RV METEOR – M185 “ASSOCIATE”

29.10. - 26.11.2022, Hamburg - Lisbon

3rd Weekly Report (14. - 20.11.2022)

After three weeks of travel, RV METEOR is approaching the last stations in the Strait of Gibraltar and the Alboran Sea. Our main gear, the Isaacs Kidd Midwater Trawl (IKMT), has been deployed over 40 times and continues to bring exciting catches to light. In addition to the European eel, various willow leaf larvae of other eel-like species such as conger eels have been caught. As for the European eel, also the reproduction cycle of European conger is largely unknown. So we hope with our catches we can help to unravel some of mysteries also for conger eels, cutthroat eels, bobtail snipe eels and other species, the lifecycles of which are largely unknown. Subsequent lab analyses by experts of our multidisciplinary expedition team will increase our understanding of these fascinating creatures.

Figure 1: Close-up of a leptocephalus larva of a conger eel (Congridae).

Zooplankton Food Web

The research team of Bremen University's BreMarE Centre for marine ecological research studies zooplankton distribution, predator-prey interactions and the energy flux through the pelagic food-web. The main research questions are: What are the key zooplankton taxa responsible for the energy flux through the pelagic food-web? What is their dietary composition and trophic level? Are there regional differences in the pelagic food-web structure around the Iberian Peninsula?

The region around the Iberian peninsula is a highly productive ecosystem with coastal upwelling off Galicia during summer. During the last 30 years, substantial changes in upwelling intensity and primary production have been recorded with higher values from 1989 till 1998 and from 2007 till 2016 and lower values in between. Relatively little is known about the role of zooplankton organisms for energy transfer in this region. Therefore, we are interested in the entire pelagic food-web, which supports eel larvae arriving in Europe.

Zooplankton is sampled with a multiple opening and closing net, allowing to catch organisms from five separate, discrete depth layers in one haul. Samples are screened on board immediately after the catch. Specimens of zooplankton key species are sorted alive, identified, staged, measured and deep-frozen at -80°C for later biochemical analysis of trophic biomarkers in the home lab at Bremen University.

According to preliminary results, zooplankton biomass was generally low throughout the study area, typical of the late-autumn/winter situation in November, when there is no coastal upwelling off north-western Spain. Zooplankton abundance in the surface layer (0-50 m) was dominated by small copepods. Off the northern coast of Spain, salps occurred in high concentrations. Along the Iberian west coast, krill (lantern shrimp) dominated zooplankton biomass over the continental rise at 600 to 2000 m bottom depth.

Acoustic Doppler Current Profiler (ADCP)

The analysis of the time series of ocean current velocities (in our case from 30 to 1600 m depth) collected by the shipboard ADCP will allow the recognition of the circulation patterns along the cruise track. Given that the weather conditions during the cruise have so far been characterised by the continued passage of low-pressure systems, it is to be expected that the upper ocean currents will have a direction in line with the wind direction generated by these low-pressure systems. Due to the characteristics of the study area and the time of year, the presence of the Iberian Poleward Current (IPC) is also to be expected. For example, a very preliminary analysis of the data along transect 18 (Figure 2) indicates that there was a change in the direction of the northern component of the velocity on 13 November 2022 as we moved further towards the open ocean. This change (red dots in Figure 3) is apparent after one hour of sampling along the transect and possibly caused by a poleward movement in the water column. This movement was opposite to that recorded at the beginning of the transect.

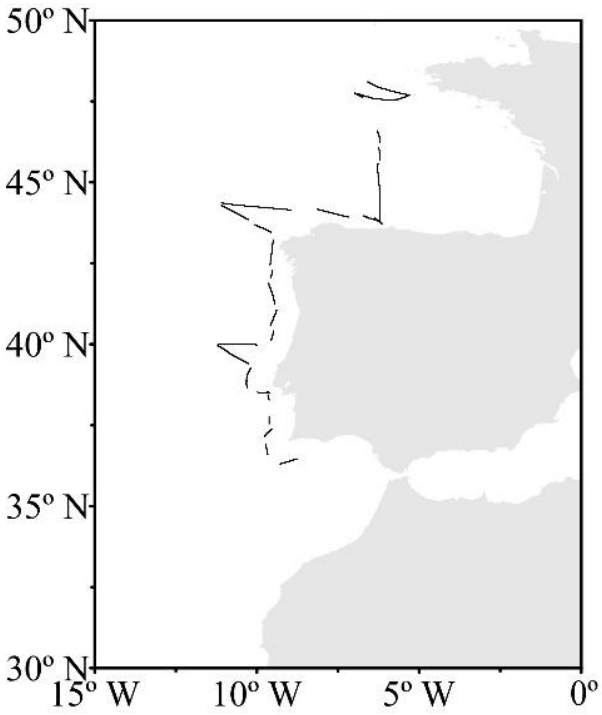

Figure 2: Map of ADCP transects until 17 November 2022 at 08:00:00 GMT.

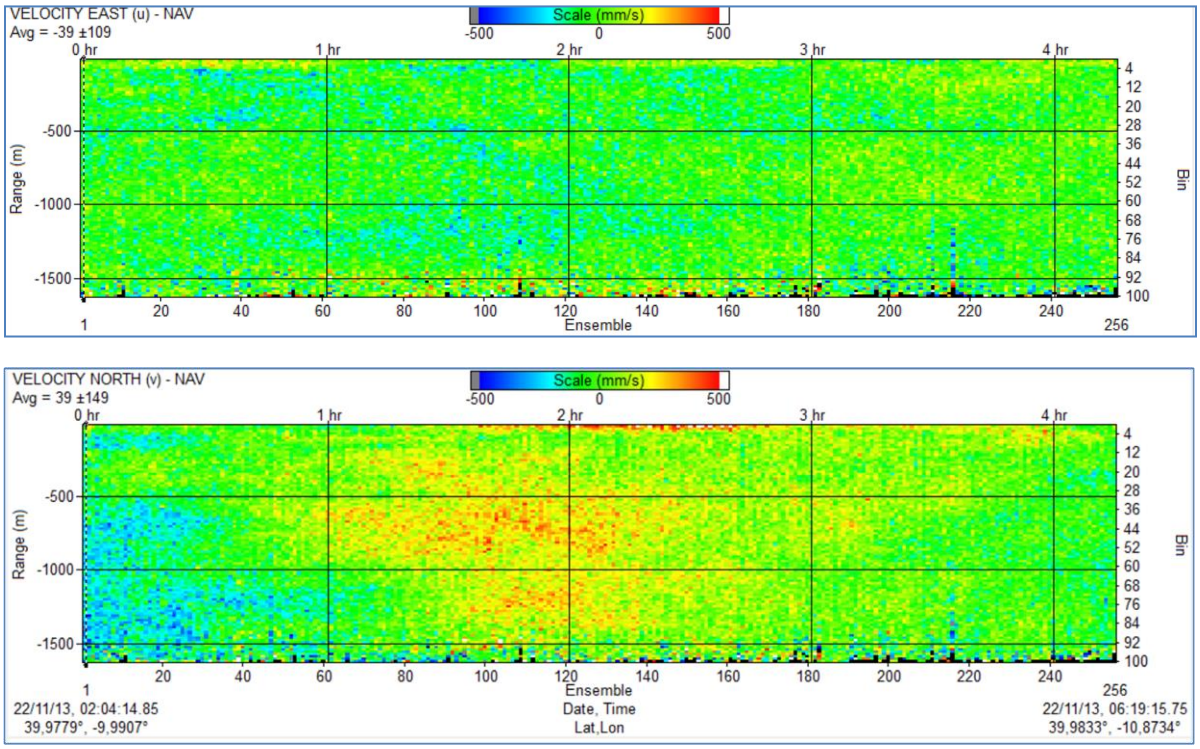

Figure 3. Time series of the eastward (top) and northward (bottom) velocity components measured by the ADCP along transect 18.

24 hours flux station

Our interdisciplinary workflow on the second 24 hours flux station ran smoothly. The weather was not that rough. As expected, the daylight catches were quite poor and mostly composed of jellyfish and siphonophores. However, nightly catches were more interesting for our research high in diversity. Since we want to measure the amount of carbon transported to the deep layers of the ocean by diel vertical migratory organisms, valuable samples could be taken for subsequent respiration analyses.

Finally, after 24 hours of work, we can happily say that we got all the samples we wanted. Moreover, we are also taking some of the crustacean samples from other stations to estimate abundance, biomass, and diversity of these organisms around the Iberian Peninsula.

In this last transect into Gibraltar Strait and the Alboran Sea, we are planning to collect more samples while slowly preparing for the disembarkation in Lisbon.

Figure 4. Left: Isaacs Kidd Midwater Trawl (IKMT), Right: Vertically towed Multiple Plankton Sampler (Multinet).

Gravitational flux

Once again, we deployed the Marine Snow Catchers (MSCs) and the Red Camera Frame (RCF) during the second of two 24-hour flux stations (Station 24). Station 24 was in the open Atlantic off the coastal shelf from Lisbon. MSCs and RCF were deployed at dusk and dawn, leaving daytime and nighttime free for net deployments so that migrant biomass could be estimated from net catches. The setup, deployments, data retrieval and laboratory analysis were much smoother the second time around as we honed our practice. All systems on the RCF provided good data and initial indications from MSC sample filtering are promising.

We carried out sinking velocity experiments on particles collected from the MSCs. This involves implanting a single particle at a time in a large measuring cylinder and timing its downward trajectory. Please enjoy another sample of images from the RCF, which display the heterogeneity of marine particles and highlight why estimations of gravitational carbon flux are so variable throughout the global ocean.

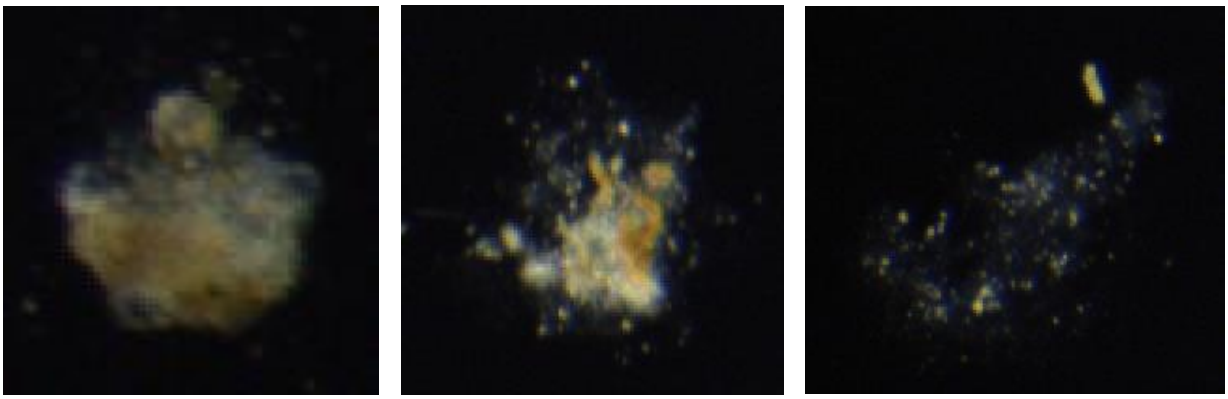

Figure 5: Pieces of "marine snow" all imaged by CPICS. The heterogeneity of these particles is clearly evident. The first (left) looks to be a compact aggregate likely made up of dead organic matter; the second (center) is has a compact nucleus most likely surrounded by exopolymers; the thirds (right) looks to be almost entirely comprised of exopolymer material. Particle size, density and composition play a significant role in the sinking speed of marine snow.

The echosounder (EK80)

The EK80, a scientific echosounder with 2 frequencies (38kHz and 200kHz), is employed during station work. It enables us to detect organisms in the water column. Specifically, it is used to observe the deep scattering layer, a dense layer of organisms found in the mesopelagic zone (200-1000m depth). This deep scattering layer is made up of a variety of organisms such as mesopelagic fishes, crustaceans, cephalopods, zooplankton, etc. Some of these organisms migrate to the surface at night and descend to deeper waters in the day. The migration undertaken by these organisms represents the largest migration on Earth in terms of biomass. With the echosounder, it is possible to observe this migration (Figure 6). Though it is not immediately possible to say exactly what organisms are present in the water column using the hydroacoustic data alone, one can generally interpret high backscatter as a high abundance in organisms. At station 16 for example, during the night-IKMT haul, the EK80 showed a strong band of high scattering, which was translated into a haul containing many small mesopelagic fish and crustaceans. The reverse is also true, at stations where the hydroacoustic data does not show much backscattering, the IKMT haul is generally very poor.

This week, the first set of calibrations of the EK80 were carried out. A small tungsten sphere had to be lowered into the echosounders beam, a procedure we carried out using fishing rods (Figure 7). After some trial and error, the skilled anglers were successful in performing the first calibration.

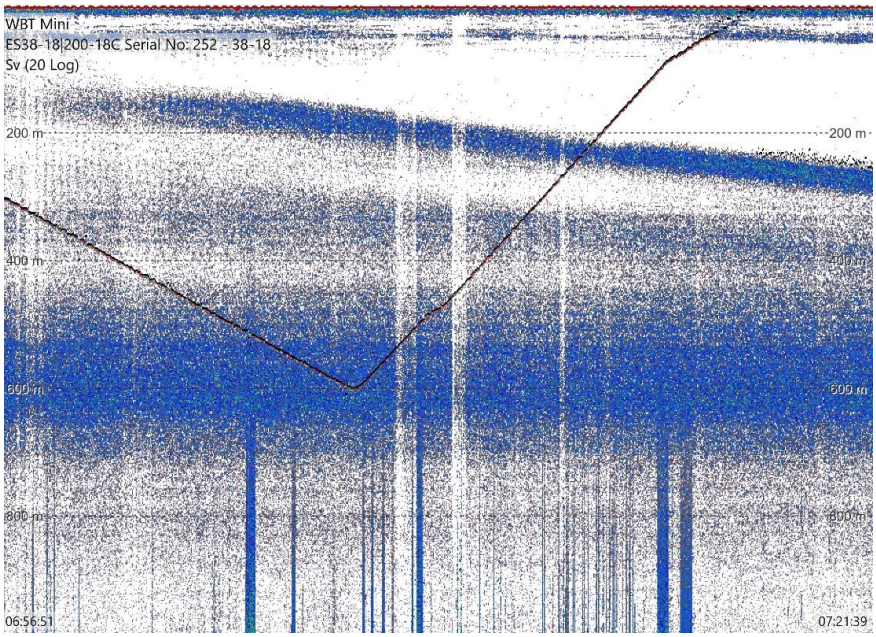

Figure 6: Screen capture from the EK80 software (38 kHz frequency) showing the migration of some organisms of the deep scattering layer from the surface to the deep in the morning. As can be seen, there are different layers migrating at different times and speeds and some organisms also didn't undertake any migration at all. The red line is the echo from the in-situ camera (RCF) descending to 600m and returning to the surface

Figure 7: *Echo sounder calibration.*

Environmental DNA (eDNA) sampling

During our trip along the west coast of the Iberian Peninsula, the weather has been favourable, and we have been able to carry out the eDNA sampling as planned. Four vertical profiles were sampled in oceanic areas in the north (off Galicia), middle (off Lisbon) and south (off Cape St. Vincent) off the Iberian Peninsula. Also, vertical profiles were sampled throughout the continental slope of Portugal. One negative control was included.

Figure 8: Water filtration in the lab (left), Filters ready to be be transported (right).

During this week, along the Portuguese and Spanish coastline we sampled some more mesopelagic fish to assess the impact of exposure to the micro plastics and related persistent pollutants. Among the most frequently encountered were Bristlemouths of the genus *Cyclothone*, Spotted lantern fishes (*Myctophum punctatum*) and Silvery light fishes (*Maurolicus muelleri*). Our samples are ready now, however it is yet unknown if and how micro plastic particles are affecting the physiological condition of the fish, especially in the gills, muscles and nervous system. The lipid composition and oxidative stress indicators will hopefully tell us a bit more about that.

Greetings on behalf of all cruise participants,

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