



# **NASA's Earth Observing System Data and Information System - EOSDIS**

**Presented at  
George Mason University**

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# Acknowledgements

- **Materials for this presentation have evolved over many years of the author's work with NASA's Earth Science Data Systems and contain contributions from several people in the Earth Science Data and Information System Project, the Goddard Space Flight Center and NASA Headquarters**
- **Any opinions expressed here are those of the author and do not necessarily imply official NASA policy**



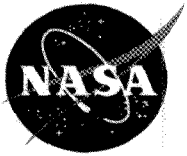
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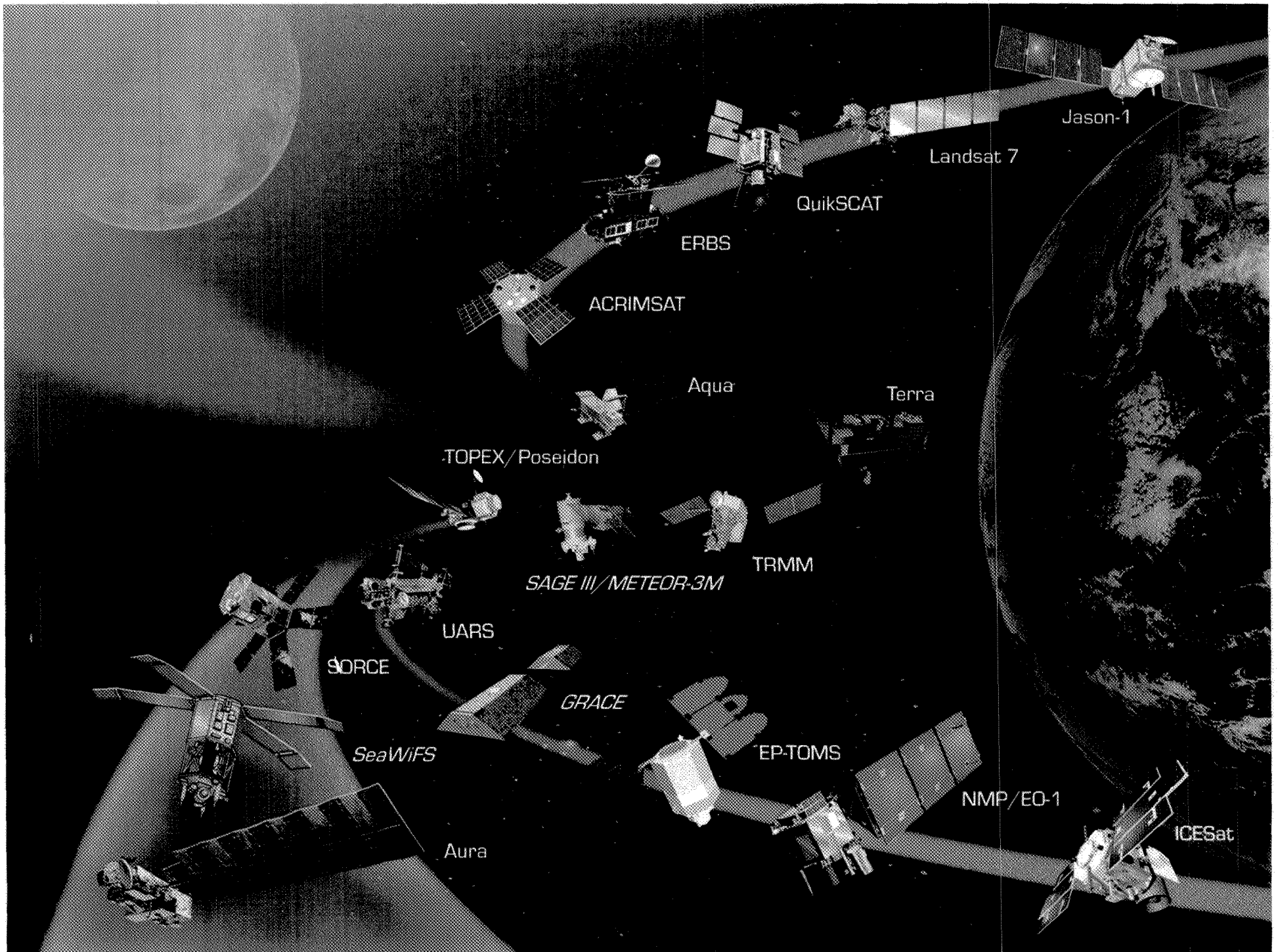
# Global Climate Change – IPCC Report

- **Quotes from Synthesis Report of the Intergovernmental Panel on Climate Change ([http://www.ipcc.ch/pdf/assessment-report/ar4/syr/ar4\\_syr\\_spm.pdf](http://www.ipcc.ch/pdf/assessment-report/ar4/syr/ar4_syr_spm.pdf))**
  - **“Warming of the climate system is unequivocal, as is now evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice and rising global average sea level.”**
  - **“Observational evidence from all continents and most oceans shows that many natural systems are being affected by regional climate changes, particularly temperature increases.”**
  - **“There is medium confidence that other effects of regional climate change on natural and human environments are emerging, although many are difficult to discern due to adaptation and non-climatic drivers.”**
- **Accurate, long-term, consistent, global observations, modeling and analysis are key to understanding the Earth system, predicting its behavior and supporting policies beneficial to society**



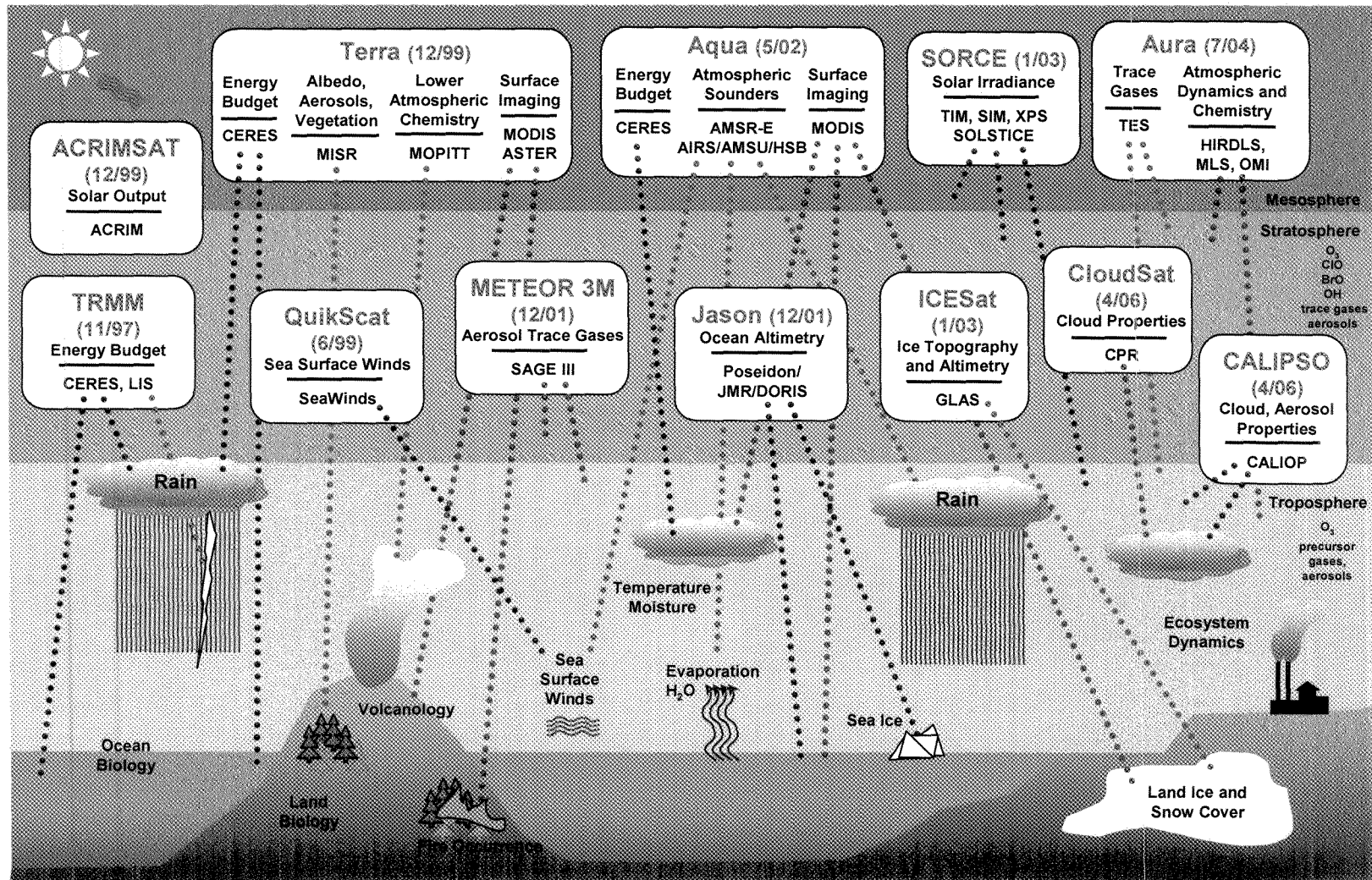
# **NASA's Earth Science Data Systems**

- **NASA Strategic Plan (2011) – Strategic Goal #2: Expand scientific understanding of the Earth and the universe in which we live.**
  - **2.1 Advance Earth system science to meet the challenges of climate and environmental change.**
- **NASA's Earth Science Data Systems directly support this objective by providing end-to-end capabilities to deliver data and information products to users**





# 24 EOS Measurements





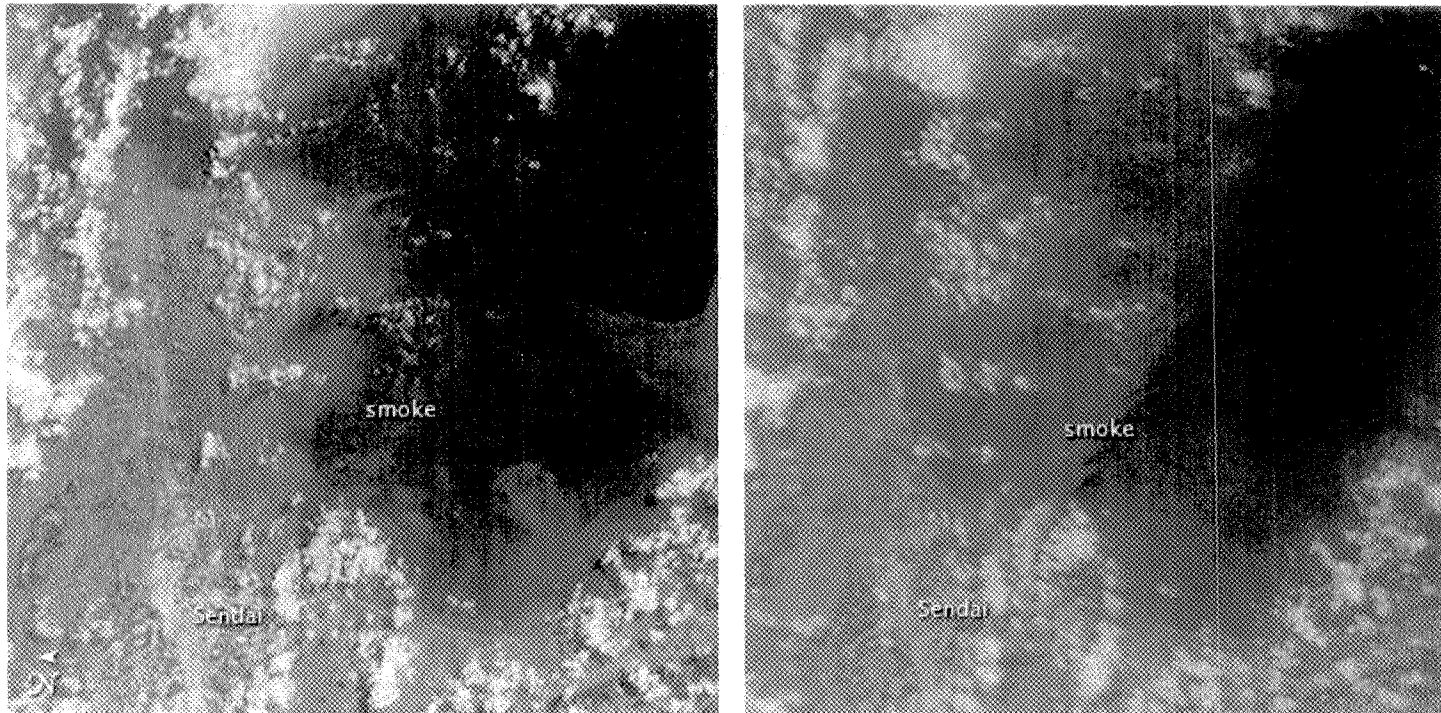
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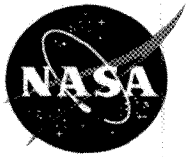




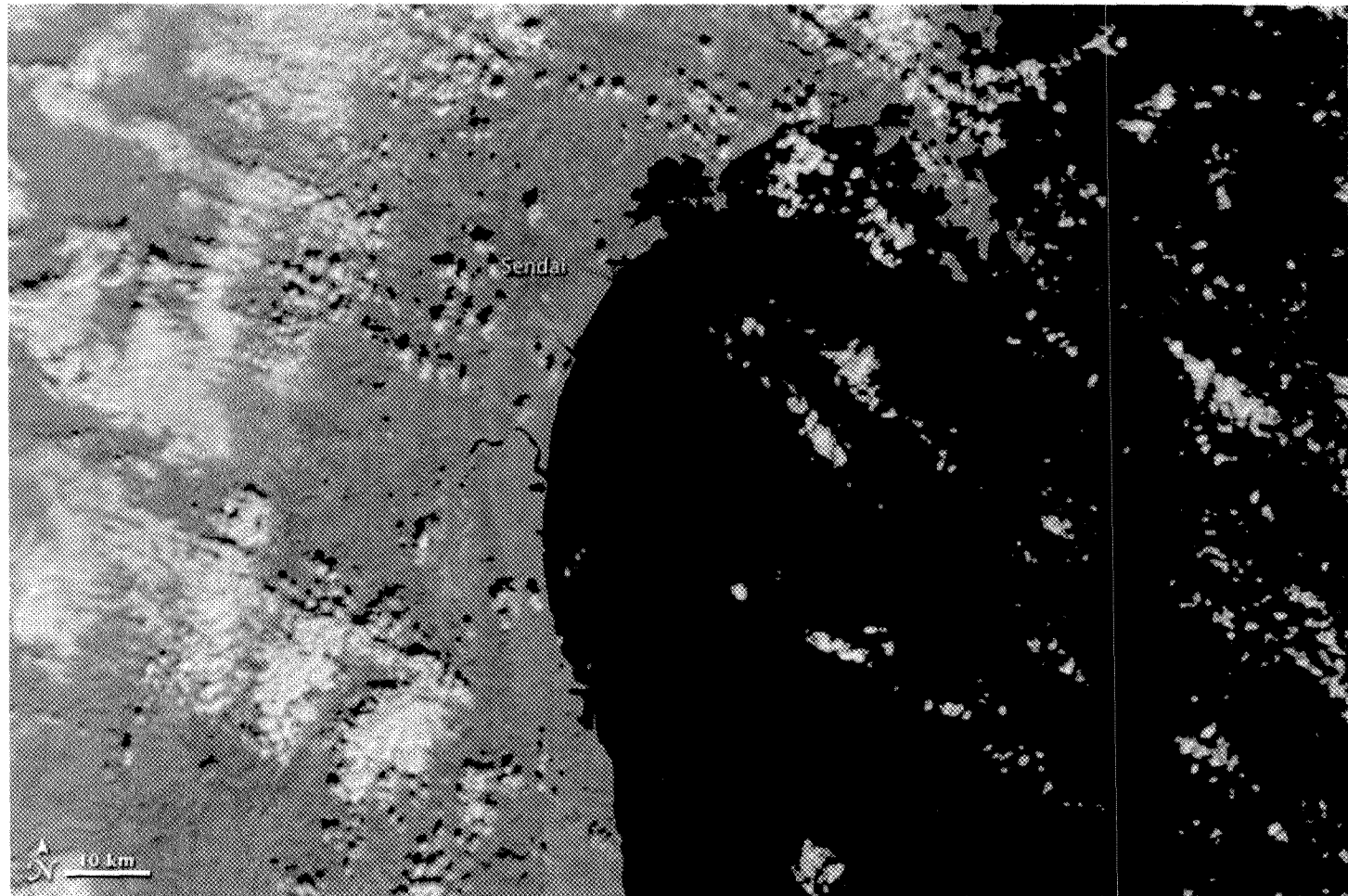
## Earthquake and Tsunami near Sendai, Japan – 2:46 p.m. local time, March 11, 2011



This pair of images, acquired on March 12, 2011, by the Multi-angle Imaging SpectroRadiometer (MISR) instrument aboard NASA's Terra spacecraft, shows a large smoke plume that appears to be associated either with the Shiogama incident or the Sendai port fires. The presence of clouds makes it difficult to pinpoint the exact origin. The data were obtained at a local time of about 10:30 a.m. - <http://earthobservatory.nasa.gov/> ; Image Credit: NASA/GSFC/LaRC/JPL, MISR Team



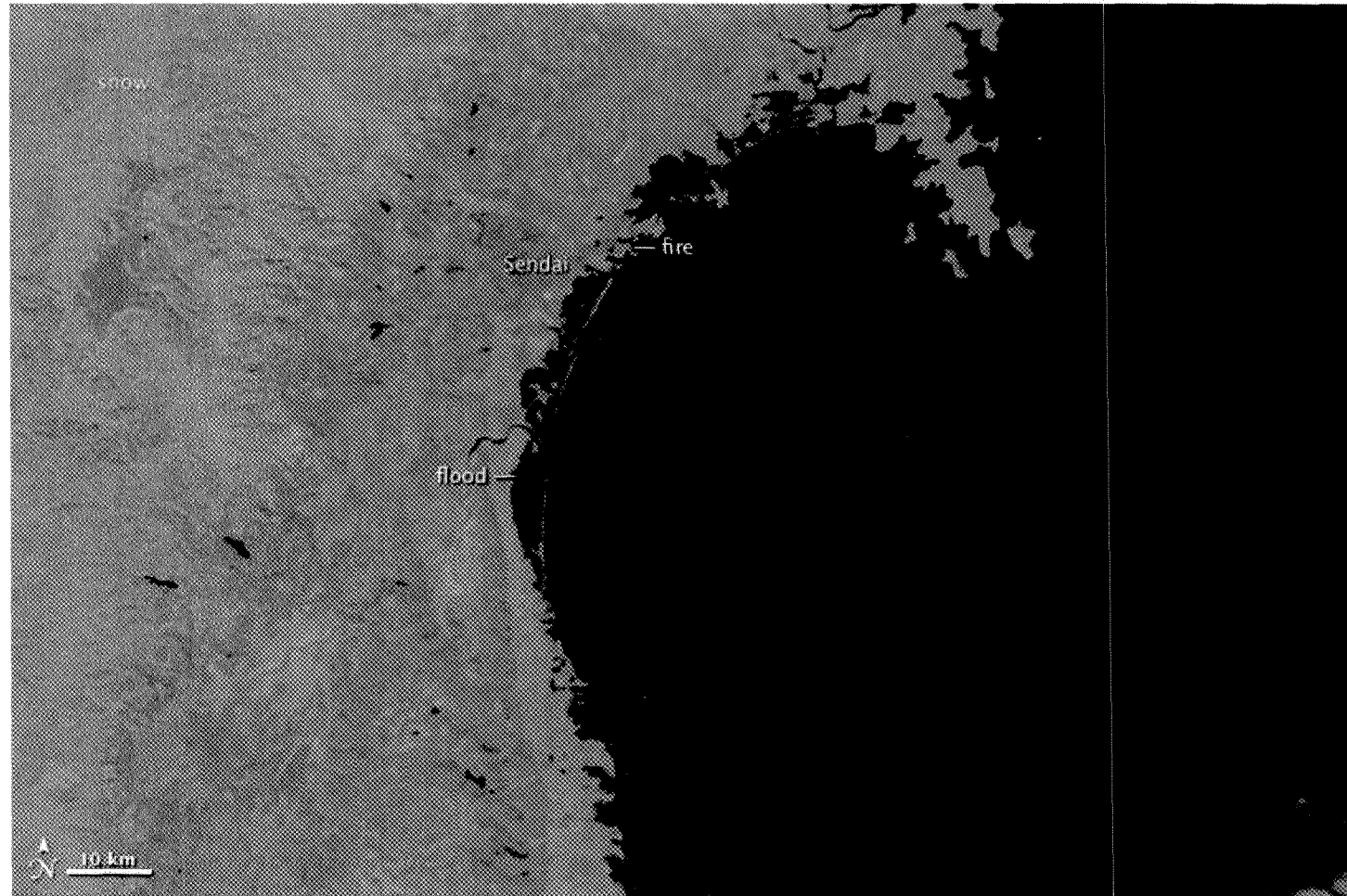
## Image of area near Sendai, Japan – February 26, 2011



Pre-Tsunami image, taken on February 26, 2011, shows the coastline under normal conditions. - <http://earthobservatory.nasa.gov/>. Image Credit: the MODIS Rapid Response Team at NASA GSFC; Instrument: Aqua MODIS



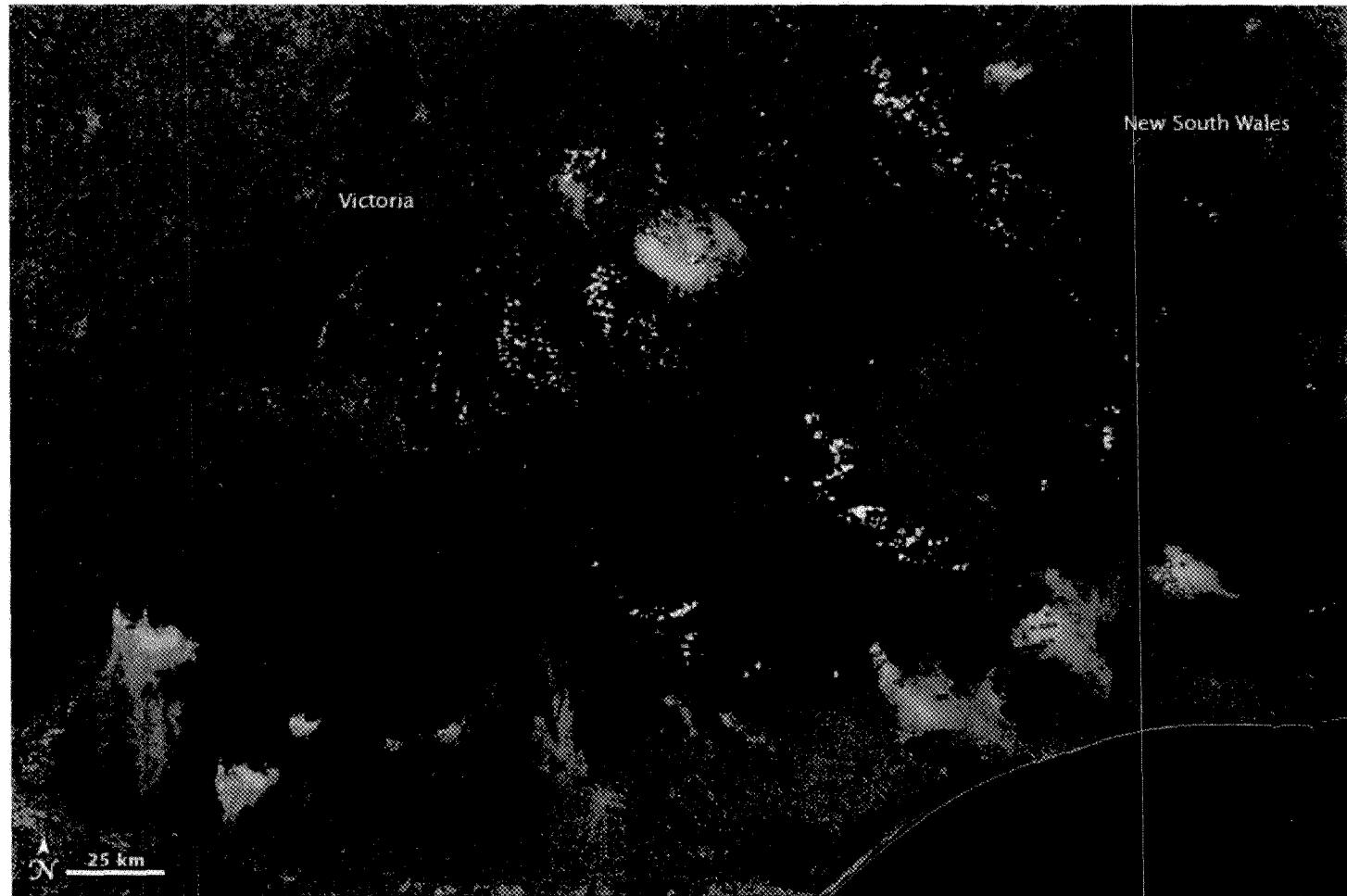
## Tsunami flooding near Sendai, Japan – March 13, 2011



Post-Tsunami image, taken on March 13, 2011, provides a clear view of tsunami flooding along the coastline. Water, black and dark blue in these false-color images, still covers the ground as much as five kilometers (three miles) from the coast. <http://earthobservatory.nasa.gov/>. Image Credit: the [MODIS Rapid Response Team](#) at NASA GSFC; Instrument: Aqua MODIS



# Fires in Southeastern Australia



Red boxes outline the locations of several fires burning in southeastern Australia on March 7, 2011. The fires are burning primarily in the dark green forest-covered Australian Alps in Victoria. Though the smoke pouring from the fires makes them appear to be large wildfires, most are controlled burns. The Moderate Resolution Imaging Spectroradiometer (MODIS) on NASA's [Aqua](#) satellite acquired this true-color image early in the afternoon on March 7 – <http://earthobservatory.nasa.gov/>. Image Credit: Jeff Schmaltz, [MODIS Rapid Response Team](#) at NASA GSFC



## Hurricane Bertha – July 9, 2008

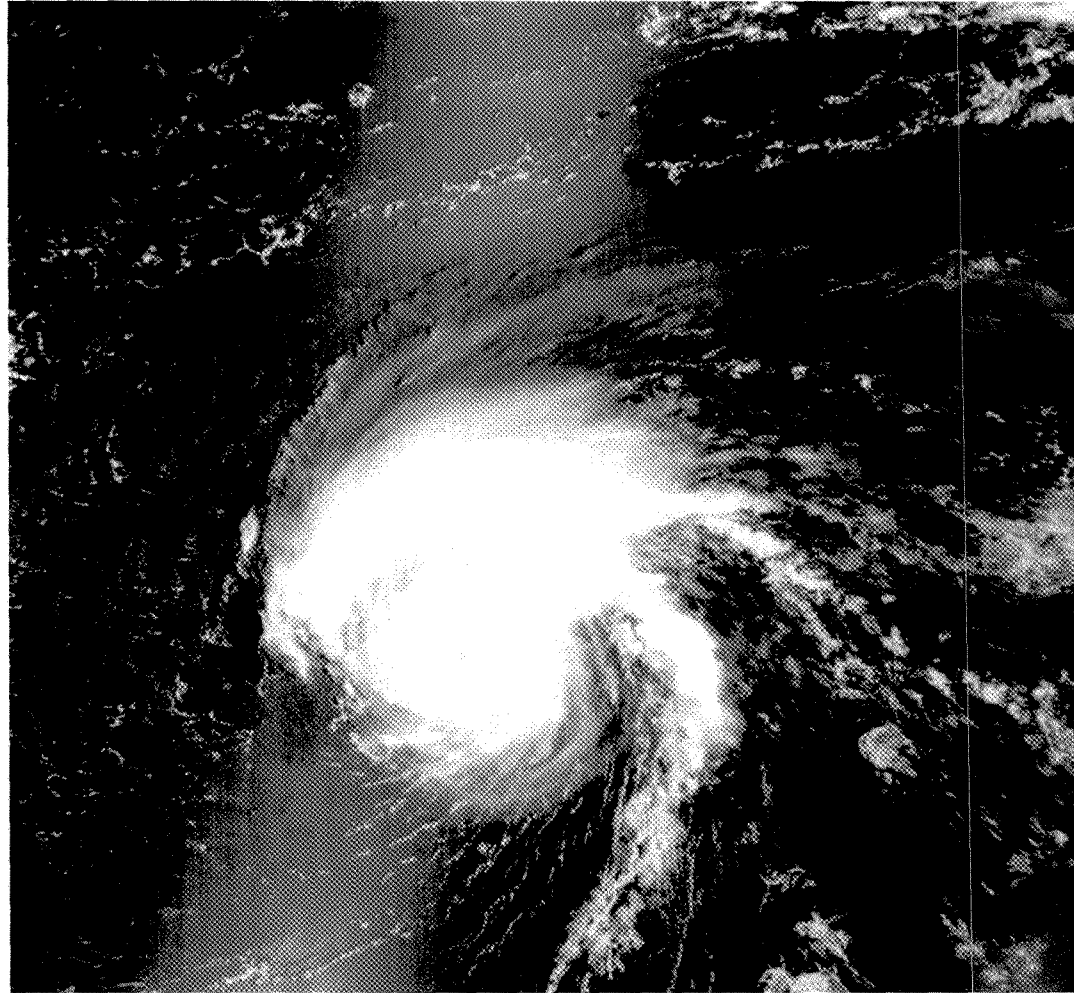
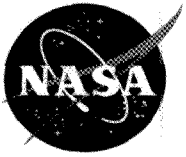


Image captured by the Moderate Resolution Imaging Spectroradiometer (MODIS) on NASA's Terra satellite.

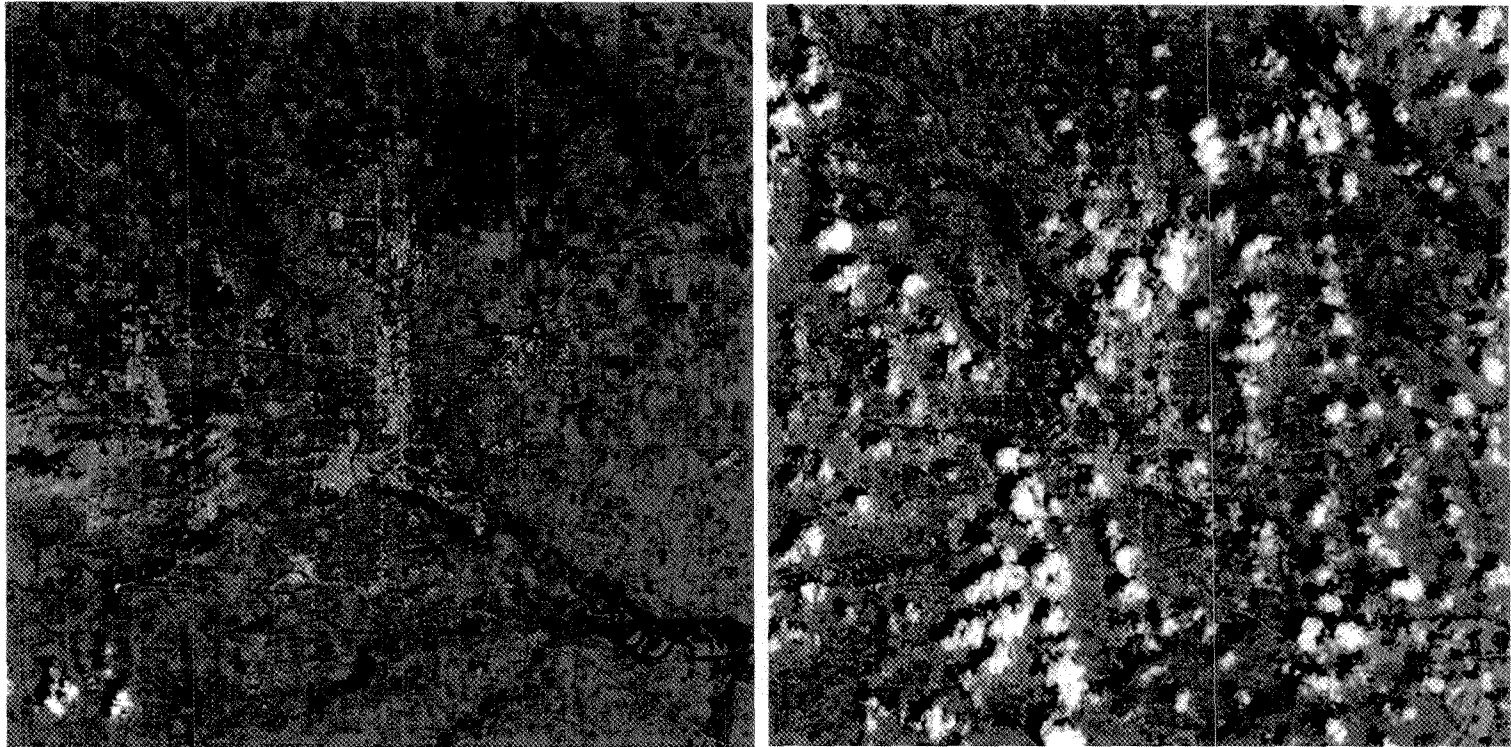
Image from <http://earthobservatory.nasa.gov/> .

NASA image created by Jesse Allen, using data provided courtesy of MODIS Rapid Response Team.





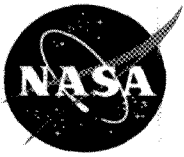
# Floods in Iowa – June 2008



ASTER Images of Des Moines, Iowa area. June 30, 2005 – Left; June 29, 2008 – Right  
ASTER is a Japanese instrument on NASA's Terra satellite.

Images from <http://earthobservatory.nasa.gov/> .

NASA image created by Jesse Allen, using data provided courtesy of NASA/GSFC/METI/  
ERSDAC/JAROS, and U.S./Japan ASTER Science Team.



## Global Fire Map (June 29 – July 8, 2008)

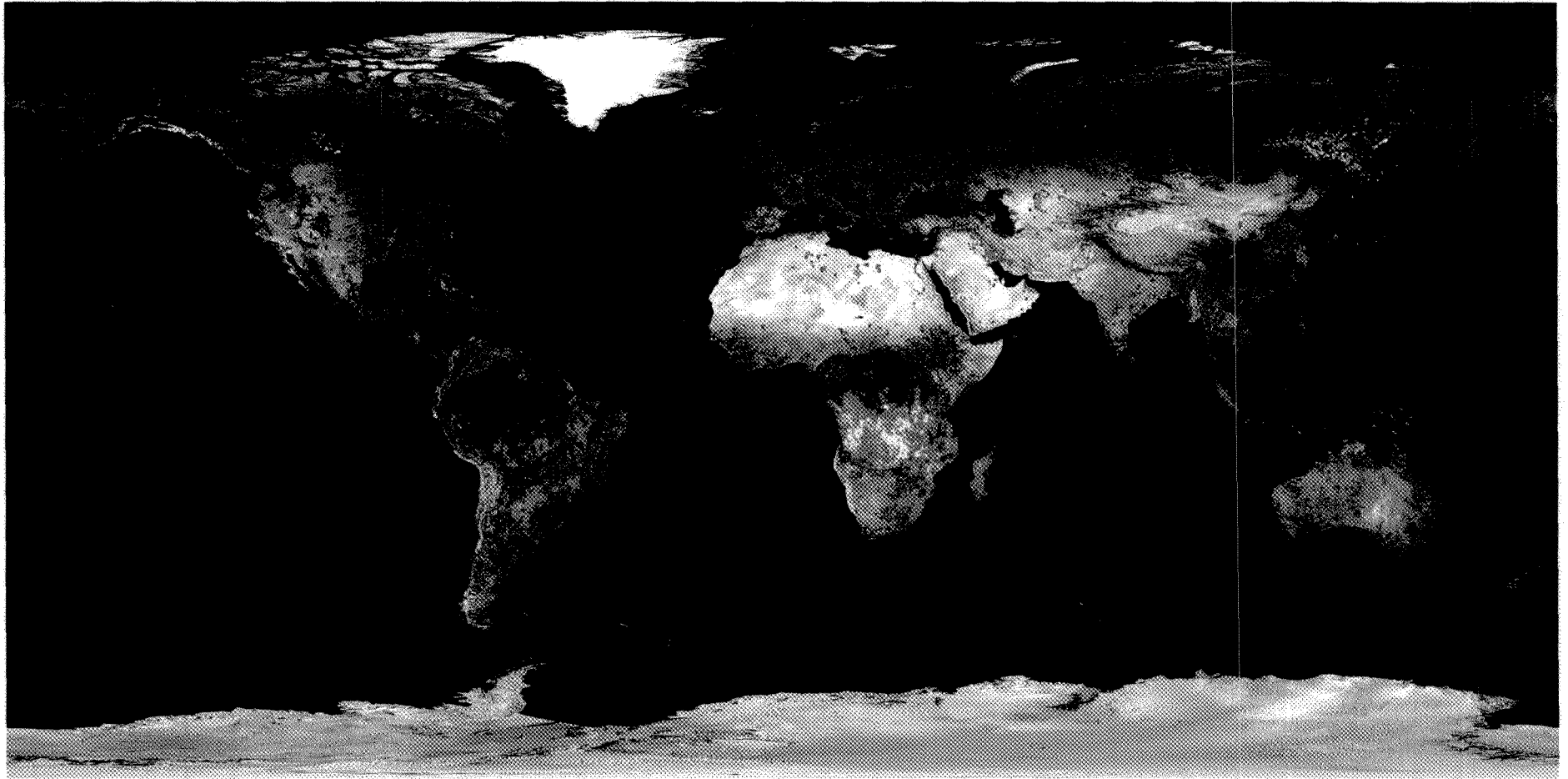


Image from <http://rapidfire.sci.gsfc.nasa.gov/firemaps/> .

Fire maps created by Jacques Descloitres, MODIS Rapid Response System at NASA/GSFC. Fire detection algorithm developed by Louis Giglio. Fire locations produced by the MODIS Rapid Response System since mid-2001.



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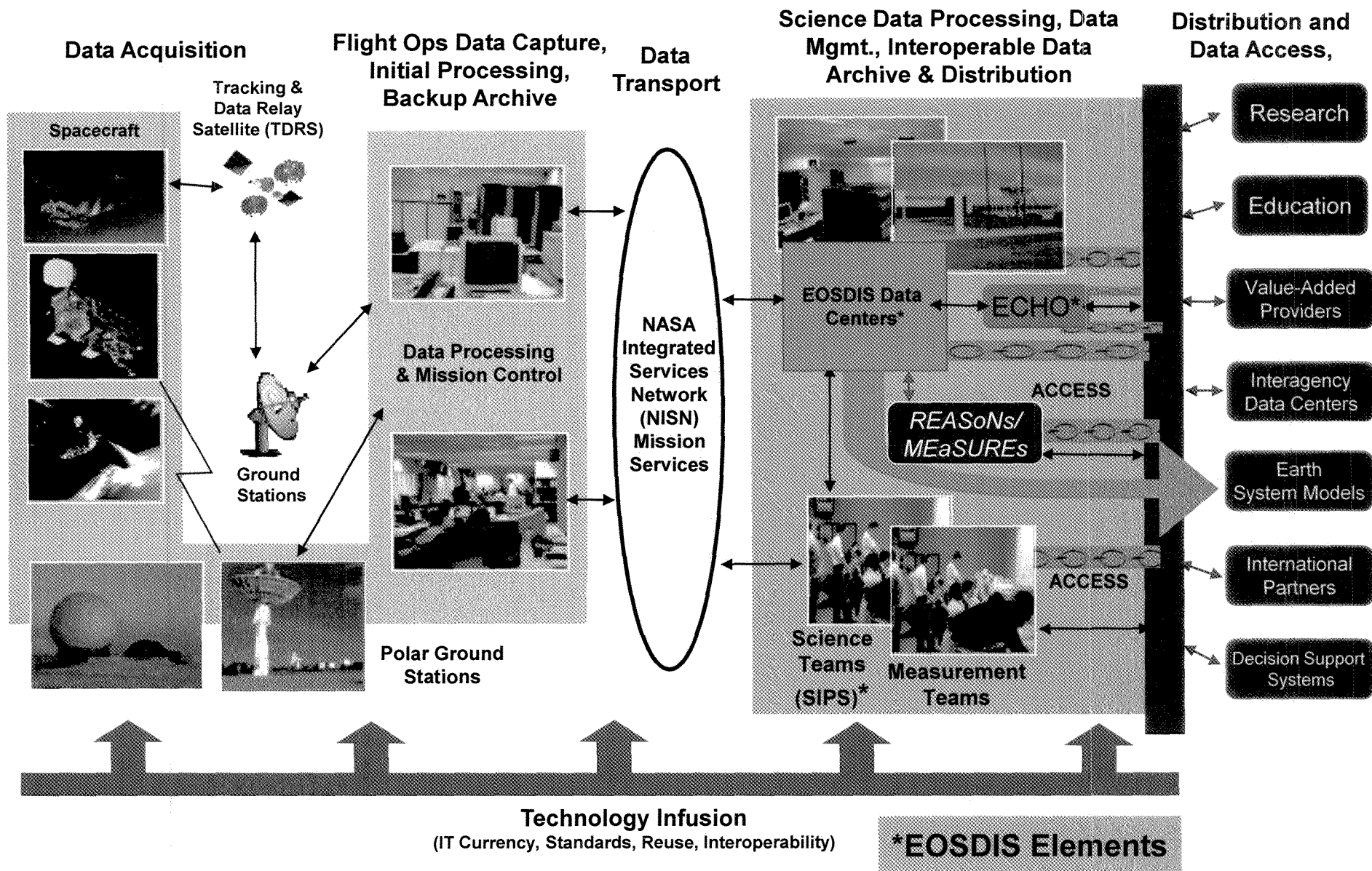


## **Core and Community Capabilities - Definition**

- **‘Core’ data system elements reflect NASA’s responsibility for managing Earth science satellite mission data characterized by the continuity of research, access, and usability.**
- **The core comprises all the hardware, software, physical infrastructure, and intellectual capital NASA recognizes as necessary for performing its tasks in Earth science data system management.**
- **‘Community’ elements are those pieces or capabilities developed and deployed largely outside the NASA core elements and are characterized by their ‘evolvability’ and innovation.**

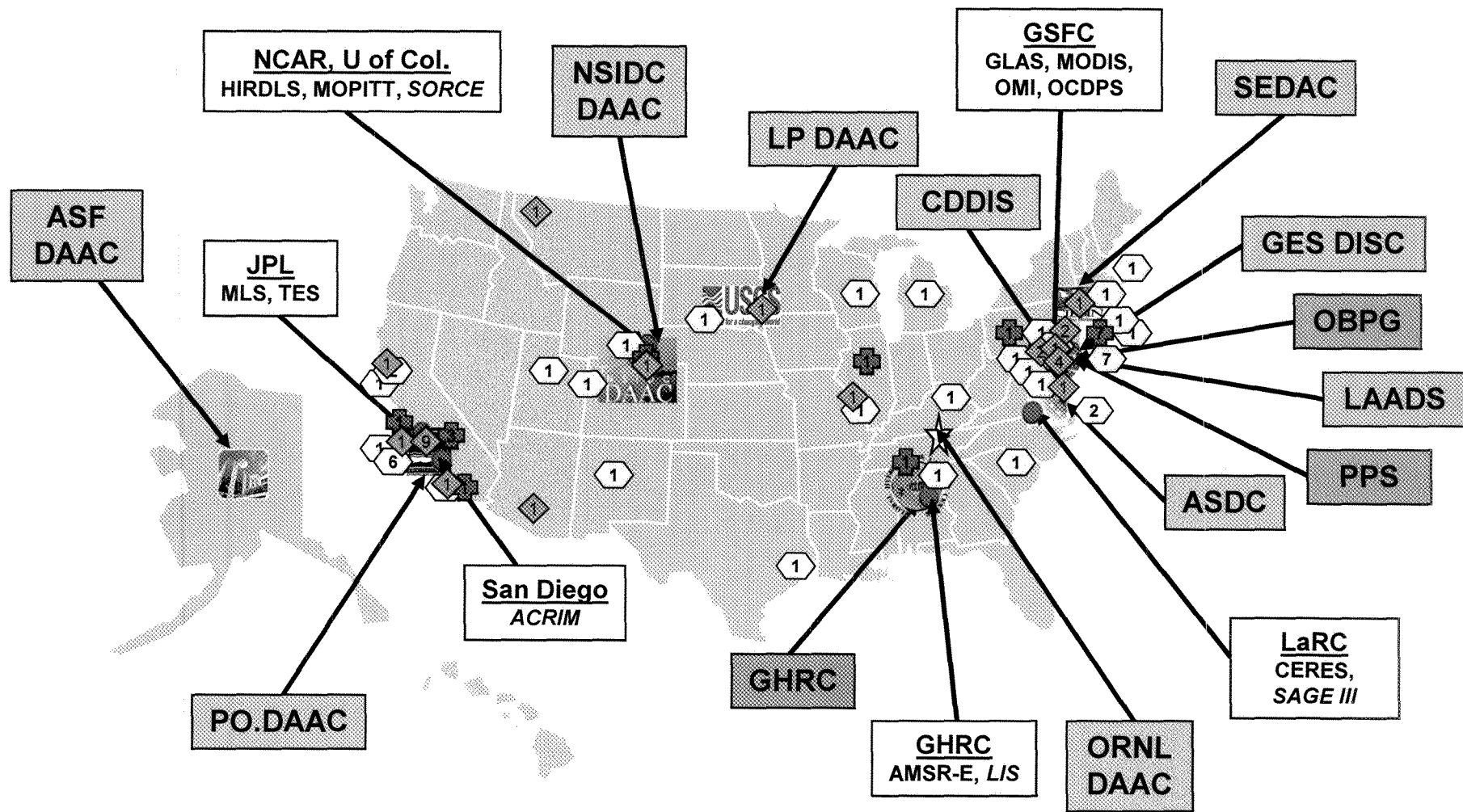


# Earth Science Data Systems Context

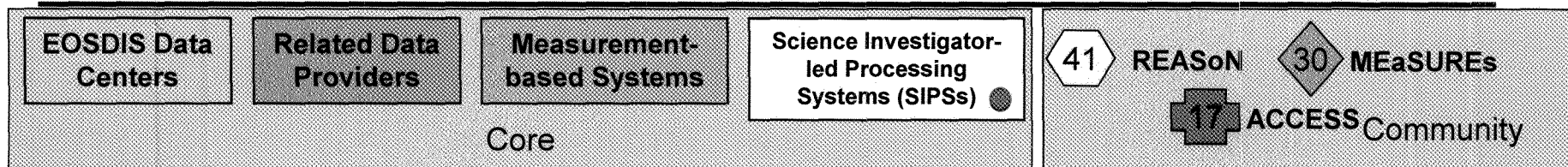




# NASA Earth Science Data Systems (Core and Community)



## KEY





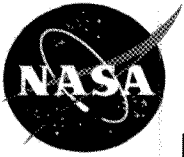
## **EOSDIS: A Core Capability**

- **NASA's Earth Observing System Data and Information System (EOSDIS) is a petabyte-scale archive of environmental data that supports global climate change research**
- **EOSDIS provides for**
  - **Data ingest**
  - **Data processing**
  - **Data distribution**
  - **Archive management**



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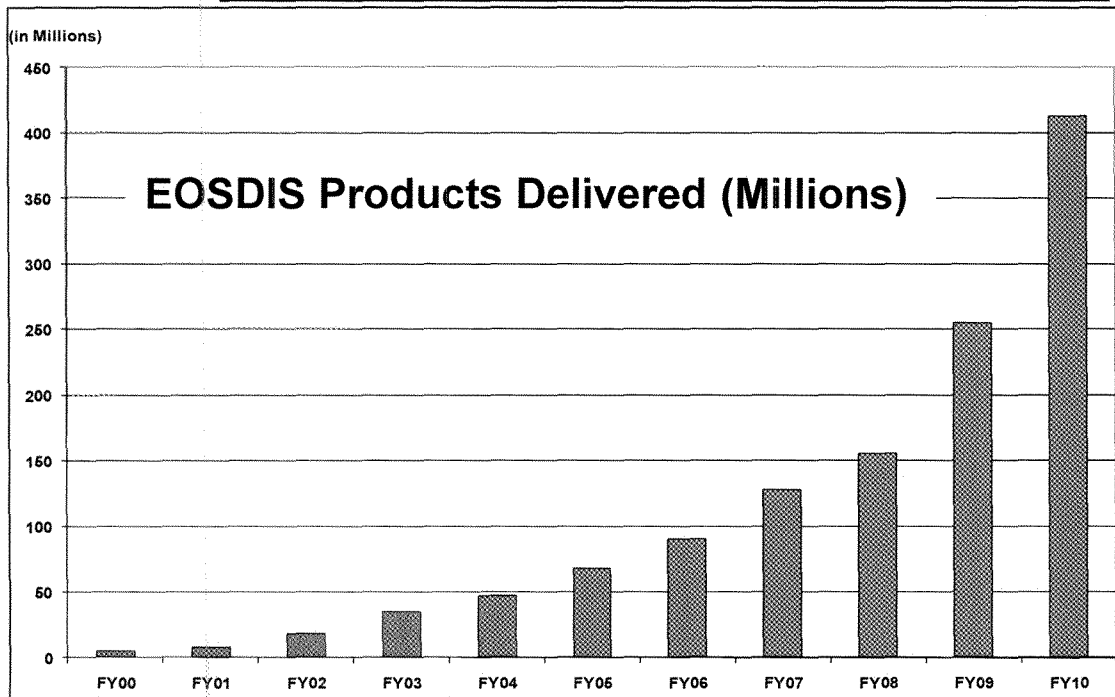
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# EOSDIS Key Metrics

<b>EOSDIS Metrics (Oct 1, 09 to Sept 30, 10)</b>	
Unique Data Products	> 4,200
Distinct Users of EOSDIS Data and Services	> 1.1 M
Web Site Visits of 1 Minute or more	> 1.1 M
Average Daily Archive Growth	2.9 TB/day
Total Archive Volume	4.6 PB
End User Distribution Products	> 412 M
End User Average Daily Distribution Volume	9.9 TB/day

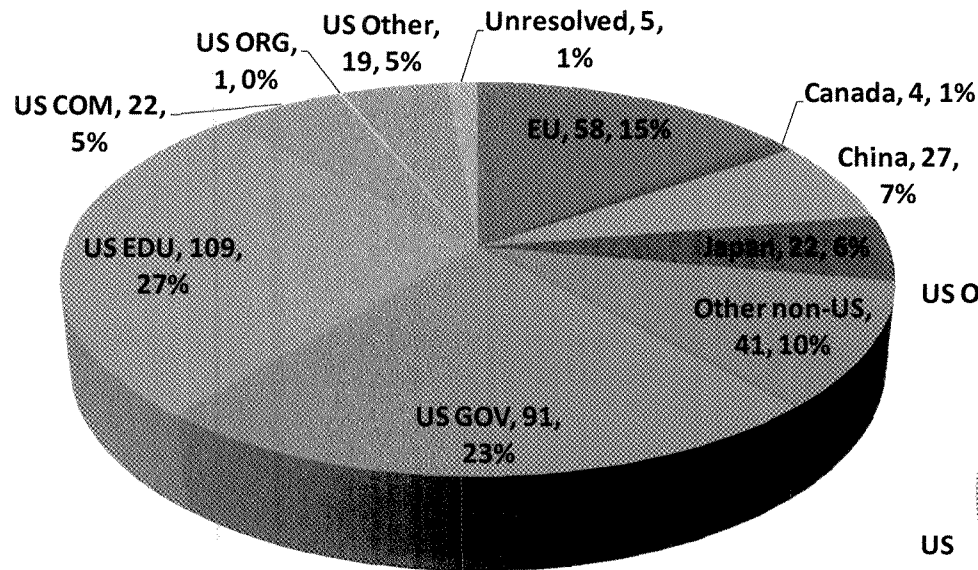
<b>EOSDIS Project Supports</b>		
<b>Science System Elements</b>	Data Centers	12
	SIPS	14
<b>Interfaces</b>	Interface Control Documents	32
<b>Partnerships</b>	US	8
	International	13
<b>Missions</b>	Science Data Processing	10
	Archiving and Distribution	38
	Instruments Supported	87



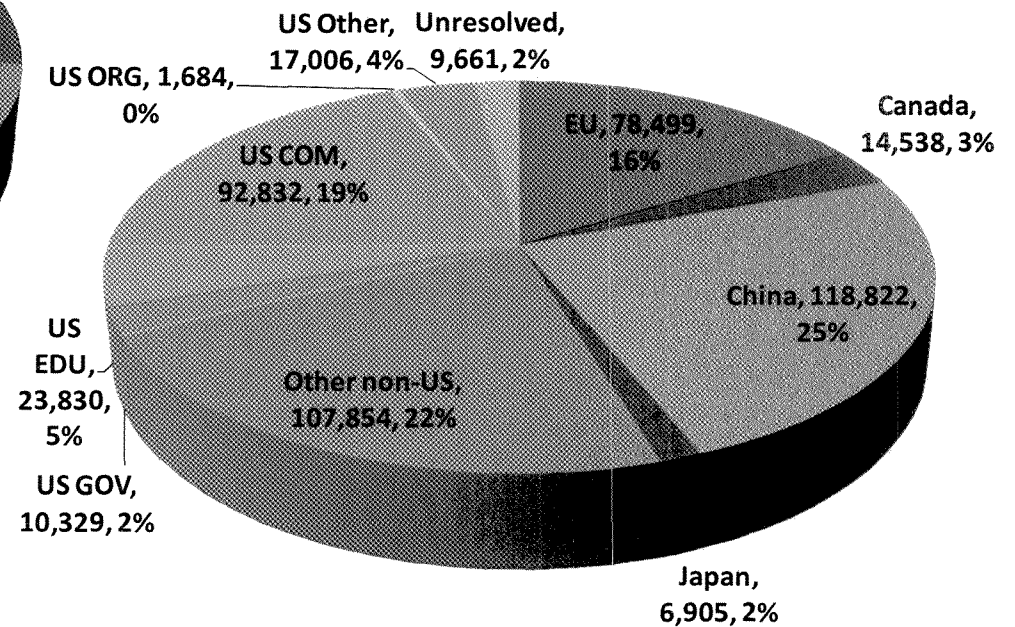


# EOSDIS Data Distribution In FY2010

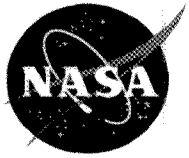
Number of Products Distributed in FY10 (Millions)



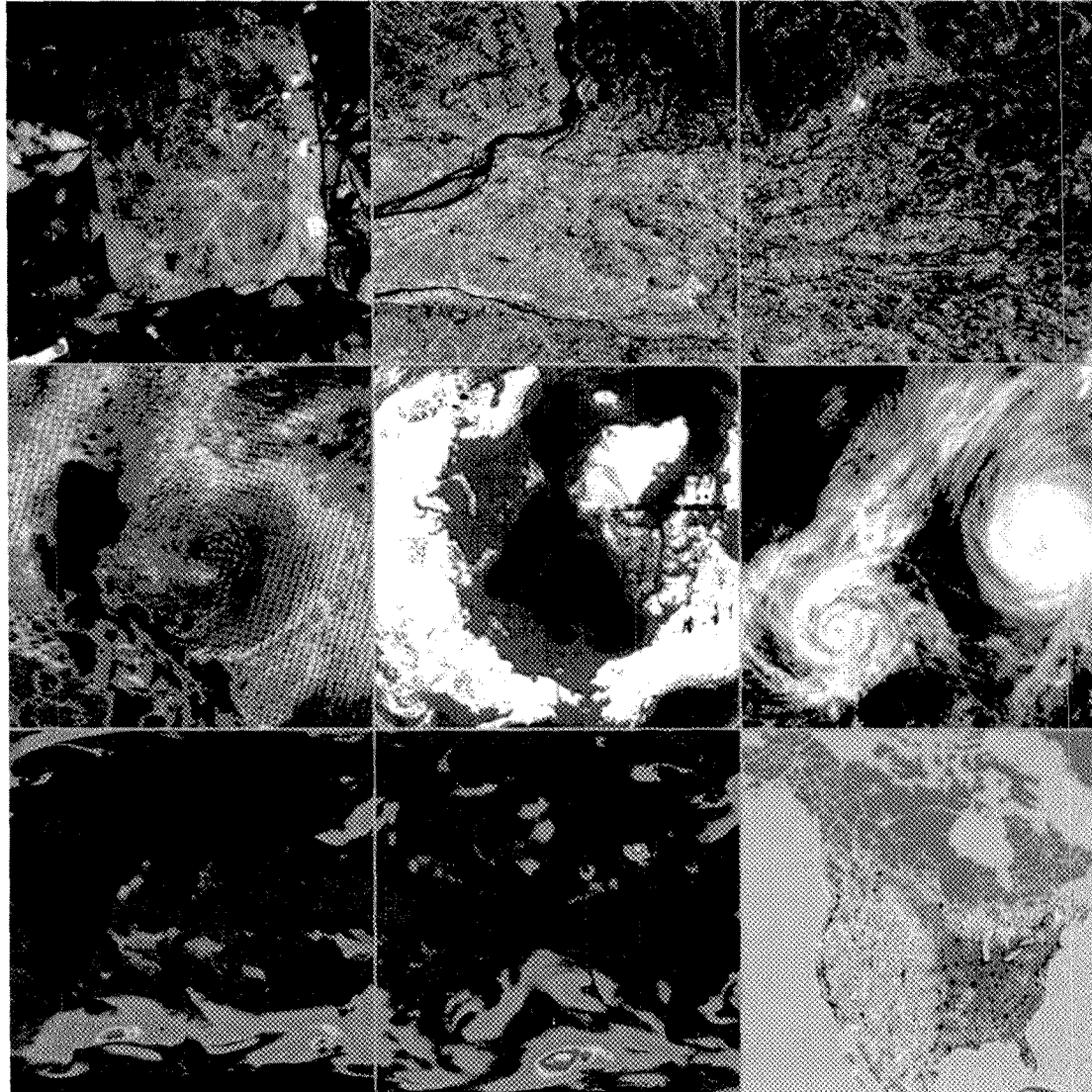
Number of Distinct Data Users in FY2010



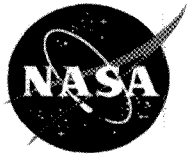




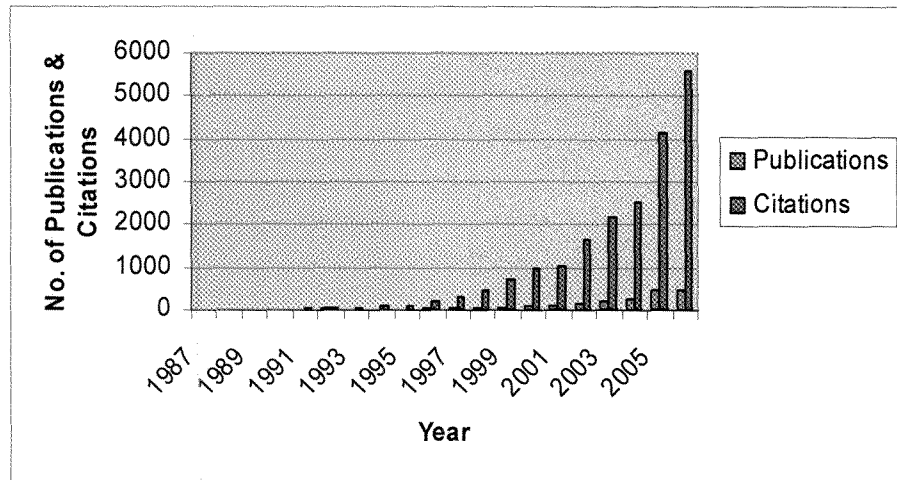
# Impact of EOSDIS - Earth Science Research



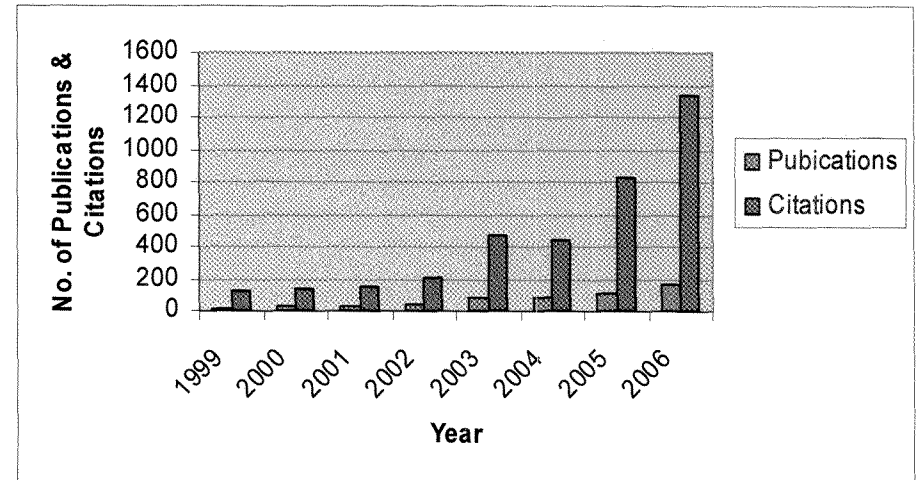




# Impact of EOSDIS - Scientific Productivity



Publications resulting from EOS Terra (12/99 launch) instruments and data



Publications resulting from EOS Aqua (05/02 launch) instruments and data

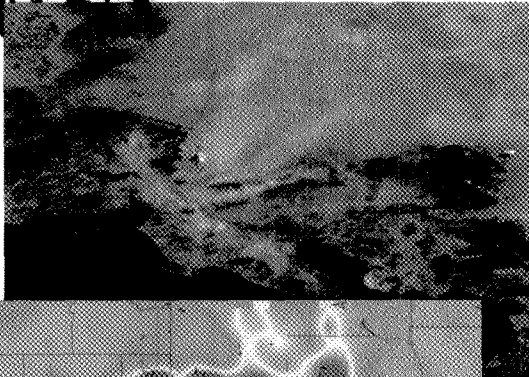
- Publications and citations shown here are a good indicator of scientific growth resulting from NASA's Terra and Aqua missions
- Pre-launch publications and citations are significant, but dramatic growth seen post-launch
- NASA's EOSDIS, through its well-established data management practices:
  - Produces and stores data and metadata in formats compliant with well-documented standards
  - Provides data, metadata and software tools promptly to a broad scientific community
- Data management is a key element in supporting scientific growth

•Terra metrics from Imhoff, M. L., S. C. Tsay, R. E. Wolfe, M. Hato, M. J. Abrams, B. A. Wielicki, D. J. Diner, V. V. Salomonson, J. R. Drummond, and J. C. Gille, 2007: Terra Senior Review Proposal, submitted to NASA Headquarters March 16, 2007

•Aqua metrics from Parkinson, C. L., S. E. Platnick, M. T. Chahine, V. V. Salomonson, A. Shibata, R. Spencer, B. Wielicki, J. Gainsborough, and S. M. Graham, 2007: Aqua Senior Review Proposal, submitted to NASA Headquarters March 16, 2007



Pyrocumulus clouds & smoke - Station Fire 2009

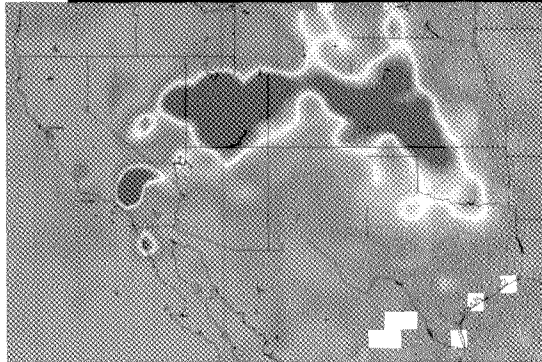
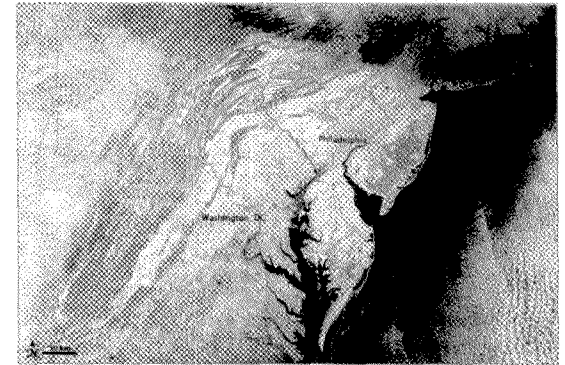


# Impact of EOSDIS/Applications

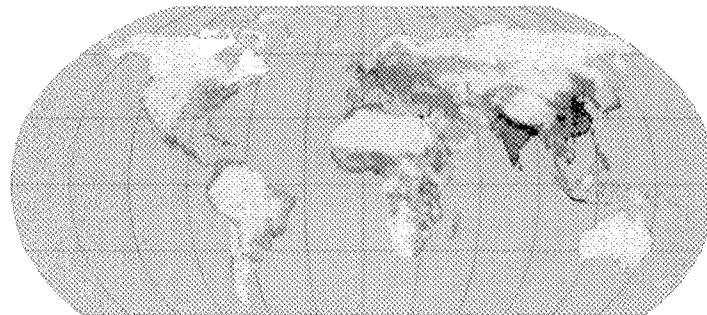
Flooding – North Dakota 2010



Snow - East Coast 2010



Carbon monoxide emissions - Station Fire 2009

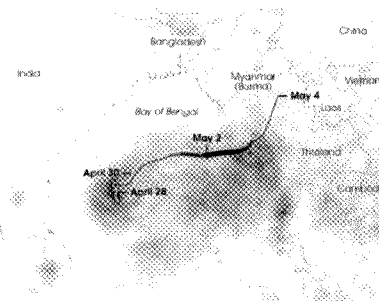
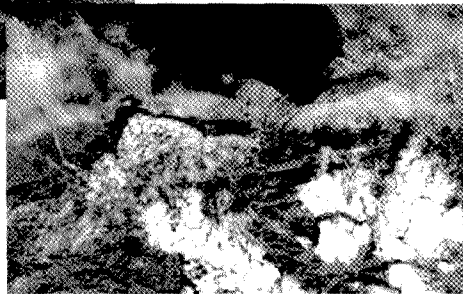


Gridded Population Density

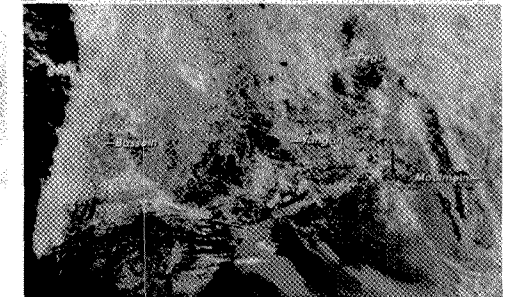
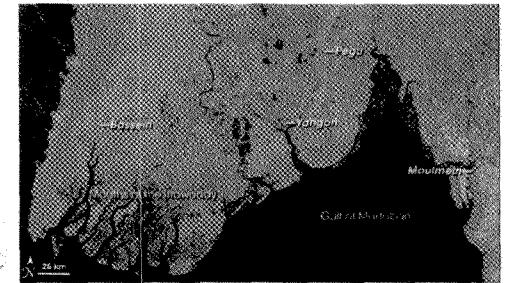


Composite 2007&2009

Earthquake - Haiti 2010



Cyclone and Flooding – Myanmar 2008





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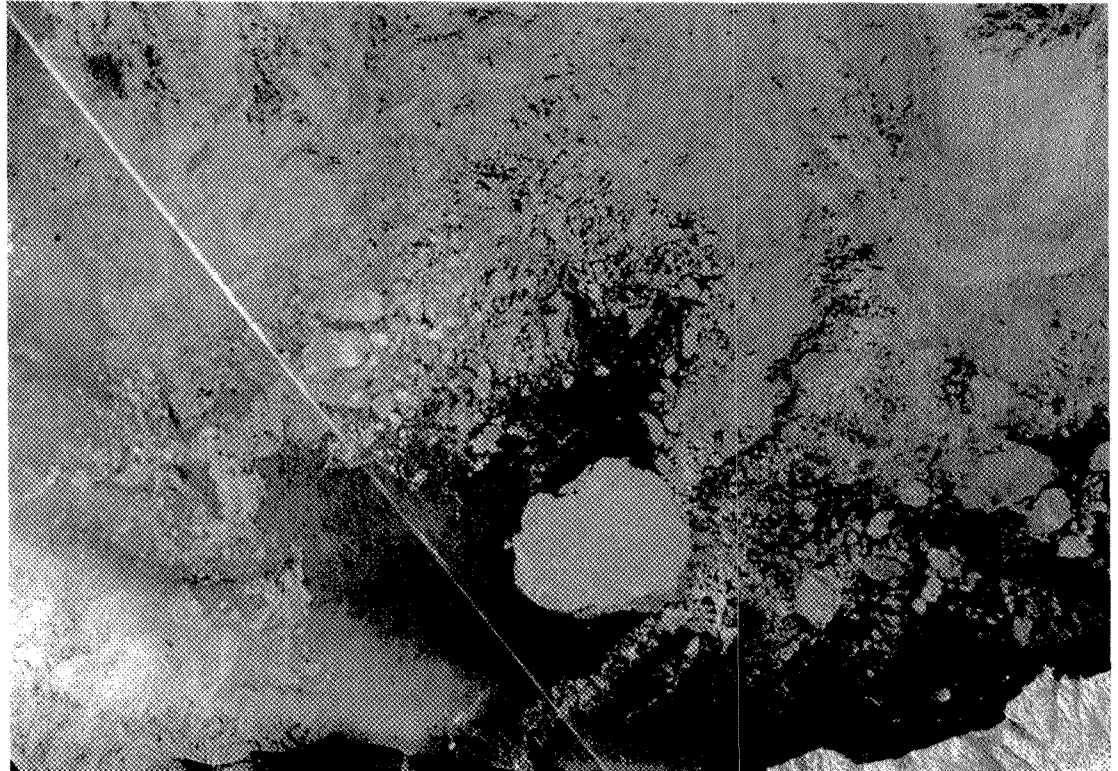


# ASF DAAC (Alaska Satellite Facility DAAC)

- Located: University of Alaska, Fairbanks, AK
- Cryosphere, Solid Earth, Land Use/Land Cover, Natural Hazards, Oceans
- Archive size (approx): 391 TB
- Ingest rate (approx): 73 GB/Day
- Distributes (approx): 54 GB/Day



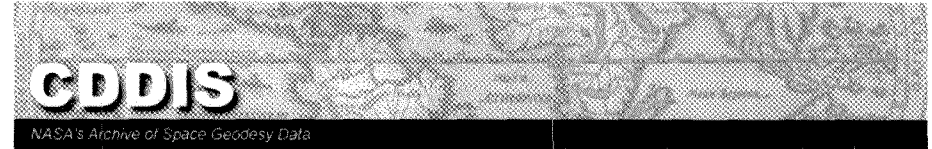
Synthetic Aperture Radar Imagery of the Bering Sea from Radarsat-1 taken near real-time for USCG Healy.



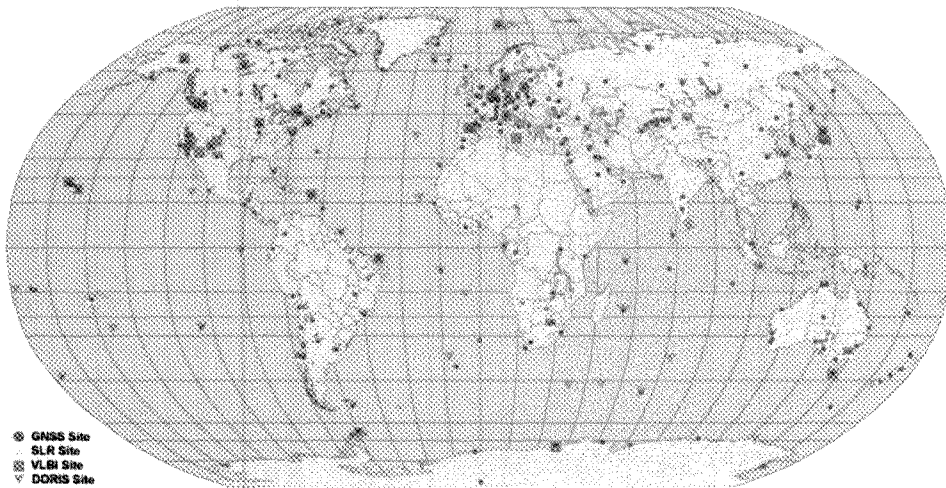


# CDDIS (Crustal Dynamics Data Information System)

- Located: NASA GSFC, Greenbelt, MD
- Solid Earth - Space Geodesy
- Archive size (approx): 4 TB
- Ingest rate (approx): 2.0 GB/Day
- Distributes (approx): 50 GB/Day

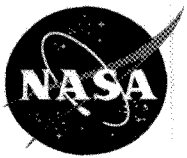


- Specialized data center responsible for the archive of space geodesy data sets: GNSS, laser ranging (SLR), VLBI, DORIS and products derived from these data (station positions and velocity for the terrestrial reference frame, Earth orientation parameters, precise satellite ephemerides, total electron content maps, troposphere parameters, etc.)
- Supports geodetic (e.g., LAGEOS, Etalon, etc.) and multi-disciplinary missions (e.g., LRO, GRACE, CHAMP, ERS, Envisat, SPOT, Jason, ALOS, etc.)
- Extensive international partnerships with the International Association of Geodesy (IAG) and serves as a primary data center for IAG geometric services
- Access provided through anonymous ftp
- <http://cddis.gsfc.nasa.gov/>



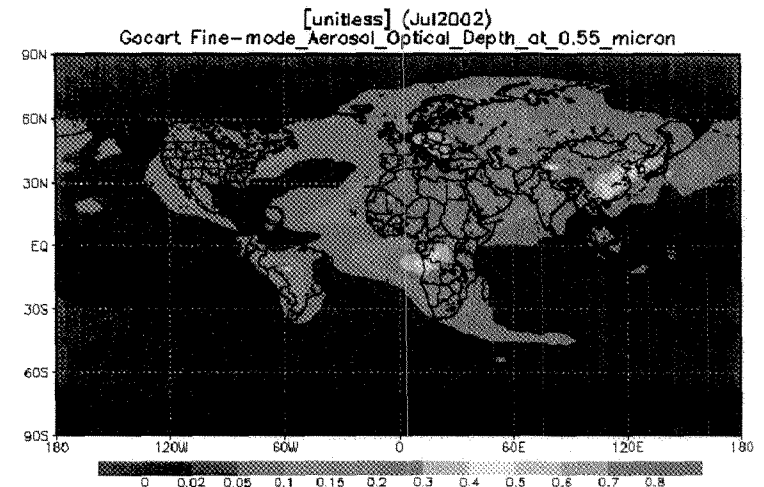
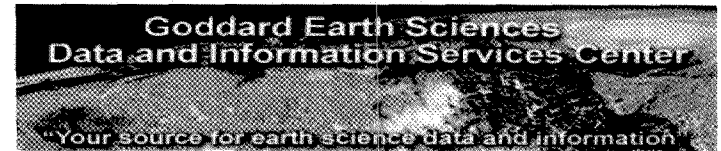
The global space geodesy network today includes 385 GNSS receivers, 35 laser ranging sites, 42 VLBI stations, and 55 DORIS sites and provides the means of determining an accurate and global Terrestrial Reference Frame. The CDDIS provides data from these sites and higher-level data products derived from the data to support a wide range of Earth science research.



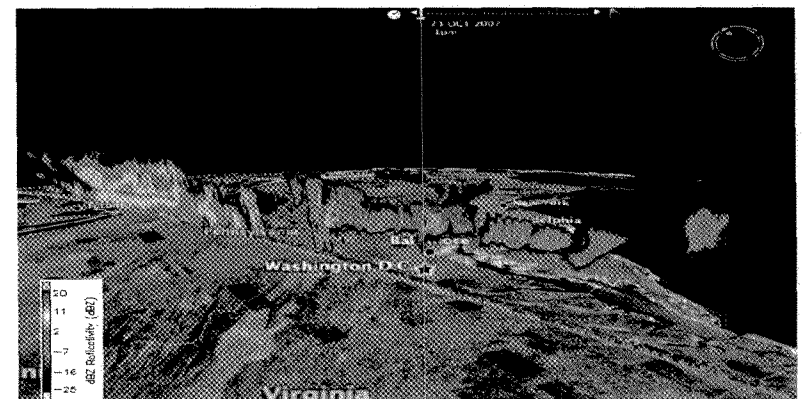
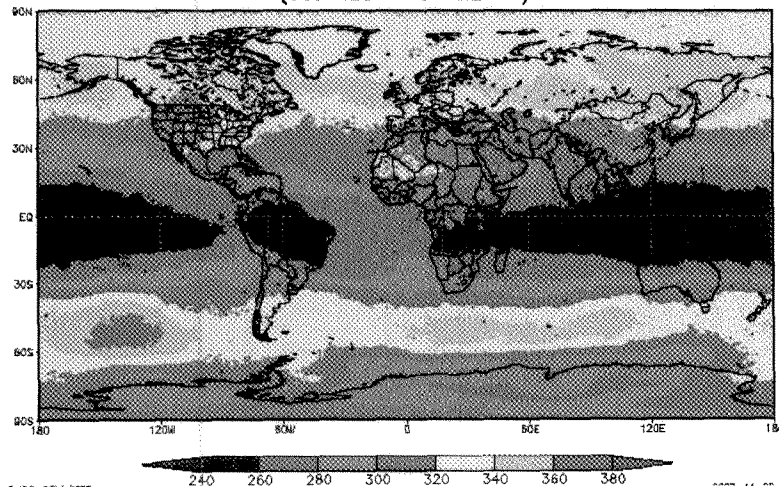


# GES DISC (GSFC Earth Sciences Data and Information Services Center)

- Located: GSFC, Greenbelt, MD
- Atmospheric Dynamics, Hydrology, Atmospheric Composition, Atmospheric Modeling, Multi-Sensor data management
- Archive size (approx): 250 TB
- Ingest rate (approx): 466 GB/Day
- Distributes (approx): 436 GB/Day



Daily AIRS Column Amount Ozone Ascending/Daytime [DU]  
(30Jun2007-31Jul2007)

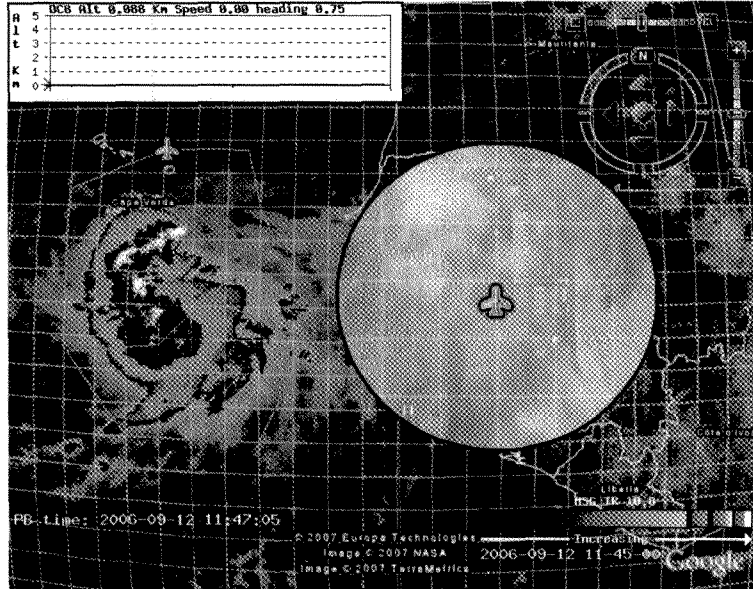


Global data products, such as from AIRS, Modeled data, such as from GOCART, and vertical measurements, such as from A-Train's Cloudsat, can be user-selected, subsetted, displayed, and accessed using GIOVANNI

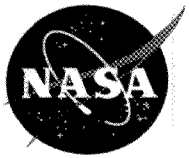


# Global Hydrology Resource Center

- **Located: Marshall Space Flight Center Huntsville, AL**
- **Atmospheric Science, Water and Energy Cycle, Weather**
- **Archive size (approx): 5 TB**
- **Ingest rate (approx): 5 GB/Day**
- **Distributes (approx): 34 GB/Day**

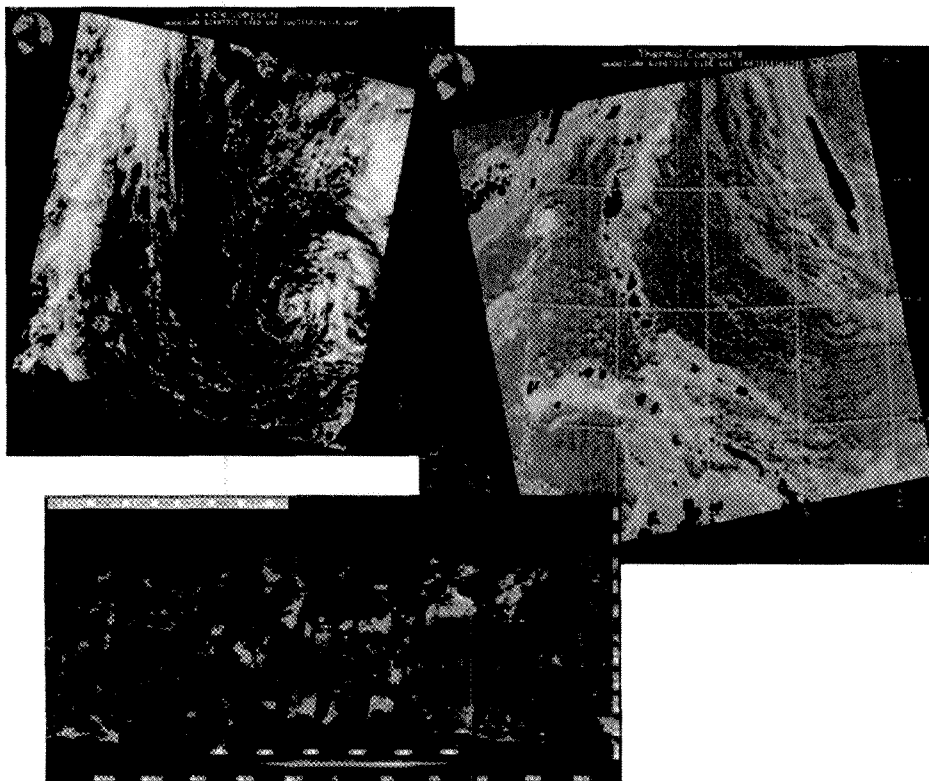


- **Lightning Imaging Sensor SCF: national lightning data center for the TRMM Lightning Imaging Sensor and validation networks**
- **Field campaigns: Web-based collaboration for science before, during, and after experiments. Data acquisition, integration, archive and distribution:**
  - CAMEX (1998, 2001), ACES (2002),
  - TCSP (2005), NAMMA (2006), TC4 (2007)
- **DISCOVER: Highly accurate long-term (decadal+) climate and ocean data sets from multiple instruments on multiple platforms**
  - Interoperability technologies for improved data access and usability
- **<http://ghrc.msfc.nasa.gov>**

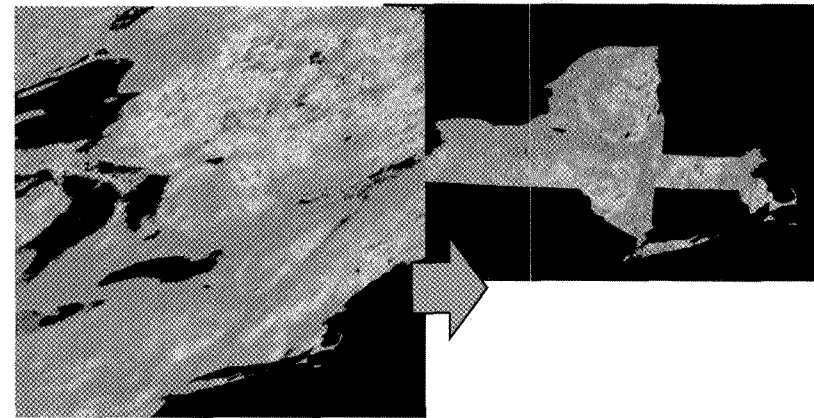


## Level 1 and Atmosphere Archive and Distribution System (LAADS, a MODIS Adaptive Processing System)

- Located: Goddard Space Flight Center
- MODIS Level 1 and atmosphere products
- Archive size (approx): 600 TB
- Ingest rate (approx): 100 GB/Day
- Distributes (approx): 5 TB/Day



- Provide access to MODIS Level 1 and Atmosphere products



- Subsetting, sub-sampling, mosaicing, masking, reprojection and format conversion options enable users to transform MODIS standard products
- <http://ladsweb.nascom.nasa.gov/>



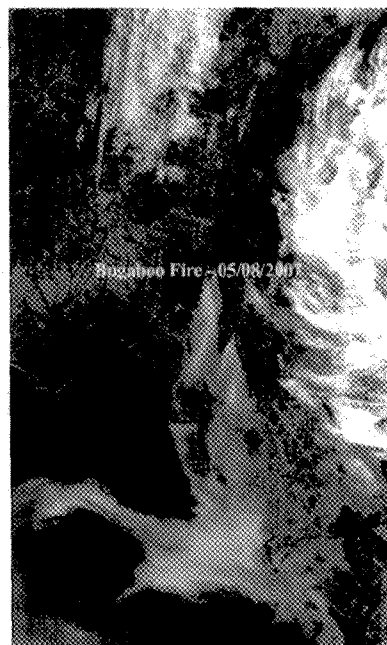


## Land Processes DAAC (LPDAAC)

- **Location:** Earth Resources Observation and Science (EROS) Center, Sioux Falls, SD
- **Role:** Process, archive, and distribute land-related data collected by EOS sensors, thereby promoting the inter-disciplinary study and understanding of the integrated Earth system (**Climate Variability and Change, Carbon Cycle and Ecosystems, and Solid Earth and Natural Hazards**)
- **Products:**
  - ASTER: 1 archived, 20 on-demand
  - MODIS: 60+ archived Land Products
- **Key Metrics:**
  - Archive: ~1,450 TB
  - Ingest: ~600 GB/Day
  - Distribution: ~1,200 GB/Day
- <http://edcdaac.usgs.gov/main.asp>

*Land Processes*

*Distributed Active Archive Center*



MODIS, 8 May 2007  
Bugaboo Fires  
Georgia and Florida



ASTER, 4 Sept 2007  
Tanzania's Ol Doinyo Lengai  
Volcano Erupts

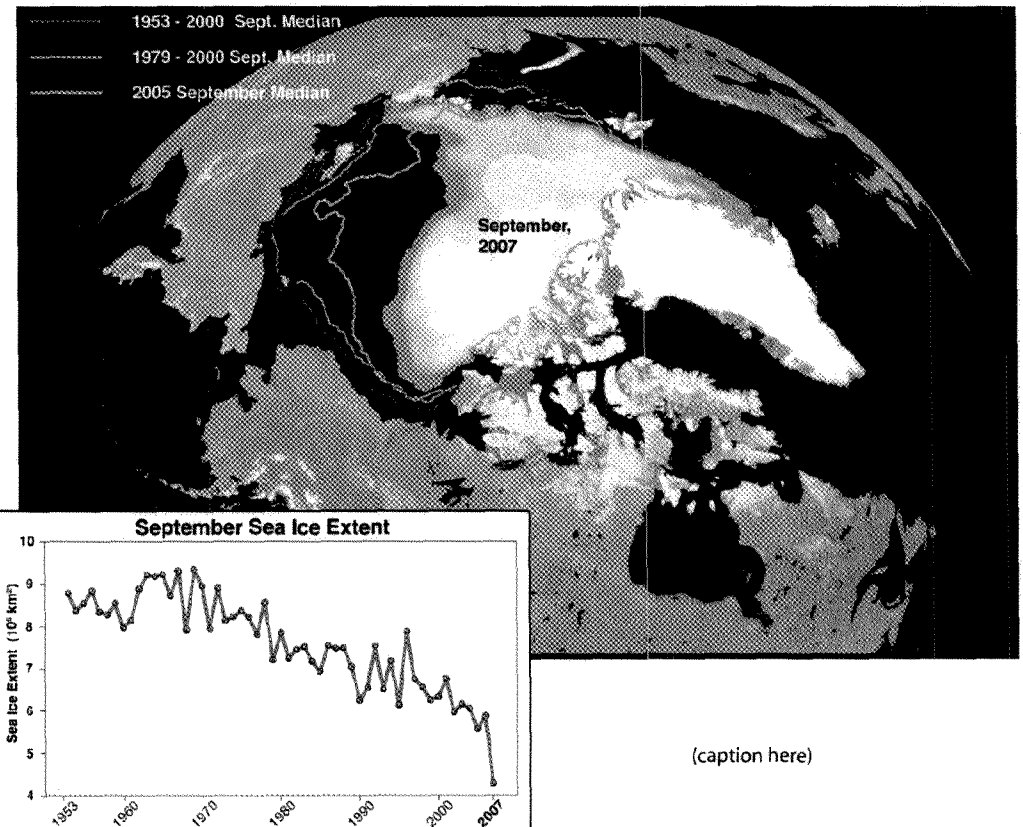


# National Snow & Ice Data Center DAAC (NSIDC DAAC)

- Located: University of Colorado, Boulder, CO
- Snow and Sea Ice Extent, Ice Dynamics, Icesheet topography, Glacier Changes and Hydrology
- Increasingly Active Snow and Ice Data Distribution and Services from MODIS, ICESat, AMSR-E, SSM/I, SMMR and other sensors and data sources.
- Archive size (approx): 146 TB ^
- Ingest rate (approx): 50 GB/Day ^
- Distributes (approx): 135 GB/Day ^



National Snow and Ice Data Center  
*Supporting Cryospheric Research Since 1976*



Sea Ice Extent  
From in-situ and PM  
data

(caption here)



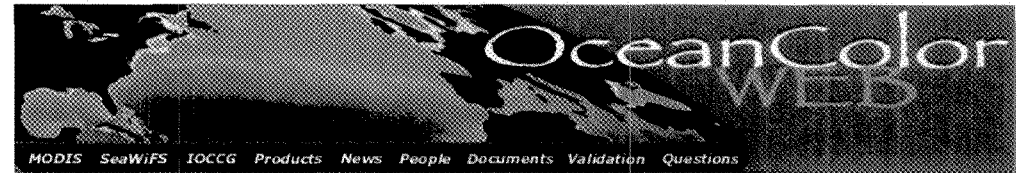
# NASA Ocean Biology Processing Group

- Located: Goddard Space Flight Center
- Total Archive size: **313 TB**
- Distribution (> 2/04): **24 million files**

- MODIS support is implemented within the framework and facilities of the current NASA Ocean Data Processing System (ODPS) which has been successfully supporting operational, satellite-based remote-sensing missions since 1996, and its capabilities continue to evolve and expand to meet the demands and challenges of future missions

## MISSIONS SUPPORTED

- SeaWiFS : 1997 - active
- MODIS (Terra and Aqua) : 2000 - present
- CZCS / Nimbus-7 : 1978 - 1986
- OCTS / ADEOS-I : 1996 - 1997
- Glory data system prototype : 2009 launch
- Aquarius / SAC-D : 2010 launch
- VIIRS / NPP : 2010 launch
- Community Processing & Analysis Software SeaDAS (1991- present)



[oceancolor.gsfc.nasa.gov](http://oceancolor.gsfc.nasa.gov)

## Consolidated data access, information services and community feedback

The screenshot shows the OceanColor WEB interface. At the top, there's a navigation menu with links for MODIS, SeaWiFS, IOCCG, Products, News, People, Documents, Validation, and Questions. Below the menu is the URL [oceancolor.gsfc.nasa.gov](http://oceancolor.gsfc.nasa.gov). The main content area is titled "Consolidated data access, information services and community feedback".

The interface includes a search bar with "SeaWiFS User Login" and a "GO" button. Below the search bar, there are several filter options:
 

- SeaWiFS**: GAC, LAC, MLAC, Day, Night
- MODIS**: OCTS (ADEOS), MODIS (Terra), MODIS (Aqua), CZCS (Nimbus 7)
- Radius (km)**: 72, 400, 800, 1200, 1500
- Select swaths containing (at least):** any part, 25 %, 50 %, 75 %, all
- Select only swaths having in situ matchups**: Yes, No

A world map is displayed, showing the location of the selected swaths. The map is titled "Monday, 30 October 1978 through Friday, 2 November 2007" and "Chlorophyll".

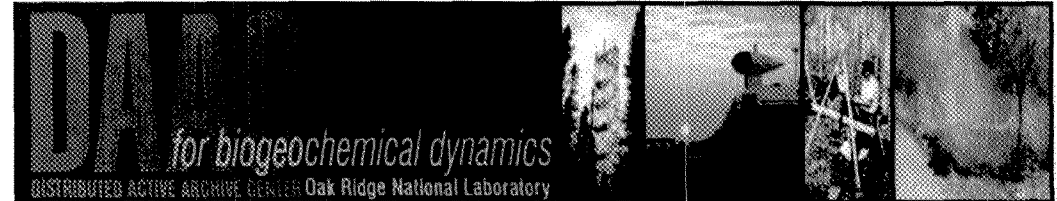
On the right side, there are options to "Select one or more regions:" and a list of regions: AdriaticSea, AegeanSea, Antarctica, ArabianSea, AralSea, Arctic, Australia, AustraliaCoast, Azores, Bahamas, BalticSea, and others. There are also input fields for "N:", "W:", and "S:" to specify boundary coordinates or a single location. A "Find swaths" button is located at the bottom right.

At the bottom, there is a "Display results 10 at a time." and a "Reconfigure page" button. Below this, there are three calendar grids for September 2007, October 2007, and November 2007, showing the days of the week and the number of swaths available for each day.

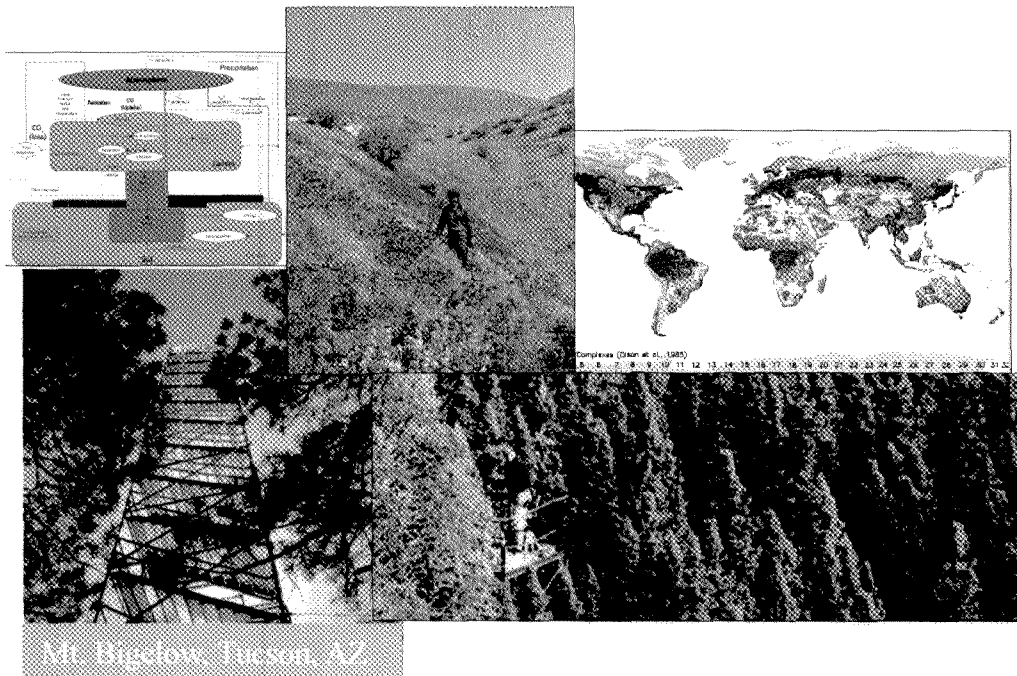


# Oak Ridge National Laboratory DAAC ( ORNL DAAC)

- Located: Oak Ridge, TN
- Biogeochemistry, Terrestrial Ecology, Land Validation, Carbon/Energy Cycles
- Archive size (approx): 1.08 TB
- Ingest rate (approx): 78 GB/year
- Distributes (approx): 1.4 TB/year



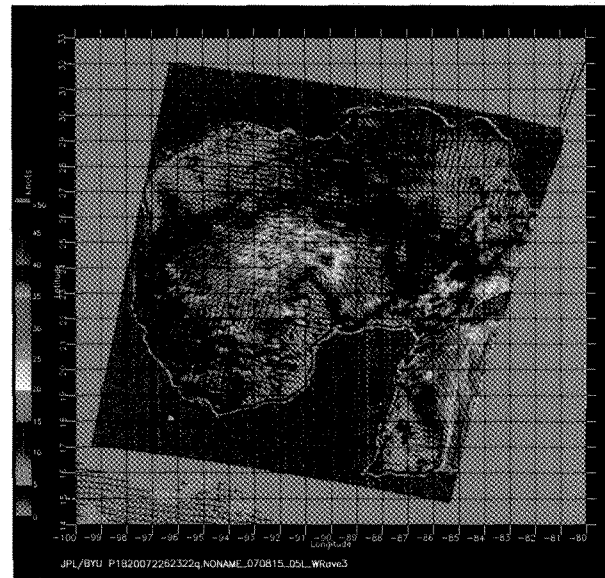
- Archive for field campaigns (ongoing): Large-scale Biosphere Atmosphere Experiment in Amazonia
- Support for Validation of Remote Sensing Products: providing ground-based measurements (FLUXNET); **Development of tools to aid in validation (MODIS subsets for field sites, collaboration with NOAA / NCDC)**
- Archive for regional and global data for land surface models: Global fire emissions data; ISLSCP II archive; model source code archive; **Tools for visualizing Spatial data (WebGIS)**
- [www.daac.ornl.gov](http://www.daac.ornl.gov)



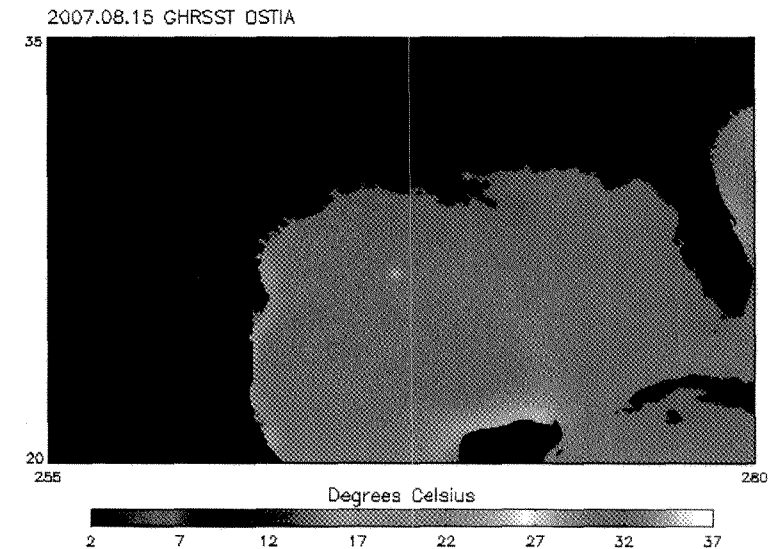


# PODAAC (Physical Oceanography DAAC)

- Located: JPL, Pasadena, CA
- Physical Oceanography, Sea Surface Temperature, Sea Level Height, Seasonal Climate, Ocean Vector Winds
- Archive size (approx): 45 TB
- Ingest rate (approx): 43 GB/Day
- Distributes (approx) 465 GB/Day



Erin Aug. 15, 2007 - QuikSCAT



Erin Aug. 15, 2007 - Global High-Resolution Sea Surface Temperature (GHRSSST)/Operational Sea Surface Temperature and Sea Ice Analysis (OSTIA)

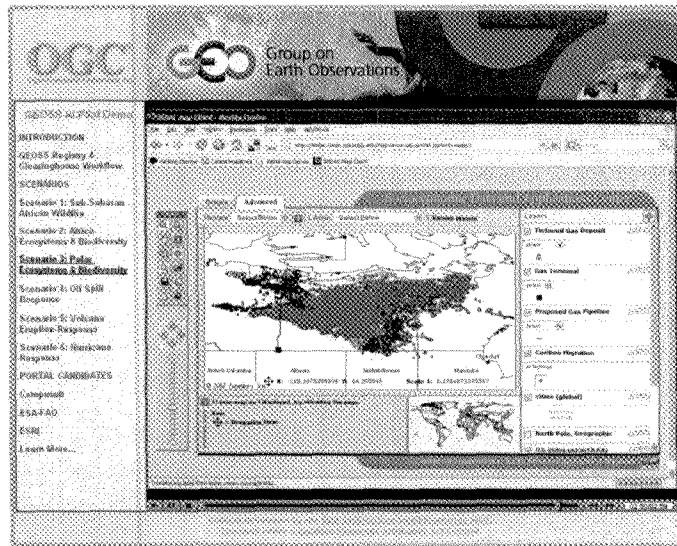


# Socioeconomic Data and Applications Center (SEDAC DAAC)

- Located: Columbia University, NY
- Population, urbanization, land use, conservation, hazard vulnerability, environmental health, GHG emissions, poverty, food security, sustainability, environmental treaties, climate impacts
- Archive size (approx): 452 GB
- Ingest rate (approx): 0.4 GB/day
- Distributes (approx): 0.4 GB/Day



World Data Center for Human  
Interactions in the Environment



Screen shot from OGC videos for GEO-IV Plenary

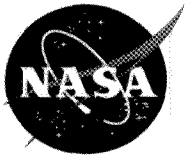
- Active support for GEOSS development through access to data, metadata, and map client via open standards, including contributions to Architecture Implementation Pilot, GEOSS clearinghouse and portal candidates, and GEO data sharing guidelines
- Host for IPCC Socioeconomic Data Distribution Centre and active in recent IPCC meetings on regional climate vulnerability and development of new scenarios
- High profile citations and data usage in 2008 *World Development Report*, recent UN reports, IPCC FAR, NRC studies, *Science*, National Geographic atlases, online media
- <http://sedac.ciesin.columbia.edu/>



# Science Investigator-led Processing Systems (SIPSs)

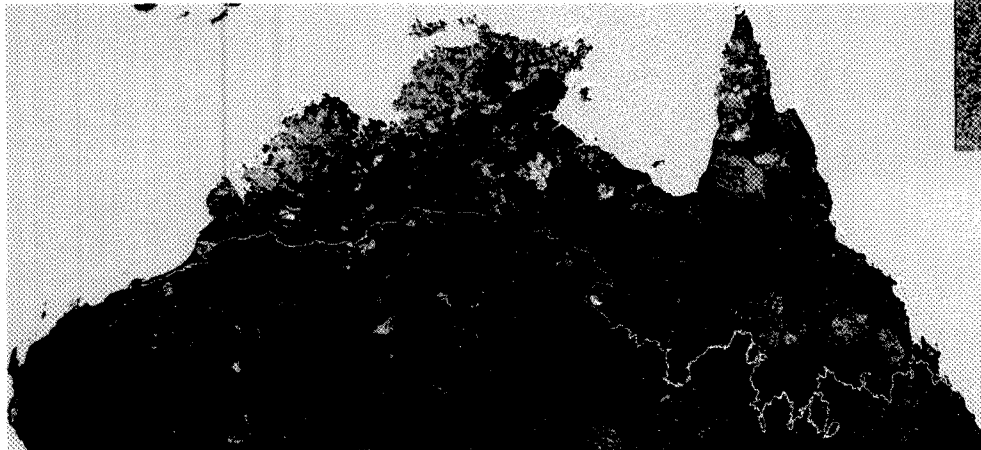
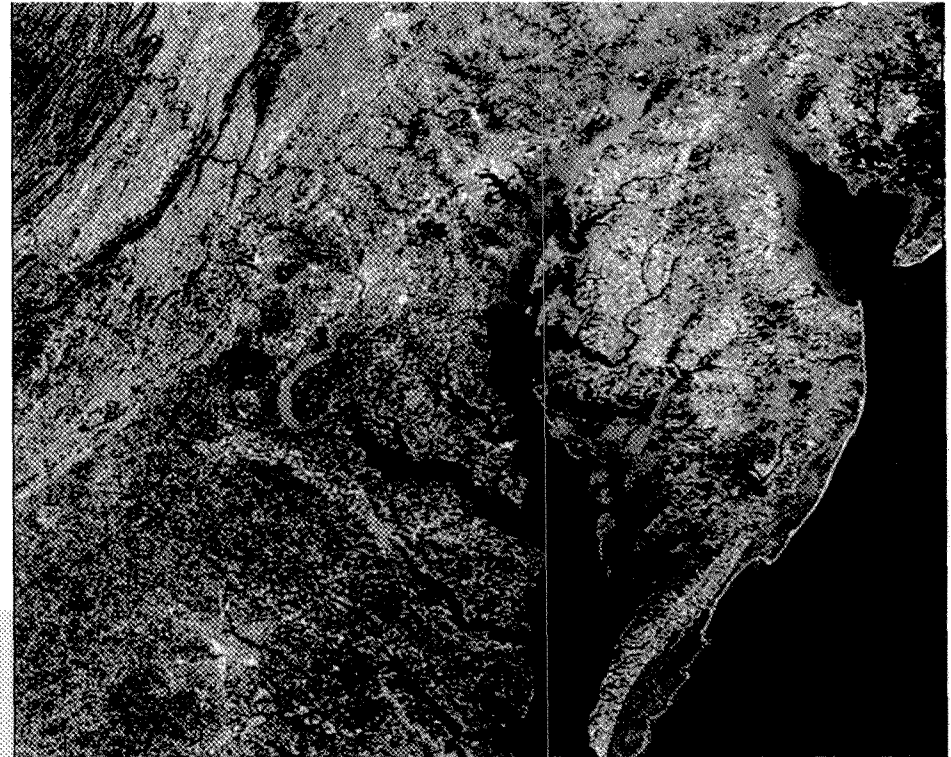
- **MODAPS – Moderate Resolution Imaging Spectroradiometer (MODIS) Adaptive Processing System**
  - Product Generation
  - Archive and Distribution
- **OBPG - Ocean Biology Processing Group**
- **AMSR-E SIPS - Advanced Microwave Scanning Radiometer for EOS SIPS**
- **ICESat SIPS - Ice, Clouds, and Land Elevation Satellite SIPS**
- **MOPITT SIPS - Measurement of Pollution in the Troposphere SIPS**
- **HIRDLS SIPS - High-Resolution Dynamics Limb Sounder SIPS**
- **MLS SIPS - Microwave Limb Sounder SIPS**
- **OMI SIPS - Ozone Monitoring Instrument SIPS**
- **TES SIPS - Tropospheric Emission Spectrometer SIPS**





# MODAPS – Product Generation

- Location: GSFC, Greenbelt, MD
- MODIS - Level 1, Land and Atmosphere products
- Science Team Size: 50
- No. of Products: 51
- Daily Ingest: 0.1TB
- Daily Output: 0.5TB(current day) to 2.2TB (reprocessing)
- Products Archived at: LP DAAC, NSIDC and LAADS



Land Surface Reflectance with dynamic aerosol model improves correction for aerosol

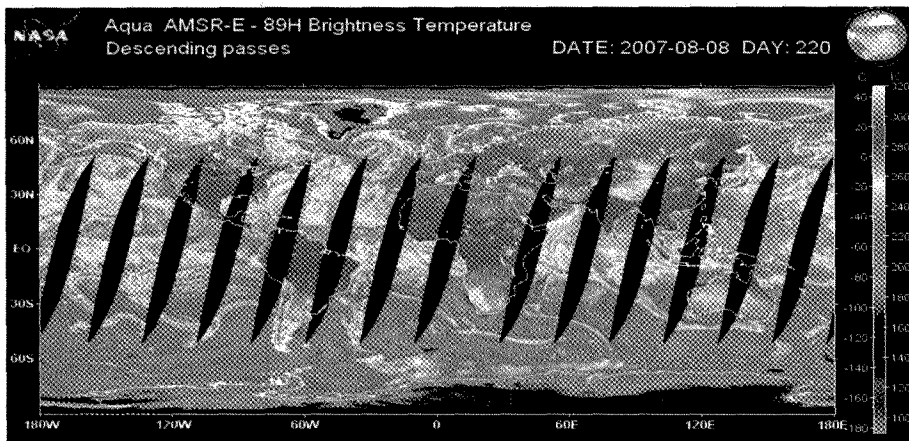
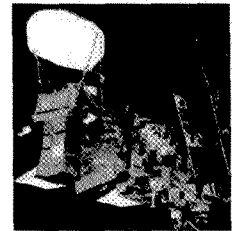
Burned areas over the 2003 dry season in Australia (March-November) from the new MODIS burned area product



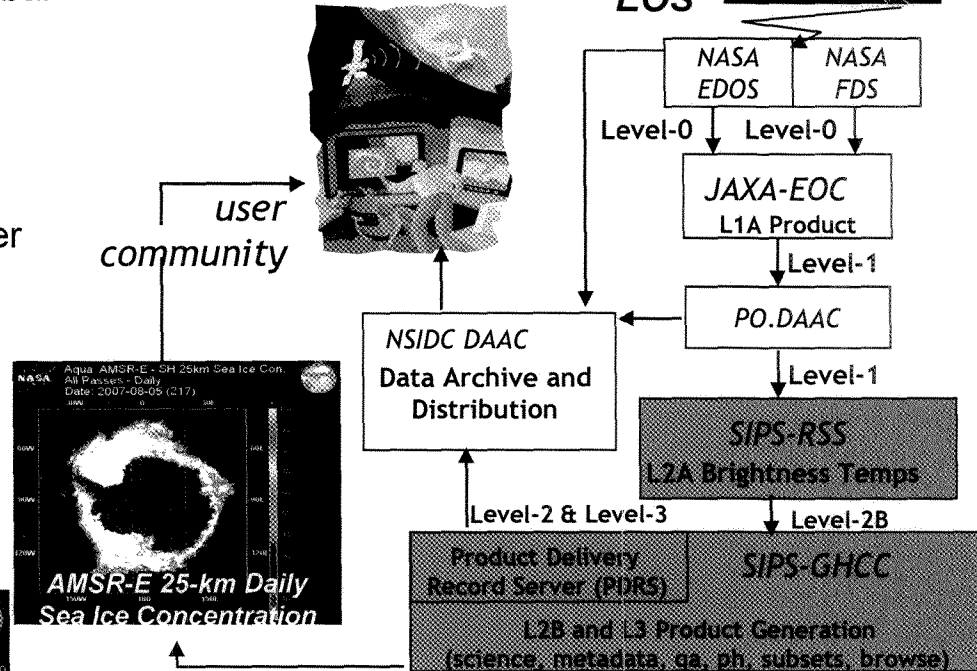
# AMSR-E SIPS

- **Location:** MSFC, Huntsville, Alabama
- **Science Disciplines:** standard products for the global hydrologic cycle
- **Science Team Size:** ~ 70
- **No. of Products:** 15
  - rainfall, sea ice, sea surface temperatures, water vapor, cloud water, soil moisture, snow
- **Ingest rate:** ~2.5 GB/Day
- **Output Rate:** ~3.5 GB/Day
- **Products Archived at:** NSIDC DAAC

*Aqua's  
Advanced  
Microwave  
Scanning  
Radiometer -  
EOS*



**89H GHz Brightness Temperatures Imagery  
Descending Passes for 2007-08-08**

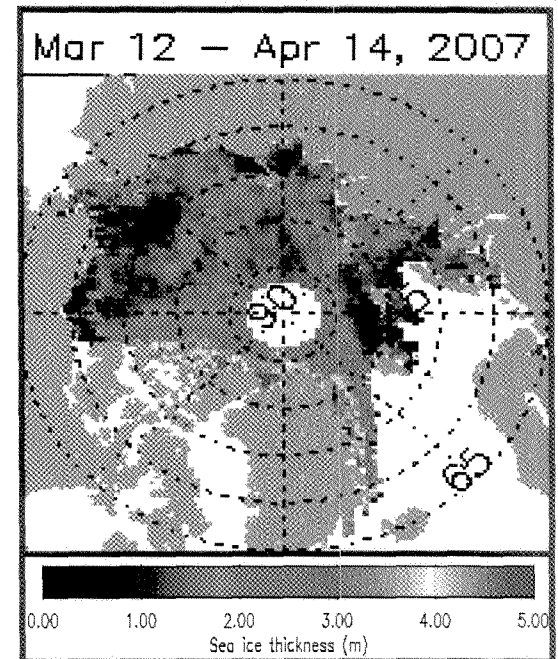
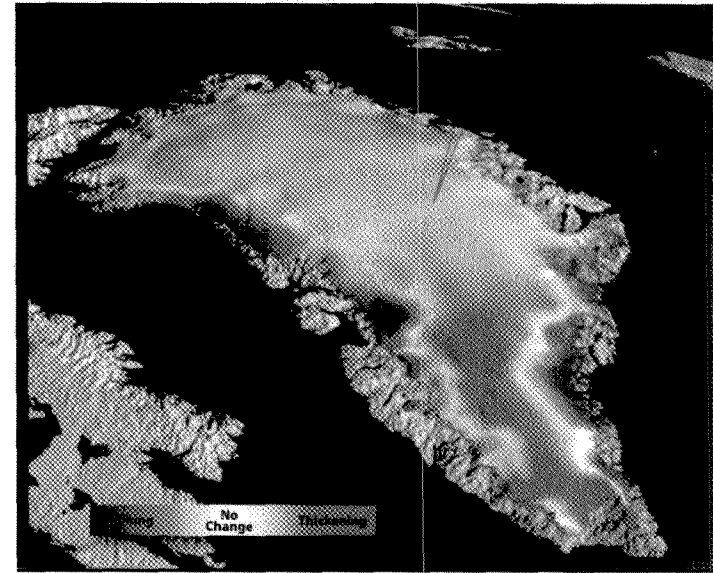


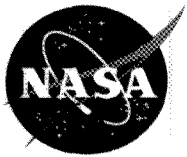
**AMSR-E Data Flow**



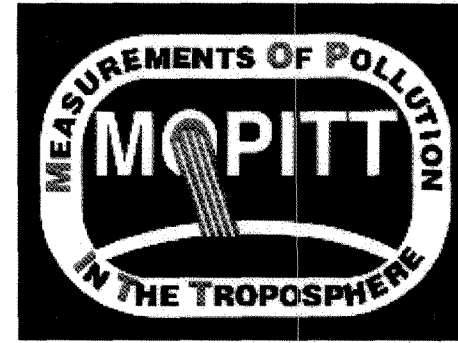
## I-SIPS (ICESat SIPS) - Geoscience Laser Altimeter System (GLAS)

- Location: GSFC, Greenbelt, Maryland
- Science Disciplines: Polar Ice Sheet Mass Balance, Land Topography, Hydrology, Vegetation Canopy Heights, Cloud Heights and Atmospheric Aerosol Distributions.
- Science Team Size: 23
- No. of Products: 15
- Ingest rate (approx): 5 GB/Day
- Output Rate (approx): 18 GB/Day
- Products Archived at: NSIDC

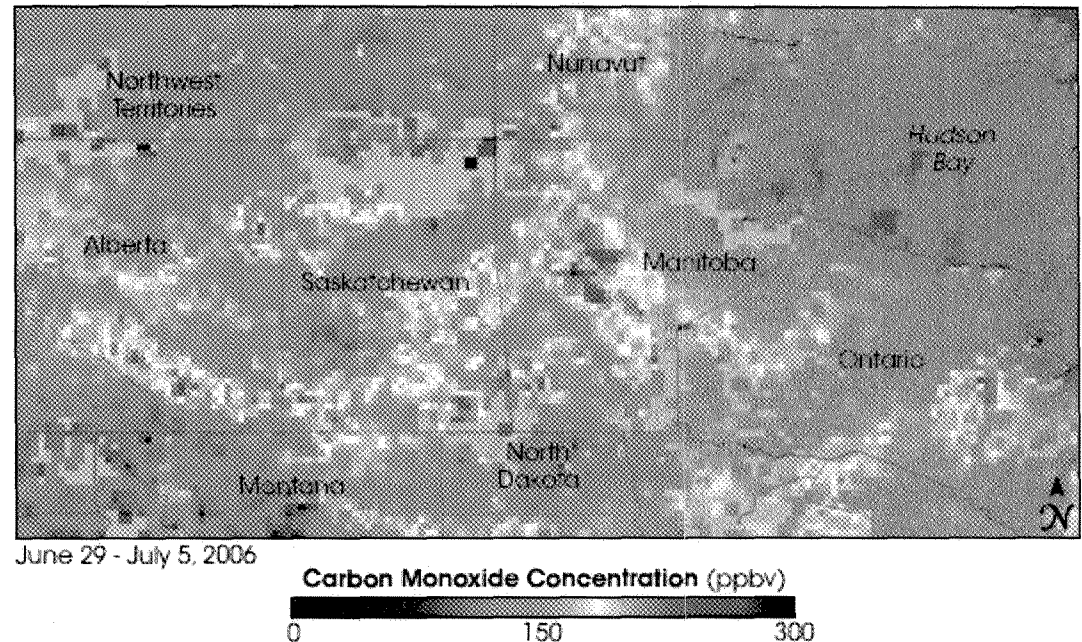




# Measurements of Pollution in the Troposphere (MOPITT) SIPS



- Location: National Center for Atmospheric Research (NCAR), Boulder, CO
- Atmospheric chemistry, pollution transport
- Science Team Size: 7
- No. of Products: 5
- Ingest rate (approx): 400 MB/Day
- Output Rate (approx): 230 MB/Day
- Products Archived at: LaRC DAAC

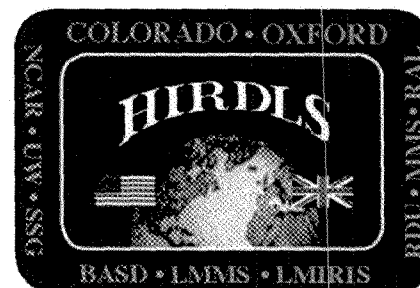


MOPITT CO measurements from Canadian fires in June –July, 2006.

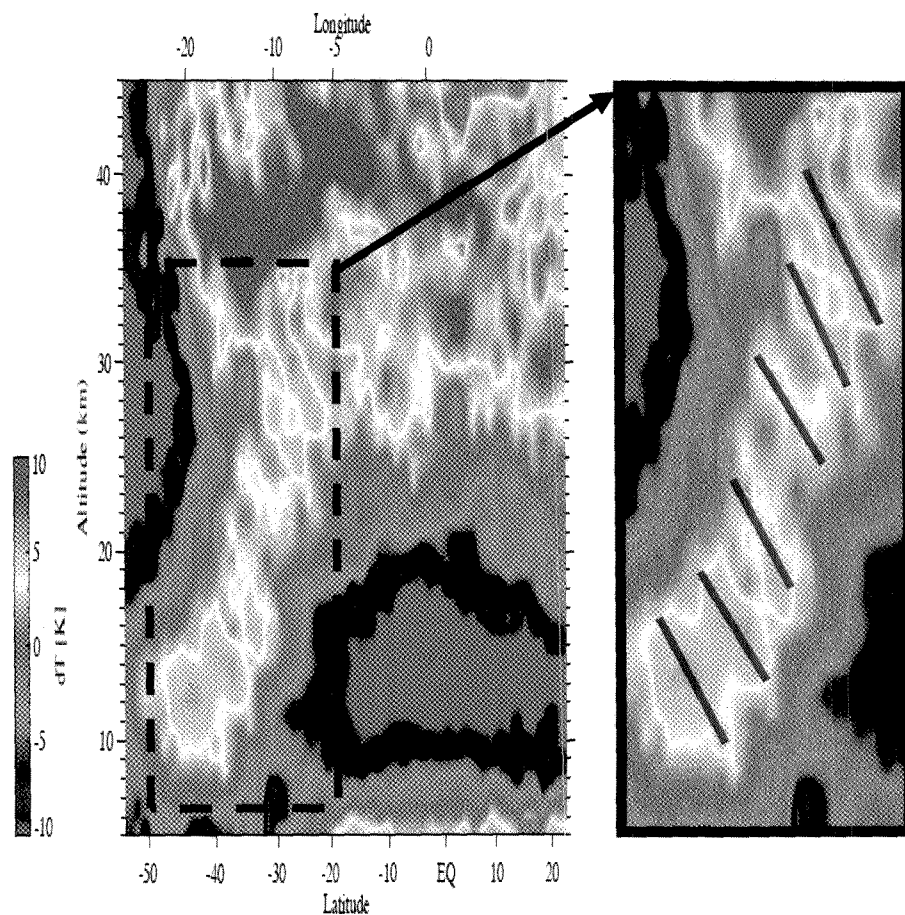


# High Resolution Dynamics Limb Sounder (HIRDLS) SIPS

- Location: University of Colorado/NCAR, Boulder, CO
- HIRDLS studies small scale dynamics and transports (stratosphere-troposphere exchange, UTLS chemistry, aerosol, cirrus and PSC distributions, gravity waves)
- Science Team Size: 17 FTE
- No. of Products: 4 to date (temperature, ozone, nitric acid, cloud top pressure)
- Ingest rate (approx): 2.5 GB/Day
- Output rate (approx): When in routine production, HIRDLS expects to deliver about 800 MB/Day
- Products Archived at: GES DISC



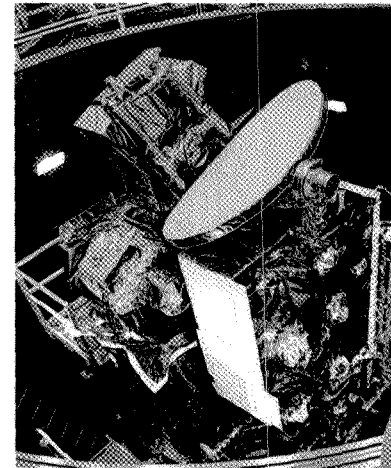
HIRDLS uniquely observes small scale gravity waves, permitting assessment of gravity wave forcing in stratospheric circulation.



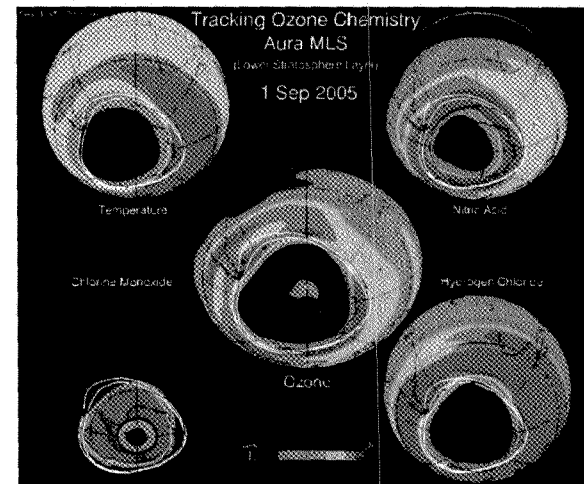


# Microwave Limb Sounder (MLS) SIPS

- **Location:** JPL and Raytheon, Pasadena, CA
- **Science Discipline:** Atmospheric Chemistry
- **Science Team Size:** 18
- **No. of Products:** 25 products/Day
- **Ingest rate (approx):** 1 GB/Day
- **Output Rate (approx):** 5 GB/Day
- **Products Archived at:** GES-DISC



Aura MLS instrument



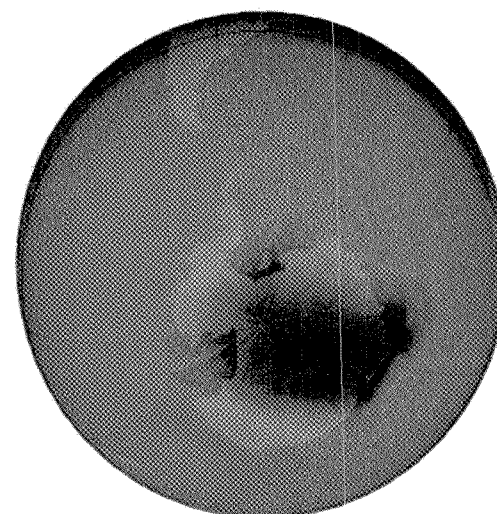
Ozone Chemistry over Antarctica in 2005





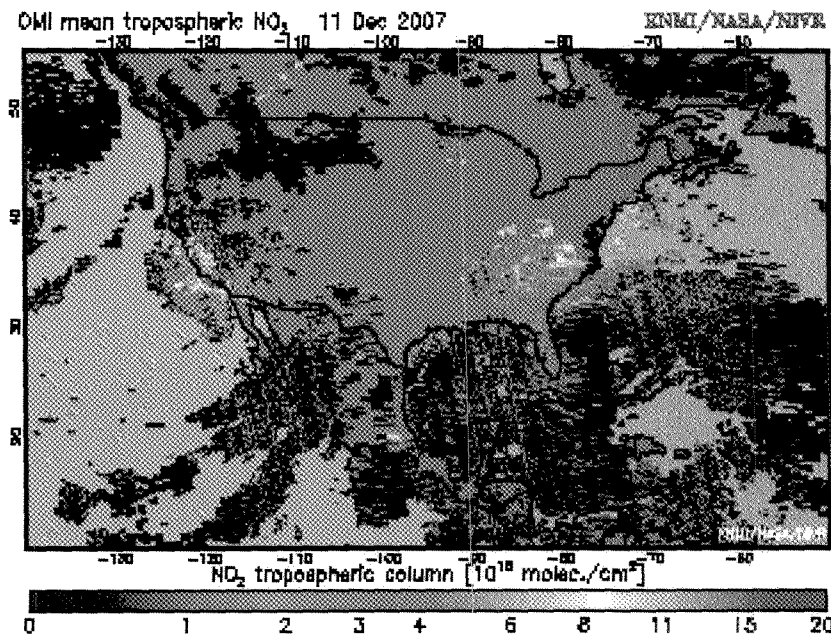
# Ozone Measuring Instrument (OMI) SIPS

- Location: NASA GSFC, Greenbelt, MD
- Science Discipline: Atmospheric Chemistry
- Science Team Size: 20
- No. of Products: 16 Standard Products
- Ingest rate (approx): 11 GB/day
- Output Rate (approx): 30.5 GB/day
- Products Archived at: GES DAAC



Total Ozone (Dobson Units)  
110 220 330 440 550

Ozone Hole, December 4, 2007

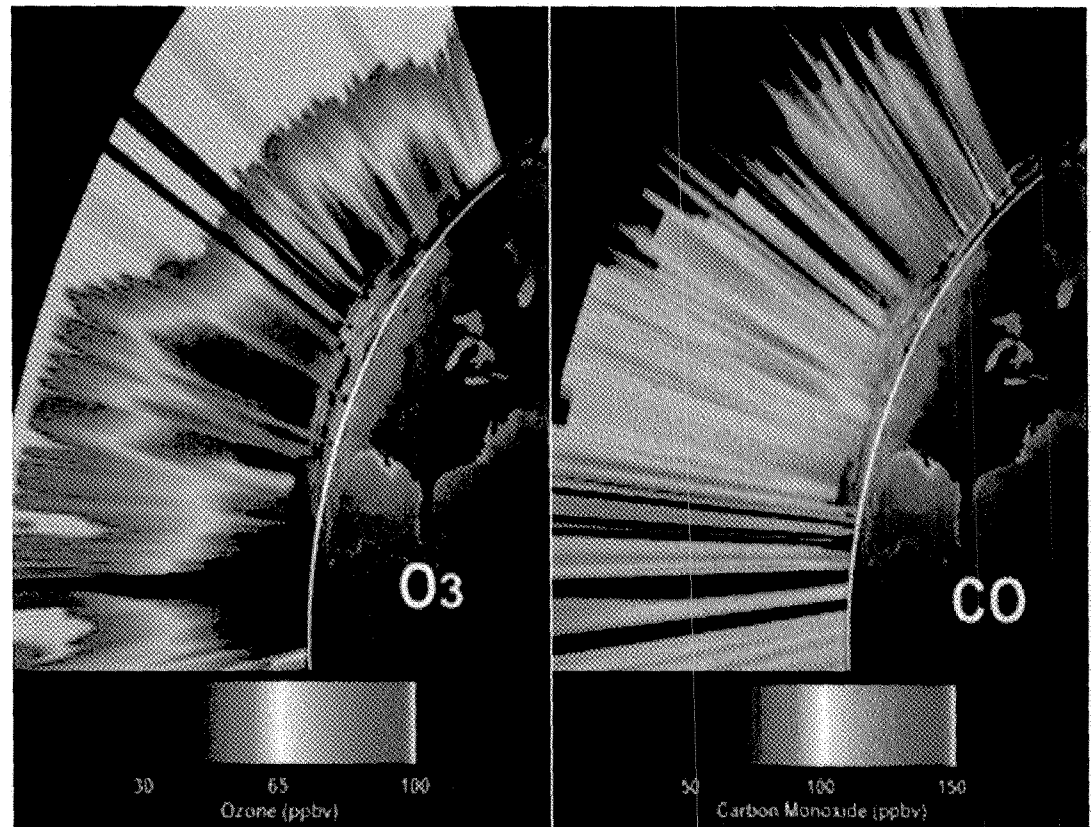






# Tropospheric Emission Spectrometer (TES) SIPS

- Location: JPL, Pasadena, CA
- Science Discipline: Atmospheric Chemistry
- Science Team Size: 15
- No. of Products: (January 4, 2008)
  - 497 R10 Global Survey products
  - 1070 R10 Special Observation products
- Ingest rate (approx): 6 GB/day
- Output Rate (approx): 5 GB/day
- Products Archived at: Atmospheric Science Data Center (ASDC) DAAC



TES Step and Stare Transects showing concentrations of atmospheric pollutants ozone (O<sub>3</sub>) and carbon monoxide (CO)



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- **Near-Real-Time Capability (LANCE)**
- **Data Access**
- **Evolution**



# **EOSDIS Near Real-time support**

## **LANCE (Land, Atmosphere Near-real-time Capability for EOS)**

- **Building on existing EOSDIS elements, provides data from MODIS, OMI, AIRS, MLS, and AMSR-E instruments in near real-time (< 3 hours from observation)**
- **Utilizes standard science product generation software, but relaxes requirements for ancillary data inputs**
- **High operational availability**
- **92 products available across MODIS, AIRS, AMSER-E, OMI, and MLS**
- **Applications of LANCE data include:**
  - **Numerical weather & climate prediction/forecasting**
  - **Monitoring of Natural Hazards**
  - **Disaster Relief**
  - **Agriculture**
  - **Air quality**
  - **Homeland Security**
- **Over 150 users accessing data from LANCE on a regular basis**



# LANCE Enabling Ash Cloud Monitoring

OMI detects ash (Aerosol Index, AI) and SO<sub>2</sub>

Aura/OMI - 04/15/2010 11:58-12:04 UT - Orbit 30584

Aura/OMI - 04/15/2010 11:58-12:04 UT - Orbit 30584

April 15

Total SO<sub>2</sub> mass  
~3000-4000 tons.

Aura/OMI - 04/16/2010 07:51-12:46 UT

Aura/OMI - 04/16/2010 07:51-12:46 UT

SO<sub>2</sub> mass: 0.497 kt; Area: 130128 km<sup>2</sup>; SO<sub>2</sub> max: 1.89 DU at lon: 28.66 lat: 64.60, 09:28UTC

1.0

April 16

Aerosol Index

SO<sub>2</sub> column 5 km [DU]

The Eyjafjallajokull (Iceland) 2010 eruption was unusual because effusive eruptions typically emit limited ash that falls locally. Here, glacial melt produced much phreatic fine ash that drifted at relatively low altitudes.

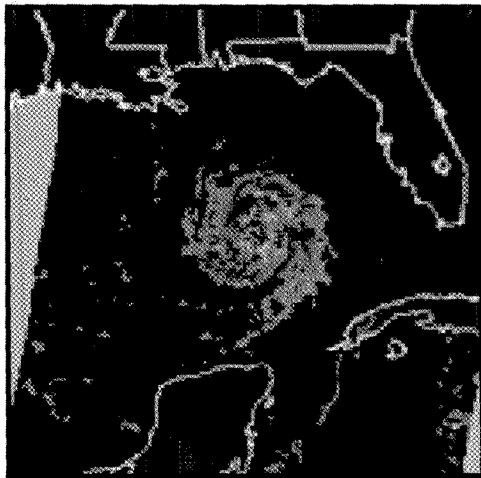


# LANCE Enabling Weather Forecasters

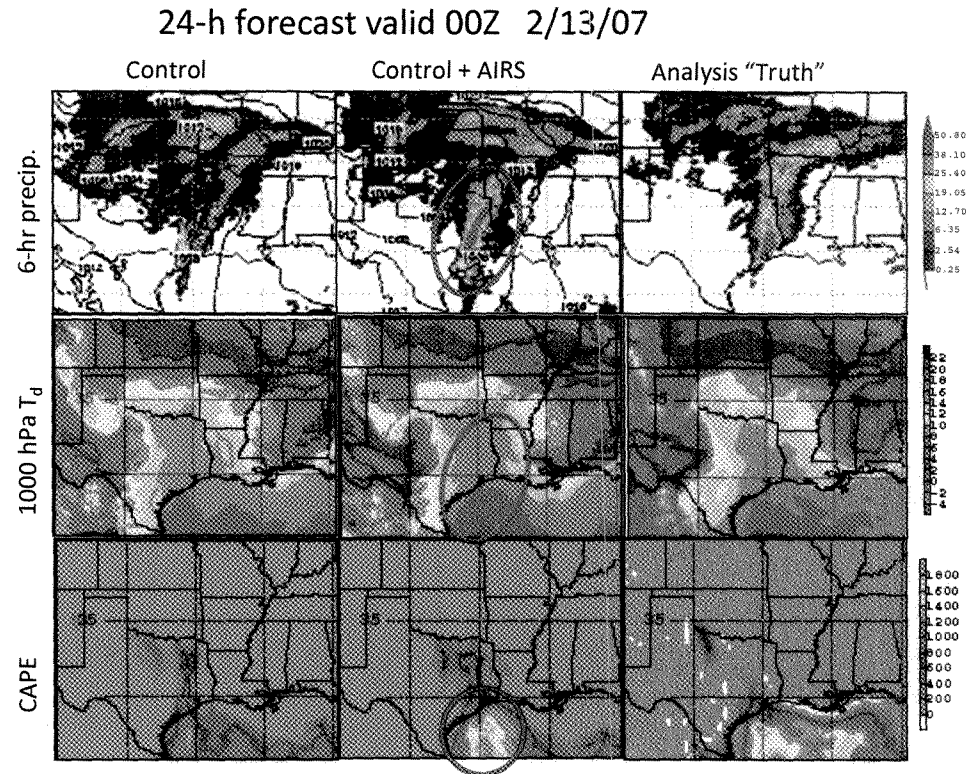
SPoRT: Short-term Prediction Research and Transition Center

Products used to improve situational awareness of weather events, and short term weather forecasts

- off shore weather processes
- improved forecasts of clouds, fog, precipitation , and temperature in coastal regions



AMSR-E Rain Rate

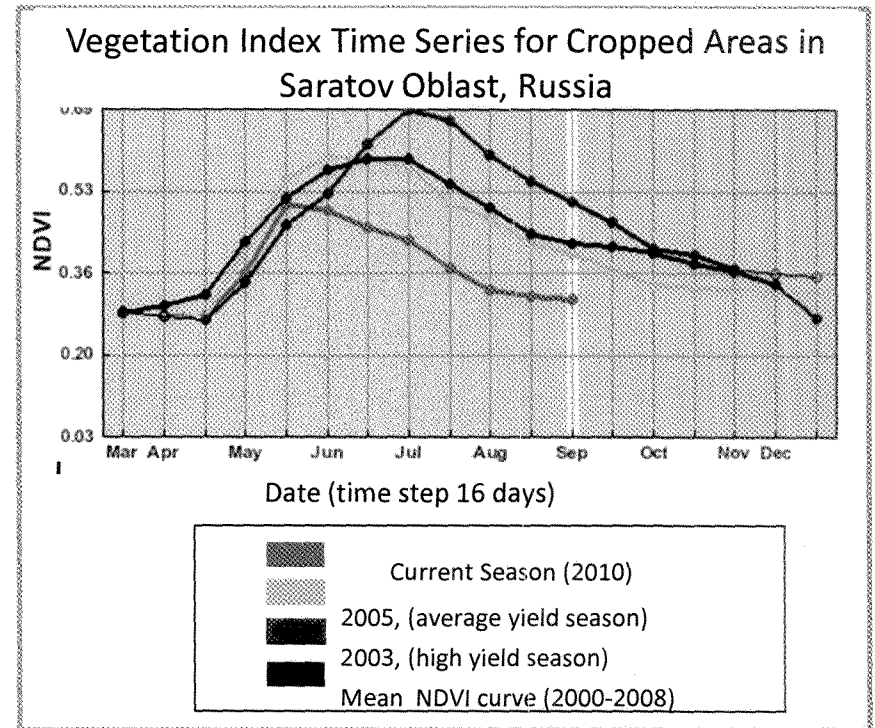
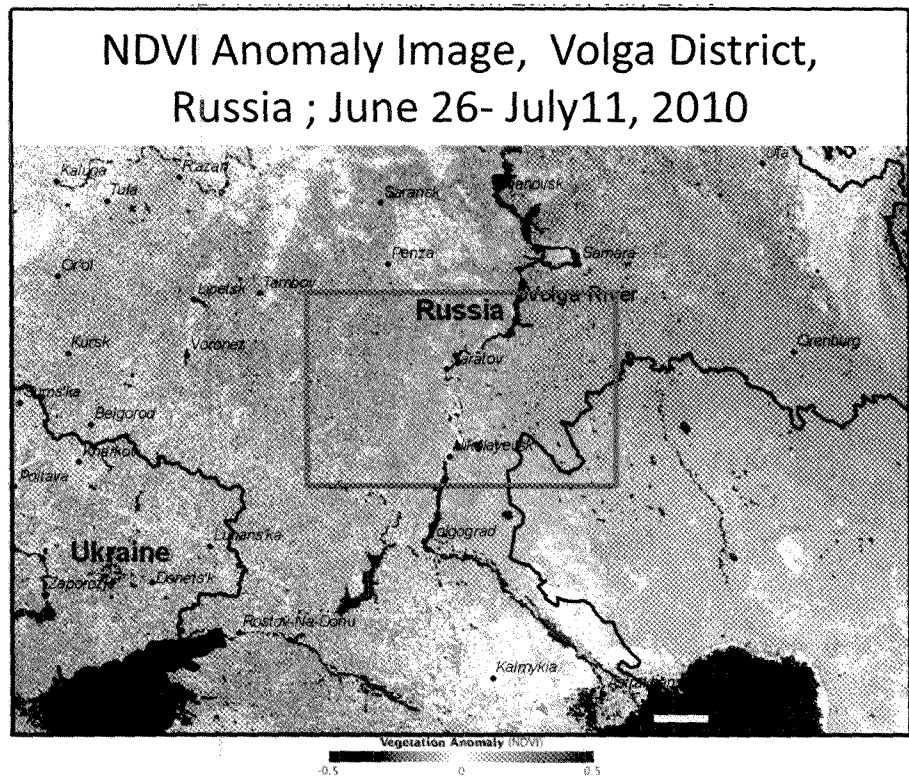


*AIRS profiles improve model initial conditions in data void regions producing improved analyses and forecasts*



# LANCE Data Used for Drought Monitoring

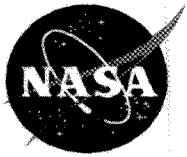
## Global Agricultural Monitoring System Monitoring Drought Impact on Crops in Volga District, Russia



Near Real Time Data from LANCE has been integrated into the GLAM (Global Agricultural Monitoring) system which enables timely monitoring of agricultural areas by USDA crop analysts. LANCE products are used until the MODIS Science Products are released.

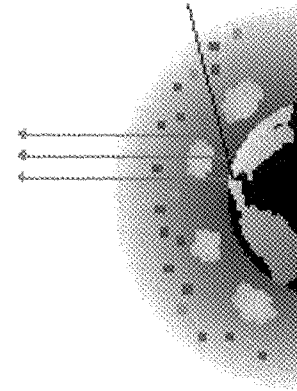






# Atmospheric Science Data Center (Langley DAAC)

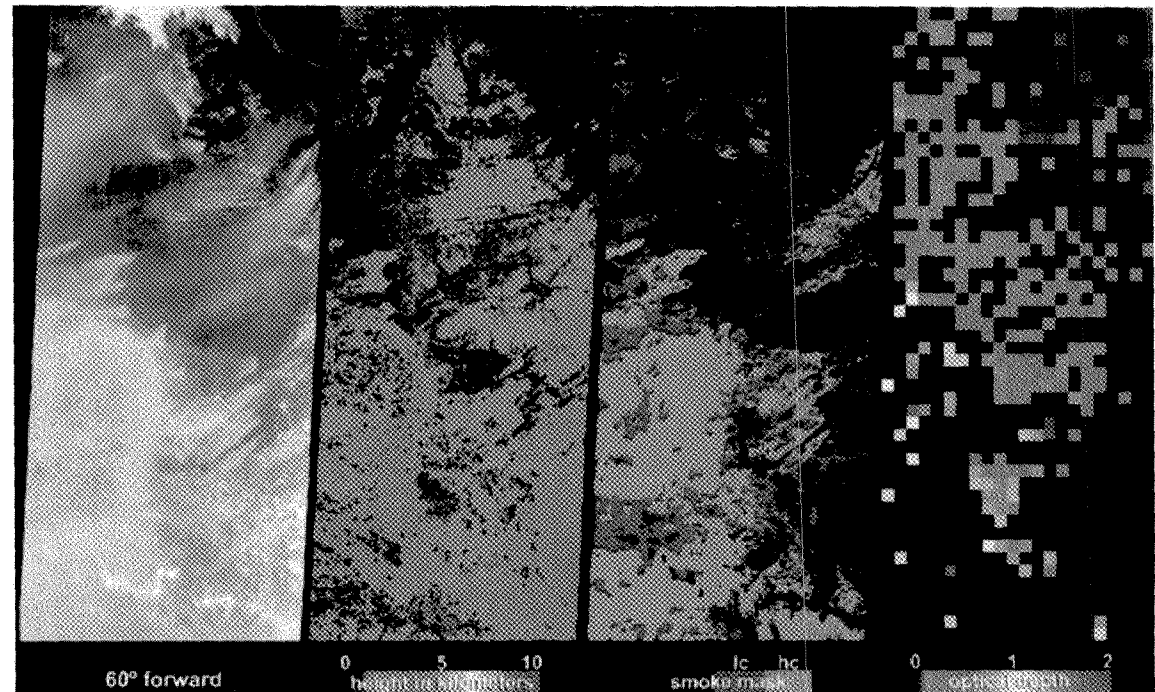
- Located: NASA Langley Research Center, VA
- Radiation Budget, Aerosols, Clouds, Tropospheric Chemistry
- Archive size (approx): 2,081 TB
- Ingest rate (approx): 329 GB/Day
- Distributes (approx): 754 GB/Day



Atmospheric  
Science  
Data  
Center

**MISR distinguishes clouds from smoke  
and determines aerosol optical depth as a  
measure of air quality for Yukon fires on  
June 30, 2004**

(Image Credit: NASA/GSFC/LaRC/JPL, MISR Team)







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# Data Access

- **NASA's Earth Science Data Systems provide end-to-end capabilities to deliver data and information products to users using an "open data policy"**
  - Data available to all users with no period of exclusive access
  - Users obtain most of the data at no charge
  - Distributed, heterogeneous system – a "virtual data system" or "System of Systems"
- **Several data access mechanisms are provided**
  - "One-Stop Shopping" through EOS Clearing House (ECHO) and Warehouse Inventory Search Tool (WIST)
  - Data Center-unique software clients
- **Most of data in EOSDIS are available on-line (disks)**



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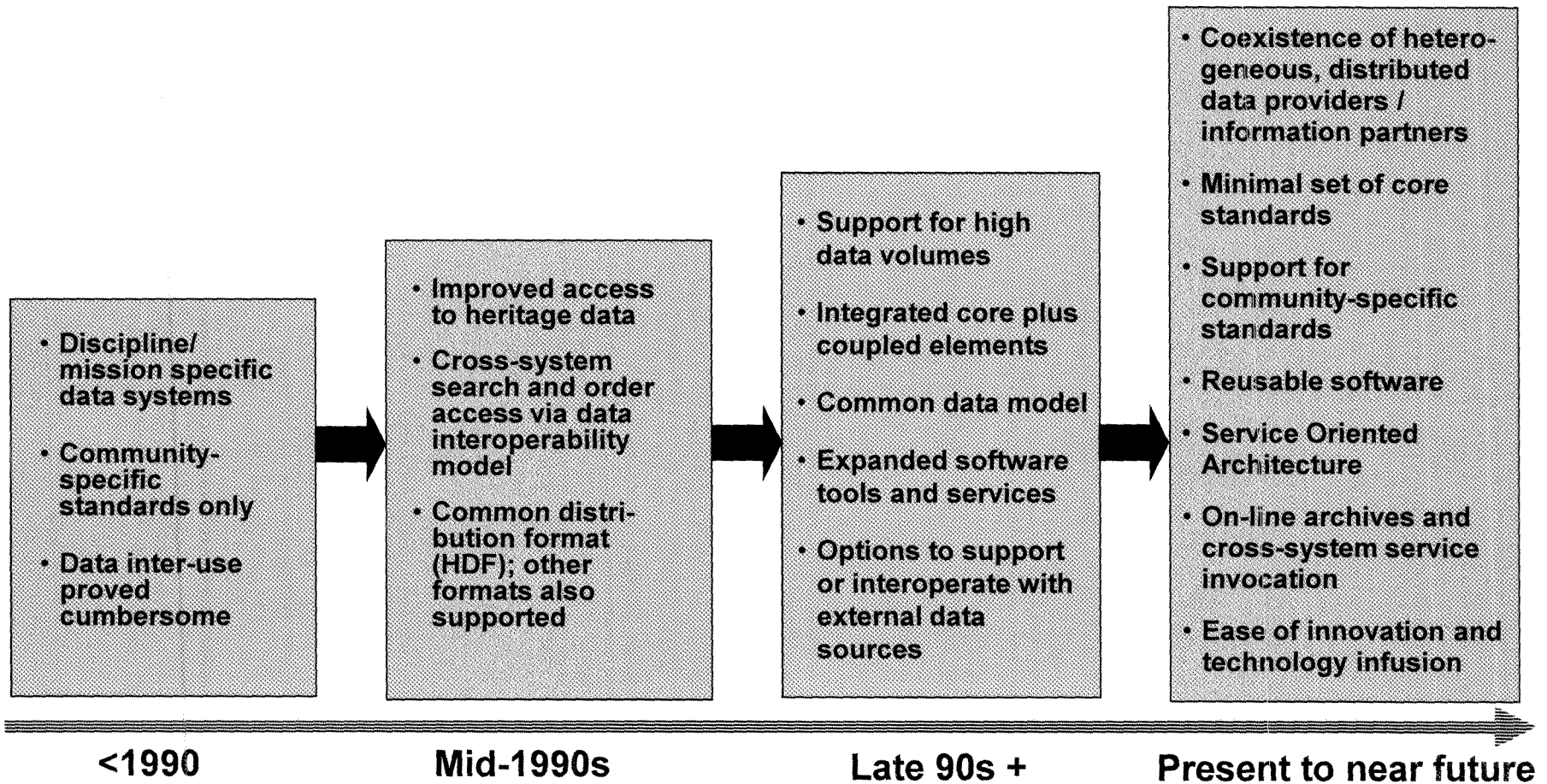


# Evolution

- **“Research archive” maintenance implies *continuing evolution***
  - **keep up with technologies – hardware upgrades, data migration, upgrade of software and tools to “keep up with the times”**
    - For example, all data were initially stored on near-line robotic archives; now they are on-line (RAID)
    - Data distribution was both on media and on-line; now it is only on-line (with very rare exceptions)
  - **Data from community data system projects and from new missions are accommodated within the functioning infrastructure, e.g.,**
    - Preparing for Decadal Survey Missions
    - Archiving and distribution of products from MEaSURES Projects



# Evolution of Data System Features



Lessons learned and information technology advances coupled with advice/comments from community supports a continuously evolving data system with growing capabilities



# EOSDIS Evolution - 2015 Vision Tenets

Vision Tenet	Vision 2015 Goals*
<b>Archive Management</b>	<ul style="list-style-type: none"> <li>▪ NASA will ensure safe stewardship of the data through its lifetime.</li> <li>▪ The EOS archive holdings are regularly peer reviewed for scientific merit.</li> </ul>
<b>EOS Data Interoperability</b>	<ul style="list-style-type: none"> <li>▪ Multiple data and metadata streams can be seamlessly combined.</li> <li>▪ Research and value added communities use EOS data interoperably with other relevant data and systems.</li> <li>▪ Processing and data are mobile.</li> </ul>
<b>Future Data Access and Processing</b>	<ul style="list-style-type: none"> <li>▪ Data access latency is no longer an impediment.</li> <li>▪ Physical location of data storage is irrelevant.</li> <li>▪ Finding data is based on common search engines.</li> <li>▪ Services invoked by machine-machine interfaces.</li> <li>▪ Custom processing provides only the data needed, the way needed.</li> <li>▪ Open interfaces and best practice standard protocols universally employed.</li> </ul>
<b>Data Pedigree</b>	<ul style="list-style-type: none"> <li>▪ Mechanisms to collect and preserve the pedigree of derived data products are readily available.</li> </ul>
<b>Cost Control</b>	<ul style="list-style-type: none"> <li>▪ Data systems evolve into components that allow a fine-grained control over cost drivers.</li> </ul>
<b>User Community Support</b>	<ul style="list-style-type: none"> <li>▪ Expert knowledge is readily accessible to enable researchers to understand and use the data.</li> <li>▪ Community feedback directly to those responsible for a given system element.</li> </ul>
<b>IT Currency</b>	<ul style="list-style-type: none"> <li>▪ Access to all EOS data through services at least as rich as any contemporary science information system.</li> </ul>

\*Developed by EOSDIS Elements Evolution Study Team - 2005