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The MOSES Sternfahrt Expeditions of the Research Vessels ALBIS, LITTORINA, LUDWIG PRANDTL, MYA II and UTHÖRN to the Elbe River, Elbe Estuary and German Bight in 2022

Edited by
Ingeborg Bussmann, Norbert Anselm, Holger Brix,
Norbert Kamjunke, Matthias Koschorreck,
Björn Raupers, Tina Sanders

with contributions of the participants

HELMHOLTZ

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Herausgeber

Dr. Horst Bornemann

Redaktionelle Bearbeitung und Layout

Susan Amir Sawadkuhi

Alfred-Wegener-Institut
Helmholtz-Zentrum für Polar- und Meeresforschung
Am Handelshafen 12
27570 Bremerhaven
Germany

www.awi.de
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Editor

Dr. Horst Bornemann

Editorial editing and layout

Susan Amir Sawadkuhi

Alfred-Wegener-Institut
Helmholtz-Zentrum für Polar- und Meeresforschung
Am Handelshafen 12
27570 Bremerhaven
Germany

www.awi.de
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Titel: Die Forschungsschiffe Uthörn und Ludwig Prandtl mit Blick von der Littorina vor Helgoland (Photo: Björn Raupers, GEOMAR).

Cover: The research vessels Uthörn and Ludwig Prandtl as seen from the RV Littorina in front of the island of Heligoland (photo by Björn Raupers, GEOMAR).

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The MOSES Sternfahrten 2022
with RV *Albis*, RV *Littorina*, RV *Ludwig Prandtl*, RV *Mya II*, RV *Uthörn*

Binnen Elbe	25.04. – 03.05.2022
Tide Elbe	23.05. – 25.05.2022
Stern_9	30.05. – 02.06.2022
Sylt Transects	March – December 2022
Tangermünde	18.08. – 22.08.2022

From Dresden to the North Sea

Modular Observation Solutions for Earth Systems

Chief Scientists

Ingeborg Bussmann (AWI) – RV *Mya II* and RV *Uthörn*

Holger Brix, Tina Sanders (Hereon) – RV *Ludwig Prandtl*

Björn Raupers (GEOMAR) – RV *Littorina*

Norbert Kamjunke (UFZ) – RV *Albis*

Coordinator

Ingeborg Bussmann

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1. ÜBERBLICK UND EXPEDITIONSVERLAUF

Ingeborg Bussmann, Philipp Fischer DE.AWI,
Holger Brix DE.Hereon

Fünf verschiedene Expeditionen im Jahr 2022 dienten dazu, als MOSES-Konsortium einen Beitrag zu den im POV-4-Programm der Helmholtz-Gemeinschaft festgelegten Forschungszielen zu leisten. Die Expeditionen dienten dazu, die Prozesse im Küstenmeer, in der Atmosphäre und an Land miteinander zu verknüpfen. Die Anknüpfung an ähnliche Fahrten in den Vorjahren wird es uns ermöglichen, Veränderungen in den jeweiligen Umgebungen erfassen können (Bussmann et al. 2020; 2021; 2022). Die Feldarbeit konzentrierte sich auf die Erfassung der wichtigsten Nährstoff- und Kohlenstoffquellen auf saisonalen bis jährlichen Zeitskalen für das Kontinuum zwischen Einzugsgebiet und Ozean wie z. B. den Transport von Nährstoffen aus dem Elbeeinzugsgebiet in das Ästuar, das Wattenmeer und die Deutsche Bucht der Nordsee. Das ehrgeizige Programm war nur möglich durch die enge Zusammenarbeit der Helmholtz-Partner mit ihren jeweiligen Schiffen: UFZ mit der *Albis*, Hereon mit der *Ludwig Prandtl*, Geomar mit der *Littorina* und AWI mit der *Mya II* und *Uthörn* sowie durch die tatkräftige Unterstützung der Schiffsbesatzungen.

Unsere Fahrten und Expeditionen begannen im Frühjahr 2022 in der Nähe der Elbquelle in der Tschechischen Republik und folgten dem Flusslauf bis zum Geesthachter Wehr. Wir konzentrierten uns auf die Dynamik von Phytoplankton und Nährstoffen, die Konzentration und Zusammensetzung gelöster organischer Stoffe sowie die Dynamik von Treibhausgasen im Wasser und in der Atmosphäre. Die darauffolgende Expedition startete Ende Mai an der Insel Scharhörn in der Elbmündung und fuhr gegen das abfließende Wasser bis auf die andere Seite des Geesthachter Wehrs. Die Ausbreitung der Elbfahne wurde anschließend von den Stern-9-Fahrten mit den drei Küstenforschungsschiffen in einem weiten Bereich von 7,6°O bis 8,9°O und von 53,5°N bis 54,8°N verfolgt. Um die Frühjahrsblüte mit der Herbstblüte zu vergleichen, folgte Stern_9-Fahrt im Mai 2022 der gleichen Fahrtroute die Stern_5 im September 2020 zurückgelegt hatte. Der neue MOSES-Container wurde im Vorfeld mit unseren Standardinstrumenten ausgestattet und kurz vor der Fahrt auf die Uthörn verbracht. Um auch den Norden unseres Untersuchungsgebietes mit den grundlegenden hydrographischen Parametern zu erfassen, verließ *Mya II* monatlich List auf Sylt Richtung Westen ("Butendiek Transects").

Eine frühere Studie unserer MOSES-Gruppe hatte gezeigt, dass die anthropogenen Buhnenstrukturen entlang der Elbe einen starken Einfluss auf den Methanhaushalt haben. Die Ergebnisse vorheriger Ausfahrten wurden daher genutzt, um in einer kleinskaligen Studie die zeitliche und räumliche Variabilität der terrestrischen und aquatischen Flüsse von Kohlendioxid und Methan näher zu untersuchen.

In den Vorjahren hatten wir ein IT-System zum Austausch von Daten und Informationen zwischen den Schiffen auf der Nordsee eingerichtet. In diesem Jahr bestand das Ziel darin, die Daten mit der ODV-Software in nahezu Echtzeit zu visualisieren

SUMMARY AND ITINERARY

Five separate expeditions in 2022 were used to contribute as MOSES consortium to the research objectives outlined in the Helmholtz Association's POV-4 programme. The expeditions served to link the processes in the coastal sea, the atmosphere and on land. Combining the data gathered in 2022 with those from similar cruises in previous years will enable us to register changes in the respective environments (Bussmann et al. 2020; 2021; 2022). The fieldwork focused on identifying the main sources of nutrients and carbon at

seasonal to annual time scales for the catchment-to-ocean continuum. This encompassed, for example, the transport of nutrients from the Elbe catchment into the estuary, German Bight, Wadden Sea and North Sea. The ambitious programme was only possible through a strong cooperation between the Helmholtz partners and their research vessels: UFZ with *Albis*, Hereon with *Ludwig Prandtl*, Geomar with *Littorina* and AWI with *Mya II* and *Uthörn;* as well as the energetic support of the ship's crews.

Our cruises and expeditions started in early spring 2022 near the source of the river Elbe in the Czech Republic, following its course to the Geesthacht weir. We focused on phytoplankton and nutrient dynamics, the concentration and composition of dissolved organic matter, and greenhouse gas dynamics in the water and the atmosphere. The subsequent expedition started in late May at the island of Scharhörn in the Elbe Estuary, cruising against the outflowing water up to the other side of the weir of Geesthacht. The spreading of the Elbe plume was subsequently followed by the Stern_9 cruises involving three coastal research vessels covering a wide range from 7.6°E to 8.9°E and from 53.5°N to 54.8°N. In order to compare a spring bloom situation with an autumn situation, Stern_9 followed the same cruise track covered by Stern_5 in September 2020. The new MOSES container was equipped beforehand with our standard instruments and was placed on the Uthörn, shortly before the cruise. To also cover the north of our study area with the basic hydrographic parameters, *Mya II* left List of Sylt and headed to the west ("Butendiek Transects") on a monthly basis.

A previous study from our MOSES group had shown that the anthropogenic groyne structures along the Elbe have a strong impact on the methane budget. Thus, the results from these cruises will be used to go into more detail here, with a small-scale study investigating the influence of temporal versus spatial variability on the terrestrial and aquatic fluxes of carbon dioxide and methane.

In previous years we had set up an IT system to exchange data and information between the ships on the North Sea. This year, the aim was to visualize the data, in near-real time, with the ODV-software.

2. BINNEN ELBE WITH *ALBIS* (25.04. – 03.05.2022, HYDREX_2022_APR_INLAND_ELBE)

Sven Bauth[1], Vera Brandtner[2], Charlotte Hempel[1], Heike Goretzka[1], Norbert Kamjunke[1], Ute Link[1;]
not on board: Ingeborg Bussmann[3]

[1]DE.UFZ
[2]DE.TU Braunschweig
[3]DE.AWI

Objectives

The objective of the measurements in the freshwater part of the Elbe River was to investigate riverine eutrophication, i.e., phytoplankton and nutrient dynamics, as well as bacteria and dissolved organic matter (DOM) quality, greenhouse gasses in water and air, mercury enrichment in phytoplankton along the whole stretch of the river, from near the Czech source to the weir at Geesthacht (Fig. 2.1). As a consequence, we expect a longitudinal decrease of dissolved nutrients as nitrate and phosphate are taken up by algae. The growth of high algal biomass in the river might affect water quality in the estuary as the degradation of the algal bloom causes oxygen deficiency.

Fig. 2.1: Map of the Elbe sampling sites in Germany from Schmilka (Elbe km 4) towards Geestacht (Elbe km 585). Red dots indicate the sampling stations, blue dots the stations at tributary mouths.

Work on the river

Water samples were taken at fixed stations which were investigated in previous years / cruises. These stations are located along the Elbe, mainly at bridges and at the outlet of tributaries. At these stations the left side, the middle and right side of the river were sampled. At each location the ship was anchored. Basic hydrographic parameters were measured using a YSI multiparameter probe at each station (Fig. 2.2). Each evening water samples were picked up from colleagues and transported to the home laboratory (UFZ Magdeburg) for subsequent analyses.

Fig. 2.2: Horizontal water sampler, Albis at Magdeburg (Photos by N. Kamjunke)

In addition to the programme of the colleagues from Magdeburg, a PocketFerryBox and a LosGatos Analyzer were set up to continuously measure the basic hydrographic parameters and dissolved methane. PocketFerryBox and LosGatos Analyzer were pumping water from the moon pool of the *Albis*. Its volume was approx. 14.7 L with a flow rate of approx. 0.8 L/sec, thus the turnover time (V/f) was 19 sec. The pressure regulator for the degasser was not working properly during this cruise, thus there might be data gaps.

During the cruise, meteorological parameters and atmospheric gas concentrations were measured continuously. The LI-COR Trace Gas Analyzer LICOR 7810 uses Optical Feedback-Cavity Enhanced Absorption Spectroscopy (OF-CEAS) to measure the concentration of greenhouse gasses such as CH_4 in ppb and CO_2 in ppm. This LICOR 7810 was installed on the upper deck to continuously measure these atmospheric gas concentrations every second. Required meteorological data such as air temperature, air pressure, relative humidity and rainfall were measured by the SenseBox and Watchdog 2700 weather station as well.

Details on the station list, the applied sensors and locations for data access can be found in Table A.3.1 and Table A.3.2

Preliminary results

Water temperature ranged between 11 – 15 °C (Fig. 2.3). The Elbe River was eutrophic, i.e., and showed high chlorophyll-a concentrations (increasing longitudinally from 40 to 70 µg L^{-1}; Fig. 2.4), oxygen oversaturation ranged from 110 – 160 %, and high pH values (8.7 – 9.2) were observed.

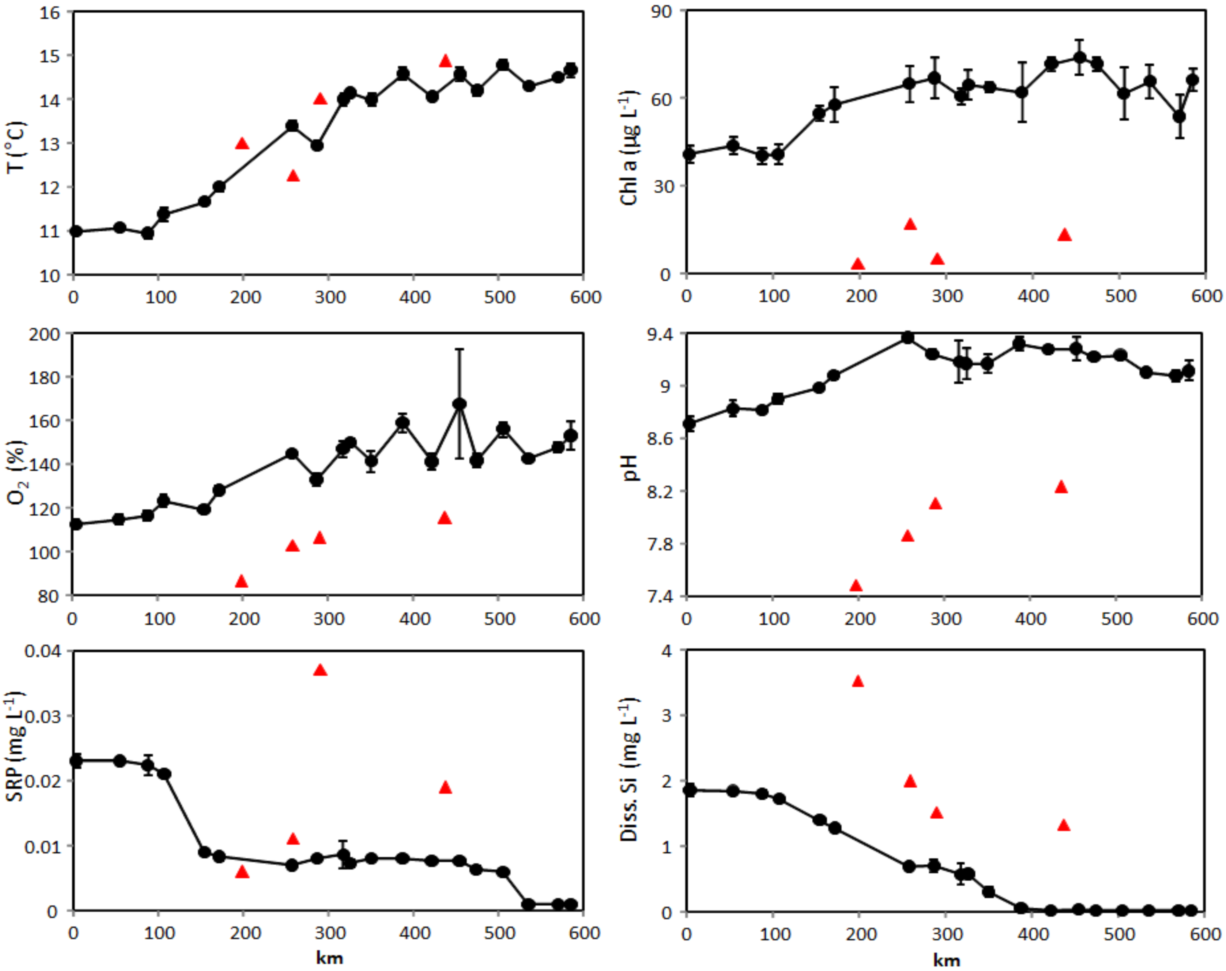

Fig. 2.3: Water temperature, chlorophyll a, oxygen, pH, phosphate and silica concentrations in the German freshwater Elbe. Black: Elbe River, red: tributaries

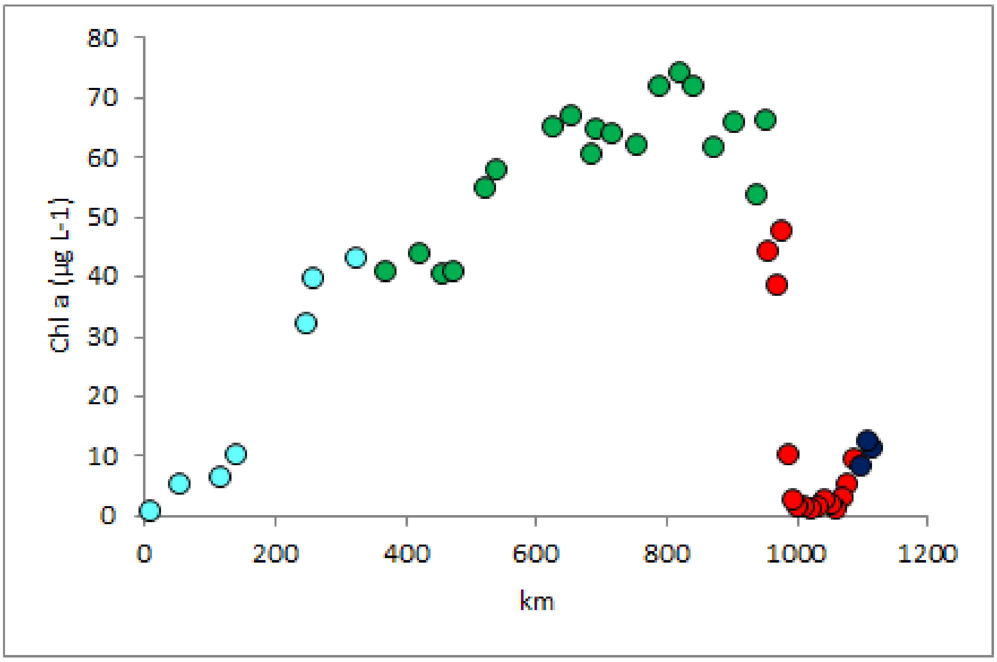

Fig. 2.4: Chlorophyll-a concentration along the Elbe River;
light blue: increasing values in the Czech part, green: maximum values in the German freshwater Elbe,
red: minimum in the estuary, dark blue: slight increase in the German Bight

3. TIDE-ELBE (23.05. – 25.05.2022, HYDREX_2022_TIDAL_ELBE)

Rhiannon Breider[1], Hannah Jebens[2], Norbert Kamjunke[3], Vanessa Russnak[1], Tina Sanders[1], Leon Schmidt[1],

[1]DE.Hereon
[2]DE.AWI
[3]DE.UFZ

Objectives

The Tide-Elbe transect cruises which are led by Hereon start in the North Sea, near the island of Scharhörn and end just before the weir in Geesthacht. Since we were cruising against the outflowing water, it took us several days to cover the distance to the weir of Geesthacht. On the first day (23.05.2022) we headed from Cuxhaven towards Scharhörn. We reached the island approximately 1 hour after high tide, and started our way back up the Elbe until Glückstadt. On the second day (24.05.2022), we covered the distance between Glückstadt and Oortkaten and on the third day (25.05.2022) we continued from Oortkaten on the last stretch until the weir in Geesthacht. During the cruise there were no fixed stations, but samples were continuously taken from the ferry box outlet every 20 minutes.

Basic hydrographic parameters were recorded with the ferrybox from the *Ludwig Prandtl*. For dissolved methane water samples (n = 37) were taken along the transect and with the LosGatos-System it was recorded continuously. In addition, atmospheric methane was recorded with a Licor instrument on top of the vessel (Tab. A.4.2). Multiple water samples were taken at the ferrybox outlet for later laboratory analysis by colleagues from Hereon and UFZ (details see Tab. A.4.1).

Preliminary results

The measured parameters revealed clear patterns in the Elbe Estuary (Fig. 3.1). Salinity started to rise between km 665 and 675, depending on the tide at the two sampling days. Oxygen saturation was above 100 % upstream of the Hamburg Port, with a clear minimum (< 60%) in the port region. Downstream of Hamburg Port the oxygen saturation continuously increased towards the North Sea. During this cruise no clear MTZ (Maximum Turbidity Zone) was developed. The water temperature decreased on the way to the North Sea (from 19 °C to 13 °C).

Nutrients (ammonium, nitrite, nitrate, silicate and phosphate) also showed clear patterns: Ammonium and nitrite peaked in Hamburg Port and in the onset of the salinity gradient. In contrast, nitrate, silicate and phosphate concentration were depleted at the beginning of the estuary and increased towards the onset of the salinity gradient and were subsequently mixed conservatively into the North Sea water.

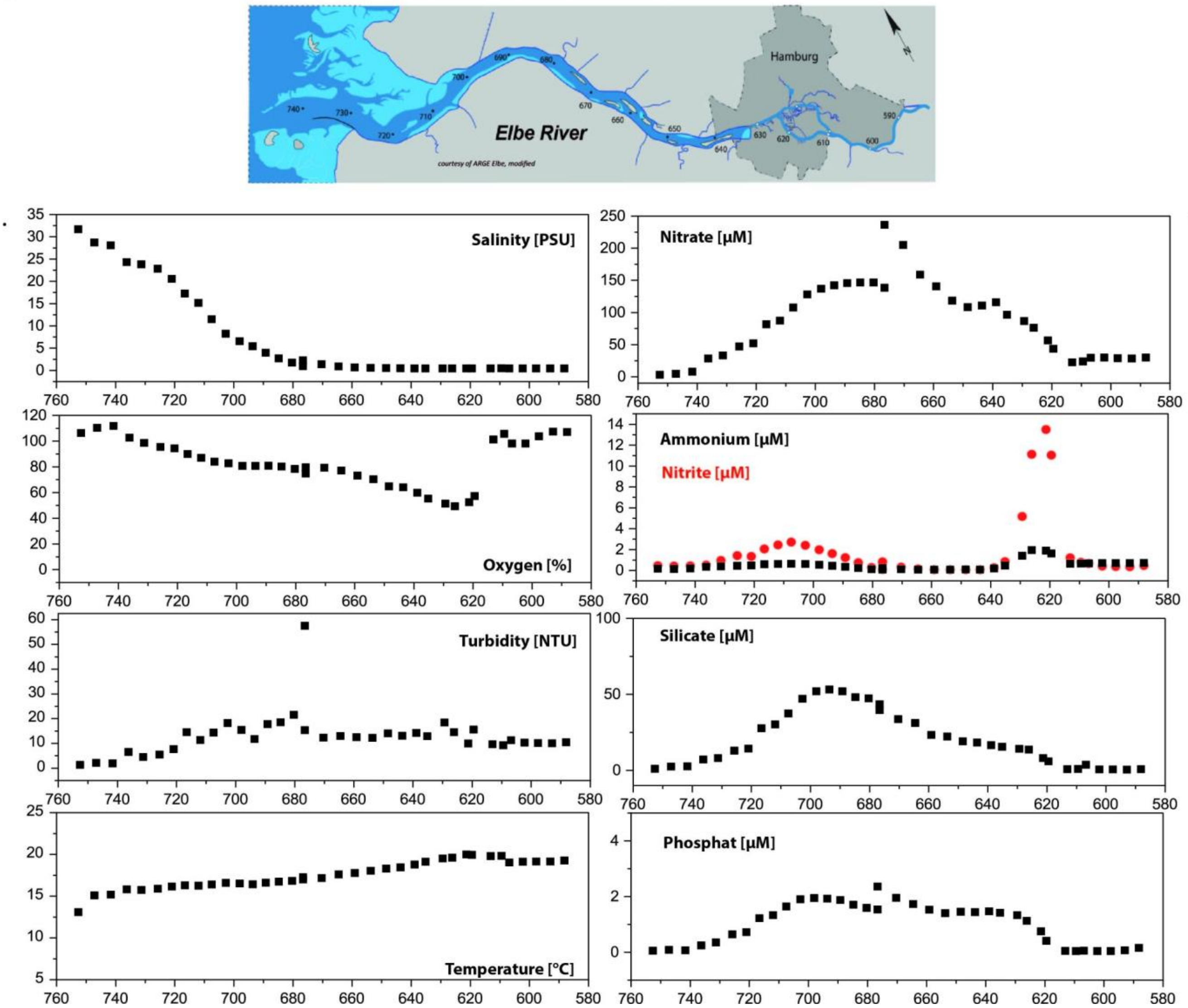

Fig. 3.1: Preliminary data from the Tide Elbe: Salinity, oxygen, turbidity and temperature were measured by Ferrybox Sensors and nutrient concentrations in water samples were determined by autoanalyzer AA3. The kilo-metrization starts at the German-Czech Border.

4. STERNFAHRT_9 (30.05. – 02.06.2022, HYDREX_2022_GERMAN_BIGHT_STERN_9)

Objectives

As the previous cruises were mainly conducted in August / September, this cruise was set up to cover a late spring situation in the German Bight. The cruise track and positions of the stations were similar to Sternfahrt_5 in September 2020, thus covering a wide range from 7.6°E to 8.9°E and from 53.5°N to 54.8°N (Fig. 4.1).

Continuous sampling for Chlorophyll-a and dissolved organic matter from the Elbe, Tide-Elbe and North Sea and subsequent detailed analysis at the UFZ will give new insights on the chemical transformations of these compounds.

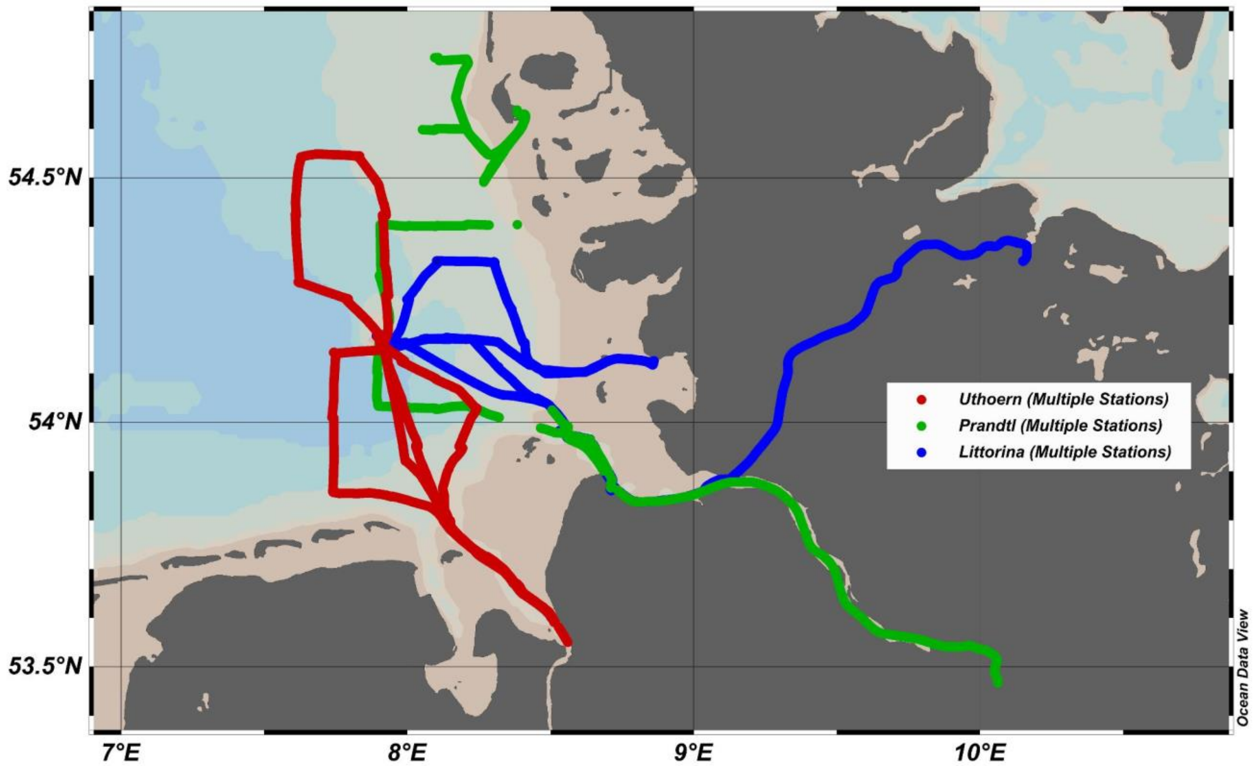

Fig. 4.1 Cruise track of Uthörn (red), Ludwig Prandtl (green) and Littorina (blue) on Sternfahrt_9

Work at sea with *Ludwig Prandtl*

Holger Brix[1], Götz Flöser[1], Charlotte Hempel[2], Hannah Jebens[3], Elija Kurbjeweit-Garcia[1], Hendrik Rust[1]

[1]DE.Hereon
[2]DE.UFZ
[3]DE.AWI

Ludwig Prandtl left Niedersachsenkai in Cuxhaven on Monday, 30 May 2022 at 06:03 (all times UTC). A total of eight stations were occupied on the first day on the way to Heligoland. Weather was mostly fine, calmer than expected after the storm that had passed the weekend before. The sea was slightly choppy. The first station (P01, 53.9626°N, 8.6362°E) was an intercalibration station together with *Littorina*. Communication with *Littorina* was hampered by missing phone contact and only intermittent contact via the communication antennae – the main problem here was re-establishing the contact after interuptions. There was no intercalibration station near Heligoland at the end of the day, as the ships' arrival times was staggered. *Ludwig Prandtl* arrived at Heligoland at 13:35.

On 31 May 2022, *Ludwig Prandtl* left Heligoland at 06:17 for an intercalibration station with all three vessels (P09, 54.1557°N, 7.9077°E) before steaming north. At position P09 a problem with surplus pressure occurred with the pump. After that, the pressure produced by the pump, was not sufficient any more for the FerryBox. Therefore, the FB was only supplied with the regular underway bord water stream for the rest of the cruise, the hose water supply was used exclusively for the Los Gatos device. The chat situation with the other ships improved, but there was a problem with the speakers on *Ludwig Prandtl*, though. About halfway through the cruise, the connection to the other ships ceased due to signal strength issues (distance related). Throughout day 2 (and 3) we observed strong subsurface chlorophyll maxima. Arrival time in Amrum, Steenodde at 13:59. The landing site can only be approached during high tide, which also led to the early departures on the following days.

Ludwig Prandtl left Amrum on 1 June 2022 at 03:44. The hose pressure issues persisted and so the sampling scheme from the previous day was continued. The antenna connection only worked close to Amrum, for the rest of the cruise *Ludwig Prandtl* did not have any contact with the other vessels. Due to tidal constraints at Amrum, return time to Steenodde Mole was already at 11:51 . Weather conditions on days 2 and 3 were extremely calm.

On 2 June 2022, *Ludwig Prandtl* left Amrum at 03:30. Due to inclement weather conditions (wind up to 7 bft), all planned stations after P26 were canceled. Due to strong ship movement water supply to the FerryBox stopped at 04:59 (pump stopped working probably due to sucking air). The FerryBox could be restarted after pump repair at 08:22 (UTC). Communication with *Littorina* was complicated as *Littorina* was not registered with the antenna network. Due to ship-to-ship radio connection a last intercalibration station could be agreed upon close to Cuxhaven (P27, 53.9949°N, 8.5498°E). *Ludwig Prandtl* arrived at Alter Fischereihafen, Cuxhaven at 10:19. Weather conditions prevented most data collection this day and waiting out improvement was unfortunately not an option, either.

Measurements: Due to issues with missing laboratory equipment (logistics problem at Hereon), no DIC samples could be taken during the cruise. Deep casts were limited to approximately 7.5 meters due to hose length restrictions (setup was such that the water supply was switched from regular supply to hose supply as soon as the CTD was in the water). After station P09 the hose water supply (vertical profiles) only served the Los Gatos. Due to a shortage of lids for the nutrient water bottles, starting with station P21 on day 3, the bottles were sealed with foil, aluminum foil and tape. The LISST battery pack experienced issues with the charge of the battery packs on day 3.

Details on the station list, the sensors used and locations for data access can be found in Table A.5.6 and -5.7

Work at sea with *Uthörn*

Norbert Anselm[1], <u>Ingeborg Bussmann[1]</u>, Matthias Koschorrek[2], Rebecca Lauerburg[1], Augusto Neubauer[1]

[1]DE.AWÍ
[2]DE.UFZ

From the MOSES project a new laboratory container had been funded and in spring 2022 its first usage took place. On Monday morning (23 May 2022, a week before the actual cruise) the crane was ordered to pick up the MOSES container (Fig. 4.2) and deposit it on board of *Uthörn*. We realized that the chains of our pick-up device were too short, but the crane could help out. The container was deposited in line with the ship; so the door opened forward. Thus, it was protected, but it was difficult to move from side to side. We set up all our instruments and the water supply (board water and freshwater), however, as we could not connect to electricity due to a missing cable, we could not complete our test for the set-up. Nevertheless, we headed for Heligoland where we reached port at 16:30. The “Haus-Technik " from AWI provided the correct electricity cable and a quick check was possible. Most of the scientists left the island with the catamaran at 18:00.

Fig. 4.2: Transfer of the MOSES Container onto Uthörn; photo: I. Bussmann

For communication between the ships and with the home institute, antennas were set up on *Uthörn* in Bremerhaven on 27 May 2022. A Kongsberg antenna was installed above the bridge of the ship and connected via cable to the computers in the container as well as to the wet lab (further details see below).

Next Monday morning (30 May 2022) a colleague from UFZ embarked with his equipment, and some minor adjustments were made. We left the lock at 9:30 and headed for Heligoland. Our first station was reached within one hour. As always, the first station took a little longer to settle, and the Niskin bottle had to be repaired. Water samples were taken from the surface for TA and methane followed by DOC, POC, pigments and nutrients. At the stations we also determined the diffusive flux of CO_2 and CH_4 from the water into the atmosphere with a floating chamber. On the way measurements included atmospheric and dissolved methane, as well as basic hydrographic parameters from the FerryBox. For dissolved methane a method comparison was carried out: Sample taken from the Niskin bottle and analyzed at AWI versus sample taken from a bucket and analyzed at UFZ. After the storm at the previous weekend, we encountered a considerable swell, which was calming down towards Heligoland. Outside of the Weser, we encountered flocks and flumes of foam on the water (Fig. 4.3).

Fig. 4.3: Floating chamber measurement of gas fluxes to calculate k600 and foam on surface waters, by I. Bussmann.

On 1 June 2022, the weather was still fine and the cruise track of Uthörn led her towards Cuxhaven and back to Heligoland in a triangle. Concerning the dissolved CH_4 measured with the LosGatos setup, we realized that the water flow of the degasser decreased continuously. We cleaned the cartridge without much effect. Re-adjustments of the water flow always resulted in a change of the CH_4 signal. One reason for this unstable water flow might be the strong ship vibrations leading to vibrations of the needle valve and subsequent modified water flow. A solution would be to make the valve stiffer or to open it completely.

On 2 June 2022 we returned to Bremerhaven, however with rough weather with about 5 kn of wind and we could steam with 9 – 12 kn. Thus, no k_{600} measurements were possible at the first 3 stations.

Details on the station list, the sensors used and locations for data access can be found in Table A- 5.4 and 5.5

Work at sea with Littorina

Mahmoud Altahan[1], Sayoni Bhattacharya[1], Claas Faber[1], Isabell Hentschel[2], Björn Raupers[1], Li Qui[1],

[1]DE.Geomar
[2]DE.AWI

The *Littorina* cruise L07-22 (Sternfahrt_9) was conducted as a joint survey of the German Bight. together with *Ludwig Prandtl* (HZG) and *Uthörn* (AWI) (Fig. 4.4). The cruise was planned to investigate the outflow region of the Elbe River between Cuxhaven, Heligoland and Büsum. Real time outflow data of the Elbe River was acquired.

For the measurements, a range of sensors (e.g., CTDs, Methane, Nitrate, pCO_2, pH) was placed in a 200 L tank on deck, which was continuously supplied with surface water (from 3 m depth) from the underway water supply of *Littorina* during transects. The flow rate was set to about 100 L/min allowing for fast exchange of the entire water volume inside the box. In spite of the fast water exchange, the turnover time of two minutes should be considered when processing the data. The analyzers “LosGatos” and “Picarro” were set up for continuous measurements of methane and CO_2 in the surface water and in the atmosphere, respectively. The offset of the Picarro system was determined to be 45 s from the bow of the ship to the laboratory. A lab based FerryBox system for measuring physical and chemical oceanographic parameters was supplied with surface water from the underway water supply during transects. Each day 7 CTD casts were performed in an evenly distributed manner along the track. On the last day, stations were reduced due to unfavorable weather conditions that made work unsafe for some of the scientific staff.

At those stations the water supply for LosGatos and the FerryBox was switched from underway to an *in-situ* pump that was attached to the CTD rosette. The *in-situ* pump supplied both devices with surface and deep water (max 20 m) for at least three minutes each. Additionally, discrete samples were taken from the onboard underway water supply in order to verify the sensor data. For collecting discrete samples an aquarium pump was submerged into the 200 L tank supplying the underway water via a 3 m silicone hose into the laboratory, where samples were taken.

On 29 May 2022 at 04:45 (all times UTC) the crew departed from Kiel heading to Cuxhaven via the Nord-Ostsee-Kanal. The transit was used to set up the instruments and the water basin for continuous real-time measurements of the surface water. The FerryBox, LosGatos and the *in-situ* pump had already been installed prior to this and only needed to be setup. After arrival in Cuxhaven at 15:00 two crew members, one from AWI and one from GEOMAR, left the ship.

Additionally, a Kongsberg MBR IT antenna was successfully installed on *Littorina´s* compass bridge to set up a network system which allows fast data transfer and communication between the participating vessels. This antenna was connected via Ethernet to a central computer placed in the laboratory. An internal network was configured in order to have full control of the Picarro and the FerryBox instruments from the central computer via remote desktop connections and to share a live screen via Team Viewer to the other two ships which were also members of the Kongsberg antenna network.

On 30 May 2022 the *Littorina* headed from Cuxhaven to Heligoland. The sea was a little rough due to strong winds coming from the west and north the week before. Together with *Ludwig Prandtl* the first intercalibration was conducted close to the harbour of Cuxhaven in the Elbe Bay. The ships then left for Heligoland. During its cruise all planned stations were conducted on the *Littorina*. The vessel reached Heligoland at noon. On 31 May 2022 the ships *Littorina*, *Ludwig Prandtl* and *Uthörn* met in front of Heligoland (Fig. 4.4) for the second intercalibration. The *Littorina* then headed to the mainland again with Büsum as destination. On 1 June 2022 *Littorina* departed Büsum at 05:00 to head back to Heligoland on a different route. On both days the sea was extraordinarily calm so that there were no inconveniences while conducting all stations. Due to different arrival times the intercalibration station was skipped on this day. On 2 June 2022 the ships caught up on the intercalibration in front of Heligoland. After that, only one more station was conducted before the captain and cruise leader decided to sail directly to the last station due to rough and dangerous weather conditions. The last station was again an intercalibration station. At 10:00 am the vessels were back in Cuxhaven to exchange samples and gear. After everything was exchanged *Littorina* headed back to Kiel overnight where we arrived at 23:00 on 3 June 2022.

Details on the station list, the sensors used and locations for data access can be found in Table A.5.2 and A.5.3.

Fig. 4.4: Uthörn and Ludwig Prandtl at the intercalibration station in front of Heligoland taken from the bow of the Littorina; photo by B. Raupers

Communication, IT and Data Management

As in the preceding Sternfahrt cruises a cross-ship-ethernet was established via Kongsberg Marine Broadcast Radio (MBR).

The MBR-IPU land station was newly assembled (Fig. 4.5). All parts were compiled in a 19" six HU mobile rack, the antenna placed in a three HU drawer for underway storage, its power supply (two HU) and the controlling IPU-PC (one HU) fixed in the rack. On the backside a five-port mobile switch was mounted to the rack. For underway storage space is sufficient to pack the mobile LTE-router and an IP44 junction box. Together with the power and ethernet cable, a clamp to mount the antenna to e.g., handrails or alike, and a GSM-plug box to reboot the complete setup via SMS. The whole land station was assembled on 27 May 2022 at the lighthouse by employees of the AWI Centre for Scientific Diving.

On *Uthörn* the Kongsberg antenna was mounted on the starboard side. Power supply and processing PC (IPU) were deployed to the MOSES container in the IT rack.

After leaving the lock on Monday 30 May 2022 *Uthörn* headed towards Heligoland. Soon after bypassing Cuxhaven the MBR-IPU network became available. Then the exchange of measuring data (FerryBox data only) set in as background job. On long distances between the hosts (Kongsberg antennas) the bandwidth was in the beginning rather low, but increased constantly. Thus, initially only the Jitsi chat protocol was constantly available, but soon video and audio transmission were possible too.

On Tuesday, Wednesday and Thursday *Uthörn* was orbiting Heligoland, hence the contact to the land station (gateway) was constantly available including all background data synchronization jobs. *Ludwig Prandtl* and *Littorina* occasionally were out of sight, mostly due to radar shadow or by leaving the broadcasting range of the antenna at the lighthouse.

As a side project the FerryBox data was utilized to create live input for a webODV collection. Therefore, the synchronized FerryBox files were merged into a single odv-compatible file. This odv-file was transferred to a running webODV-server and inserted to a predefined collection. Hence, the latest available data was available in webODV and accessible via the network aboard *Uthörn*.

In this set-up the “views” of ODV are saved on the local computer, it might be better to store some standard “views” on a central computer (Fig. 4.6).

Fig. 4.5: Details of the communication installation:
A(top left): Front side of land station containing antenna drawer, IPU (https://sensor.awi.de/?id=8048) and power supply (fbtt); B (top right): Rear side of the land station, containing switch (left-hand side) and junction box; C (bottom left): Pre-plugged cables at the rear-side; D (top right): Maritime Broadband Radio (MBR 179 MK2) stored in a drawer, photo by N. Anselms

Fig. 4.6: Screen with near real time ODV plots from all three ships, by I. Bussmann

Preliminary Results of Stern_9

Cruise Stern_9 was intended to compare a spring situation with a summer situation (Stern_5, September 2020). In Figure 4.7 the spatial extension of the cruises together with water temperature and salinity are shown. As expected, the water in September 2020 was much warmer, ranging from 17.6 – 26.2 °C compared to Mai 2022 (ranging from 11.2 – 19.5 °C). Differences in salinity were not so pronounced, ranging from 5.1 – 33.0 °C in Sept 2020 compared to a range of 6.8 – 32.1 °C in May 2022.

The work in and outside of the new MOSES container went well. Some minor technical modifications will be necessary for the next mission. However, it has to be kept in mind that the distance from the container and its instruments to the winch is rather long. The cables and tubings thus had to be extended. The tube for the *in-situ* pump is covered with a black protection that warms the water inside. This warm water can be seen every time the water supply for the FerryBox has been switched.

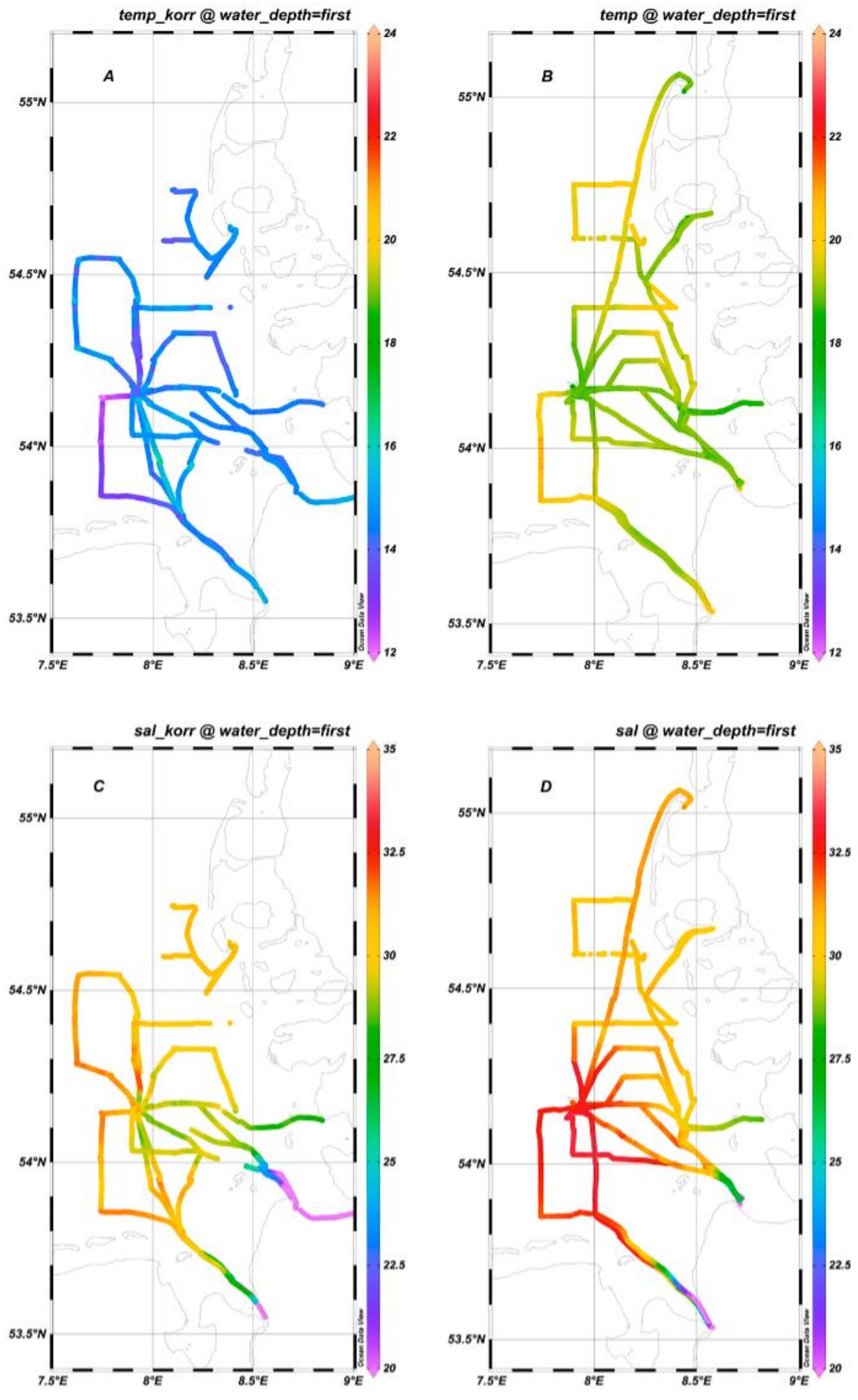

Fig. 4.7: Plots showing the surface water temperature in May 2022 (A) and September 2020 (B), as well as the salinity of surface waters in May 2022 (C) and September 2020 (D)

Dissolved methane concentrations were 6 times lower in spring (Stern_9, median 4 nmol/L; ranging from 1 – 380 nmol/L) than in late summer (Stern_5, median 23 nmol/L, ranging from 1 – 608 nmol/L). The method comparison revealed very good agreement between CH_4 concentrations determined by AWI and UFZ from water samples (Fig. 4.8).

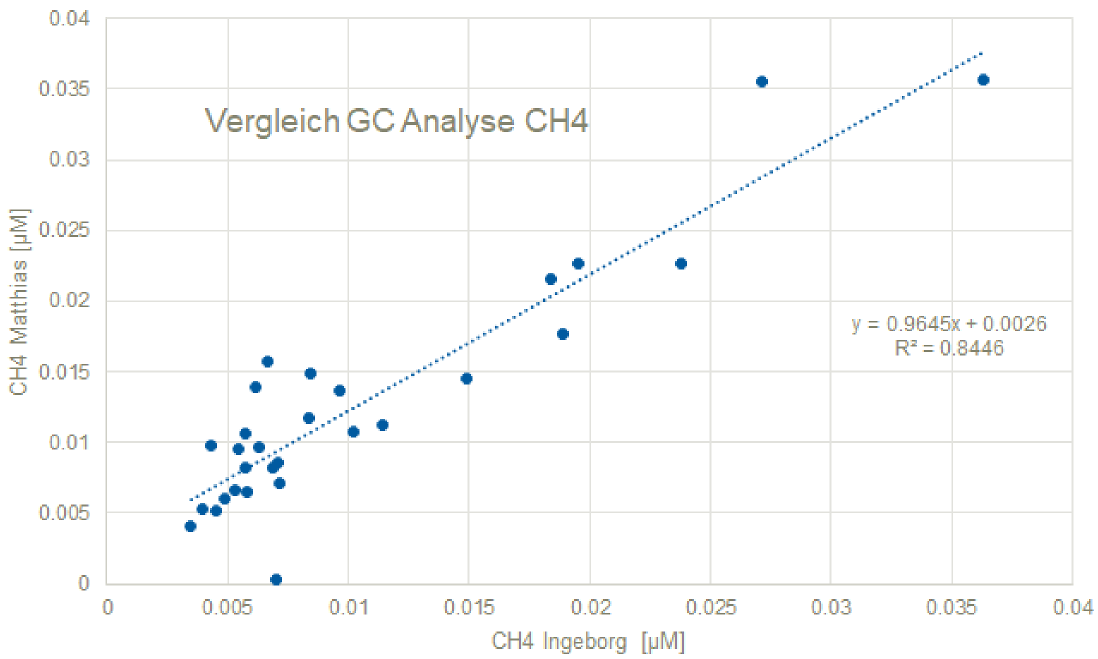

Fig. 4.8: Comparison of CH_4 analysis at AWI (x-axis) and UFZ (y-axis)

Comparing the median nutrient concentrations revealed a spring situation depleted in phosphate and nitrite (Table 4.1). Also, Silicate concentrations were lower than in autumn. Nitrate was twice as high in spring than in autumn, while ammonium concentrations did not change.

Tab. 4.1: Comparison of the main nutrients from May 2022 (this study) with September 2020 (Stern_5). Given are the median values of all stations and all ships.

Median concentration (µmol/L)	**May 2022, Stern_9**	**September 2020, Stern_5, https://doi.org/10.1594/PANGAEA.934894**
Silicate	2.66	11.61
Phosphate	0.07	0.78
Nitrite	0.09	0.25
Nitrate	2.03	1.27
Ammonium	0.88	0.89

5. TRANSECT CRUISES WEST OFF SYLT

Ingeborg Bussmann[1], Lasse Sander[1], [1]DE.AWI

Objectives

As a spatial extension of our main research area, the monthly cruises with *Mya II* (if possible, every first Wednesday of the month) were continued in 2022, called Butendiek-Transects. Starting from List (Sylt), these cruises headed towards about 7.5°E to the north-west (Fig. 5.1) while the inboard FerryBox continuously measured the basic hydrographic parameters (T, S, pH, O_2, chlorophyll, pCO_2, turbidity). We thus hope to be able to assess the influence of the Elbe inflow to the northern German Bight. These trips took place on the following dates: 09.03.2022, 30.03.2022, 27.04.2022, 16.06.2022, 12.07.2022, 10.08.2022, 07.09.2022, 08.12.2022. In October and November no cruises were possible due to bad weather and a broken engine.

Preliminary results

The average water temperature in 2022 was 12.7 ± 5.5 °C, ranging from 3.3 to 21.2 °C. The water stayed cold until the end of March; highest temperatures were recorded in August, near the shore. In December, there was a strong gradient from 4 °C near shore to warmer water (9 °C) offshore (Fig. 5.2).

The average chlorophyll concentration in 2022 was 0.5 ± 0.2 µg/L, ranging from 0.2 to 1.9 µg/L. The spring bloom was recorded during both cruises in March, however no further significant increase of chlorophyll was detected during summer. In December low values around 0.2 µg/L were recorded (Fig. 5.3).

Data management

The data can be found at https://dashboard.awi.de/data-ingest/index.html# (vessel:mya_ii) and the respective dates.

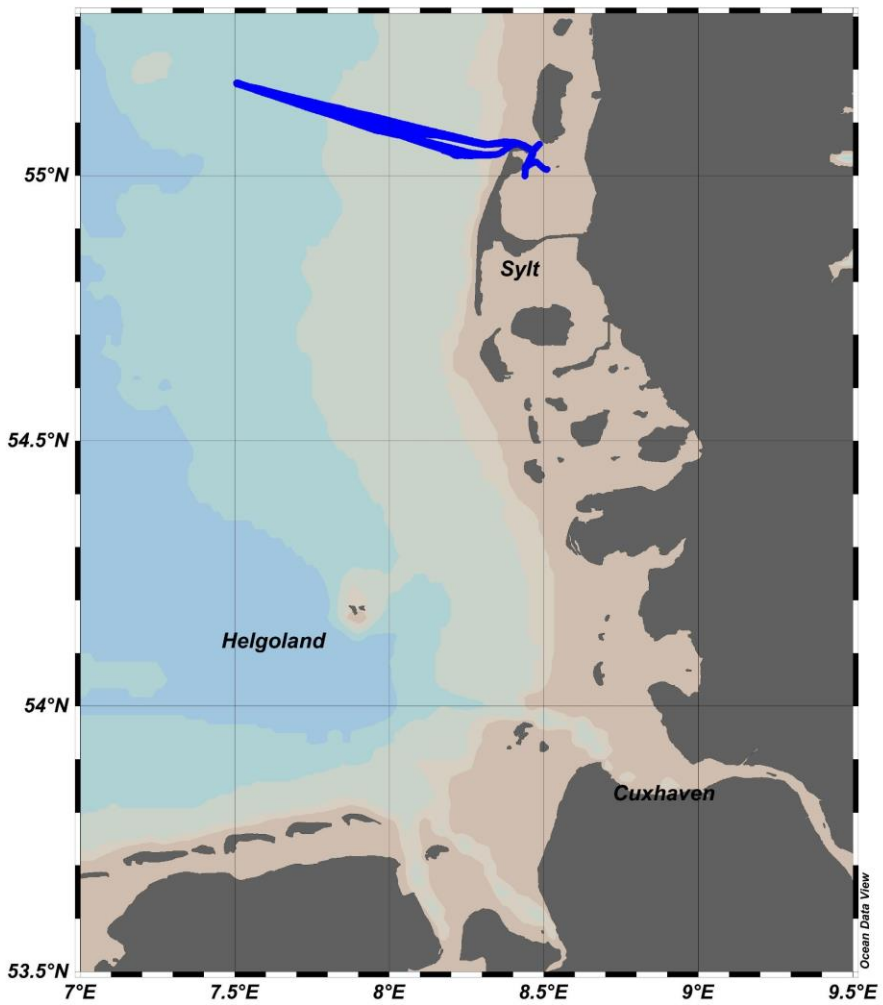

Fig. 5.1: Track of Mya II on the monthly western cruises

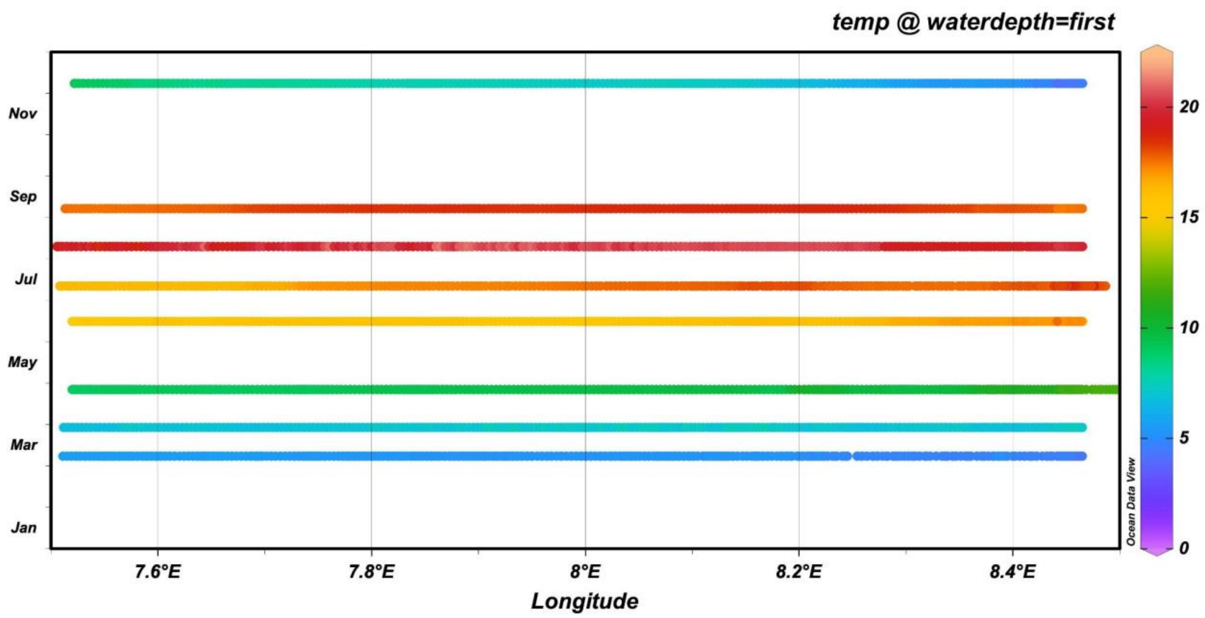

Fig. 5.2: Temperature profiles in surface waters during 2022

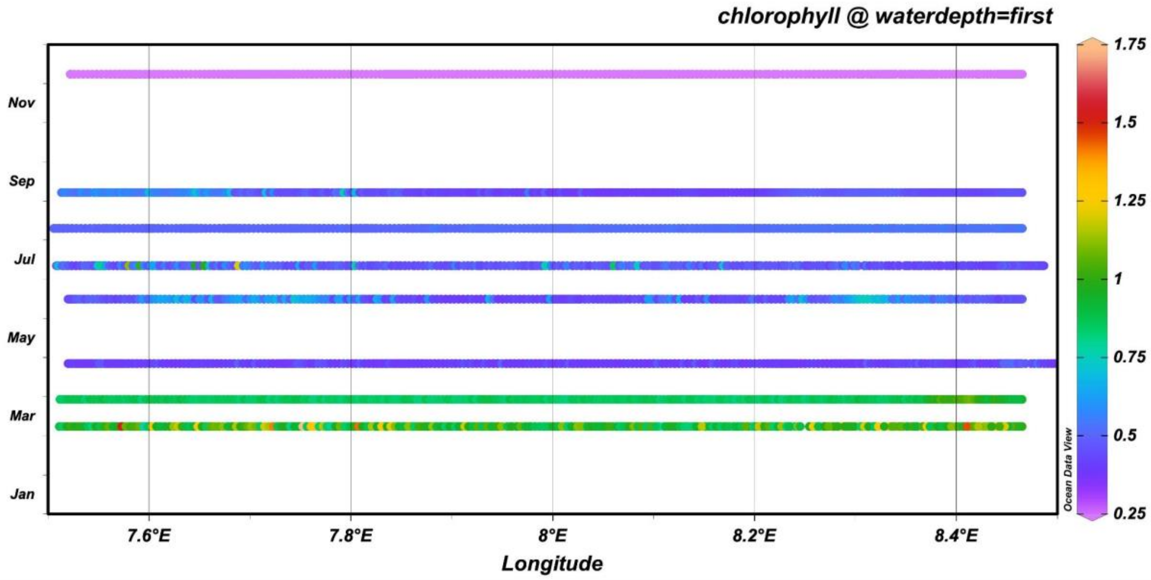

Fig. 5.3: Chlorophyll profiles in surface waters during 2022

6. TANGERMÜNDE (18.08. – 22.08.2022, HYDREX_2022_AUG_INLAND_ELBE)

Sven Baut[1], Ingeborg Bussmann[2],
Norbert Kamjunke[1], Matthias Koschorrek[1],
Uta Ködel[1], Michael Rode[1], Claudia Schütze[1],
Corinna Völkner[1]

[1]DE.UFZ
[2]DE.AWI

Objectives

In order to examine the role of groynes for the methane budget of the river Elbe more closely, a more detailed examination was planned. The village Tangermünde and the pier of the WSA (Wasserstraßen und Schifffahrtsamt, Tangermünde) were chosen, as the vessel could be anchored for three days at an exposed site and several groyne fields were close by.

Fig. 6.1: Aerial view of the groyne fields south of Tangermünde, Germany.

Work at the river

Albis was anchored at the WSA pier and basic hydrographic (Ferrybox and CTD) as well as atmospheric parameters were continuously monitored from the afternoon of 18 August until the morning of 22 August. Dissolved gasses (CH_4 and CO_2) were monitored continuously with two Contros sensors in the moon-pool of the *Albis*. Atmospheric measurements included measurements with the Sensebox (Air pressure (hPa), CO_2 concentration (ppm), humidity (%), temperature (^oC), VOC concentration (g/cm^3)) and occasional measurement of CO_2 and CH_4 by an FTIR analyzer (GASMET). In addition, with two rubber boats the current velocity and water depth was determined with an ADCP at several transects across the river at the groyne field.

The *Albis* left her fixed position on 19 August from 08:37 to 12:17 to survey the whole groyne field from Tangermünde upstream to Elbe km 386 – 387 (Fig. 6.1), with all on the way systems running. The *Albis* zig-zagged from the left to the right shore, entering each groyne field as much as possible. However, at 12:30 the water was too shallow, the pump for the moon pool came in contact with sand and all systems were stopped until the pump could be cleared again.

The detailed spatial distribution of dissolved methane was determined on 20 and 21 August 2022 with the LosGatos devices set up with a battery in a rubber boat. With this set-up we entered 4 – 5 groyne fields as far as possible without touching ground, we then stopped at the head of each groyne field for some minutes, trying to measure the turbulence there.

After the initial investigations one groyne field was chosen for detailed investigations on terrestric fluxes of CO_2 and CH_4 from the shore. Three chambers were set up to continuously measure the CO_2 flux from a sandy shore, vegetated shore, and a muddy shore (Fig. 6.2). Measurements were performed every hour for 2 minutes. In addition, the spatial variability of the CO_2 and CH_4 flux was assessed with a second system which was deployed at several locations with different sediment structure at our main groyne field and adjacent fields. Both systems also monitored the soil moisture and soil temperature.

On 21 August, we tested the hypothesis that the wave and wake of a passing ship (*Albis*) would enforce an export of groyne water into the river. Therefore, we set up three measuring points to take water samples for dissolved methane and to measure the conductivity, north of the groyne field, in the center and south of the field. Water samples were taken before, during and after the ship's passing. Starting at 15:07, 15:15, 15:24, 15:25, 15:26, 15:27, 15:28, 15:30, 15:34, and 15:45 (all times UTC); between the last 2 measurements two jet-skis were passing, creating additional waves. At 15:53 and 16:01 the experiment was repeated with measurements of conductivity only.

Fig. 6.2: Chamber flux measurements at the Elbe shore (Photo by C. Schütze)

Experiments for CH_4 production rates were set up with surface sediments and water samples from our main groyne field. Surface sediment and overlying water were sampled from three sites with three replicates. Sediment samples were diluted with sterile filtered and O_2 free water from the study site. Glass bottles were incubated in a net at 1 m water depth. Measurement for CH_4 concentrations in the headspace were performed according to Wilkinson et al (2018) from 19.08 – 22.08.2022.

Details on the different set-ups and measurements can be found in Table A.6.1

Preliminary results

The continuous measurements in the water at the pier of Tangermünde revealed clear diurnal patterns for water temperature, pH, oxygen and chlorophyll, while the conductivity remained stable over timer (Fig. 6.3). Lowest pH values were recorded between 05:15 and 05:30 (all times UTC), while coldest water temperatures were a bit later, 06:00 – 07:00. For the dissolved gasses, CO_2 followed the pattern of photosynthesis, with concentrations ranging from 539 – 1,173 ppm. Dissolved methane was rather stable with no diurnal pattern, concentrations ranged from 360 – 380 nmol/L (Fig. 6.2).

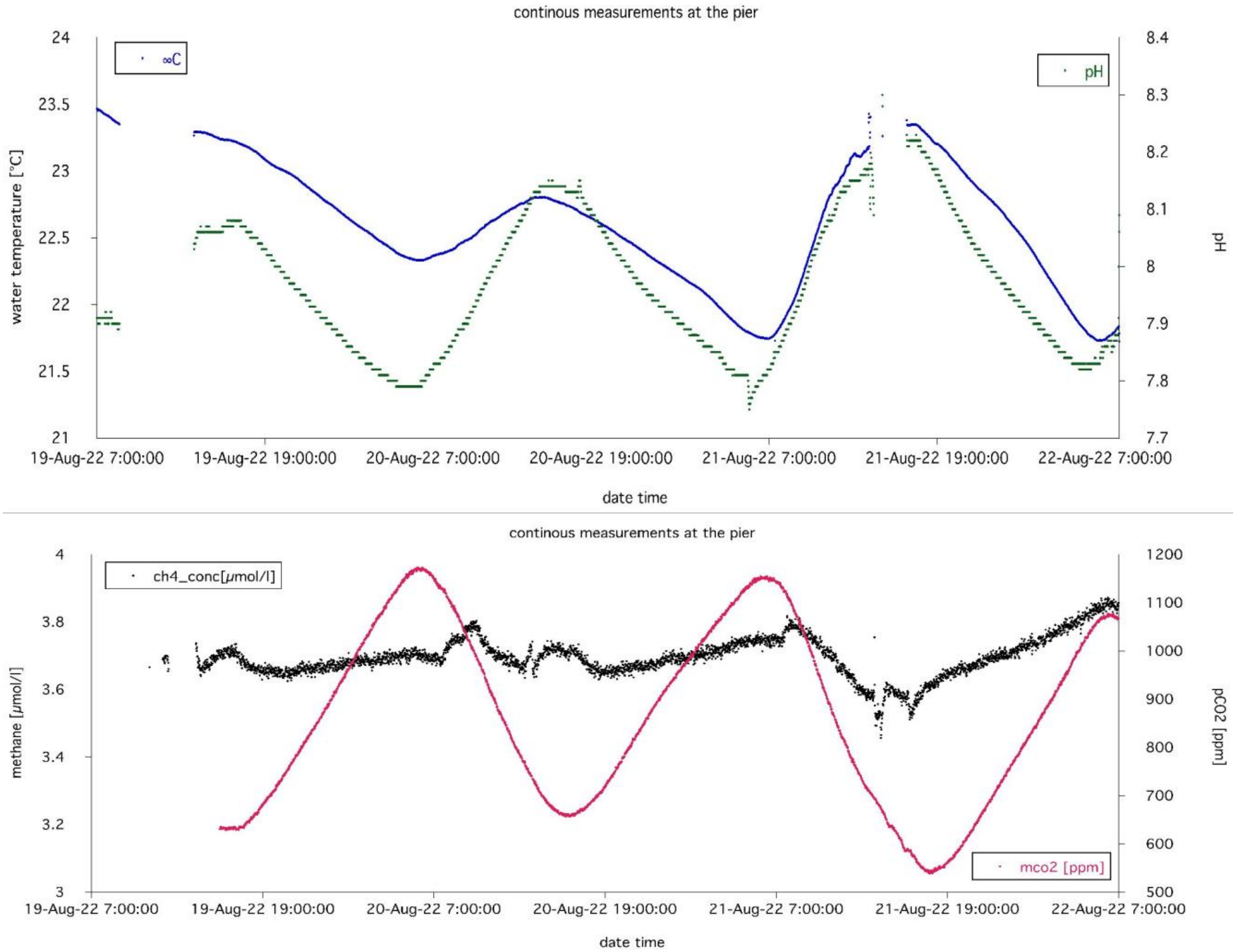

Fig. 6.3: Temporal pattern of water temperature and ph (upper panel) and dissolved CH_4 and CO_2 (lower panel).

GHG emissions from the water surface were dominated by CO_2 with only minor contributions of CH_4-flux (Fig.6.4). Carbon dioxide fluxes were highest in the middle of the river, and low in the groyne field. In contrast, lowest methane emissions were observed in the middle of the river and higher emissions at the top of the groyne and within the groyne field.

Carbon dioxide emissions from exposed sediments showed pronounced diurnal fluctuations with higher emissions in the night and CO_2 uptake (negative emissions) at noon time (Fig. 6.5). Soil temperature was warmest at noon time, and coldest in the early morning hours. The water level of the Elbe was rising on 21.08.2022, thus the soil moisture increased as well.

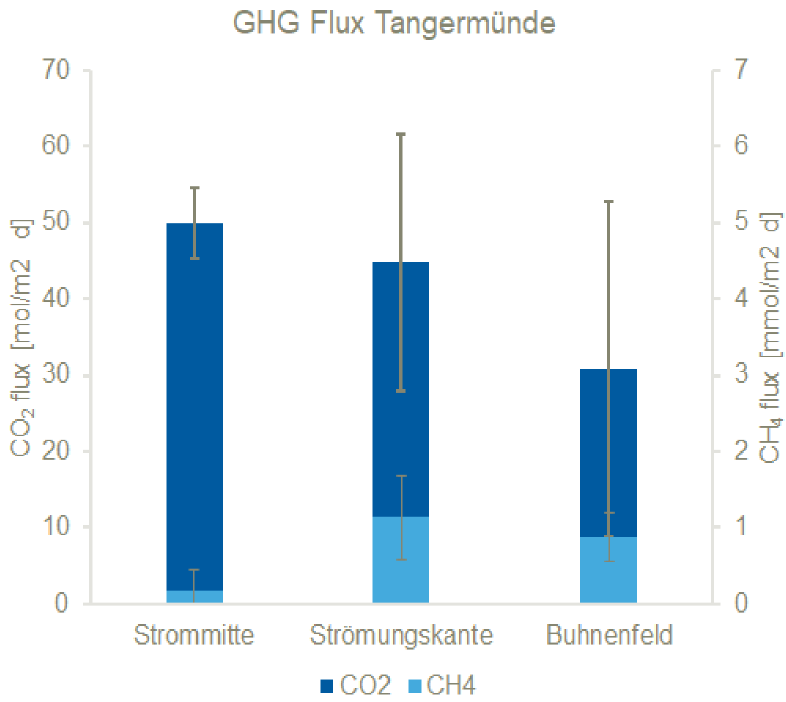

Fig. 6.4: GHG fluxes from the water surface measured with a floating chamber. Note different scales on the y-axis

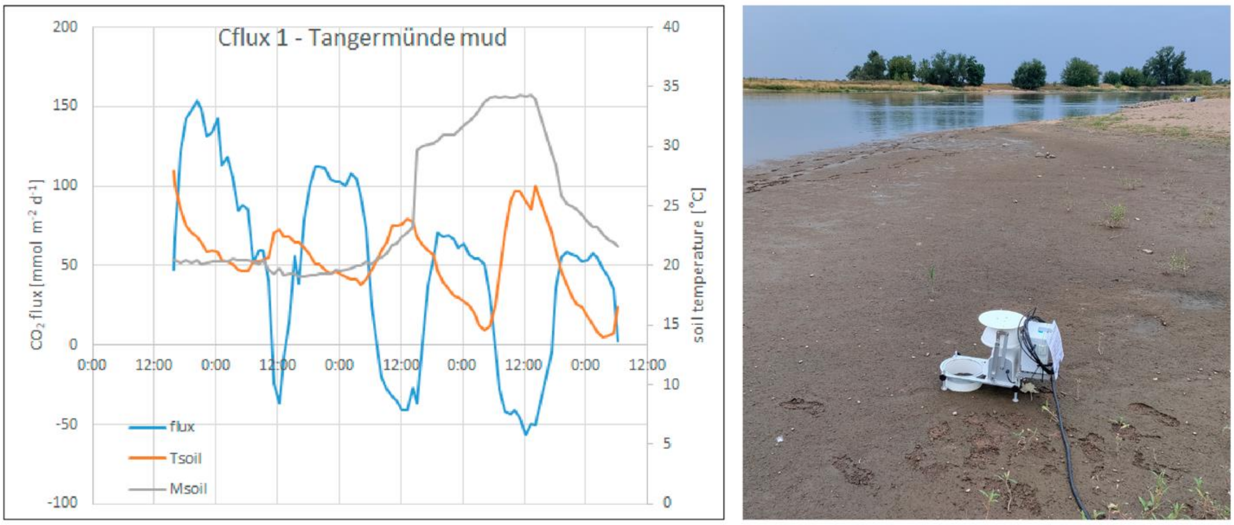

Fig. 6.5: Diurnal fluctuation of CO_2 flux and sediment temperature and moisture from the muddy shore; photo by M. Koschorrek

APPENDIX

A.1 TEILNEHMENDE INSTITUTE / PARTICIPATING INSTITUTES

A.2 FAHRTTEILNEHMER:INNEN / CRUISE PARTICIPANTS

A.3 TABLES FOR FESHAWATER ELBE

A.4 TABLES FOR TIDE ELBE 2022

A.5 TABLES FOR STERNFAHRT_9

A.6 TABLES FOR TANGERMÜNDE

A.1 TEILNEHMENDE INSTITUTE / PARTICIPATING INSTITUTES

Tab. A.1.1: Participating institutions and their address

Institution	Address (all in Germany)
AWI	Alfred-Wegener-Institut Helmholtz-Zentrum für Polar- und Meeresforschung, Postfach 120161, 27515 Bremerhaven
GEOMAR	GEOMAR Helmholtz-Zentrum für Ozeanforschung Kiel, Wischhofstraße 1-3, 24148 Kiel
Hereon	Helmholtz-Zentrum Hereon, Max-Planck-Str. 1, 21502 Geesthacht
UFZ	Helmholtz Centre for Environmental Research GmbH – UFZ, Brückstr. 3a, 39114 Magdeburg
UFZ	Helmholtz Center for Environmental Research GmbH – UFZ, Permoserstr. 15, 04318 Leipzig

Tab. A.1.2: Participating research vessels

Name of Vessel	Name of Cruise	Start Date	End Date	Name of Chief Scientist
Albis	Binnen-Elbe	2022-04-25	2022-05-03	Norbert Kamjunke
Ludwig Prandtl	Tide-Elbe	2022-05-23	2022-05-25	Tina Sanders
Uthörn	Sternfahrt 9	2022-05-30	2022-06-02	Ingeborg Bussmann
Ludwig Prandtl	Sternfahrt 9	2022-05-30	2022-06-02	Holger Brix
Littorina	Sternfahrt 9	2022-05-30	2022-06-02	Björn Raupers

A.2 FAHRTTEILNEHMER:INNEN / CRUISE PARTICIPANTS

Tab. A.2.1: Cruise participants of Binnen-Elbe

Ship	Name / Last name	Vorname / First name	Institut / Institute	Beruf / Profession
Albis	Bauth	Sven	UFZ	Captain
Albis	Brandtner	Vera	TU Braunschweig	Master student
Albis	Goretzka	Heike	UFZ	technician
Albis	Hempel	Charlotte	UFZ	internship
Albis	Kamjunke	Norbert	UFZ	scientist
Albis	Link	Ute	UFZ	technician

Tab. A.2.2: Cruise participants of Tide-Elbe

Ship	Name / Last name	Vorname / First name	Institut / Institute	Beruf / Profession
Ludwig Prandtl	Gerbatsch	Heiko	Hereon	Captain
Ludwig Prandtl	Heinze	Detlef	Hereon	Shipman
Ludwig Prandtl	Engelke	Lars	Hereon	Shipman
Ludwig Prandtl	Sanders	Tina	Hereon	scientist
Ludwig Prandtl	Breider	Rhiannon	Hereon	master student
Ludwig Prandtl	Schmidt	Leon	Hereon	Technican
Ludwig Prandtl	Russnak	Vanessa	Hereon	PhD Student
Ludwig Prandtl	Kamjunke	Norbert	UFZ	scientist
Ludwig Prandtl	Jebens	Hanah	AWI	Technician

Tab. A.2.3: Cruise participants of Sternfahrt_9

Ship	**Name / Last name**	**Vorname / First name**	**Institut / Institute**	**Beruf / Profession**
Uthörn	Becker	David	Reederei Laeisz	Navigation officer
Uthörn	Jardner	Dirk	Reederei Laeisz	Captain
Uthörn	Mühle	Erik	Reederei Laeisz	Technical officer
Uthörn	Siemens	Kai	Reederei Laeisz	Shipman
Uthörn	Breiholz	Ove	Reederei Laeisz	Shipman
Uthörn	Anselm	Norbert	AWI	IT
Uthörn	Bussmann	Ingeborg	AWI	Scientist
Uthörn	Neubauer	Augusto	AWI	Engineer
Uthörn	Lauerburg	Rebecca	AWI	IT
Uthörn	Koschorreck	Matthias	UFZ	Scientist
Littorina	Altahan	Mahmoud	GEOMAR	PhD Student
Littorina	Bhattacharya	Sayoni	GEOMAR	PhD Student
Littorina	Qiu	Li	Xiamen University	PhD Student
Littorina	Faber	Claas	GEOMAR	IT / Scientist, (Kiel -> Büsum)
Littorina	Hentschel	Isabell	AWI	Student
Littorina	Raupers	Björn	GEOMAR	Scientist
Littorina	Lingner	Stefan	GEOMAR	IT / Scientist (Transit Kiel → Cux only)
Littorina	Jebens	Hanah	AWI	Technician (Transit Kiel → Cux only)
Littorina	Flindt	Danny	Briese Research	Captain
Littorina	Stieg	Dustin	Briese Research	First Nautical Officer
Littorina	Stieg	Devin	Briese Research	Ship Machinist
Littorina	Tamm	Stefan	Kiel University	Ship Mechanic
Littorina	Kazarian	Grant	Briese Research	Chief

Ship	Name / Last name	Vorname / First name	Institut / Institute	Beruf / Profession
Ludwig Prandtl	Gerbatsch	Heiko	Hereon	Captain
Ludwig Prandtl	Heinze	Detlef	Hereon	Shipmen
Ludwig Prandtl	Engelke	Lars	Hereon	
Ludwig Prandtl	Brix	Holger	Hereon	Scientist
Ludwig Prandtl	Flöser	Götz	Hereon	Scientist
Ludwig Prandtl	Hempel	Charlotte	UFZ	Student
Ludwig Prandtl	Jebens	Hannah	AWI	Technician
Ludwig Prandtl	Kurbjeweit-Garcia	Elija	Uni HH/Hereon	Student
Ludwig Prandtl	Rust	Hendrik	Hereon	Technician

A.3 TABLES FOR FRESHWATER ELBE

Tab. A.3.1: Station list Freshwater Elbe, 25.04. – 03.05.2022. At each station the following parameters were determined: carbon, nutrients, ions, basic parameters, pigments, dissolved and particulate metals*. All times are given in CEST (Central European Summer Time).

*Carbon: DIC, DOC, POC, TIC, TOC, nutrients: NH_4, NO_2, NO_3, PN, SRP, TP, Si, TSi, ions: K, Ca, Mg, Na, Cl, SO4, basic parameters: SPM, UV254, pigments with HPLC: Chl a, Chl b, phaeophytin a & b, dissolved and particulate metals: Al, As, Cd, Cr, Co, Cu, Fe, Hg, Mn, Ni, Pb, Sn, Zn

Site	km	Lat	Lon	Date	Time
Schmilka links	4.0	50.8890	14.2320	25.04.2022	13:30
Schmilka mitte	4.0	50.8890	14.2320	25.04.2022	13:47
Schmilka rechts	4.0	50.8932	14.2277	25.04.2022	14:00
Dresden Carolabrücke links	54.5	51.0541	13.7476	25.04.2022	17:37
Dresden Carolabrücke Mitte	54.5	51.0547	13.7473	25.04.2022	18:03
Dresden Carolabrücke rechts	54.5	51.0553	13.7471	25.04.2022	17:55
Zehren links	88.0	51.2030	13.4110	26.04.2022	11:14
Zehren mitte	88.0	51.2030	13.4110	26.04.2022	11:24
Zehren rechts	88.0	51.2030	13.4110	26.04.2022	11:39
Riesa Brücke links	107.0	51.3104	13.2951	26.04.2022	13:18
Riesa Brücke Mitte	107.0	51.3107	13.2954	26.04.2022	13:30
Riesa Brücke rechts	107.0	51.3109	13.2957	26.04.2022	13:47
Torgau Brücke links	154.5	51.5579	13.0107	27.04.2022	10:26
Torgau Brücke Mitte	154.5	51.5580	13.0111	27.04.2022	10:38
Torgau Brücke rechts	154.5	51.5581	13.0115	27.04.2022	10:55

Site	km	Lat	Lon	Date	Time
Dommitzsch links	172.6	51.6490	12.8945	27.04.2022	12:20
Dommitzsch Mitte	172.0	51.6494	12.8951	27.04.2022	12:40
Dommitzsch rechts	172.0	51.6495	12.8955	27.04.2022	12:56
Schwarze Elster Mündung	199.0	51.8230	12.8390	28.04.2022	10:06
Roßlau links	258.0	51.8600	12.2110	28.04.2022	15:53
Roßlau Mitte	258.0	51.8811	12.2342	28.04.2022	16:08
Roßlau rechts	258.0	51.8600	12.2110	28.04.2022	16:20
Mulde Mündung	259.0	51.8737	12.2458	29.04.2022	08:45
Breitenhagen links	287.0	51.9570	11.9130	29.04.2022	11:12
Breitenhagen mitte	287.0	*51.9570*	11.9130	29.04.2022	11:36
Breitenhagen rechts	287.0	51.9302	11.9558	29.04.2022	11:48
Saale Mündung	290.7	51.9770	11.8860	29.04.2022	12:12
Westerhüsen links	318.0	52.0669	11.6792	29.04.2022	14:56
Westerhüsen Mitte	318.0	52.0672	11.6805	29.04.2022	15:14
Westerhüsen rechts	318.0	52.0673	11.6816	29.04.2022	15:28
Magdeburg Neue Strombrücke links	326.53	52.1291	11.6437	29.04.2022	16:14
Magdeburg Neue Strombrücke Mitte	326.53	52.1290	11.6442	29.04.2022	16:25
Magdeburg Neue Strombrücke rechts	326.53	52.1287	11.6446	29.04.2022	16:40

Site	km	Lat	Lon	Date	Time
Rogätz links	351.0	52.3340	11.8130	30.04.2022	12:47
Rogätz mitte	351.0	52.3340	11.8130	30.04.2022	13:01
Rogätz rechts	351.0	52.3340	11.8130	30.04.2022	13:16
Tangermünde links	388.0	52.5398	11.9790	30.04.2022	15:51
Tangermünde Mitte	388.0	52.5397	11.9803	30.04.2022	16:02
Tangermünde rechts	388.0	52.5396	11.9815	30.04.2022	16:16
Werben links	422.25	52.8379	12.0393	01.05.2022	12:18
Werben Mitte	422.25	52.8376	12.0405	01.05.2022	12:29
Werben rechts	422.25	52.8374	12.0417	01.05.2022	12:44
Havel Mündung	438.0	52.9081	11.8795	01.05.2022	14:07
Wittenberge. links	454.9	52.9863	11.7516	01.05.2022	15:53
Wittenberge. mitte	454.9	52.9870	11.7519	01.05.2022	16:03
Wittenberge. rechts	454.9	52.9875	11.7523	01.05.2022	16:22
Schnackenburg links	475.0	53.0472	11.5542	02.05.2022	10:51
Schnackenburg mitte	475.0	53.0480	11.5560	02.05.2022	11:04
Schnackenburg rechts	475.0	53.0481	11.5572	02.05.2022	11:19
Dömitz links	506.0	53.1335	11.2488	02.05.2022	14:24
Dömitz Mitte	506.0	53.1342	11.2492	02.05.2022	14:34
Dömitz rechts	506.0	53.1345	11.2508	02.05.2022	14:56
Neu Darchau links	536.0	53.2327	10.8978	03.05.2022	09:58
Neu Darchau mitte	536.0	53.2335	10.8987	03.05.2022	10:08

Site	km	Lat	Lon	Date	Time
Neu Darchau rechts	536.0	53.2340	10.8992	03.05.2022	10:19
Lauenburg links	570.4	53.3680	10.5477	03.05.2022	12:58
Lauenburg Mitte	570.4	53.3691	10.5482	03.05.2022	13:07
Lauenburg rechts	570.4	53.3701	10.5483	03.05.2022	13:20
Geestacht links	585.5	53.4245	10.3507	03.05.2022	14:33
Geesthacht Mitte	585.5	53.4261	10.3506	03.05.2022	14:43
Geestacht rechts	585.5	53.4302	10.3507	03.05.2022	14:57

Tab. A.3.2: Instruments on *Albis* in 2022

On the way / vertical	Air / water	Parameter(s)	Responsible person	Instrument name	Sensor ID at HYDREX_2022Apr_Inland_Elbe	Remarks
on the way	air	atmospheric CH4 (ppb) and CO2 (ppm)	U. Ködel/ C. Schütze	LICOR 7810 $CH_4/CO_2/H_2O$ Trace Gas Analyzer	vessel:albis:ufz_licor_7810,	only UTC time no GPS coordinates
on the way	air	air pressure (hPa), CO2 concentration (ppm), humidity (%), temperature (oC), VOC concentration (g/cm3)	U. Ködel/ C. Schütze	Sensebox from Reedu GmbH	vessel:albis:ufz_sensebox_albis	provides GPS coordinates
on the way	water	hydrographic parameters, position	Bussmann I	pocketferrybox	pfb awi [4079] vessel:albis:pfb_awi_751801:latitude_0001	
on the way	water	hydrographic parameters, position	N. Kamjunke	EXO-CTD		
on the way	water	dissolved CH4	Bussmann I	LosGatos with degasser	vessel:albis:losgatos_awi_3599:ch4_ppm + 1704673-003	

A.4 TABLES FOR TIDE ELBE 2022

Tab. 4.1 Station List – Samples for C/N, Chl a, PIP/TPP, nutrients, TN, DON, Isotope, Alk/TA, T/Sal will be analyzed by colleagues from Hereon (contact T. Sanders). Samples for DOM, DOC and Chl a will be analyzed by colleagues from UFZ (N. Kamjunke).

ID	Date	Time	Elbe kilometer [km]	Latitude	Longitude	Samples
1031	23.05.2022	06:00	749.90	53.4538	10.0807	C/N, Chl a, PIP/TPP, nutrients, TN, DON, Isotope, Alk/TA, T/Sal, DOM, DOC
1032	23.05.2022	06:20	746.91	53.5489	9.8262	C/N, Chl a, PIP/TPP, nutrients, TN, DON, Isotope,
1033	23.05.2022	06:40	741.92	53.6066	9.5710	C/N, Chl a, PIP/TPP, nutrients, TN, DON, Isotope, Alk/TA, DOM, DOC
1034	23.05.2022	07:00	736.54	53.7131	9.4782	C/N, Chl a, PIP/TPP, nutrients, TN, DON, Isotope,
1035	23.05.2022	07:20	731.57	53.8861	9.1964	C/N, Chl a, PIP/TPP, nutrients, TN, DON, Isotope, Alk/TA, DOM, DOC
1036	23.05.2022	07:40	726.00	53.8450	8.8849	C/N, Chl a, PIP/TPP, nutrients, TN, DON, Isotope, T/Sal
1037	23.05.2022	08:00	721.21	53.9777	8.3989	C/N, Chl a, PIP/TPP, nutrients, TN, DON, Isotope, Alk/TA, DOM, DOC
1038	23.05.2022	08:20	716.80	53.9747	8.4432	C/N, Chl a, PIP/TPP, nutrients, TN, DON, Isotope, T/Sal
1039	23.05.2022	08:40	712.22	53.9657	8.5167	C/N, Chl a, PIP/TPP, nutrients, TN, DON, Isotope, Alk/TA, DOM, DOC
1040	23.05.2022	09:00	707.56	53.9527	8.5963	C/N, Chl a, PIP/TPP, nutrients, TN, DON, Isotope,
1041	23.05.2022	09:20	702.97	53.9249	8.6557	C/N, Chl a, PIP/TPP, nutrients, TN, DON, Isotope, Alk/TA, DOM, DOC
1042	23.05.2022	09:40	698.26	53.8842	8.6997	C/N, Chl a, PIP/TPP, nutrients, TN, DON, Isotope, Alk/TA, T/Sal
1043	23.05.2022	10:00	693.86	53.8494	8.7549	C/N, Chl a, PIP/TPP, nutrients, TN, DON, Isotope, Alk/TA, DOM, DOC
1044	23.05.2022	10:20	689.47	53.8371	8.8261	C/N, Chl a, PIP/TPP, nutrients, TN, DON, Isotope,
1045	23.05.2022	10:40	685.01	53.8404	8.8987	C/N, Chl a, PIP/TPP, nutrients, TN, DON, Isotope, Alk/TA, DOM, DOC
1046	23.05.2022	11:00	680.57	53.8474	8.9699	C/N, Chl a, PIP/TPP, nutrients, TN, DON, Isotope,

ID	Date	Time	Elbe kilometer [km]	Latitude	Longitude	Samples
1047	23.05.2022	11:20	676.19	53.8600	9.0377	C/N, Chl a, PIP/TPP, nutrients, TN, DON, Isotope, Alk/TA, T/Sal, DOM, DOC
1048	24.05.2022	09:30	675.43	53.8758	9.1037	C/N, Chl a, PIP/TPP, nutrients, TN, DON, Isotope, Alk/TA, T/Sal
1049	24.05.2022	09:50	670.59	53.8786	9.1703	C/N, Chl a, PIP/TPP, nutrients, TN, DON, Isotope,
1050	24.05.2022	10:10	664.82	53.8751	9.2368	C/N, Chl a, PIP/TPP, nutrients, TN, DON, Isotope, Alk/TA, DOM, DOC
1051	24.05.2022	10:30	659.39	53.8571	9.2975	C/N, Chl a, PIP/TPP, nutrients, TN, DON, Isotope,
1052	24.05.2022	10:50	654.01	53.8323	9.3520	C/N, Chl a, PIP/TPP, nutrients, TN, DON, Isotope, Alk/TA, DOM, DOC
1053	24.05.2022	11:10	648.73	53.7958	9.3798	C/N, Chl a, PIP/TPP, nutrients, TN, DON, Isotope,
1054	24.05.2022	11:30	643.91	53.7895	9.3843	C/N, Chl a, PIP/TPP, nutrients, TN, DON, Isotope, Alk/TA, DOM, DOC
1055	24.05.2022	11:50	639.09	53.7482	9.4092	C/N, Chl a, PIP/TPP, nutrients, TN, DON, Isotope,
1056	24.05.2022	12:06	635.38	53.7137	9.4754	C/N, Chl a, PIP/TPP, nutrients, TN, DON, Isotope, Alk/TA, T/Sal, DOM, DOC
1057	24.05.2022	12:32	629.57	53.6690	9.5071	C/N, Chl a, PIP/TPP, nutrients, TN, DON, Isotope,
1058	24.05.2022	12:42	628.13	53.6238	9.5378	C/N, Chl a, PIP/TPP, nutrients, TN, DON, Isotope, Alk/TA
1059	24.05.2022	13:06	626.41	53.5935	9.5986	C/N, Chl a, PIP/TPP, nutrients, TN, DON, Isotope, DOM, DOC
1060	24.05.2022	13:25	621.48	53.5683	9.6587	C/N, Chl a, PIP/TPP, nutrients, TN, DON, Isotope,
1061	24.05.2022	13:31	620.49	53.5620	9.7310	C/N, Chl a, PIP/TPP, nutrients, TN, DON, Isotope, Alk/TA
1062	24.05.2022	13:50	619.68	53.5566	9.7862	C/N, Chl a, PIP/TPP, nutrients, TN, DON, Isotope, Alk/TA, DOM, DOC
1063	24.05.2022	14:20	613.34	53.5418	9.8704	C/N, Chl a, PIP/TPP, nutrients, TN, DON, Isotope,
1064	24.05.2022	14:35	609.73	53.5245	9.8915	C/N, Chl a, PIP/TPP, nutrients, TN, DON, Isotope, Alk/TA, DOM, DOC
1065	25.05.2022	04:05	606.34	53.5407	9.9185	C/N, Chl a, PIP/TPP, nutrients, TN, DON, Isotope,

ID	Date	Time	Elbe kilometer [km]	Latitude	Longitude	Samples
1066	25.05.2022	04:25	602.49	53.5364	9.9889	C/N, Chl a, PIP/TPP, nutrients, TN, DON, Isotope, Alk/TA, T/Sal, DOM, DOC
1067	25.05.2022	04:45	597.99	53.5270	10.0029	C/N, Chl a, PIP/TPP, nutrients, TN, DON, Isotope,
1068	25.05.2022	05:05	593.18	53.5344	10.0161	C/N, Chl a, PIP/TPP, nutrients, TN, DON, Isotope,
1069	25.05.2022	05:25	588.35	53.4922	10.0510	C/N, Chl a, PIP/TPP, nutrients, TN, DON, Isotope, Alk/TA, T/Sal, DOM, DOC

Tab. A.4.2: Instruments on the Tide Elbe

On the way / vertical	Parameter(s)	Responsible person	Instrument name	Sensor ID HYDREX_2022_Tidal_Elbe	Remarks
on the way	temperature, salinity, oxygen saturation, turbidity, fluorescence, pCO2, CDOM	M. Gehrung/ H. Rust	FerryBox		https://hcdc.hereon.de/campaign_db/#/download
on the way	dissolved CH4	Bussmann I.	LosGatos + degasser #3599 [6977]	vessel:prandtl_hzg: losgatos_awi_3599:h2o_ppm	https://dashboard.awi.de/data-ingest/index.html#
on the way	atmospheric CH4 (ppb) and CO2 (ppm)	U. Ködel / C. Schütze	LICOR 7810 $CH_4/CO_2/H_2O$ Trace Gas Analyzer	vessel:albis:ufz_licor_7810,	https://dashboard.awi.de/data-ingest/index.html#
on the way	NO_2, NO_3, DOM		Trios		https://hcdc.hereon.de/campaign_db/#/download

A.5 TABLES FOR STERNFAHRT_9

Tab. A.5.1: List for Intercal-Stations, all ships were close together with all under-way systems running

Intercalibration	Station ID	Start time	End time	Location	Latitude	Longitude	Distance [m]
I-1	L-01	30.05.2022 07:20	30.05.2022 07:23	near Cuxhaven	53.9626	8.6349	
	P-1	30.05.2022 07:15	30.05.2022 07:27		53.9636	8.6363	144
I-2	L-08	31.05.2022 06:21	31.05.2022 07:04	near Heligoland	54.1538	7.9107	
	P-9	31.05.2022 06:31	31.05.2022 07:02		54.1557	7.9045	454
	U-7	31.05.2022 06:17	31.05.2022 07:07		54.1557	7.9079	278
I-3	L-22	02.06.2022 05:26	02.06.2022 05:56	near Heligoland	54.1508	7.9106	
	U-23	02.06.2022 05:27	02.06.2022 05:57		54.1473	7.9050	534
I-4	L-24	02.06.2022 08:51	02.06.2022 09:15	near Cuxhaven	53.9955	8.5499	
	P-27	02.06.2022 09:08	02.06.2022 09:16		53.9921	8.5572	609

Tab. A.5.2 Station List for *Littorina*

Station ID	Device	Start time [datetime UTC]	Stop time [datetime UTC]	Latitude	Longitude	Water depth [m]	Remarks
L-01	In-situ CTD	2022-05-30 07:10	2022-05-30 07:23	53.9626	8.6349		oxygen data invalid for this station
	In-situ pump surface	2022-05-30 07:21	2022-05-30 07:23			1	
	In-situ pump bottom	2022-05-30 07:18	2022-05-30 07:20			9	
	Water sampler	2022-05-30 07:21		53.9626	8.6349	1	CH4, DOC, POC (250 ml), TA, Explosives, NS, Chlorophyll
L-02	In-situ CTD	2022-05-30 08:00	2022-05-30 8:09	53.9827	8.5313		oxygen data invalid for this station
	In-situ pump surface	2022-05-30 08:03	2022-05-30 08:09			1	
	In-situ pump bottom	2022-05-30 08:00	2022-05-30 08:03			5	
	Water sampler	2022-05-30 08:04		53.9827	8.5313	1	CH4, DOC, POC (250 ml), TA, Explosives, NS, Chlorophyll
L-03	In-situ CTD	2022-05-30 08:59	2022-05-30 09:09	54.0491	8.4523		oxygen data invalid for this station
	In-situ pump surface	2022-05-30 09:03	2022-05-30 09:09			1	

Station ID	Device	Start time	Stop time	Latitude	Longitude	Water depth	Remarks
	In-situ pump bottom	2022-05-30 08:60	2022-05-30 09:03			9	
	Water sampler	2022-05-30 09:03		54.0491	8.4523	1	CH4, DOC, POC (250 ml), TA, NS, Chlorophyll
L-04	In-situ CTD	2022-05-30 10:06	2022-05-30 10:15	54.1139	8.3150		oxygen data invalid for this station
	In-situ pump surface	2022-05-30 10:11	2022-05-30 10:15			1	
	In-situ pump bottom	2022-05-30 10:06	2022-05-30 10:10			13	
	Water sampler	2022-05-30 10:12		54.1139	8.3150	1	CH4, DOC, POC (250 ml), TA, NS, Chlorophyll
L-05	In-situ CTD	2022-05-30 10:51	2022-05-30 11:01	54.1680	8.2303		oxygen data invalid for this station
	In-situ pump surface	2022-05-30 10:55	2022-05-30 11:01			1	
	In-situ pump bottom	2022-05-30 10:52	2022-05-30 10:54			16	
	Water sampler	2022-05-30 10:54		54.1680	8.2303	1	CH4, DOC, POC (250 ml), TA, NS, Chlorophyll
L-06	In-situ CTD	2022-05-30 11:30	2022-05-30 11:39	54.1713	8.1491		oxygen data invalid for this station

Station ID	Device	Start time	Stop time	Latitude	Longitude	Water depth	Remarks
	In-situ pump surface	2022-05-30 11:34	2022-05-30 11:39			1	
	In-situ pump bottom	2022-05-30 11:31	2022-05-30 11:33			18	
	Water sampler	2022-05-30 11:37		54.1713	8.1491	1	CH4, DOC, POC (250 ml), TA, NS, Chlorophyll
L-07	In-situ CTD	2022-05-30 12:02	2022-05-30 12:11	54.1705	8.0663		oxygen data invalid for this station
	In-situ pump surface	2022-05-30 12:07	2022-05-30 12:11			1	
	In-situ pump bottom	2022-05-30 12:04	2022-05-30 12:06			20	
	Water sampler	2022-05-30 12:08		54.1705	8.0663	1	CH4, DOC, POC (250 ml), TA, NS, Chlorophyll
L-08	In-situ CTD	2022-05-31 06:22	2022-05-31 07:00	54.1539	7.9107		
	In-situ pump surface	2022-05-31 06:57	2022-05-31 07:00			1	
	In-situ pump bottom	2022-05-31 06:54	2022-05-31 06:56			20	
	Water sampler	2022-05-31 06:58		54.1539	7.9107	1	CH4, DOC, POC (250 ml), TA, Explosives, NS, Chlorophyll
L-09	In-situ CTD	2022-05-31 07:48	2022-05-31 07:56	54.1690	8.0537		

Station ID	Device	Start time	Stop time	Latitude	Longitude	Water depth	Remarks
	In-situ pump surface	2022-05-31 07:53	2022-05-31 07:56			1	
	In-situ pump bottom	2022-05-31 07:49	2022-05-31 07:52			20	
	Water sampler	2022-05-31 07:53		54.1690	8.0537	1	CH4, DOC, POC (250 ml), TA, Explosives, NS, Chlorophyll
L-10	In-situ CTD	2022-05-31 08:34	2022-05-31 08:42	54.1723	8.1328		
	In-situ pump surface	2022-05-31 08:40	2022-05-31 08:42			1	
	In-situ pump bottom	2022-05-31 08:35	2022-05-31 08:39			17.5	
	Water sampler	2022-05-31 08:40		54.1723	8.1328	1	CH4, DOC, POC (250 ml), TA, Explosives, NS, Chlorophyll
L-11	In-situ CTD	2022-05-31 09:03	2022-05-31 09:09	54.1702	8.2073		
	In-situ pump surface	2022-05-31 09:07	2022-05-31 09:09			1	
	In-situ pump bottom	2022-05-31 09:04	2022-05-31 09:06			16	
	Water sampler	2022-05-31 09:07		54.1702	8.2073	1	CH4, DOC, POC (250 ml), TA, Explosives, NS, Chlorophyll

Station ID	Device	Start time	Stop time	Latitude	Longitude	Water depth	Remarks
L-12	In-situ CTD	2022-05-31 09:32	2022-05-31 09:39	54.1641	8.3133		
	In-situ pump surface	2022-05-31 09:36	2022-05-31 09:39			1	
	In-situ pump bottom	2022-05-31 09:32	2022-05-31 09:35			13.5	
	Water sampler	2022-05-31 09:36		54.1641	8.3133	1	CH4, DOC, POC (250 ml), TA, Explosives, NS, Chlorophyll
L-13	In-situ CTD	2022-05-31 10:20	2022-05-31 10:28	54.1172	8.4330		
	In-situ pump surface	2022-05-31 10:25	2022-05-31 10:28			1	
	In-situ pump bottom	2022-05-31 10:21	2022-05-31 10:24			7	
	Water sampler	2022-05-31 10:26		54.1172	8.4330	1	CH4, DOC, POC (250 ml), TA, Explosives, NS, Chlorophyll
L-14	In-situ CTD	2022-05-31 11:37	2022-05-31 11:44	54.1296	8.7627		
	In-situ pump surface	2022-05-31 11:40	2022-05-31 11:44			1	
	In-situ pump bottom	2022-05-31 11:38	2022-05-31 11:40			13	

Station ID	Device	Start time	Stop time	Latitude	Longitude	Water depth	Remarks
	Water sampler	2022-05-31 11:41		54.1296	8.7627	1	CH4, DOC, POC (250 ml), TA, Explosives, NS, Chlorophyll
L-15	In-situ CTD	2022-06-01 05:16	2022-06-01 05:27	54.1047	8.6282		O2 data invalid for this station
	In-situ pump surface	2022-06-01 05:24	2022-06-01 05:27			1	
	In-situ pump bottom	2022-06-01 05:20	2022-06-01 05:24			10	
	Water sampler	2022-06-01 05:25		54.1047	8.6282	1	CH4, DOC, POC (250 ml), TA, Explosives, NS, Chlorophyll
L-16	In-situ CTD	2022-06-01 06:22	2022-06-01 06:29	54.1629	8.4100		
	In-situ pump surface	2022-06-01 06:26	2022-06-01 06:29			1	
	In-situ pump bottom	2022-06-01 06:23	2022-06-01 06:26			8	
	Water sampler	2022-06-01 06:27		54.1629	8.4100	1	CH4, DOC, POC (250 ml), TA, Explosives, NS, Chlorophyll
L-17	In-situ CTD	2022-06-01 06:58	2022-06-01 07:04	54.2316	8.3623		
	In-situ pump surface	2022-06-01 07:01	2022-06-01 07:04			1	

Station ID	Device	Start time	Stop time	Latitude	Longitude	Water depth	Remarks
	In-situ pump bottom	2022-06-01 06:59	2022-06-01 07:01			9	
	Water sampler	2022-06-01 07:02		54.2316	8.3623	1	CH4, DOC, POC (250 ml), TA, Explosives, NS, Chlorophyll
L-18	In-situ CTD	2022-06-01 07:46	2022-06-01 07:56	54.3279	8.3022		
	In-situ pump surface	2022-06-01 07:53	2022-06-01 07:56			1	
	In-situ pump bottom	2022-06-01 07:49	2022-06-01 07:52			10	
	Water sampler	2022-06-01 07:53		54.3279	8.3022	1	CH4, DOC, POC (250 ml), TA, Explosives, NS, Chlorophyll
L-19	In-situ CTD	2022-06-01 08:47	2022-06-01 08:56	54.3300	8.1022		
	In-situ pump surface	2022-06-01 08:52	2022-06-01 08:56			1	
	In-situ pump bottom	2022-06-01 08:48	2022-06-01 08:51			12.5	
	Water sampler	2022-06-01 08:52		54.3300	8.1022	1	CH4, DOC, POC (250 ml), TA, Explosives, NS, Chlorophyll
L-20	In-situ CTD	2022-06-01 09:39	2022-06-01 09:47	54.2509	7.9982		

Station ID	Device	Start time	Stop time	Latitude	Longitude	Water depth	Remarks
	In-situ pump surface	2022-06-01 09:44	2022-06-01 09:47			1	
	In-situ pump bottom	2022-06-01 09:41	2022-06-01 09:43			16	
	Water sampler	2022-06-01 09:43		54.2509	7.9982	1	CH4, DOC, POC (250 ml), TA, Explosives, NS, Chlorophyll
L-21	In-situ CTD	2022-06-01 10:38	2022-06-01 10:46	54.1503	7.9136		
	In-situ pump surface	2022-06-01 10:43	2022-06-01 10:46			1	
	In-situ pump bottom	2022-06-01 10:40	2022-06-01 10:42			20	
	Water sampler	2022-06-01 10:43		54.1503	7.9136	1	CH4, DOC, POC (250 ml), TA, Explosives, NS, Nano plastics, Chlorophyll
L-22	In-situ CTD	2022-06-02 05:26	2022-06-02 05:54	54.1508	7.9106		
	In-situ pump surface	2022-06-02 05:52	2022-06-02 05:54			1	
	In-situ pump bottom	2022-06-02 05:50	2022-06-02 05:51			18	
	Water sampler	2022-06-02 05:32		54.1508	7.9106	1	CH4, DOC, POC (250 ml), TA, NS, Chlorophyll

Station ID	Device	Start time	Stop time	Latitude	Longitude	Water depth	Remarks
L-23	In-situ CTD	2022-06-02 07:47	2022-06-02 07:52	54.0558	8.3358		
	In-situ pump surface	2022-06-02 07:49	2022-06-02 07:52			1	
	In-situ pump bottom	2022-06-02 07:48	2022-06-02 07:48			11	
	Water sampler	2022-06-02 07:50		54.0558	8.3358	1	CH4, DOC, POC (250 ml), TA, NS, Chlorophyll
L-24	In-situ CTD	2022-06-02 08:47	2022-06-02 09:15	53.9955	8.5499		
	In-situ pump surface	2022-06-02 08:52	2022-06-02 09:15			1	
	In-situ pump bottom	2022-06-02 09:09	2022-06-02 09:11			4	
	Water sampler	2022-06-02 09:12		53.9955	8.5499	1	CH4, DOC, POC (250 ml), TA, NS, Chlorophyll

Tab. A.5.3: Instruments on *Littorina* on Stern_9

On the way / vertical	Parameter(s)	Responsible person	Instrument name	Sensor ID at https://dashboard.awi.de/data-ingest/index.html HYDREX_2022_German_Bight_Stern9,	remarks
On the way	Longitude / Latitude	C. Faber	*Littorina* Navigation	vessel:littorina:lat_0001;vessel:littorina:lon_0001	data also included in Picarro dataset
On the way & vertical with in-situ pump	Dissolved methane: amb temp, ch4, ch4dry, co2, co2dry, fitflag, gas pressure, gastemp, ch4_dissolved_calculated	I. Bussmann	LosGatos	vessel:littorina:losgatos_awi_1142:ch4_dissolved_calculated	
On the way	Position: latitude, longitude, speed, course_over_ground	H. Rust	FerryBox pocket	vessel:littorina:pfb_hereon_ernie:longitude	
On the way & vertical with in-situ pump	Hydrography: flow_main_0001, Temperature_sbe45, conductivity_sbe45,, salinity_ sbe45, ph, Temperature_phsensor, oxygen_concentration, oxygen_saturation, temperature, turbidity, chlorophyll,	H. Rust	FerryBox pocket	vessel:littorina:pfb_hereon_ernie:salinity_sbe	
On the way	pH: ph_P0235, temperature,	M. Altahan / S. Bhattacharya	SAMI pH Sensor	vessel:littorina:sami_ph_geomar_p0235	

On the way / vertical	Parameter(s)	Responsible person	Instrument name	Sensor ID at https://dashboard.awi.de/data-ingest/index.html HYDREX_2022_German_Bight_Stern9,	remarks
On the way	Nitrate: salinity, temperature, salinity	M. Altahan / S. Bhattacharya	OPUS Nitrate Sensor	vessel:littorina:opus_geomar_71f9	
On the way	pH	M. Altahan / S. Bhattacharya	Lab on Chip pH	vessel:littorina:loc_ph_gmr_a7105-07-003	
On the way	Hydrography: conductivity_17F102065, depth_17h100268, nlf_conductivity_17f102065, odo_saturation_17h104627, odo_concentration_17h104627, odo_local_17h104627, salinity_17f102065, specific_conductivity_17f102065, total_dissolved_solids_17f102065, tss_18E100560 temperature_17f102065, vertical_position_17h100268	M. Altahan / S. Bhattacharya	EXO CTD	vessel:littorina:exo1_geomar_0001	
On the way	Dissolved methane: raw_ch4, corrected_ch4, pressure_sensor_temperature, pressure_millibar	M. Altahan / S. Bhattacharya	Pro OCEAN CH4 Sensor	vessel:littorina:methane_geomar_37-477-25	
Vertical	Hydrography: conductivity,, pressure, salinity,,temperature,	B. Raupers	CTD rosette	vessel:littorina:ctd_geomar_1070210	

On the way / vertical	Parameter(s)	Responsible person	Instrument name	Sensor ID at https://dashboard.awi.de/data-ingest/index.html HYDREX_2022_German_Bight_Stern9,	remarks
	oxygen_saturation, oxygen_concentration_mll, oxygen_concentration, pH, density, sound_velocity,				
On the way	Atmospheric CH4 and pCO2: ch4dry, co2dry, lat, lon	J. Greinert	Picarro	vessel:littorina:crds_cfbds2040	

Tab. A.5.4: Station list for *Uthörn*, for water samples taken from a Niskin water sampler for analysis of methane, DOC and POC (dissolved and particulate carbon), TA (total alkalinity) and NS (nutrients). UFZ GHG samples headspace equilibration samples in Exetainers. Data will be published in the Pangea database .

Station ID	Device	Start time [datetime UTC]	Stop time [datetime UTC]	Latitude	Longitude	Water depth [m]	Remarks
U-1	Water sampler	30.05.2022 08:24		53.5982	8.5061	1	from bucket, CH_4, DOC, POC (500 ml), TA, NS, Chl-a (500 ml)
	In-situ pump surface	30.05.2022 08:31	30.05.2022 08:34			1	
	In-situ pump bottom	30.05.2022 08:35	30.05.2022 08:38				
	In-situ CTD						none
	Bucket	30.05.2022 08:30					at UFZ CH_4, CO_2, N_2O
U-2	Water sampler	30.05.2022 09:45		53.6662	8.3866	1	CH_4, DOC, POC (500 ml), TA, NS, Chl-a (500 ml)
	In-situ pump surface	30.05.2022 09:49	30.05.2022 09:52			1	
	In-situ pump bottom	30.05.2022 09:53	30.05.2022 09:56				
	In-situ CTD	30.05.2022 11:49	30.05.2022 11:56				
	Bucket	30.05.2022 09:50					at UFZ CH4, CO_2, N_2O
U-3	Water sampler	30.05.2022 10:48		53.7218	8.2882	1	CH_4, DOC, POC (500 ml), TA, NS, Chl-a (500 ml)

Station ID	Device	Start time [datetime UTC]	Stop time [datetime UTC]	Latitude	Longitude	Water depth [m]	Remarks
	In-situ pump surface	30.05.2022 10:49	30.05.2022 10:52			1	
	In-situ pump bottom	30.05.2022 10:53	30.05.2022 10:56				
	In-situ CTD	30.05.2022 12:49	30.05.2022 12:56				
	Bucket	30.05.2022 10:55					at UFZ CH_4, CO_2, N_2O
U-4	Water sampler	30.05.2022 11:50		53.7980	8.1494	1	CH_4, DOC, POC (500 ml), TA, NS, Chl-a (500 ml)
	In-situ pump surface	30.05.2022 11:52	30.05.2022 11:56			1	
	In-situ pump bottom	30.05.2022 11:56	30.05.2022 12:00				
	In-situ CTD	30.05.2022 11:51	30.05.2022 12:00				
	Bucket	30.05.2022 11:55					at UFZ CH_4, CO_2, N_2O
U-5	Water sampler	30.05.2022 13:03		53.9187	7.9993	1	CH_4, DOC, POC (500 ml), TA, NS, Chl-a (500 ml)
	In-situ pump surface	30.05.2022 13:05	30.05.2022 13:10			1	
	In-situ pump bottom	30.05.2022 13:10	30.05.2022 13:15				
	In-situ CTD	30.05.2022 13:03	30.05.2022 13:15				

Station ID	Device	Start time [datetime UTC]	Stop time [datetime UTC]	Latitude	Longitude	Water depth [m]	Remarks
	Bucket	30.05.2022 13:05					at UFZ CH_4, CO_2, N_2O
U-6	Water sampler	30.05.2022 14:49		54.1435	7.9221	1	CH_4, DOC, POC (500 ml), TA, NS, Chl-a (500 ml)
	In-situ pump surface	30.05.2022 14:51	30.05.2022 14:56			1	
	In-situ pump bottom	30.05.2022 14:57	30.05.2022 15:02				
	In-situ CTD	30.05.2022 14:50	30.05.2022 15:02				
	Bucket	30.05.2022 14:50					at UFZ CH_4, CO_2, N_2O
U-7	Water sampler	31.05.2022 06:55		54.1557	7.9079	1	Intercal with *Prandtl* & *Littorina* CH_4, DOC, POC (500 ml), TA, NS, Chl-a (500 ml)
	In-situ pump surface	31.05.2022 06:57	31.05.2022 07:02			1	
	In-situ pump bottom	31.05.2022 07:02	31.05.2022 07:07				
	In-situ CTD	31.05.2022 06:57	31.05.2022 07:07				
	Bucket	31.05.2022 6:50					at UFZ CH_4, CO_2, N_2O
U-8	Water sampler	31.05.2022 07:55		54.2591	7.9255	1	CH_4, DOC, POC (500 ml), TA, NS, Chl-a (500 ml)

Station ID	Device	Start time [datetime UTC]	Stop time [datetime UTC]	Latitude	Longitude	Water depth [m]	Remarks
	In-situ pump surface	31.05.2022 07:56	31.05.2022 08:01			1	
	In-situ pump bottom	31.05.2022 08:01	31.05.2022 08:06				
	In-situ CTD	31.05.2022 07:55	31.05.2022 08:06				
	Bucket	31.05.2022 7:55					at UFZ CH_4, CO_2, N_2O
U-9	Water sampler	31.05.2022 09:16		54.4236	7.9150	1	CH_4, DOC, POC (500 ml), TA, NS, Chl-a (500 ml)
	In-situ pump surface	31.05.2022 09:17	31.05.2022 09:22			1	
	In-situ pump bottom	31.05.2022 09:23	31.05.2022 09:28				
	In-situ CTD	31.05.2022 09:17	31.05.2022 09:29				
	Bucket	31.05.2022 9:20					at UFZ CH_4, CO_2, N_2O
U-10	Water sampler	31.05.2022 10:27		54.5439	7.8285	1	CH_4, DOC, POC (500 ml), TA, NS, Chl-a (500 ml)
	In-situ pump surface	31.05.2022 10:29	31.05.2022 10:34			1	
	In-situ pump bottom	31.05.2022 10:35	31.05.2022 10:40				
	In-situ CTD	31.05.2022 10:29	31.05.2022 10:40				

Station ID	Device	Start time [datetime UTC]	Stop time [datetime UTC]	Latitude	Longitude	Water depth [m]	Remarks
	Bucket	31.05.2022 10.30					at UFZ CH_4, CO_2, N_2O
U-11	Water sampler	31.05.2022 11:33		54.5423	7.6291	1	CH_4, DOC, POC (500 ml), TA, NS, Chl-a (500 ml)
	In-situ pump surface	31.05.2022 11:33	31.05.2022 11:38			1	
	In-situ pump bottom	31.05.2022 11:39	31.05.2022 11:44				
	In-situ CTD	31.05.2022 11:33	31.05.2022 11:45				
	Bucket	31.05.2022 11:35					at UFZ CH_4, CO_2, N_2O
U-12	Water sampler	31.05.2022 12:38		54.4222	7.6118	1	CH_4, DOC, POC (500 ml), TA, NS, Chl-a (500 ml)
	In-situ pump surface	31.05.2022 12:40	31.05.2022 12:45			1	
	In-situ pump bottom	31.05.2022 12:45	31.05.2022 12:51				
	In-situ CTD	31.05.2022 12:39	31.05.2022 12:52				
	Bucket	31.05.2022 12:45					at UFZ CH_4, CO_2, N_2O
U-13	Water sampler	31.05.2022 13:55		54.2853	7.6234	1	CH_4, DOC, POC (500 ml), TA, NS, Chl-a (500 ml)
	n-situ pump surface	31.05.2022 13:56	31.05.2022 14:01			1	

Station ID	Device	Start time [datetime UTC]	Stop time [datetime UTC]	Latitude	Longitude	Water depth [m]	Remarks
	In-situ pump bottom	31.05.2022 14:01	31.05.2022 14:06				
	In-situ CTD	31.05.2022 13:56	31.05.2022 14:06				
	Bucket	31.05.2022 14:00					at UFZ CH_4, CO_2, N_2O
U-14	Water sampler	31.05.2022 14:58		54.2517	7.7932	1	CH_4, DOC, POC (500 ml), TA, NS, Chl-a (500 ml)
	In-situ pump surface	31.05.2022 14:59	31.05.2022 15:04			1	
	In-situ pump bottom	31.05.2022 15:04	31.05.2022 15:09				
	In-situ CTD	31.05.2022 14:59	31.05.2022 15:09				
	Bucket	31.05.2022 15:00					at UFZ CH_4, CO_2, N_2O
U-15	Water sampler	01.06.2022 06:04		54.1251	7.9899	1	CH_4, DOC, POC (500 ml), TA, NS, Chl-a (500 ml)
	In-situ pump surface	01.06.2022 06:04	01.06.2022 06:09			1	
	In-situ pump bottom	01.06.2022 06:10	01.06.2022 06:15				
	In-situ CTD	01.06.2022 06:04	01.06.2022 06:15				
	Bucket	01.06.2022 6:10					at UFZ CH_4, CO_2, N_2O

Station ID	Device	Start time [datetime UTC]	Stop time [datetime UTC]	Latitude	Longitude	Water depth [m]	Remarks
U-16	Water sampler	01.06.2022 06:59		54.0885	8.1012	1	CH_4, DOC, POC (500 ml), TA, NS, Chl-a (500 ml)
	In-situ pump surface	01.06.2022 07:00	01.06.2022 07:05			1	
	In-situ pump bottom	01.06.2022 07:05	01.06.2022 07:10				
	In-situ CTD	01.06.2022 06:59	01.06.2022 07:10				
	Bucket	01.06.2022 7:00					at UFZ CH_4, CO_2, N_2O
U-17	Water sampler	01.06.2022 07:59		54.0262	8.2415	1	CH_4, DOC, POC (500 ml), TA, NS, Chl-a (500 ml), foam on the surface, filters were smelly
	In-situ pump surface	01.06.2022 08:00	01.06.2022 08:05			1	
	In-situ pump bottom	01.06.2022 08:05	01.06.2022 08:10				
	In-situ CTD	01.06.2022 07:59	01.06.2022 08:10				
	Bucket	01.06.2022 8:00					at UFZ CH_4, CO_2, N_2O
U-18	Water sampler	01.06.2022 08:53		53.9505	8.1805	1	CH_4, DOC, POC (500 ml), TA, NS, Chl-a (500 ml), foam on the surface, filters were smelly

Station ID	Device	Start time [datetime UTC]	Stop time [datetime UTC]	Latitude	Longitude	Water depth [m]	Remarks
	In-situ pump surface	01.06.2022 08:54	01.06.2022 08:59			1	
	In-situ pump bottom	01.06.2022 08:59	01.06.2022 09:04				
	In-situ CTD	01.06.2022 08:54	01.06.2022 09:05				
	Bucket	01.06.2022 9:00					at UFZ CH_4, CO_2, N_2O
U-19	Water sampler	01.06.2022 10:03		53.8176	8.1324	1	CH_4, DOC, POC (500 ml), TA, NS, Chl-a (500 ml)
	In-situ pump surface	01.06.2022 10:04	01.06.2022 10:09			1	
	In-situ pump bottom	01.06.2022 10:10	01.06.2022 10:15				
	In-situ CTD	01.06.2022 10:03	01.06.2022 10:15				
	Bucket	01.06.2022 10:10					at UFZ CH_4, CO_2, N_2O
U-20	Water sampler	01.06.2022 11:34		53.9518	8.0288	1	CH_4, DOC, POC (500 ml), TA, NS, Chl-a (500 ml)
	In-situ pump surface	01.06.2022 11:35	01.06.2022 11:40			1	
	In-situ pump bottom	01.06.2022 11:41	01.06.2022 11:46				
	In-situ CTD	01.06.2022 11:35	01.06.2022 11:46				

Station ID	Device	Start time [datetime UTC]	Stop time [datetime UTC]	Latitude	Longitude	Water depth [m]	Remarks
	Bucket	01.06.2022 11:40					at UFZ CH_4, CO_2, N_2O
U-21	Water sampler	01.06.2022 12:33		54.0429	7.9794	1	CH_4, DOC, POC (500 ml), TA, NS, Chl-a (500 ml)
	In-situ pump surface	01.06.2022 12:34	01.06.2022 12:39			1	
	In-situ pump bottom	01.06.2022 12:39	01.06.2022 12:44				
	In-situ CTD	01.06.2022 12:34	01.06.2022 12:44				
	Bucket	01.06.2022 12:35					at UFZ CH_4, CO_2, N_2O
U-22	Water sampler	01.06.2022 13:25		54.1246	7.9291	1	CH_4, DOC, POC (500 ml), TA, NS, Chl-a (500 ml)
	In-situ pump surface	01.06.2022 13:26	01.06.2022 13:31			1	
	In-situ pump bottom	01.06.2022 13:31	01.06.2022 13:36				
	In-situ CTD	01.06.2022 13:26	01.06.2022 13:36				
	Bucket	01.06.2022 13:30					at UFZ CH_4, CO_2, N_2O
U-23	Water sampler	02.06.2022 05:50		54.1473	7.9050	1	Intercal with Littorina CH_4, DOC, POC (500 ml), TA, NS, Chl-a (500 ml),
	In-situ pump surface	02.06.2022 05:52	02.06.2022 05:57			1	

Station ID	Device	Start time [datetime UTC]	Stop time [datetime UTC]	Latitude	Longitude	Water depth [m]	Remarks
	In-situ pump bottom						none, not enough weight without the CTD
	Bucket	02.06.2022 5:45					at UFZ CH_4, CO_2, N_2O
U-24	Water sampler	02.06.2022 06:44		54.1431	7.7426	1	CH_4, DOC, POC (500 ml), TA, NS, Chl-a (500 ml)
	In-situ pump surface	02.06.2022 06:45	02.06.2022 06:50			1	
	In-situ pump bottom	02.06.2022 06:50	02.06.2022 06:55				
	Bucket	02.06.2022 6:45					at UFZ CH_4, CO_2, N_2O
U-25	Water sampler	02.06.2022 07:49		54.0106	7.7365	1	CH_4, DOC, POC (500 ml), TA, NS, Chl-a (500 ml)
	In-situ pump surface	02.06.2022 07:50	02.06.2022 07:55			1	
	In-situ pump bottom	02.06.2022 07:55	02.06.2022 08:00				
	Bucket	02.06.2022 7:50					at UFZ CH_4, CO_2, N_2O
U-26	Water sampler	02.06.2022 09:02		53.8571	7.7396	1	CH_4, DOC, POC (500 ml), TA, NS, Chl-a (500 ml)
	In-situ pump surface	02.06.2022 09:04	02.06.2022 09:09			1	
	In-situ pump bottom	02.06.2022 09:09	02.06.2022 09:14				

Station ID	Device	Start time [datetime UTC]	Stop time [datetime UTC]	Latitude	Longitude	Water depth [m]	Remarks
	Bucket	02.06.2022 9:00					at UFZ CH_4, CO_2, N_2O
U-27	Water sampler	02.06.2022 09:58		53.8510	7.9267	1	CH_4, DOC, POC (500 ml), TA, NS, Chl-a (500 ml), foam on the surface, filters were smelly
	In-situ pump surface	02.06.2022 10:00	02.06.2022 10:05			1	
	In-situ pump bottom	02.06.2022 10:05	02.06.2022 10:10				
	Bucket	02.06.2022 10:00					at UFZ CH_4, CO_2, N_2O
U-28	Water sampler	02.06.2022 10:53		53.8009	8.1248	1	CH_4, DOC, POC (500 ml), TA, NS, Chl-a (500 ml)
	In-situ pump surface	02.06.2022 10:54	02.06.2022 11:00			1	
	In-situ pump bottom	02.06.2022 11:00	02.06.2022 11:05				
	Bucket	02.06.2022 10:50					at UFZ CH_4, CO_2, N_2O
U-29	Water sampler	02.06.2022 12:06		53.6708	8.3703	1	CH_4, DOC, POC (500 ml), TA, NS, Chl-a (500 ml)
	In-situ pump surface	02.06.2022 12:07	02.06.2022 12:12			1	
	In-situ pump bottom	02.06.2022 12:12	02.06.2022 12:17				

Station ID	Device	Start time [datetime UTC]	Stop time [datetime UTC]	Latitude	Longitude	Water depth [m]	Remarks
	Bucket	02.06.2022 12:10					at UFZ CH_4, CO_2, N_2O

Tab. A.5.5: Instruments on the *Uthörn* on Stern_9

On the way / vertical	Parameter(s)	Responsible person	Instrument name	Sensor ID at https://dashboard.awi.de/data-ingest/index.html HYDREX_2022_German_Bight_Stern9	Remarks
on the way	position	N. Anselm	d-ship Uth [3111]	vessel:uthoern:weather:longitude	with respective date(s)
on the way + vertical		I. Bussmann	pocket ferry box pfb awi [4079]	vessel:uthoern:pfb_awi_751801:conductivity_sbe45_0001	time offset 351” with in-situ pump #1
on the way	atmospheric CH4 and CO2	I. Bussmann	Picarro [6083]	vessel:mya_ii:picarro_awi_cfads2156	time offset 27”
on the way	wind speed, wind direction	N. Anselm	d-ship [3111]	vessel:uthoern:weather:true_wind_speed	with respective date(s)
on the way + vertical	dissolved CH4 and CO2	I. Bussmann	LosGatos #1303 [4044] with Degasser: 1704673-003	vessel:uthoern:losgatos_awi_1303:ch4d_ppm	time offset 780” 1704673-003???
on the way	communication unit	N. Anselm	IPU	hulk [8047]	no data
on stations only	CO2 and CH4 flux	M. Koschorreck	GASMET	SN112228	with floating chamber, data not in O2A

On the way / vertical	Parameter(s)	Responsible person	Instrument name	Sensor ID at https://dashboard.awi.de/data-ingest/index.html HYDREX_2022_German_Bight_Stern9	Remarks
vertical	chlorophyll, conductivity, oxygen, temperature, salinity, turbidity, pressure	L. Happel	CTD 1420	vessel:uthoern:moses_moblab:ctd_awi_1420:pressure_01	attached to in-situ pump

Tab. A.5.6: Station list for *Ludwig Prandtl* on Stern_9. Water samples were taken from a Niskin water sampler for analysis of methane (CH4) and oxygen (O2), dissolved and particulate carbon (DOC, POC), total alkalinity (TA), nutrients (NS: Silicate, nitrate, nitrite, phosphate, ammonia); chlorophyll (Chl) and dissolved organic matter (DOM). Niskin water samples were taken at the end of the CTD time. Data will be published in the pangea database.

Station ID	Device	Start time [datetime UTC]	Stop time [datetime UTC]	Latitude	Longitude	Water depth [m]	Remarks
P-1	In-situ CTD	30.05.2022 07:15	30.05.2022 07:27	53.9636	8.6363	10	O2, DOC, POC, NS, Chl-a, DOM
P-2	In-situ CTD	30.05.2022 08:40	30.05.2022 08:54	53.9952	8.4121	12	CH4, TA, O2, DOC, POC, NS, Chl-a, DOM
P-3	In-situ CTD	30.05.2022 09:32	30.05.2022 09:45	54.0099	8.3196	13	CH4, TA, O2, DOC, POC, NS, Chl-a, DOM
P-4	In-situ CTD	30.05.2022 10:17	30.05.2022 10:28	54.0337	8.1994	17	CH4, TA, O2, DOC, POC, NS, Chl-a, DOM
P-5	In-situ CTD	30.05.2022 11:00	30.05.2022 11:10	54.0275	8.0986	12	CH4, TA, O2, DOC, POC, NS, Chl-a, DOM
P-6	In-situ CTD	30.05.2022 11:35	30.05.2022 11:46	54.0306	8.0003	12	CH4, TA, O2, DOC, POC, NS, Chl-a, DOM
P-7	In-situ CTD	30.05.2022 12:13	30.05.2022 12:21	54.1566	7.9089	11	CH4, TA, DOC, POC, NS, Chl-a, DOM
P-8	In-situ CTD	30.05.2022 12:48	30.05.2022 12:58	54.1566	7.9089	11	CH4, TA, DOC, POC, NS, Chl-a, DOM
P-9	In-situ CTD	31.05.2022 06:31	31.05.2022 07:02	54.1557	7.9045	20	CH4, TA, DOC, POC, NS, Chl-a, DOM
P-10	In-situ CTD	31.05.2022 06:51	31.05.2022 07:04	54.1557	7.9045	21	CH4, TA, DOC, POC, NS, Chl-a, DOM
P-11	In-situ CTD	31.05.2022 08:08	31.05.2022 08:19	54.3009	7.9050	22	CH4, TA, DOC, POC, NS, Chl-a, DOM
P-12	In-situ CTD	31.05.2022 08:58	31.05.2022 09:08	54.4045	7.9082	20	CH4, TA, DOC, POC, NS, Chl-a, DOM

P-13	In-situ CTD	31.05.2022 09:27	31.05.2022 09:38	54.4013	8.0024	17	CH4, TA, DOC, POC, NS, Chl-a, DOM
P-14	In-situ CTD	31.05.2022 09:57	31.05.2022 10:06	54.4012	8.1011	19	CH4, TA, DOC, POC, NS, Chl-a, DOM
P-15	In-situ CTD	31.05.2022 10:26	31.05.2022 10:35	54.4021	8.1997	18	CH4, TA, DOC, POC, NS, Chl-a, DOM
P-16	In-situ CTD	31.05.2022 10:43	31.05.2022 10:49	54.4037	8.2068	18	CH4, TA, DOC, POC, NS, Chl-a, DOM
P-17	In-situ CTD	31.05.2022 12:54	31.05.2022 13:02	54.5541	8.3378	17	CH4, TA, DOC, POC, NS, Chl-a, DOM
P-18	In-situ CTD	01.06.2022 05:00	01.06.2022 05:09	54.6004	8.2027	6	CH4, TA, DOC, POC, NS, Chl-a, DOM
P-19	In-situ CTD	01.06.2022 05:30	01.06.2022 05:40	54.5987	8.0985	11	CH4, TA, DOC, POC, NS, Chl-a, DOM
P-20	In-situ CTD	01.06.2022 06:01	01.06.2022 06:10	54.6002	7.9971	8	CH4, TA, DOC, POC, NS, Chl-a, DOM
P-21	In-situ CTD	01.06.2022 06:31	01.06.2022 06:41	54.6002	7.8977	12	CH4, TA, DOC, POC, NS, Chl-a, DOM
P-22	In-situ CTD	01.06.2022 07:42	01.06.2022 07:52	54.7502	7.9044	14.5	CH4, TA, DOC, POC, NS, Chl-a, DOM
P-23	In-situ CTD	01.06.2022 08:15	01.06.2022 08:25	54.7447	8.001	14	CH4, TA, DOC, POC, NS, Chl-a, DOM
P-24	In-situ CTD	01.06.2022 08:57	01.06.2022 09:06	54.7420	8.1094	10	CH4, TA, DOC, POC, NS, Chl-a, DOM
P-25	In-situ CTD	01.06.2022 09:29	01.06.2022 09:39	54.7419	8.2075	9.6	CH4, TA, DOC, POC, NS, Chl-a, DOM
P-26	In-situ CTD	02.06.2022 04:24	02.06:2022 04:33	54.5244	8.2981	7	CH4, DOC, POC, NS, Chl-a, DOM
P-27	In-situ CTD	02.06.2022 09:08	02.06.2022 09:16	53.9921	8.5572	7	CH4, TA, DOC, POC, NS, Chl-a, DOM

Tab. A.5.7: Instruments on the *Ludwig Prandtl* on Stern_9

On the way / vertical	Parameter(s)	Responsible person	Instrument name	Sensor ID https://dashboard.awi.de/data-ingest/index.html **HYDREX_2022_German_Bight_Stern9**	Remarks
on the way	temperature, salinity, oxygen saturation, turbidity, fluorescence, pCO2, CDOM	Hendrik Rust	FerryBox Orion	vessel:prandtl_hzg:fb_hzg_orion:temperature_0001	
vertical	temperature, salinity, oxygen saturation, turbidit	Götz Flöser	CTD313	vessel:prandtl_hzg:ctd_hzg_313:pressure_01	
on the way	CH4 and CO2 in water	Hannah Jebens	LosGatos #3599 with degasser: 1704673-003	vessel:prandtl_hzg:losgatos_awi_3599:ch4_dissolved_calculated	
on the way	weather station	Götz Flöser	weather station GMX600	vessel:Prandtl_hzg:weather_station_hzg_1957ps001	

A.6 TABLE FOR TANGERMÜNDE

Tab. A.6.1: Time table of the different measurements and instruments at the Tangermünde site

Location			Parameter	Instrument	18.08.2022	19.08.2022	20.08.2022	21.08.2022	22.08.2022
pier in Tangermünde, on board of *Albis*, not from 19.08 08:37 to 12:17, restart at 13:42; not from 21.8 14:30 - 16:30	atmospheric	continuous	CO_2 + CH_4	GASMET	-	9:12-13:07	-	10:24 -19:17	-
	dissolved	continuous	CO_2 + CH_4	AMT + Contros Sensor		00:00- 24:00	00:00- 24:00	00:00- 24:00	00:00- 8:00
	dissolved	continuous	temp, cond, chl, pH, turb, O_2	Exo-CTD, ferrybox				fb data only from 0:00 - 7:00	fb data only from 0:00 - 7:00
transects across the river	dissolved	continuous	temp, cond, chl, pH, turb, O_2	Exo-CTD ferrybox		08:37 to 12:17			
	dissolved	continuous	CO_2 + CH_4	Contros Sensors + LosGatos on the *Albis*		08:37 - 12:17	10:05-10:20 10:23-10:44 10:49-11:13	16:19 -16:53	
	with rubber boat		depth and current profiles	ADCP		10:00 - 14:00?			
	atmospheric	continuous	CO_2 + CH_4	von Matthais??					
groyne field on land	atmospheric	3 static sites	CO_2 flux + CO_2	chamber Matthias	16:44-24:00	00:00- 24:00	00:00- 24:00	00:00 - 24:00	00:00 - 6:17
	atmospheric	several locations	CO_2 + CH_4 flux	chamber LICOR 7810		12:00-14:00	10:00-15:00	8:00 - 20:00	

Location			Parameter	Instrument	18.08.2022	19.08.2022	20.08.2022	21.08.2022	22.08.2022
top of groynes	dissolved	continuous	$CO_2 + CH_4$	LosGatos in rubber boat			10:00 -11:20	16:00 -16:53	
	dissolved	several locations	CO_2 flux, CH_4 flux, CO_2, CH_4	GASMET in rubber boat			X	X	
swell of *Albis;* on 21.8 14:30 - 16:3	dissolved		$CO_2 + CH_4$	water samples				15:11; 15:57; 16:04	
	dissolved		conductivity	Exo-CTD, CTD von Karsten, WTW hand-held					
methane production rates	sediment		CH_4production	LosGatos		X	X	X	X

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BREMERHAVEN

Am Handelshafen 12
27570 Bremerhaven
Telefon 0471 4831-0
Telefax 0471 4831-1149
www.awi.de

HELMHOLTZ