Insights into the Mesoscale Circulation of the Rockall Trough

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The Rockall Trough is the nearest region of truly deep oceanic water west of the British Isles, and it is one of the main conduits for warm salty water that is transported to high latitudes as well as the source of oceanic water feeding onto the shallow European Shelf. A full picture of decadal variations of the circulation in the AMOC, and of the Sub-Polar Gyre in particular, requires a proper understanding of the mesoscale variability of this eastern boundary region.

Annual scientific cruises have monitored the temperature and salinity of the Trough since 1975. Since 1995 satellite altimeters have measured small fluctuations in level of the sea surface to determine variations in the European slope current that is an important northward transport path on the eastern side of the Trough, and to quantify the intensity of large horizontal eddies that mix its ocean waters. In recent years remotely operated underwater gliders have begun to supplement these observations with regular crossings of the Trough to report detailed in situ measurements of currents, temperature and salinity from the surface to 1000 m.

This talk describes the results of the first such glider mission which involved eight crossings over the winter of 2009/2010. Its principal findings are that:

i. Much of the surface and deeper meandering current field in the central Rockall Trough is driven by deep eddies that have migrated into the Trough from both its northern and southern entrances.

ii. Surface currents appear to be much stronger during the autumnal period of seasonal surface stratification than in late winter when the upper Trough is mixed to a depth of 600 m.

iii. In late 2009, during a period of unusually large eddy activity, a chance arrangement of some deep circulations caused a westward deflection of the slope current that resulted in a large quantity of slope water being carried to, and thereby warming, the upper 500 m of the western side of the Trough.

iv. Limitations to the altimeter observations the sea surface are identified. By combining them with glider measurements it is shown that they do not pick out the mean flow in narrow slope currents either side of the Rockall Trough.

Novel measurement techniques invariably result in new scientific understanding. The insights derived from this first underwater glider mission in the Rockall Trough confirm that it is a dynamically active region but that much of this activity is driven by deep hidden processes and results in significant fluctuations in the observed mean conditions. There are important implications here for OSNAP in the interpretation of satellite altimeter observations, the understanding of the causes of variability in the results of regular ocean monitoring programmes, and in the establishment and interpretation of the results of ocean modelling exercises.

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