

**Continuation of the ALTOMOOR Mooring Program
(Now Referred to as the Bermuda Testbed Mooring Program)**

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LONG-TERM GOAL

The long-term goal of the Bermuda Testbed Mooring (BTM) Program is to provide a reliable platform in the deep ocean for instrumentation testing and development.

OBJECTIVES

Our objectives for the BTM are to provide mooring design, fabrication and operations support for ongoing instrumentation development and related environmental measurements. The tasks required to meet these objectives include building replacement moorings, leading the field operations, organizing the cruise logistics, and working closely with other researchers who are using or plan to use the platform.

APPROACH

Figure 1 shows the most recent mooring configuration for the BTM. Our technical approach involves mooring turnarounds at 4-month intervals with yearly replacement of all mooring hardware. The mooring itself is a semi-taut surface design where the nylon section located below 2000m provides compliance for wave and current forces. The mooring is retrieved on each turnaround and returned to the Bermuda Biostation for instrument maintenance. A new anchor is used on each deployment.

WORK COMPLETED

1. We recovered the Bermuda Testbed Mooring on November 20, 1997 and refurbished the instruments at the Bermuda Biostation.
2. The refurbished BTM with the instrument payload shown in Figure 1 was deployed on November 26, 1997. M. Tabacco's new CO₂ sensor was mounted beneath the surface buoy for its initial open ocean trial. This addition included adding solar panels, rechargeable batteries, and Argos telemetry as well as the instrument itself.

Report Documentation Page

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3. L. Merlivat of LODYC connected her CARIOCA CO₂ measuring surface buoy to the BTM via a surface tether for a second trial.
4. The BTM was recovered on March 31, 1998.
5. We attempted to re-deploy the BTM in August 1998, but bad weather forced us to postpone deployment until the first week of November 1998.

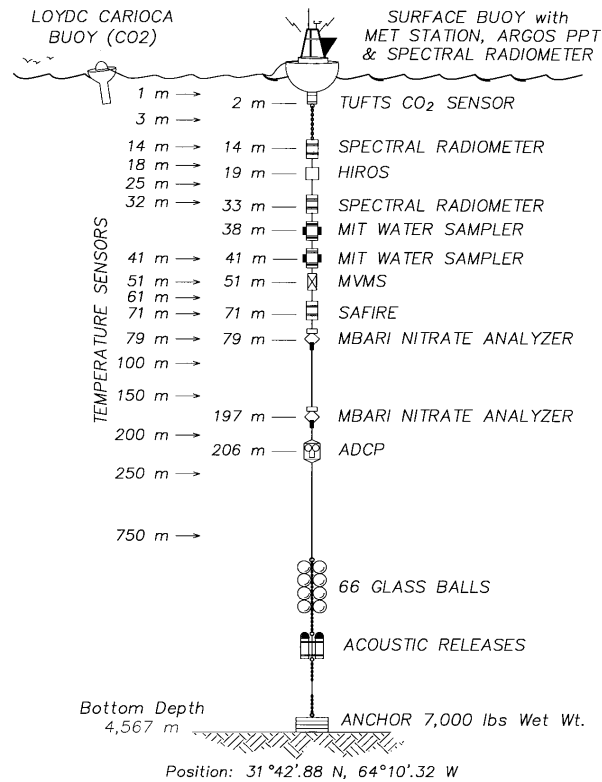


Figure 1. Bermuda Testbed Mooring configuration deployed November 26, 1997 through March 31, 1998

RESULTS

The BTM was on station from November 26, 1997 until March 31, 1998. It has been on shore since March 31 due to a combination of instrumentation maintenance requirements, ship scheduling problems, and bad weather. A deployment is scheduled for early November 1998 to cover the winter and early spring (1999) period.

IMPACT/APPLICATIONS

The BTM provides the means to test new instruments through long term use in the deep ocean and through comparison with other sensors and techniques. The list of instruments presently being evaluated on the mooring include the following:

- CARIOCA CO₂ sensor (second 1-month deployment)
- MIT Trace Metal Sampler (generations 1 and 2 – several years' deployments)

- MBARI Nitrate Analyzers (several instruments for several years)
- UCSB Bioptical Sensor Systems (several year's deployments of several sensor systems)
- Tufts CO₂ sensor(1 deployment)

TRANSITIONS

Various scientists are using the data collected from the BTM for both instrumentation development and for science programs[1]. The instrumentation investigators include:

- Dr. Thomas Dickey of the University of California Santa Barbara has been funded under a NSF grant to use the BTM for testing a variety of new bioptical instruments. He has installed ten or more instruments on each deployment.
- Dr. Dickey is also using the mooring as a platform for NASA-funded radiometry measurements in support of satellite ground-truth measurements.
- Dr. Hans Jannasch of the Monterey Bay Aquarium Research Institution (MBARI) is conducting long-term tests of his osmotic pump nitrate analyzers. These instruments pump seawater slowly through a measurement and calibration line to collect time series data.
- Dr. Ed Boyle of MIT has deployed 2 generations of trace metal samplers on the BTM.
- Dr. L. Merlivat, Laboratoire D'Océanographie Dynamique et de Climatologie (LODYC) has conducted a second deployment of her CARIOCA CO₂ measurement system. This instrument, mounted in a separate surface buoy, is tethered to the BTM via a floating cable. It has gone adrift after about 1 month in both deployments to date. Dr. Merlivat is planning a third deployment using a different mooring configuration.
- Dr. M. Tabacco deployed her new CO₂ sensor on the BTM in November 1997. The system worked, but it was removed following the BTM recovery in March 1998 for modification.

REFERENCES

- [1] T. Dickey, D. Frye, H. Jannasch, E. Boyle, and A. Knap, 1997: "Bermuda sensor system testbed," *Sea Technology*, Vol. 38, No. 4, April, pp. 81-86.

PUBLICATIONS

von der Heydt, K., Frye, D. and Johnson, M., 1998: "A moored system for data telemetry and control of autonomous underwater vehicles," to be published in the *Proceedings of the Ocean Community Conference*, Baltimore, Nov.

Paul, W., 1998: ONR/MTS Buoy Workshop - Summary, Abstracts, & Attendees, WHOI publication, October, 20p.

Dickey, T., Frye, D., Jannasch, H., Boyle, E., Manov, D., Sigurdson, D., McNeil, J., Stramska, M., Michaels, A., Nelson, N., Siegal, D., Chang, G., Wu J., and Knap, A., 1998: "Initial results from the Bermuda Testbed Mooring program," *Deep Sea Research*, I, 45, pp. 771-794.

Dickey, T., Frye, D., McNeil, J., Manov, D., Nelson, N., Sigurdson, D., Jannasch, H., Siegel, D., Michaels, T., and Johnson, R., 1998: "Upper ocean temperature response to Hurricane Felix as measured by the Bermuda testbed mooring," *Monthly Weather Review*, Vol.126, pp.1195-1201.