2nd Weekly Report M219, Recife-Mindelo-Emden

1.6.-7.6.2026

Work in our first study area at 11°S, south of Recife (Brazil), began just 16 hours after departing the harbor. Here, GEOMAR Helmholtz Centre for Ocean Research Kiel operates a long-term observing system to monitor the western boundary current system and the Atlantic Meridional Overturning Circulation (AMOC). Measurements using deep-sea moorings were already carried out between 2000 and 2004 and have been continued continuously since 2013. Within only a few days, four deep-sea moorings were successfully recovered and redeployed. In addition, six Pressure Inverted Echo Sounders (PIES) were deployed on the seafloor, and one PIES was recovered. All instruments operated continuously and recorded valuable data, representing a major success—particularly for the preceding research cruise.

The moorings are primarily used to measure the strength of the North Brazil Undercurrent (NBUC) in the upper 1,200 m of the water column and the Deep Western Boundary Current (DWBC), whose core is located at a depth of approximately 1,900 m. These currents form an essential component of the AMOC. A long-term weakening of the AMOC, as projected in response to climate warming, should therefore also be reflected in a weakening of the western boundary current system. However, the estimation of long-term trends is often complicated by the natural variability of the currents. For example, variability in the DWBC is strongly influenced by fluctuations with periods of about 60 days that are caused by deep eddies. In addition, we observe variations in current velocity on time scales of several years (Fig. 1, lower panel), which are primarily driven by variability in tropical winds. A detailed analysis of all current measurements is therefore required to determine long-term trends in water mass transport.

PIES instruments are primarily used to measure bottom pressure. These observations are used to determine the pressure difference between Brazil and Angola, where a comparable observing system provides corresponding bottom-pressure

measurements. The pressure difference at various depths is used to calculate the mean meridional velocity across the Atlantic between Brazil and Angola and thereby derive a measure of the strength of the AMOC. As demonstrated in a modeling study, the pressure difference at a depth of 500 m is particularly informative for characterizing the seasonal to interannual variability of the AMOC. These data have now been available since 2013 (Fig. 1, upper panel) and will be used to improve our understanding of the links between the AMOC and tropical climate variability.

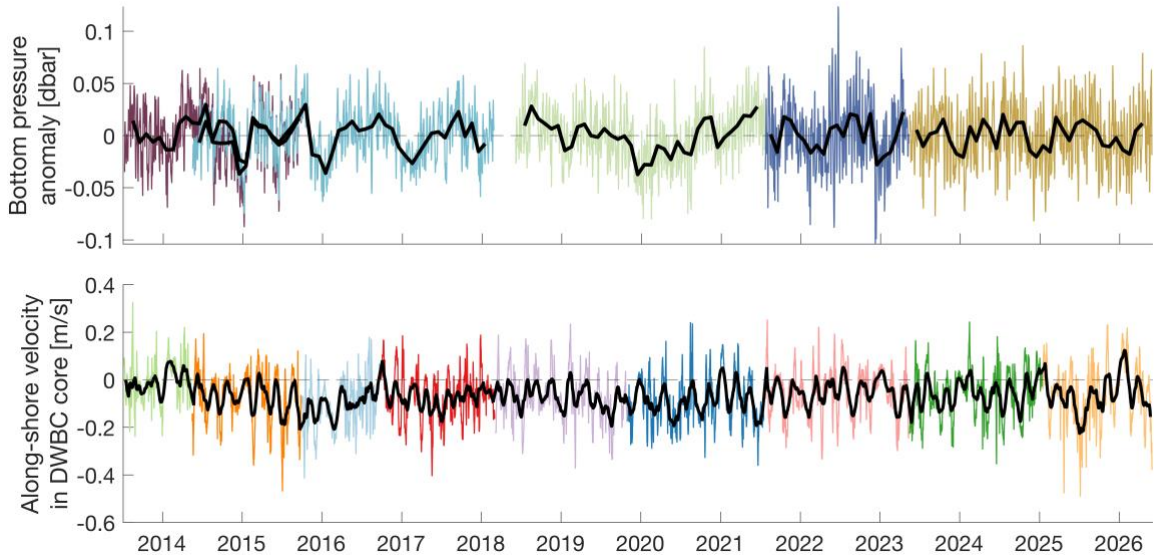

Fig. 1: Time series from various instruments moored at approximately 11°S off the Brazilian coast (Figure: A. C. Hans). Upper panel: bottom pressure measurements from PIES instruments (different colors indicate measurements from different instruments). Lower panel: current velocity in the core of the Deep Western Boundary Current (different colors indicate individual mooring periods; shown are nine measurement periods completed by ten research cruises).

In addition to the moored instruments, continuous shipboard measurements and extensive station work are being carried out. During every research cruise involving mooring operations—ten cruises since 2013 to date—measurements of velocity, temperature, salinity, and other tracers are collected from the surface to the seafloor. The resulting velocity observations (Fig. 2) allow us to determine both the mean circulation and patterns of spatial variability, which are subsequently used to calculate transports from the mooring data.

The intensive work at 11°S, typically involving mooring operations during the day and station work and instrument calibrations throughout the night, was successfully completed on 4 June. We would like to express our sincere gratitude to both the ship's crew and the scientific team for their tireless dedication and commitment.

The completion of the work was celebrated with a traditional icebreaker gathering. We are now underway toward the equator at 23°W, where the next mooring operations are scheduled to take place.

Greetings from the tropics,
Peter Brandt and the participants of Meteor cruise M219

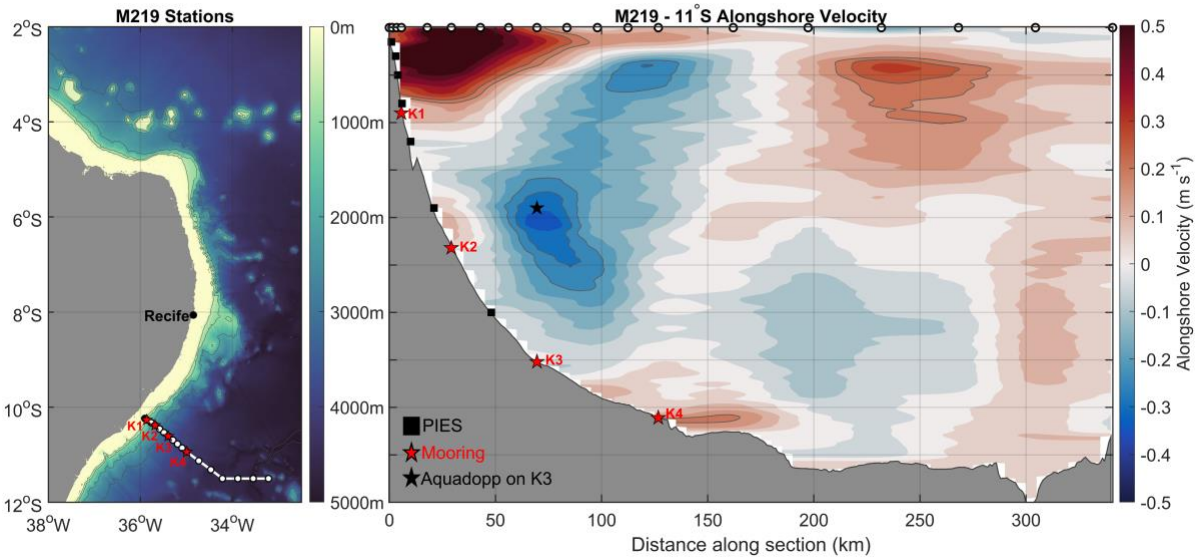

Fig. 2: Bottom topography showing the locations of the moorings and CTD/LADCP stations (left), and the alongshore velocity component along the section (right; red northward, blue southward), derived from LADCP (Lowered Acoustic Doppler Current Profiler) measurements obtained with the CTD rosette. The locations of the PIES instrument at 500 m depth and the Aquadopp current meter, whose time series are shown in Fig. 1, are indicated, together with the positions of all moorings (red stars) and PIES instruments (black squares) (Figure: N. Krauzig).