

# NOAA Research to Operations: A Status Report

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# National Oceanic & Atmospheric Administration



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## NOAA Mission:

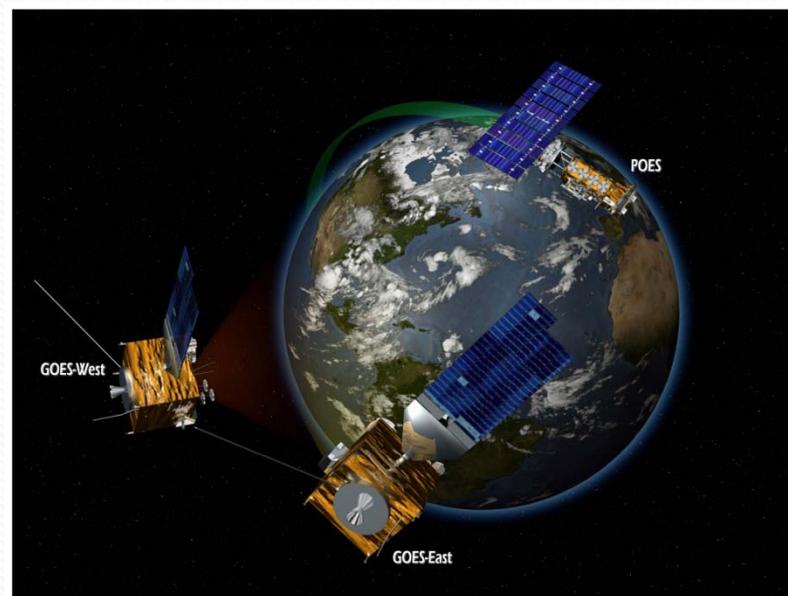
To understand and predict changes in Earth's environment and conserve and manage coastal and marine resources to meet our nation's economic, social, and environmental needs

## NOAA's Priorities

1. Ensure continuity of climate, weather, and ocean observations, both *in situ* and from space
2. Development of a National Climate Service
3. Improve weather forecasts & disaster warnings
4. Eliminate overfishing and ensure the sustainability of marine fisheries
5. Promote sustainable, resilient, and healthy coastal communities
6. Strengthen Arctic science and stewardship

## NOAA Capabilities & Partnerships

- **NOAA operates two core systems of satellites to provide Earth and space weather observations**
  - Operational polar-orbiting satellites
    - Operational: Polar Operational Environmental Satellites series (POES)
    - Under development with DOD and NASA: National Polar-orbiting Operational Environmental Satellite System (NPOESS)
  - Operational geostationary satellites
    - Operational: Geostationary Operational Environmental Satellites series (GOES)
    - Under development with NASA: next generation GOES satellites – GOES-R series
- **NOAA's legacy operational satellite systems (POES and GOES) have their roots in successful R2O transitions from NASA to NOAA**



## NOAA Capabilities & Partnerships

- **In implementing its legacy systems, NOAA partners and coordinates nationally and internationally**
  - NOAA operates DOD's operational polar-orbiting weather satellites – Defense Meteorological Satellite Program (DMSP)
  - NOAA's polar orbiting satellites and instruments are part of the International Joint Polar-orbiting Operational Satellite System (IJPS)
    - Partnership with Europe's EUMETSAT organization (which develops and operates the METOP series of polar-orbiting satellites)
    - Instruments are shared, orbits are coordinated, data is fully shared
  - NOAA's geostationary satellite coverage is coordinated with other countries (Europe, China, Japan, India, Russia) to ensure global Earth observation from the geostationary vantage point
    - Orbits are coordinated, data is shared



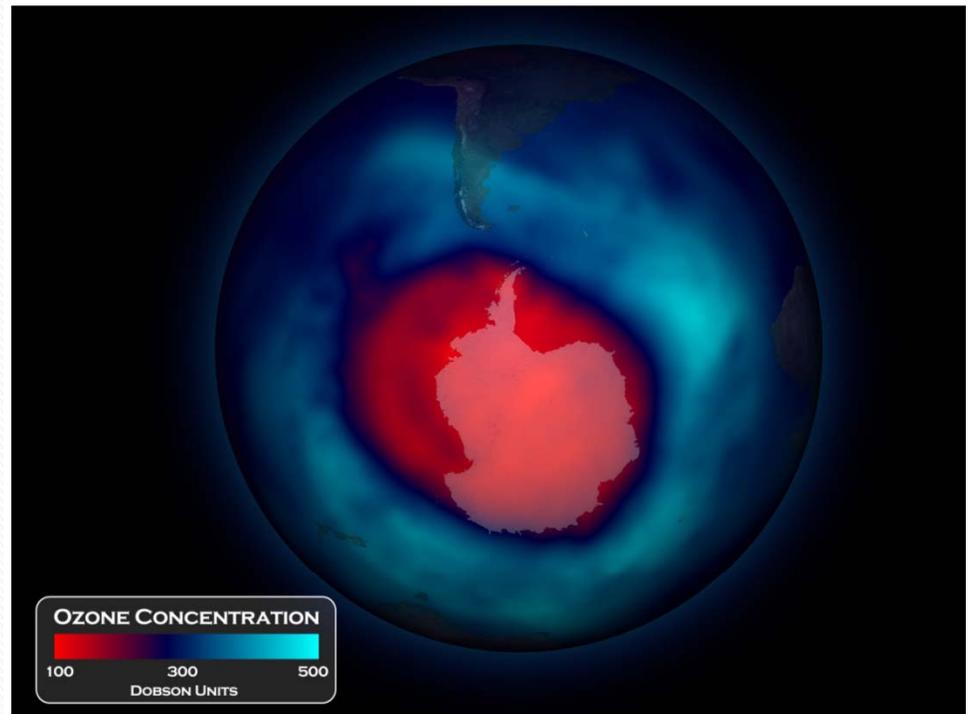


## NOAA Capabilities & Partnerships

- **NOAA also meets its requirements for space-based Earth observation by**
  - Engaging in additional national and international partnerships
    - Partnership with Taiwan, NASA and National Science Foundation for Constellation Observing System for Meteorology Ionosphere and Climate (COSMIC) mission
      - Temperature, humidity and ionosphere profile measurements
    - Partnership with the French Space Agency, EUMETSAT, and NASA for the Jason-2 mission
      - Ocean surface topography measurements
    - Partnerships with the Canadian Space Agency for the RADARSAT-1 mission
      - Synthetic aperture radar measurements
  - Purchasing data
    - Purchase of synthetic aperture radar data (Canada's RADARSAT-2 mission and the European Space Agency's ENVISAT mission)
    - Purchase of ocean color data (GeoEye's OrbView 2/SeaStar mission)

## NOAA Capabilities & Partnerships

- **NOAA meets its requirements by utilizing research measurements from multiple NASA research missions**
  - ACE and SOHO missions – solar wind and corona measurements
  - QuikSCAT mission – ocean surface vector wind measurements
    - QuikSCAT stopped working in Nov. 2009
  - SORCE mission – solar irradiance measurements
  - Terra and Aqua missions -- radiances, aerosols, ocean color, land and sea surface temperatures, atmospheric water quantities, ice, snow, and cloud measurements
  - Aura mission -- ozone, air quality measurements
  - TRMM mission – rainfall measurements, lightning events, radiances



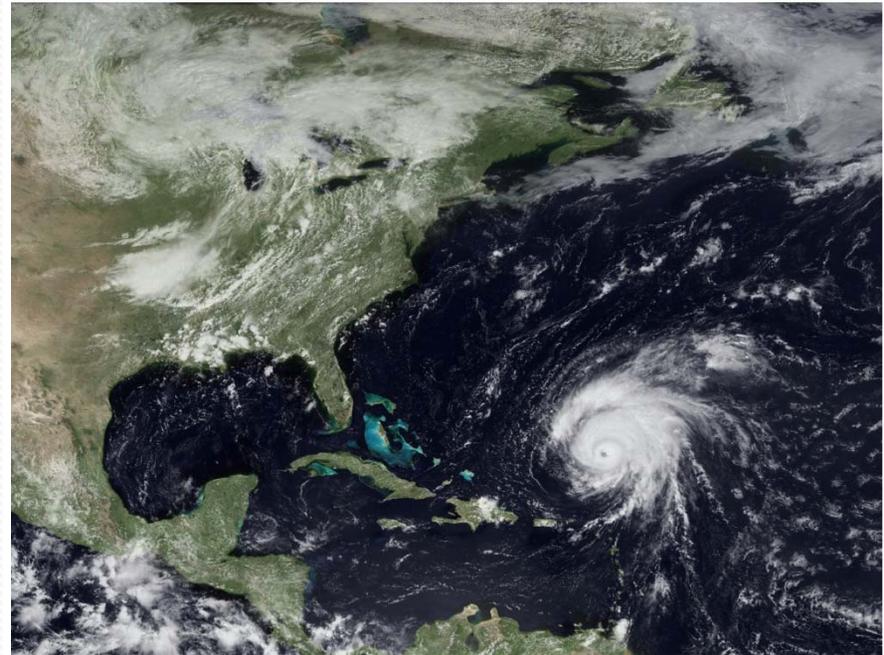
## When NASA Missions End

- **NOAA's use of research measurements to meet its operational requirements provides a temporary solution for meeting NOAA's needs**
  - NASA has no mandate to sustain the measurements
- **When NASA's research missions end – NOAA products and services utilizing the measurements from that mission are impacted.**
  - In some cases, products are degraded.
  - In other cases, products can no longer be produced
- **As a result, NOAA's priorities for funding Research to Operations transitions emphasize transitioning research measurements already in use operationally**



## Assessment: Recent Reports & Recommendations

- **Multiple reports emphasize the importance of an effective research-to-operations process between NASA and NOAA:**
  - From Research to Operations in Weather Satellites and Numerical Weather Prediction – Crossing the Valley of Death, National Academies Press, 2000 (“Valley of Death”)
  - Satellite Observations of the Earth’s Environment - Accelerating the Transition of Research to Operations, National Academies Press, 2003 (“CONNTRO”)
  - A Review of NASA’s 2006 Draft Science Plan: Letter Report, National Academies Press, 2006
  - Earth Science and Applications from Space: National Imperatives for the Next Decade and Beyond, National Academies Press, 2007





## Assessment: Recent Reports & Recommendations

- **Multiple reports identify specific measurements that should be sustained operationally:**
  - Earth Science and Applications from Space: National Imperatives for the Next Decade and Beyond, National Academies Press, 2007
    - Earth radiation budget measurements, total solar irradiance measurements, atmospheric temperature and humidity profile measurements ocean surface vector wind measurements
  - Impacts of NPOESS Nunn-McCurdy Certification on Joint NASA-NOAA Climate Goals, report to White House Office of Science and Technology Policy, January 2007
    - Total solar irradiance, Earth radiation budget, radar altimetry, ozone mapping, aerosol polarimetry
  - Impacts of NPOESS Nunn-McCurdy Certification and Potential Loss of ACE Spacecraft Solar Wind Data on National Space Environmental Monitoring Capabilities, report to White House Office of Science and Technology Policy, January 2008
    - Space weather measurements

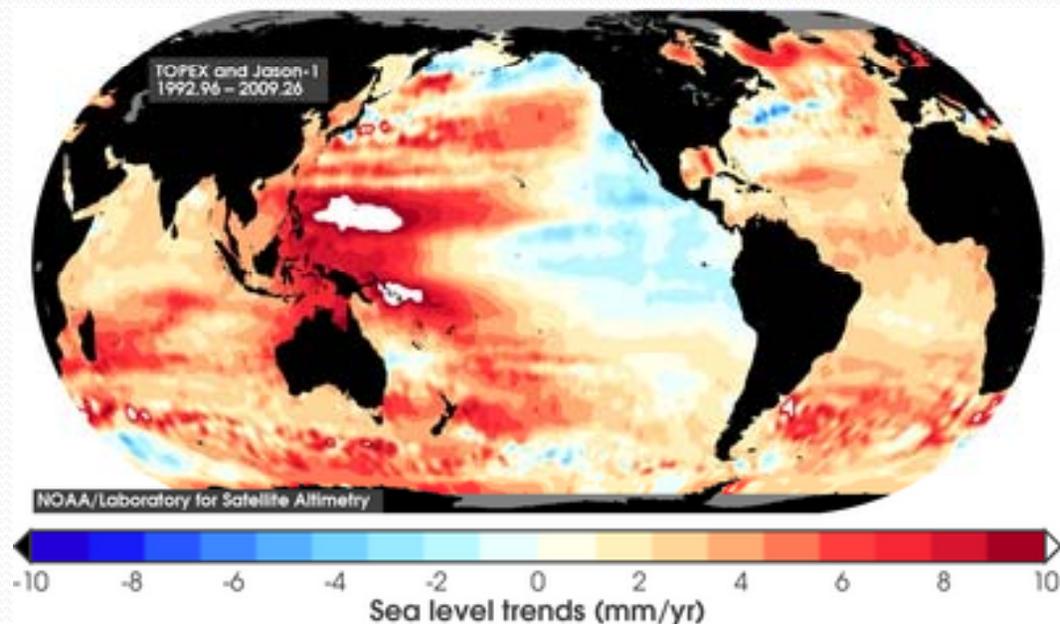


## NOAA Satellite Operational Continuity Plans

- **In 2007, a NOAA/NASA team developed an internal Satellite Strategic Plan**
  - Examined NOAA’s documented Earth observation requirements and how currently being met; outlined strategy for addressing future NOAA requirement
- **The plan recommended that NOAA:**
  - **Continue the current programs**
    - GOES-N, GOES-R, POES, NPOESS, and Ocean Altimetry
  - **Ensure climate data continuity**
    - Deliver climate sensors to NPP and NPOESS
    - Long term strategy defined by 2010
  - **Pursue “Research to Operations” transitions**
    - Pursue high priority measurement candidates for research to operations (R2O) transition and incorporate into budget submissions as they are ready
      - Ocean altimetry, solar wind, radio occultation measurements for atmospheric temperature and humidity profiles, ocean surface vector winds
    - Identify future measurement candidates and partnerships for R2O transitions
    - Continue work with commercial sector for possible purchase of satellite products and services

## Continuity of Climate Data

- **Climate sensors (ozone and Earth radiation budget) have been delivered to NPP and are under development (Earth radiation budget and total solar irradiance) for NPOESS C<sub>1</sub>**
- **Options for continuity beyond NPOESS C<sub>1</sub> are being examined**
  - Includes CERES, TSIS, OMPS and APS
  - NPOESS, government and/or commercial free flyers under consideration
- **Funds have been appropriated for the Jason-3 Ocean Altimetry in the FY10 budget**





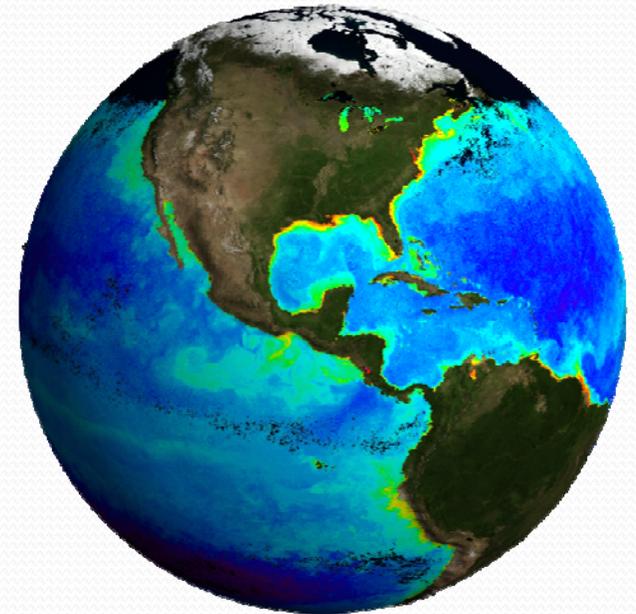


## Planning for Future Research to Operations Opportunities

- **NOAA scientists are participating on NASA science teams and public workshops for future NASA Earth Science missions**
  - Global Precipitation Mission
  - Glory -- Total Solar Irradiance, Aerosol Polarimetry
  - Aquarius – Sea-surface Salinity
  - NRC Decadal Survey
    - SMAP -- Soil Moisture
    - ICESAT 2 – Ice Sheet Climatology
    - DesDynI – Ice Concentration
    - CLARREO – Absolute calibration standard, GPSRO
    - ACE -- Polar-orbiting atmospheric properties and ocean color
    - GeoCAPE – Geostationary Atmospheric Composition and Ocean Color
    - SWOT – Altimetry
- **NOAA is providing supplemental funding to JPL microwave imager / sounder development for potential future flight on geostationary satellite mission**
  - GeoSTAR (Instrument Incubator Program)

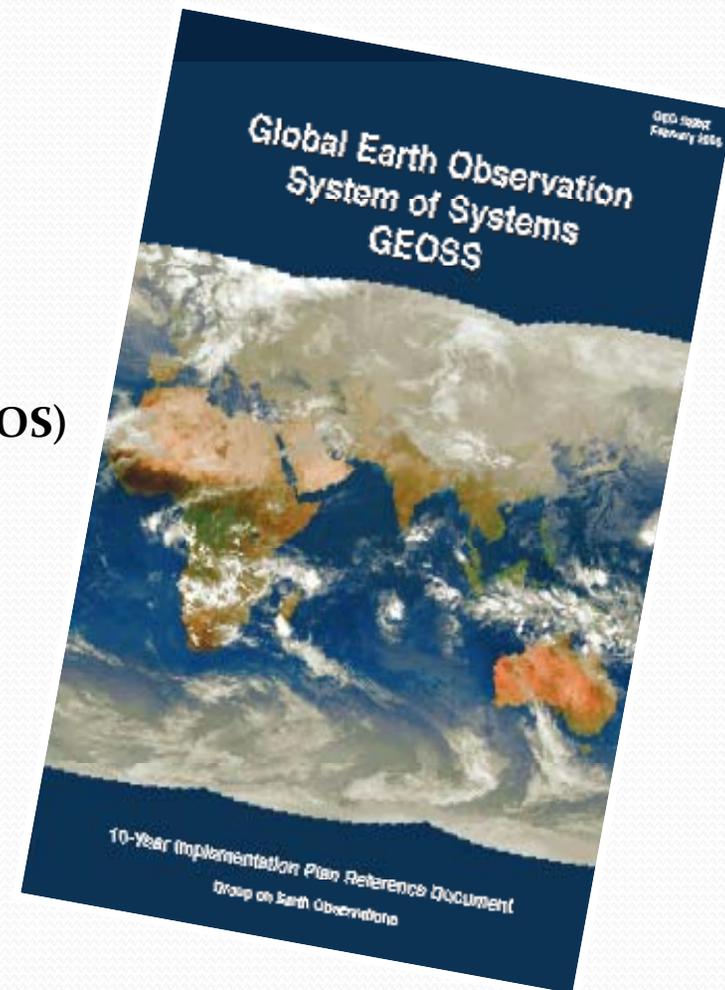
## Exploring Commercial Alternatives

- **Request for Quotation (RFQ): Price Validation and Technical Feasibility studies for commercial services to meet earth and space weather observation requirements**
- **To date, three sets of contract awards issued totaling \$550,000**
  - Set A for Total solar irradiance, solar wind, Coronal Mass Ejection, GPS Radio Occultation
  - Set B for Earth Radiation Budget, Ocean Color, Altimetry, and Geostationary advanced soundings
  - Set C for Aerosol Polarimetry and Ozone Profiles
- **Final reports for Set A and Set B studies were received and have been evaluated. Set C final reports were submitted in December 2009**
- **Based on study results to date, we expect opportunities for commercial partnerships**



## Civil Space International Capabilities: Coordination of International Earth Observations

- **Group on Earth Observations (GEO)**
- **U.S. Group on Earth Observations (USGEO)**
- **Committee on Earth Observation Satellites (CEOS)**
- **Unifying Principle: Global Earth Observation System of Systems (GEOSS)**





## Improving the R2O Process

- **National Commitment**
  - U.S. must embrace operational continuation of NASA Earth measurements
  - Includes Administration & Congress
- **Funding**
  - Stable funding sufficient to support R2O transitions will make NOAA a credible and viable NASA R2O partner
- **A NASA Strategic Imperative**
  - NOAA encourages NASA to formally embrace the goal of enhancing NOAA's observational technology
  - NOAA's long-term requirements considered in NASA's research portfolio – in a way which doesn't compromise NASA's research imperatives
  - Mission reviews should consider NOAA's operational applications
    - NASA's Extended Mission reviews do this
- **NASA and NOAA must employ transition-friendly procurement strategies**
  - Ex: NASA contract options which allow NOAA to procure follow-on instruments
  - Requires funding in the NOAA portfolio to support efforts (e.g. participating in long-term parts buys, funding in place to exercise options)



## Summary

- **Importance of R2O transition emphasized in multiple National Academy reports and last two NASA Authorization Acts**
- **NOAA's most immediate R2O challenge is the loss of NASA observations that are routinely used in NOAA's warnings and forecasts**
- **Some Recent Funding Successes**
  - Climate Sensors continuity
  - Jason 3
- **Current areas of emphasis:**
  - Transition planning for solar wind, GPS Radio Occultation and scatterometry measurements
- **Consistent R2O success requires commitment, funding, considering operational requirements from the get-go, and creating enabling mechanisms for timely transition**