RV METEOR M207

04.01.-11.02.2025
Belém – Mindelo

6. Weekly Report
03.02. - 09.02.2025

After successfully recovering the mooring on Saturday, February 1st and completing a CTD station to calibrate our instruments, we continued southward to 3°S to survey the entire ITCZ. This also allowed us to complete the section of the EUC with the shipboard ADCPs (Fig. 1).

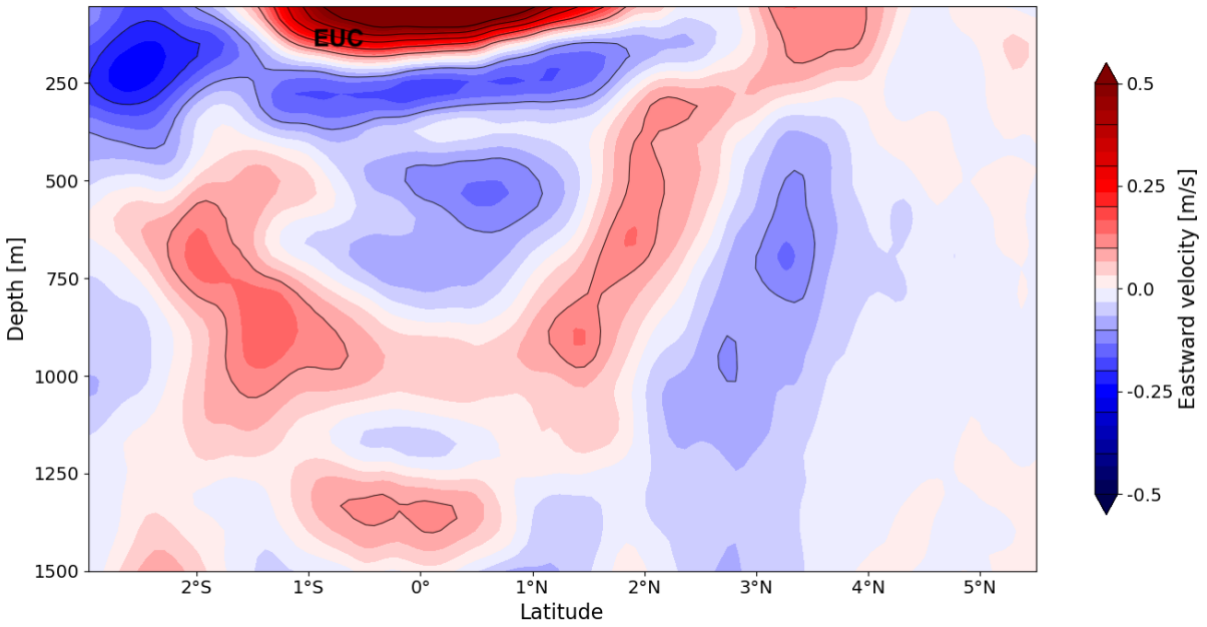

Fig. 1: Section along 23°W across the EUC between 3°S and 5.5°N from the shipboard ADCP. Graphic: Thies Johnsen.

From the moored ADCPs we only have the flow of the EUC at one location, namely exactly on the equator, but we have a good vertical and also temporal resolution of the flow (Fig. 2). Since we have often collected sections across the EUC (as in Fig. 1) on many research cruises, the information from the spatially well resolved sections, which only represent snapshots in time, can be combined with the temporally well resolved mooring data, which are fixed at one position, in order to obtain a temporally and spatially well resolved picture of the flow. This requires the use of a number of mathematical methods that are only well defined if sufficient ship sections are available.

After we had turned around at 3°S, we were able to catch another overflight of the EarthCare satellite on Monday night and deployed the mooring at the equator again in the morning of February 3, 2025 without any problems. It was very cloudy during the deployment, but we didn't have to use the rain jackets we had already prepared. During the night of February 5, 2025, we passed through some heavy thunderstorms, which delighted the meteorological team from MPI, which is involved in ITCZ research and uses radiosondes as one of their data bases.

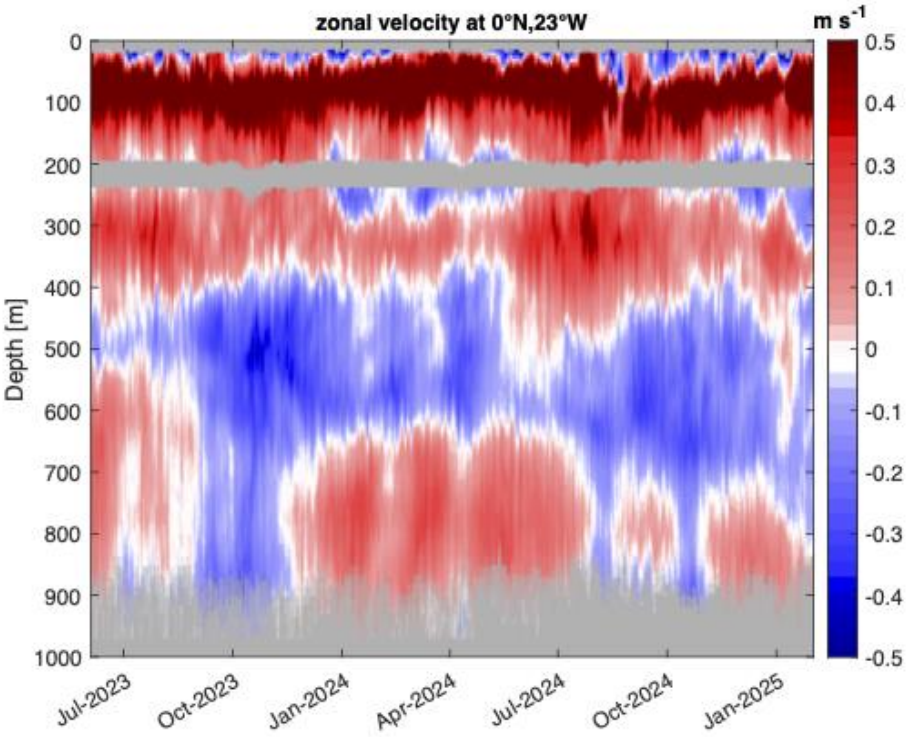

Fig.2 East (red)-west (blue)ward currents from the mooring at 23°W at the equator in the upper about 1000m. The strong eastward band in the upper 50-100m can be assigned to the Equatorial Undercurrent (EUC). Graphic: Rebecca Hummels

The radiosondes are used to obtain precise, vertically high-resolution data of the ITCZ and its surrounding area. The aim is to gain a better understanding of the ITCZ and thus of the tropical climate in general, which should also contribute to a better understanding of how it will be changing with global warming. To this end, the weather balloons to which the radiosondes are attached were launched at three-hour intervals.

Fig. 3: Weather balloon during the ascent of RV Meteor. Photo: Marius Schulz.

The weather balloons are filled with helium and rise during around 1.5 hours, reaching an average height of 24.9 km on this cruise, which is already well into the stratosphere. There they have grown to a size of approx. 7 m due to the low pressure and burst. Our weather balloons are also equipped with

parachutes, which makes it possible to obtain a second profile of the atmosphere as they fall. The probes have sensors that take measurements of pressure, temperature and humidity, which are transmitted to an antenna on board every second via a radio transmitter.

A total of 185 radiosondes were launched in cooperation between the Max Planck Institute for Meteorology and the German Weather Service. Special attention was paid to the regions where the water vapor column exceeds 48 mm, which is a common definition of the ITCZ, and launched there with the high three-hour intervals.

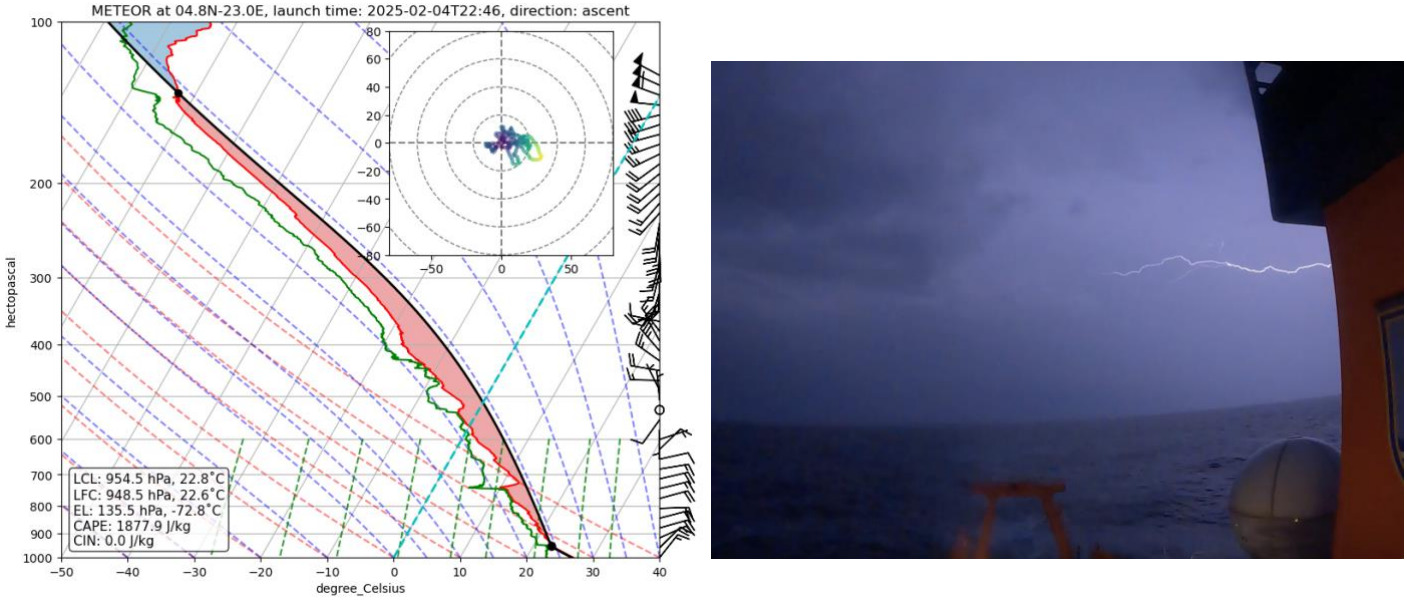

Fig.4 Left: SkewT diagram during the thunderstorm on February 04. The temperature profile shows a very warm and humid atmospheric boundary layer, while the temperature of the free troposphere (red) is below the humid adiabatic (black), and thus an instability prevails, which is expressed in the energy potentially available for convection (CAPE). Right: Lightning during a night-time thunderstorm. Graphic and photo: Marius Schulz.

Figure 5 shows the contrast between the humid tropical atmosphere and the dry subtropics. At the beginning of the week (left), the air is close to saturation throughout the troposphere, which enables deep convection. The white bar on February 4th around 7 pm is due to a weather balloon that lost contact with a thunderstorm in the ITCZ, possibly due to a lightning strike. Towards the end of the week, when RV Meteor was between 10-17°N, only the atmospheric boundary layer was still humid, while the free troposphere had a humidity of around 10% for the most part.

For most of the week, we were on a northerward course more or less directly towards Cape Verde. As we still had one last chance to catch an overflight of the EarthCare satellite, we deviated onto to the nearby satellite track at around 7°N to get as many good comparative measurements as possible with the TROPOS Oceanet-Atmosphere container, which will be later on compared with the satellite measurements. During the

night of February 8, we passed between the Cape Verdean islands of Santiago and Maio, but it was too dark and too dusty to see land. At noon on February 8, we reached the mooring position of the Cape Verde Ocean Observatory (CVOO) and began the recovery.

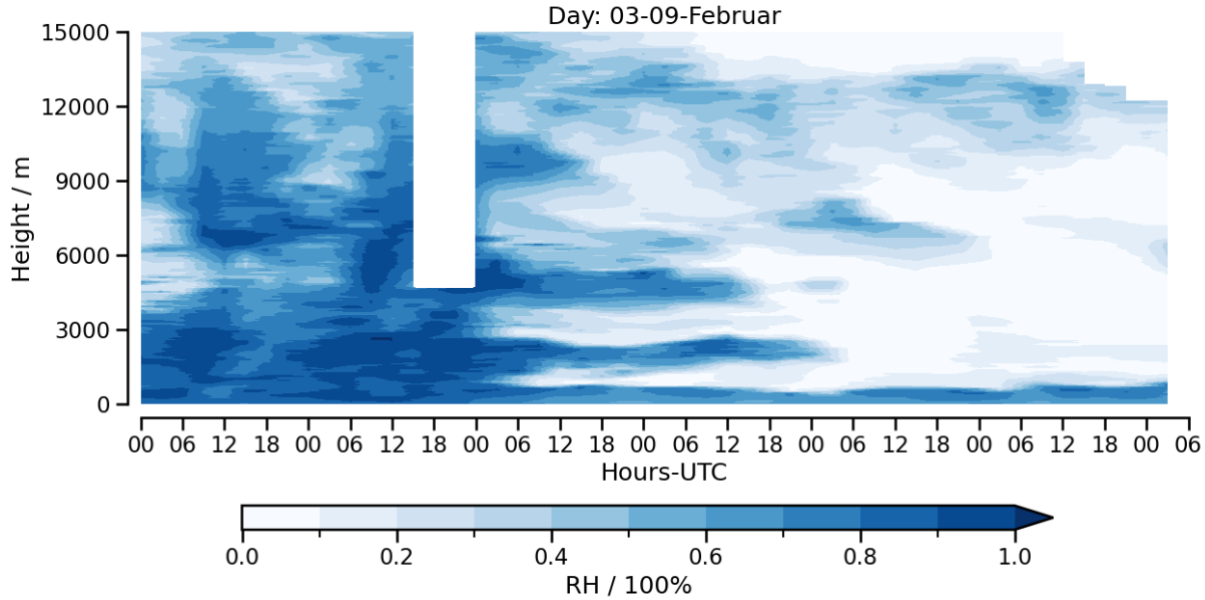

Fig.5: Time series of relative humidity profiles between February 03 and 09. Graphic: Lennéa Hayo.

The CVOO is an interdisciplinary mooring that, in addition to the usual instruments of our moorings, which typically measure currents and hydrography (temperature, salinity and also oxygen), including underwater vision profilers (UVPs) and a sediment trap. The recovery of the CVOO mooring took a little longer than expected, as there were a lot of long fishing lines tangled up around the mooring wire (Fig. 6). This intensive fishing

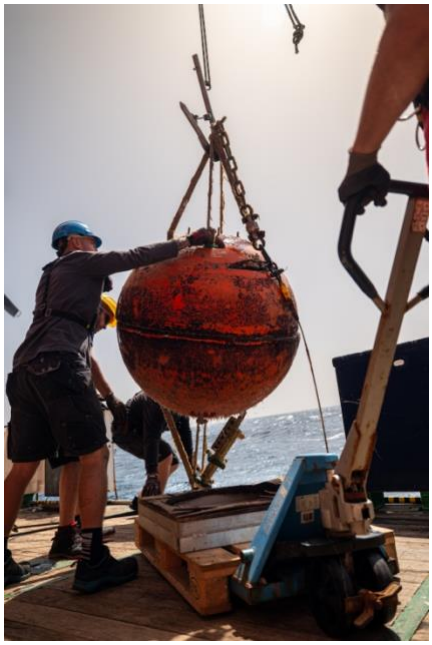

Fig. 6: Photos of the recovery of CVOO. Photos: David Menzel.

activity probably also led to the telemetry buoy, which floats on the surface and enables real-time data transmission from the upper instruments, being torn off shortly after the last deployment in June 2023. Fortunately, however, it could be recovered elsewhere and deployed again together with the other CVOO instruments on the afternoon of February 9. This deployment was the last station of Meteor cruise M207 and we are now on our way to the port of Mindelo.

Fig.7: The scientific team of M207 (last row from left to right: Hugo Silva Soares, Thies Johnsen, Arne Leuzinger, Zoe Brunßen, David Menzel, Anna Christina Hans, Ronny Engelmann, Franz Kanngießer, René Witt, Paula Damke, Philipp Henning, Matthias Klopfer, Joke Lübbecke, Philip Tuchen, Natalia Sudarchikova, Marius Schulz, Hannah-Theresa Gaenslen, Andebo Waza; front row: Tarsila Lima, Maria Américo, Cristina Mulet-Benzo, Lennéa Hayo, Daniel Rudloff, Annett Skupin, Rebecca Hummels). Photo: Christian Rohleder.

We would like to thank the captain and the entire crew of Meteor for a great research trip!

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Rebecca Hummels on behalf of the team of M207
(GEOMAR Helmholtz Center for Ocean Research Kiel)