Woods Hole Oceanographic Institution
Upper Ocean Processes Group

Technical Note

Buoy Meteorological Instrumentation—Part 1—Overview

The goal of the Upper Ocean Processes Group is "to study and better understand the processes in the upper ocean including air-sea interaction." Buoy meteorological instrumentation capable of obtaining high quality data is critical to achieving this goal. The current standard for high quality data has been established by the World Ocean Circulation Experiment (WOCE). The UOP group has met this requirement with a proven record based on past performance for: high data return, high accuracy, high reliability, and advancing the state of the art. The special capabilities of the group include:

1. Measurement of upper ocean variables (velocity, temperature, and salinity).
2. Measurement of near-surface meteorology (wind, humidity, air temperature, sea surface temperature, barometric pressure, rain, short-wave radiation and long-wave radiation).
3. Experience with measurement platforms including research ships, Volunteer Observing Ships (VOS) and buoys.

UOP surface buoys are equipped with meteorological sensors and recording packages with satellite telemetry capability. These buoys are typically deployed for unattended operation of up to eight months. Special tests of sensors and instruments to determine the effects of severe weather and motion are ongoing. Testing programs include data acquisition, verification, and archiving. Other areas of expertise include: meteorological instrument calibration, including the operation of constant temperature baths, a controlled humidity and temperature chamber, barometric pressure standards, operation of a wind tunnel, and maintenance of a suite of meteorological sensors which are used for intercomparison studies.

There are three generations of Improved METeorological (IMET) instruments that have been developed and are being used by the UOP group. The UOP group developed the **(1) original IMET** system (Reference Hosom 1995) with funding from the National Science Foundation (NSF) to meet the data quality requirements of WOCE. This system is now in use on several UNOLS ships and is available commercially.

(2) An **upgraded IMET** system with lower power consumption was developed and is in use by the UOP group on buoys. The IMET technology has been extended for use on VOS in the design of **(3) VOS - IMET** modules, currently being tested in cooperation with the Scripps Institution of Oceanography (SIO) VOS program. These modules are self-powered, self-recording, and can communicate on the standard IMET data bus. The following modules are currently in use:

1. Barometric pressure
2. Sea surface temperature
3. Relative humidity/air temperature
4. Air temperature (static or aspirated)
5. Wind speed and direction
6. Precipitation
7. Long-wave radiation (incoming)
8. Short-wave radiation (incoming)

Custom modules have been designed for special applications such as:

1. Precipitation temperature
2. Global Positioning System (GPS)
3. ADCP interface
4. ARGOS satellite telemetry

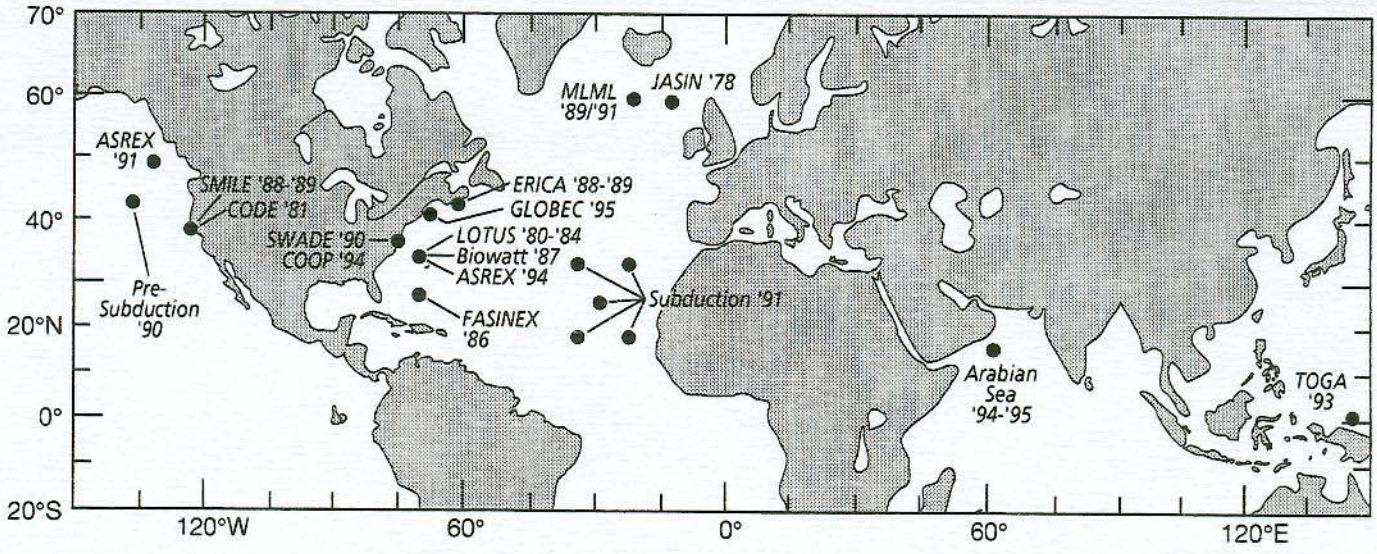

Figure 1 – Buoy Locations

The IMET architecture is built around an **addressable digital data bus.** Each sensor is housed in a separate intelligent module that includes all of the sensor specific functions and that communicates with a central controller (PC, laptop, or any computer that has a serial port), via RS485 in an ASCII protocol. The units are calibrated prior to an experiment and the calibration constants are stored in the module (EEPROM) so that all data is in calibrated engineering units. A post-experiment calibration is carried out to determine any drift (very small on most units). Should a module have to be changed during an experiment, the new module is plugged in and outputs calibrated data. The concept permits adding multiple sensors of any type since each module is addressable. While averaging takes place within each module, the interrogation and storage of data are typically at a one minute rate.

Ship and buoy IMET systems are integrated systems that have one central data logger and power supply, as well as interface to a satellite transmitter for real time data recovery. VOS modules are designed for ease of carry-on installation on ships that cannot have permanently installed cables and central computers. The VOS units are self powered (6 months on an 8 D-cell battery) and self recording (on a 4 megabyte flash card, at the one minute rate). The size of a VOS unit is about the same as an IMET unit.

IMET systems have been used on surface buoys for the following programs:

Subduction, 1991-1992; Coare, 1992-93; ASREX, 1992-93; GLOBEC, 1995; and Arabian Sea, 1994-95. Figure 1 shows the locations of various UOP buoy moorings. The MLML mooring and the Arabian Sea moorings are in severe weather locations. IMET systems are currently installed on the following research ships: *Oceanus*, *Knorr* (AGOR 15), *Thompson* (AGOR 23), *Melville* (AGOR 14), *Blue Bird*, and *Seward Johnson*. VOS modules are currently installed on the VOS *California Star*. Rutgers University has an IMET system installed on an offshore data collection platform with fiber-optics link to shore.

The success of the UOP group in obtaining high quality data and contributing significantly to the understanding of upper ocean processes is based on being a team of highly skilled people working together in a process of continual improvement. Each of the areas of expertise (science and analysis, management and planning, engineering design, system and instrument preparation, instrument calibration, field operations, and data processing) is critical to the success of the combined effort. The attention to detail at each step of the process, from initial planning right up through the full system "burn-in" prior to any deployment, has resulted in successfully meeting our goals.

ACKNOWLEDGMENTS

Development of the IMET system was supported by NSF Grant OCE-8709614 from the National Science Foundation, Ocean Science Division as part of the Long-Lead Time Development Activity for the World Ocean Circulation Experiment. The VOS development was supported by the National Oceanic and Atmospheric Administration - Office of Global Programs through the Lamont/Scripps Consortium for Climate Research.

REFERENCES

"The IMET (Improved METeorology) Ship and Buoy Systems" by D. Hosom, R. Weller, R. Payne and K. Prada, published in the *Journal of Atmospheric and Oceanic Technology*, Vol 12, No. 3, June 1995.

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

Published by the Upper Ocean Processes Group, Woods Hole Oceanographic Institution, Woods Hole MA 02543-1542.
Contact: Rick Trask, ext. 2395. Design by Jeannine Pires, WHOI Graphics

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