

SHELFBREAK PRIMER: SLOPEWATER CIRCULATION AND WATER MASSES

Robert S. Pickart
Physical Oceanography, MS #21
Woods Hole Oceanographic Institution
Woods Hole, MA 02543
Phone: (508) 289-2858 Fax: (508) 457-2181 Email: rpickart@whoi.edu
Award Number: N00014-95-1-0575

LONG-TERM GOALS

The overall aim of the PRIMER slopewater component is to quantify the circulation of the slopewater and elucidate its role in forcing the shelfbreak jet. This will in turn help clarify the factors governing the propagation of sound from the continental slope to the shelf.

OBJECTIVES

The main objectives are (1) to determine the mean and seasonally varying currents and water-mass structure in the mid-Atlantic Bight, and (2) to investigate the nature of the mesoscale variability — in particular to better understand the coupling between the slopewater currents and shelfbreak circulation.

APPROACH

A field program was undertaken to obtain long-term moored measurements in the slopewater and adjacent shelfbreak, supplemented by repeat hydrography. This was to be done over a two-year period. During this period two intense studies were done by the entire PRIMER group. These included high-resolution SEASOAR surveys (shelfbreak group) and short-term acoustical moored arrays (acoustics group). Both AVHRR and altimeter data have been archived over the entire two-year period (remote sensing group).

WORK COMPLETED

The long-term slopewater moored array was set in December, 1995 and will be recovered in December, 1997 (Figure 1). This array consists of three tall VACM moorings (15 instruments) spanning the continental slope. Inshore of this two upward-looking bottom-mounted ADCPs were set in the shelfbreak current in December, 1995 and retrieved in February, 1997. (Although originally scheduled to be out for two years, these two instruments were recovered after 15 months because of continued difficulty due to fishing activity.) The moored ADCP data are currently being processed. Throughout the PRIMER field experiment hydrographic measurements have been taken along the mooring line (which also corresponds to a TOPEX altimetric sub-track, Figure 1). As of December, 1997 the shelfbreak portion of the line will have been occupied seven times, and the slope portion five times. A NBIS Mark-III has been used for all occupations, calibrated with bottle salinity measurements for the deep stations. A lowered ADCP attached to the CTD frame has measured velocity on the slope stations. The processing/calibration of the CTD data is presently in progress.

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 30 SEP 1997		2. REPORT TYPE		3. DATES COVERED 00-00-1997 to 00-00-1997	
4. TITLE AND SUBTITLE Shelfbreak Primer: Slopewater Circulation and Water Masses				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) Woods Hole Oceanographic Institution, Department of Physical Oceanography, Woods Hole, MA, 02543				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					
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			

RESULTS

Although the moored array is still in the water and some of the CTD data are still being processed, we have analyzed the shelfbreak hydrography from the first PRIMER cruise in December, 1995. A manuscript resulting from this work has been submitted. Two highly resolved surveys were made across the shelfbreak jet during the deployment of the moored array, separated by three days. These sections respectively sampled the convergent and divergent phases of a shelfbreak meander (Figure 2). The flow field measured by the shipboard ADCP is consistent with that seen in models of baroclinic jets (*e.g.*, Spall, 1997) and with observations taken in the Gulf Stream (*e.g.*, Rossby and Hummon, 1997). Using surface thermal imagery we determined that the meander of the shelfbreak jet steepened due to the influence of a nearby Gulf Stream ring. One of the unique aspects of this study is that we quantitatively compared the fully non-linear ADCP fields with the thermal wind signal from the hydrography, thereby determining the downstream dynamical balances.

IMPACT

Future work will include using the mooring data to help address the coupling between the shelfbreak jet and slopewater circulation (such as the ring/jet event observed during the first PRIMER cruise). This will ultimately help us understand better the variability and dynamics of the shelfbreak jet, and hence the propagation of sound across it.

TRANSITIONS

The shelf and deep-slope hydrographic data are available to the other components of the PRIMER experiment. So far the summer 1996 data have been used by the acoustics group to aid in their propagation studies.

RELATED PROJECTS

The shelfbreak PRIMER is a multi-disciplinary program involving numerous PIs from different institutions. One of the premises of the experiment is that the shelfbreak jet does not evolve in isolation, but is strongly influenced by the adjacent slopewater circulation. At the same time the acoustics associated with the jet are strongly influenced by the physical oceanography. Consequently, the field experiment contained numerous related projects. There are also several modeling studies within PRIMER using both regional and idealized numerical models.

REFERENCES

- Hummon, J. and T. Rossby, 1997. Spatial and temporal evolution of a Gulf Stream crest-warm core ring interaction. *Journal of Geophysical Research*, submitted.
- Spall, M. A., 1997. Baroclinic jets in confluent flow. *Journal of Physical Oceanography*, **27**, 1054–1071.

Shelfbreak PRIMER

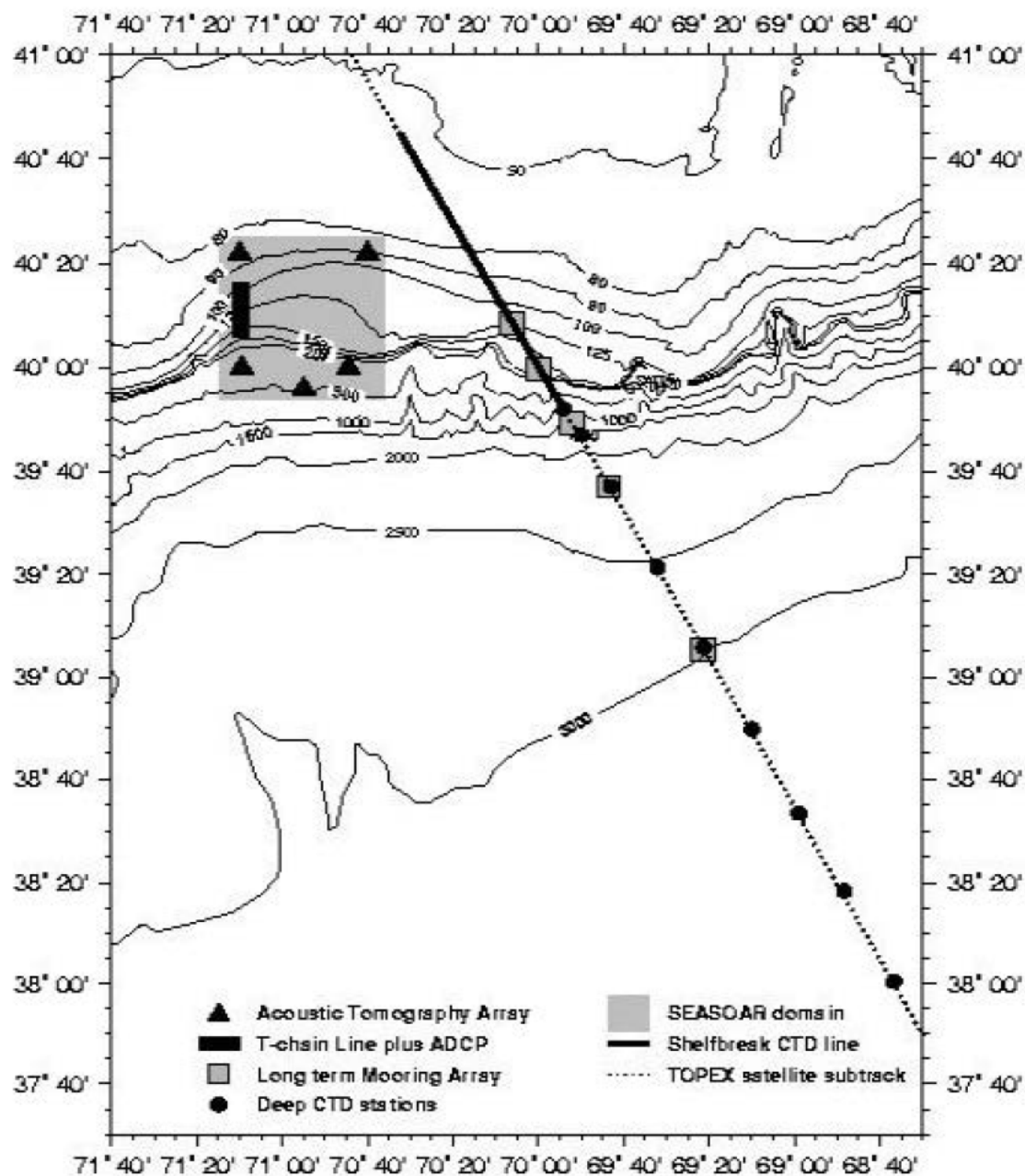


Figure 1: Fieldwork components of the Shelfbreak PRIMER.

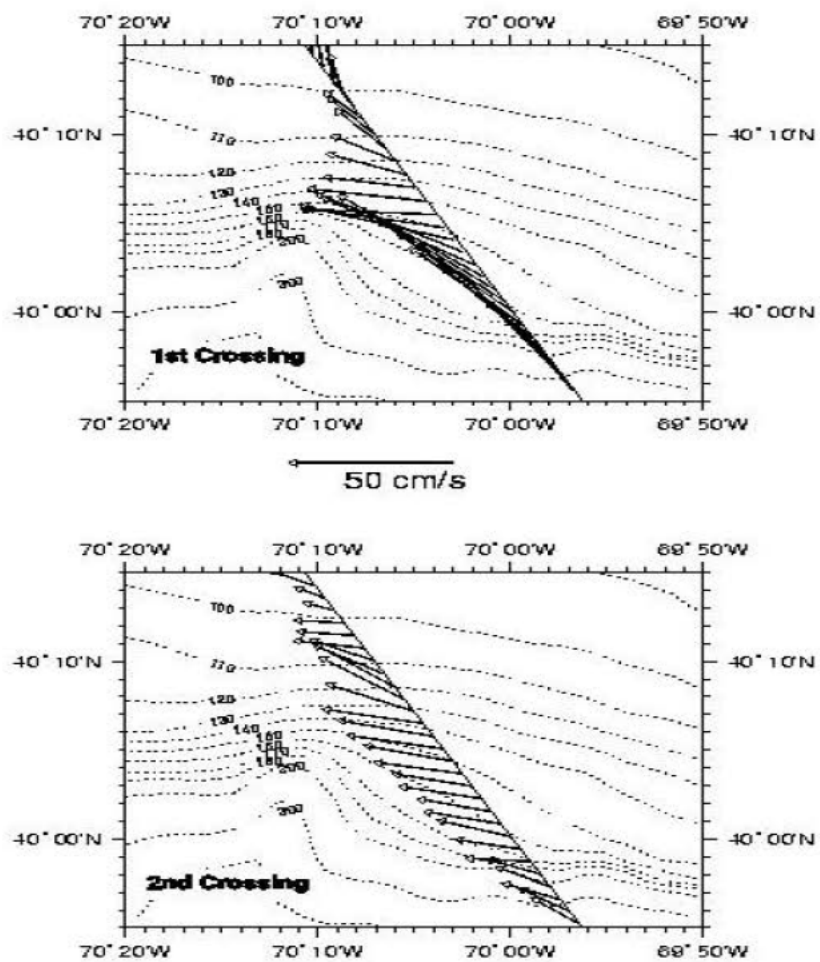


Figure 2: Depth-Integrated velocity of the shelfbreak current during the first **PRIMER** cruise (from the shipboard **ADCP**). The two sections are separated by three days, and sampled two different phases of a meander.