The Global Drifter Program

Drifter Measurements of Surface Velocity, SST, SSS, Winds and Air Pressure

Luca Centurioni
[1]CIMEC and CASPO, Scripps Institution of Oceanography, La Jolla, California

Project Summary

The Global Drifter Program [GDP hereafter, *Niiler*, 2001] is a NOAA funded program and the principal component of the Global Surface Drifting Buoy Array, a branch of NOAA's Global Ocean Observing System (GOOS). The GDP is also a scientific project of the Data Buoy Cooperation Panel (DBCP). The DBCP is an international program coordinating the use of autonomous data buoys to observe atmospheric and oceanographic conditions over ocean areas where few other measurements are taken. The DBCP was formed in 1985 as a joint body of the World Meteorological Organization (WMO) and of the Intergovernmental Oceanographic Commission (IOC) of the United Nations Educational, Scientific and Cultural Organization (UNESCO). The DBCP constitutes the data buoy component of the Joint WMO-IOC Technical Commission for Oceanography and Marine Meteorology (JCOMM).

The ***broad objectives*** of the GDP are to:

1) Maintain an ocean-observing network of 1250 Lagrangian drifters with a nominal resolution of 5°X5° that, through the Argos and Iridium satellite systems, return data of meteo-marine variables including near-surface ocean currents (15 m depth), sea surface temperature (SST), sea surface salinity (SSS), sea-level atmospheric pressure (SLP), sea-level winds (SLW) and subsurface temperature (Tz), and
2) Provide a data processing system for the scientific use of the drifter data.

Societal Rationale

Approximately 53% of the US population lives in coastal counties (estimated in 2003, source: NOAA http://oceanservice.noaa.gov/programs/mb/supp_cstl_population.html) and, globally, the density of the population is significantly higher in coastal areas than inland [*Small and Nicholls*, 2003]. The threats to coastal communities include a variety of short-term (i.e. severe weather, hurricanes, marine pollution) and long-term (i.e. climatic changes and coastal erosion) natural and anthropogenic conditions. The GDP array provides data which are readily available, either in real-time or near-real-time, for direct analysis or to be assimilated by a variety of models designed to understand, forecast and mitigate the impact of the Earth system and of pollution on people's lives, including commercial and recreational activities. On short time scales, examples include measurements of ocean currents to track pollutants such as oil and marine debris, to support fisheries management, to aid commercial and Navy's ship operations, as well as measurements of SLP, SLW, SST and SSS to improve Numerical Weather Prediction (NWP) and hurricane forecast. On longer time scales, examples include climate records of ocean currents, SST, SLP for use in climate models. Accurate measurements of the global distribution of the SLP, which is the weight of the atmosphere over the ocean –also called the inverse barometer effect- are important to accurately determine the global sea-level which is measured by the altimeters fitted to several satellites.

Scientific and Technical Rationales

Specific Science Objectives of the GDP

- Provide the Global Telecommunication System (GTS) of the World Weather Watch (WWW) with a stream of near-real time data of SST, SLP, SSS, SLW and Tz for use in climate, NWP and tropical cyclones forecast models. The data latency, i.e. the time between collection and availability on the GTS, ranges from ~2 hours with the Argos satellite system to ~10 minutes with if the Iridium telemetry is used.
- Measure the mixed layer currents globally and provide colleagues at the Atlantic Oceanographic and Meteorological Laboratory (AOML) of NOAA with data to produce maps of the World's ocean circulation that resolve seasonal and inter-annual variations. The quality-controlled ocean current data are available in delayed mode.
- Provide the scientific oceanographic, climate and meteorological communities and the general public with enhanced, research-quality data sets of ocean currents that incorporate drifter data from individual research programs, including historical data from instruments that differ from the Surface Velocity Program (SVP) Lagrangian drifter design corrected for the wind-induced velocity bias, also known as "slip" [*Niiler and Paduan*, 1995].
- Support programs of national and international interest, such as the recently launched Aquarius mission to measure SSS from space and NWP efforts worldwide.
- Analyze the GDP drifter data and provide a scientific interpretation of the results. Publish the findings in peer-reviewed, easily accessible journals.

Specific Technical Objectives of the GDP

- Maintain the nominal array resolution of 5°X5°, which is needed to keep the potential SST satellite bias error smaller than 0.5ºC [*Zhang et al.*, 2009].
- Monitor and evaluate the performances of the GDP array in order to identify and troubleshoot technical issues as soon as possible.
- Develop and introduce drifter' construction technological advances in sensors, electronics, power, methods of assembly and packaging for deployment. Special emphasis is given to the implementation of new sensors, air deployable instruments and methods for hurricane intensification research, SSS measurements, and technical solutions to increase the endurance of the drifters.
- Share the technological advances with the drifter manufacturer community (commercial, university and federal agencies) with the goal to maintain a healthy GDP array.

Data and Products Accessibility/Archiving

- A subset of the GDP data, SST, SLP, SSS, SLW and Tz are publicly available through the GTS of the WWW.

All GDP data and products are available from the GDP Data Assembly Center at AOML (http://www.aoml.noaa.gov/phod/dac/dacdata.php), where some details of GDP data management can be found and the drifter data management plan is described in the OceanObs'09 Community White Paper "Data Management System for Drifting Buoys" by Keeley, Pazos and Bradshaw, available at http://www.oceanobs09.net/blog/?p=225.

- All GDP data and products are updated quarterly and are available from SIO upon request to Luca Centurioni (lcenturioni@ucsd.edu), Chris McCall (cmccall@ucsd.edu) or Lance Braasch (lbraasch@ucsd.edu). A SIO web page for data viewing is available at http://gdp.ucsd.edu/dashboard.html (password protected).
- All GDP raw and processed data and metadata are archived at AOML from the beginning of the program, and at SIO (starting from FY'11 for the raw data).

Users of the GDP data

The main users of the GDP data include:

- Weather Services: (including US, UK, France, Australia, New Zealand, Brazil, Canada, India, Republic of South Africa). Data used: Sea SST, SLP, Tz and SLW for weather and tropical cyclones forecast.
- Climate research centers (US, UK, Brazil, Canada, France, New Zealand, Republic of South Africa). Data used: SST for climate models.
- National Climate Data Center (NCDC, US). Data used: SST for satellite data for calibration/validation.
- AOML (US). Near surface velocity (15 m depth) for annual and seasonal mean currents and anomalies.
- Researchers (worldwide). Drifter velocity data for enhanced 15 m depth velocity dataset for oceanographic and climate research.
- US Coast Guard. Near surface velocity data and sea surface temperature to aid commercial navigation in high latitude (icebergs drift).
- Space Agencies (EU, US) Sea Surface Salinity to calibrate/validate satellite data.
- Satellite altimetry scientific community. The atmospheric pressure data from drifters contribute to the calculation of the inverted barometer effect needed to estimate sea-level rise from altimeter data. The drifter velocity data are also used for sea level computations.

Drifter velocity data are also used by operational agencies (e.g. UK MetOffice) for ocean current models and by schools worldwide for outreach programs (see for example NOAA's "Adopt a Drifter Program" http://www.adp.noaa.gov/)