2nd Weekly Report SO284, Emden-Emden

Jul. 05 - Jul. 11, 2021

During the second week, we arrived at the Cape Verde archipelago. North of the island São Vicente a long-term mooring is installed, the Cape Verde Ocean Observatory (CVOO). This interdisciplinary observatory was for the first time deployed in 2006 and since then continuously serviced. Here, we have, for example, observed the first open-ocean anoxic event in the tropical Atlantic within an ocean eddy that originated at the eastern boundary of Mauretania. The long timeseries of CVOO will allow us to study, if such events become more frequently in the future due to a general oceanic oxygen reduction under climate warming conditions. The main research topic that is addressed using the mooring data is the physical forcing of biological productivity in an oligotrophic ocean under the influence of Saharan dust input.

Fig. 1: Mooring deployment of the Cape Verde Ocean Observatory. The top element of the mooring is already in the water. Here, the ADCP (acoustic Doppler current profiler) is just to be deployed, finally being located 300m below the surface (Photo: David Menzel).

CVOO was recovered on Wednesday morning followed by a CTD station for measuring hydrographic parameters, currents and biological parameters in the whole water column. In the afternoon, CVOO was deployed by using fresh instruments that were partly calibrated during CTD casts during the previous days (Fig. 1). At a first glance, with the mooring recovery we acquired a complete mooring dataset. Its analysis will start in the coming weeks. After the end of the work at CVOO, we had to depart from our original cruise track to head to the port of Mindelo, where one of our crew members had to disembark because of medical issues. We wish him a fast recovery.

Leaving the Cap Verde Islands, a Saharan dust layer, at times extending from 1km up to a height of almost 7km, was detected by our remote sensing instruments, e.g. the PollyXT Lidar, and was also clearly visible by eye, for an example see Figure 2. This air layer originated from the Saharan desert and was lifted above the colder air of the marine boundary layer. Due to the local wind in the Sahara, this air mass contains a large quantity of dust which is now transported in the direction of South- and Middle America, where the arrival of Saharan dust can lead to a fertilization of the soil. The detailed onboard measurements of such an air layer, as currently performed on RV Sonne, provide, for example, reference measurements for satellites detecting aerosol.

Fig. 2: Sunset as seen through a deep Saharan dust layer (Photo: Ronny Engelmann).

On our track south, we have now entered the tropics, traditionally defined as the region between 23°N and 23°S. During this part of the cruise, we are constantly measuring vertical profiles of the atmospheric large-scale overturning circulation, the so called Hadley circulation, with the Intertropical Convergence Zone in the center. The Intertropical Convergence Zone can be easily identified as the region where the north-east and south-east trade winds meet and it is generally marked by high clouds and heavy rain, see for example the satellite image in Fig. 3 where two bands of clouds mark the southern and northern edge of the Intertropical Convergence Zone in the morning of July 10th. For us onboard, entering the Intertropical Convergence Zone was marked by a strong tropical rain shower, which has been followed by more rain showers. Our scientific interest in the rain clouds is due to their central role in controlling the tropical atmosphere. The high clouds in the tropics are the drivers of the entire tropical circulation, which makes understanding how and where they form crucial for our understanding of the tropical atmosphere as a whole. Despite their central role, there remain open questions, some of which can be addressed with the data collected during SO284. In particular, we are interested in how these rain clouds change the environmental conditions for subsequent clouds. To address this and other questions, we have so far launched 42 radiosondes which are complimented by continuous measurements of rain rate, temperature, wind speed, and humidity. We have now started evaluating this data and are, at the same time, preparing for our next crossing of the Intertropical Convergence Zone off the coast of Brazil.

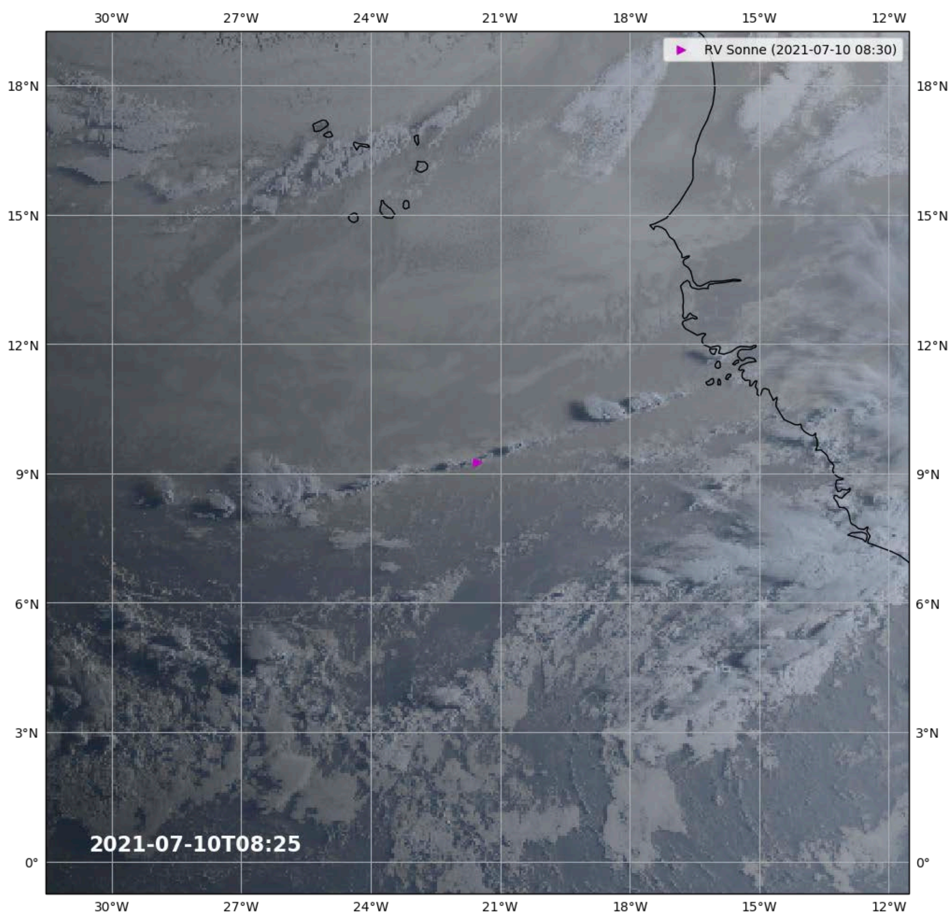

Fig. 3: Satellite image showing the location of the clouds and the location of the RV Sonne as we entered the Intertropical Convergence Zone (image taken by the GOES-16 satellite).

Within the Intertropical Convergence Zone, we also planned to have an upper ocean mixing study. By using an autonomous glider and a freely drifting surface buoy, we want to understand wind-induced surface current fluctuations. Such events are generated quite rarely but result due to the associated strong mixing into sea surface cooling and upward nutrients supply associated with enhanced biological productivity. The plan was to combine the wind-mixing study with a mixing study near a seamount. Mixing near seamounts is mostly due to tide-topography interaction. We had chosen the Annan Seamount, which is a volcanic cone that pile up from about 4500m in the deep ocean to 200m below the surface. However, when arriving at the seamount, we had to notice that we are not the only ones interested in the seamount: two fishing boats from Dakar, Senegal, 400 nm away, were anchoring at the top of the seamount. We decided to deploy the glider and the buoy somewhat outside of the area of their possible line-fishing activity. During the following days, we steered the glider around and across the seamount to measure the mixing activity with a microstructure probe attached to the glider. After this initial mission the glider will follow the freely drifting buoy, waiting for a rare wind-induced mixing event that, however, is expected to occur most often in the period July-September. We will recover the glider and the buoy at the end of our cruise.

Fig. 4: Test of the autonomous glider in the pool aboard RV Sonne. The glider (yellow) is equipped with several hydrographic sensors and a microstructure probe, which is the black piggyback instrument on top of the glider (Photo: David Menzel).

Now, we are on our way toward the equator, 23°W, where we want to service another long-term moored observatory. Transit times are used to prepare the instruments for the upcoming mooring, to calibrate the different sensors and to analyse the already acquired data. During our daily seminars, we present and discuss the results of our cruise in relation to our expectations or previous scientific results. There is also time to play table tennis, table football, or use the sauna and fitness room of RV Sonne.

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

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