M130, Mindelo – Recife

August 28th to October 3rd, 2016

2nd Weekly Report, September 4th, 2016

After successfully completing mooring work to the North of the Cape Verde Island São Vicente and recovering a drifting surface buoy, our activities are now focused on investigating different processes within the oxygen minimum zone of the tropical northeastern Atlantic.

Oxygen minimum zones are usually found in regions of sluggish circulation. Oxygen-rich waters subducted from the mixed layer into thermocline in the subtropics barely reaches these “shadows zones” within the mean circulation pathways. Historical data has shown that since the 1970s, oxygen content in the oxygen minimum zone of the tropical northeastern Atlantic, like in most other oxygen minimum zones, has decreased. The reason for this decrease is not fully understood, in particular because state of the art climate biogeochemistry models do not correctly simulate oxygen minimum zones.

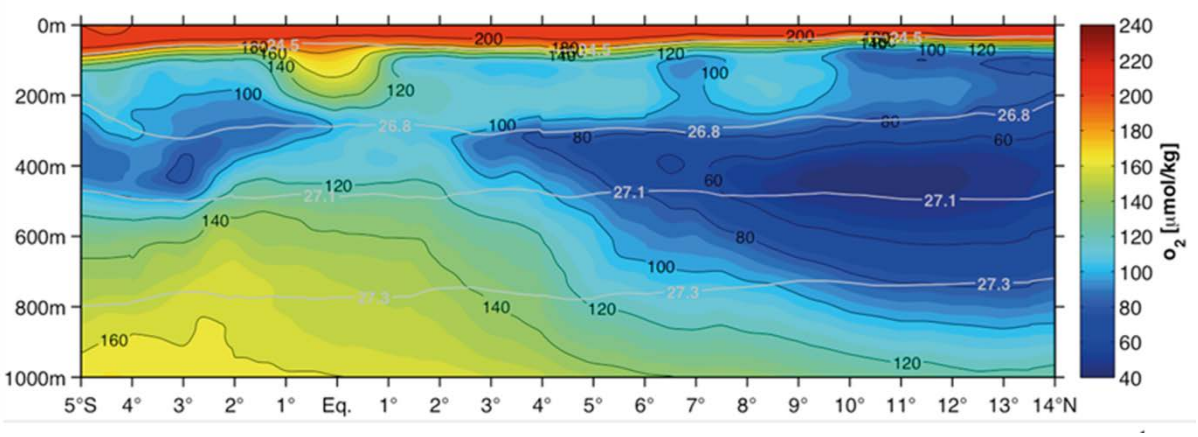

Fig. 1: Average oxygen concentrations along the meridional transect at 23°W.

Within the second phase of SFB 754, an oxygen budget for the northeastern tropical Atlantic based on data collected within SFB 754 was developed for the first time. It showed that more than 60% of the oxygen consumption due to respiration of sinking organic material in the deep oxygen minimum zones (300-700m depth, Fig. 1) is balanced by the divergence of meridional eddy fluxes. A further 20% of this consumption is balanced by diapycnal mixing from layers above and below the oxygen minimum zones. Parts of the remaining 20% are carried to oxygen minimum zone by the zonal circulation, while a smaller percentage contributes to the ongoing decrease in oxygen content. A major goal of our activities in the oxygen minimum zone is to improve understanding of the processes related to the oxygen balance and to determine more accurately the magnitude of the individual terms of the balance.

A second objective of the measurement program is to investigate interannual to decadal variability of oxygen and hydrography in the oxygen minimum zone. The data sets collected during SFB 754 field campaigns to the tropical northeast Atlantic

in the last 10 years show that recent trends in oxygen concentrations strongly depend on the depth interval and time span considered. In the upper region (150m-300m) oxygen content has strongly reduced during the last 10 years. On the other hand, oxygen content in the deeper water column (350m-700m) of the oxygen minimum zones has slightly increased. Extending the available oxygen and hydrographic data set will thus contribute to elucidate the processes responsible for interannual to decadal variability of oxygen and hydrography in the eastern tropical Atlantic.

The measurement program consists of CTD/O_2 (conductivity-temperature-depth and oxygen concentration profile) measurements along the 23°W section as well as the recovery and redeployment of two moorings measuring long-term time series of oxygen concentrations and hydrography. Additionally, tracer (CFC-12, SF_6) concentrations measurements are being performed at high-spatial resolution. This data will be used together with climatological data to review existing methods to determine water mass ages in order to achieve a consistent estimate of oxygen consumption in the oxygen minimum zone.

CVOO Time series station

Shortly after leaving port last Monday, we started the recovery of the CVOO (Cape Verde Ocean Observatory) mooring to the north of the island São Vicente, Cape Verde.

The CVOO was deployed in June 2006 for the first time. Since then, the mooring has been serviced at a 1.5-year interval. It serves as an interdisciplinary observatory which hosts a large number of instruments including temperature, salinity, oxygen, carbon dioxide and chlorophyll sensors as well as current meters that are distributed throughout the whole water column. During this deployment phase, Zooplankton settlement samplers were included for the first time. The data from these samplers will be interpreted in reference with other plankton samplers currently moored close to the Canary Islands and the Porcupine bank.

Fig. 2: Preparations for the deployment of the CVOO mooring (photo Jan F. Schubert)

Recovery of a drifting surface buoy

A few days before our cruise started we were contacted by Dutch colleagues from Royal Netherlands Institute for Sea Research. They informed us of a moored surface buoy off Mauritania that had come loose and was drifting towards the Cape Verde Islands. The buoy is part of a mooring array for determining the input of dust to the northern tropical Atlantic Ocean. The surface buoy was located about 150 nm northeast of the CVOO mooring position when we started the mooring recovery last Monday. In between recovery and redeployment, we used the preparation time to recover the surface buoy that was subsequently placed on the bow of METEOR and secured. Thanks to the professionalism of METEOR's crew, the recovery of the buoy was completed within a few hours, minimizing the loss of ship time for our cruise. We will hand over the buoy to our Dutch colleagues upon arrival in Recife, Brazil.

Fig. 3: Recovery of the drifting surface buoy (photo: Simona Dittrich-Knüppel)

On Monday afternoon, our work along the 23°W section will be suspended in order to survey a tracer in the eastern tropical Atlantic that was deliberately released in the center of the oxygen minimum zone 3 years ago. On Wednesday, we will recover and redeploy a mooring at 11°S 21°W.

Best regards from the tropical north Atlantic,

Marcus Dengler and the participants of M130