Deep Western Boundary Current variability at 34.5°S during 2009-2012

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Study description

In March 2009 an array of four PIES/CPIES was deployed near 34.5°S as part of the SAM project. The motivation for this array is to measure the currents near the western boundary, in particular the Deep Western Boundary Current (DWBC) and the Brazil Current, with the ultimate goal of determining the western boundary components of the Meridional Overturning Circulation (MOC) along this latitudinal. It was also hoped that the SAM array would form the cornerstone of a complete trans-basin-MOC array in the South Atlantic; a hope that is beginning to come true through the involvement of France, Brazil, and South Africa.

In December 2012, and subsequently in December 2013, the SAM array was bolstered by the addition of three CPIES, an ADCP, and a BPR. Future analyses will include the data from these new instruments, the poster highlights the DWEML measurements made during the initial 3.5-year span of the SAM array from March 2009 through December 2012.

PIES/CPIES records

This PIES/CPIES measures both round-trip acoustic travel time and bottom pressure continuously for up to four years (see at left). One instrument failed due to electronic problems and was not recovered (Site B) during 2010-2011. To date the PIES/CPIES are observing energy at a wide range of time scales with no consistent dominant peaks (see below).

PIES/CPIES analysis

The travel time measurement of the PIES/CPIES is not very useful on its own, but when combined with hydrographic measurements in the region the time-lapse measurement can yield an estimated full water-column profiles of density, temperature, or salinity (see example at right). The “Gravest” PIES/CPIES analysis serves to estimate the transports associated with the DWBC variability. Integrating the transport vertically to estimate the flow associated with the Deep Western Boundary Current (DWBC) is actually quite tricky, as in this region dissolved oxygen (not observable with the PIES) can be a key tracer of DWBC-related mid-water features. Future work will be required to do better at this; but for now we estimate the transport between fixed pressure levels of 800 and 4800 dbar (the bottom where it is shallower than 4800 dbar) to estimate the transports associated with the DWBC layer.

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Conclusions

• The SAM array has provided 3.5 years of data to date, with a roughly one-year gap at a key site due to equipment failure. An additional 21 months of data should be downloaded during a September 2014 cruise completed jointly with our international partners on a Brazilian research vessel (IN. Oc. Arg. Cruzes).
• The data analyzed to date indicates that the deep flow in this region is highly variable, with the temporal standard deviation exceeding the mean by about 15%.
• Similar to what has been previously observed in the North Atlantic at 26.5°N, the variability of the DWBC flows at 34.5°S greatly exceeds that of the MOC itself, illustrating the need for a basin-wide measurement system.
• The flow variability has both strong baroclinic and barotropic contributions, demonstrating the need for absolute velocity measurements to understand DWBC variability.

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Further reading
