

Low Cost Modular Telemetry For Coastal Time-series Data

Bradford Butman
Woods Hole Field Center
U.S. Geological Survey
384 Woods Hole Road
Woods Hole, MA 02543-1598
phone: (508) 457-2212 fax: (508) 457-2309 email: bbutman@usgs.gov

Daniel E. Frye
Department of Applied Ocean Physics and Engineering
Woods Hole Oceanographic Institution
Woods Hole, MA 02543
phone: (508) 289-2759 fax: (508) 457-2154 email: dfrye@whoi.edu
N00014-98-1-0816

W. Rockwell Geyer
Department of Applied Ocean Physics and Engineering
Woods Hole Oceanographic Institution
Woods Hole, MA 02543
phone: (508) 289-2759 fax: (508) 457-2194 email: rgeyer@whoi.edu

LONG-TERM GOALS

Our goal is to develop and demonstrate a low-cost system for retrieving oceanographic data from instruments in the coastal ocean and delivering these data in near real time. This work is conducted under the National Ocean Partnership Program with Federal, State, Academic and private industry participation and funding.

OBJECTIVES

We wish to develop and demonstrate a low-cost modular system for telemetering oceanographic data ashore. The system consists of 4 components: (1) a low-cost, medium bandwidth acoustic data link from oceanographic instruments below the surface to a surface buoy; (2) an acoustic modem/RF link to receive the acoustic transmissions and telemeter data to shore; (3) a buoy system for deployment of the acoustic modem/RF link, and (4) a system for distributing the data over the World Wide Web.

APPROACH

Our conceptual approach is to use very low cost, low power acoustic transmitters which are capable of transmitting data from many sensors located on a mooring line or on the bottom in the vicinity of a surface buoy (figure 1). These acoustic transmitters are small, inexpensive, and low power, except during the brief periods during which they burst data at 2000 - 4000 b/s. They operate in the 30-40 kHz band in a random access mode. The receive system, located at the surface buoy, consists of a Utility Acoustic Modem integrated directly with an RF telemetry link capable of providing high-reliability, medium bandwidth connection to shore. In this work a line-of-sight RF link, capable of operating over

Report Documentation Page				Form Approved OMB No. 0704-0188	
Public reporting burden for the collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to a penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number.					
1. REPORT DATE 1998		2. REPORT TYPE		3. DATES COVERED 00-00-1998 to 00-00-1998	
4. TITLE AND SUBTITLE Low Cost Modular Telemetry for Coastal Time-series Data				5a. CONTRACT NUMBER	
				5b. GRANT NUMBER	
				5c. PROGRAM ELEMENT NUMBER	
6. AUTHOR(S)				5d. PROJECT NUMBER	
				5e. TASK NUMBER	
				5f. WORK UNIT NUMBER	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) U.S. Geological Center, Woods Hole Field Center, 384 Woods Hole Rd, Woods Hole, MA, 02543-1598				8. PERFORMING ORGANIZATION REPORT NUMBER	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)				10. SPONSOR/MONITOR'S ACRONYM(S)	
				11. SPONSOR/MONITOR'S REPORT NUMBER(S)	
12. DISTRIBUTION/AVAILABILITY STATEMENT Approved for public release; distribution unlimited					
13. SUPPLEMENTARY NOTES See also ADM002252.					
14. ABSTRACT					
15. SUBJECT TERMS					
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT Same as Report (SAR)	18. NUMBER OF PAGES 4	19a. NAME OF RESPONSIBLE PERSON
a. REPORT unclassified	b. ABSTRACT unclassified	c. THIS PAGE unclassified			

6 - 20 miles, depending on the height of the shore-based receive station, will be utilized for simplicity. Onshore, the data will be distributed over the world wide web. The system will be demonstrated by transmitting Acoustic Doppler Current Profiler (ADCP) data from two long-term monitoring sites in Massachusetts Bay (figure 2). At the site offshore of Boston, the UAM/RF link will be deployed on an existing Coast Guard Navigation Buoy. At the site offshore of Scituate, the UAM/RF link will be deployed on a stand-alone research buoy. These two deployment platforms will provide two options for deployment of the system in the coastal ocean.

The project is carried out as part of the National Ocean Partnership Program (NOPP). It is conducted cooperatively with the U.S. Geological Survey (USGS), Woods Hole Oceanographic Institution (WHOI), RD Instruments (RDI), the Massachusetts Water Resources Authority (MWRA), and the U.S. Coast Guard (USCG).

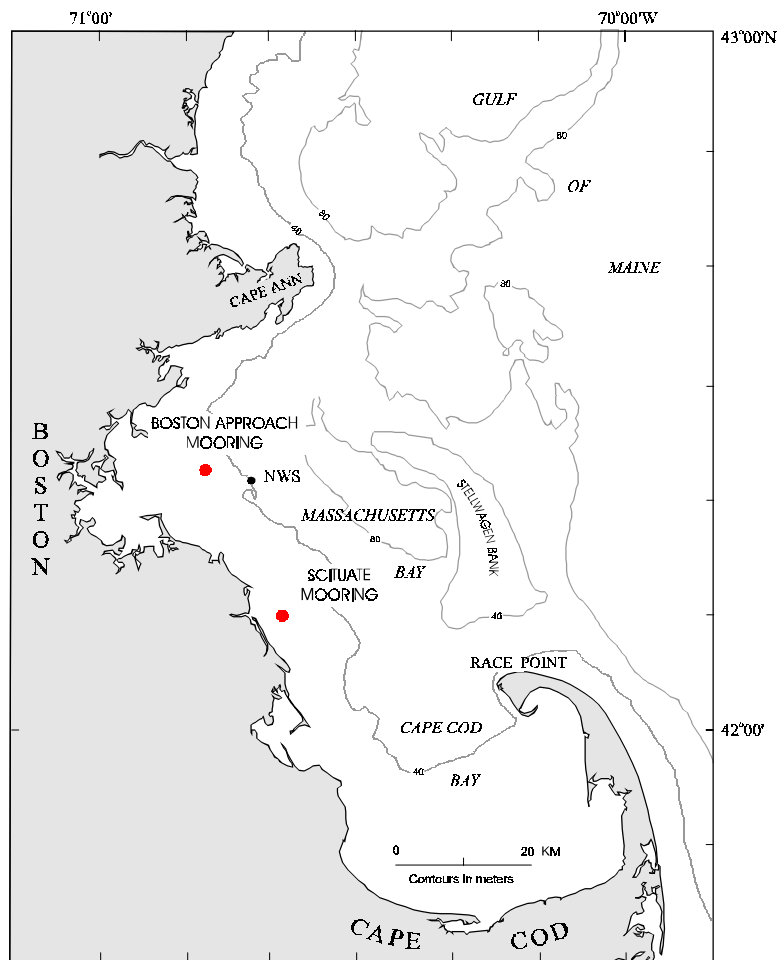


Figure 1: The acoustic telemetry system will be tested at two long-term monitoring stations in Massachusetts Bay, one at the Boston Approach 'B' Buoy (30 m water depth) and one offshore of Scituate, Massachusetts (20 m water depth).

Our project involves 5 tasks:

Task 1: Acoustic and RF telemetry

Task 1a: Design low-cost transmit-only acoustic link (Year 1, WHOI)

Task 1b: Design for the UAM/RF link (Year 1, WHOI)

Task 1c: Low cost transmitter integrated with the ADCP (Year 1 WHOI and RDI)

Task 2: Buoy deployment systems

Task 2a: Design low-cost surface mooring (Year 1, WHOI)

Task 2b: Design system for deploying the UAM/RF link on a Coast Guard Buoy (Year 1, USGS, USCG, WHOI)

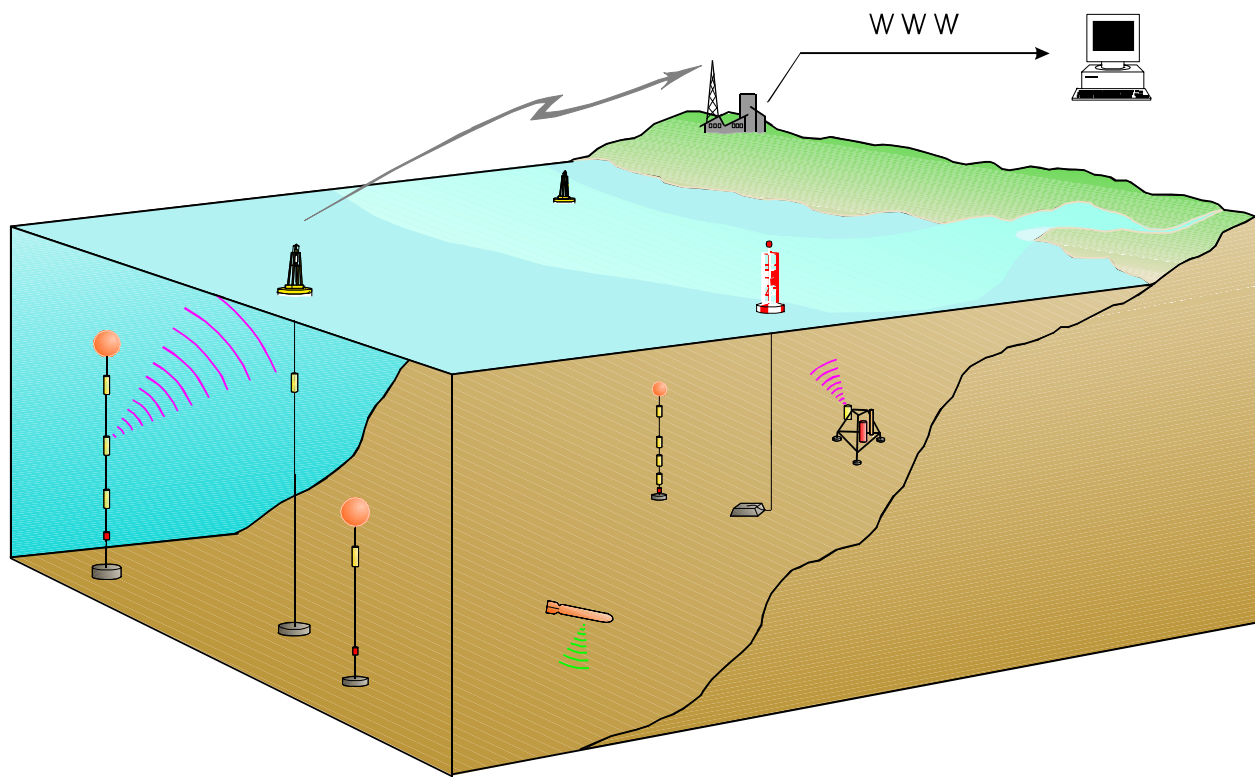


Figure 2: Schematic diagram showing operation of low-cost acoustic telemetry system for retrieving coastal time-series data in near real time. Instruments are deployed within approximately 2 km of a surface buoy and transmit data to a Utility Acoustic Modem (UAM) mounted on the buoy. The data are immediately re-transmitted to shore via RF telemetry (line-of-sight radio, satellite or cell phone) and further distributed over the World Wide Web (WWW). Sensors may be added or removed from the instrument array and the data are automatically added to the data stream without modification to the surface buoy. The low cost telemetry and buoy system provides the potential for distributed arrays capable of monitoring the coastal ocean in near real time on space and time scales as needed.

Task 3: Distribution of data

Task 3a: Develop software to receive data from the RF link and distribute it in real time via the Web (Year 1, WHOI, USGS)

Task 3b: Distribute data over the Web during the field demonstration (Year 2, WHOI, USGS)

Task 4: Demonstration

Task 4a: Demonstrate transmission of ADCP data from USGS/MWRA Scituate site using low-cost buoy as the surface platform (two 4 month deployments) (Year 2, WHOI, USGS, RDI)

Task 4b: Demonstrate transmission of ADCP data from USGS/MWRA long-term mooring utilizing Coast Guard Navigation buoy as the surface platform (two 4-month deployments) (Year 2, USGS, USCG, WHOI, RDI)

Task 5: Document results (Year 2, WHOI, USGS, RDI)

WORK COMPLETED

Design of coastal telemetry mooring

At sea tests of 3 prototype telemetry moorings conducted as part of the AOSN Cape Cod test cruise.

Utility Acoustic Modem (UAM) and RF modem integrated for real time applications.

RESULTS

At-sea tests of the prototype coastal telemetry mooring clearly showed the utility of the concept. The moorings were inexpensive, easy to deploy, and provided reliable acoustic and RF connections between the ship, the moorings and in some instances an autonomous underwater vehicle (AUV). Several shortcomings in the design were noted and the necessary modifications will be incorporated into the NOPP systems which are under construction now.

IMPACT/APPLICATIONS

The development of the low cost systems has the potential to provide observations from distributed arrays with multiple sensors on a wide variety of spatial scales. Such observations are needed to resolve key processes, for ocean prediction, to aid in developing optimal sampling strategies (particularly for coupled physical and biological studies), and for long-term monitoring.