Surface Drifter Program

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Project Summary

The Surface Drifter Program is AOML's contribution to the Global Drifter Program (GDP), a branch of NOAA's Integrated Ocean Observing System (IOOS) and a scientific project of the Data Buoy Cooperation Panel (DBCP). The primary goals of this project are to maintain a global 5°x5° array of ARGOS-tracked Lagrangian surface drifting buoys to meet the need for an accurate and globally dense set of in-situ observations, and to provide a data processing system for the scientific use of these data that support short-term (seasonal-to-interannual, "SI") climate predictions as well as climate research and monitoring. AOML's GDP responsibilities are to: (1) manage drifting buoy deployments around the world using research ships, Volunteer Observation Ships (VOS) and aircraft; (2) insure the data is placed on the Global Telecommunications System (GTS) for distribution to meteorological services everywhere; (3) maintain META files describing each drifter deployed, (4) process and archive the data at AOML and at MEDS (Canada); (5) develop and distribute data-based products; (6) maintain the GDP website; and (7) maintain liaisons with individual research programs that deploy drifters.

The drifters provide sea surface temperature (SST), near surface (mixed layer) currents, air pressure and wind observations needed to (a) calibrate SST observations from satellite; (b) initialize SI forecast models; and (c) provide nowcasts of the structure of global surface currents. Global drifter coverage is required as present forecast models simulate not only Pacific conditions but also global conditions to improve prediction skill. Secondary objectives of this project are to use the resulting data to increase our understanding of the dynamics of SI variability, and to perform model validation studies, in particular in the Atlantic Ocean. Thus, this project addresses both operational and scientific goals of NOAA's program for building a sustained ocean observing system for climate.

Of particular interest is the data collected in the Tropical and subtropical South Atlantic. Large-scale SST distributions drive the response of the climate in the tropical Atlantic sector, and over land areas as distant as the southern and eastern Unites States. In spite of its importance, no dynamical model has successfully predicted tropical Atlantic SST one-to-several seasons in advance. The current generation of coupled ocean-atmospheric models cannot reproduce, much less predict, the SST in the tropics. A recent comparison of 23 GCM results (Davey et al., 2002) concentrated on simulated fields from the tropical oceans (i.e. SST, zonal wind stress and upper layer depth averaged temperature). In the Atlantic Ocean, discrepancies between the model and observed mean states were dramatic. Specifically, in the equatorial Atlantic, the simulated meridional temperature gradient was wrong, with cold temperatures in the west and warm temperature in the east (Figure 4, Davey et al., 2002[1]). While some very recent experimental coupled models demonstrate improvements in simulating these SST distributions, their parameterization of the underlying physical processes must be carefully evaluated against in-situ observations before operational coupled models can be reliably improved. Beyond these issues, the variability of the subtropical Atlantic and its interaction with the tropics is far from understood, primarily due to the paucity of data that for years have been mainly collected in the major commercial lanes. The variability of the inter-tropical convergence zone (ITCZ) is highly sensitive to changes in SST gradients within the broader tropical Atlantic region, particularly in the meridional direction south of the tropics and during boreal spring (Kushnir et al., 2003). To better understand this variability, improved SST products must be developed and calibrated/validated with in-situ observations. Starting in 1998, a new component was added to this sustained program to fill existing gaps in the observational network, by deploying additional surface drifters in the tropic and subtropical South Atlantic (30°N to 40°S). The main objective was to accurately describe the basin-scale Atlantic currents system and SST seasonal to interannual variations, and the effects of the variability in the climate of the surrounding areas. During FY06, this grant received additional support to deploy surface drifters in support of the CLIVAR Mode Water Dynamics Experiment (CLIMODE). The goal of this effort is to resolve eddy fluxes across the Gulf Stream front, where strong interannual variability is poorly simulated in present ocean models. Drifters in support of CLIMODE were deployed primarily from WHOI CLIMODE cruises in November 2005 and January 2006.

Accomplishments

The global drifter array became the first component of the IOOS that reached completion, with 1250 active in September 2005. This number has since been maintained. During FY06, the GDP coordinated worldwide deployments of 999 drifters, 851 funded by NOAA/OCO; 158 were deployed in the Atlantic between 30ºN and 40ºS. AOML managed observations from 2079 unique drifters during FY06 (this is greater than 1250, as some died while new ones were deployed to maintain ~1250).

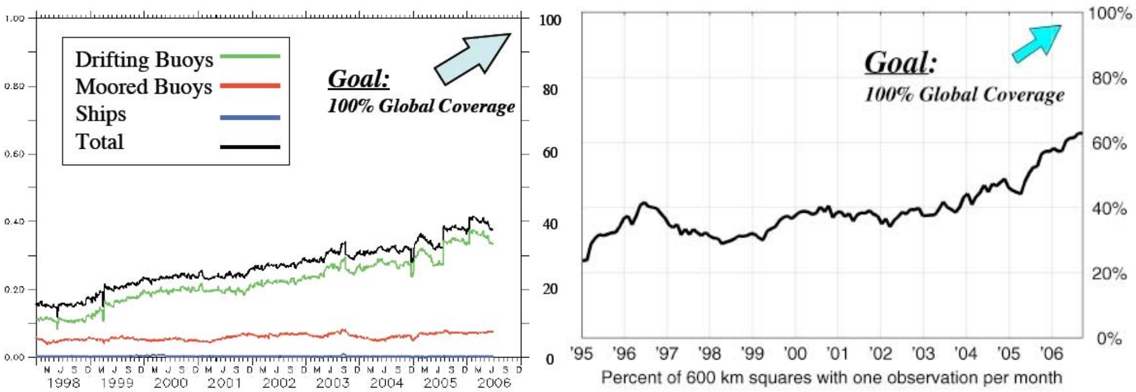

Fig. 1: FY06 Q4 reports evaluating the spatial coverage of the Integrated Ocean Observing System (IOOS) for SST (left) and near surface current (right) measurements. On the left, the black curve is for the entire IOOS; green curve is for surface drifters. Drifters dominate the overall IOOS' spatial coverage of near-surface current measurements.

The main challenge is now to increase the spatial coverage of the array while maintaining its size. We are addressing these challenges with a two-pronged strategy. First, we are actively seeking new ships to participate in the VOS program. For example, this year AOML has initiated drifter deployments from a Ghana-to-Cape Town vessel to help fill the gap in the Gulf of Guinea. We are also seeking deployments with a broader group of Global Drifter Program collaborators such as Kenya's Division of Oceanography and Marine Meteorology Services (20 drifters deployed in FY06 in a data-sparse region of the Indian Ocean). Second, we have developed a tool to predict the array coverage, in order to anticipate and plan for gaps before they develop (Fig. 2). These forecasts are publicly available at http://www.aoml.noaa.gov/phod/graphics/dacdata/forecast90d.gif.

In FY06 AOML completed a study of drifter performance from four manufactures. This evaluation was particularly valuable in reassessing drogue (sea anchor) presence on the drifters. Results led to a major effort to reevaluate drogue presence for all drifters deployed since 1998, initiated in FY05 and completed in May 2006. During the FY05 performance study, the GDP identified some systematic problems for individual manufacturers' drifters. Numerous interactions during FY06 were used to communicate these problems to the manufacturers and the broader DBCP community; the results of the FY06 comparison study demonstrated that the manufacturers have solved all of these problems.

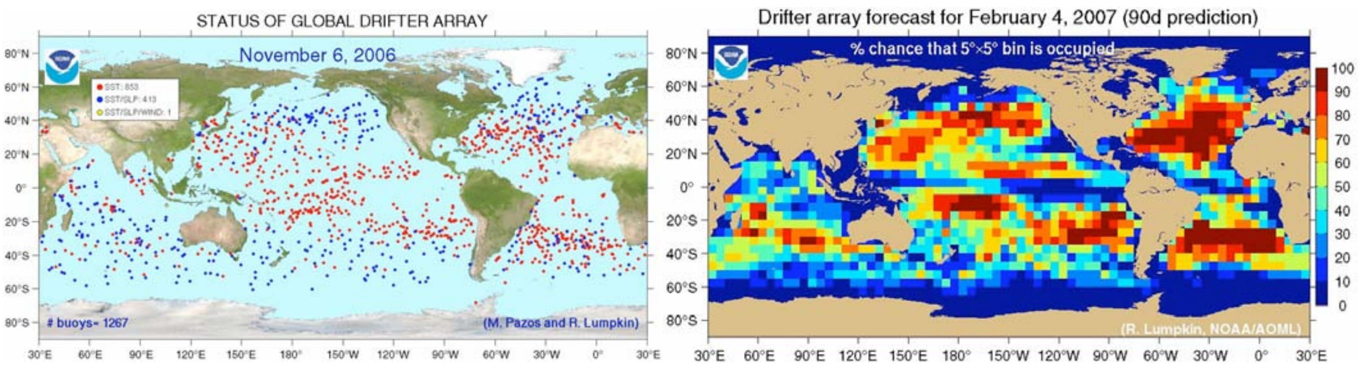

Fig. 2: Global population of drifters as of November 6, 2006 (array size 1267 drifters), and 90 day prediction of coverage (% chance that a 5ºx5º bin will have a drifter if no additional drifters are deployed in the interim).

During FY06, the GDP conducted a major revision of the web pages used to distribute drifter data, information and products (http://www.aoml.noaa.gov/phod/dac/gdp.html). We have received uniformly positive feedback on these changes.

Publications and Reports:

- Lumpkin, R. and M. Pazos, 2006: "Measuring surface currents with Surface Velocity Program drifters: the instrument, its data, and some recent results." Chapter two of *Lagrangian Analysis and Prediction of Coastal and Ocean Dynamics* (LAPCOD), ed. A. Griffa, A. D. Kirwan, A. J. Mariano, T. Ozgokmen, and T. Rossby.

- Garzoli S. L., B. Molinari and R. Lumpkin, 2006: Surface drifter program. In *Annual Report on the State of the Ocean and the Ocean Observing System for Climate (FY-2005),* ed. J.M. Levy, D.M. Stanitski, and P. Arkin. NOAA Office of Climate Observation, Silver Spring, MD, 124-127.

- Lumpkin, R. and G. J. Goni, 2006: Global oceans: Surface currents. In *State of the Climate*

in 2005, K.A. Shein, A.M. Waple, H.J. Diamond, and J.M. Levy (eds.). Bulletin of the American Meteorological Society, **87**(6), S25-S26.

- Lumpkin, R. and G. J. Goni, 2006: Surface currents. In *Annual Report on the State of the Ocean and the Ocean Observing System for Climate (FY-2005),* J.M. Levy, D.M. Stanitski, and P. Arkin (eds.). NOAA Office of Climate Observation, Silver Spring, MD, 61-67.