FACT SHEET

NATIONAL OCEANIC & ATMOSPHERIC ADMINISTRATION

The Contribution of NOAA Buoys to a Global Ocean Observing System

Benefits to Climate Prediction And Research

Building on previous success in predicting short-term weather and El Niño, NOAA meteorologists and oceanographers are ready to take the next step—understanding decade scale phenomena that are correlated with weather anomalies all over the globe. Such anomalies include the Arctic Oscillation (AO), the Pacific Decadal Oscillation (PDO), and the North Atlantic Oscillation (NAO). Like El Niño, sea surface temperature variations associated with these phenomena can significantly impact local, regional, and global climate. However, in order to better forecast these anomalies, researchers must be able to observe and understand conditions at and beneath the surface of the ocean via an advanced global ocean observing system.

Existing ocean observing systems will assist in these efforts. However, they are constrained by a number of important limitations. For example, satellites cannot collect data from beneath the ocean surface. Likewise, many existing ocean buoy networks—such as the TAO (Tropical Atmospheric-Ocean)/TRITON array (an important component of NOAA's ENSO Observing System for the Tropical Pacific) and the Pilot Research Moored Array in the Tropical Atlantic (PIRATA)—collect data from limited geographical regions. Until researchers are able to expand and improve upon existing ocean observing systems, the effects of less well known phenomena (such as AO, PDO, and NAO) cannot be fully incorporated into climate forecasts. Thus, there is an urgent need for new ocean observing technologies that span the globe, such as the Argo array of profiling floats.

Why We Need an Ocean Observing System

The basic rationale for ocean observations for climate research and forecasting is straightforward. Basically, the upper 10 feet of the ocean has the same heat capacity as the entire atmosphere and therefore has an tremendous influence on both short- and long-term air temperature changes. Likewise, the ocean holds a significant amount of carbon dioxide, which can influence future atmospheric levels of this greenhouse gas. Observing these properties of the ocean and incorporating relevant data into models—like what is done in weather forecasting—is essential to the prediction of our future climate (whether it is the onset of the next El Niño or the longer term decadal changes linked to the AO, PDO, and NAO). Therefore, the accuracy of future climate forecasts will depend on improvements to our ocean observations (especially temperature, salinity, and currents) within the upper layers of the ocean.

As part of the FY2002 request for Climate Observations and Services in the Oceanic and Atmospheric Research budget activity, NOAA requested $7.2 million to continue implementing an integrated global oceanographic observing network (i.e., the Argo network) necessary for climate prediction and research. The observing network is based on a set of core observations (e.g., temperature, winds, salinity, and carbon dioxide), consisting of both in-situ (in other words "in the water") and satellite measurements, that have been identified to satisfy climate forecasting and assessment needs. NOAA's primary contribution to a global ocean observing system will include both: improving existing ocean observing systems

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(including the TAO/TRITION array—the major "oceanic" component of NOAA's El Niño/Southern Oscillation (ENSO) Observing System—and implementing new ocean observing systems, such as the Argo profiling floats.

TAO/TRITION Array

Critical to NOAA's advanced global climate monitoring capabilities are NOAA's polar orbiting satellites and the TAO/TRITON Array, which was designed to study (and predict) the year-to-year climate variations related to the El Niño Southern Oscillation (ENSO). The array of 72 moored buoys spans the Equatorial Pacific Ocean (including both NOAA TAO moorings in the eastern and central Pacific and Japanese TRITON moorings in the western Pacific). TAO/TRITON moorings measure surface meteorological parameters and upper ocean temperatures. NOAA's research ship, the KA'IMIMOANA, is dedicated to servicing TAO moorings and spends about 250 days at sea. Significant ship time is also contributed by Japan to maintain TRITON moorings in the western Pacific.

The TAO/TRITON array proved itself in that the data collected from this array (in conjunction with satellites) was collated and fed into computer models, that enabled NOAA's Climate Prediction Center to forecast the 1997-1998 El Niño (and the subsequent La Niña)—six months in advance. Although an estimated 125 million people were affected by climate-related events associated with this El Niño, NOAA's forecast gave the public advanced warning, allowing time to better prepare for and mitigate El Niño-related climate impacts (and any socio-economic repercussions ....both positive or negative) from this potentially catastrophic event.

Although TAO/TRITON broke new ground in the understanding and prediction of climate variability on seasonal and inter-annual time scales (along with the PIRATA array based on TAO technology is operating with joint support from NOAA, French, and Brazilian institutions) these arrays are of limited geographical extent. What is needed was a consistent, global observing system to collect the upper level ocean data necessary to complement space-based observations and existing in-situ ocean observations for improved understanding of climate variability and for ingestion into computer forecast models. Fortunately, the profiling float technology necessary to meet this criteria exists today. Known as Argo, this series of profiling floats will build upon existing systems to enhance our understanding of climate variability and provide reliable forecasts worldwide.

ARGO

Initiated in 2000, Argo is an international effort to implement an array of 3,000 autonomous (free-drifting) temperature/salinity floats as a major component of a global ocean observing system. The President's FY2003 budget includes a proposal for the United States to increase its share from one third to one half of the global array of Argo floats. These floats will be joined by other floats from Canada, Japan, the United Kingdom, France, Germany, Australia, the European Community, India, New Zealand, Republic of Korea and Spain. Global coverage with 3,000 floats is expected by the end of 2005. Argo will contribute to the Global Ocean Data Assimilation Experiment (which together with Climate Variability and Predictability Experiment [CLIVAR] and Global Climate Observing System/ Global Ocean Observing System [GCOS/GOOS], provide the major scientific and operational impetus for Argo). Furthermore, this initiative will (for the first time) enable the broad-scale physical state of the upper ocean to be systematically measured and assimilated in near real-time.

When deployed at the surface with a horizontal spacing of ~300 km (186 miles or 3 degrees), each float will sink to a typical depth of 2,000 meters (or slightly more than an mile). After drifting with the ocean current at that depth for ten days, it will slowly rise, measuring the temperature and salinity at each layer as it makes its way to the surface. On the surface, the float will transmit its data and position to an orbiting satellite before returning to depth and continuing with another cycle. The great advantage of the floats is that, after deployment, they will continue to operate unattended. Floats will continue cycling throughout their design life of four to five years. Satellites will relay the data received from Argo floats to land-based receiving stations. From there, the data with automated quality control are made available within 24 hours for operational forecast centers (and with more rigorous quality control within five months for scientists). All data will be openly available, without proprietary restriction.

The Argo measurements of temperature, salinity, pressure and reference velocity (together with sea surface height from satellite altimetric data) form a dynamically complete description of the upper ocean—one which is the oceanic equivalent of today's operational observing system for the atmosphere. The combined ocean/atmosphere observing system will collect necessary data to understand and predict phenomena that influence our global climate. The high degree of synergy between float and altimetric data gives rise to the name Argo, chosen to stress the complementary relationship of the float array with the next generation Jason altimeter (the name Argo stresses the close connection between observations from the floats and the Jason-1 Satellite. Jason was a mythological Greek hero and Argo was his ship).

A global monitoring network that includes Argo enable scientists to enhance their ability to forecast seasonal and interannual (i.e., El Niño/La Niña) climate phenomena and improve their ability to forecast other (large scale) climate variations. Furthermore, the information gathered from this network will serve a variety of other purposes—including improving climate modeling, short-term weather forecasting, and our understanding the ocean and its circulation patterns in general.