RV METEOR – M185 “ASSOCIATE”

29.10. - 26.11.2022, Hamburg - Lisbon

2nd Weekly Report (07. - 13.11.2022)

We have had good weather and calm seas for a few days. So the station work is progressing quickly. However, the search for late-stage leptocephalus larvae of the European eel started with several negative stations. But soon after we were successful and confirmed the catchability of our nets for the agile, transparent, about 7 cm long early life stages of this enigmatic species.

At the first 24-hour station, we sampled zooplankton with a Multinet, and micronekton with the midwater trawl, twice during the day and night time. Also the sensors were deployed multiple times, day and night, to observe changes in the depth distribution of organisms and to measure carbon fluxes from the sea surface to the deep sea.

The daily vertical migration of many plankton organisms (including copepods, krill, pteropods) and small fish (including lanternfish) from their depths of 300 to 400 m during the day to the sea surface at night is by far the largest animal migration and biomass shift on our planet. When these organisms eat unicellular algae on the surface of the sea at night and excrete part of the ingested food at great depths during the day as feces or exhale as carbon dioxide, they contribute to the flow of carbon into the deep sea and thus remove climate-damaging carbon dioxide from the direct exchange between the atmosphere and the ocean. This biological carbon pump is an important process that counteracts the greenhouse effect and global warming.

Figure 1: A small selection of our mesopelagic fish and krill catches for subsequent lab analyses.

Environmental DNA (eDNA) sampling

In addition to the net sampling, water samples were taken for the subsequent analyses of environmental DNA (eDNA). Vertical profile sampling was performed in open ocean areas in the Bay of Biscay. The first sampling took place in the middle of the bay and the second sampling was located off the galician coast at the 24-hour station. In order to identify the composition and behaviour of migratory species, also the eDNA sampling was conducted during day and night. A total of six different depths were sampled to obtain a representative vertical structure.

Figure 2: Exposing the CTD rosette with so-called Niskin bottles for water sampling (left), filling into prepared canisters for eDNA filtration (right)

Gravitational flux

The first of two 24-hour flux stations (Station 14) saw the first deployments of the Marine Snow Catchers (MSCs) and the Red Camera Frame (RCF) carrying a number of in-situ cameras. With the first station having been moved from the Bay of Biscay due to bad weather, the SUMMER Team deployed this gear north-west of Galicia.

Marine Snow Catchers offer the opportunity to capture large volumes of water and associated sinking particles, to determine downward flux of particulate organic carbon (POC; the rate of sinking material in a given area). However, this approach only permits study of sinking particles at a limited number of discrete depths in the water column.

The RCF carries four imaging systems (LISST-Holo2; CPICS; UVP5; ECOTriplet) and a CTD logger (RBR Concerto) and affords continuous measurements throughout the water column. By pairing MSC measurements with novel, state-of-the-art camera systems on the RCF, we are able to study sinking particles in far greater resolution from the surface down to 600m.

A combination of MSCs and the RCF were deployed successfully at both dawn and dusk. Preliminary checks of the data from all camera systems are very encouraging and we are looking forwards to analysing the MSC data to use in conjunction with the image data.

Below are a few sample pictures we have seen from the camera systems!

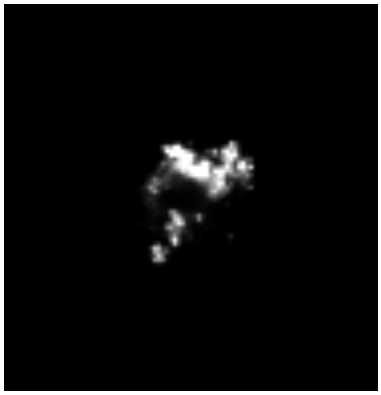

Figure 3: A piece of "marine snow", imaged by the UVP5. So-called because these sinking particles have the appearance of snowflakes when seen underwater, these particles are key in transporting carbon away from the atmosphere to the deep ocean.

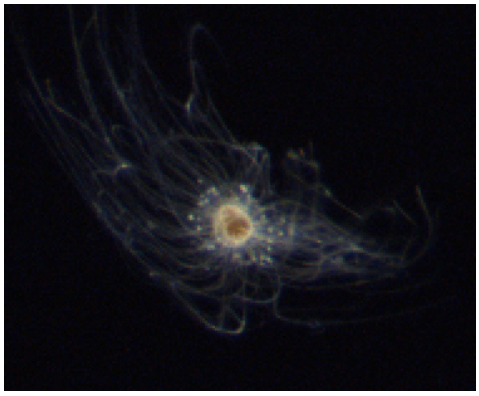

Figure 4: A jellyfish, illuminated by the CPICS camera. The team onboard studying eelse with be very familiar with these, having collected huge numbers of gelatinous plankton in their net hauls!

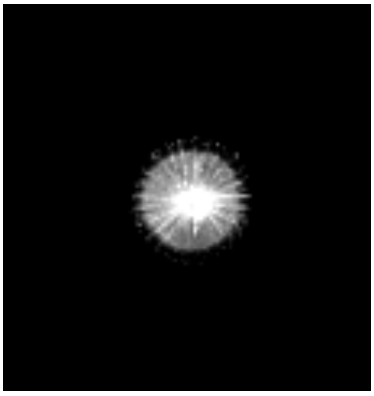

Figure 5: It might have been fireworks night in the UK this week, but this isn't a firework, it's a Phaeodarian! These cool critters make elaborate mineral skeletons made of silica.

Hydroacoustic current measurements

Upper-ocean velocities (from the sea surface to 1600 m depth) were measured and recorded along the cruise track by a vessel-mounted 38 kHz Acoustic Doppler Current Profiler (ADCP). The instrument is similar to a sonar and uses the Doppler effect of sound waves scattered back from particles within the water column. The transducer was located at 5 m below the water line. The instrument was operated in narrowband mode with 16 m bins and a blanking distance of 16 m, while 100 bins were recorded using a pulse of 2.89 s.

The figure below shows an example of the data obtained from the ADCP (echo intensity time series, profiles of the northward and eastward components of the ocean velocities, magnitude and direction of these velocities, and some statistics of collected data, and magnitude and direction time series in the first bin located at approximately 31 m depth).

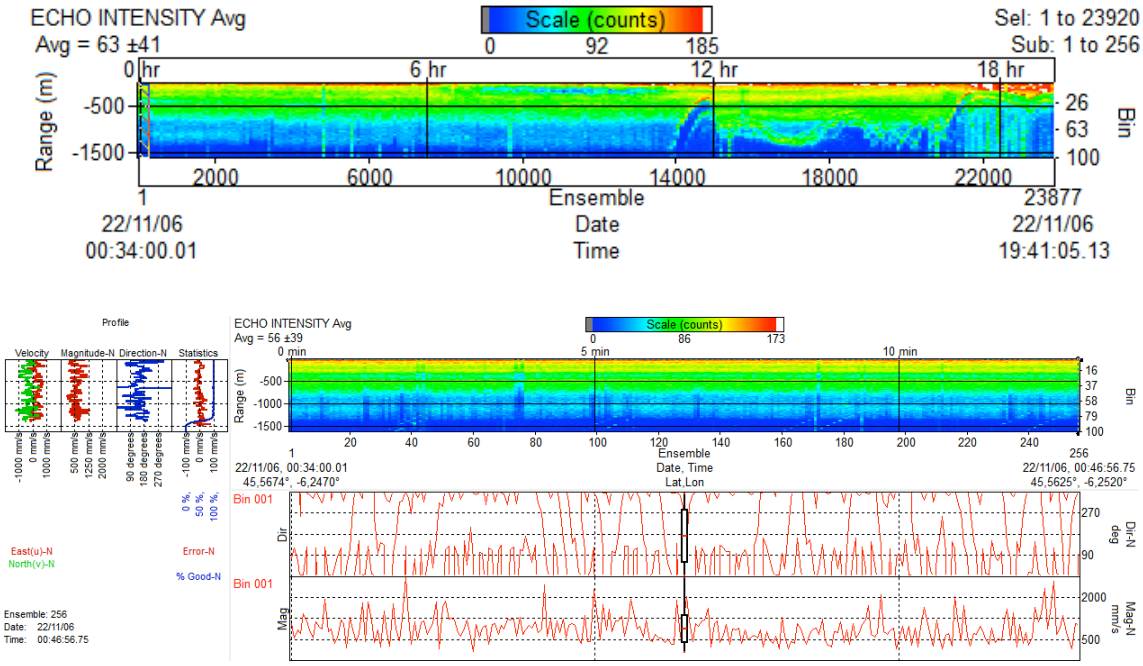

Figure 6: (Top) Time series of the echo intensity profile measured by the ADCP on 6 November 2022 from 00:34:00 GMT (first ensemble) to 19:41:05 GMT (last ensemble). (Bottom left) Profiles of the northward and eastward velocity components, velocity magnitude and direction, and percentage of accurate measurements and error at 00:34:00 GMT. (Bottom right) Time series of the echo intensity profile measured by the ADCP on 6 November 2022 from 00:34:00 GMT to 00:46:57 GMT. Vessel positions (latitudes and longitudes) at the beginning and end of this time series are also included. The times series of the velocity direction and magnitude measured by the ADCP at approximately ---32 m depth (location of the first bin of the ADCP configuration) are also shown at the bottom (in red). The units of echo intensity and velocity are counts and mm/s, respectively.

Deep sea fish projects

Over the week, several midwater trawl deployments steadily increased our total catch of mesopelagic fish. Although some catches were not particularly rich, we managed to catch and sample some attractive species, among which the Silvery lightfishes (*Maurolicus muelleri*), Spotted lanternfishes (*Myctophum punctatum*), and Half-naked hatchetfishes (*Argyropelecus hemigymnus*) were the most abundant. All of them are equipped with light organs in species-specific arrangements. Boa dragon fishes (*Stomias boa*) with a bioluminescent barbel and Bluntsnout smooth-heads (*Xenodermichthys copei*) also appeared in the catches and were sampled for genomic investigations on the evolutionary adaptations of fish eyes to the specific light conditions in the deep ocean. The number of samples is increasing every day and we are looking forward to deep trawls and southern stations that could reveal even higher biodiversity.

Figure 7: The Boa dragonfish (Stomias boa) (left)
and Half-naked hatchetfish (Argyropelecus hemigymnus) (right).

Some of the caught fish species will be also monitored for the presence of microplastics in their digestive system. Ingested microplastic particles are reported to potentially cause negative impact on the health status of fish, such as lipid oxidative damage in different fish organs, neurotoxicity and many others. We hope not to find any such effects that would indicate stress for the organisms in the deep sea!

Greetings on behalf of all cruise participants,

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