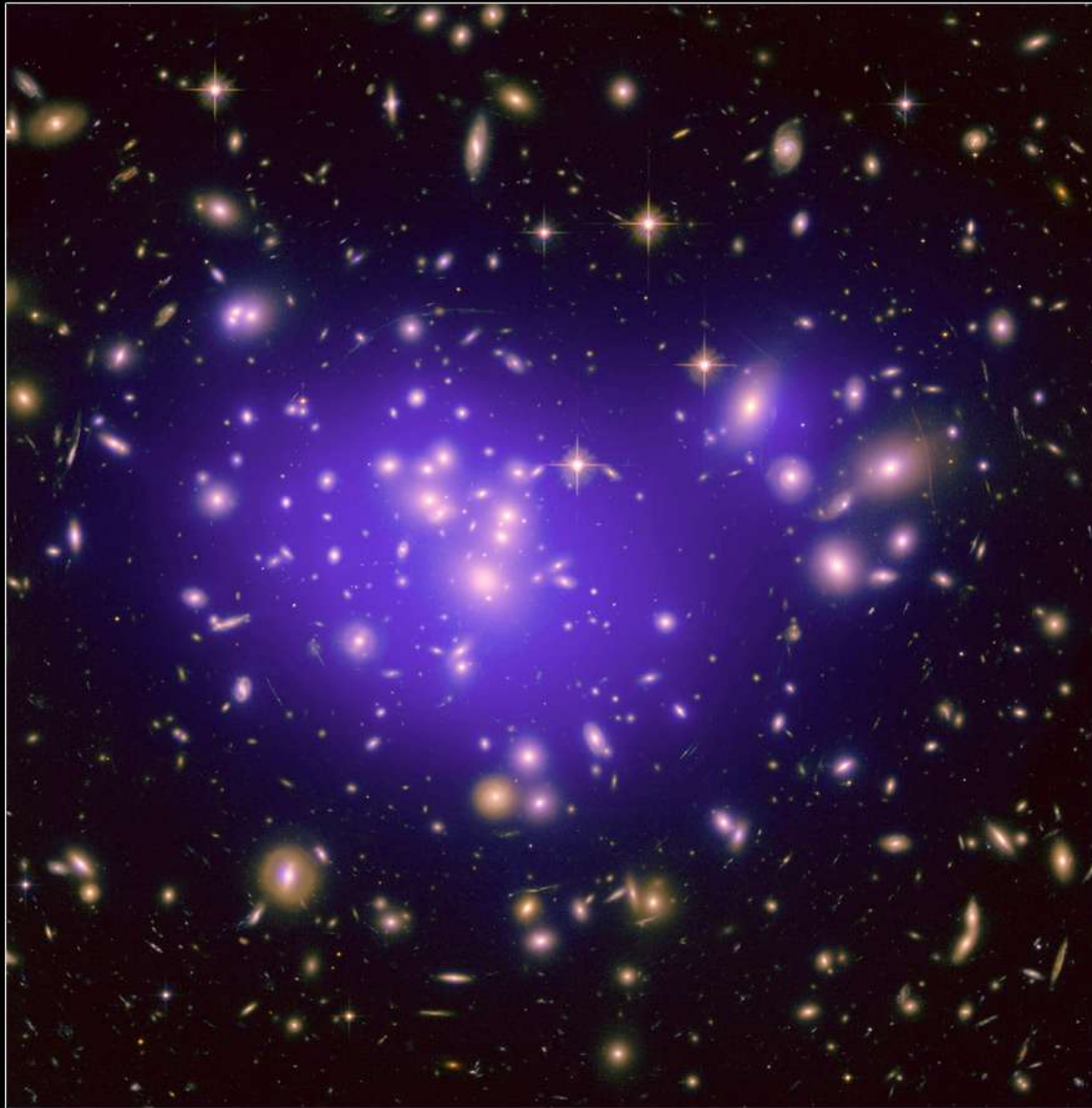
First Science Flight
December 1, 2010

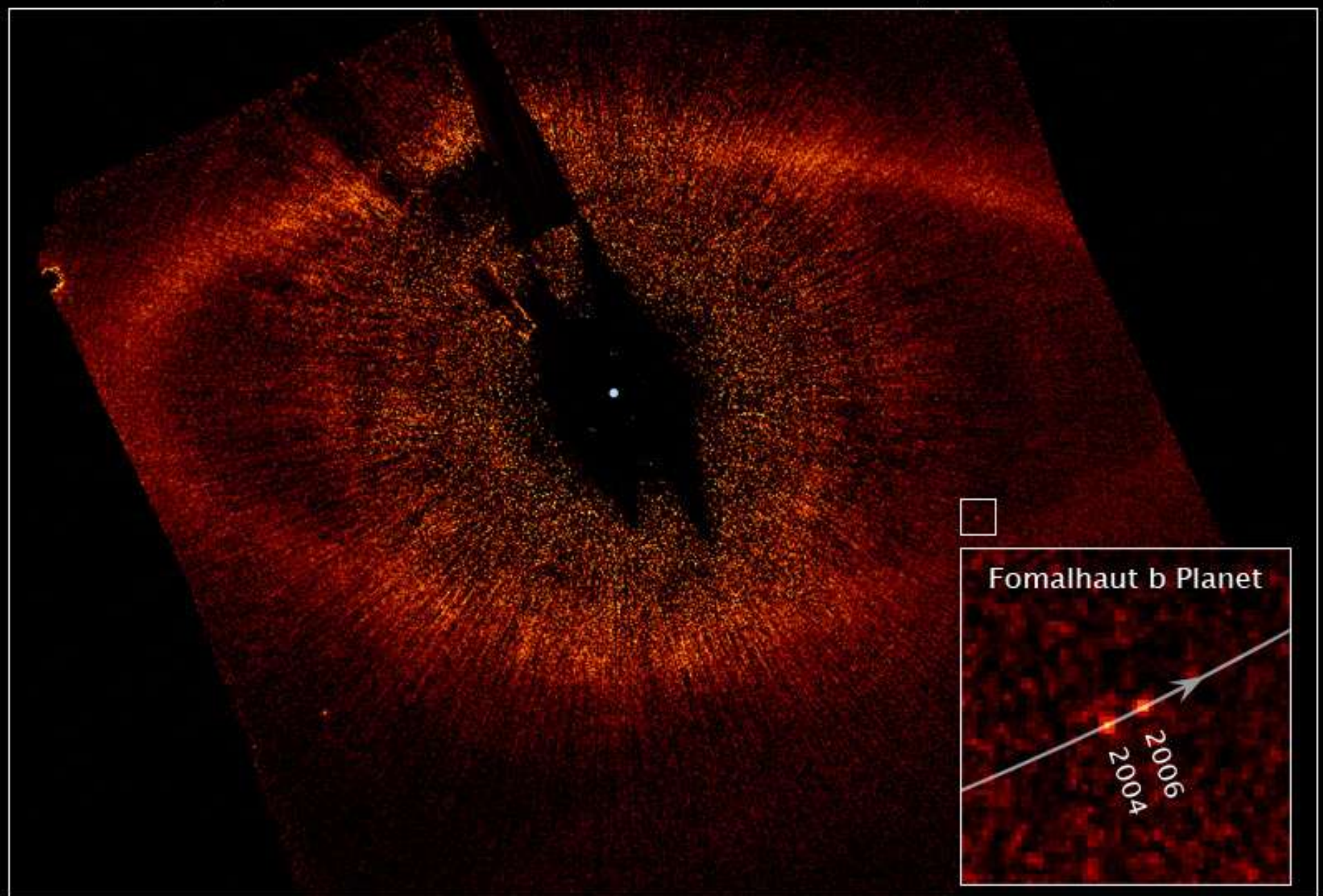


James Webb Space Telescope (JWST)



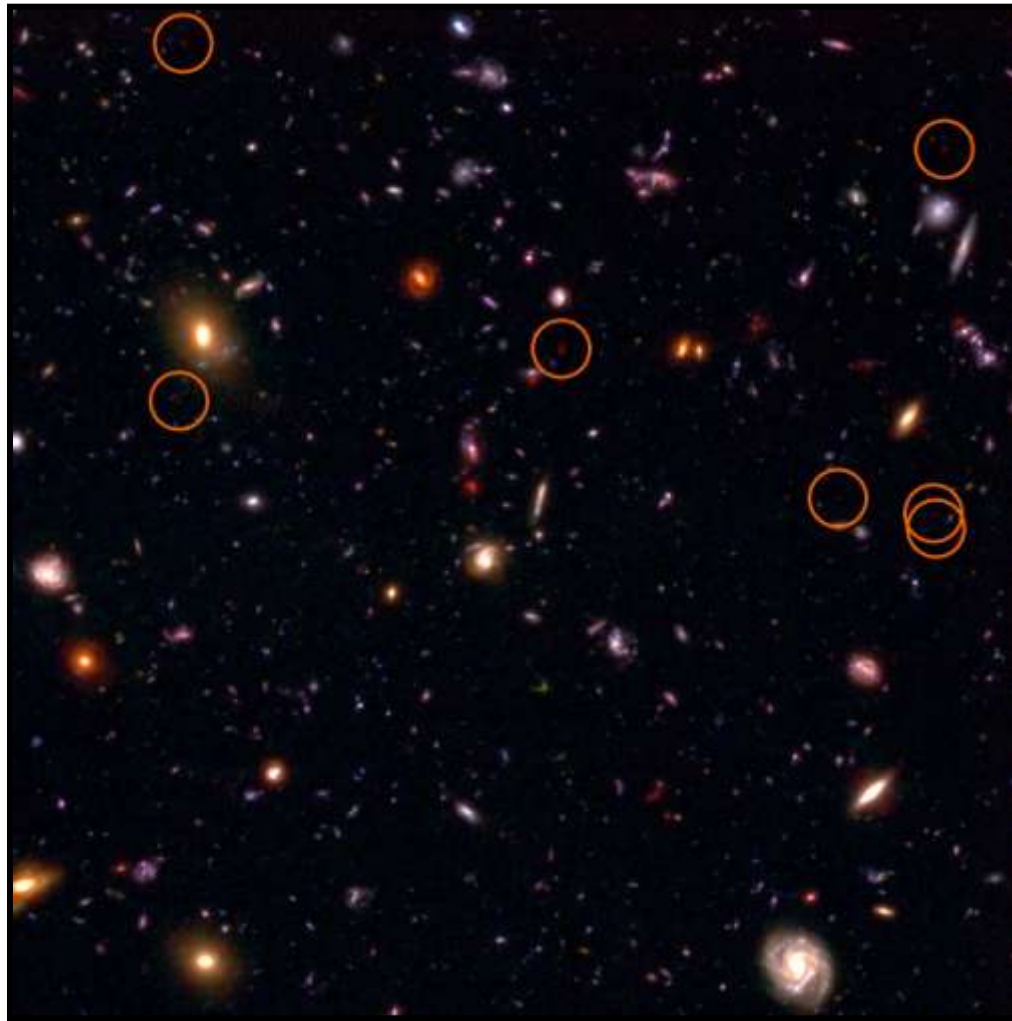
The James Webb Space Telescope (sometimes called JWST) is a large, infrared-optimized space telescope. **The project is working to a 2018 launch date.** JWST will look back in time to find the first galaxies that formed in the early Universe, connecting the Big Bang to our own Milky Way Galaxy. JWST will peer through dusty clouds to see stars forming planetary systems, connecting the Milky Way to our own Solar System.



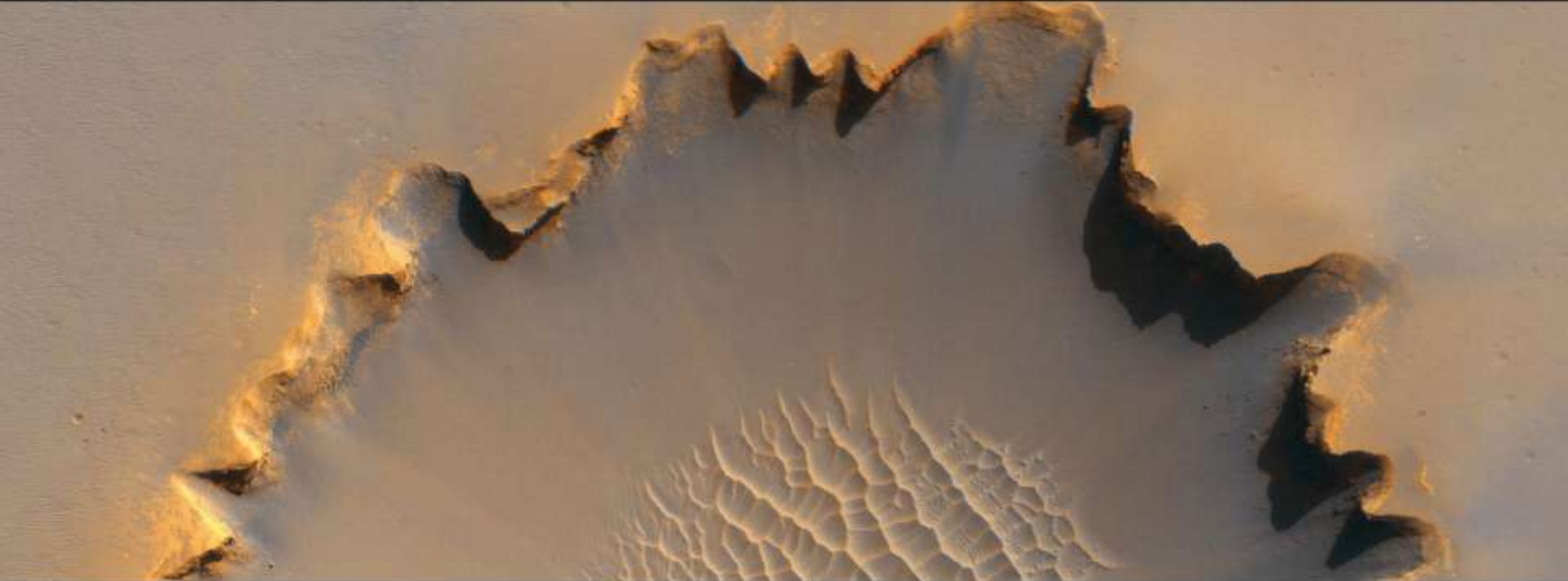




Hubble's Deepest View of the Universe



The Hubble Space Telescope has acquired the deepest image of the universe ever taken in near-infrared light using the newly installed ¹⁶ Wide Field Camera 3.



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?



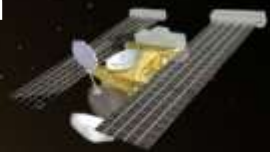
Planetary Science Missions in Operation



Deep Impact-EPOXI
2005



Messenger
2004 (8 year mission)



Stardust-NEXT
1999



Cassini (NASA/ESA)
1997 (9 year mission)



New Horizons
2006 (15 year mission)



Rosetta (ESA)
2004 (15 year mission)



Dawn
2007 (10 year mission)



Mars Express (ESA/NASA)
2003 (2 year mission)

Mars Odyssey
2001 (3 year mission)

MRO
2005 (5.5 year mission)

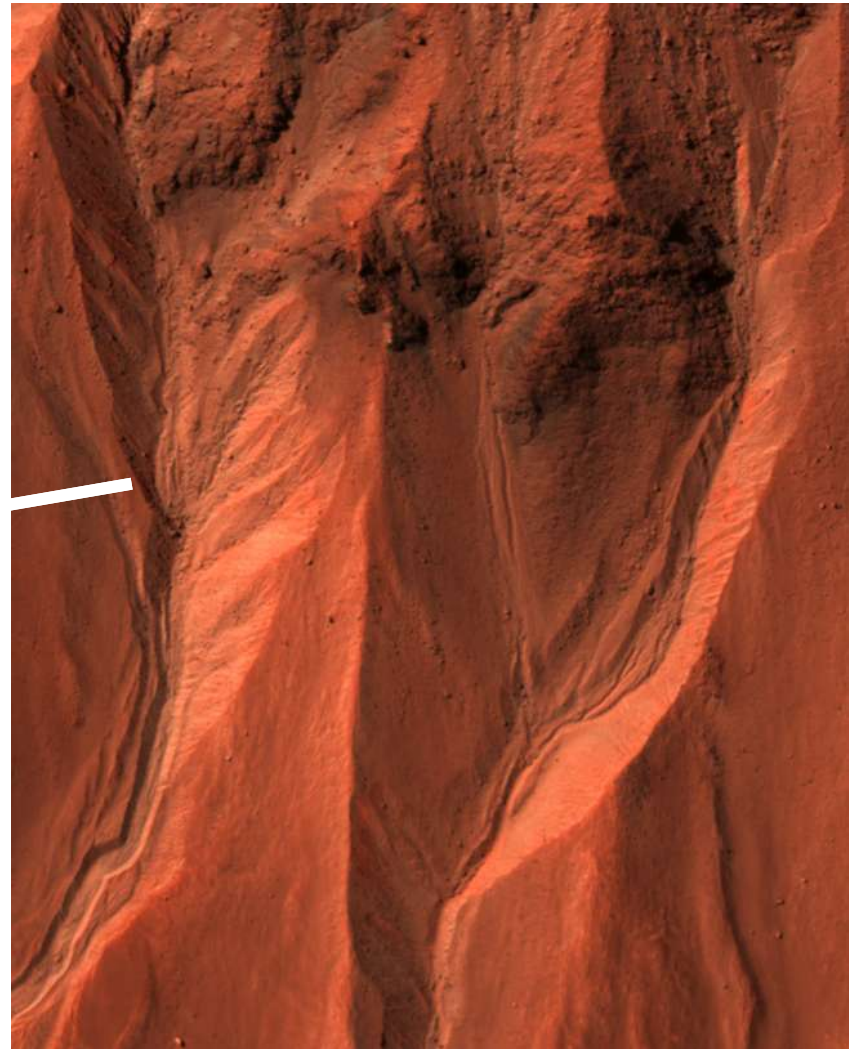
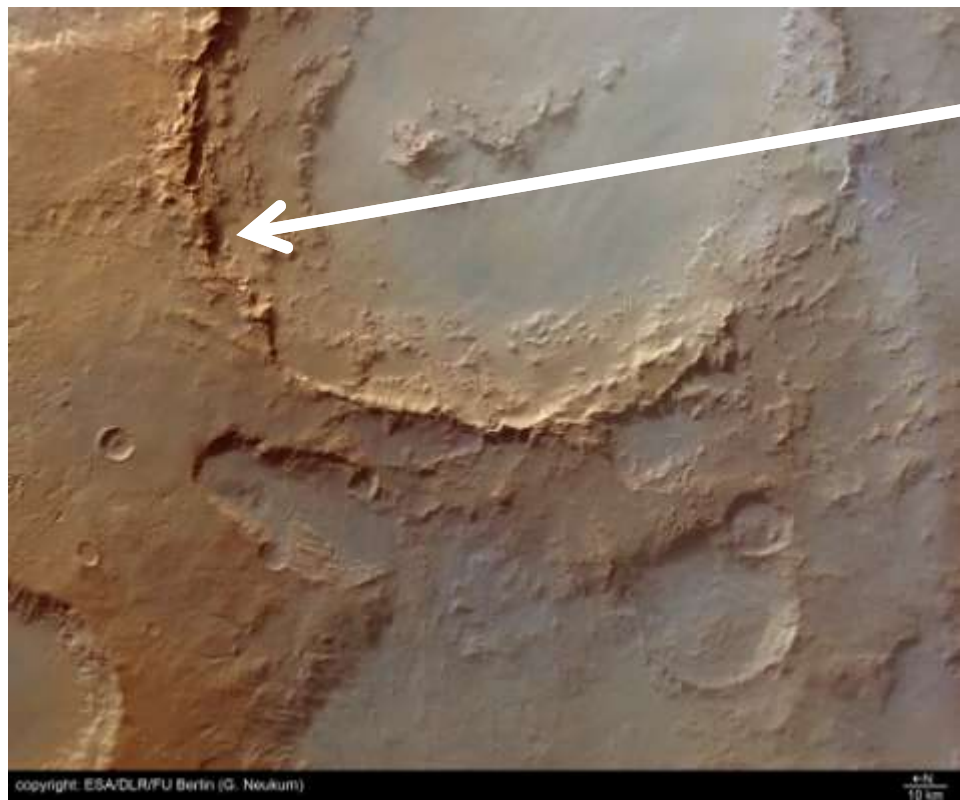
Mars Rovers Spirit & Opportunity
2003 (92 day mission)



Gullies on Mars: Are the Flow Features from Water?

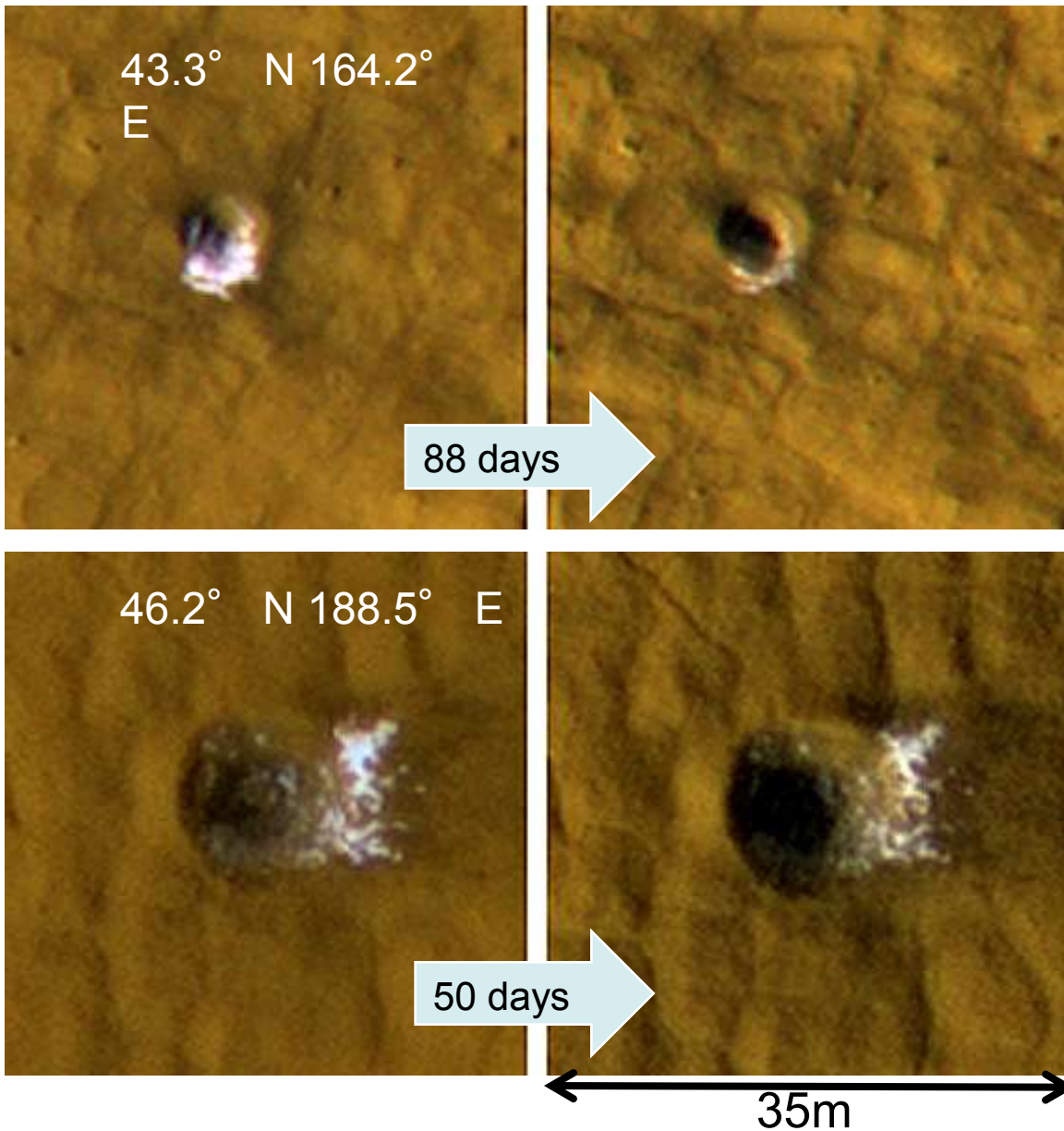
Hale Crater showing gullies on side of crater wall.

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





Martian Ice Found Just Below the Surface



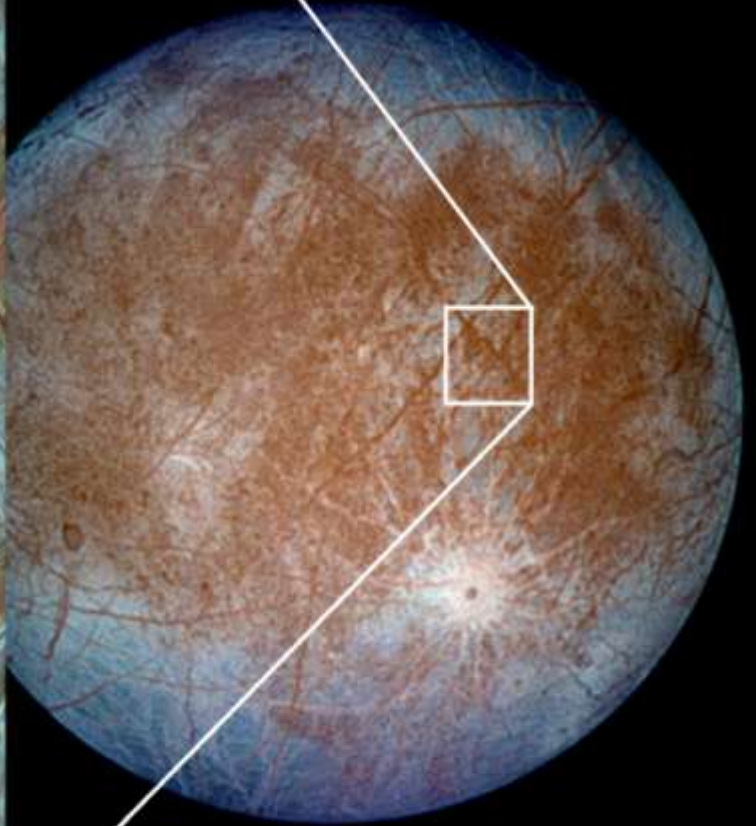
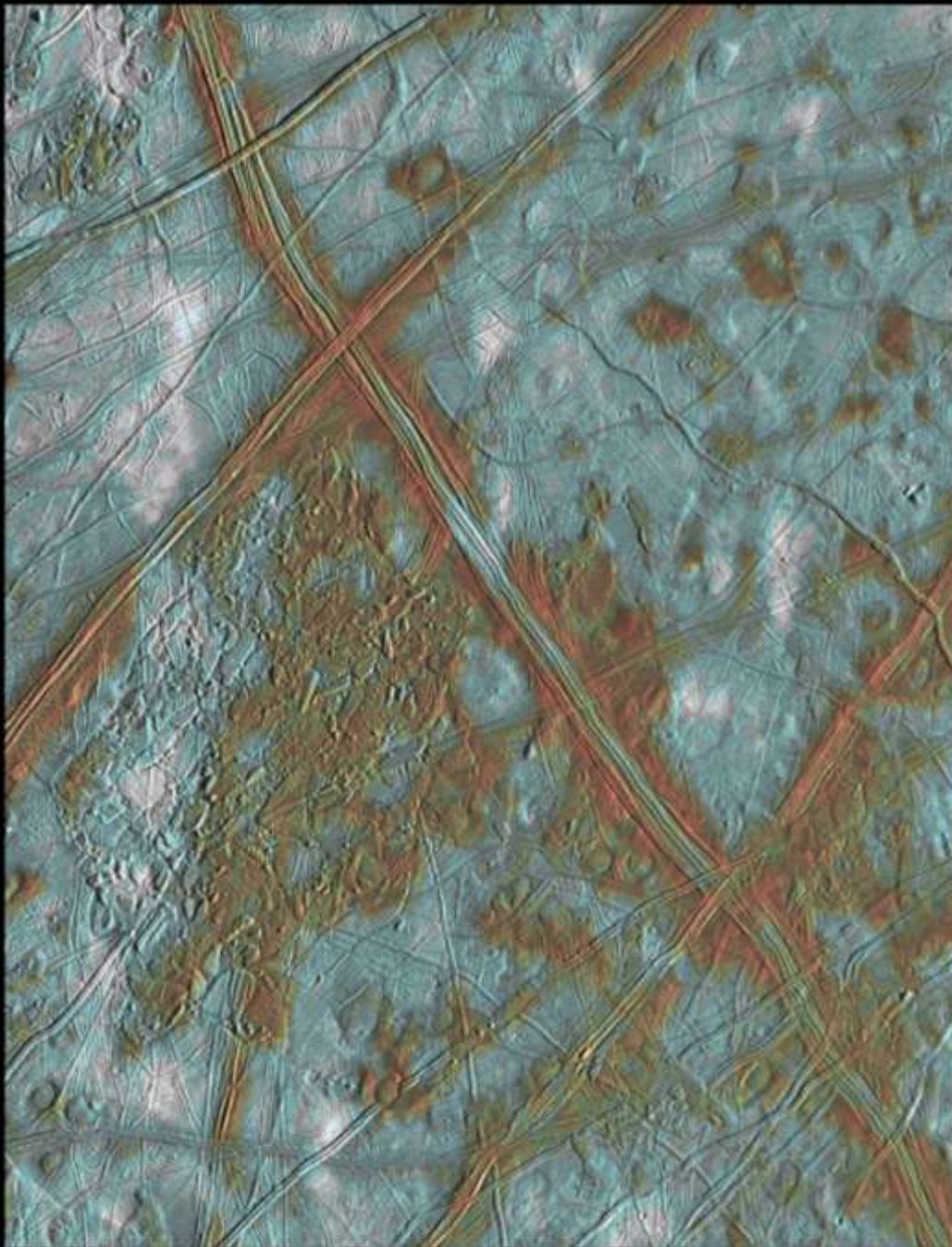
- Fresh small impact craters show:
 - Ice layer ~0.5 – 1m below surface
 - Sublimates over several weeks
- Spectral analysis shows ~99% pure water
- Ice more extensive than expected from current climate
- Mars had a wet history

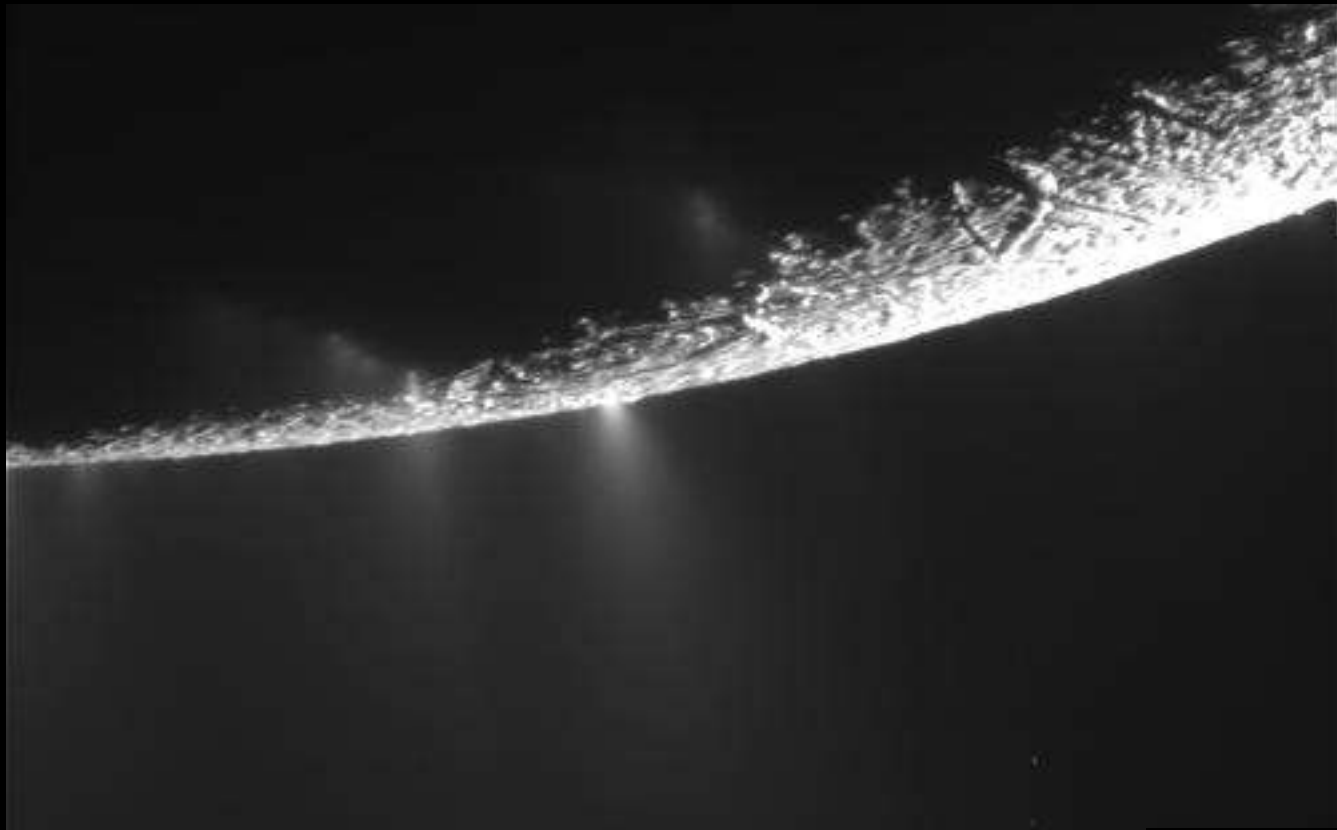


Life in Extreme Environments: Yellowstone N.P.

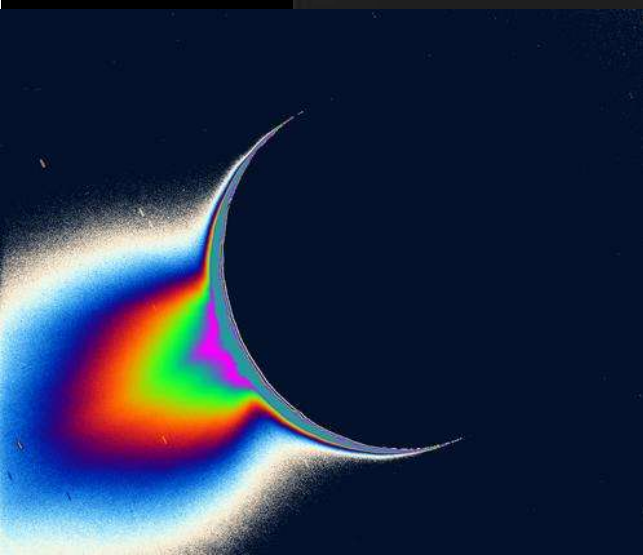


The Icy Surface of Europa





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





Mars Rover Family Portrait

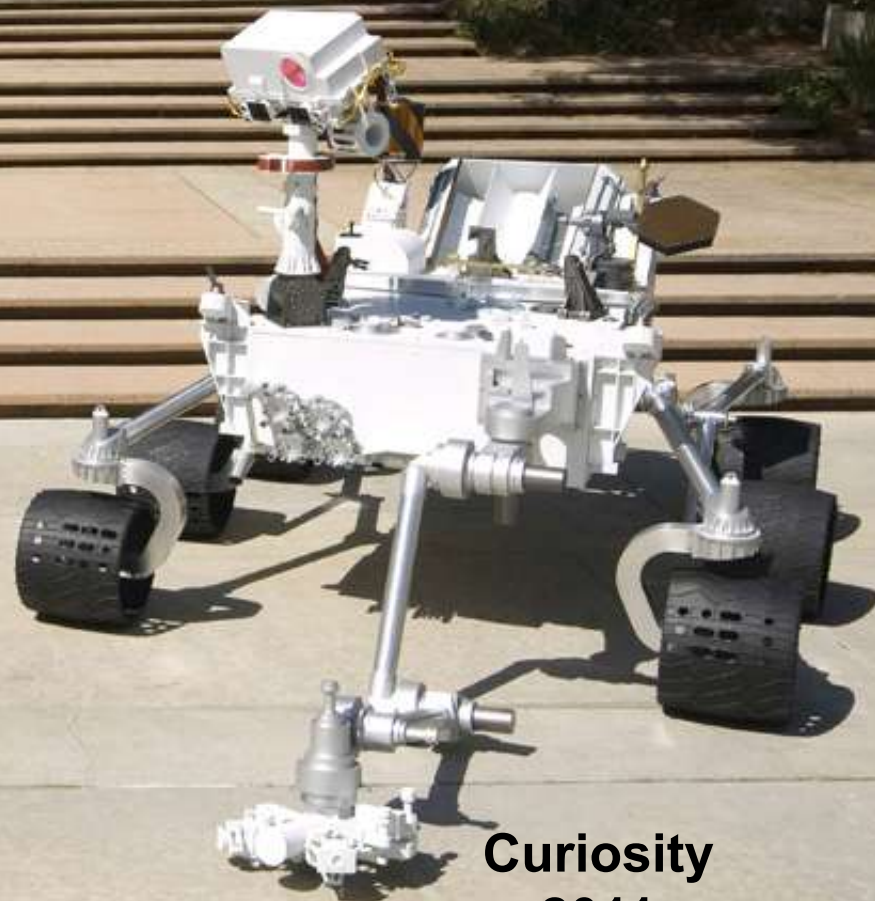
MSL "Curiosity" is the largest rover yet...to assess whether Mars ever was, or is still today, an environment able to support microbial life. In other words, its mission is to determine the planet's "habitability."



**Spirit and
Opportunity
2003**



**Sojourner
1996**



**Curiosity
2011**



Mars Science Laboratory

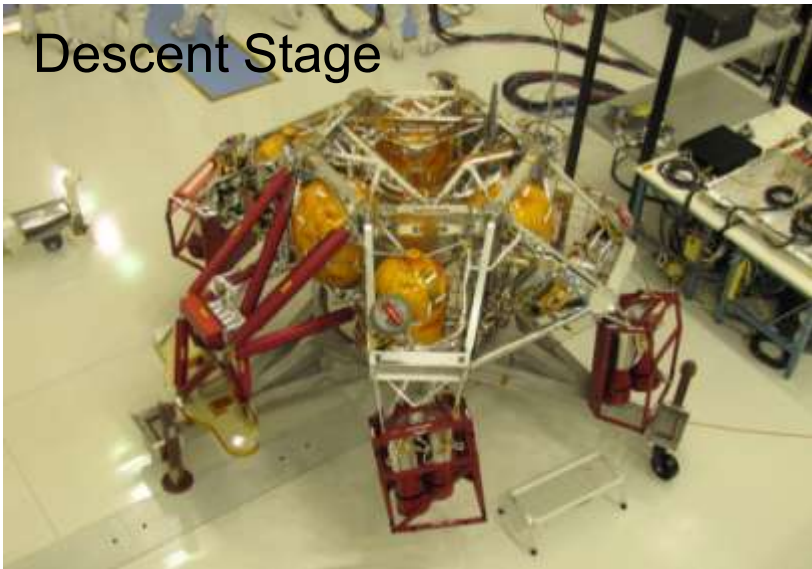
SAM Installation



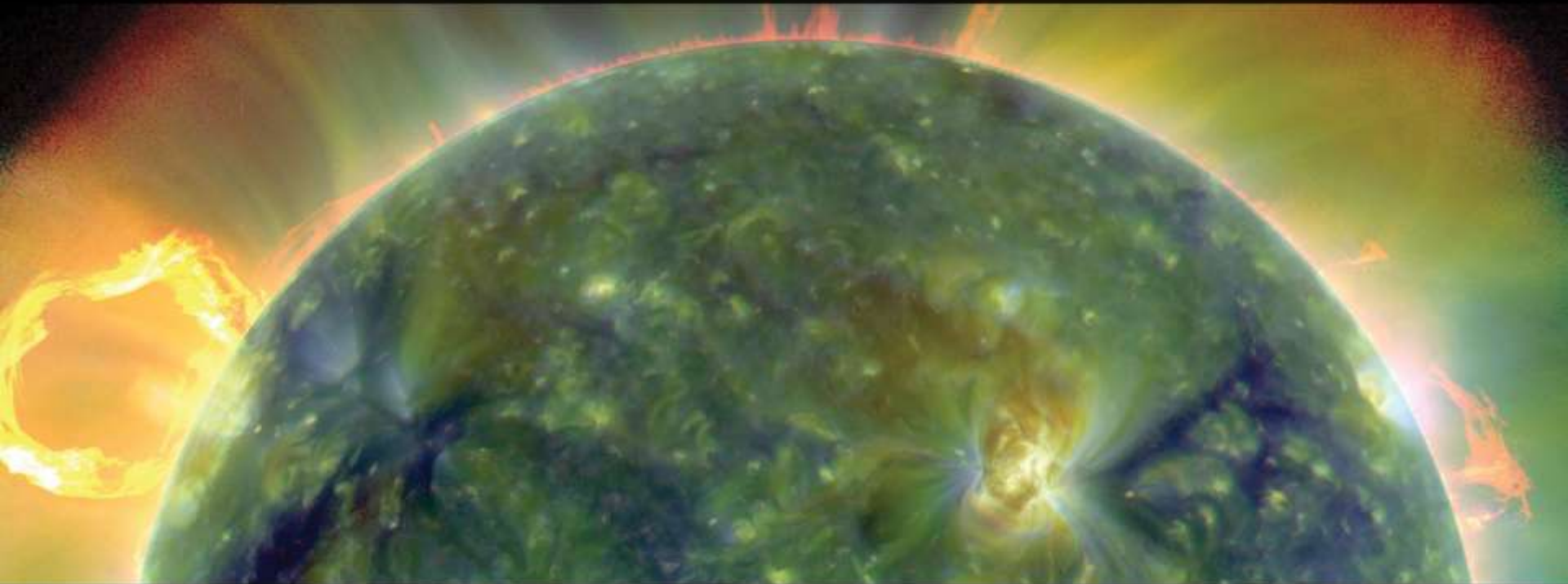
Rover Driving Test



Descent Stage



Assembled Spacecraft



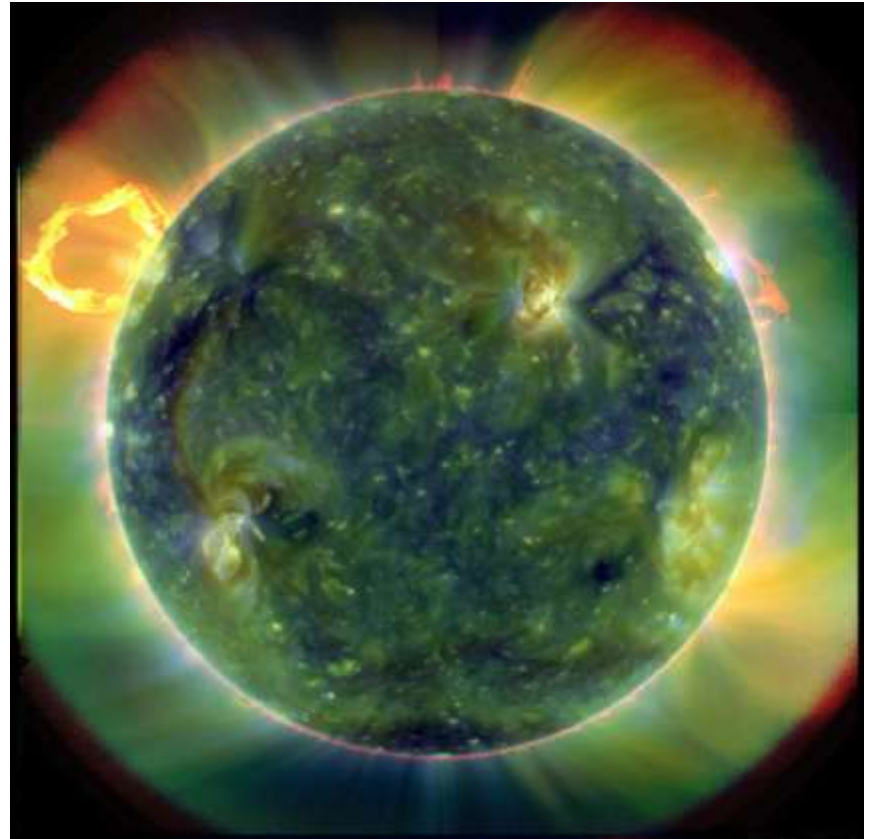
Heliophysics



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

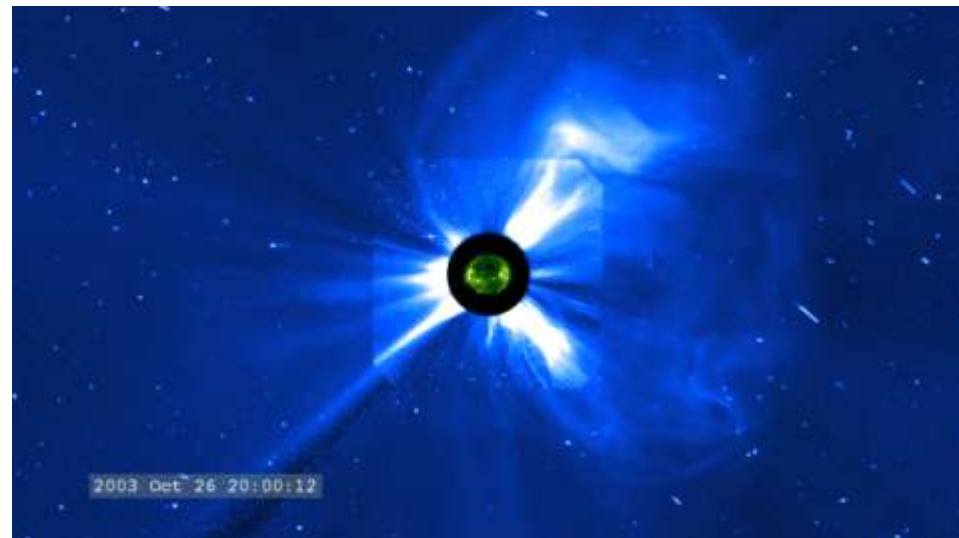
Modern society depends on a variety of technologies susceptible to the extremes of space weather

- 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)




AIM
2007 (2 year mission)




ACE
1997 (5 year mission)



SDO
2010 (5 year mission)



WIND
1994 (2 year mission)




Hinode-JAXA
2006 (3 year mission)



TIMED
2001 (2 year mission)



THEMIS (5)
2007 (2 year mission)



TWINS (2)
2008 (7 year mission)



Geotail-JAXA
1992 (3.5 year mission)



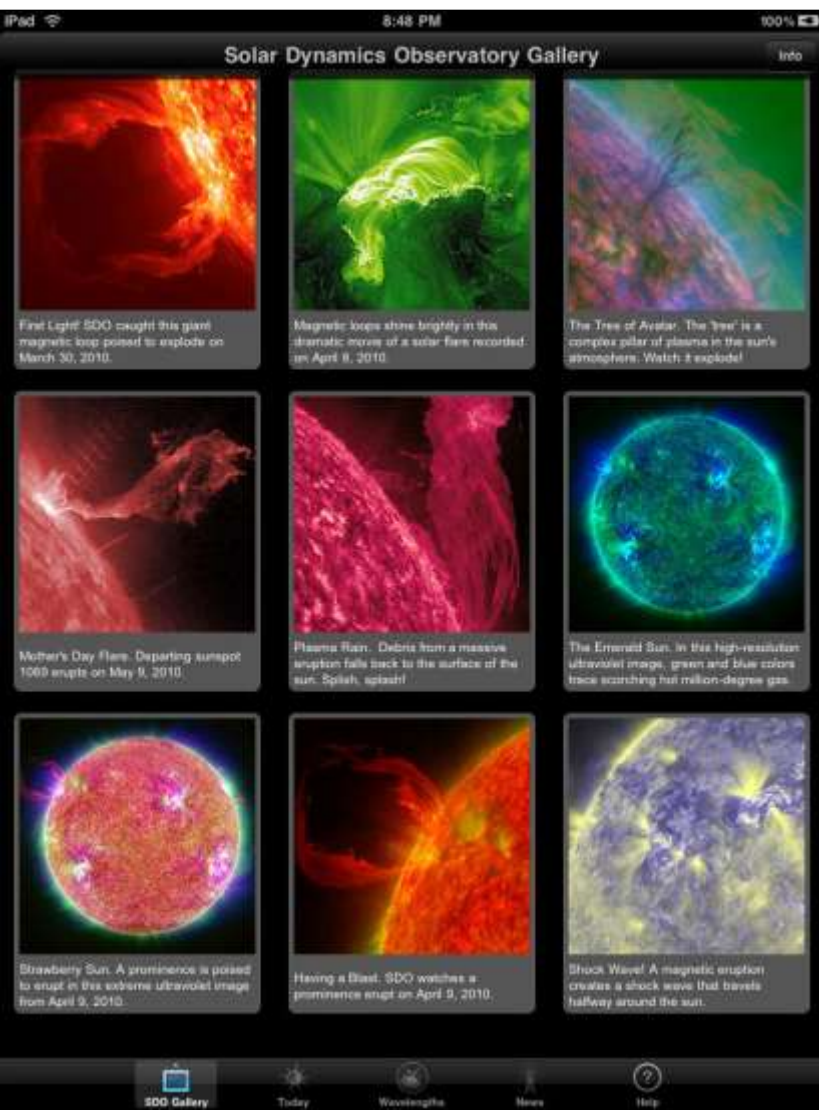
Voyager (2)
1977 (5 year mission)



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

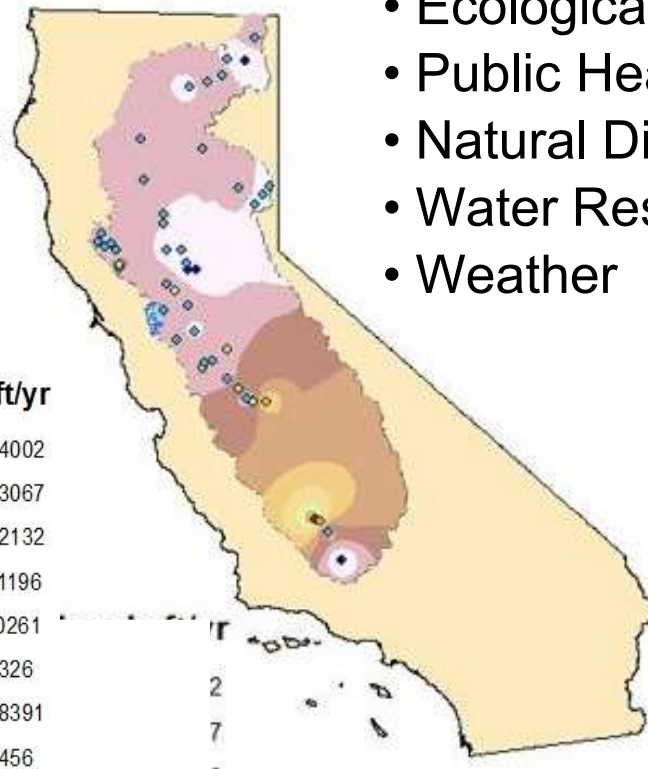
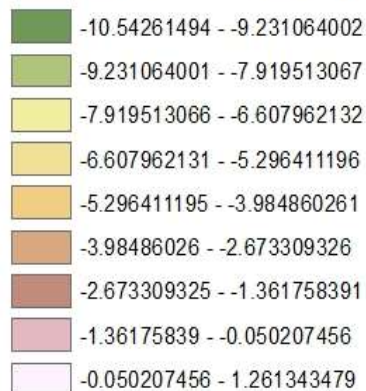
Science Focus Areas:

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

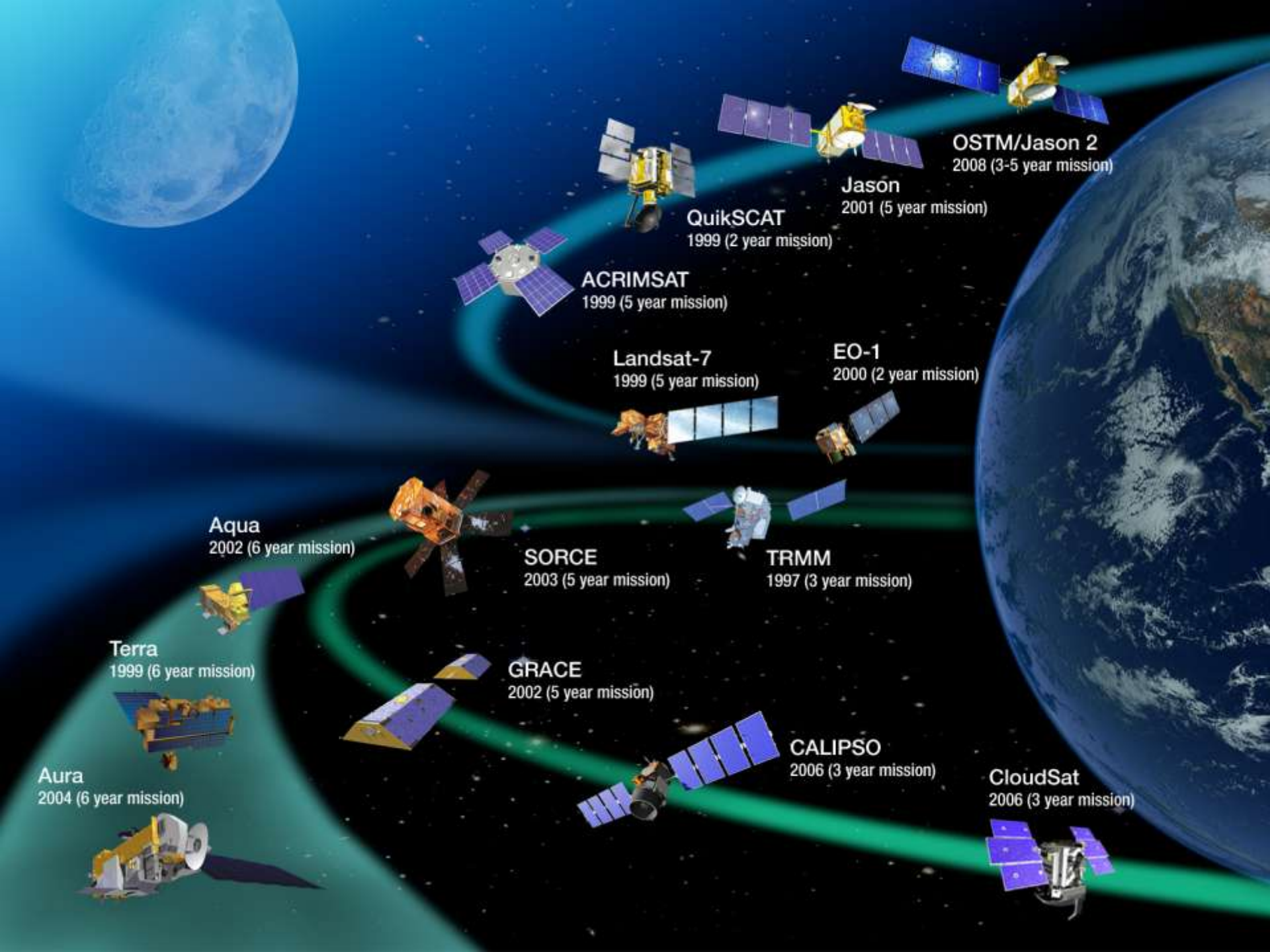
Applications Themes:

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

Ground Water Trends ft/yr



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)

EO-1
2000 (2 year mission)

Landsat-7
1999 (5 year mission)

TRMM
1997 (3 year mission)

SOFIE
2003 (5 year mission)

Aqua
2002 (6 year mission)

Terra
1999 (6 year mission)

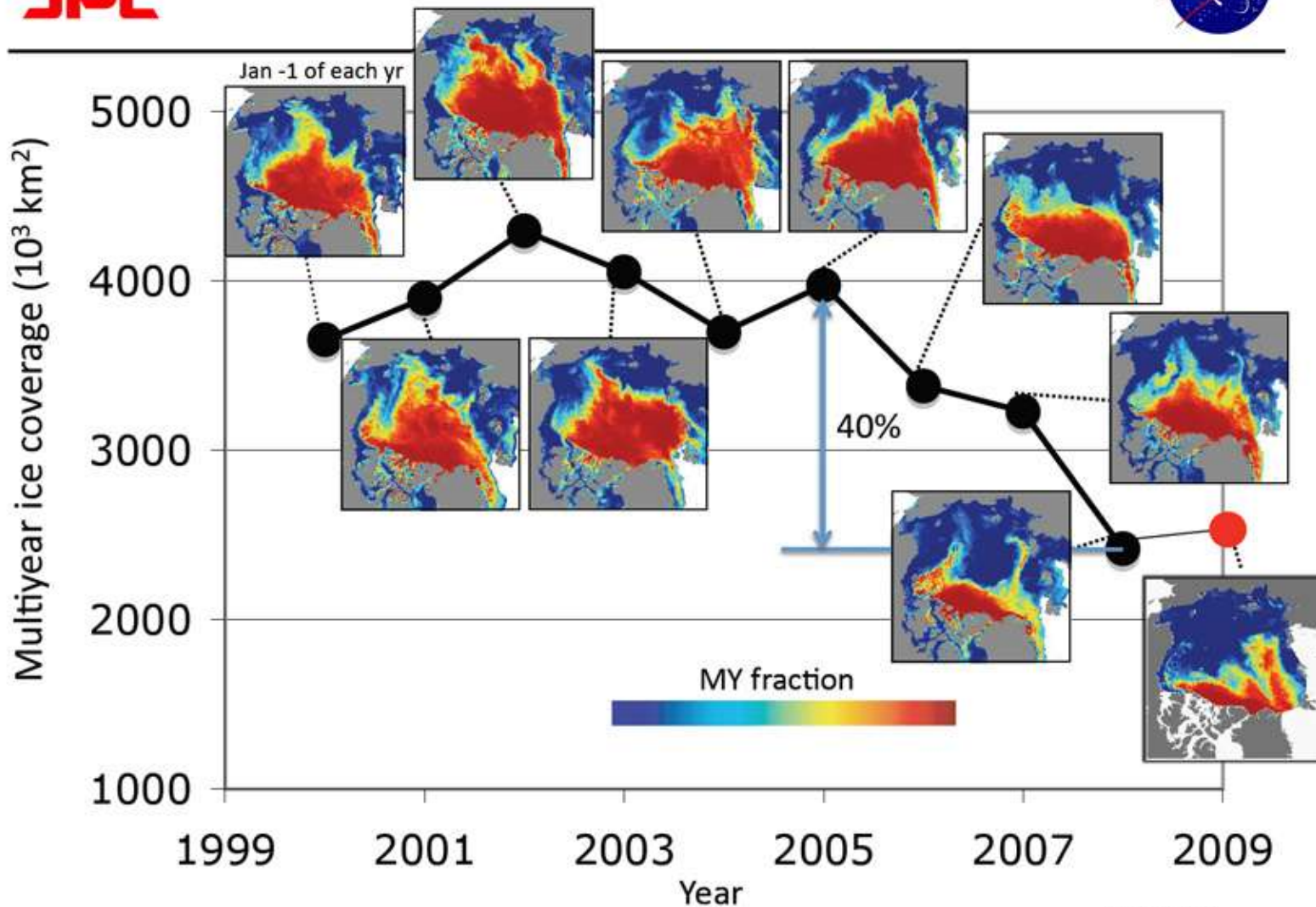
GRACE
2002 (5 year mission)

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)

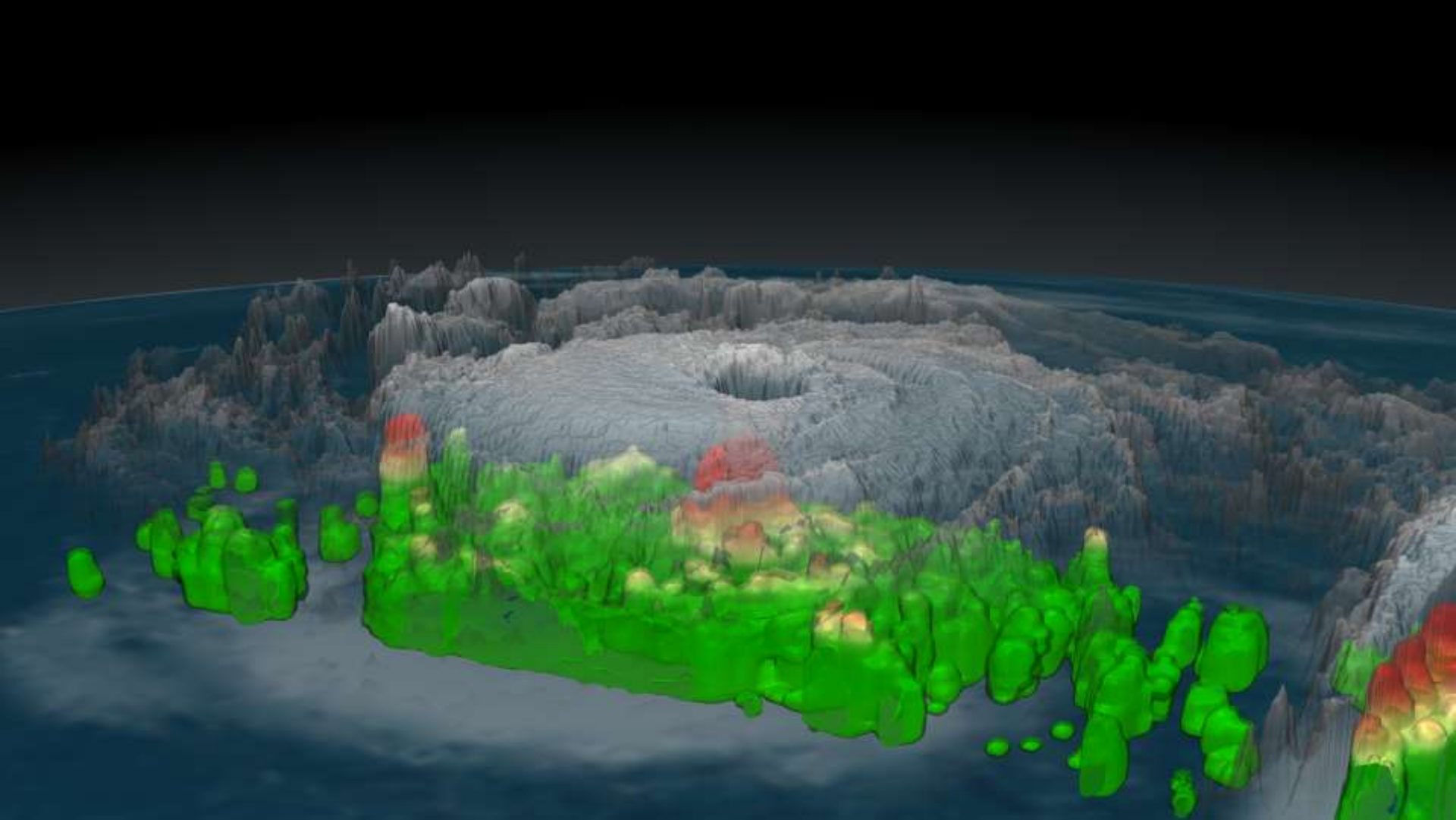


(Kwok, 2009)



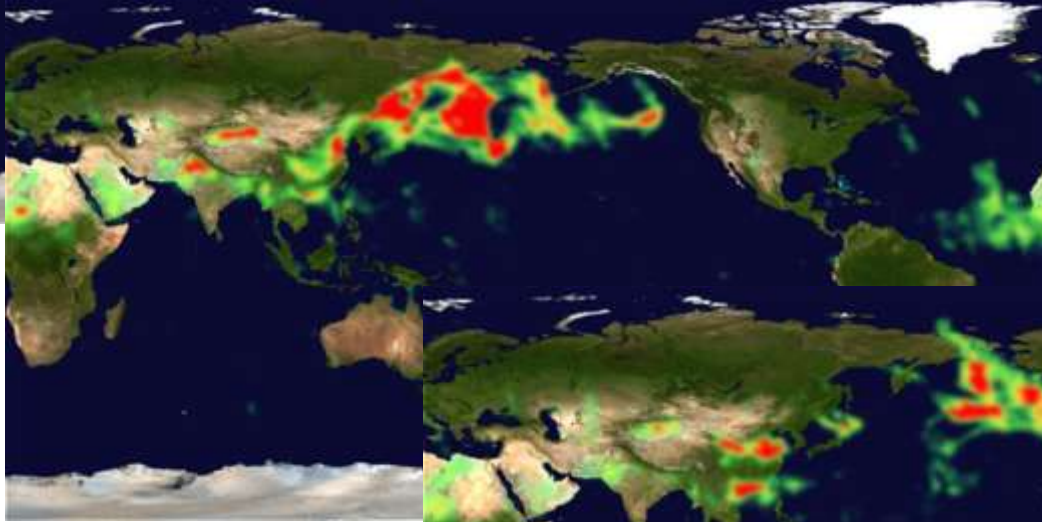
Hurricane Danielle's Hot Towers from TRMM

August 27, 2010

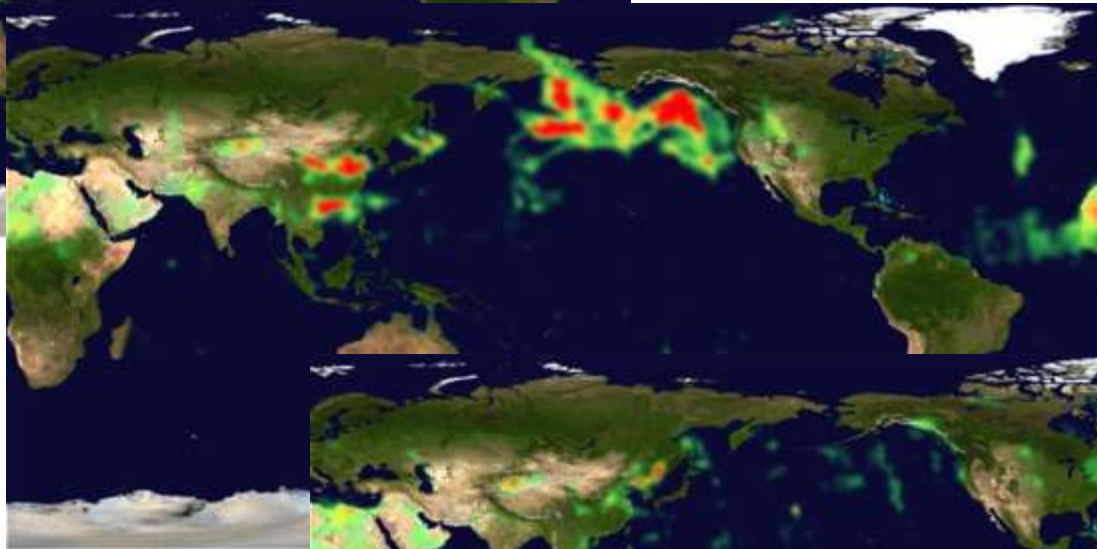




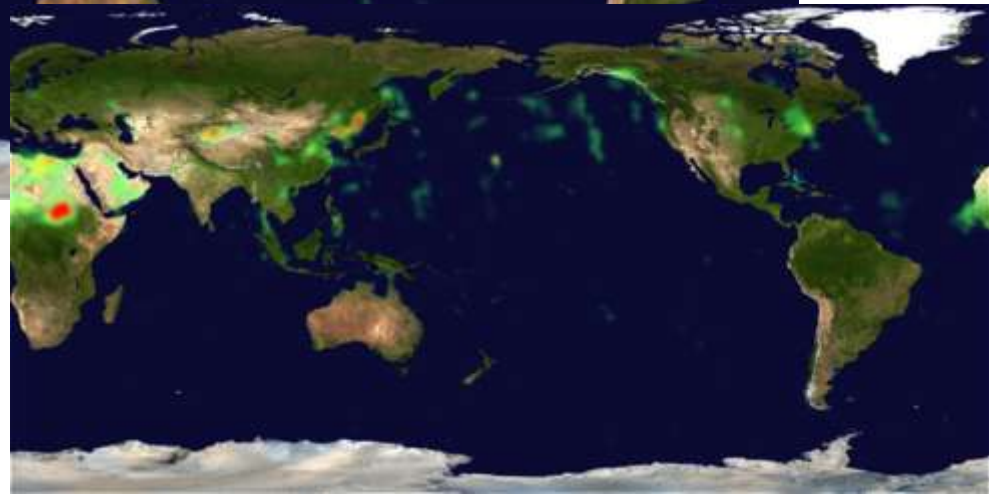
April 7, 2001



April 11, 2001



April 13, 2001

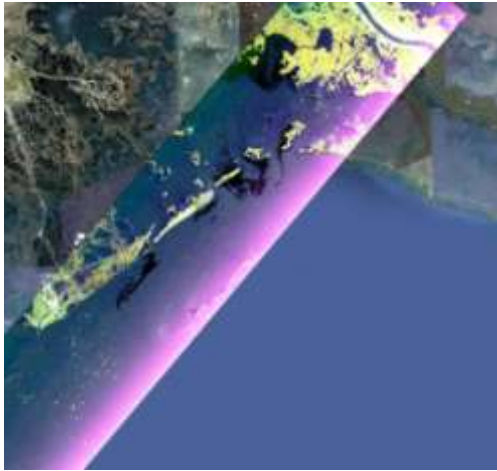


April 16, 2001

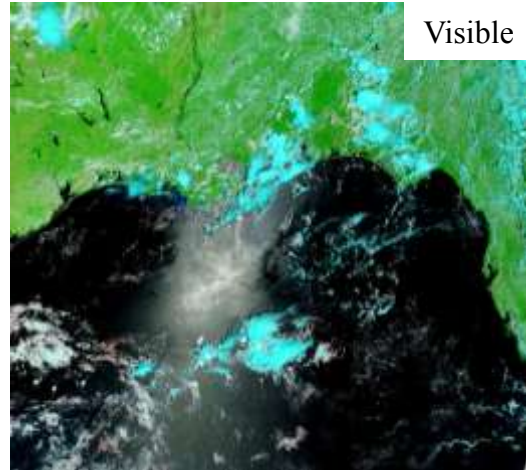
China Dust Storm
Pollutes the Air in
the Eastern US in
April 2001

Response to Gulf Oil Spill

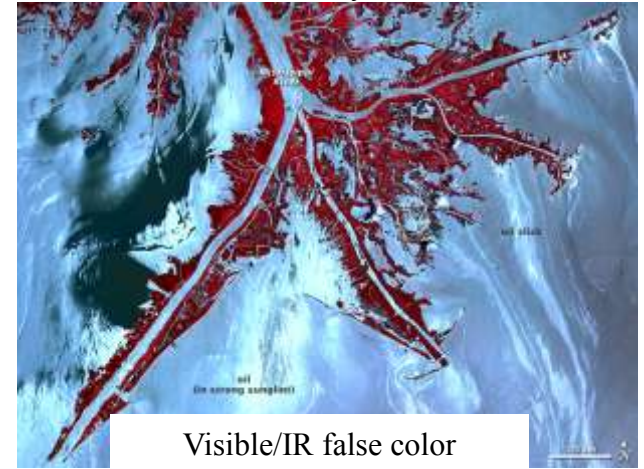
UAVSAR 23 June 2010



MODIS 31 May 2010



ASTER 24 May 2010



Satellite instruments: continually monitored the extent of the spill

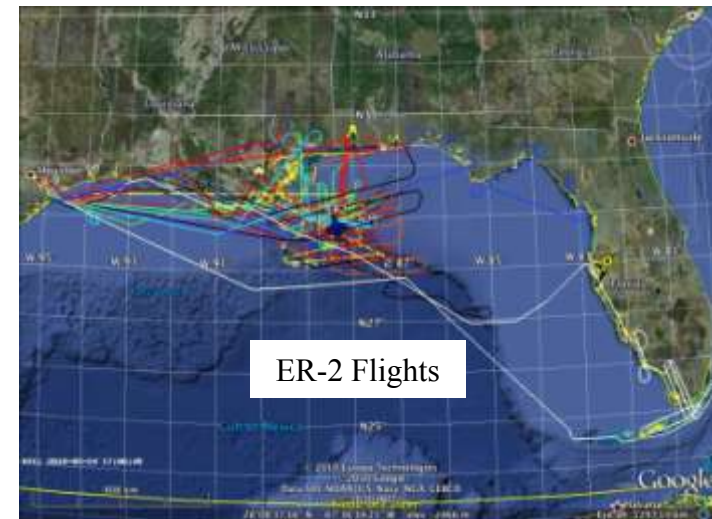
- Terra & Aqua / MODIS – visible and infrared daily synoptic
- Terra / ASTER – visible, near IR and thermal IR high res
- EO-1 / Advanced Land Imager and Hyperion – highest res
- Terra / MISR
- CALIPSO / CALIOP

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;

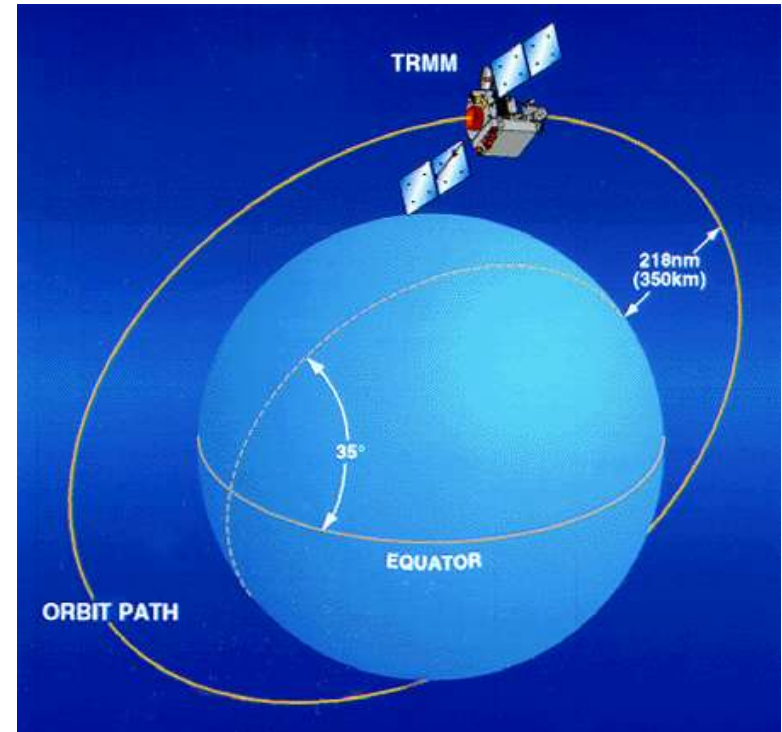
NOAA using radiances to initialize trajectory model, USGS for oil concentration





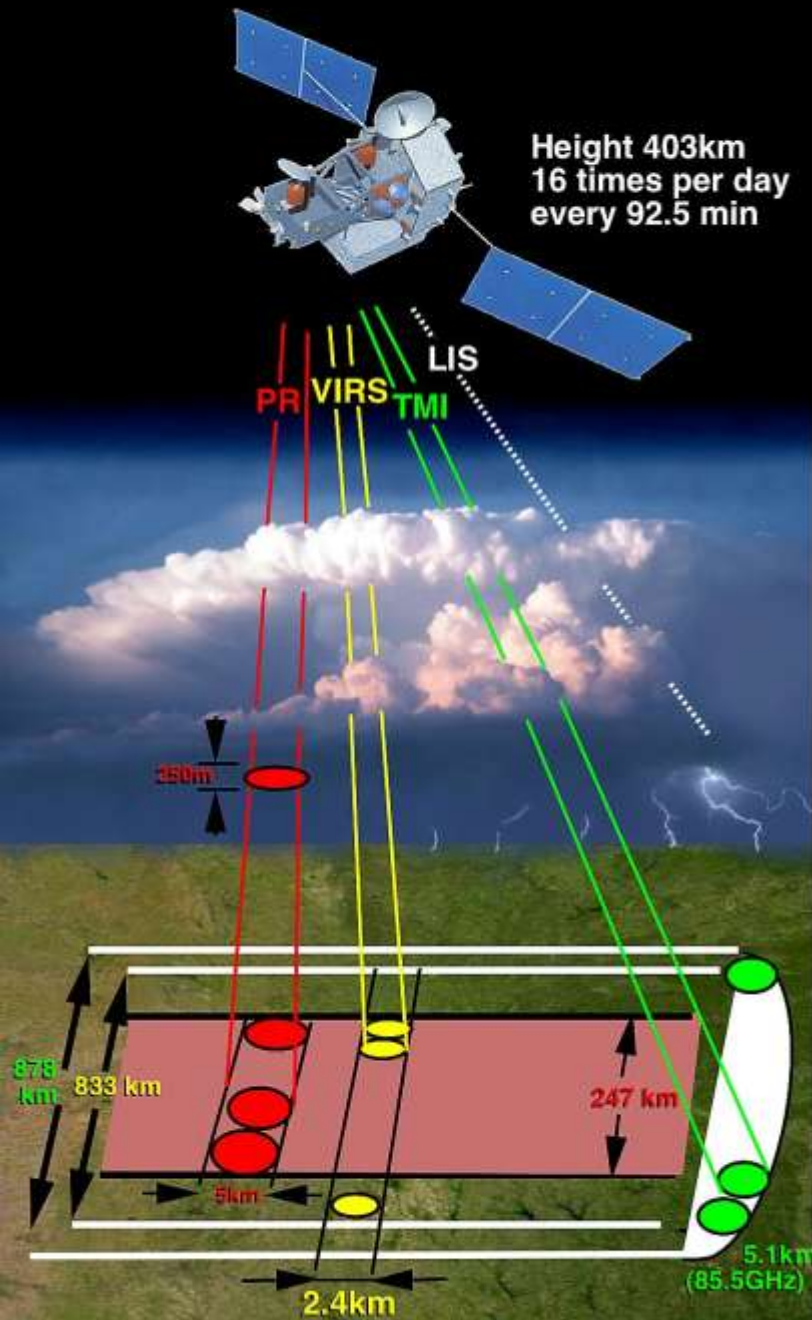
Tropical Rainfall Measurement Mission (TRMM)

- Launched in Dec. 1997.
- TRMM's goal is to determine rainfall in the tropics and subtropics of the Earth.
- 14 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.**



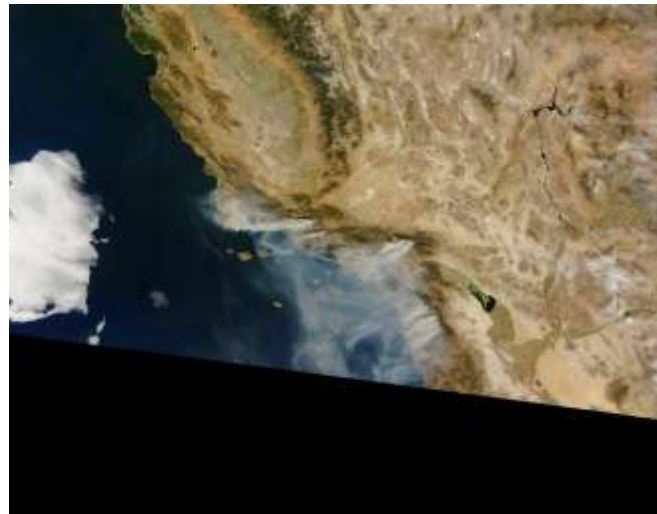


Instruments on TERRA



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

- **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)**



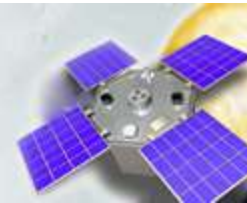
Terra MODIS, 28 October
2003, 1825 UTC: Fires in
Southern California



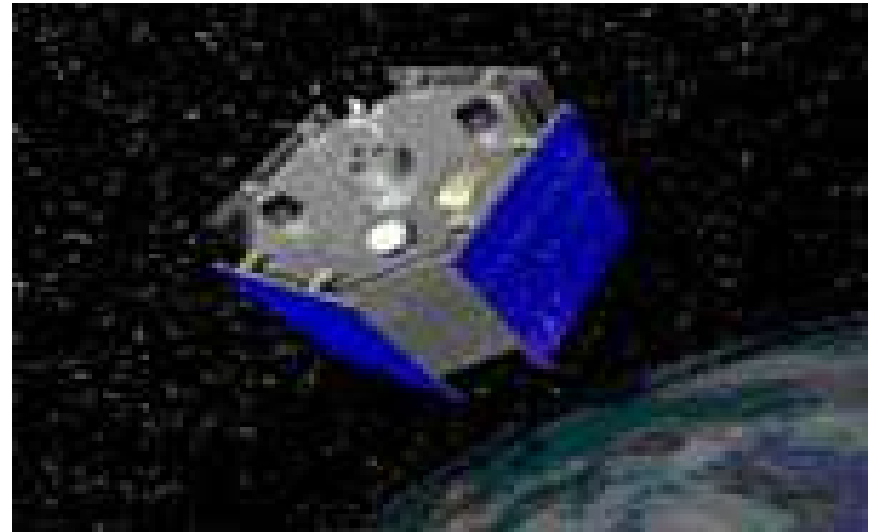
Active Cavity Radiometer Irradiance Monitor (ACRIMSAT)

ACRIMSAT

Measuring the Sun's Energy



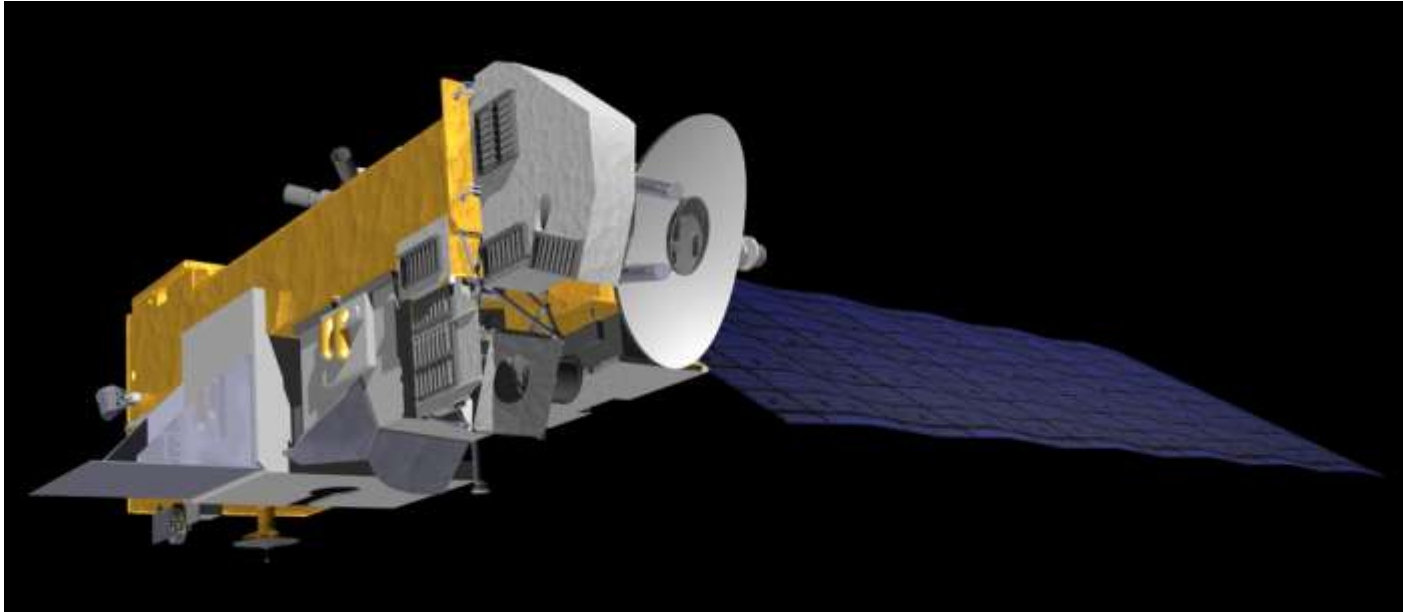
Launch Date:
December 20,
1999.



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



Aura-- 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

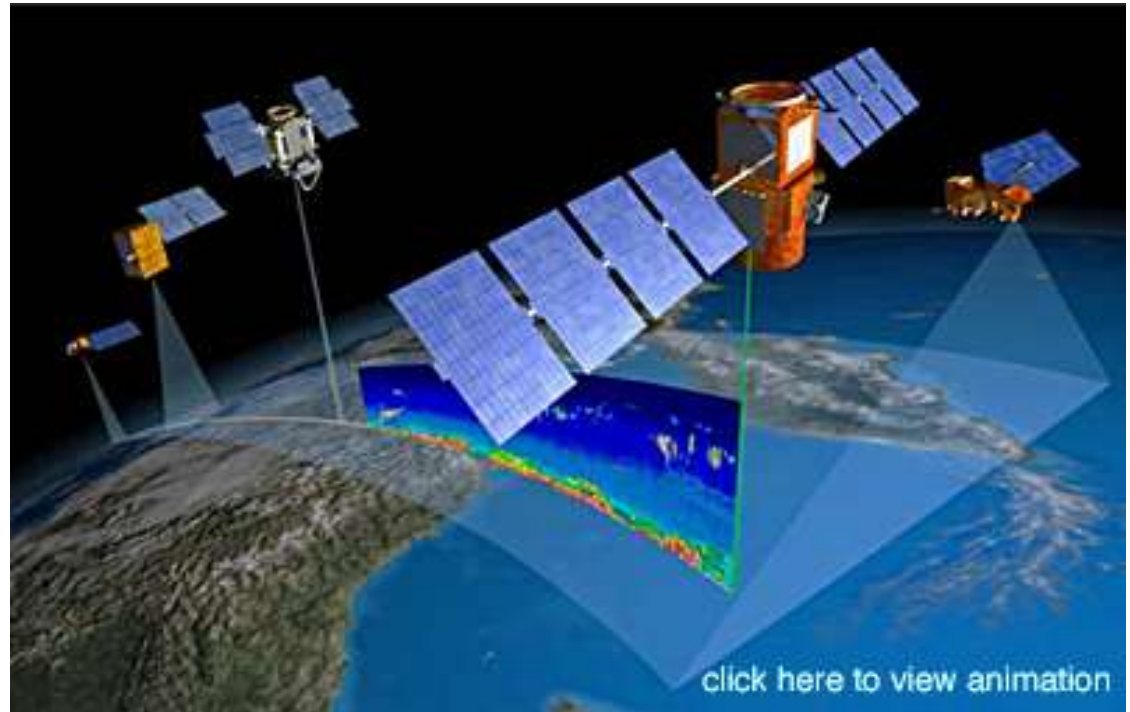
Aqua, Latin for "water," is named for the large amount of information that the Aqua spacecraft will collect about **the Earth's water cycle**. In particular, the Aqua data will include information on water vapor and clouds in the atmosphere, precipitation from the atmosphere, soil wetness on the land, 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

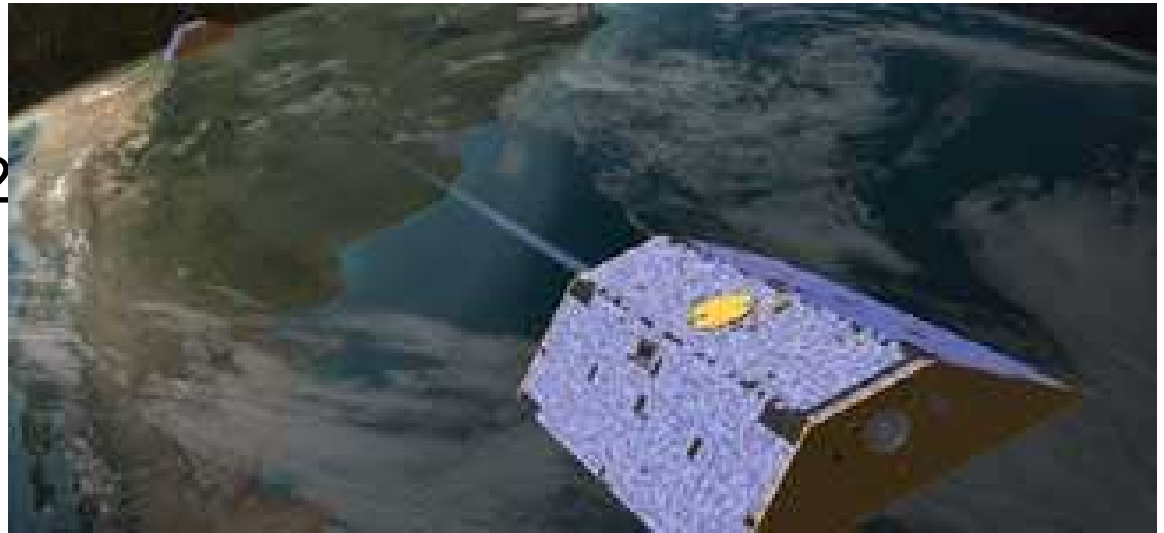


The GOES I-M satellites are the primary element of **U.S. weather monitoring and forecast operations** and are a key component of NOAA's National Weather Service operations and modernization program. Spacecraft and ground-based systems work together to accomplish the mission of providing weather imagery 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

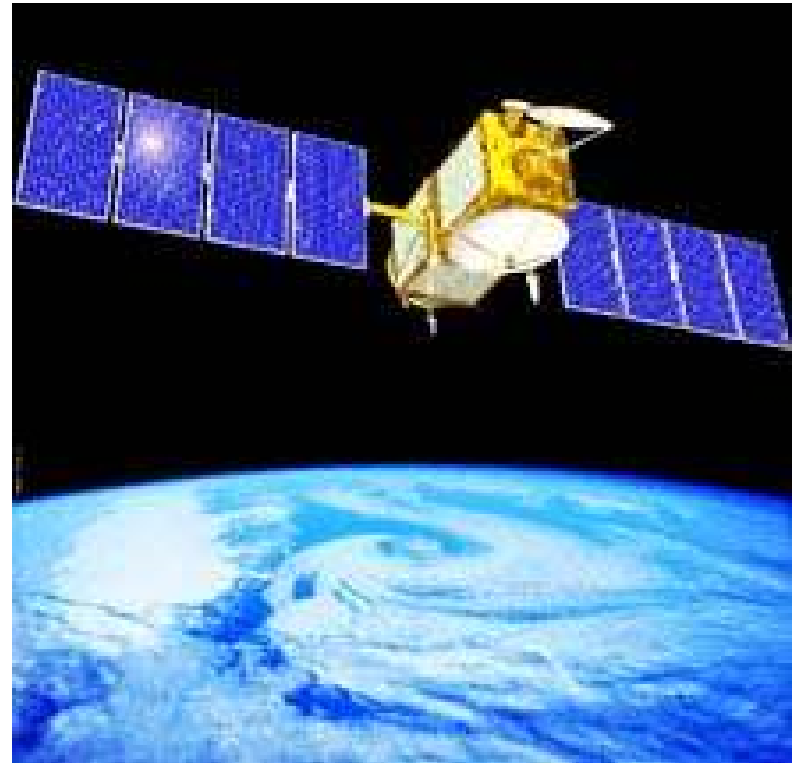


GRACE, twin satellites launched in March 2002, are making detailed measurements of **Earth's gravity field** which will lead to discoveries about gravity and Earth's natural systems. These discoveries could have far-reaching benefits to society and the world's population.



Jason-1: Launched on December 07, 2001

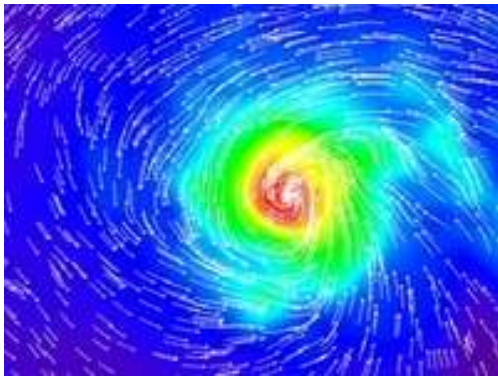
Jason is an oceanography mission to monitor **global ocean circulation**, improve global climate predictions, and monitor events such as El Niño conditions and ocean eddies. The Jason-1 satellite carries a radar altimeter, and it is a follow-on mission to the highly successful TOPEX/Poseidon mission, 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 ⁵²



Global Precipitation Measurement (GPM)

Launch Date:
Early 2014



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 28, 2011

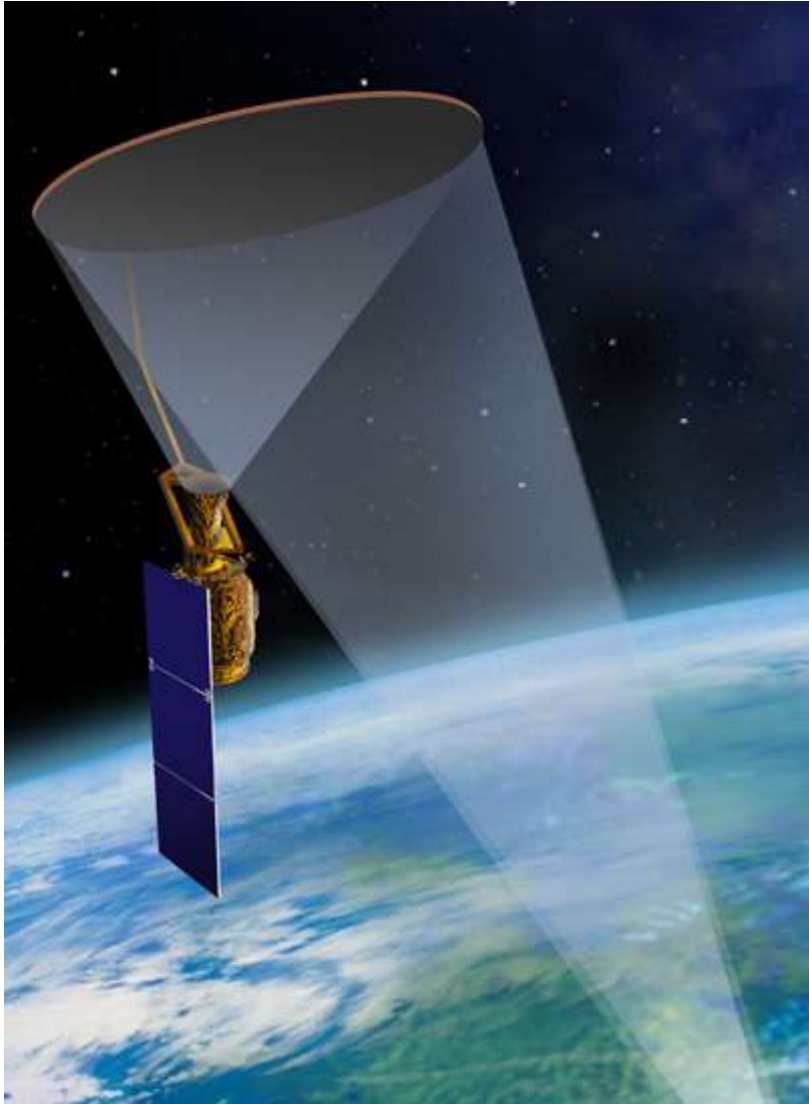


Image taken by
VIRS on NPP:
Lights of London
(March 27 2012)

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. USRP is NASA's largest nationwide internship program for undergraduates. Students may apply for a 10-week Summer session or a 15-week Spring or Fall session.

The *NASA-USRP* will consist of a 10–15 week research experience at a [participating NASA Center](#) under the supervision of a NASA technical mentor. Selected students must be available to work 10 consecutive weeks at 40 hours per week during the Summer session or 15 consecutive weeks at 40 hours per week during Spring or Fall sessions (exact dates to be determined by Centers).

Submit Internship Application for Spring 2013 in [OSSI:SOLAR](#)

06/01/2012 - 10/11/2012

<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>



NSF Research Experiences for Undergraduates:

http://www.nsf.gov/crssprgm/reu/reu_search.cfm

• **University of Oklahoma Norman Campus:** [REU Site: Research Experiences for Undergraduates at the National Weather Center](http://www.caps.ou.edu/reu/). <http://www.caps.ou.edu/reu/>

• **Astryd Rodriguez:** Our last year intern who were accepted for this OU REU program this summer. She studied how forecasters manage uncertainty at NSSL in Norman OK. Part of the program is doing a bit of tornado chasing (May 25, 2012 Dodge City, KS, 3 tornados):





NSF Research Experiences for Undergraduates:

http://www.nsf.gov/crssprgm/reu/reu_search.cfm

- **Colorado State University**

[Center for Multi-Scale Modeling of Atmospheric Processes](http://www.cmmmap.org/scienceEd/internships.html)

[\(CMMAP\)](http://www.cmmmap.org/scienceEd/internships.html) <http://www.cmmmap.org/scienceEd/internships.html>

- **Tony Cosio & Heather Vazquez:** Our last year interns who were accepted for this CSU REU program this summer.





Some Pictures from Last Year:

<http://tcpf.fiu.edu/Jiang/education/HRSSERP/index.html>





Some Pictures from Last Year:

<http://tcpf.fiu.edu/Jiang/education/HRSSERP/index.html>





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