MSM121

Nuuk — Ponta Delgada
September 23 — October 16, 2023

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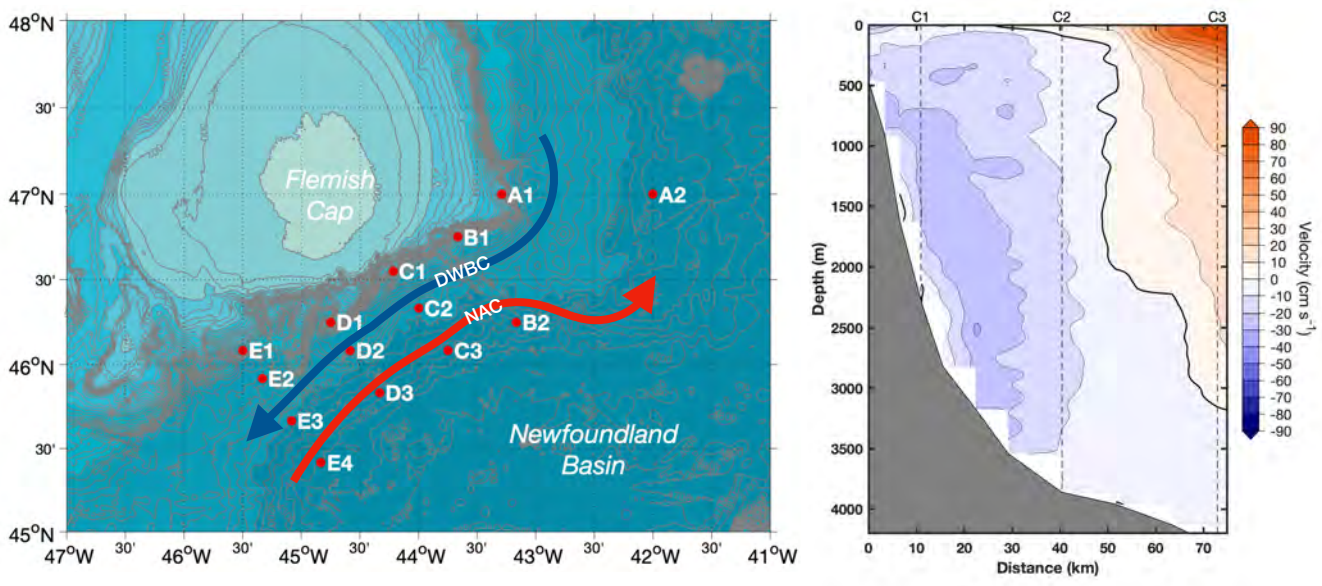
The Deep Western Boundary Current (DWBC) forms the cold southward flowing branch of the Atlantic Meridional Overturning Circulation (AMOC). The DWBC has been observed at different latitudes along the western Atlantic continental slope. However, several observation have identified a considerable loss of water from the DWBC in the Newfoundland Basin. A prominent example being floats deployed upstream (north of Flemish Cap) within the DWBC leaking into the interior Newfoundland Basin between Flemish Cap and the Grand Banks. Quantification of the DWBC leakiness is a major goal of the field work component of EPOC (*Explaining and Predicting the Ocean Conveyor,* epoc.blog.uni-hamburg.de) and a motivation for our work on Maria S. Merian cruise MSM121. Last week we already deployed an array of current meter moorings south of the Grand Banks with the aim to measure a time series of DWBC transports at the exit of our research area. This week we started the deployment of an array of inverted echo sounders south of Flemish Cap. In this region, the DWBC flows around the southeast corner of the cape and the deployed instruments will be used to measure time series of DWBC transport along and across the bathymetry.

Inverted echo sounders (IES) are compact landers, equipped with a hydrophone the emits and receives acoustic pulses and measures the travel time of the acoustic pulses from the seafloor to the surface and back. The acoustic travel time is quite sensible to the temperature distribution above the instrument, low temperatures result in a longer travel time while the sound pulses travel faster at higher temperatures. The changes in travel time are quite subtle and therefore the accuracy of the measurement must be in the range of milliseconds.

Inverted echo sounders with pressure sensors (PIES) on deck of Maria S. Merian, ready for being deployed. The devices are deployed with the hydrophone pointing upwards. For recovery the tripod is disconnected on an acoustic signal. On ascend the PIES turn around and the small flags point upwards for better retrieval (photo: Christian Mertens).

Pairs of inverted echo sounders can then be used to derive the horizontal gradients of temperature or density which are proportional to the geostrophic flow between the instruments (also known as *thermal* wind). IESs can not provide as much information about



Left: Map of positions of 14 inverted echo sounders with schematic representation of the southward Deep Western Boundary Current (DWBC) and the northward North Atlantic Current (NAC). Right: Across-section current velocity at line C, negative values (blue) show the DWBC, positive values show the NAC.

the flow as moorings, but they are also much less expensive, which allows the deployment of a larger number of stations. On the MSM121 cruise, 14 IESs are planned to be deployed south and east of the Flemish Cap, 10 of which (lines C, D, and E) have been deployed in the past week. Measurement with CTD and ADCP made along the sections show the DWBC and the directly adjacent North Atlantic Current (NAC).

On Thursday afternoon, the wind picked up significantly, and we left the area south of Flemish Cap to continue work west and north of Flemish Cap. However, in the following days the wind and swell remained strong, so no mooring work was done. Instead, the CTD program was continued.

More information about our research activities and life on board can be found in the blog posts at https://epoc.blogs.uni-hamburg.de/our-work/expeditions/msm121/.

Best wishes from the scientific party of MSM121.

Christian Mertens
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Deployment of an inverted echo sounder during the night (photo: Eleanor Frajka-Williams).