FS Meteor
Expedition **M206**

01.12.2024 (Fortaleza) –
30.12.2024 (Belém)

M206, 3. Weekly Report 09.12.-15.12.2024

After we had sampled the Rio Pará itself downstream of Belém at the end of last week, we then started with the Pará transect (Fig. 1) from the estuary towards the open ocean. We already knew from satellite data that relatively little freshwater was currently flowing from the Pará onto the shelf due to the pronounced dry season. For our stations, this meant that we already found a very high salinity of 10-25 PSU in the estuary area and thus a large part of the geochemical reactions that occur when fresh and saltwater mix and significantly influence the flow of substances into the ocean are currently already taking place in the estuary area. This includes the flocculation of colloids and sedimentation of particles with sorbed trace metals and DOM (dissolved organic matter). The sometimes very fine-grained sediment cores that we have sampled in the Pará and its estuary will provide us with information about the sediment as a sink for these substances. After 60 nautical miles from the point of lowest salinity in the river (3 PSU), 'normal' seawater salinity of >36 PSU had already been reached and further multicorer stations showed sandy sediment again, which documents increased bottom currents.

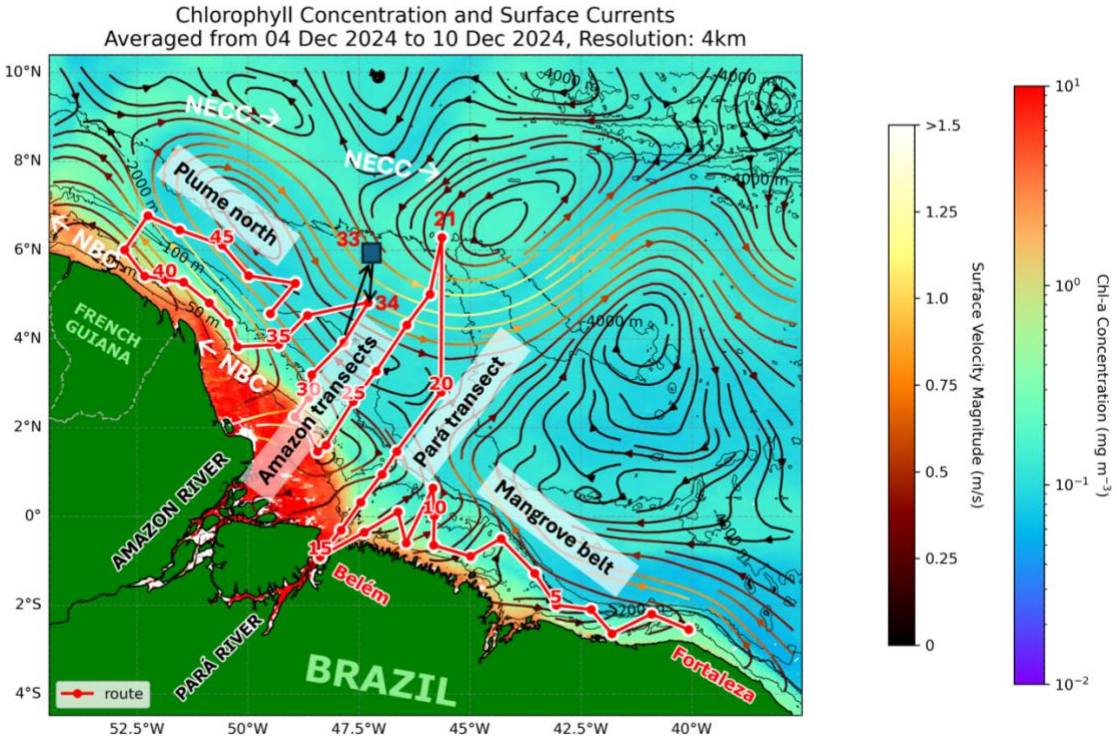

Abb. 1: Map of the working area based on chlorophyll data (map created by Rami Kalfouni; source of data: Copernicus product Global Ocean Colour (Copernicus-GlobColour), Bio-Geo-Chemical, L4 (monthly and interpolated) from Satellite Observations (1997-ongoing)), which shows the influence of the mangrove belt and the Amazon and Pará river plume. The stations 1-33 (mangrove belt, Pará transect and Amazon transect) and further planned stations in the direction of the river plume flowing north-west with the NBC are shown. The two northernmost stations 21 and 33 were added to the original route to cover the part of the plume that branches off to the east with the NECC and splits at 8-10°N. NBC = North Brazil Current; NECC = North Equatorial Counter Current

After several stations on the shelf and the shelf edge and a further deep station at a water depth of approx. 4000 m, which was already clearly outside the area of influence of the river water plume, we decided to place a further station approx. 200 nautical miles further north at 6°N in the area where satellite data again show an increase in chlorophyll concentrations. The overall picture of the research area (Fig. 1) shows that the river plume, which moves north-westwards along the coast with the North Brazil Current (NBC), splits into two parts in the border area between French Guyana and Suriname. One part moves further north-west towards the Caribbean and the other changes direction between 8°N and 10°N due to the influence of the North Equatorial Counter Current (NECC) and flows back to the south-east. The slightly increased chlorophyll concentrations indicate that there are obviously still enough nutrients being transported from the Amazon plume to measurably increase phytoplankton productivity. In fact, we also see a decrease in surface water salinity of up to 0.4 PSU towards this region, possibly also an effect of the Amazon plume, which appears to be held in this region by an eddy. We hope to detect this far-reaching river plume effect in the samples from Station 21 conducted there in the data from the various parameters to be analysed in the home laboratory. The corresponding preparatory work on the water samples is already taking place on board (two of the laboratories are presented in Fig. 2).

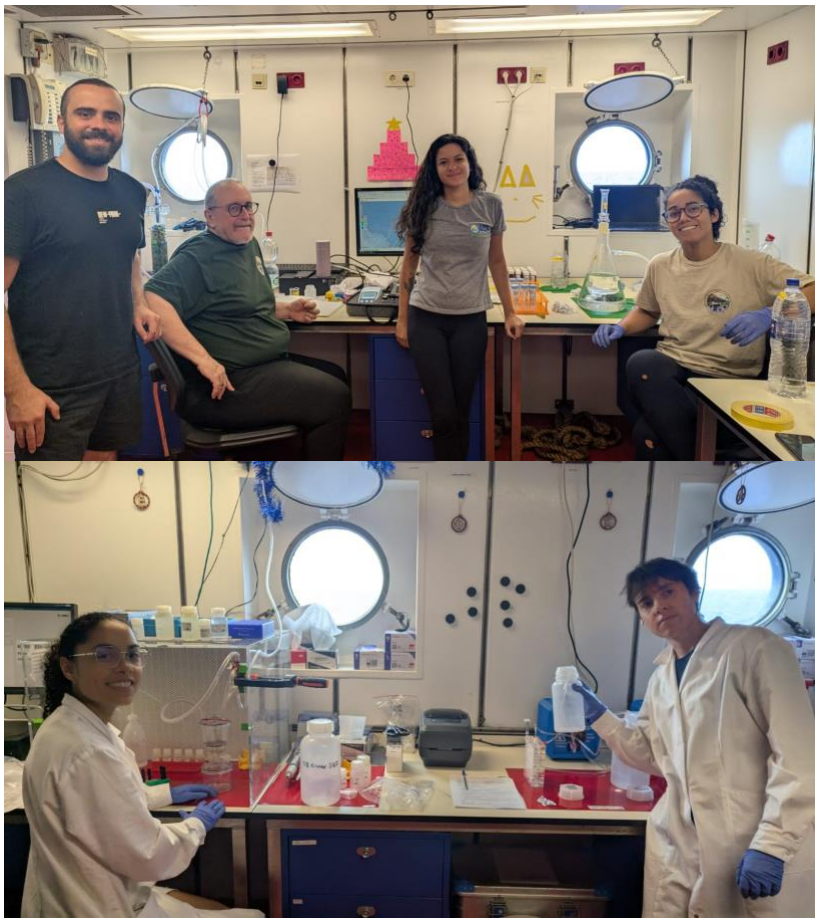

Fig. 2a: Organic laboratory of the Brazilian colleagues Diego Lacerda, Carlos Rezende, Alana Lima Reis Delatorre and Mariana Freitas de Souza (from left); here DOM (dissolved organic matter) is enriched by solid phase column extraction and various parameters such as CO_2 are measured in the samples.

Fig. 2b: Laboratory for the filtration of water samples for later trace metal analysis in different size fractions between truly dissolved and particulate: Sequential filtration through membrane filters (Caitlyn Kelly, left) and ultrafiltration (Adrian Hollister, right).

After completing the Pará transect, we started the southern Amazon transect from the seawater end link with an alternation of pure surface water sampling and a full programme including the entire water column and surface sediment on the route towards the Amazon outflow. In the area of the shelf edge, a very strong current hampered some of the equipment deployments, but apart from this, all sampling was successful. However, about 100 nautical miles from the mouth of the Amazon, the shelf was already so shallow and interspersed with sandbanks that the stations we had planned further

towards the mouth could not be carried out. At the south-westernmost sampling point of the Amazon transect, the minimum salinity was already 28 PSU, so that we could not reach the low-salinity mixing area here. We therefore switched to the northern Amazon transect and over the past three days we have successfully carried out water and sediment stations parallel to the southern Amazon transect up to the seawater end-member at station 34. In addition, we added another station (33, Fig. 1) at 6°N to sample the part of the Amazon plume diverted by the NECC, similar to station 21.

We have already submitted an application to navigate the Amazon via the North Channel to Macapá and hope that this will be approved in time before the end of the trip so that we can sample the Amazon river end-member and the low-salinity mixing area here on the return journey from the EEZ of French Guiana, our northernmost working area, to Belém. In the coming week, we will first move westwards back to the coastal region in the direction of French Guiana and follow the river plume further north-west. Samples to measure radium isotopes, which will be taken at all water stations, will give us information about the path of the water masses and the time they need from the outflow to the different areas of the river plume.

Best regards from Andrea Koschinsky and Martin Frank (M206 co-chief scientists) and the entire M206 team