6th Weekly Report SO284, Emden-Emden

Aug. 2 - Aug. 8, 2021

With the 6th week of RV Sonne cruise SO284 the main scientific program ended. Only meteorological and oceanographic underway measurements will continue until we reach the Exclusive Economic Zone (EEZ) of France within the approaches to the English Channel.

With the recovery of the drift buoy and the autonomous glider that were deployed at the beginning of our cruise ended also the upper ocean mixing process study (Fig. 1).

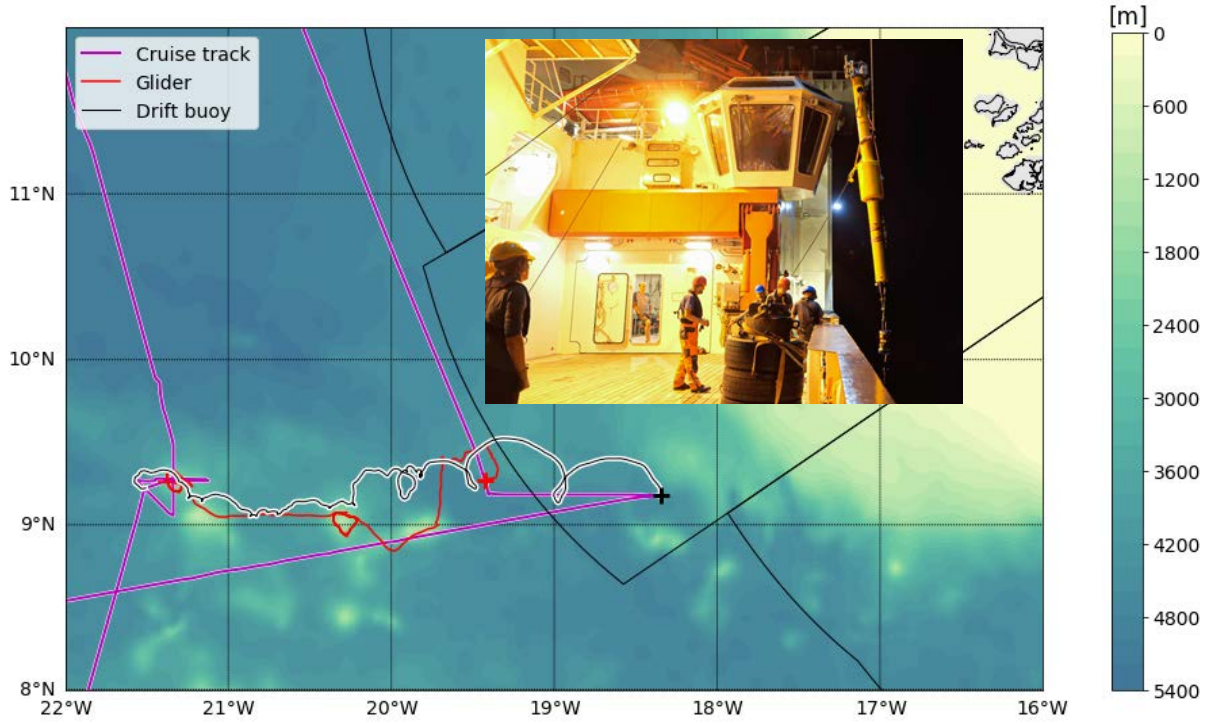

Fig. 1: Geographical map showing the cruise track of RV Sonne, the free drift of the buoy, and the track of the autonomous glider. The buoy and the glider were deployed on Jul. 10, 2021 near the Annan seamount and moved eastward. The black and the red plus signs mark the position of the buoy and glider recovery, respectively. Black lines show the boundaries of the EEZs of the coastal countries. The buoy drifted in the territorial waters of Guinea-Bissau, where it was recovered on Aug. 4, 2021. The photo shows the recovery of the drift buoy during the night (Fig. Mareike Körner, Photo David Menzel).

The original plan was to stay with the buoy and the glider almost at the deployment position measuring upper ocean conditions in the central tropical North Atlantic. Unfortunately, the buoy drifted unexpectedly fast eastward and arrived in the EEZ of Guinea-Bissau. However, with the help of the German Research Fleet Coordination Centre and the German Embassy in Dakar we were able to get the official allowance to recover the buoy in the territorial waters of Guinea-Bissau. We arrived with RV Sonne almost during midnight at the buoy position and could recover the buoy without problems. During the next morning the glider was recovered as well using the work boat of RV Sonne. The analysis of the data is still ongoing. While most of the

measurements such as velocity, temperature, salinity and oxygen continued successfully until the end, the microstructure measurements by the glider stopped few days before recovery and missed the end of the mission. Overall an exceptional dataset could be acquired that will be used to better understand the highly variable mixing processes in the upper tropical Atlantic Ocean.

In the meantime, the analysis of the acquired shipboard data is ongoing revealing the high quality of the different datasets. Here we show the equatorial current system as measured along the 35°W meridian by the lowered ADCPs (lADCP, lowered acoustic Doppler current profilers, Fig. 2). Two lADCPs, one upward and one downward looking instrument, were attached to the CTD rosette. The instruments worked exceptionally well including also the power supply via the CTD cable (making the use of batteries unnecessary) as well as the data download via Bluetooth allowing a first inspection of the acquired velocity profile already minutes after the CTD rosette was back on the ship. The 35°W section is of high interest as here the exchange of water masses between both hemispheres as part of the Atlantic-wide meridional overturning circulation and its connection to the equatorial circulation can be directly observed.

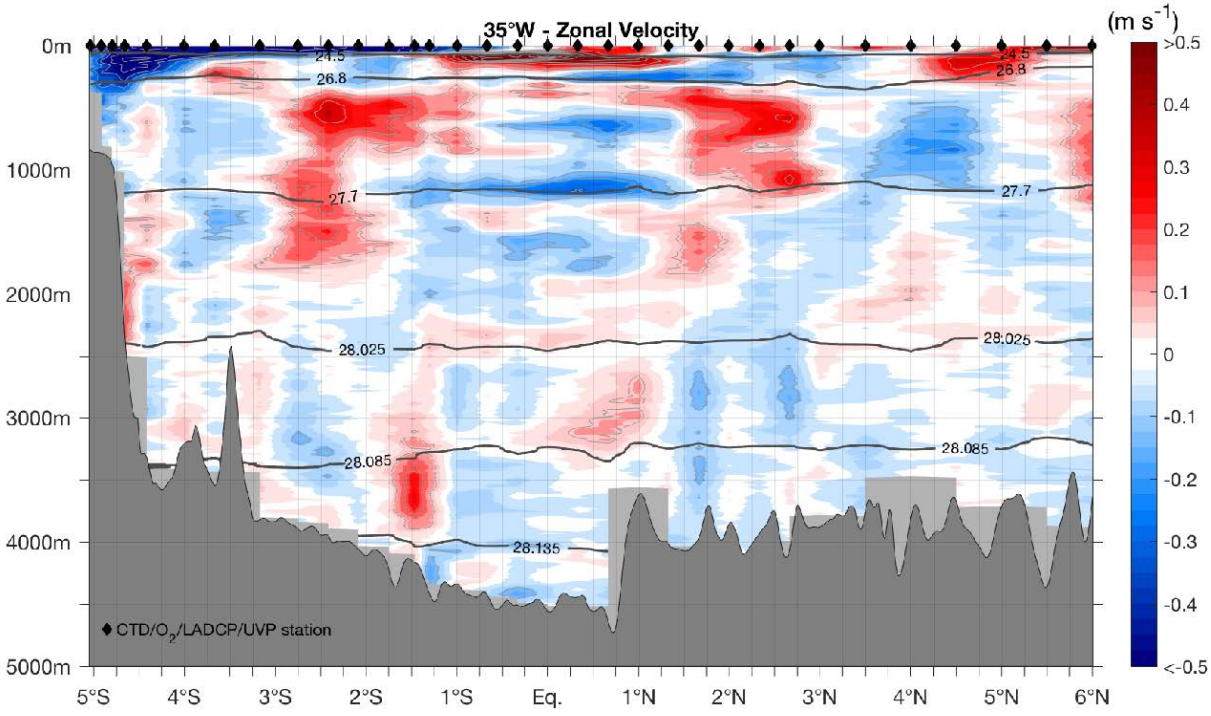

Fig. 2: Zonal velocity as measured at the CTD stations along the 35°W section (black diamonds). Eastward flow is marked by reddish colors and westward flow by blueish colors (Fig. Philip Tuchen).

From an atmospheric perspective, the last week was particularly interesting as we first travelled along the Intertropical Convergence Zone (ITCZ) and then crossed it in a south-north direction. The ITCZ is the zone where the deep rain clouds form that drive the entire tropical wind system. Because of their central role for the tropical climate, these clouds are a focus of our research, but their exact location and intensity is difficult to predict. This makes planning an ITCZ section difficult, and we were therefore very glad that our west-east crossing of the tropical Atlantic perfectly

matched the location of the high clouds during this time, see for example the satellite image shown in Figure 3. This figure also shows the locations of the 46 radiosondes we launched every two hours in the core region during this section of our campaign. While we were recovering the drift buoy from Guinea-Bissau, our location was south of the ITCZ, so we also crossed the ITCZ in a south-north direction during the last days, launching the last of our 157 radiosondes at 19°N and 22°W on 6 August. While we had some difficulties with the data transmission from the radiosondes to the station on board during the first crossing of the ITCZ three weeks ago due to a defective antenna, the transmission worked very well during both sections. We are currently analysing the resulting data set, which consists on the one hand of the vertically high-resolution profiles of temperature, humidity, pressure, wind speed and wind direction measured by the radiosondes and is on the other hand complemented by rain rate measurements (disdrometer) and continuous wind and humidity measurements by the wind and Raman lidar, respectively.

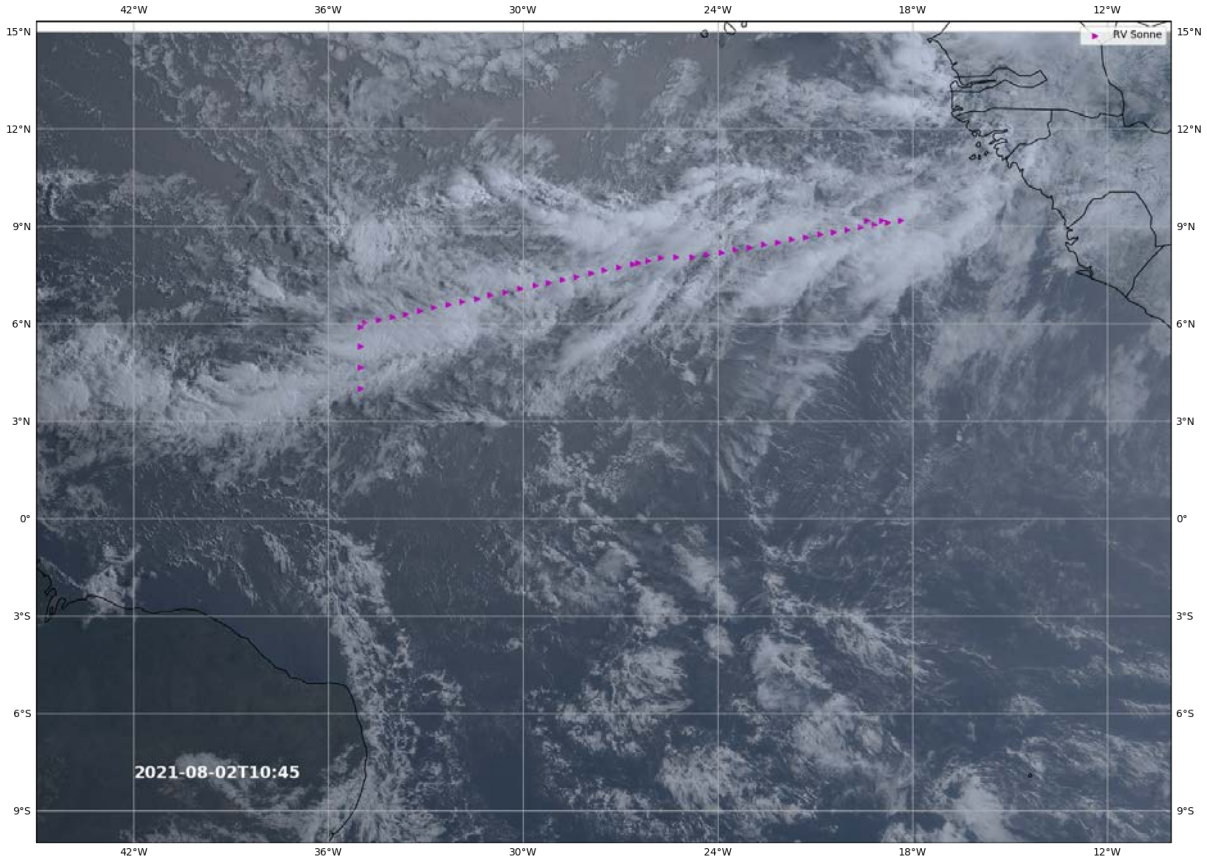

Fig. 3: Satellite image of the ITCZ with the locations of the radiosonde starts during the along-ITCZ section marked in purple (satellite image from GOES-16).

One particularly notable event that we were able to measure during the section running along the ITCZ was the impact of a tropical disturbance that formed north of us and south of the Cape Verde Islands around August 2nd and 3rd. Tropical disturbances are the first stage of development of a hurricane, although it should be noted that only

few disturbances actually develop into a hurricane. These disturbances are characterized by an area of low pressure on the ground with slightly rotating winds. While the intertropical convergence zone is often characterized by low wind speeds on the ground, a tropical disturbance can lead to an increase in wind speed in this region. Both, the decrease in surface pressure and the increase in wind speed, were measured by the instruments on board (see e.g. Fig. 4).

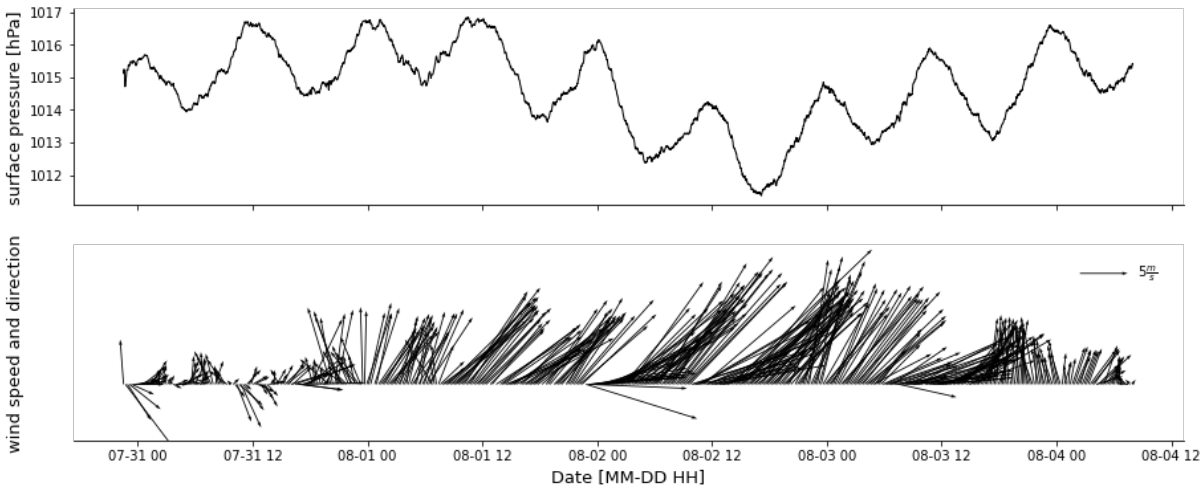

Fig. 4: Temporal evolution (top) of surface pressure and (bottom) of wind speed and direction during our cruise section along the ITCZ (Fig. Julia Windmiller).

The end of our oceanographic and meteorological station work was celebrated together with another birthday of one of our scientific crew members. Due to the quite long transit back to Germany, the time can be used for further data analysis, writing the cruise report and maybe preparing already for the next cruise.

Greetings from the tropics in the name of the cruise participants of SO284,

Peter Brandt, GEOMAR Helmholtz Centre for Ocean Research Kiel and
Julia Windmiller, Max-Planck-Institut für Meteorologie, Hamburg