Surface Buoy Data on the WWW

The US GLOBEC Georges Bank Stratification Program is a research project designed to study the physical processes at work along the southern flank of Georges Bank. It is part of a large, multi-disciplinary, multi-institutional program addressing the question of how global climate change may affect the ocean and marine life. As part of these studies, the Upper Ocean Processes (UOP) Group deployed a surface mooring equipped with meteorological and oceanographic instrumentation to monitor physical conditions during the Stratification experiment. The mooring was deployed during Cruise 260 of the R/V *Endeavor*, on January 31, 1995, about 80 miles east of Cape Cod, in 76 meters of water.

GLOBEC investigators have agreed to make their data available in the most timely manner possible. By utilizing the daily data transmission from Argos satellites and the new opportunities afforded by the World Wide Web (WWW), the UOP group is able to make *in-situ* meteorological data from our GLOBEC buoy available within 24 hours of measurement, and within one hour of receipt, on the UOP WWW homepage. Values are transmitted from the surface buoy via Argos satellite, processed automatically, and plots are updated in Graphic Interchange Format

(GIF) files linked to the homepage at the uniform resource locator (URL) address http://uop.whoi.edu. Figure 1 is a sample plot.

This system allows us to monitor, from any computer with a WWW browser, the meteorological data being collected in the field. The system not only makes the current environmental parameters accessible to GLOBEC investigators, it also provides the UOP group with early information about problems with sensors, instruments, or buoys, when they occur. While we have been

using Argos data transmission systems for many years to monitor buoy data (Reference 1), it is only recently that we have been able to make this data available to the scientific community in the same time-frame that we receive it. This advance was made possible by using the built-in utilities in the UNIX operating system and by the distribution potential of the WWW.

The primary meteorological instruments on the UOP buoy are a Vector Averaging Wind Recorder (VAWR) and an Improved Meteorological (IMET) System. Each is equipped with a Platform Transmitter Terminal, or PTT, which collects and transmits data continuously. When an Argos satellite is in range of the PTTs, it collects the data messages and forwards them to Service Argos computers in Landover, Maryland. The data is stored there and forwarded over the Internet to a UNIX workstation in the UOP group's data analysis section once each day, using ftp.

The processing software, running on a Sun workstation, is coordinated by a UNIX shell script. This script is run automatically every hour by the UNIX scheduling utility, cron. Its first task is to check for a new data file; if the file is not found, the script exits, to be called again at the next hour. If the in-
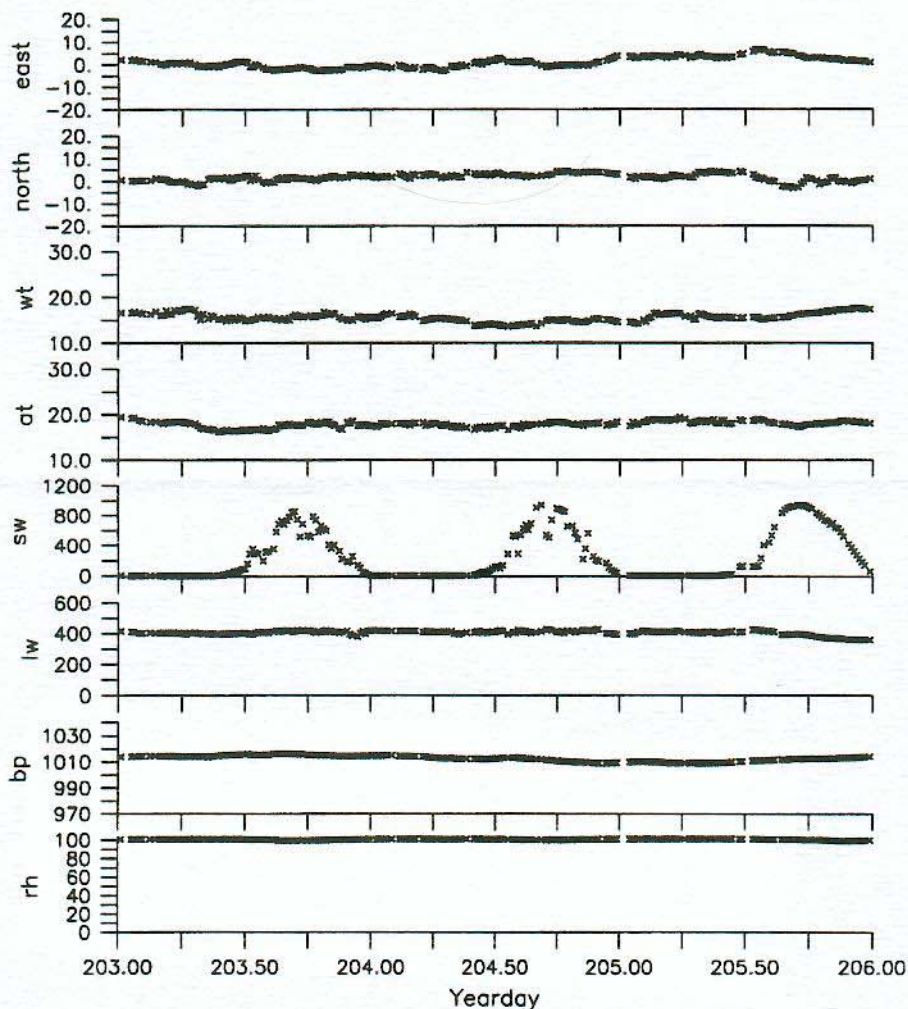

Figure 1. Sample plot of VAWR Data

coming file is found, processing begins.

The processes that extract and scale the instrument data are C programs. These programs were designed to allow changes in instrumentation and recalibration without any programming changes. For each instrument represented in the Argos message, an ASCII calibration file, called a table file, describes the contents of the Argos message: PTT number, sensor order, sensor message length, sensor calibrations, and timing information. The processing program uses this information to extract data for a specified instrument from the Argos data file, identify and scale sensor data, and store the resulting calibrated data in a text file. The main processing script needs to pass only the name of the table file to be used to the processing program.

The VAWR data files produced by this system contain the variables yearday, wind east and north, wind speed and direction, short-wave radiation, relative humidity, barometric pressure, sea and air temperature, long-wave thermopile voltage, body and dome temperature, and long-wave radiation. The variables in the working or archive version of the IMET files are yearday, wind east and north, short wave radiation, relative humidity, barometric pressure, air and sea temperature, long wave radiation, battery voltage, mooring tension, and precipitation.

Meteorological data are plotted using the graphics program Pplus, developed at the Pacific Marine Environmental Labo-

ratory (Reference 2). Metafile output is prepared for WWW viewing using a GIF plot filter. The GIF output files overwrite existing files in our WWW disk hierarchy, so that our homepage links always point to the most recent data plots.

Position data is generated by the Argos system whenever a satellite receives a data transmission from a PTT. These position records are extracted from the incoming Argos file by a series of scripts, and plotted with Matlab, a commercially available package. As for meteorological variables, the position data is plotted to GIF files for WWW viewing.

For the GLOBEC experiment, we are using the WWW as a tool for viewing the most up-to-date field data available. Because this is a fully-automated system, it allows our data to appear on the WWW as quickly as possible. This also means that the displayed data has not been subjected to any real quality control. Errors may be introduced by transmission problems, faulty calibration files, or by other circumstances we can't foresee. For this reason, we present the data only graphically, not in any form that could be used to generate a working data set. For those who need to have the data in digital form, and who understand the shortcomings of the automated system, we have incorporated a data distribution script into our processing system.

In the future, we hope to provide WWW access for more of our meteorological instruments. Although some areas

of the world oceans still have incomplete coverage by Argos satellites, resulting in gaps in the data stream of up to six hours, enough data is usually transmitted to give a useful view of *in-situ* conditions. We also hope to explore new uses of the WWW for data distribution. This powerful tool is changing the way we communicate, and making oceanographic data more accessible to the entire scientific community.

REFERENCES

[1] Galbraith, N., 1995. A Processing System for Argos Meteorological Data, WHOI Tech. Report 95-06, 54 pp.

[2] Denbo, D.W., 1994. Plot Plus Scientific Graphics System Version 1.2d, Pacific Marine Environmental Laboratory, National Oceanic and Atmospheric Administration, 119 pp.

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Note: Previous issues of the UOP Technical Note can be found on our homepage at http://uop.whoi.edu

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