Evolution of a "Poleward Undercurrent" over the Continental Slope of Arctic Alaska

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Study Area and Methods:

The USCGC Healy contains a hull-mounted 75 kHz Ocean Surveyor (OS75) acoustic Doppler current profiler manufactured by RD Instruments, Inc. The phased array is mounted in its own well and is separated from the water by an acoustically transparent window. Trimble Inc. Centurio P-code and Accutrack Inc. attitude global positioning systems provide U.S. military-grade navigational and heading information to transform single ping data from beam to averaged earth referenced velocity estimates.

USCGC Healy, summer 2003:

Introduction:

Our perception of the Arctic Ocean circulation presently undergoes major revisions as traditional water mass analyses become augmented with direct velocity observations from moored current meters (Woodgate et al. 2001), drifting buoys (Plueddemann et al., 1997), and ship-mounted ADCP surveys (Gawarkiewicz and Plueddemann, 1995; Münchow et al., 2000).

Winds Oct.-Oct. 2003:

Two flow features emerge that advect mass in the downstream, that is, south-eastward direction (Kelvin wave propagation), their combined volume flux is ~0.76 Sv (10^6 m^3/s). We find

(a) a subsurface current slope between the 100-300 m isobath (0.13 Sv), and
(b) a surface intensified jet (0.63 Sv) in the same direction seaward of the 500-m isobath.

The surface current is ~10 km wide and extends vertically 75 m from the bottom. The surface jet is ~20 km wide and extends vertically 150 m from the surface.

Two-Week Mean Flow Sept.-Oct.-2003 from 75-kHz ADCP surveys

We surveyed a single section across the outer Beaufort Sea from the 40 m to the 2000 m isobath repeatedly for about 16 days from Sept. 24 (Hour-24) through Oct. 09 (Hour-672), with ~20 ADCP and 5 hydrographic CTD sections. A typical ADCP-only section with <1 km horizontal resolution took generally less than 3 hours.

ADCP Oct.-1, 2003

ADCP Oct.-2, 2003

ADCP Oct.-3, 2003

ADCP Oct.-4, 2003

ADCP Oct.-5, 2003

ADCP Oct.-6, 2003

Conclusions:

Volume fluxes of 10-km wide bottom intensified slope current (Beaufort Undercurrent?) are ~1-0.5 between those of a 20-km wide surface jet (Beaufort Gyre) reach ~1.5 Sv.

Roosby numbers of bottom- and surface-intensified flows were ~0 suggesting that nonlinear inertial terms contribute to the dynamics in addition to topographic beta-effects.

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