Deep Cyclogenesis in Drake Passage

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OS 2010
Portland OR
cDrake Array

- Transport line & local dynamics array
- 4-year deployment: 2007-2011
- Annual data return via acoustic telemetry

cDrake Objectives

- Determine the time-varying ACC transport
- Describe the mesoscale eddy field
- Guide future monitoring
- Assess model skill
CPIES: current and pressure recording inverted echo sounder

Measures bottom current (50 m off bottom).

Emits 12kHz sound pulses. Measures round trip travel times of acoustic pulses to sea surface and back.

Measures bottom pressure & temperature.
Bottom Currents and the Antarctic Circumpolar Current

- ACC is a deep reaching current, strongly influenced by topography.
- Bottom torques thought to balance wind stress and wind stress curl that drives the ACC and sets its transport.
- Deep jets make direct observations difficult.
Recent Observations of ACC Bottom Currents

- Instantaneous bottom velocities in the range 4-20 cm/s eastward (Donohue et al., 2001; Cunningham et al, 2003).

- Mean speeds 2-6 cm/s eastward observed in AUSSAF and SAFDE (Phillips and Rintoul, 2000; Meinen et al., 2002).

- Transient eddies can have much larger currents - peak speeds observed in SAFDE were ~30 cm/s.
Record-length (~1 yr) mean currents (50-m above bottom) and standard deviation ellipses

Northern Drake Passage:

Means exceed 10 cm/s at 15 sites. Directions not aligned with surface flow.

Southern Drake Passage:

Mean bottom flow near PF ~5-8 cm/s Directions aligned with the front.

(Chereskin et al., GRL 2009)
Mean fronts: Lenn et al., 2008

D01 max speed 69.3 cm/s

D02 max speed 71.1 cm/s

E01 max speed 57.7 cm/s

1/6 degree, 42 levels, MITgcm, assimilation (altimetry; ARGO)

SOSE mean bottom currents (100-m above bottom) and 3500 m pressure anomaly

Courtesy of Matthew Mazloff
Mean (1999-2009) surface EKE from altimetry

Mean (2007-2008) surface EKE from altimetry

Mean (2007-2008) bottom EKE from mapped currents and pressures from cDrake

(Chereskin et al., GRL 2009)
SAF/PF meanders and deep cyclogenesis

(Chereskin et al., GRL 2009)
Peak “event” EKE $> 350 \text{ cm}^2 \text{s}^{-2}$

5 events over year
Conclusions

• Velocity variance is largest in northern Drake Passage, both at the surface and the bottom.

• Year-long-mean bottom currents between the SAF and PF exceed 10 cm/s, and the direction is not parallel with the surface flow.

• Multiple bottom current events, with peak speeds of 70 cm/s, last for 10 days or more and are correlated between sites separated by 45 km.

• Events indicate deep cyclogenesis occurs in the high EKE zone between the SAF and the PF.