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Intermittency in the East Madagascar flow

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The East Madagascar Current is believed to provide a significant component of the input to the Agulhas Current, but its flow around the south of Madagascar is far from constant, with westward-propagating eddies from the southern Indian Ocean interacting with features already present in the current. Whilst altimeter and ocean colour data have shown for some while the complex interplay of features here, the sub-surface data have been scarce. In 2005 the UK deployed moorings close to the Madagascar Ridge, which extends southwards from the island. Three of the moorings were laid along the ground-track occupied regularly by the TOPEX and Jason altimeters, with the 4th mooring being further east to enable some interpretation of the propagation rate of features, as well as whether their sub-surface profiles were evolving as they approached a significant bathymetric feature. The variability in the 14-month records from these current meters and temperature and salinity sensors indicates a number of deep and broad eddies passing through the array section and subsequently across the Madagascar Ridge. In several instances there are currents of up to 1m/s causing significant knock-down of the moorings. Analysis of these subsurface records enables us to calculate the associated heat and salt anomalies and determine how much eddies contribute to the exchange across the ridge. Comparison with contemporaneous satellite data helps determine the origin of these eddies and puts the observations of this short duration deployment in context. Altimetric data provide a general means of tracking features according to their sea surface height expression, whilst ocean colour data enable us to image eddies through two separate means. First, there may be enhanced productivity locally due to upwelling within cyclonic systems raising the nutricliine and thus enhancing phytoplankton growth; second, highly productive waters along the Madagascan coast may be entrained around the outside of eddies, a process that

seems more effective for anticyclonic eddies. The moorings also show a persistent sub-surface counter current flowing east just to the south of Cape St. Marie. Further offshore there are branches of eastward flow at the surface, which could be ascribed to a putative East Madagascar Retroflection; however the depth of such flow is much shallower than that of the supposed parent, the East Madagascar Current (EMC). For example, current profiles from ship-mounted acoustic doppler systems show the westward flow rates in the EMC to be fairly uniform throughout the top 800m, whereas the eastward flow is concentrated in the top 200m. Indications of such shallow return flow have also been noted from other hydrographic cruises in the area. Our understanding of such systems is also helped by a number of satellite-tracked drifters that have been used to confirm the direction of rotation and estimate the rotation rate for these eddies. A programme of delayed-release surface drifters was used to help seed a particular region within the EMC. It was found that the trajectories of buoys released close in time soon diverged. Whilst satellite data show that most of the coherent features are moving in a west-southwest direction to join the Agulhas Current, only two of the eight buoys did so within their operating lifetime.