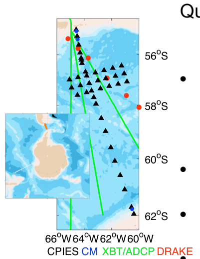
PO35O

Barotropic Transport Variability in Drake Passage from the cDrake experiment

Kathleen A. Donohue[1], Teresa K. Chereskin[2], D. Randolph Watts[1], Karen L. Tracey[1], Amy Cutting[1]
[1]Graduate School of Oceanography, University of Rhode Island, Narragansett, RI, USA.
[2]Scripps Institution of Oceanography, University of California, San Diego, La Jolla, CA, USA.
kdonohue@gso.uri.edu

1. cDrake Objectives



Quantify ACC transport and dynamics.

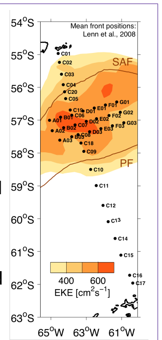
- Determine horizontal and vertical structure of the time-varying transport.
- Describe the eddy field.
- Guide future monitoring.
- Assess model skill.

2. Motivation

- ISOS concluded that barotropic ACC transport could be monitored using across passage pressure differences.
- Hughes et al. (1999) provided a theoretical case for a southern barotropic transport mode that is highly correlated to bottom pressure on the southern side of the ACC.
- Observationally, this mode is difficult to observe, local baroclinic processes swamp the larger-scale barotropic variability.

3. Data

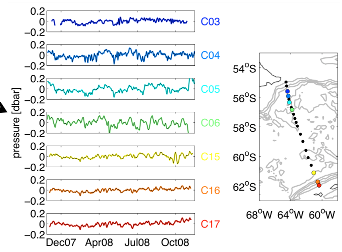
- 38 current and pressure recording inverted echo sounders (CPIES).
- Array deployed in 2007.
- Annual telemetry cruises until 2011 recovery.
- Pressure data are dedrifted and detided (including Mf and Mm: Egbert and Erofeeva, 2002).

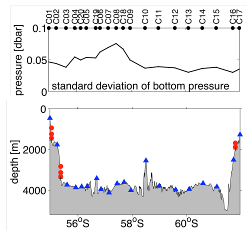


4. Bottom Pressure Records

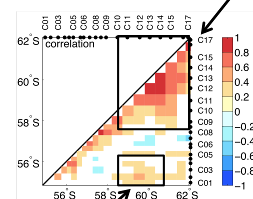
Bottom pressure in the dynamics array is strongly influenced by ACC meandering (cyclogenesis).

Variance within the dynamics array is two times higher than to the north and three times higher than to the south.





Southern deep sites are highly correlated (>0.7).



Horizontal scales vary across the passage.

- Northern Drake 60 km
- Dynamics Array 50 km
- Southern Drake 125 km

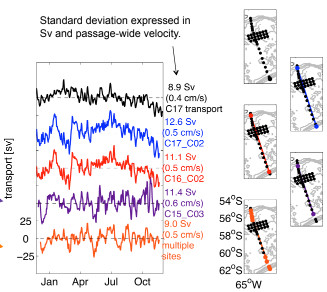
North-South correlations as high as 0.5 exist between some sites.

5. Transport Estimates

Barotropic transports are estimated by bottom pressure differences across the passage.

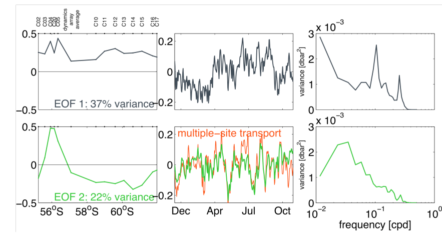
- C17-C02, C16-C02 span a wide fraction of the passage.
- C15-C03 derives from sites that are locally correlated.
- Multiple-site averages further reduce local small-scale eddy variability.

Yet these `best' estimates are quite different -- Transports are sensitive to the choice of endpoint, particularly the northern endpoint.



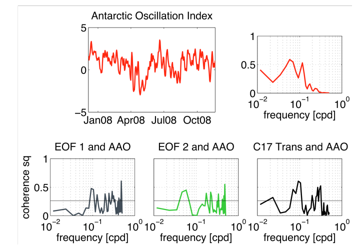
Large fluctuations, as high as 30 Sv, occur over time scales of weeks to days.

6. Empirical Orthogonal Functions



- EOF 1 --a passage-wide uniform-amplitude signal.
  - –spectral peaks near 10 and 4 days
- EOF 2 --a transport mode and correlates well with the multiple-site transport estimate.
  - –broad spectral peak centered at 30 days

7. Relationship with Atmospheric Forcing



Both modes are coherent and in phase with the Antarctic Oscillation Index but at different frequencies.

8. Conclusions

- Drake Passage barotropic transport estimates require temporally and spatially resolved measurements.
- The Drake Passage common pressure signal indicates that transports cannot be monitored by a single southern gauge.
- Low-pass filtering may produce a viable estimate of low-frequency transport -- to be investigated as more cDrake observations accumulate.

References
Egbert, G. D. and S. Erofeeva (2002), Efficient inverse modeling of barotropic ocean tides, JTECH, 19
Hughes, C.W, M. P. Meredith and K. J. Heywood (1999) Wind-driven transport fluctuations through Drake Passage: A southern mode, JPO, 29, 1971-1992.
Lenn, Y.-D, T.K. Chereskin, and J. Sprintall (2008) Improving estimates of the Antarctic Circumpolar Current streamlines in Drake Passage, JPO, 38, 1000-1010.

AAO Index: http://www.cpc.noaa.gov/products/precip/CWlink/daily_ao_index/aao/aao_index.html
Barotropic Mf and Mm tides. http://www.oce.orst.edu/research/po/research/tide/

Acknowledgements: NSF OPP grants ANT-0636493 and ANT-0635437. We thank G. Chaplin, S. Escher, D. Holloway, E. Sousa and A. Troisi, as well as the captains and crew of the RVIB Nathanial B. Palmer and Raytheon Polar Services.

cDrake OS2010 Posters
Wednesday
IT35M-04. Constituents of sea surface height variability in Drake Passage. *A. L. Cutting*
Thursday
IT45K-22. The Vertical Structure of the ACC in Drake Passage from Direct Velocity Observations and the SOSE. *Y. L. Firing*

cDrake OS2010 Presentations
Friday 8:15
IT51E-02. Deep Cyclogenesis in Drake Passage. *T. K. Chereskin*

Also see:
http://www.po.gso.uri.edu/dynamics/Drake
http://tryfan.ucsd.edu/cpies/cpies.htm