Eddy-Induced Cross-Slope Exchange in the Northwestern Gulf of Alaska

Sea surface height anomaly occurrence and evolution of Gulf of Alaska eddies and their influence on cross-slope exchange and phytoplankton distribution. However, the TOPEX satellite radar are the norm in the Gulf of Alaska, the SeaWifs sensor can not reliably provide a regularly-sampled, gulf-wide observational record with which to monitor the concentration acquired on 10 May 2000 during an extensive clearing of characteristically cloudy skies (nominal shelf break). The oblique solid 200 m isobath (nominal shelf break).

A time-longitude plot of the eight and one-half year record of TOPEX SSHAs show a SSHA dome (anticyclone and downwelling) centered at about 148°W (~100 km south of the end of the Seward Line). A trough (upwelling) in SSHAs occurs near the shelfbreak at ~149°W. The doming of the isohalines and the presence of a strong (~10 cm/s) eddy along the shelf break in the CTD data (Fig. 5c) show the influence of the shelfbreak front on the flow in this region. These adjustments coincide with the boundary of the shelfbreak front and offshore migration of shelf waters as suggested in Fig. 1 (cf. Lorier and Gawarkiewicz, 2001, for similar processes in the Mid-Atlantic Bight).

A comparison of SSHAs along 149°W and hydrography and geostrophic velocity sections along the Seward Line indicate that the observed mesoscale features influence the salinity and density structure along the shelfbreak and inner slope. The March SSHAs profiles (Fig. 5a) show a SSHA dome (anticyclone and downwelling) centered at about 148°W (~100 km to the south of the end of the Seward Line). A trough (upwelling) in SSHAs occurs near the shelfbreak at ~149°W. The doming of the isohalines and the presence of a strong (~10 cm/s) eddy along the shelf break in the CTD data (Fig. 5c) show the influence of the shelfbreak front on the flow in this region. These adjustments coincide with the boundary of the shelfbreak front and offshore migration of shelf waters as suggested in Fig. 1 (cf. Lorier and Gawarkiewicz, 2001, for similar processes in the Mid-Atlantic Bight).

The vertical dotted line at ~142.5°W identifies the location of the 200 m isobath (nominal shelf break). The slower moving features propagate at ~1.5 km/day and have a wavelength of ~100 km. These features appear to alter the shelfbreak velocity field and the structure of the shelfbreak front in a manner consistent with the theoretical work of Gawarkiewicz and Chapman [1992]; i.e. a decrease in the strength of the alongshelf flow should lead to onshore migration of the shelfbreak front and vice versa. These phenomena probably play an important role in the cross-shelf exchange of freshwater, nutrients, and organics. If so, interannual variations in their frequency of occurrence and seasonal phasing should be an important source of physical and biological variability for the shelf.

Conclusions:
- Our preliminary analysis suggests that these mesoscale features are accompanied by upwelling at their leading and trailing edges, with downwelling in the center in a similar manner similar to that described by Oguz et al. [1997]. These features appear to alter the shelfbreak velocity field and the structure of the shelfbreak front in a manner consistent with the theoretical work of Gawarkiewicz and Chapman [1992].
- These phenomena probably play an important role in the cross-shelf exchange of freshwater, nutrients, and organics. If so, interannual variations in their frequency of occurrence and seasonal phasing should be an important source of physical and biological variability for the shelf.

References:

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Figures:
- Fig. 2: Time-longitude plot of smoothed SSHAs along ground track on 10 May 2000. 149°W is the nominal shelf break.
- Fig. 3: Time-longitude plot of smoothed SSHAs along ground track on 10 May 2000. 149°W is the nominal shelf break.
- Fig. 4: Time-longitude plot of smoothed SSHAs along ground track on 10 May 2000. 149°W is the nominal shelf break.
- Fig. 5: March 1999 profiles.
- Fig. 6: A comparison of SSHAs along 149°W and hydrography and geostrophic velocity sections along the Seward Line indicate that the observed mesoscale features influence the salinity and density structure along the shelfbreak and inner slope. The March SSHAs profiles (Fig. 5a) show a SSHA dome (anticyclone and downwelling) centered at about 148°W (~100 km south of the end of the Seward Line). A trough (upwelling) in SSHAs occurs near the shelfbreak at ~149°W. The doming of the isohalines and the presence of a strong (~10 cm/s) eddy along the shelf break in the CTD data (Fig. 5c) show the influence of the shelfbreak front on the flow in this region. These adjustments coincide with the boundary of the shelfbreak front and offshore migration of shelf waters as suggested in Fig. 1 (cf. Lorier and Gawarkiewicz, 2001, for similar processes in the Mid-Atlantic Bight).
- Fig. 7: A comparison of SSHAs along 149°W and hydrography and geostrophic velocity sections along the Seward Line indicate that the observed mesoscale features influence the salinity and density structure along the shelfbreak and inner slope. The March SSHAs profiles (Fig. 5a) show a SSHA dome (anticyclone and downwelling) centered at about 148°W (~100 km south of the end of the Seward Line). A trough (upwelling) in SSHAs occurs near the shelfbreak at ~149°W. The doming of the isohalines and the presence of a strong (~10 cm/s) eddy along the shelf break in the CTD data (Fig. 5c) show the influence of the shelfbreak front on the flow in this region. These adjustments coincide with the boundary of the shelfbreak front and offshore migration of shelf waters as suggested in Fig. 1 (cf. Lorier and Gawarkiewicz, 2001, for similar processes in the Mid-Atlantic Bight).
- Fig. 8: A comparison of SSHAs along 149°W and hydrography and geostrophic velocity sections along the Seward Line indicate that the observed mesoscale features influence the salinity and density structure along the shelfbreak and inner slope. The March SSHAs profiles (Fig. 5a) show a SSHA dome (anticyclone and downwelling) centered at about 148°W (~100 km south of the end of the Seward Line). A trough (upwelling) in SSHAs occurs near the shelfbreak at ~149°W. The doming of the isohalines and the presence of a strong (~10 cm/s) eddy along the shelf break in the CTD data (Fig. 5c) show the influence of the shelfbreak front on the flow in this region. These adjustments coincide with the boundary of the shelfbreak front and offshore migration of shelf waters as suggested in Fig. 1 (cf. Lorier and Gawarkiewicz, 2001, for similar processes in the Mid-Atlantic Bight).