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First Year Observations of Antarctic Circumpolar Current Variability and Internal Wave Activity from the DIMES Mooring Array

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A key component of DIMES (Diapycnal and Isopycnal Mixing Experiment in the Southern Ocean) is the deployment of a two-year cross-shaped mooring array in the Antarctic Circumpolar Current to the east of Drake Passage close to 57°W. Motivation for the cluster arises from the need to understand how eddies dissipate in the Southern Ocean, and specifically how much energy is extracted from the mesoscale by breaking internal waves, which in turn leads to turbulent mixing. The location of the mooring cluster was chosen to fulfil these objectives, being situated in a region of pronounced finestructure with high eddy kinetic energy and rough topography. The array, comprising 34 current meters and Microcats and a downward-looking ADCP, was first deployed in December 2009 and serviced in December 2010.

Time series of current meter results from the most heavily-instrumented 'C' mooring indicate that a strong (up to 80 cms-1) surface-intensified north-eastward directed ACC occupies the region for most of the year, with over 85% of the variability in current speed being accounted for by equivalent barotropic fluctuations. A strong mean poleward heat flux is observed at the site, which compares favourably in magnitude with literature results from other ACC locations. Interestingly, four episodes of mid-depth ($\sim$2000 m) current speed maxima, each of a few days duration, were found during the 360-day time series, a situation also observed by the lowered ADCP during mooring servicing in December 2010. Early results indicate that these episodes, which coincide with time minima in stratification close to 2000 m, could profoundly influence the nature of eddy-internal wave interactions at these times.

Quantification of the energy budget at the mooring cluster has been a key priority. When compared with previous moorings located in Drake Passage (Bryden, 1977), a near threefold-increase in mean eddy kinetic energy (EKE) is observed despite a small reduction in the mean kinetic energy between these sites. The magnitude of interactions between the available potential energy and EKE and between the EKE and mean kinetic energy are of similar magnitude to those observed in Drake Passage. Unfortunately, the collapse of two moorings early in 2010 has meant that second-year data will be required before the exchange of energy between the eddy and internal wave frequency bands can be rigorously quantified. However, data from the downward-looking ADCP between 2700 and 3400 m is starting to identify the important frequencies and mechanisms of internal wave activity.