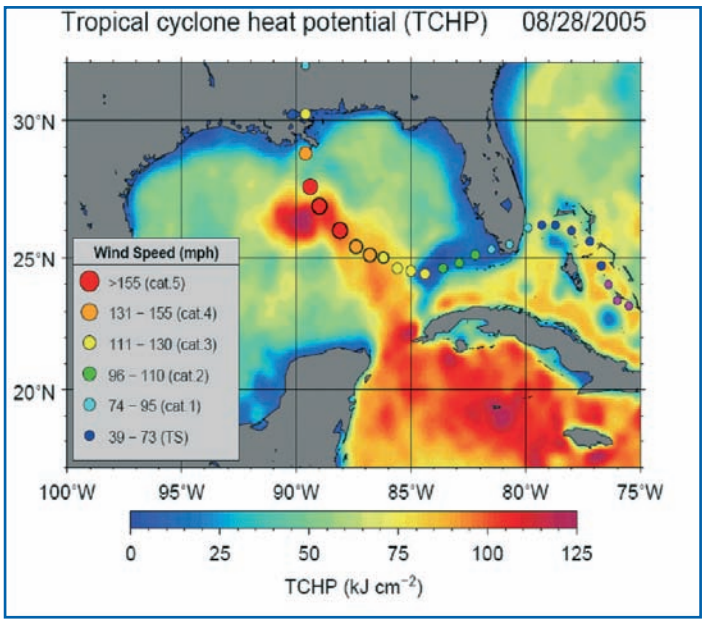
Establishment of a U.S. National Land Imaging Program

Description

Satellite measurements of the global surface topography of the ocean in recent years have revealed the critical role of the ocean in disasters, weather, climate, water resources, marine ecosystems, and human health. These measurements, coming from a simultaneous series or constellation of satellites carrying altimeters, are a fundamental part of any global Earth observing system and should be continued as part of GEOSS. Shaped by currents, winds and Earth's gravity, the surface of the ocean tells a larger story about its most basic functions; how it stores vast amounts of energy from the Sun, how it moves that energy around the globe and how it works together with the atmosphere to create climate and weather. Just as forecasting atmospheric changes requires both surface pressure and atmospheric density, so does forecasting ocean circulation require the surface pressure field from ocean surface topography as well as density profiles in the ocean. Sampling is key; scientists have learned that one altimeter is not enough. At least one precision altimeter in an inclined reference orbit must be joined with at least two complementary altimeters in polar orbits to observe the full range of scales from global to mesoscale. In addition, for scientific understanding and operational forecasts, the altimetry data must be combined with in situ information that comes from various sources including the global Argo float array, moored buoys, and coastal sea level gauges. When fully operational, the constellation and in situ instruments will provide valuable societal information.

The data collected to date by the existing constellation are striking. Today, we have the first accurate global observations of sea-level change. The new data has allowed modeling of the ocean response to warming and ice melting, and has shown the impact of the ocean on atmospheric temperature and precipitation, as well as on hurricanes and typhoons. For weather, altimeter data has improved knowledge of upper-ocean heat content and hurricane intensity forecasting, helped high-seas forecasting, and has improved operational oceanography (forecasting eddies, etc) in general. For climate, the altimetry data has yielded for the first time the basin-scale variability in the oceans including ENSO forecasting and its impact on seasonal floods and droughts, and longer-term decadal changes such as the North Atlantic Oscillation.



The era of modern satellite altimetry began with the European ERS-1 in 1991 and the US/French TOPEX/POSEIDON in 1992. These have been followed by ESA's ERS-1, ERS-2, and Envisat; the US Navy's GFO, and the French/US Jason-1 and (when launched next year) Jason-2. These altimeter satellites are now advancing our knowledge of ocean circulation and seasonal changes, improving forecasting of climate events, measuring global sea-level change, improving open ocean tide models, and providing estimates of significant wave height and wind speeds over the ocean. For the future, the Committee on Earth Observation Satellites (CEOS) has recommended that the Jason-derived climate data record be continued beyond Jason-2, together with continuity of coverage by at least two complementary altimeters in polar orbit, thus enabling both the global aspect of ocean processes as well as oceanic mesoscale variability to be monitored. This future constellation is currently being planned and implemented, with some budget commitments not yet been made. To avoid gaps and provide long-term continuity, nations need to commit now to all aspects of the ocean surface topography constellation for GEOSS.

Added Value

In addition to the points mentioned above, an ocean topography constellation adds value by providing data for operational forecasts ranging from tides and marine ecosystems to human health and water resources on land. For example, when used together with coastal tide gauges, the altimeter information provides tide-resolving forecasts of sea level in coastal areas around the world. Information on long term ocean change such as the North Atlantic Oscillation can be linked to fisheries regime changes, zooplankton variability, and marine mammal migration. Changes in coastal currents that affect water-borne diseases are also monitored by the altimeter constellation. Moreover, the altimeter provides crucial information on the amount and extent of polar ice, and will be an important contribution to the International Polar Year(IPY). Finally, building on constellation results, new wide-swath precision altimeters promise data on water levels over land that will be critical for management of water resources.

Relevance to GEO

Information from the ocean surface topography constellation together with in situ data system contributes to several of the GEO Societal Benefit Areas (SBAs 1,2,4,5,6,7,8: Work Plan Task Numbers indicated):

- Disasters:
  Data to improve the forecast track for hurricanes and typhoons and associated flooding (DI-07-01)
- Health:
  Data for predicting coastal ocean currents and temperatures for harmful algal blooms and water-borne diseases such as cholera outbreaks (HE-06-03)
- Climate:
  Data provides basic ocean and ice information for assimilation and forecasting seasonal, interannual, and long term climate change (CL-06-02, CL-06-05, CL-06-06, and CL-07-01)
- Water:
  Data provides basic information on terrestrial water levels and state of water resources for forecasting and for water resource management (WA-06-02, WA-06-05, WA-06-07, and WA-07-02)
- Weather:
  Data provides basic ocean information on circulation and heat content for global forecasts (WE-06-02, WE-07-01)
- Ecosystems:
  Data provides the basic ocean information necessary for management of marine resources (EC-07-01)
- Agriculture:
  Data improves seasonal forecasts of drought and precipitation (AG-07-02)

Participants

The existing and proposed series of missions are supported by partnerships between GEO participants US (NASA, Navy, and NOAA), ESA, EUMETSAT, France (CNES), China (SOA), and India (ISRO). All data are to be made freely available for use by others, and are regularly assimilated into operational forecasting models in the US (NCEP), Europe (ECMWF), and in forecasting centers around the world.

Current Status and Next Steps

Currently, intensive discussions are on-going between EUMETSAT and NOAA to define a concept for a Jason-3 precision altimeter mission in the reference orbit, and funding is in the process of being committed. Continuity of coverage for global and mesoscale will require at least two complementary altimeter missions. Several countries, including the US, France, ESA, EUMETSAT, China, and India are involved in the planning for the complementary altimeters. The first satellite in the Chinese HY-2 series is now committed, as is the Indian/French SARAL mission. ESA's Sentinel-3 series, part of GMES, is under active development. NASA is considering a wide-swath altimetry mission. It is hoped that substantial progress towards commitments to the ocean surface topography constellation can be made by the time of the GEO Ministerial Summit. But final budget commitments, particularly for Jason-3, are not yet in place, and gaps are possible. Without commitments soon, society may lose essential long-term continuity of the data. Commitment to an ocean surface topography mission will be an important part of the success of GEO and GEOSS.