

# Increasing Needs for Government Usage as a Growth Driver

A Perspective from the U.S. National Oceanic  
and Atmospheric Administration (NOAA)

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1<sup>st</sup> Symposium on Earth Observation  
Business  
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# NOAA's Operational Use of Satellite Data



- **Over the course of 50 years, NOAA's use of satellite data has evolved from a narrow focus on weather forecasting to a broad environmental focus**
- **NOAA uses satellite data for:**
  - **Weather**
    - Routine weather forecasting
    - Warnings of severe weather events
    - Space weather
  - **Long-term climate monitoring**
  - **Ocean forecasts and monitoring**
  - **Marine ecosystems monitoring**
  - **Disaster response**
- **Land remote sensing is a joint responsibility of USGS and NASA**

# NOAA Satellite Programs

- **Current**

- **Geostationary satellites (GOES)**
- **Polar-orbiting satellites (POES)**
- **Defense Meteorological Satellite Program (DMSP)**
  - Operated by NOAA for the U.S. Air Force
- **Jason-2 altimetry satellite**
  - Collaborative program with EUMETSAT, CNES, and NASA
- New data products from current satellite sensors



- **Future**

- **National Polar-orbiting Operational Environmental Satellite System (NPOESS)**
- **New generation of geostationary satellites (GOES-R)**
- **Jason-3 altimetry satellite**
- Requirements development for new satellite systems



- **Data and Information Services**

- Near real time data from **Satellite Operations Facility**
- Long time series data from three **National Data Centers**



# Recent Satellite Launches

- **Jason-2 launched June 2008, currently being operated from NOAA's Satellite Operations Facility**
  - Handover from CNES to NOAA occurred October 29, 2008
  - Operational Geophysical Data Records (OGDRs) publicly available December 15, 2008
- **NOAA-19 launched February 6, 2009**
  - Handover from NASA to NOAA occurred February 26, 2009
  - Declared operational in May 2009
- **GOES-14 launched June 27, 2009**
  - Undergoing post launch testing
  - Will be placed in storage upon completion of testing

NOAA-19 Launch

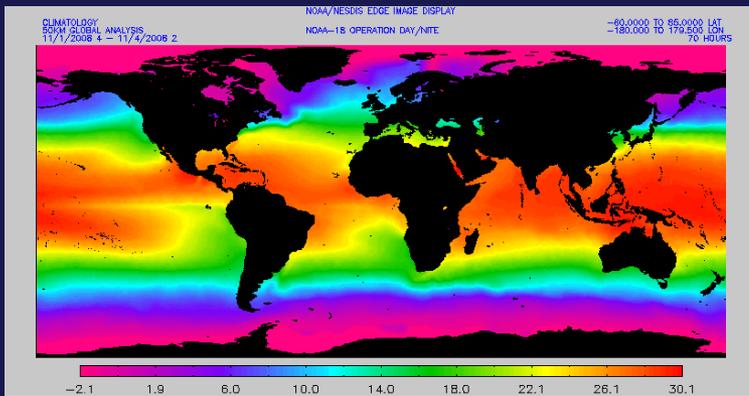


# Instruments on Current NOAA Satellites

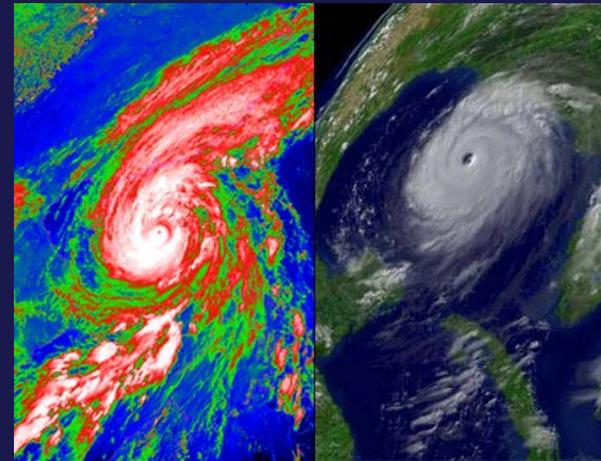
- **Imagers and Sounders**
  - On POES, GOES, and DMSP
  - Provide atmospheric measurements
    - Imagers look directly at the Earth
    - Sounders look on an angle, profiling the atmosphere
  - Support many different current environmental monitoring applications
- **Space Weather**
  - On POES, GOES, and DMSP
  - Monitor the sun and the space environment
  - NOAA's Space Weather Prediction Center provides alerts, forecasts, reports, and summaries used by the communications, power, and other industries that can be disrupted by electromagnetic pulses from the sun
- **Search and Rescue (SARSAT)**
  - Both POES and GOES receive emergency beacon signals from planes, ships, and individuals and re-transmit the signals to search and rescue authorities
- **Data Collection**
  - Both POES and GOES are used to receive and re-transmit signals from remote *in situ* observing systems (ocean buoys, rain gauges, animal monitoring) to scientists/researchers

# What are Some Uses of NOAA Satellite Data?

## Global Sea Surface Temperature



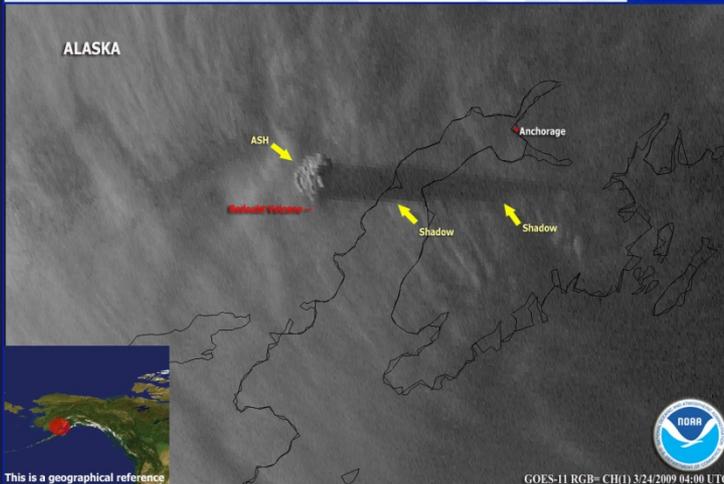
## Hurricane Forecasting



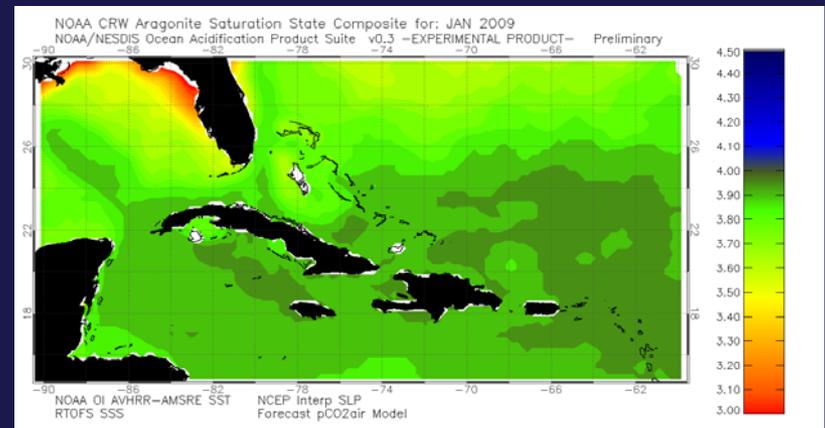
## Volcanic Ash Monitoring

This GOES-11 satellite image shows ash from the Redoubt Volcano eruption poking above the clouds. A shadow from the ash is seen on the clouds in this satellite view. The Redoubt Volcano produced a series of five explosive eruptions since March 22. National Weather Service radar, pilot reports, and Alaska Volcano Observatory analysis suggest that these events produced ash clouds that reached 60,000 ft above sea level (asl), with the bulk of the ash volume between 25 - 30,000 ft asl.

Credit: NOAA



## Ocean Acidification



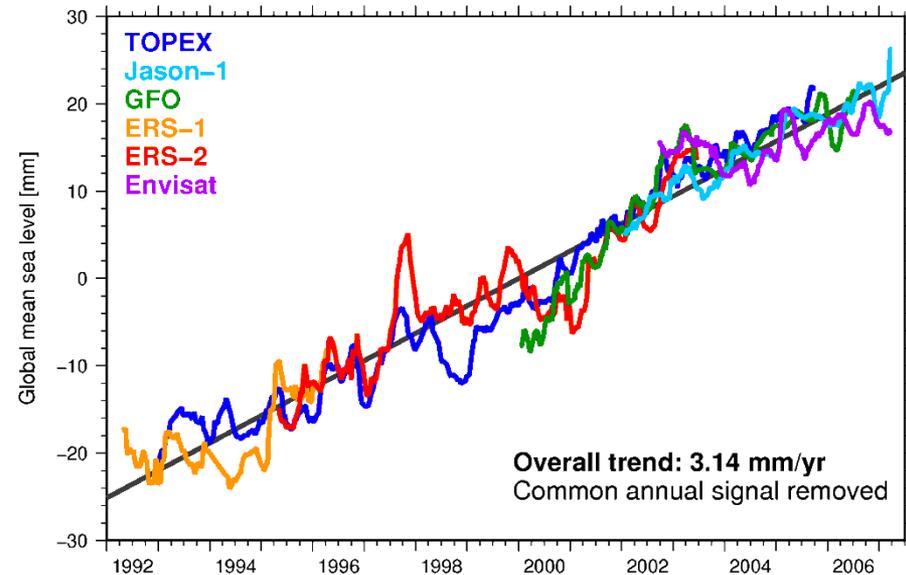
# Rationale for International Partnerships

- **NOAA's budget is not sufficient for all of its satellite needs**
  - Satellites have become increasingly expensive in recent years
  - The number of data streams needed by users is growing
- **International partnerships avoid the duplication of costly satellite investments**
- **NOAA's current international partnerships**
  - Polar meteorological satellites: EUMETSAT flies METOP satellite in morning orbit; NOAA flies POES satellite in afternoon orbit; full sharing of data from both orbits
  - Radar altimetry: CNES, EUMETSAT, NASA, and NOAA share the cost of Jason 2
  - GPS radio occultations: NOAA, NASA, UCAR, and Taiwan share the cost of COSMIC
- **Pending international partnerships**
  - NOAA and JAXA are discussing data sharing between GCOM and NPOESS
  - NOAA and Taiwan are discussing a follow-on to COSMIC
  - NOAA is discussing data sharing with both India and China
- **NOAA is actively involved in international coordination mechanisms such as GEO, CEOS, and CGMS**
- **NOAA strongly advocates the free, open, and timely sharing of earth observing data across international boundaries**

# International Partnership: Using Radar Altimetry to Monitor Sea Level Rise

- **Unbroken Continuity of Observations that Provide Climate Quality Measurements of Sea Level**
- **Jason-2 transitioned from CNES to NOAA and EUMETSAT for routine operations on October 29, 2008**
- **Forming US-European partnership for Jason-3 to continue these observations**
- **Community engagement on long-term strategy**
- **NOAA and EUMETSAT co-lead a CEOS Constellation on Ocean Surface Topography**
  - **Writing a User Requirements Document for the Altimeter Constellation laying basis for coming 15 years—due end of summer**

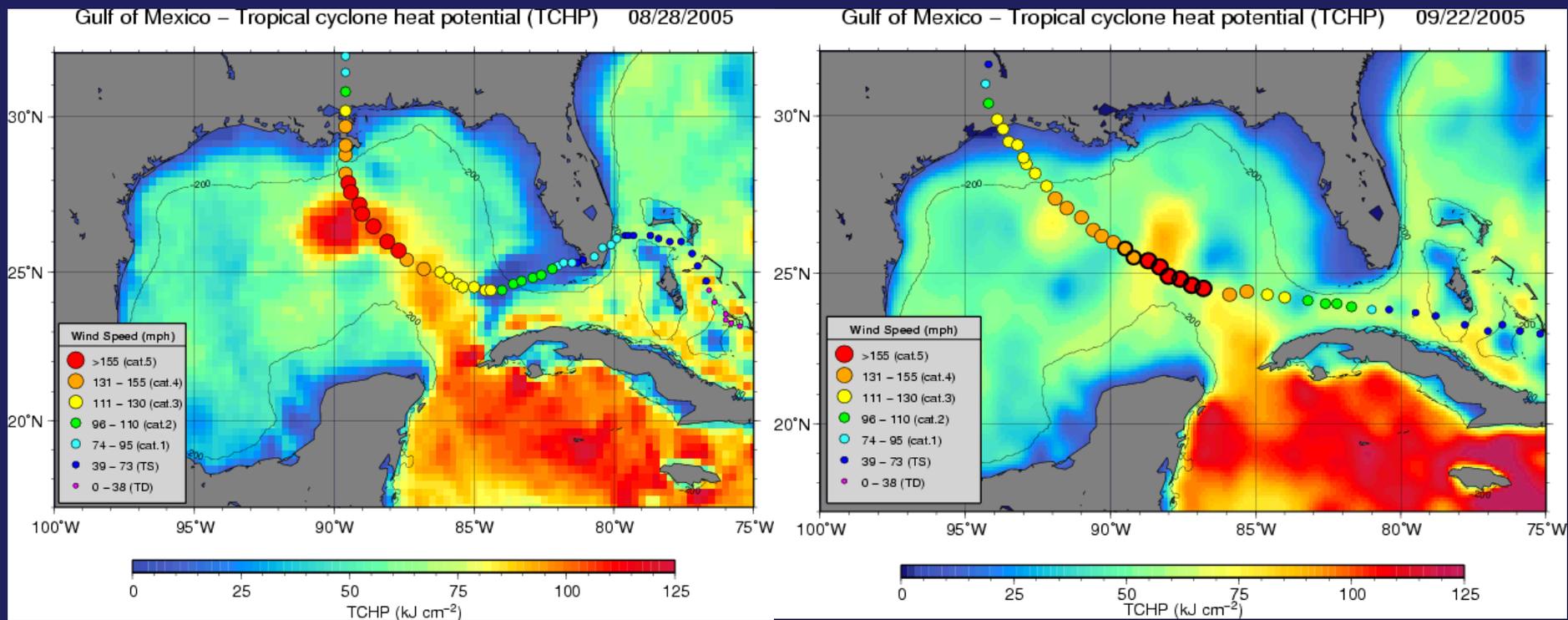
While data from all satellite altimeters were used, the high-accuracy T/P & Jason missions were critical to *calibrate* the others



Courtesy of Remko Scharroo, NOAA/NESDIS



# International Partnership: Using Radar Altimetry to Forecast Tropical Cyclone Heat Potential (Katrina and Rita, 2005)

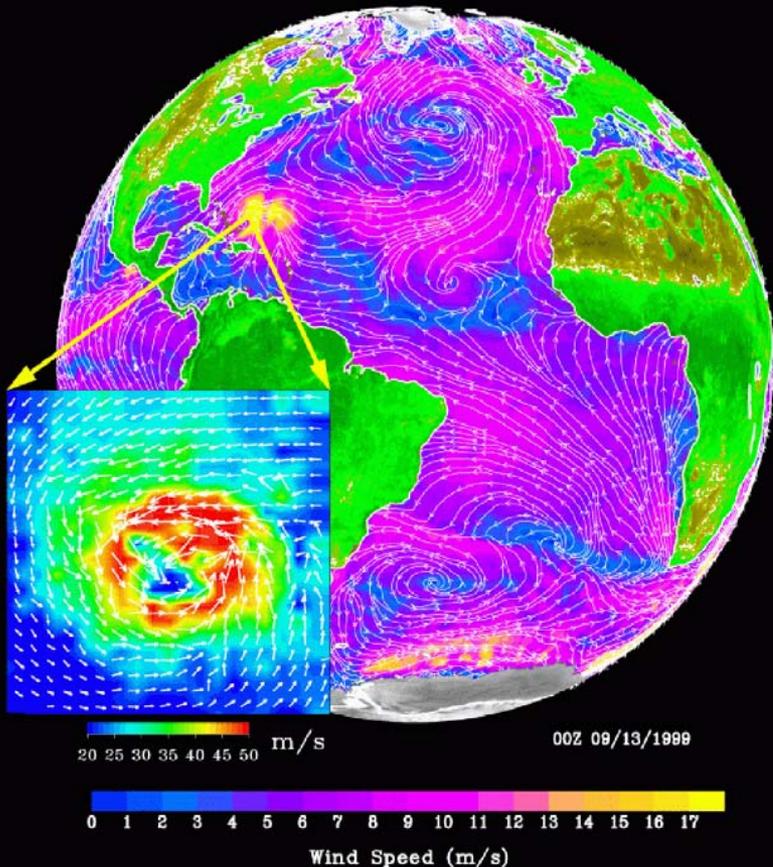


Figures courtesy of Gustavo Goni, NOAA/OAR/AOML  
Based on NASA/CNES T/P & Jason-1, USN GFO, and ESA ENVISAT

# NOAA Depends Heavily on NASA Research Satellites

- **NOAA does not have its own research budget and looks to NASA to advance the state of the art in earth observations**
- **As NASA research satellite data streams become available, NOAA uses them to improve weather forecasting, climate monitoring, etc:**
  - **ACE: solar winds**
  - **QuikSCAT: scatterometry for hurricanes and winter storms**
  - **SeaWiFS: ocean color data to monitor hazardous algal blooms and other ocean chemistry parameters**
  - **Tropical Rainfall Measuring Mission (TRMM)**
  - **Moderate Resolution Imaging Spectroradiometer (MODIS): 36 spectral bands providing data on the lower atmosphere, ocean color, sea surface temperature, snow and ice, and land cover**
  - **Atmospheric Infrared Sounder (AIRS)**
  - **Advanced Microwave Scanning Radiometer-EOS (AMSR-E)**
- **NASA does not promise continuity of any of these observations**
- **NOAA, therefore, seeks to incorporate the NASA technologies into operational NOAA satellites (“research to operations”)**

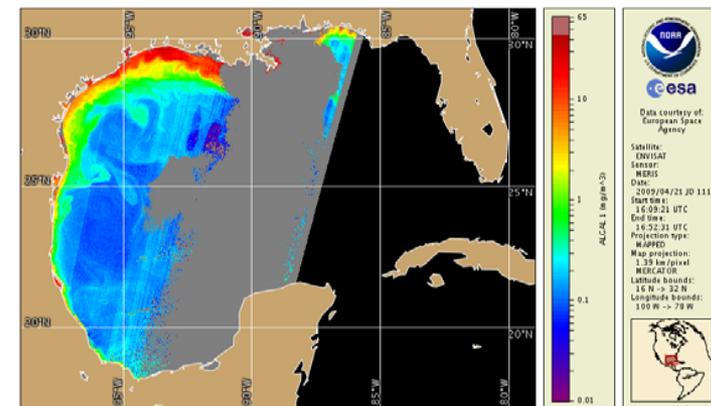
# NOAA's Use of NASA Research and International Satellites: Radar Scatterometry



- **NOAA is using satellite-derived Ocean Surface Vector Wind (OSVW) observations operationally**
  - NASA's QuikSCAT
  - EUMETSAT's ASCAT on MetOp-1
- **Exploring with JAXA the possibility of flying a U.S. dual frequency scatterometer on JAXA's GCOM-W2**
  - One frequency is less sensitive to rain
  - The other frequency is less sensitive to high winds
  - Together they improve hurricane forecasting

# NOAA's Use of NASA Research and International Satellites: Ocean Color Radiometry

- Exploring potential alternatives to ocean color data to address gaps that may occur between NASA SeaWiFS/MODIS and VIIRS on NPOESS C1
  - MERIS and Derivative on ESA's Sentinel-3
  - SGLI on JAXA's GCOM-C1
  - OCM-2 on ISRO's Oceansat-2
  - Color scanner on China SOA's HY-1B
- National Research Council (NRC) Ocean Studies Board and Committee on Earth Science of the Space Studies Board
  - 18-month study on national needs and associated observational requirements for ocean color radiometry
- NPOESS IPO working on algorithms and software to obtain the greatest possible utility of NPP/VIIRS for ocean color applications
- Working to ensure long-term continuity of ocean color data to establish climate records
  - This presumes appropriate *in situ* calibration



April 21, 2009



# NOAA's Satellite Continuity Strategy

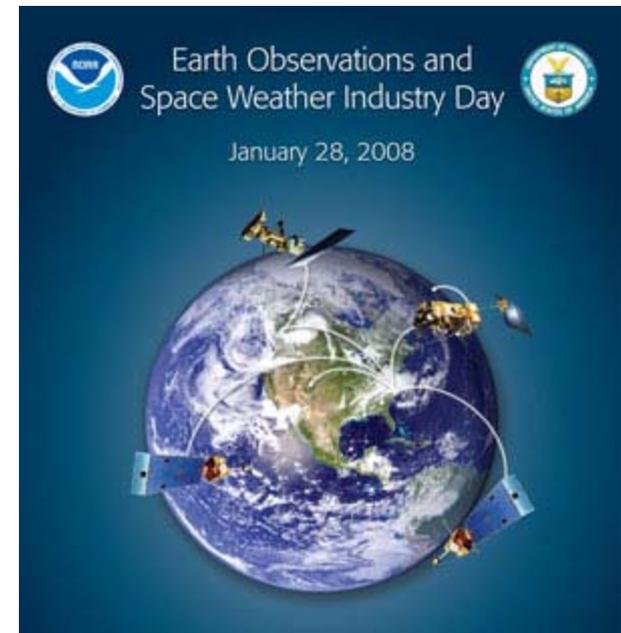


Katrina on a vegetation index map overlaid on the forecast track from the National Hurricane Center

1. NOAA satellites for core capabilities
2. Augment with data from international partnerships
3. Use data from NASA research satellites
4. Purchase data from commercial satellite operators to fill critical gaps

# The Role of the Private Sector

- **Business Opportunities**
  - **Traditional model**: building satellites and instruments for delivery to the government
  - **Commercial model**: selling data to the government from privately-owned satellites (e.g., SeaWiFS)
- **January 2008 – NOAA Industry Day**
  - NOAA presented examples of space-based Earth observation requirements with the potential for commercial solutions
  - Several dozen representatives from industry participated
  - NOAA issued three requests for quotations (RFQs) over the next 18 months



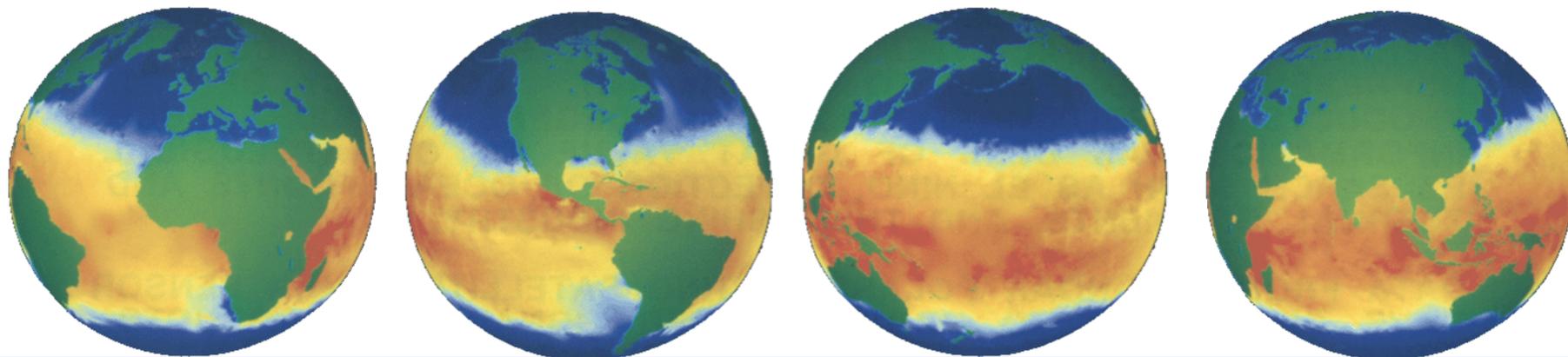
# NOAAs Three Sets of Request for Quotations (RFQs)

- **Set A RFQs were issued in August 2008 for**
  - Solar irradiance
  - Atmospheric profiles (GPS radio occultation)
  - Wind speed and direction (ocean surface – scatterometry)
  - Solar wind
  - Coronal mass ejection
- **Set B RFQs were issued in March 2009 for**
  - Total and clear sky radiative flux
  - Sea surface height/topography
  - Geostationary high spectral atmospheric profiles
  - Ocean color
- **Set C RFQs were issued in August 2009 for**
  - Ozone profiles
  - Aerosol polarimetry
  - Wind speed and direction profiles (tropospheric and stratospheric)

# Concluding Thoughts



- NOAA will continue to own and operate its primary satellites
- NOAA will make increasing use of international partnerships
  - NOAA strongly advocates the free, open, and timely sharing of earth observing data across international boundaries
- NOAA will continue to take advantage of NASA research satellite data streams whenever possible
- NOAA will make increasing use of data from privately-owned satellites when the business case makes sense



360 Degree View of the Earth's Oceans Sea Surface Temperature from AVHRR, 1992



# Backup Slides



# Hosted Payloads

## Utilizing excess capacity on commercial satellites:

- **Accommodates additional instruments or sensors in a timely and cost-effective manner.**
- **Allows the Government to plan in shorter cycles, 24 months versus 7-15 years.**
- **Leverages an existing/planned satellite bus, launch vehicle, and satellite operations.**
- **Satellite manufacturers and operators have created new divisions to accommodate hosted payloads.**

## Examples of hosted payloads include:

- **FAA - Wide Area Augmentation System (WAAS), hosted on Intelsat & Telesat.**
- **U.S. Coast Guard - Nationwide Automatic Identification System (NAIS) Project, hosted on Orbcomm.**
- **Department of Defense - Internet Protocol Router in Space (IRIS) Joint Capability Technology Demonstration, hosted on Intelsat.**
- **U.S. Air Force - Commercially Hosted Infrared Payload (CHIRP) Flight Demonstration Program, hosted on SES Americom.**

# U.S. National Space Policy: Earth Observation System



**The United States will utilize government and commercial space-based and related capabilities wherever feasible to enhance disaster warning, monitoring, and response activities; and take a leadership role in international fora to establish a long-term plan for coordination of an integrated global Earth observation system and promote the adoption of policies internationally that facilitate full and open access to government environmental data on equitable terms.**



# U.S. National Space Policy: Commercial Space Guidelines

- **It is in the interest of the United States to foster the use of U.S. commercial space capabilities around the globe and to enable a dynamic, domestic commercial space sector**
- **Use U.S. commercial space capabilities and services to the maximum practical extent; purchase commercial capabilities and services when they are available in the commercial marketplace and meet United States Government requirements; and modify commercially available capabilities and services to meet those United States Government requirements when the modification is cost effective**
- **Refrain from conducting activities that preclude, deter, or compete with U.S. commercial space activities, unless required by national security or public safety**
- **Maintain a timely and responsive regulatory environment for licensing commercial space activities and pursue commercial space objectives without the use of direct Federal subsidies**

# Websites

## NESDIS.NOAA.Gov

**NOAA Satellite and Information Service**  
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**Image of the day**

**In the Spotlight!**  
NESDIS data visualizations

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# Session Topics to be Raised by Session Chair

- **Governments requirements for EO satellite data**
  - Applications driving demand from governments (security/defense; environment...), emerging applications, future requirements (performance, service, costs...), suitability of EO data to meet government users' needs
- **Impact of new government systems**
  - Impact of multiple data sources from established players rationale, requirements for increasing coordination for environment missions and the role of GEOSS/CEO; opportunities arising and focus of emerging EO programmes
- **How can government benefit industry and end-users?**
  - Evolution of initiatives for services development (such as GMES), support of commercial actors through data purchasing mechanisms
- **Data policy**
  - Requirements for efficient data policy to support end users, commercial data development, protection of national interests, do you see movements towards a full open access for data?