# SFOMC Task I: Oceanographic and Environmental Measurements (Environmental Array and Data Analysis, Year 4)

Alexander V. Soloviev
Oceanographic Center
NOVA Southeastern University
8000 North Ocean Drive
Dania Beach, FL 33004
phone: (954) 262-3659 Fax: (954) 262-4098 Email: soloviev@nova.edu

Robert H. Weisberg
College of Marine Science
University of South Florida
140 Seventh Ave S.
St. Petersburg, FL 33701
phone: (727) 553-1568 fax: (727) 553-1189 Email: weisberg@marine.usf.edu

Mark E. Luther
College of Marine Science
University of South Florida
140 Seventh Ave S.
St. Petersburg, FL 33701
phone: (727) 553-1528 fax: (727) 553-1189 Email: luther@marine.usf.edu

Grant #: N00014-02-1-0950

## LONG-TERM GOAL

The long-term goal of the project is to establish a real time physical oceanographic monitoring array for environmental data on the SFOMC Dania FL range that is necessary to support Marine Vehicle Tests and to assist with interpreting ocean acoustics experiments. In addition, the array will provide a test bed for the development of new technologies, and it will form a node in a larger, regional scale integrated coastal ocean observing system. This environmental data will also be valuable for understanding a variety of scientific questions that are important for the operation of an Acoustic Observatory that is to be built in the vicinity of the SFOMC Dania Beach, FL range during the next several years and for the conduct of fleet battle experiments.

## OBJECTIVES

Our continuing objectives are to further develop and maintain an environmental array for the purposes of: (1) Supporting Marine Vehicle Demonstrations, acoustic experimentation needs, and other ONR-funded efforts; (2) Continuing the real-time collection, archiving, and distribution of long time series to characterize the seasonal cycle and the seasonally modulated synoptic scale variability that determines the background environmental conditions for the SFOMC range; (3) To perform analysis of

# Report Documentation Page

*Form Approved*
*OMB No. 0704-0188*



| 1. REPORT DATE | 2. REPORT TYPE | 3. DATES COVERED |
|---|---|---|
| **30 SEP 2002** | | **00-00-2002 to 00-00-2002** |

| 4. TITLE AND SUBTITLE | 5a. CONTRACT NUMBER |
|---|---|
| **SFOMC Task I: Oceanographic and Environmental Measurements (Environmental Array and Data Analysis, Year 4)** | 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) **Oceanographic Center,NOVA Southeastern University,,8000 North Ocean Drive,,Dania Beach,,FL, 33004** | 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

14. ABSTRACT

**The long-term goal of the project is to establish a real time physical oceanographic monitoring array for environmental data on the SFOMC Dania FL range that is necessary to support Marine Vehicle Tests and to assist with interpreting ocean acoustics experiments. In addition, the array will provide a test bed for the development of new technologies, and it will form a node in a larger, regional scale integrated coastal ocean observing system. This environmental data will also be valuable for understanding a variety of scientific questions that are important for the operation of an Acoustic Observatory that is to be built in the vicinity of the SFOMC Dania Beach, FL range during the next several years and for the conduct of fleet battle experiments.**

15. SUBJECT TERMS

| 16. SECURITY CLASSIFICATION OF: | | | 17. LIMITATION OF ABSTRACT | 18. NUMBER OF PAGES | 19a. NAME OF RESPONSIBLE PERSON |
|---|---|---|---|---|---|
| a. REPORT **unclassified** | b. ABSTRACT **unclassified** | c. THIS PAGE **unclassified** | **Same as Report (SAR)** | **6** | |

the data collected in collaboration with other SFOMC investigators; and (4) To work toward the development of a node for a larger scale integrated coastal ocean observing system.

APPROACH

NSU and USF maintain a mooring array as a part of SFOMC. The array consists of surface and bottom moorings with acoustic Doppler current profilers (ADCP) and a combination of inductively coupled and/or self-recording temperature/salinity sensors. A meteorological tower is deployed on the seaward end of the Dania Beach Pier. The Environmental Array, deployment schemes, and data acquisition software are developed at the USF College of Marine Science and the NSU Oceanographic Center. The bottom instruments work in a self-recording mode (pending connection to the SFTF/FAU MUX) while the surface moorings transmit real time data via spread-spectrum radios. The surface moorings are monitored through the ARGOS satellite network.

**WORK COMPLETED**

This project is a new start late in FY 02 (1 September 2002). In September 2002, we worked on the implementation of our project into the SFOMC acoustic experiment. During the new phase of SFOMC (Year 4), Environmental Array will have up to three elements: moorings at the 11m and 40m isobaths and a meteorological station at Dania Pier (Fig. 1).

The surface mooring (to be deployed tentatively at a 40-m isobath) will contain a downward looking ADCP instrument, which will provide the current velocity profile with a 1-m vertical resolution. The inductively coupled SBE MicroCat instruments (temperature and conductivity) will be installed at several depths between the near surface and near bottom. These T/S measurements are critical environmental monitoring components, and they are the only real time T/S measurements planned for the range. The meteorological station at the Dania Pier consists of tower, Coastal Climate weather pack (wind speed, direction, atm. pressure, air temperature, relative humidity, and rain), and a solar powered data acquisition and transmission system using Spread Spectrum radios.

The 11-m isobath bottom mooring contains an upward looking ADCP and SBE Wave Gauge. The ADCP provides current profile with a 0.5-m depth resolution; the Wave Gauge instrument measures temperature, conductivity, sea level, significant wave height, and surface wave spectrum. This mooring is designed to transmit data via the FAU MUX and also stores data internally.

For the purposes of supporting Marine Vehicle Tests, acoustic experimentation, technology development, and other ONR projects, these elements will all telemeter data in real time. The surface mooring does this via spread-spectrum radio. We would prefer to keep the 11-m isobath mooring on the same fixed location to provide continuity of the data set that has been collected with this mooring since June 1999. The bottom mooring will be modified as originally intended for connection to the FAU MUX. The location of the mooring array during the SFOMC Year 4 is now in the process of adjustment according to the needs of the SFOMC acoustic experiment.

Along with maintaining the array we will engage in scientific analyses of the data collected. These analyses will be collaborated with other SFOMC investigators and will help to understand the acoustic communication channel variability in the SFOMC Range.

## RESULTS

The SFOMC data sets for the time period 1999-2002 clearly demonstrate that the characteristic feature of the coastal circulation on the shelf off southeast Florida is a strong baroclinic velocity fluctuation, sometimes exceeding 0.5 m/s. The spectral analysis has shown that a 10-hr time period dominates during these energetic events (Luther et al., 2001; Soloviev et al., 2002). This high-energy fluctuation is modulated inter-annually, seasonally as well as on a shorter time scale (Fig. 2). The data appears to be consistent at least in the general features with the Stommel's hypothesis of a resonant cross-stream semidiurnal internal seiche in the channel between Florida and Bahamas (Stommel, 1965); Niiler, 1968). During the winter months, the baroclinic component of velocity signal weakens. The modulation on the seasonal time scale can be explained by the dependence of the channel resonant properties on the stratification and position of Gulf Stream. The stratification is also affected by spin off eddies (Lee and Mayer, 1977; Shay et al.., 2000), which modulate the density stratification over the shelf and shelf break, thereby modulating the 10-hr velocity oscillation on shorter time scales.

## IMPACT/APPLICATION

The experimental approach described herein was conducted to support the SFOMC field work and to collect a complete seasonal cycle for describing western boundary current/continental shelf interactions, including extreme conditions during hurricanes (Soloviev et al., 2000). Detailed study of environmental parameters is important for modeling and prediction of the coastal circulation on the shelf off southeast Florida. The large amplitude super-tidal baroclinic oscillation found in this area during the summer months affects marine acoustics and navigation in the area. The cross-shelf exchange of pollutants and biological species also depends on this high-energy oscillation.

## REFERENCES

Lee, T. N. and D.A. Mayer, 1977: Low-frequency current variability and spin-off eddies along the shelf off Southeast Florida. *Journal of Marine Research*, **35**, 193-220.

Luther, M E., Soloviev, A.V., and R.H. Weisberg, 2001: Internal Tides Doppler-Shifted by Gulf Stream. The Oceanography Society Meeting, 2-5 April 2001, Miami Beach, Florida USA. Abstract published in *Oceanography*, 14, No. 1, p. 35

Niiler, P.N., 1968: On the internal tidal motion in the Florida Straits, *Deep-Sea Research*, **15**, 113-123.

Shay, L. K., T. M. Cook, B. K. Haus, J. Martinez, H. Peters, J. VanLeer, A. J. Mariano, P. E. An, S. Smith, A. Soloviev, R. Weisberg, and M. Luther, 2000: VHF Radar detects submesoscale vortex along the Florida Coast. *EOS*, **81**, *209-213*.

Soloviev, A., M. Luther, and R. Weisberg, 2002: Energetic super-tidal oscillation on the shelf off southeast Florida, *Geophysical Research Letters* (manuscript for submission)

Soloviev, A.V, R.H. Weisberg, and M. Luther, 2000: Response of the Coastal Ocean to Hurricanes Floyd and Irene at the South Florida Ocean Measurement Center, In *Proceedings of the 24th Conference on Hurricanes and Tropical Meteorology,* American Meteorological Society, 45 Beacon Street, Boston, Massachusetts, USA, J64-65.

Stommel, H., *The Gulf Stream—a physical and dynamical description*, p. 68, University of California Press, Berkley, 1965, 248 pp.

**PUBLICATIONS**

Shay, L/K., T.M. Cook, H. Peters, A.J. Mariano, R. Weisberg, P.E. An, A. Soloviev, and M. Luther, 2002. “Very High-Frequency Radar Mapping of surface Currents”, *IEEE Journal of Oceanic Engineering*, 27(2), 155-169.

Luther, M.E., Weisberg, R.H., and A.V. Soloviev, 2002. “Internal Tides on the Shelf off Southeast Florida”, Abstract for 2002 Ocean Sciences Meeting, 11-15 February 2002, Honolulu, Hawaii. *Eos, Transactions, American Geophysical Union*, v. 83, No. 4, 22 January 2002, S275.

Soloviev, A.V., Thompson, T.L., Nemeth, L., Campbell, C.B. Weisberg, R. H., Luther, M. E., Cole, R. and J. Donovan, 2001. “Data Report, NSU Oceanographic Center and College of USF Marine Science”, Report #2001-1 (published by NOAA as a CD, including the data report and the data base).


***Figure 1. The NSU/USF Environmental Array in the SFOMC experimental range during Year 4. Here: W is the west (bottom) mooring, E the East Mooring, and P the Dania Pier meteorological station.***

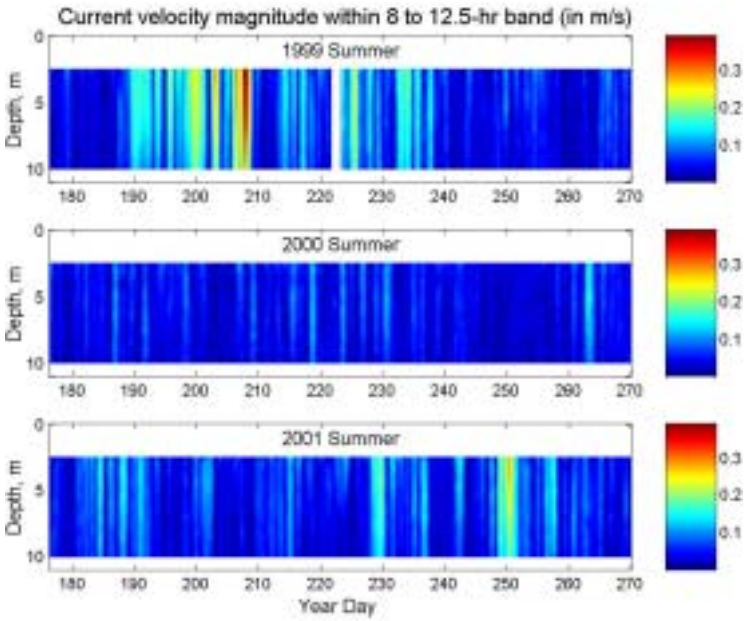


***Figure 2. Current velocity magnitude near semidiurnal time period (NW bottom mount at 11-m isobath)***