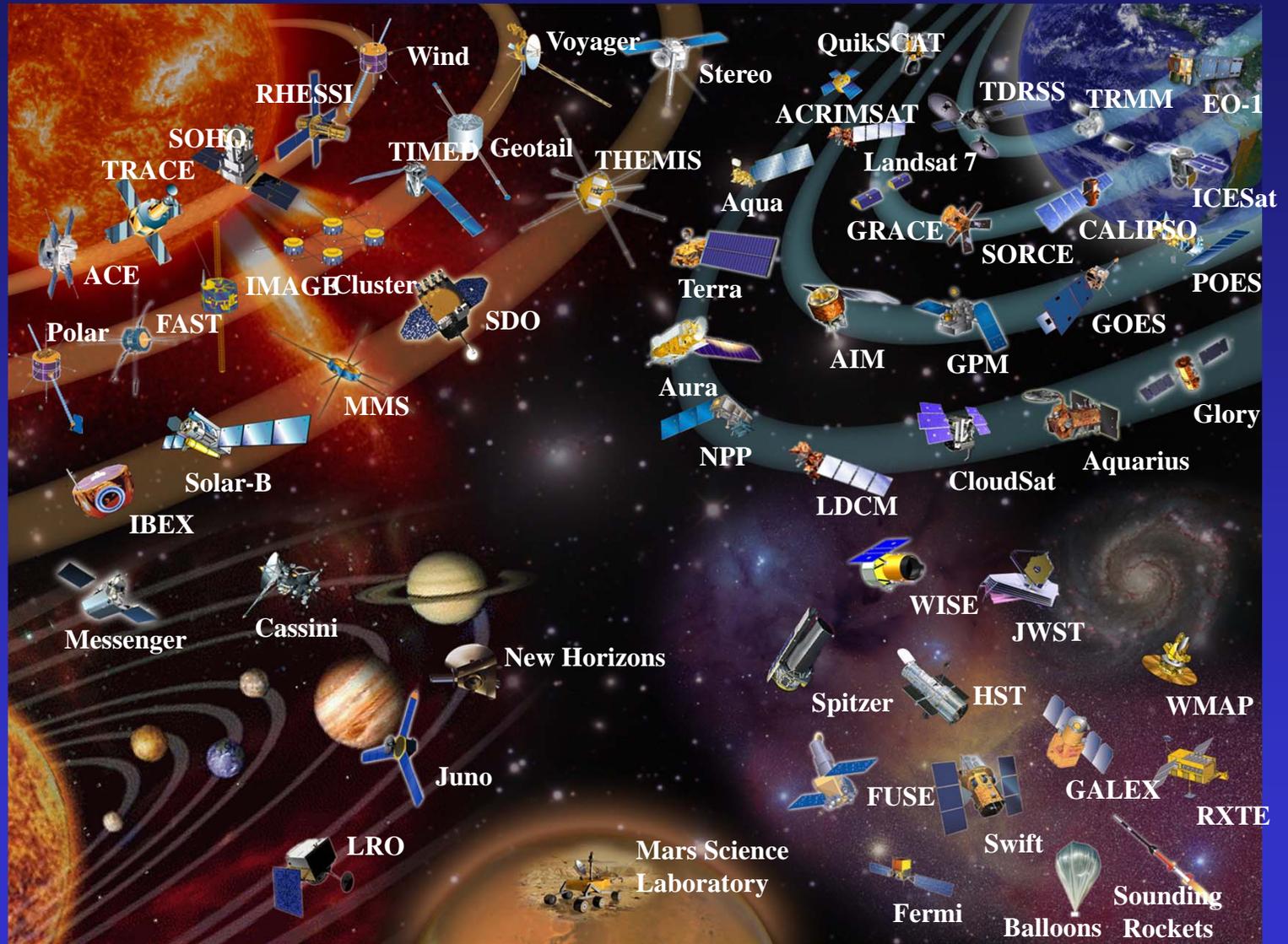


How NASA Sees the Earth and its Climate

Dr. Eric Brown de Colstoun
Earth Sciences Division
NASA Goddard Space Flight Center
Greenbelt, Maryland



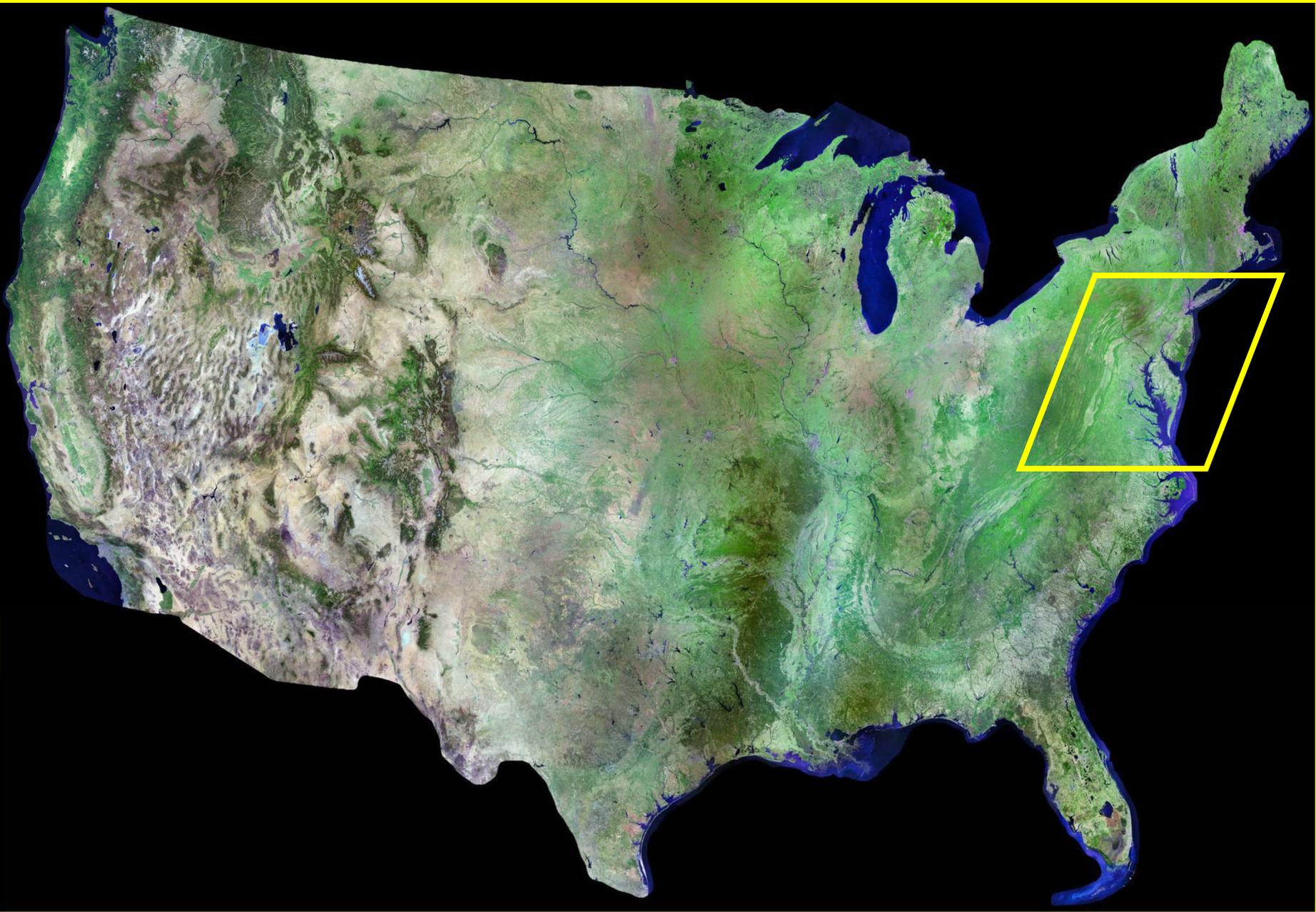
NASA Does Missions!





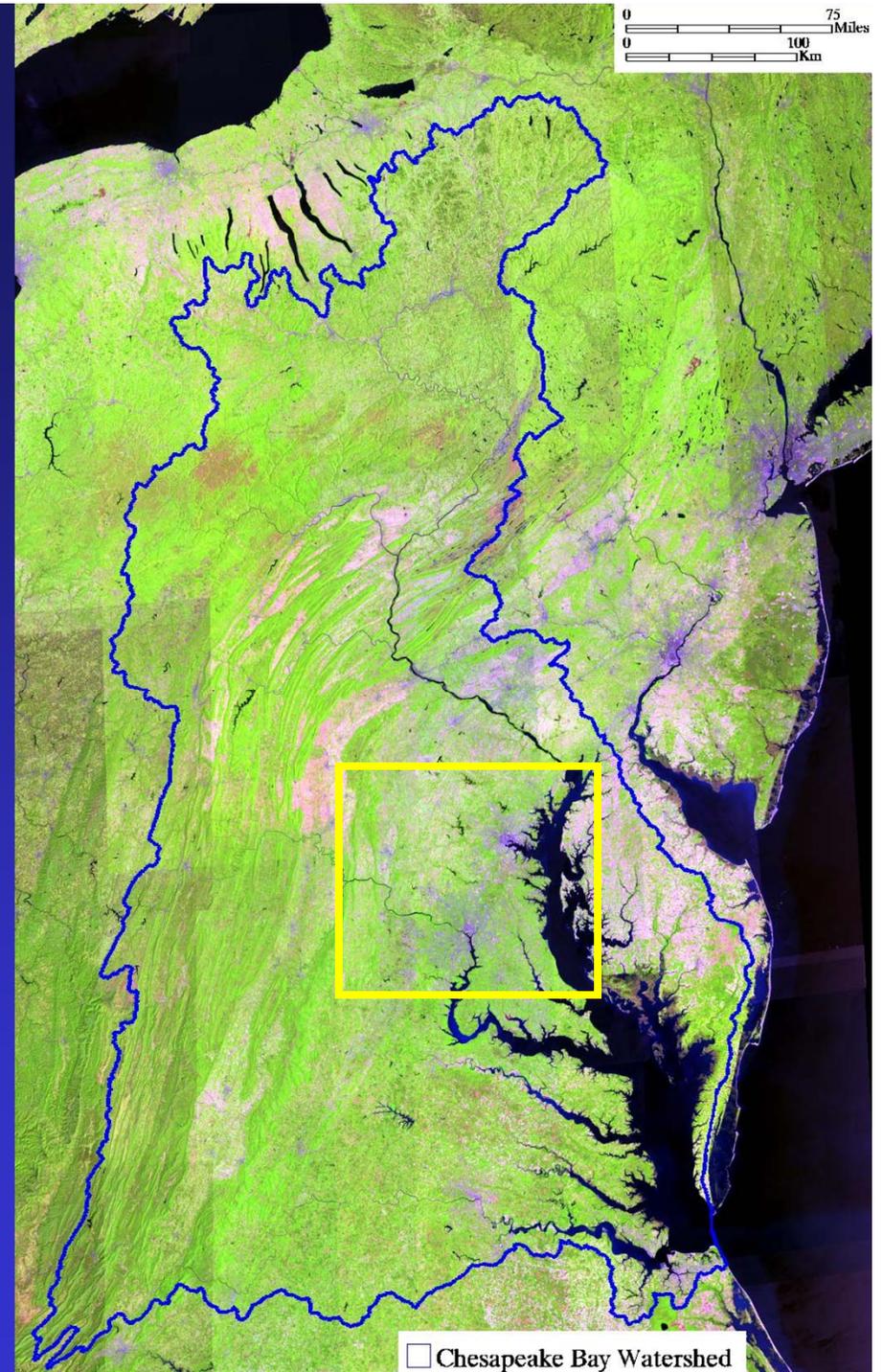
X You are here!!

VIIRS Blue Marble
4 January 2012



LEDAPS Mosaic of the Chesapeake Bay Watershed

2000 Epoch



Landsat5 TM

Acquired 06/10/08





X You are here!!

NASA Research Addresses Broad Questions

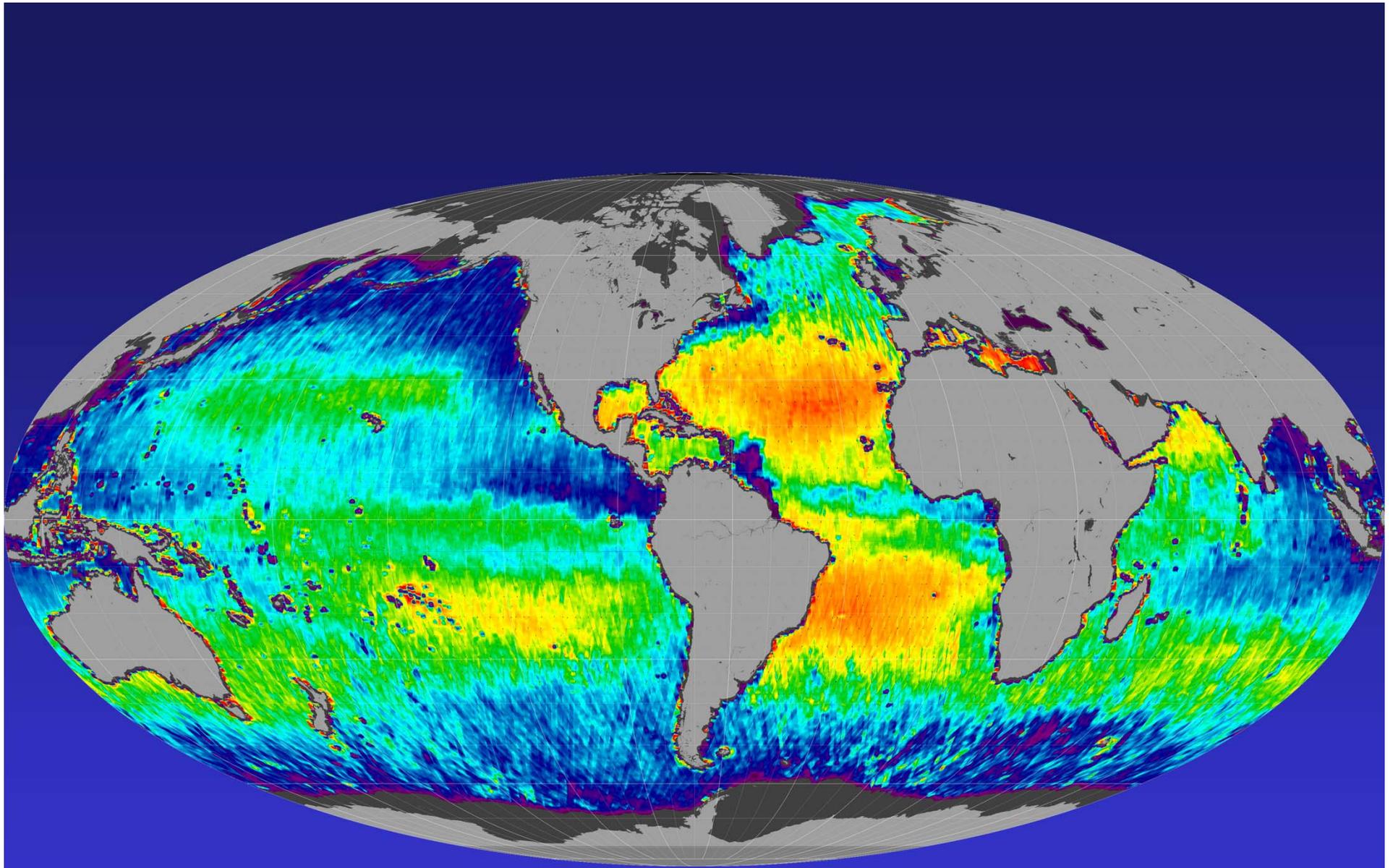


- How are global ecosystems changing ?
- What changes are occurring in global land cover and land use, and what are their causes ?
- How is the Earth's surface being transformed and how can such information be used to predict future changes ?
- What are the consequences of land cover and land use change for the sustainability of ecosystems and economic productivity ?

Earth Science News



- Vital Signs of the Planet (climate.nasa.gov):
 - CO2 at 393ppm
 - September 2011 Sea Ice Concentration Minimum third lowest in satellite record (1979-current)
 - Global Average Temperature 11th warmest since 1880
- Landsat 40th Anniversary July 23rd 2012
- One year anniversary of Aquarius on June 11th. First global maps of ocean salinity from space (see http://www.nasa.gov/mission_pages/aquarius/news/first-year.html).
- New data from Suomi NPP sensors continue long-term satellite record.
- Earth Science Week October 14-20, 2012, Theme: “Careers in Earth Science”

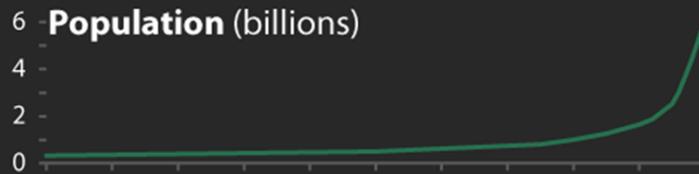


Aquarius Ocean Salinity
May 27-June 2, 2012

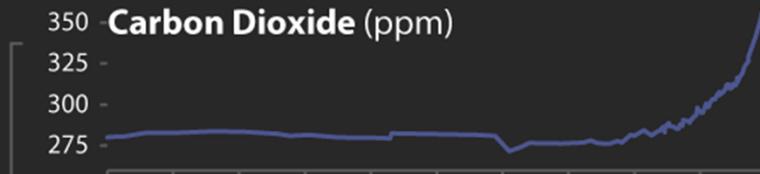
Some Resources

- Earth Science Week:
 - climate.nasa.gov/esw2010
- GLOBE Program:
 - www.globe.gov
- Landsat:
 - landsat.gsfc.nasa.gov/education

Human Fingerprints on the Climate

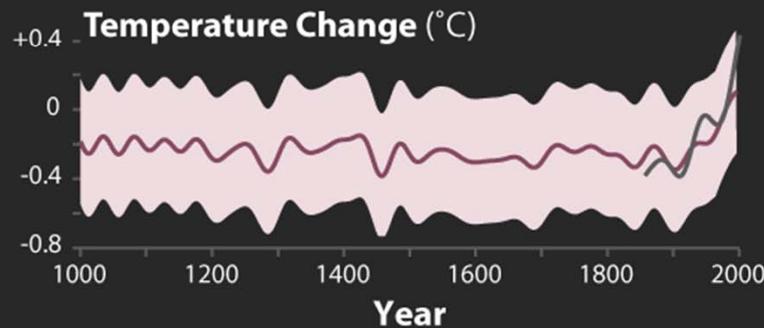
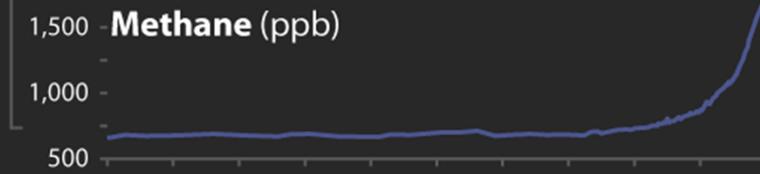
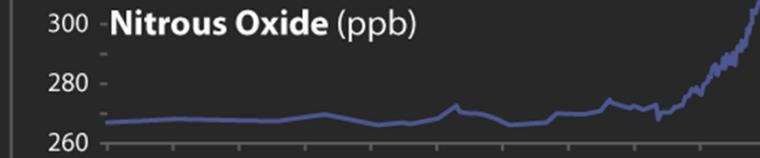


Population doubled & then doubled again over the last century, from 1.65 billion to more than 6 billion inhabitants.

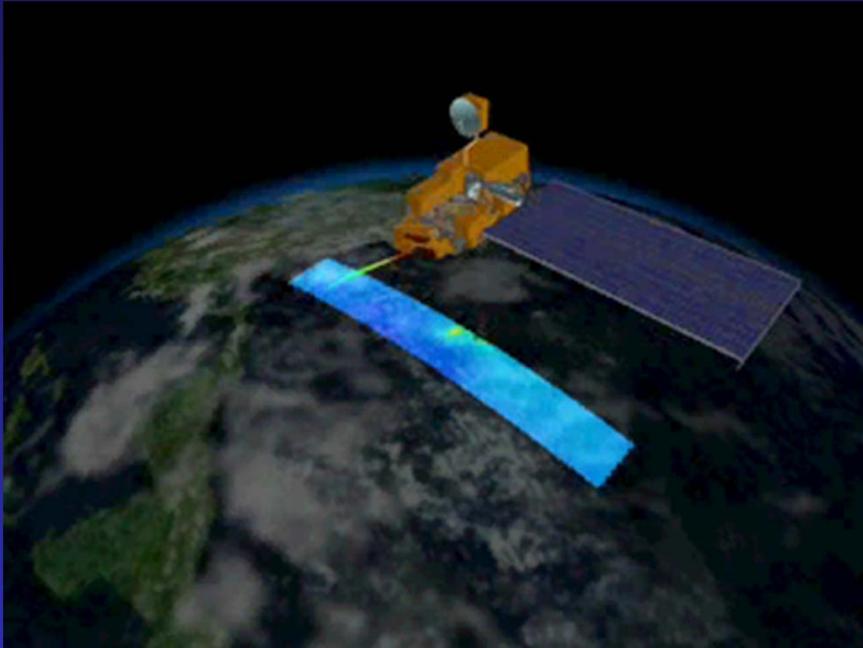


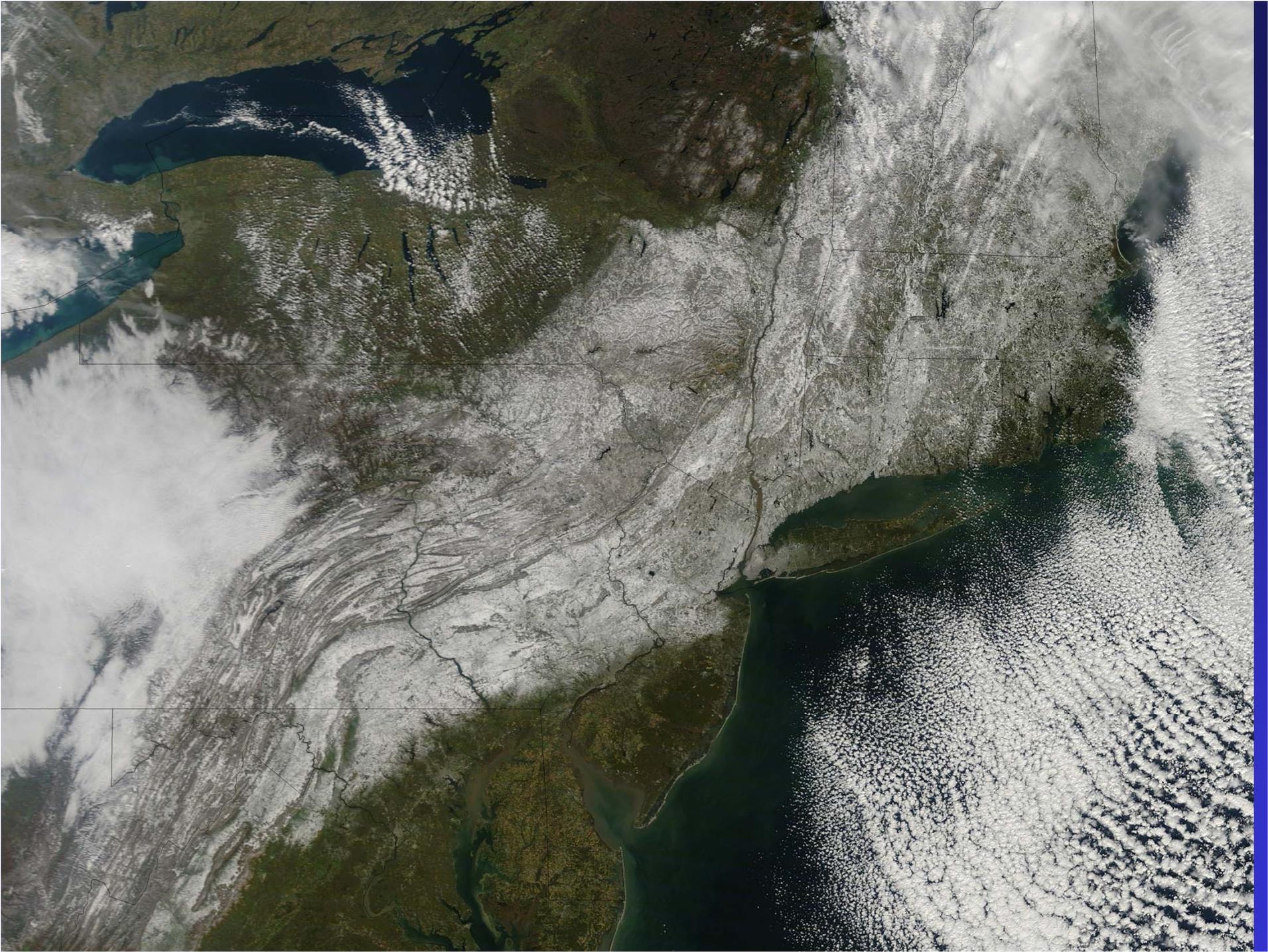
In that same span, there is a rise in the three most abundant persistent greenhouse gases that mirrors the growth in human population. Isotopic analysis and carbon cycle models established that the increase in carbon dioxide was due to fossil fuel consumption.

Greenhouse Gases



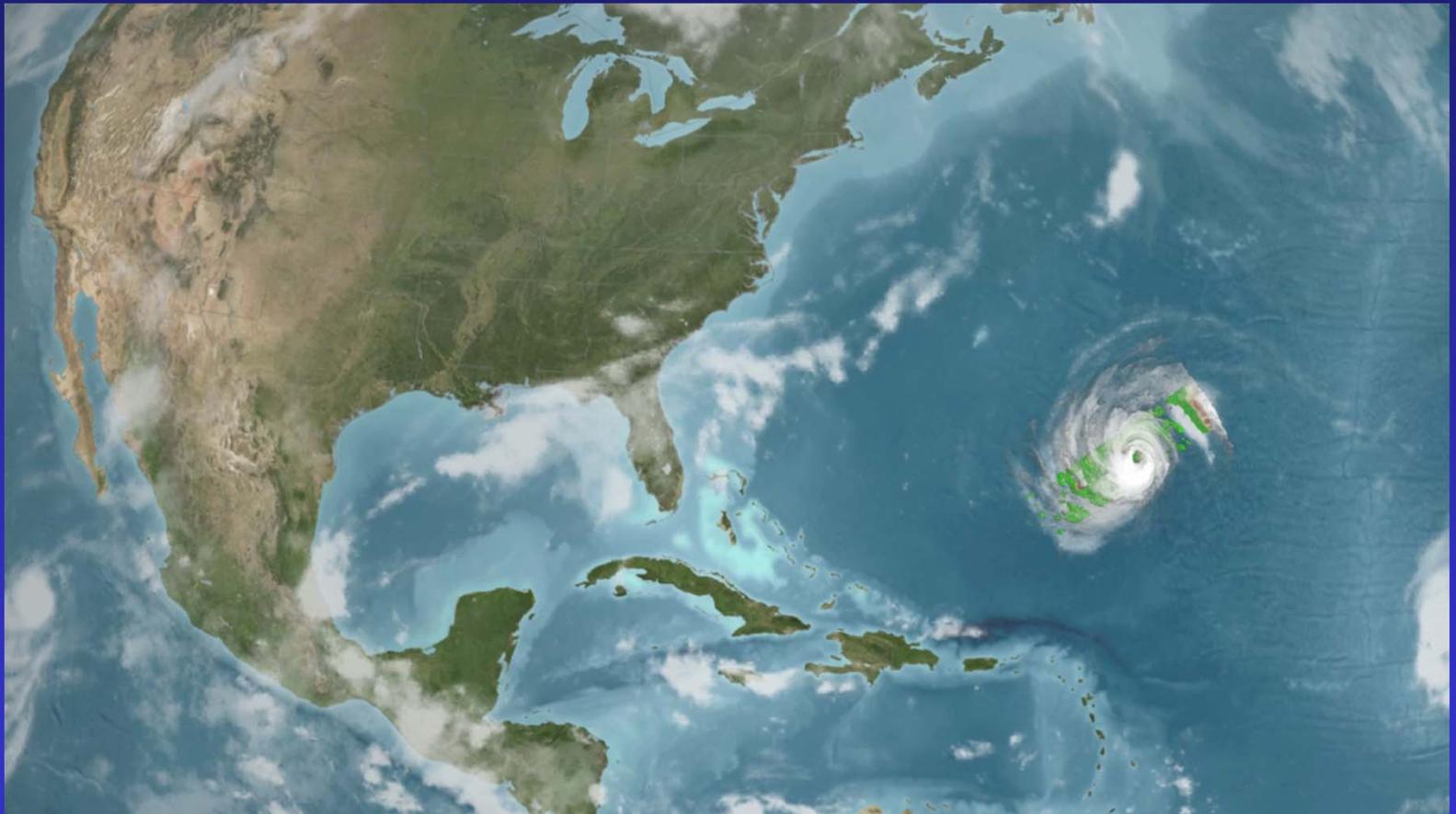
With the rise in those greenhouse gases, Earth experienced an unusually rapid rise in its average temperature—increasing $\sim 0.9^{\circ}\text{C}$ since 1880.

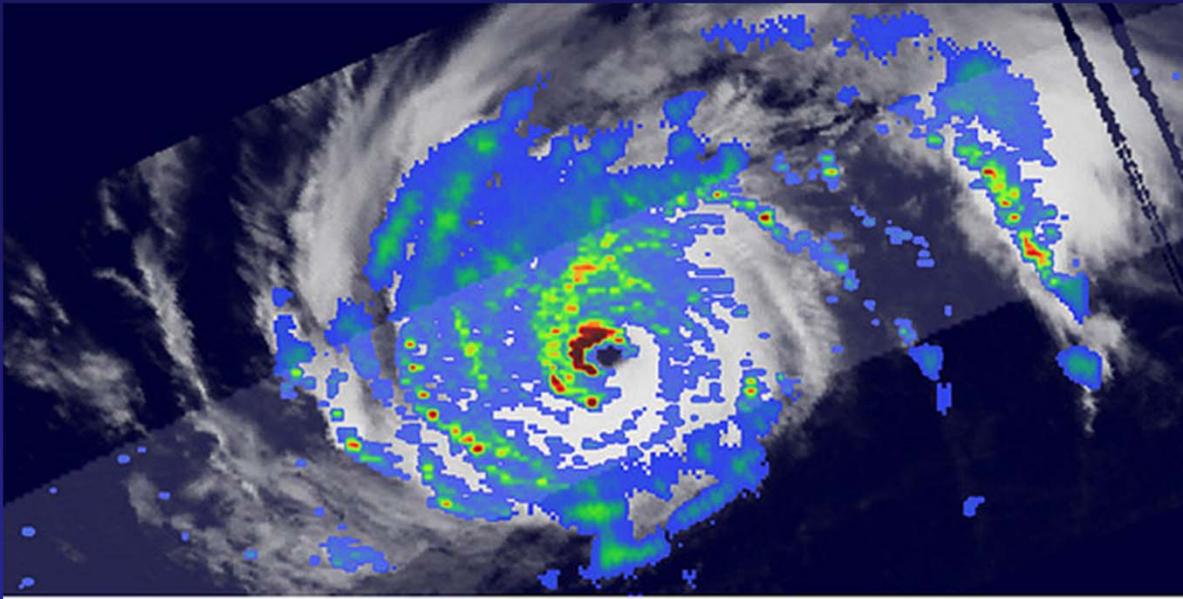




Dissecting Deadly Storms

The Tropical Rainfall Measuring Mission (TRMM) captures deeply convective “hot towers” (in red) that are the key to hurricane Danielle’s intensification (8/27/2010).





The TRMM satellite dissects Hurricane Danielle, showing the “hot towers” that allow a storm to fuel itself from the inside out (8/27/2010).

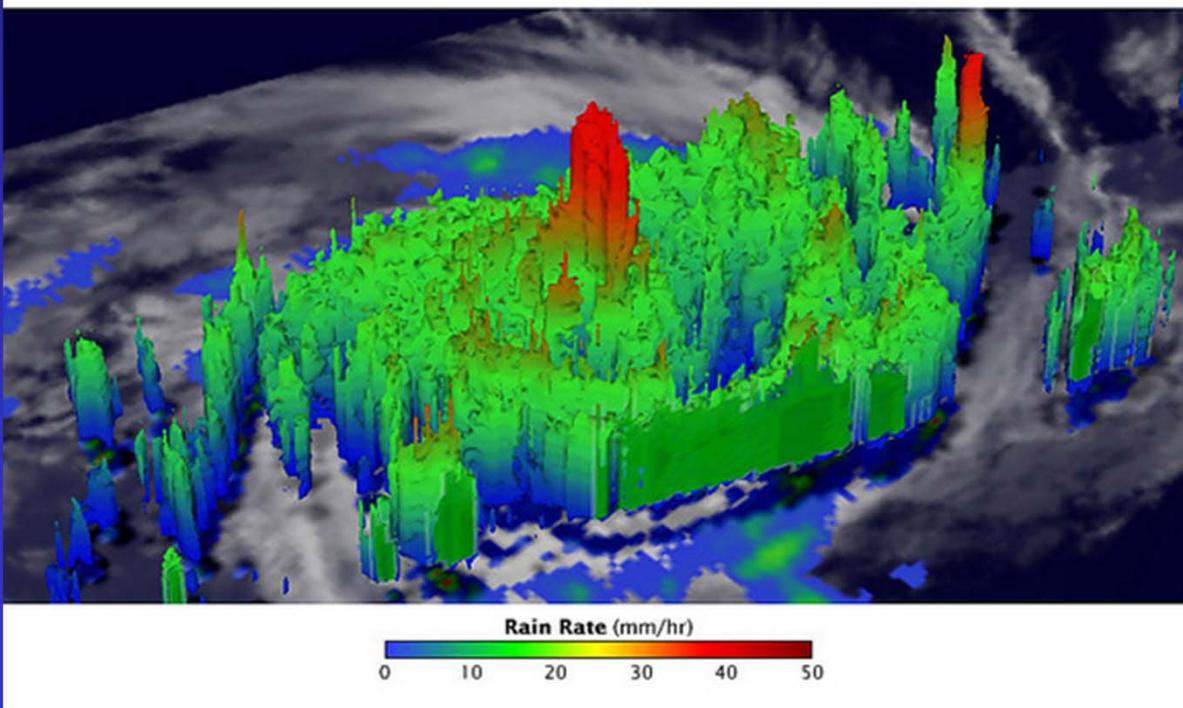


Image courtesy Hal Pierce, TRMM Team at NASA Goddard Space Flight

Hurricane Danielle, Hurricane Earl and Developing Tropical Depression
8/30/2010. Image Credit: NOAA/NASA GOES Project





Suggest to Friends

NASA's Hurricane Web Page covers tropical cyclones all around the world, every day of the year!
www.nasa.gov/hurricane. It is managed out of NASA's Goddard Space Flight Center, Greenbelt, Md.
 For questions contact:
Robert.J.Gutro@nasa.gov

Information

Founded:
2005

670 People Like This



Anthony Scott



Carlos Suárez



Christina Petch



CM



Michel



Christina

NASA's Hurricane Web Page Like

Wall Info Photos Discussions

NASA's Hurricane Web Page + Others NASA's Hurricane Web Page Just Others



NASA's Hurricane Web Page NW PACIFIC –A low pressure area near 13.9N 151.2, about 365 NM east of Guam appears conducive for development of a tropical cyclone in the next 48 hours.

Yesterday at 9:52am

Like 2 people like this.



NASA's Hurricane Web Page NW PACIFIC– Typhoon Fanapi passed through Taiwan yesterday and is in the Taiwan Strait, headed west for landfall in China tomorrow. Max. sustained winds near 74 mph.

Yesterday at 9:51am

Like Exequiel Borla likes this.



NASA's Hurricane Web Page CENTRAL PACIFIC–An area of thunderstorms persists around a weak and slow-moving low 930 miles southeast of Hilo Hawaii. Just a 10% chance of becoming a tropical depression in the next 48 hours.

Yesterday at 9:49am

Like Exequiel Borla likes this.



NASA's Hurricane Web Page E PACIFIC– A BROAD LOW PRESSURE SYSTEM CENTERED ABOUT 150 MILES SOUTH OF MANZANILLO MEXICO is producing a large area of showers and t-storms. Has a 40% chance of becoming a tropical depression in 48 hours. SATELLITE IMAGE: Low is in the bottom right corner of this GOES-11 image from this morning <http://goes.gsfc.nasa.gov>...

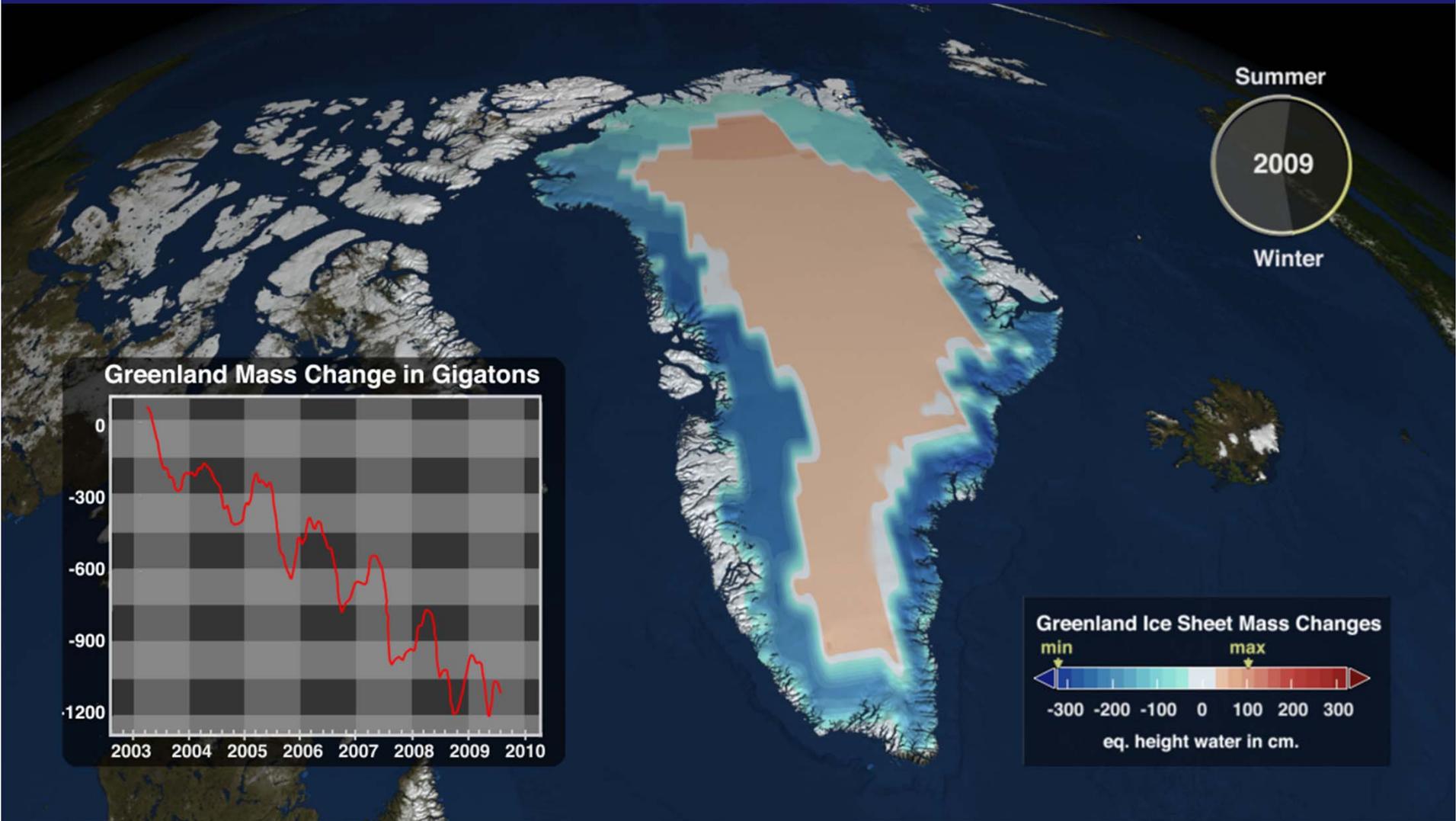
See More



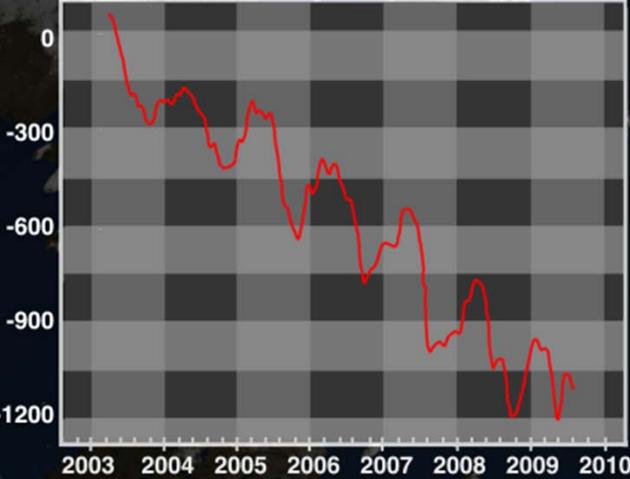
http://goes.gsfc.nasa.gov/goescolor/goeswest/pacific2/color_med/latest.jpg
goes.gsfc.nasa.gov

Like Yesterday at 9:49am · Share · Flag

Like 2 people like this.

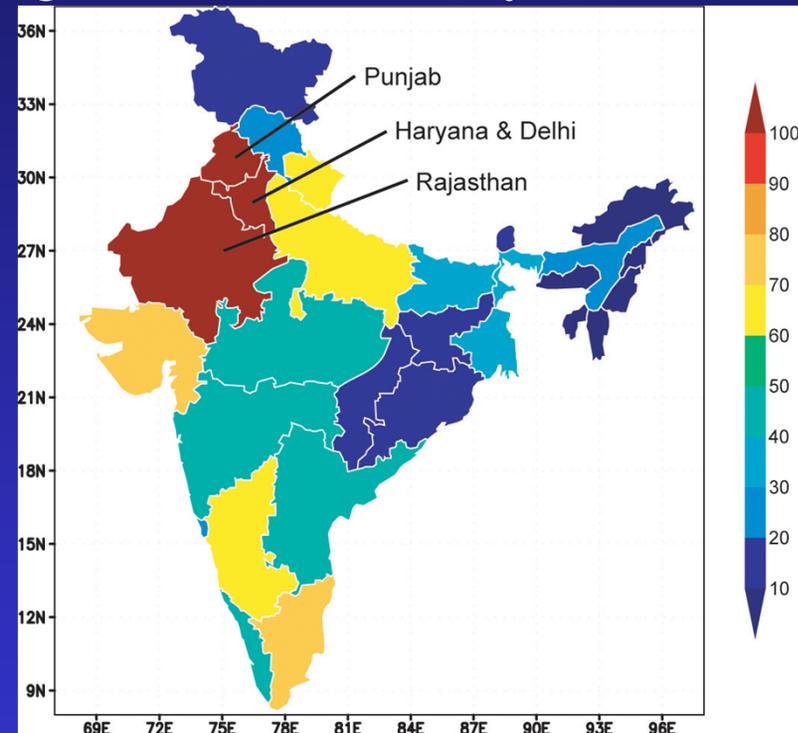
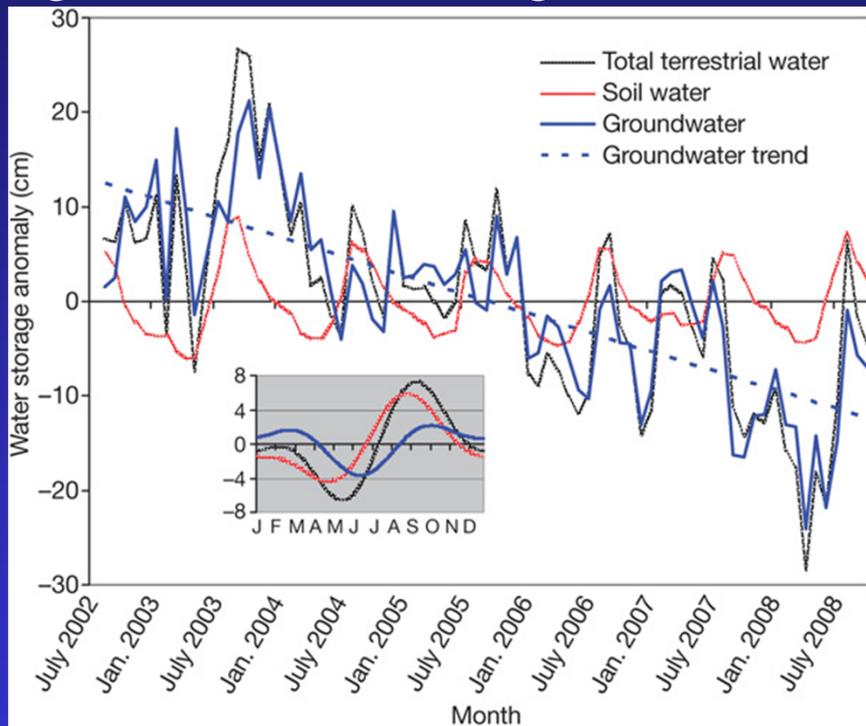


Greenland Mass Change in Gigatons



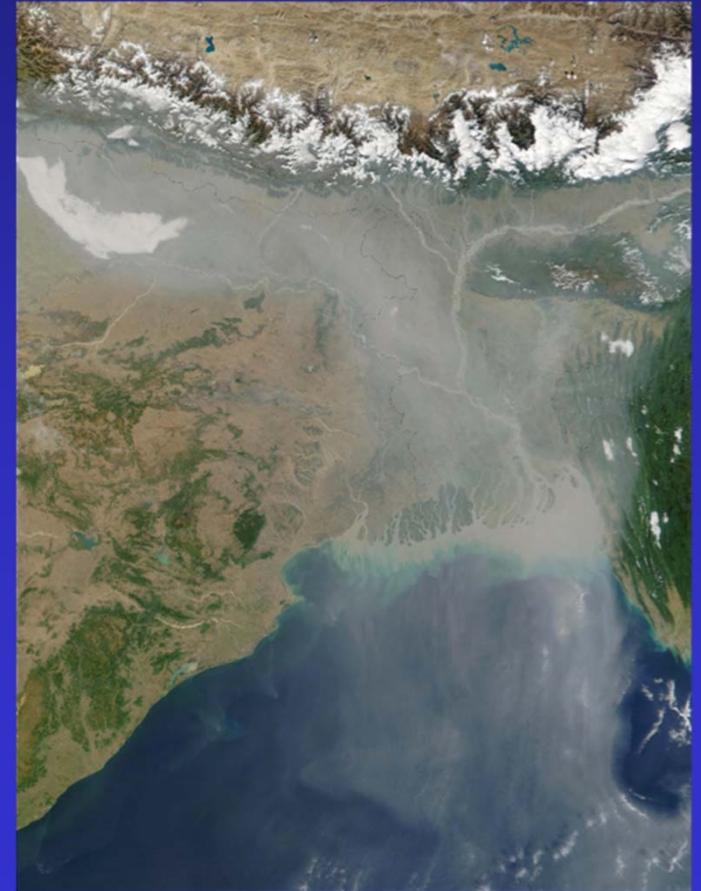
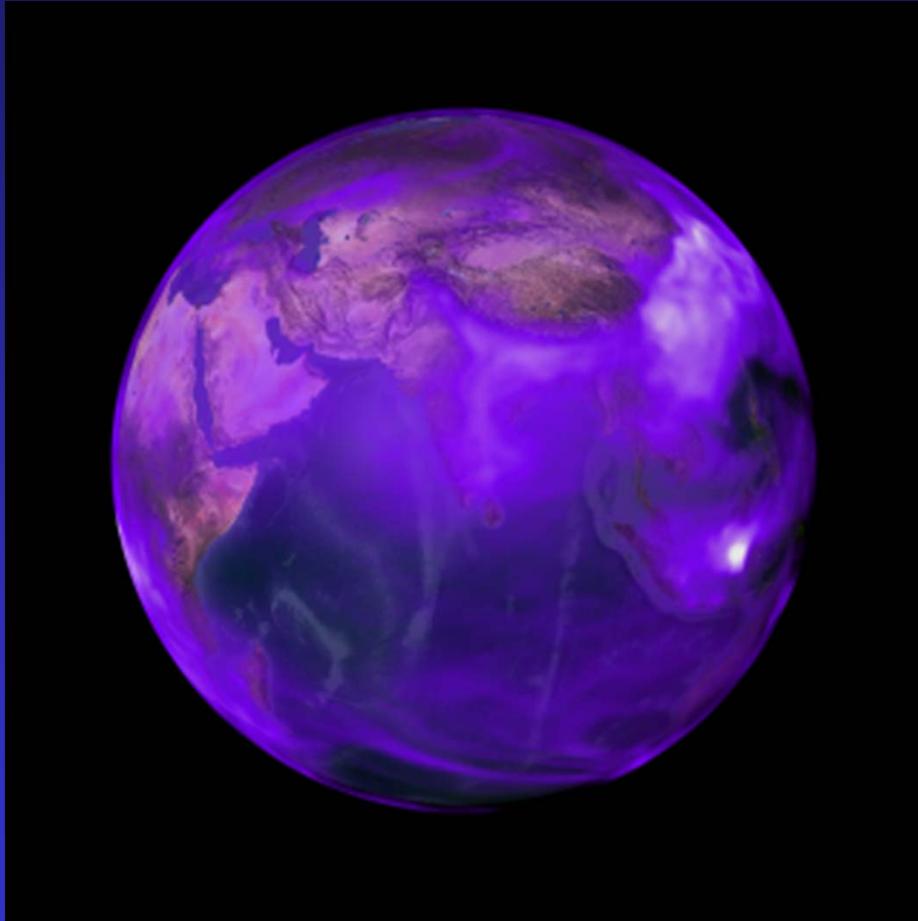
Greenland Ice Sheet Mass Changes
min max
-300 -200 -100 0 100 200 300
eq. height water in cm.

India's Disappearing Groundwater: observations by GRACE show regions that are losing centimeters of groundwater each year.

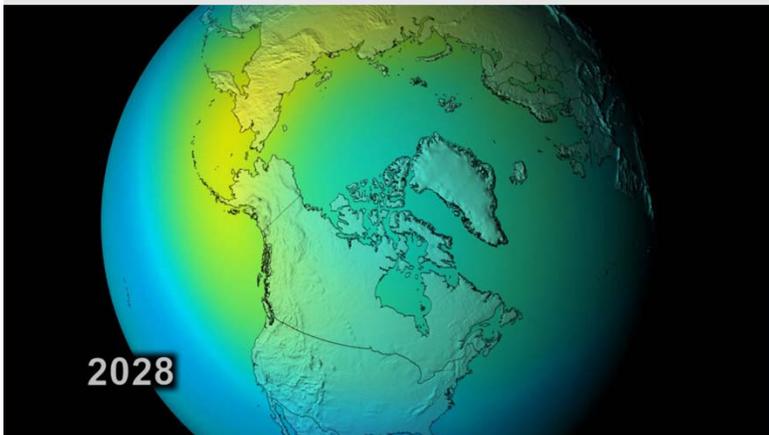
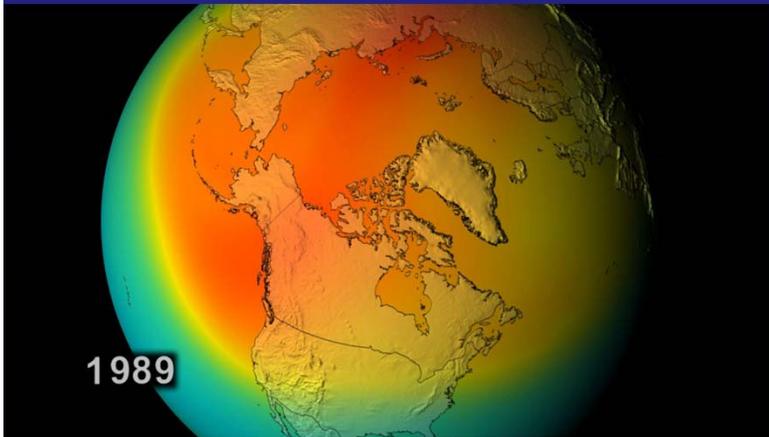
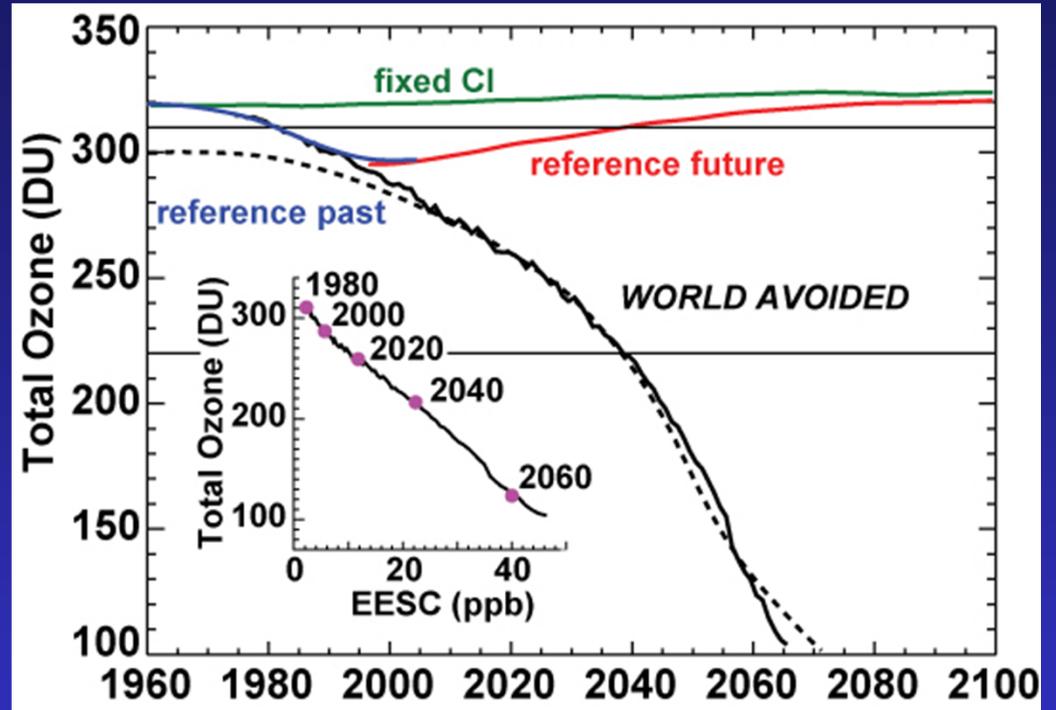


The Importance of Aerosols

12/14/09: Soot's Role in Himalayan Warming



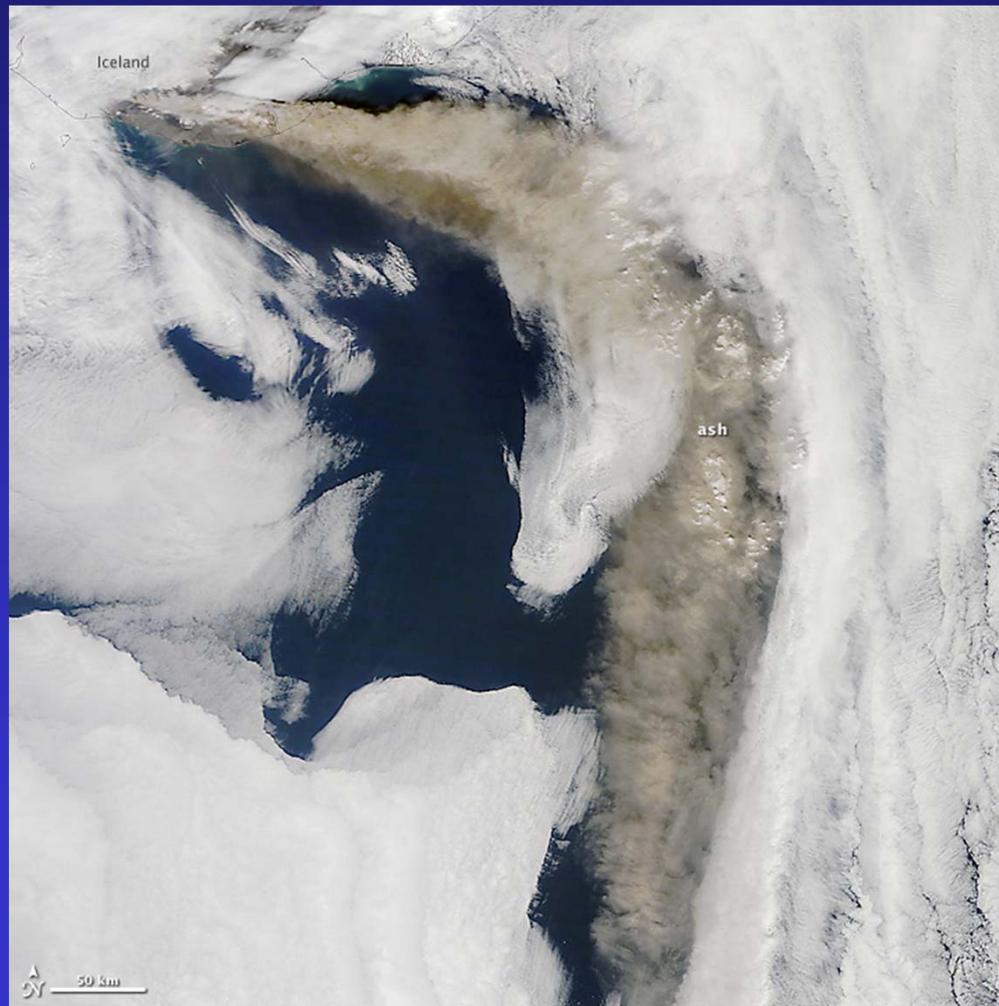
A Disaster Averted



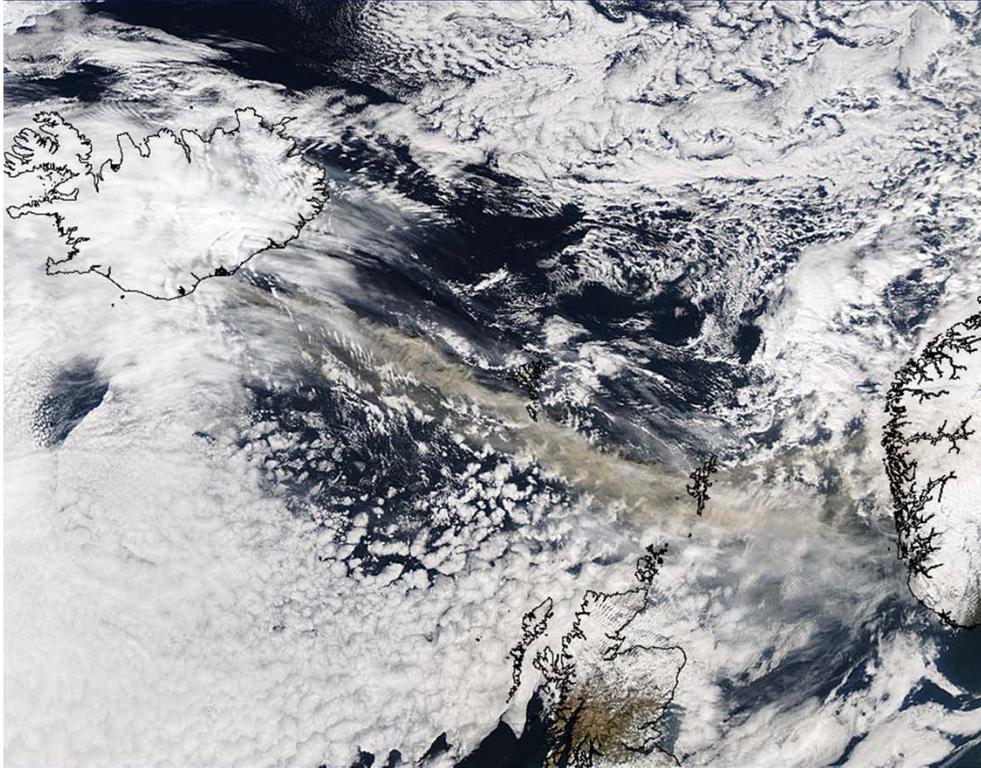
4/23/10:
Eruption of
Iceland
Volcano



Iceland Volcano from MODIS, 5/2010

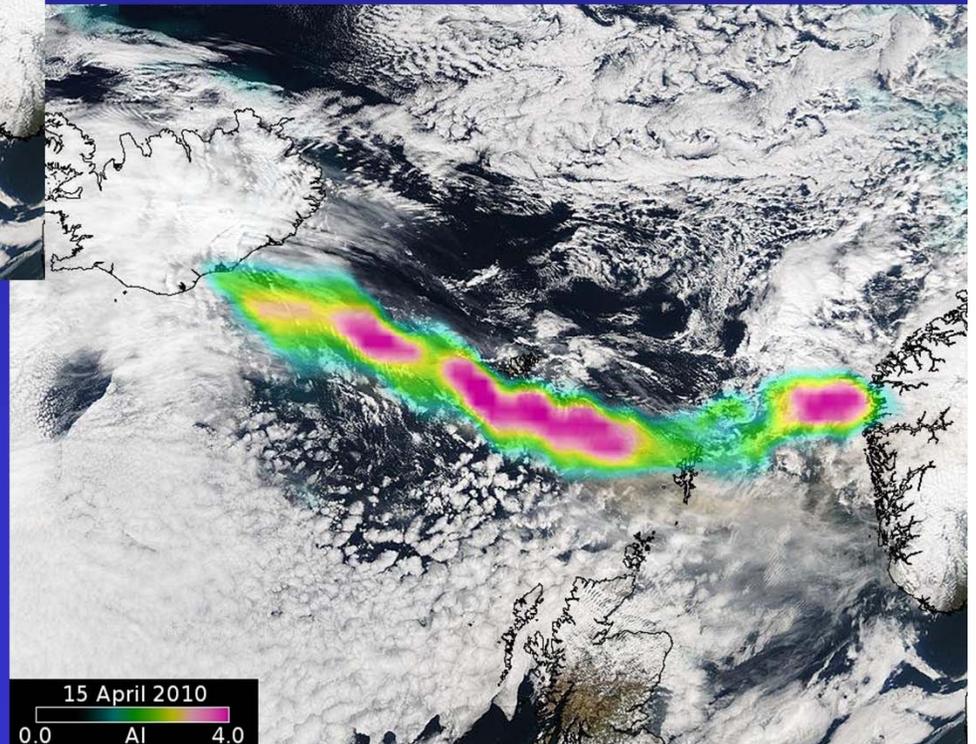


MODIS and OMI Views of the Ash Plume



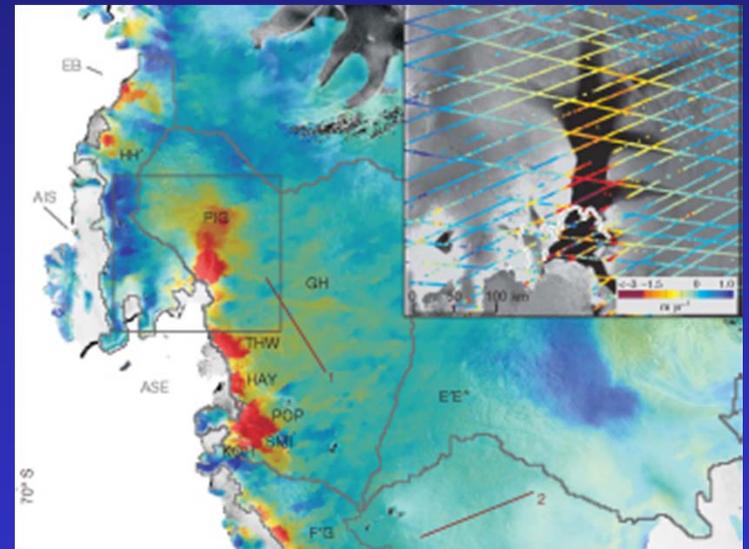
**OMI aerosol index- plume
clearly visible over clouds**

MODIS false color image



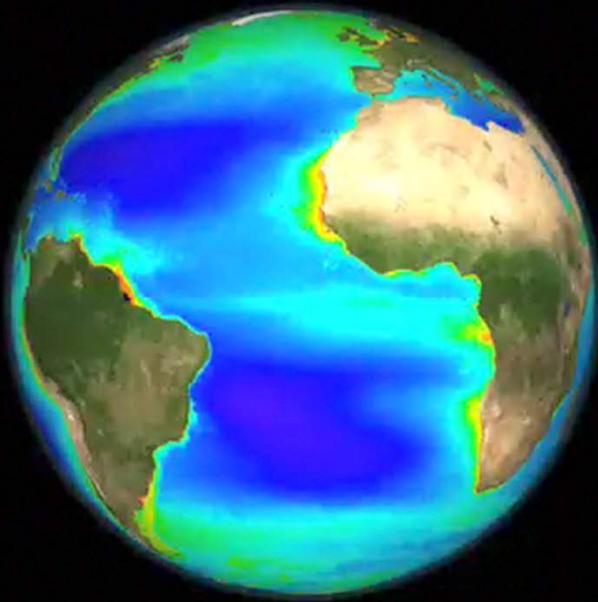
Courtesy Colin Seftor, SSAI

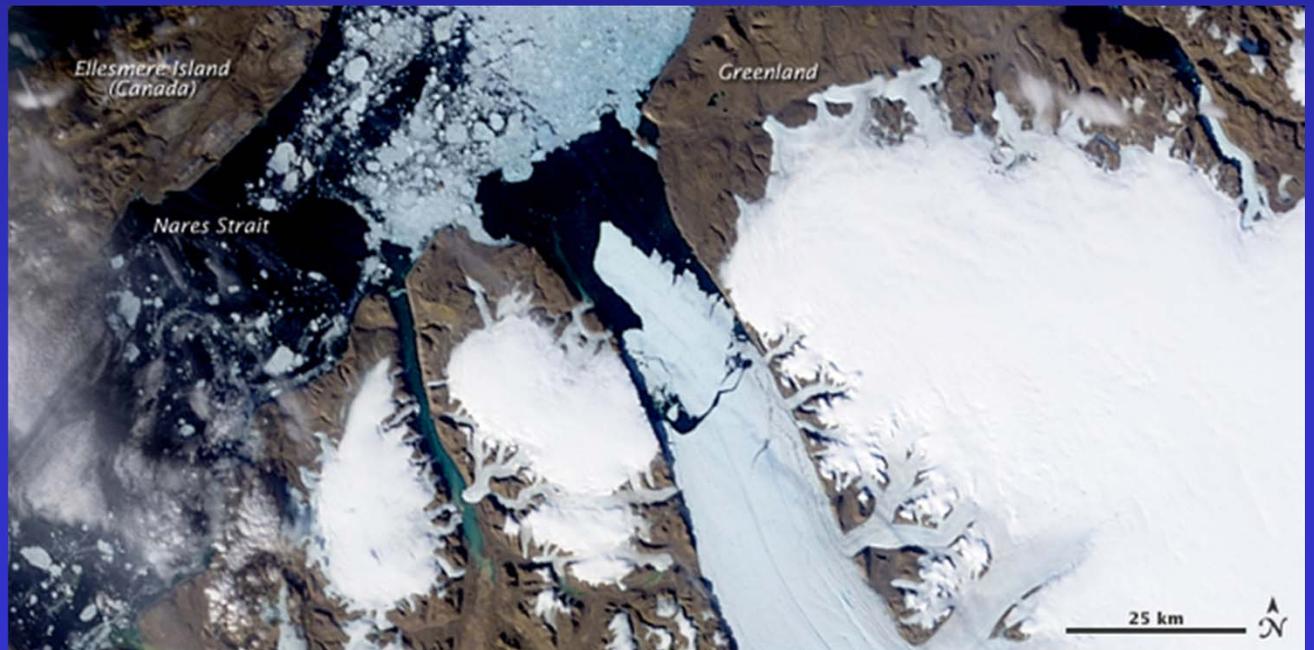
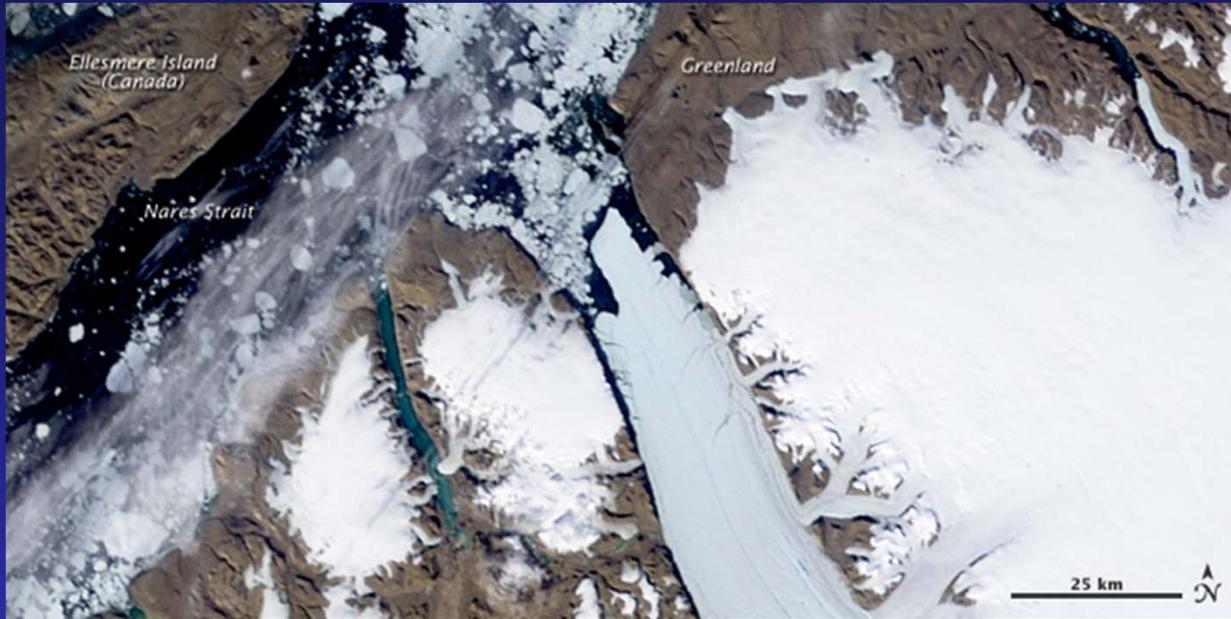
3/18/10: IceBridge Mission



Satellite data shows fast ice thinning (red) along the coast of West Antarctica. The inset shows satellite tracks over Pine Island Glacier, from ICESat, which reveal dynamic thinning concentrated on the fast-flowing areas.

Ocean Monitoring





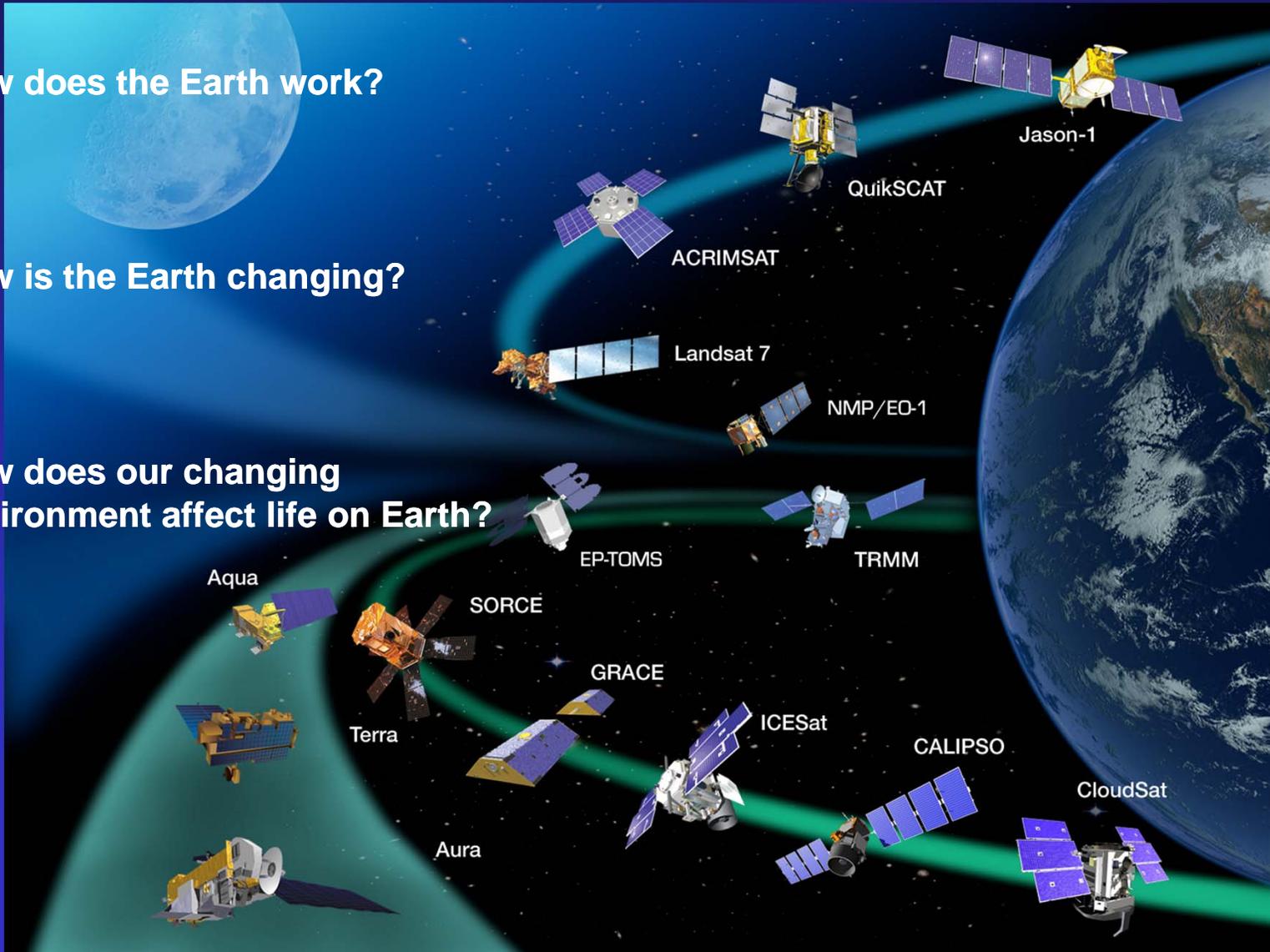


Earth Science Missions

How does the Earth work?

How is the Earth changing?

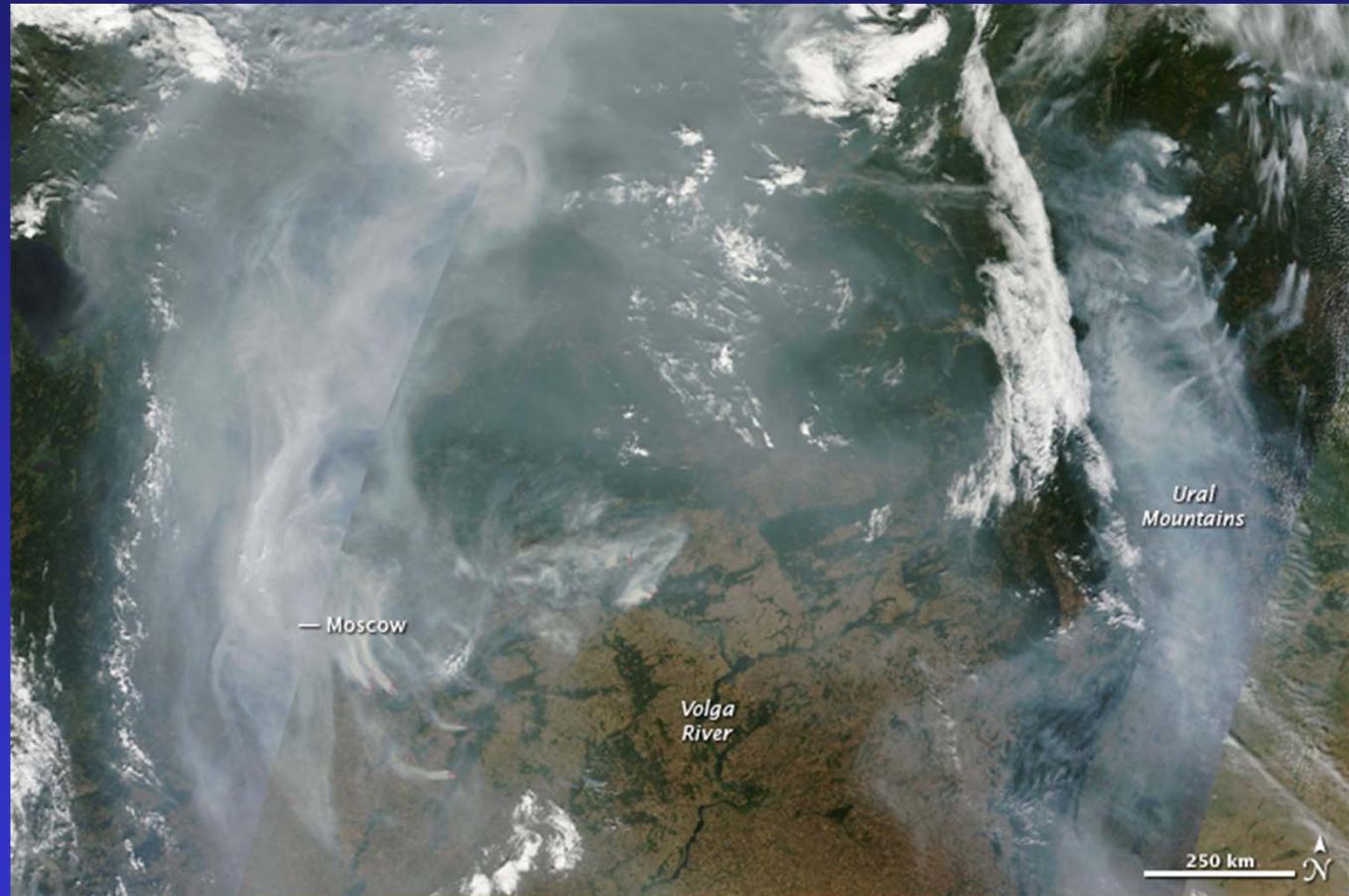
How does our changing environment affect life on Earth?



5/2010: Oil Spill in the Gulf of Mexico



Smoke over Russia, 8/2010





Imagery from the The Moderate Resolution Imaging Spectroradiometer (MODIS) instrument on the TERRA satellite shows a comparison of the Indus River in Pakistan at normal levels (7/19/2010) and in extreme flood conditions (9/7/2010).

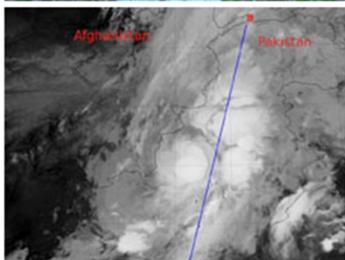


Image Credit: NASA Goddard's Earth Observator



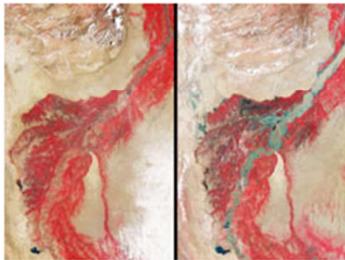
ASTER Captures New Image of Pakistan Flooding
ASTER image from Aug. 18, 2010, shows the extent of flooding in and around the city of Sukkur in Pakistan's Sindh Province. The Indus River, Pakistan's longest, snakes vertically through the image. Image credit: NASA/GSFC/METI/ERSDAC/JAROS, and U.S./Japan ASTER Science Team

Full image and caption



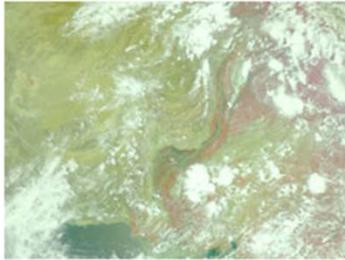
NASA's CloudSat Spots Beginning of Pakistan Floods
NASA's CloudSat captured the early genesis of the Pakistan flooding on July 28, 2010. The MODIS image from NASA's Aqua spacecraft shows the thunderstorms present at the time, along with the path of the CloudSat satellite (blue line). Image credit: NASA/JPL-The Cooperative Institute for Research in the Atmosphere, Colorado State University

Full image and caption



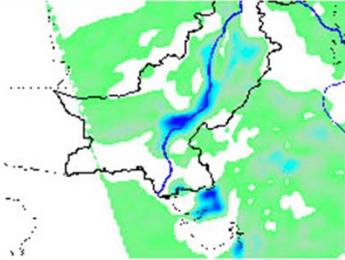
NASA's MISR Tracks Massive Flooding in Pakistan
This image pair shows perspective views of the flooding in Pakistan, taken approximately one year apart by the MISR instrument on NASA's Terra spacecraft. The left image was taken Aug. 8, 2009; the right image was taken on Aug. 11, 2010. Water appears as shades of blue and blue-green. Image credit: NASA/GSFC/LaRC/JPL, MISR Team

Full image and caption



NASA's AIRS Instrument Captures Before/After Views of Pakistan Flooding
AIRS false-color before and after images of the flooding in southern Pakistan and Sindh Province, taken July 9, 2010 (left), and Aug. 10, 2010 (right). Image credit: NASA/JPL

Full image and caption



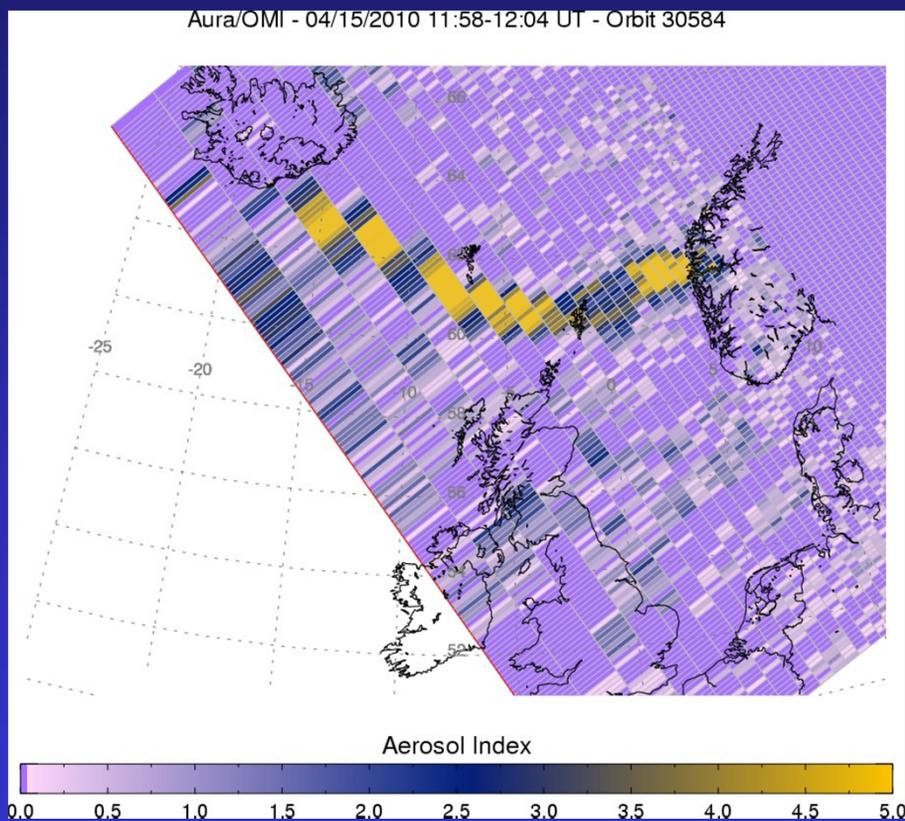
NASA's AIRS Detects Extent of Pakistan Flooding
Surface emission data from AMSU, part of the AIRS instrument suite aboard NASA's Aqua spacecraft, are used to estimate how much of the land surface has been flooded in Pakistan. Image credit: NASA/JPL

Full image and caption

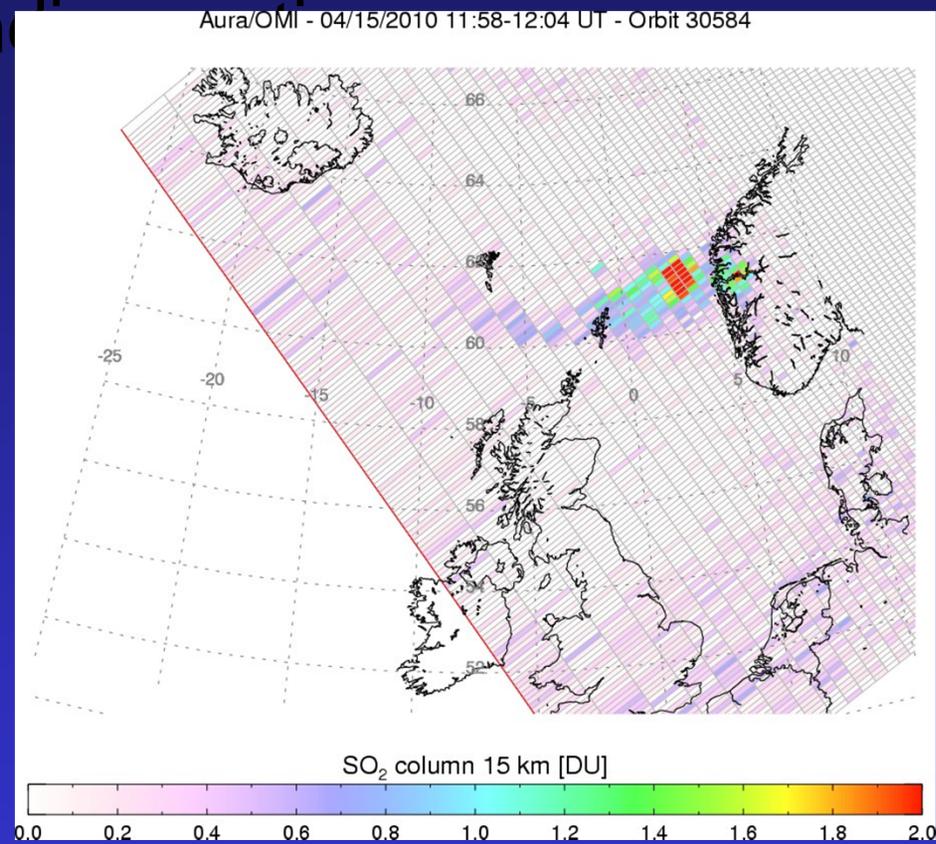
NASA used every available instrument to monitor and assess the damage from the Pakistan floods in 2010. Continuing imagery will assist with disease site prediction and prevention efforts.

Images from:
<http://www.flickr.com/photos/gsfcc/>

Near-real-time OMI images of ash and sulfur dioxide from Iceland

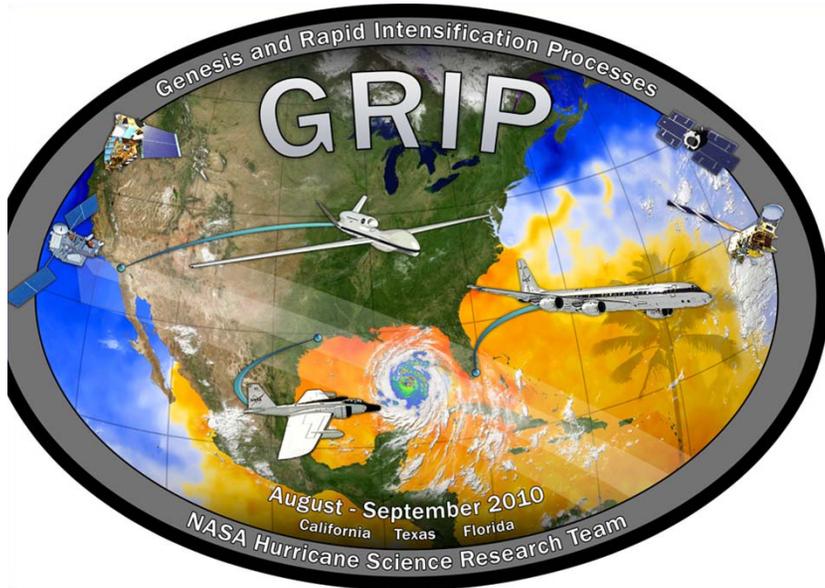


Ash plume (aerosol index)

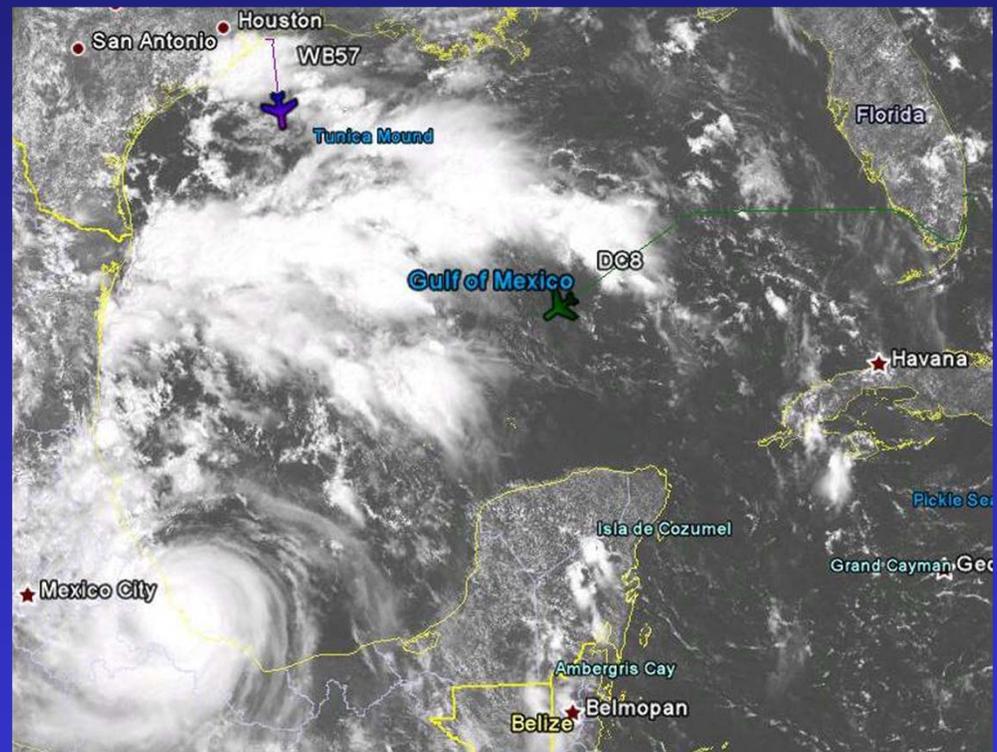


SO₂ is relatively low

Courtesy Simon Carn, Mich.



The GRIP Project combines the DC-8 aircraft, the WB-57 aircraft, and the Global Hawk Unmanned Airborne System (UAS) configured with a suite of in situ and remote sensing instruments that are observing and characterizing the lifecycle of hurricanes.



Flight information can be tracked in real time, and updates are available on Facebook and Twitter (image of Hurricane Karl from 9/16/2010).

facebook

Search

NASA's Hurricane Web Page Like

Wall Info Photos Discussions

NASA's Hurricane Web Page + Others NASA's Hurricane Web Page Just Others

NASA's Hurricane Web Page NW PACIFIC -A low pressure area near 13.9N 151.2, about 365 NM east of Guam appears conducive for development of a tropical cyclone in the next 48 hours.
Yesterday at 9:52am
2 people like this.

NASA's Hurricane Web Page NW PACIFIC- Typhoon Fanapi passed through Taiwan yesterday and is in the Taiwan Strait, headed west for landfall in China tomorrow. Max. sustained winds near 74 mph.
Yesterday at 9:51am
Exequiel Borla likes this.

NASA's Hurricane Web Page CENTRAL PACIFIC-An area of thunderstorms persists around a weak and slow-moving low 930 miles southeast of Hilo Hawaii. Just a 10% chance of becoming a tropical depression in the next 48 hours.
Yesterday at 9:49am
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NASA's Hurricane Web Page E PACIFIC- A BROAD LOW PRESSURE SYSTEM CENTERED ABOUT 150 MILES SOUTH OF MANZANILLO MEXICO is producing a large area of showers and t-storms. Has a 40% chance of becoming a tropical depression in 48 hours. SATELLITE IMAGE: Low is in the bottom right corner of this COES-11 image from this morning
<http://goes.gsfc.nasa.gov>
See More
http://goes.gsfc.nasa.gov/goescolor/goeswest/pacific2/color_med/latest.jpg
goes.gsfc.nasa.gov
Yesterday at 9:49am · Share · Flag
2 people like this.

NASA's Hurricane Web Page NW PACIFIC - The low 300 miles east of the

NASA's Hurricane Web Page covers tropical cyclones all around the world, every day of the year!
www.nasa.gov/hurricane. It is managed out of NASA's Goddard Space Flight Center, Greenbelt, Md.
For questions contact:
Robert.J.Gutro@nasa.gov

Information

Founded:
2005

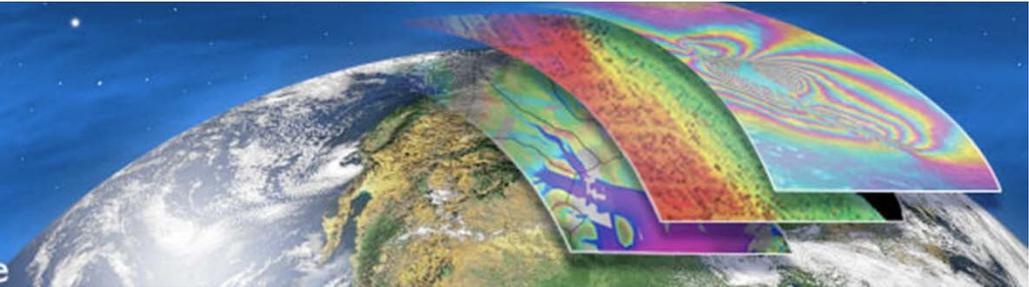
670 People Like This

what, no worry

Anthony Scott Carlos Suárez Christina Petch
CM Boryslaw Michel Tandooh Christina Dian

DESDynI

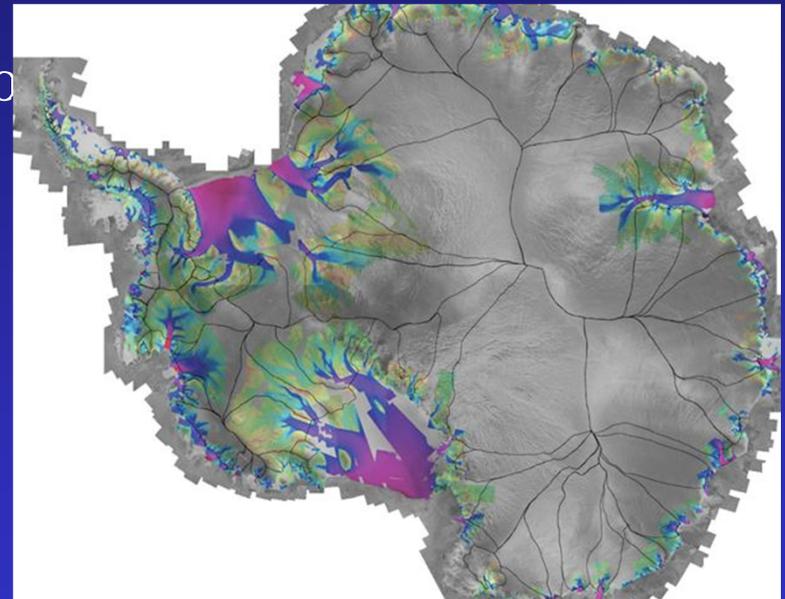
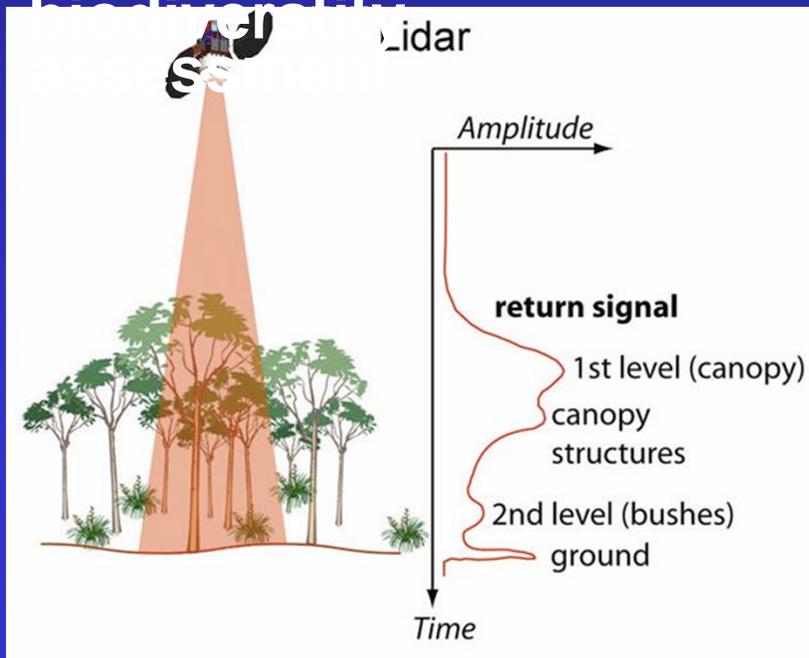
Deformation, Ecosystem Structure and Dynamics of Ice



Global direct measurement of 3-D vegetation, height, horizontal distribution and cover

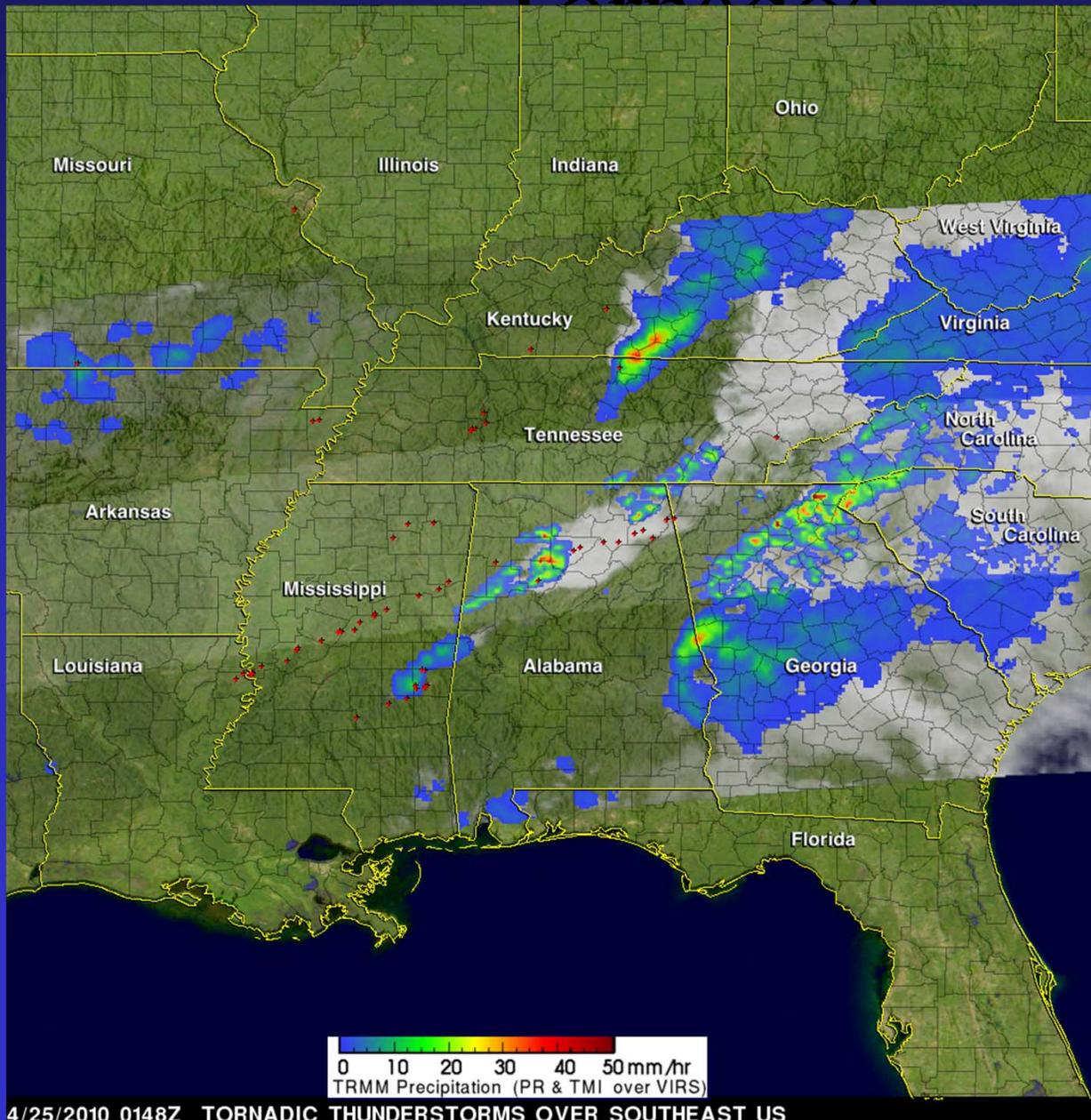
Distribution of above-ground carbon in forests

Elevation of ice, land, lakes and rivers
Transects of forest structure for



- 5 Beams - laser pulses
- 1064nm @ 240Hz
- 25m Footprint
- 30m Along track spacing

TRMM Tracks Deadly Tornadoes



4/25/2010 0148Z TORNADIC THUNDERSTORMS OVER SOUTHEAST US

Global Hawk Pacific Mission (GloPac)

Objectives

- First demonstration of the Global Hawk unmanned aircraft system (UAS) for NASA and NOAA Earth science research and applications
- Exploration of trace gases, aerosols, and dynamics of remote upper troposphere and lower stratosphere regions
- Risk reduction for future Global Hawk missions

Flights

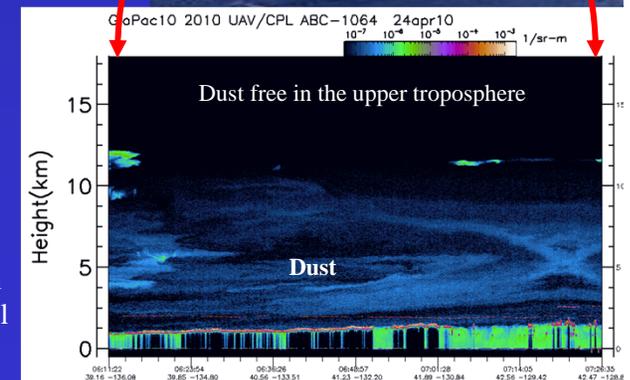
- Five flights: April 2 (test), 7, 13, 22, 30
- 28.6 hour max duration
- 65,200 max altitude
- 18,000 km range
- 82.5 hours flown
- 8 hours flown north of 70°N on April 22 →

GSFC participants

- Co-Project Scientist: Paul Newman
- GSFC flight planning: Drs. Leslie Lait, S. Randy Kawa, Huisheng Bian, Pete Colarco
- GMAO modeling and forecasts: Drs. Arlindo DaSilva, Steven Pawson
- Cloud Physics Lidar: Dr. Matt McGill
- Airborne Compact Atmospheric Mapper: Dr. Scott Janz

Prelim observations

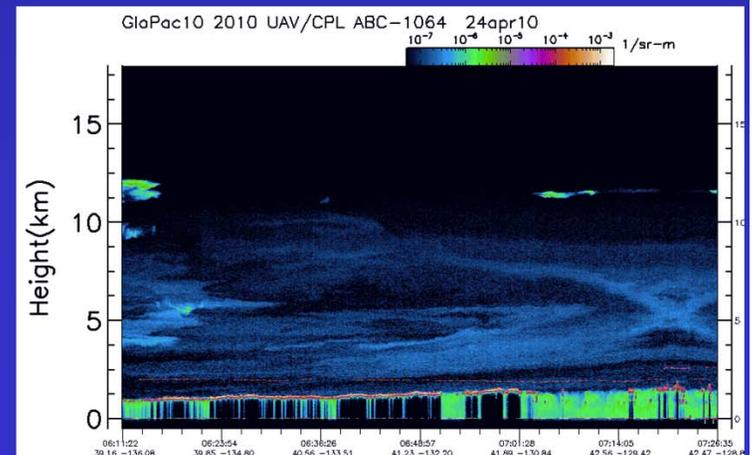
- Polar ozone vortex fragments observed
- Dust plumes from Gobi Desert observed as predicted by GSFC model
- Stratospheric trace gas distributions



Global Hawk Pacific Mission (GloPac)

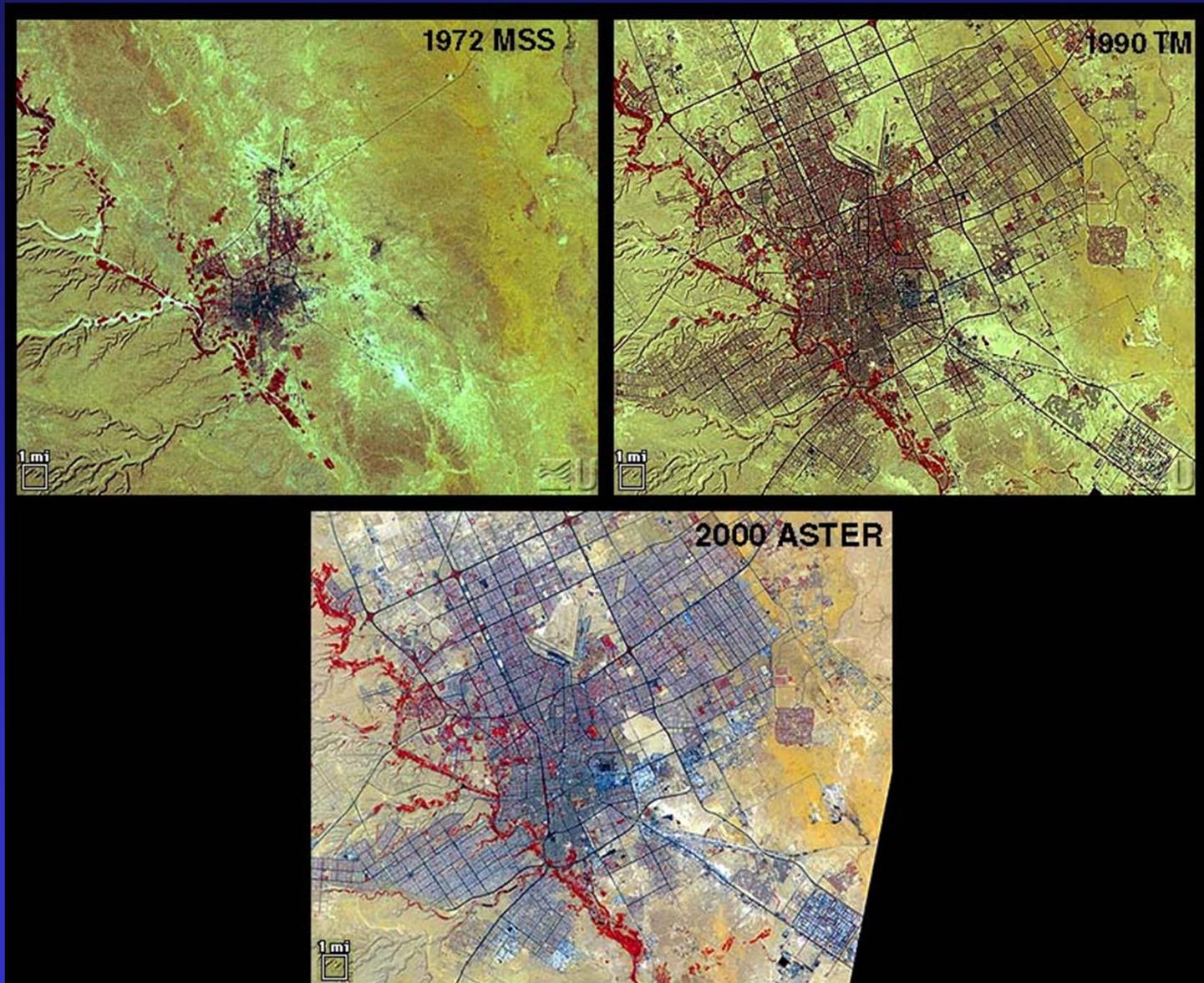
Objectives

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- Exploration of trace gases, aerosols, and dynamics of remote upper troposphere and lower stratosphere regions
- Risk reduction for future Global Hawk missions



Global Urban Growth

Riyadh, the national capital of Saudi Arabia, is shown in 1972, 1990 and 2000. Its population grew in these years from about a half million to more than two million.



*NASA/GSFC/MITI
/ERSDAC/JAROS,
and U.S./Japan
ASTER Science
Team*

Studying Urbanization from Space

Urban growth and sprawl can have significant impacts on:

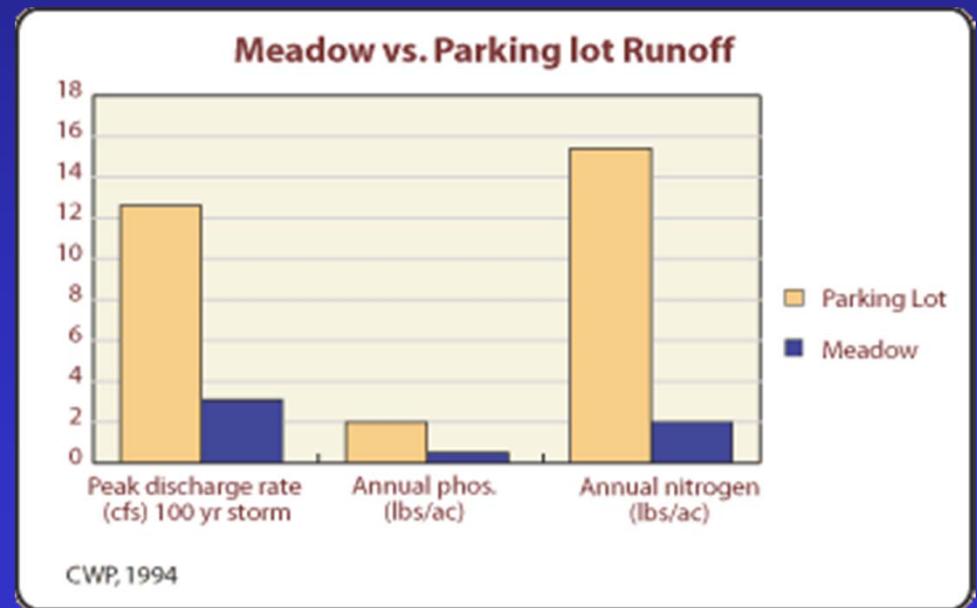
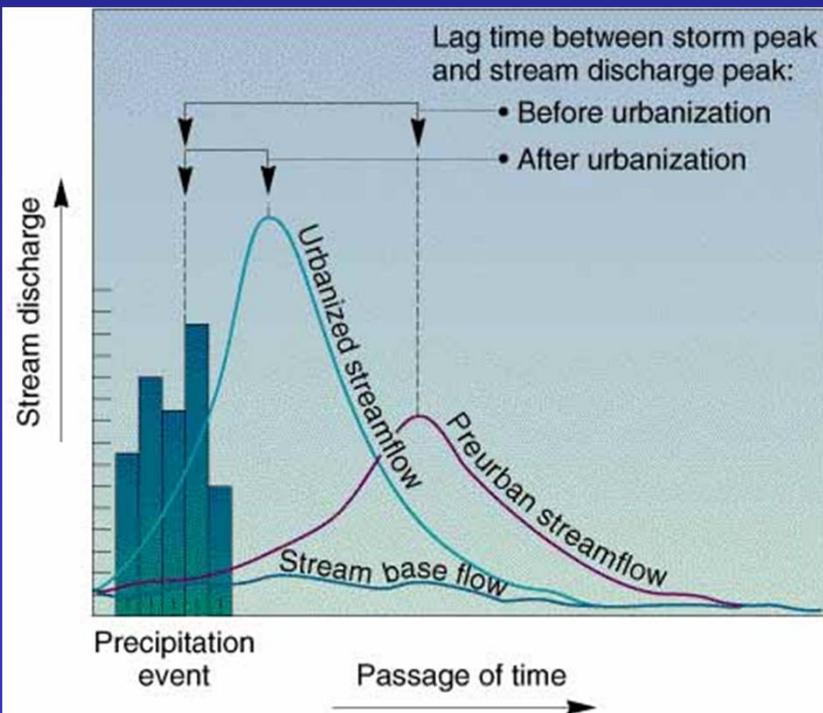
- Local meteorology (e.g. Urban “Heat Islands”).
- Hydrology through increased runoff and/or modified streamflow dynamics.
- Air pollution and water quality.

NASA Applications

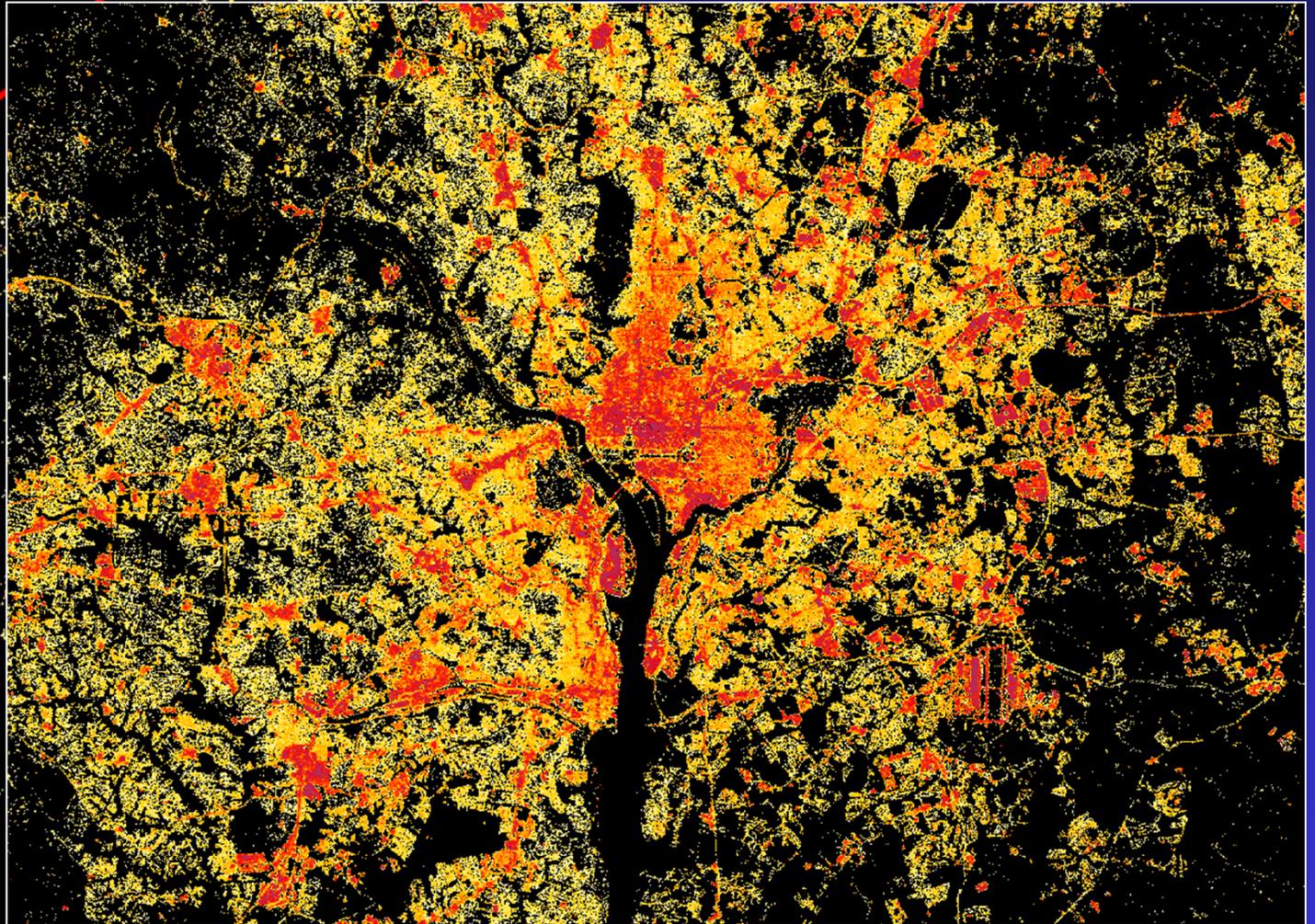
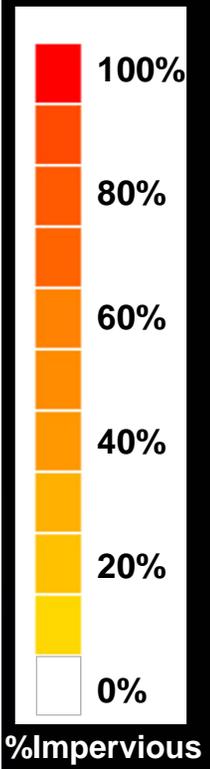


Community Growth

Scientists use Landsat data to generate accurate maps of urban extent and track the changes in impervious surfaces over time.



Impervious Surface Area Mapping of the Chesapeake Bay Watershed



Washington, DC

Courtesy Mid-Atlantic RESAC



http://ledaps.nascom.nasa.gov/ledaps/ledaps_NorthAmerica.html

Educational Activities

- Two successful training/prof. development workshops:
 - Pocono Environmental Education Center (October 2005).
 - NEIU and Colonial IU Joint Workshop (May 2006).
- Field validation activity, September 2006.
 - Weekend validation of Landsat 2005/2006 products in the field with students, parents, volunteers, NPS staff.
- Trained 58 Science, Math, Geography teachers from 33 middle/high schools. 90 student participants in field validation.
 - “We helped NASA to survey the area and I had fun.”
 - “I believe it is a great experience for anyone interested in Geography/Science.”
- “They did not give us any bug spray!”

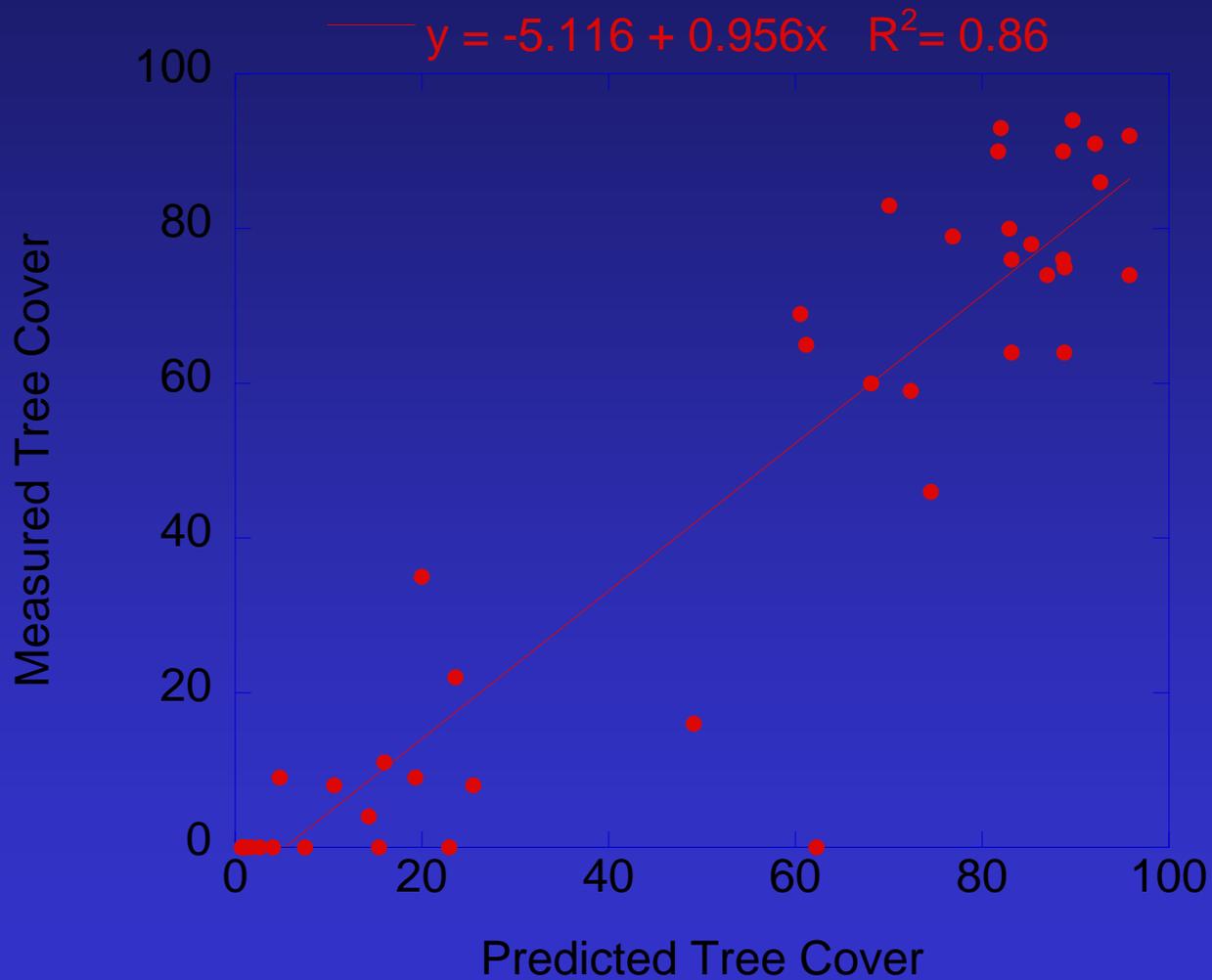
Bridging the GAPS from Space:
How to Use NASA Satellite Images in
the Classroom



Greenbelt, MD 20771
Phone: (301) 614-6597; Fax (301) 614-6095
e-mail: ericbdc@ltpmail.gsfc.nasa.gov



2005 Tree Cover Validation with Student Acquired Data



Summary



- ❖ NASA uses the view from above to monitor our changing home.
- ❖ Different satellites help us study the various systems of the Earth. No one system can do it all!
- ❖ NASA tools and science helps us to understand how the planet is changing and what the changes mean for us.
- ❖ We need your help!!!

*“We do not inherit the Earth
from our ancestors; we borrow it
from our children”*

Ancient American Indian Proverb