

SHELFBREAK PRIMER: SHELFBREAK FRONTAL STRUCTURE FROM SEASOAR

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LONG-TERM GOALS:

The overall goal of the Shelfbreak PRIMER frontal component is to investigate the physical variability of the shelfbreak front during both winter and summer stratification in order to understand better the oceanographic environment through which sound propagates between the continental slope and shelf.

OBJECTIVES:

The primary objectives are to relate the shelfbreak frontal variability to the forcing mechanisms such as offshore ring motions and wind stress, under the influence of the seasonally-varying stratification.

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APPROACH:

An integrated physical oceanography/shallow water acoustics field program was conducted during both summer and winter. This involved several different components which included intensive hydrography using SEASOAR (the frontal component), deep hydrography and mooring array (slope component), modeling, acoustic propagation and tomography studies, and remote sensing. The SEASOAR frontal effort included two intensive hydrographic surveys during July/August, 1996, and February, 1997.

WORK COMPLETED:

The winter field program was conducted during February, 1997. The SEASOAR operations consisted of six days of sampling between the 90 m and 300 m isobaths in a grid pattern. During the cruise, despite difficult weather and sea conditions, we were able to obtain 14 cross-frontal sections along with five partial sections.

In addition, two long alongshelf sections at the 100 m and 500 m isobaths were also sampled. The SEASOAR and ADCP data sets from this cruise has been processed and calibrated. Both processing and analysis of the summer SEASOAR and ADCP data sets have also been proceeding; both data sets have been calibrated and processed and three-dimensional maps of the temperature, salinity, and density fields have been computed.

A manuscript describing the climatological structure of the front (Linder and Gawarkiewicz, 1997) has been submitted, and a paper describing an unusual slope intrusion onto the shelf has been published (Gawarkiewicz *et al.*, 1996).

RESULTS:

To date, the summer data set has been examined more closely and has shown several surprises. First, the frontal jet which was anticipated from previous studies (*e.g.*, Linder and Gawarkiewicz, 1997) was present throughout the seven days of SEASOAR sampling, but was highly variable in both strength and position. While the jet had a peak velocity of 0.5 m/s at the beginning of the study (Figure 1), this decreased to 0.3 m/s by the end of the seven days, partially due to the offshore deflection of the jet. Second, the jet had a sub-surface maximum at depths of 30 to 40 m during several of the days due to reversing onshore-offshore pressure gradients between the surface mixed layer and the underlying frontal zone. This contrasts with the jet structure suggested by the climatological study of Linder and Gawarkiewicz (1997), who found a surface-trapped jet during the summer. The winter data set shows the influence of offshore Ekman transport in driving shelf water across the front and out over the continental slope (Figures 2 and 3). This suggests that the wind forcing is an important element in cross-frontal exchange during the winter. In addition, a warm-core ring was present over the slope to the southeast of the study region, and appeared to drive a westward flow of slope water over the continental shelf just shoreward of the shelfbreak. The foot of the shelfbreak front was located well shoreward of the position occupied the previous summer, consistent with observations from the Coastal Mixing and Optics program.

IMPACT:

This work is expected to provide new insights into both frontal variability at the shelfbreak as well as the effect of this variability on sound propagation between the shelf and slope. An interesting implication will be the effect of the low frequency variations of both stratification and jet velocity structure on the development and structure of high frequency motions such as internal solitons which develop near the shelfbreak.

TRANSITIONS:

None.

RELATED PROJECTS:

Numerous interactions between the SEASOAR frontal component and the other components include effects of low frequency variability on soliton structure, variability of temperature/sound speed field on modeling of sound propagation, providing SEASOAR fields for initialization of numerical forecast models, and comparison of hydrographic structure with bioluminescence fields near the shelfbreak front (in conjunction with NRL-Stennis).

REFERENCES:

- Gawarkiewicz, G., C. Linder, J. F. Lynch, A. Newhall, and J. Bisagni, 1996. A surface-trapped intrusion of slope water onto the continental shelf of the mid-Atlantic bight. *Geophysical Research Letters*, **23**, 3763–3766.
- Linder, C., and G. Gawarkiewicz, 1997. A climatology of the shelfbreak front in the Middle Atlantic Bight. *Journal of Geophysical Research*, submitted.

FIGURE CAPTIONS:

Figure 1. A cross-shelf section of the alongshelf velocity at the shelfbreak during summer, 1996 south of New England. The frontal jet is centered at a depth of about 45 m at 40.08 North. Negative velocities are to the west, in m/s.

Figure 2. A cross-shelf temperature section at the shelfbreak during winter. Ekman transport during this time was onshore.

Figure 3. A cross-shelf temperature section at the same location as Figure 2 but 24 hours later. During this time interval, the winds switched such that there was strong offshore Ekman transport. Note the shelf water carried offshore in the surface mixed layer.