HEINCKE-Berichte

Student training, research- and project-oriented teaching of physical oceanography as well as interaction ship – waterway, green shipping - North Sea

Cruise No. HE586

04.10.2021 – 16.10.2021,
Bremerhaven (Germany) - Emden (Germany) - Bremerhaven (Germany)
ICBM-HS-EMD-LER_22

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2022

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1 Cruise Summary

1.1 Summary

The research cruise HE568 with RV Heincke started under strict corona protection regulations (G2) in Bremerhaven, a crew change took place in Emden. The main objective was student training onboard a research vessel. 13 students (Bachelor, Master and PhD students) from the University of Oldenburg, University of Hamburg and University of Applied Sciences Emden/Leer participated in the cruise. The students gained extensive insights into oceanographic methods and working procedures as well as into current research topics of the ICBM, the University of Applied Sciences Emden/Leer, the Helmholtz Center Hereon, the DFKI of Lower Saxony and the IOW. In addition to the practical training, measurement data were collected, and samples taken for the BMBF-funded research project CARBOSTORE (Carbon Storage in German Coastal Seas - Stability, Vulnerability and Perspectives for Manageability) in the Skagerrak (NOR, DK)).
Another aim of the cruise was to deploy and to test both new measurement technology as well as a new self-diving Lagrangian surface drifter. This drifter was developed in the project saimidris (Sailing Intelligent Micro Drifter Swarms) jointly run by the ICBM / ZfMarS (Centre for Marine Sensor Technology, Wilhelmshaven), the DFKI Lower Saxony and the University of Applied Sciences Emden/Leer. The study area included the Skagerrak (NOR, DK), the German Bight and the estuaries of the river Ems and the Jade. During the cruise, the students and scientists had to work in shifts. No problems occurred during the cruise and the work was a very big success for everyone involved.

1.2 Zusammenfassung

Die Forschungsreise HE568 mit FS Heincke startete unter strengen Corona-Schutzauflagen (G2) in Bremerhaven, ein Crewwechseln fand in Emden statt. Das Hauptziel war die studentische Ausbildung an Bord eines Forschungsschiffes. Insgesamt nahmen 13 Studierende (Bachelor-, Master- und Promotionsstudenten) der Universitäten Oldenburg, und Hamburg sowie der Hochschule Emden/Leer teil. Die Studierenden erhielten umfangreiche Einblicke in ozeanographische Methoden und Arbeitsweisen sowie in aktuelle Forschungsthemen des ICBM, der Hochschule Emden/Leer, des Helmholtz-Zentrum hereon, des DFKI Niedersachsen und des IOW. Neben der praktischen Ausbildung der Studierenden wurden für das durch das BMBF geförderte Forschungsprojekt CARBOSTORE (Carbon Storage in German Coastal Seas – Stability, Vulnerability and Perspectives for Manageability) im Skagerrak (NOR, DK) Messdaten erhoben und Proben genommen.
Einen weiteren Schwerpunkt der Reise bildeten der Einsatz und die Erprobung neuer Messtechnik und der Einsatz eines neuen selbsttauchenden, Lagrange-Oberflächendrifter. Dieser Drifter wurde in dem Verbundprojektes saimidris (Sailing Intelligent Micro Drifter Swarms) des ICBM/ ZfMarS (Zentrum für Marine Sensorik, Wilhelmshaven), des DFKI und der Hochschule Emden/Leer entwickelt. Das Untersuchungsgebiet umfasste das Skagerrak (NOR, DK), die Deutsche Bucht sowie die Ästuare der Ems und der Jade. Während der gesamten Reise arbeiteten die Studierenden und Wissenschaftler im Schichtbetrieb. Die Fahrt verlief reibungslos und war für alle Beteiligten ein sehr großer Erfolg.

2 Participants

2.1 Principal Investigators

Name	Institution
Badewien, Thomas, Dr.	ICBM
Strybny, Jann, Prof. Dr.	HS Emden/Leer

2.2 Scientific Party

Leg 1: Bremerhaven – Emden 04.10. – 11.10.2021

Name		Profession	Discipline	Institution
Badewien	Thomas	Scientist	Oceanography	ICBM
Meyerjürgens	Jens	Scientist	Oceanography	ICBM
Lübben	Andrea	Scientist	Oceanography	ICBM
Geßner	Anna-Lena	Student	Environmental Sciences	ICBM
Rau	Camille	Student	Marine Sensors Systems	Uni Ol
Brandl	Konstantin	Student	Marine Sensors Systems	Uni Ol
Deyle	Lisa	Student	Marine Sensors Systems	Uni Ol
Steiwer	Julia	Student	Environmental Sciences	Uni Ol
Villa Castrillon	Luciana	Student	Oceanography	Uni HH
Nantke	Carla	Scientist	Environmental Sciences	IOW
Przibilla	Anna	Student	Environmental Sciences	hereon

Leg 2: Emden - Bremerhaven 11.10.2021 – 16.10.2021

Name		Profession	Discipline	Institution
Badewien	Thomas	Scientist	Oceanography	ICBM
Meyerjürgens	Jens	Scientist	Oceanography	ICBM
Lübben	Andrea	Scientist	Oceanography	ICBM
Strybny	Jann	Scientist	Maritime Technology	HS Emden/Leer
Nuñez von Voigt	Pablo	Student	Maritime Technology	HS Emden/Leer
Boeuf	Jonathan	Scientist	Maritime Technology	DFKI
Böhm	Marius	Student	Maritime Technology	HS Emden/Leer
Bühnert	Georg	Student	Maritime Technology	HS Emden/Leer
MoczkUhn	Till	Student	Maritime Technology	HS Emden/Leer
Legene	Kenny	Student	Maritime Technology	HS Emden/Leer
Jacobsen	Bentje	Student	Maritime Technology	HS Emden/Leer

2.3 Participating Institutions

ICBM	Institute for Chemistry and Biology of the marine Environment
UniOl	Carl von Ossietzky Universität Oldenburg
DFKI	Deutsches Forschungszentrum für Künstliche Intelligenz, Oldenburg
IOW	Institut für Ostseeforschung, Warnemünde
hereon	Helmholtz-Zentrum Hereon
Uni HH	Universität Hamburg
HS Emden/Leer	Hochschule Emden/Leer

3 Research Program

3.1 Description of the Work Area

The working area of the cruise HE586 with RV Heincke was the eastern part of the southern North Sea, German Bight. The educational part of the cruise took place in the nature conservation areas Sylter Aussenriff and Borkum Riffgrund as well as in the estuaries of the river Ems and the Jade. Measurements for the CARBOSTORE projects were obtained mainly in the Skagerrak where mixing of water masses from North and Baltic See are taking place.

3.2 Aims of the Cruise

During the educational part of the cruise HE586 with RV Heincke the dynamics of physical and optical water mass properties, suspended particulate matter and plankton assemblages in relation to the ambient hydrography were intensely investigated. The central topic was the education of students in the field of marine sensor technologies and bio-optics to address current methods and challenges of ocean observations. Therefor the students developed and investigate their own research project, which was already prepared before the cruise and analyzed in detail afterwards. The research question for the students project was: What strategy can be used to distinguish water bodies inside and outside a conservation area?

A consortium of ICBM, Emden/Leer University of Applied Sciences and DFKI is currently working on a large collaborative project to develop a system of drifter swarms. This project, saimidris, is funded by Ministry of Science and Culture in Lower Saxony (MWK). An essential part of the research project is the completely new development of a drifter with a sustainable sail-assist propulsion system. This can be activated on the basis of artificial intelligence and intervene in the drifting process. In this way, a kind of "geofence" can be placed around a sea area, the drifters can be fed selectively to new starting positions for new tasks as required. The Fraunhofer Group “Sustainable Maritime Mobility” at the Emden/Leer University of Applied Sciences, led by the Strybny/Vahs team, is developing different sail systems for drifters in the saimidris project. A first prototype was tested on the Heincke cruise HE586 with the help of a team of students, studying in the “Maritime Technology and Shipping Management” bachelor program.

After short introduction and familiarisation with the daily work on-board, students independently used and deployed the methods and gears for proper measurements. Each shift during the cruise was staffed with students. Supervisors controlled operation only in the background. The students are given hands-on opportunity to gain deep insight and practical training on both traditional and modern methods of marine sensor systems. This includes physical oceanography, optical methods, biogeochemical methods, testing of marine sensors and environmental aspects. Thus, this high level hands-on vocational training by using state-of-the-art marine technology develops and sharpens the awareness for marine environment. Therefore, processes and practical methods were used to achieve them forming the basis for an excellent level of education in marine sciences and sensors.

The cruise RV Heincke 586 was also part of the research project "Carbon Storage in German Coastal Seas - Stability, Vulnerability and Perspectives for Manageability CARBOSTORE“ (FONA / MARE:N), subproject “ProCarbone” led by T. Badewien, ICBM .
The main objective of the project is the investigation of the stability and vulnerability of various carbon storage pools in the German marginal seas, North Sea and Baltic Sea. The Skagerrak is considered a key region where the mixing of water masses of the North Sea, the Baltic Sea and the North Atlantic takes place. Upwelling and sinking processes due to the mixing of water masses with different density properties influence the exchange of CO_2 between the air-sea interface. By using satellite and ship-based data, a detailed understanding will be obtained to gain insights into these exchange processes in the Skagerrak area. To this end, water mass properties were investigated with high-resolution conductivity-temperature-depth (CTD) profiles. Current and mixing properties were studied with Acoustic Doppler Current Profiler (ADCP) transects across the Skagerrak basin. In addition, surface drifters were deployed to get insights into the surface circulation and mixing of various water masses in the Skagerrak. The intent of this “process study” was to thoroughly characterize turbulent mixing in the deep channel connecting the Baltic and the North Sea. This also includes time for sediment collection and in-situ experiments in the Skagerrak depositional center, examining POC accumulation and the diagenetic processes affecting the stability of the POC sink.

3.3 Agenda of the Cruise

3.3.1 Cruise Track

Defined tracks and stations within the North Sea were investigated on the HE586 expedition. The cruise started in Bremerhaven on the 4th of October, with a crew change in Emden on the 11th of October, ending again in Bremerhaven on the 16th of October. Track chart with transect is shown in Figure 3.1. A detailed station list can be found in chapter 6.

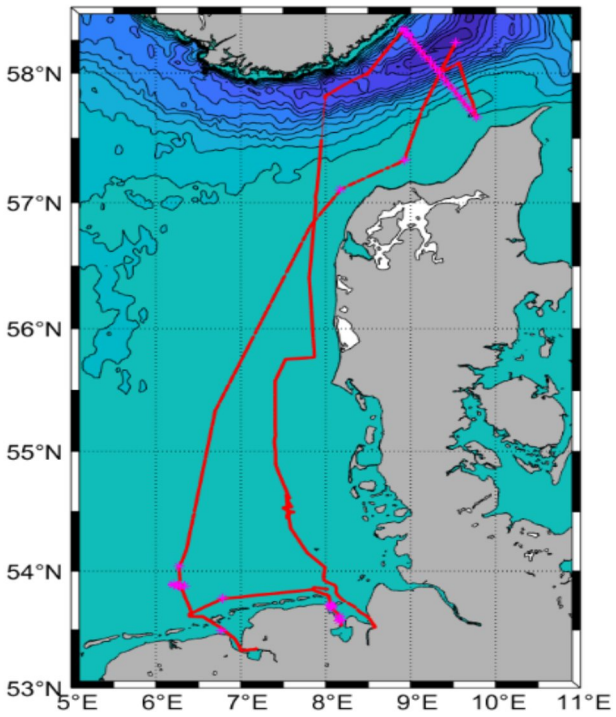


Figure 3.1 Track chart of the educational cruise HE586 with RV Heincke. Stations are marked with magenta dots.

3.3.2 Work program

During the cruise the investigations included 45 stations with 86 CTD profiles, 390 JoJo CTD profiles, 11 hyperspectral radiometric profiles, 86 Secchi disk readings, 86 Forel-Ule scale readings, three Multicorer stations, defined water sampling from CTD for suspended particular material and chlorophyll a concentration, seven van Veen grap samplings and 21 surface drifter deployments. Underway, FerryBox, ADCP and radiometric reflectance data were sampled continuously.

Station work was mainly conducted at daytime, during night underway observation were on focus, sampling took place in defined time intervals. A station typically started with a CTD operation and water sampling. Defined depths within the water column were chosen during the downcast of the CTD, adjusted with respect to a chlorophyll maximum. Samples for various parameters were withdrawn from the Niskin bottles of the CTD. In general, the determination of Secchi disc depth and Forel-Ule index readings followed the CTD operation, depending on weather conditions and currents. At the end a hyperspectral profiler was used to investigate the underwater light field. A total of 11 free-falling hyperspectral radiometric profiler casts from the back of the ship were done. Sampling activities from the Niskin bottles of the CTD were done immediately after the cast to avoid changes in parameters. Various parameters and methods were use to investigate special parameters in the lab. Lab work included filtering sampled water for chlorophyll a and suspended particulate matter.

Besides the ship-based underway measurements (weather conditions, thermosalinograph, fluorometer) additional parameters were assessed by a FerryBox system for a better characterization of surface waters of the investigated research area. This FerryBox device is a flow through system connected to the ship's continuous pump system to monitor continuously temperature, salinity, chlorophyll fluorescence, CDOM fluorescence and turbidity in a one-minute interval. To determine ocean color a radiometric setup was installed on the upper deck of the ship. Data were recorded continuously in a five-minute interval along the cruise track.

4 Narrative of the Cruise

The cruise was splitted into two legs to give more students the option to participate. Nineteen scientists and students from Germany participated in the educational cruise of RV Heincke HE586. The central topic was the education of students in the field of marine sensor technologies and bio-optics to address current methods and challenges of ocean observations. Disciplines addressed are marine environmental technology, bio-optics, ocean color, biogeochemistry and physical oceanography. Station work was combined with continuous underway measurements.

On the first leg:
The Heincke expedition HE586 started on October 4th in the morning from the port of Bremerhaven under strict corona protection regulations (G2) in Bremerhaven. The ship headed towards its first station at an outer point of river Weser. This acted as a test station for the students to get familiarized with all instrumentation and equipment on board. From the 05th to the 6th of October a process study was carried out in the *German Sylter Außenriff* nature reserve to investigate the dispersal and mixing of water masses. Since diplomatic approval was only available two days before departure and not all areas were approved as requested, the mission planning unfortunately had to be changed at short notice, License for Scientific Exploration for Norway reconnaissance license, no.804/20. After that a transit through the Danish and Norwegian territories to the second study area in the Skagerrak took place. From the 7th to the 9th of October near-surface current dynamics along a trajectory from Norway to Denmark as well as near-bottom processes of the carbon cycle to quantify the storage of CO2 in the North Sea were investigated. Then we went back to the German territory and started a second process study in the *German Borkum Riffgrund* nature reserve to investigate the dispersal and mixing of water masses (10th to 11th of October). On the 11th of October a crew change took place under strict corona protection regulations (G2) at the port of Emden.

On the second leg:
Due to weather conditions the cruise was rescheduled and testing of the drifter close to Helgoland were canceled. From the 12th to 13th of October we stayed at anker at the river Ems close to the island Borkum under safe wind and wave conditions. High-resolution Jo-Jo-profile measurements were carried out with the CTD in the Ems estuary at the anchorage position Dukegat Reede. First testing of the new sailing and diving surface drifter were done. From the 14th to the 15th of October, we conducted hydrographic measurements in the Jade during a tidal cycle. The new surface drifter was intensively tested in the Jade. On the 15th of October a research day trip with guests (students of the Jade University of Applied Sciences - Bachelor Marine Engineering) came onboard the RV Heincke, also under strict corona protection regulations (G2). The day trip was used to give more students the opportunity to have a quick look into station work on board. On the 16th of October

we arrived again at the port of Bremerhaven and the cruise ended. The research cruise gave the students of the University of Oldenburg and the University of Applied Sciences Emden/Leer very good insights into the working life on board a research vessel and the research work in the projects CARBOTORE and saimidris. There was very good, constructive support from the ship's command and the entire crew in the use of all the scientific instruments and in the testing of a new surface drifter in the saimidris project. The research cruise was a complete success.

In total, the investigations included 45 stations with 86 CTD profiles, 390 Jo-Jo CTD profiles, 25 hyperspectral radiometric profiles, 86 Secchi disk readings, 86 Forel-Ule scale readings, three Multicorer stations, defined water sampling from CTD for suspended particular material and chlorophyll a concentration, seven Van Veen grap samplings and 21 surface drifter deployments. Underway, FerryBox, ADCP and radiometric reflectance data were sampled continuously.

5 Preliminary Results

In the following section the first, preliminary results of the training cruise HE586 with RV Heincke are presented. Further data processing, analysis and interpretation will be done in the course of student projects, final theses (Bachelor and Master) and PhD projects as well as in research work. Further special laboratory analyses, which were not possible on board, will be performed in the institutes ICBM, heron and IOW.

First preliminary results are presented by topic:

5.1 Physical Oceanography – Skagerrak and Ems

(A. Lübben[1], J. Meyerjürgens[1], T. H. Badewien[1])
[1] Institute for Chemistry and Biology of the Marine Environment (ICBM)

The main instrument used in physical oceanography to determine water properties and water masses is the CTD (an instrument to determine the conductivity, temperature, depth) with a rosette water sampler. In addition to the standard oceanographic parameters (water temperature, salinity (calculated) and depth) oxygen concentration, fluorescence and turbidity are measured. At all stations, the RV Heincke's on-board CTD sonde (Seabird 'sbe911+) was used. Prior to each measurement, the CTD was adjusted to ambient water at 10 m water depth for 3 minutes. Potential water temperature was calculated according to ITS-90 temperature standard, salinity according to TEOS-10 or pss78 (practical salinity scale of 1978). All data were recorded using standard Seasave V7 software, and processing was performed using SBE Data Processing. Exemplary data from the Skagerrak and the river Ems are shown Fig. 5.1 and Fig. 5.2

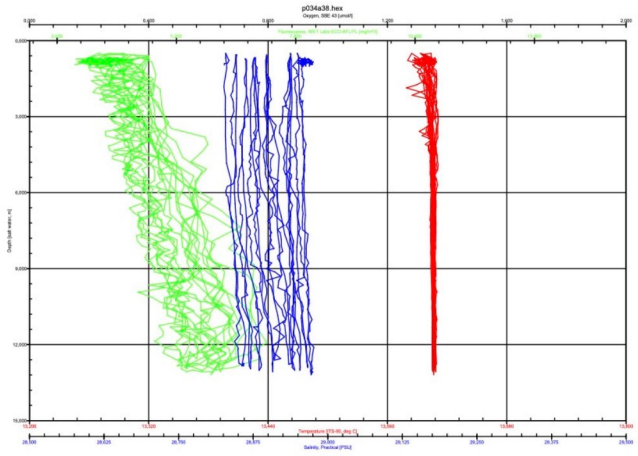


Figure 5.1: JoJo-Profile measurements in the river Ems close to the island Borkum, ten vertical up and down cast at a time period of 20 minutes (temperature in ITS-90 deg C, red line; salinity in psu, blue line; beam transmission in percent %, green line).

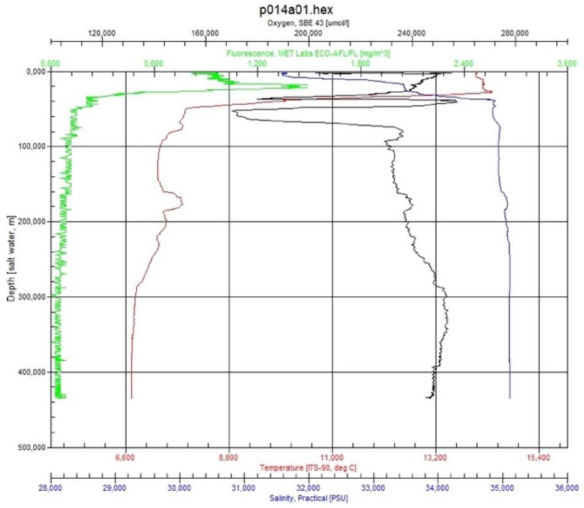


Figure 5.2: CTD profil measure measurements in the Skagerrak: temperature in ITS-90 deg C, red line; salinity in psu, blue line; beam transmission in percent %, green line; oxygen in µmol/l, black line.

Measurements in the Skagerrak were performed for the research project Carbostore. Here, water exchange processes between the North Sea and the Baltic Sea are investigated. On the one hand surface drifters were deployed (see chapter 5.2) on the other hand CTD profiles and Multicorer samples were taken. The influence of the up- and downwelling of water masses on the CO2 exchange at the air-sea interface is one of the questions which shall be investigated with these measurements.

The underway measurements performed by Ferrybox show the strong boundary between the water masses found in the Skagerrak: in the North water is coming from the East (Norwegian Coastal Current) and in the South water flowing from the North Sea into the Skagerrak (Jutland Current) (Figure 5.4). Water in the Norwegian Coastal Current is characterized by low temperatures and low salinities, whereas in the Jutland Current higher temperatures and salinities can be found.

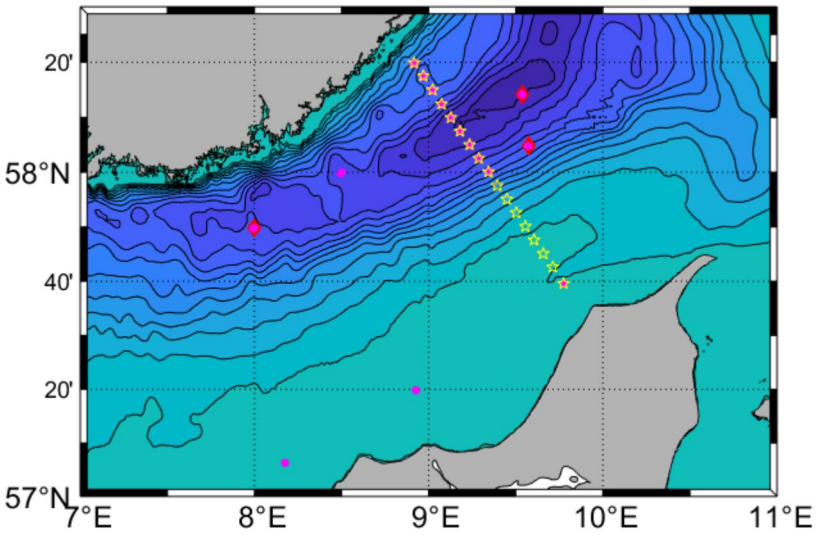


Figure 5.3: Measurements in the Skagerrak: CTD profiles marked by magenta dots, multicorer sampling marked by red diamonds, drifter deployment locations marked by yellow stars.

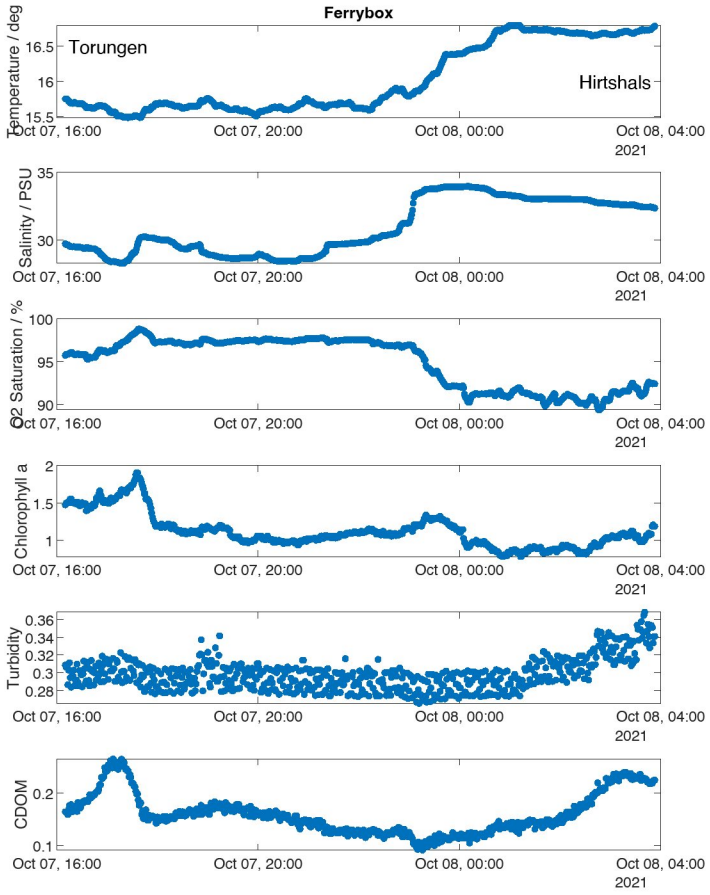


Figure 5.4: Underway ferrybox measurements along the transect through the Skagerrak from North (Torungen) to South (Hirtshals).

5.2 Investigation of surface currents in the Skagerrak using Lagrangian drifters

(J. Meyerjürgens[1], A. Lübben[1], T. Badewien[1])

[1] Institute for Chemistry and Biology of the Marine Environment (ICBM)

Seventeen surface drifters ware deployed along a transect in the Skagerrak between Torungen, Norway, and Hirtshals, Denmark, to investigate the surface current regime. The drifters were deployed in about twelve hours in equal distances starting in the North of the transect.

Trajectories after two days (Fig. 5.5 left) confirm the strong boundary between the water masses already characterized by temperature and salinity measurements (see chapter 5.1). Several days later trajectories show a circular pattern with few drifters sailing into the Kattegat (Fig. 5.5 middle). Weeks later the drifters follow mainly these circular circulation in the Skagerrak (Fig. 5.5 right).

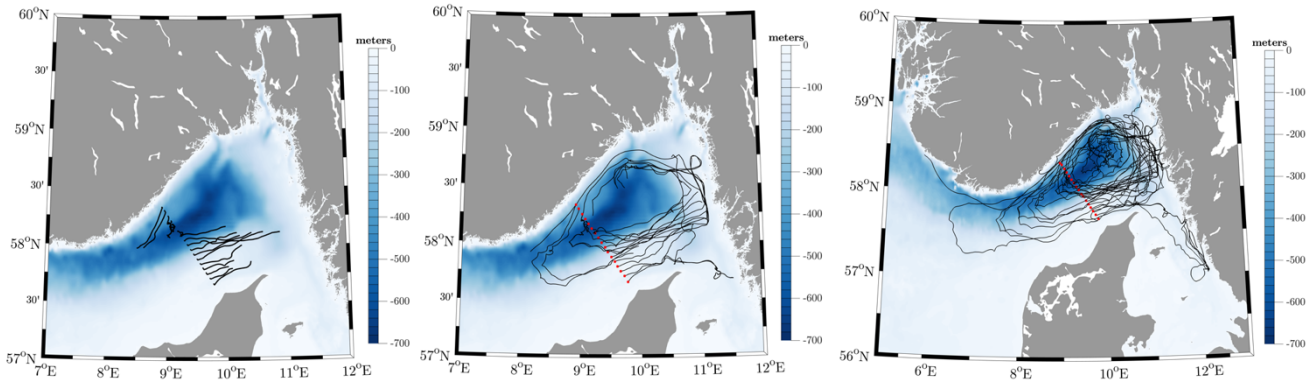


Fig. 5.5: Trajectories of 17 surface drifter; left: after 2 days of deployment, middle: after 7 days of deployment, right: after 14 days of deployment.

Christensen et al. (2018) have investigated the variability that characterizes the circulation in the Kattegat and Skagerrak with a high-resolution reanalysis model. They have shown that local wind situations in the Skagerrak strongly influence the outflow of Baltic Sea water associated with a deflection of the Kattegat-Skagerrak front.

The trajectories of the drifters confirm the local current situation in the Skagerrak and also reveal local differences in the nearshore region. The influence of the local wind field also on the circulation becomes clear when evaluating the trajectories after 14 days.

Literature:

Christensen, K. H., Sperrevik, A. K., & Broström, G. (2018). On the variability in the onset of the Norwegian Coastal Current. *Journal of Physical Oceanography*, *48*(3), 723-738.

5.3 Test of new develop sailing Lagangien diving drifter

(J. Strybny[1], A. Dilly[1], P. Nuñez von Voigt[1])

[1] HS Emden / Leer

One of the main topic of the expedition with the Heincke was to study the behavior of the new saimidris drifter with an assisting wind propulsion system in the open sea. More particularly, its stability in the waves and under the wind, both in drift mode (i.e. with the sails underwater) or in sail mode was tested.

(a) Drifting modus *(b) Sailing modus*

Figure 5.6: Saimidris drifter in both drifting and sailing positions with the standard drifter on its side

As the drifter is equipped with cameras and optical sensors on the top of the sail, a good stability is an absolute requirement. These sensors were tested for the hyperspectral detection of Paraffin residuals or debris, floating at the surface. During the test the drifter has been exposed to Beaufort wind forces between 4 and 5 (corresponding to 7 to 10 m/s). This was not compromising the stability of the drifter and the results obtained with the cameras were better than expected, as it can be seen on the following Figure 5.7.

Figure 5.7: Picture taken by the drifter's camera to detect paraffin

The working principle of the buoyancy engine is validated. It has been proven that the system "pump with valves and air bladder" meets the requirements for the project. Apart a leakage problem with the air tubes, the system can precisely and with a good reactivity control the buoyancy of the system. However, the volume of two liters of the bladder proved itself to be enough to control the buoyancy of the drifter, but even when the bladder was full, the buoyancy of the drifter was not positive enough to keep it at the surface when bigger waves were coming. The drifter fully equipped and ballasted was weighting approximately 30 kg. Considering its size and architecture, it turned out to be hard to carry it and handle it on the research vessel as well as in the motorized dinghy / RIB.

In the future version, attention needs to be paid in reducing the size and therefore weight (the less the volume, the less ballast needed) and if it is possible, develop a system making the handling of the drifter on the deck of the ship more easier (rollers, castors...).

Due to the big size of the drifter, relative to the test basin of the university (1.20 m water level whereas the drifter height is more), the behavior in the waves could not be analyzed in the wave canal.

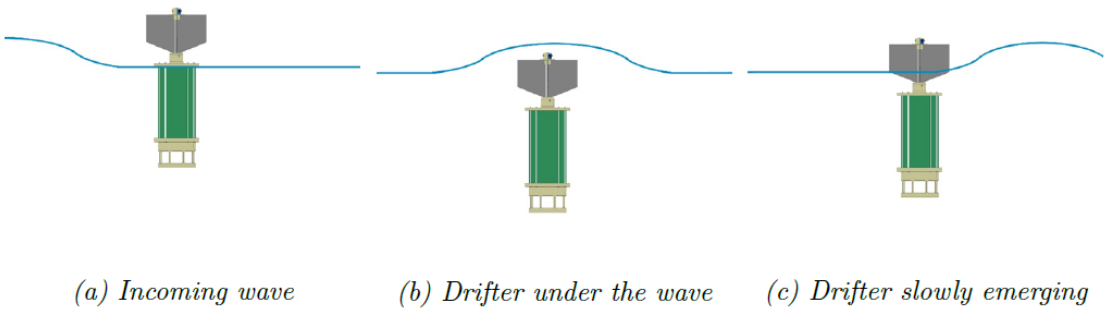


Figure 5.8: Schematic: forced diving of the drifter due to high waves

This phenomenon was observed when the drifter was caught in relatively big waves. As the wave comes, the drifters stays at its level. Then, when the wave passes, the drifter is pushed down under the water due to its weak buoyancy and the force of the wave. When the wave is finally passed, the drifter slowly comes to the surface again. This behavior shows that, in the eventuality of high waves, it would be really hard to sail with the drifter as the sails would be often underwater due to this effect. Hence, highly important is to install on the second version a bigger bladder, ensuring a stronger buoyancy of the drifter.

Two tests has been conducted with the drifter for about one hour. The first one consisted of approximately 30 minutes of drifting and 30 minutes of sailing. The second one was only sailing. Both tests have been made with the two different drifters in parallel, to compare their behavior. Here, the drifter was tested in both modes. The first part of the trajectory is straight, as it can be expected when the drifter is drifting. On the second part, the bladder was filled up and the drifter was in sailing mode.

Figure 5.9 shows clearly the impact of the wind on the trajectory of the drifter. As it was in the sail mode and that the sail was out of the water, the drifter was following a trajectory in correlation with the wind direction. However, as it can be seen per satellite, the drifter was in a zone where there is an arm between two sand bars reaching the deeper sea. This can induce strong currents and influences greatly the behavior of the drifter. This can explain why the drifter turned even more to follow a south-east course until it got stranded.

The standard drifter was sailing at the same time next to the saimidris drifter. The two stayed next to each other until the saimidris drifter went into sail mode, as it can be seen on following figure 5.9

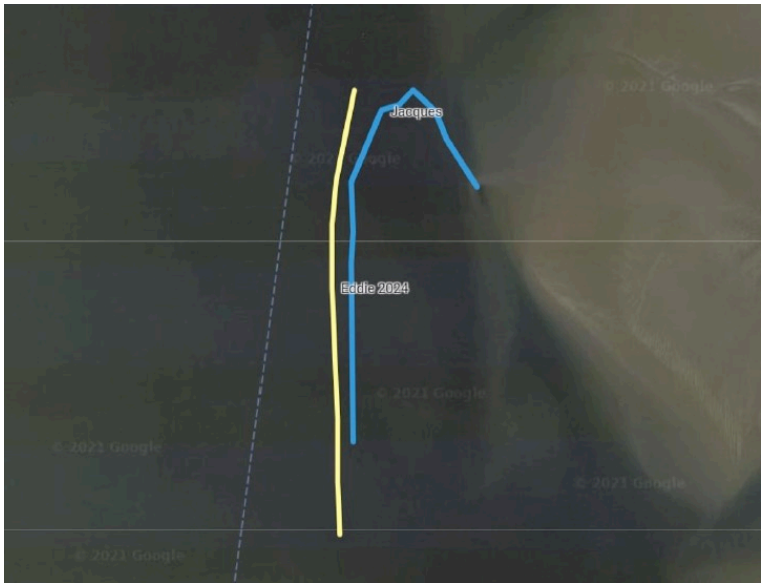


Figure 5.9: Comparison of the trajectories of the two drifters This clearly shows the impact of the square-shaped resistance sail installed on the top of the saimidris drifter. As soon as it was in contact with the wind, the course of the drifter changed.

6 Station List HE586

6.1 Overall Station List

Station Number	Device Operation	Event Date and Time (UTC)	Latitude	Longitude	Depth / m
HE586_1-1	CTD	04.10.21 13:50	53° 31,436' N	008° 33,812' E	11.9
HE586_1-2	CTD	04.10.21 14:14	53° 31,566' N	008° 33,972' E	13.9
HE586_1-3	CTD	04.10.21 14:26	53° 31,523' N	008° 33,904' E	12.8
HE586_1-4	CTD	04.10.21 14:35	53° 31,575' N	008° 34,006' E	13.3
HE586_1-5	CTD	04.10.21 14:44	53° 31,565' N	008° 34,009' E	13.2
HE586_1-6	Secdisk	04.10.21 14:56	53° 31,624' N	008° 34,023' E	13.2
HE586_2-1	Drifter	05.10.21 05:55	54° 28,252' N	007° 33,818' E	20.5
HE586_2-2	CTD	05.10.21 06:07	54° 28,221' N	007° 33,761' E	19.7
HE586_2-3	Secdisk	05.10.21 06:14	54° 28,235' N	007° 33,743' E	19.9
HE586_2-4	GRAB	05.10.21 06:24	54° 28,247' N	007° 33,746' E	20.5
HE586_2-5	CTD	05.10.21 07:06	54° 28,245' N	007° 33,847' E	20.9
HE586_2-6	CTD	05.10.21 07:36	54° 28,287' N	007° 33,776' E	20.2
HE586_2-7	CTD	05.10.21 08:06	54° 28,232' N	007° 33,735' E	20.8
HE586_2-8	Secdisk	05.10.21 08:12	54° 28,215' N	007° 33,725' E	21.0
HE586_2-9	CTD	05.10.21 08:34	54° 28,221' N	007° 33,975' E	21.2
HE586_2-10	Secdisk	05.10.21 08:37	54° 28,223' N	007° 34,024' E	20.6
HE586_2-12	CTD	05.10.21 09:34	54° 28,170' N	007° 33,791' E	21.8
HE586_2-13	Secdisk	05.10.21 09:41	54° 28,127' N	007° 33,783' E	21.3
HE586_2-14	CTD	05.10.21 10:09	54° 27,924' N	007° 33,695' E	23.2
HE586_2-15	Secdisk	05.10.21 10:12	54° 27,953' N	007° 33,636' E	22.6
HE586_2-16	CTD	05.10.21 10:35	54° 28,162' N	007° 33,261' E	3.9
HE586_2-17	Secdisk	05.10.21 10:44	54° 28,237' N	007° 33,329' E	20.6
HE586_2-18	CTD	05.10.21 11:04	54° 28,370' N	007° 33,492' E	20.3
HE586_2-19	Secdisk	05.10.21 11:14	54° 28,399' N	007° 33,535' E	20.2
HE586_2-20	CTD	05.10.21 11:36	54° 28,448' N	007° 33,548' E	20.3
HE586_2-21	Secdisk	05.10.21 11:43	54° 28,438' N	007° 33,580' E	20.0
HE586_2-22	Profiler	05.10.21 11:43	54° 28,433' N	007° 33,590' E	21.1
HE586_3-1	CTD	05.10.21 12:29	54° 29,842' N	007° 36,792' E	20.9
HE586_3-2	Secdisk	05.10.21 12:44	54° 29,889' N	007° 36,999' E	20.6
HE586_3-3	CTD	05.10.21 13:33	54° 29,904' N	007° 36,911' E	20.6
HE586_3-4	Secdisk	05.10.21 13:36	54° 29,926' N	007° 36,880' E	20.8
HE586_3-5	CTD	05.10.21 14:04	54° 29,748' N	007° 37,042' E	20.8
HE586_3-6	Secdisk	05.10.21 14:08	54° 29,763' N	007° 37,045' E	21.1
HE586_3-7	CTD	05.10.21 14:34	54° 29,796' N	007° 37,003' E	21.0
HE586_3-8	Secdisk	05.10.21 14:38	54° 29,797' N	007° 37,009' E	19.9
HE586_3-9	Profiler	05.10.21 14:41	54° 29,790' N	007° 37,028' E	20.8
HE586_3-10	CTD	05.10.21 15:06	54° 29,758' N	007° 37,096' E	21.2

HE586_3-11	CTD	05.10.21 15:34	54° 29,756' N	007° 37,181' E	21.3
HE586_3-12	CTD	05.10.21 16:06	54° 29,779' N	007° 37,159' E	19.9
HE586_3-13	CTD	05.10.21 16:34	54° 29,811' N	007° 37,063' E	19.3
HE586_3-14	CTD	05.10.21 17:05	54° 29,772' N	007° 37,205' E	20.5
HE586_3-15	CTD	05.10.21 17:36	54° 29,823' N	007° 37,206' E	21.0
HE586_3-15	CTD	05.10.21 17:40	54° 29,796' N	007° 37,219' E	20.4
HE586_4-1	CTD	05.10.21 18:25	54° 31,815' N	007° 30,444' E	22.6
HE586_4-2	CTD	05.10.21 19:13	54° 31,794' N	007° 30,825' E	21.3
HE586_4-3	CTD	05.10.21 19:37	54° 31,910' N	007° 30,800' E	23.1
HE586_4-4	CTD	05.10.21 20:03	54° 31,776' N	007° 30,679' E	20.3
HE586_4-5	CTD	05.10.21 20:34	54° 31,914' N	007° 30,541' E	22.6
HE586_4-6	CTD	05.10.21 21:00	54° 32,054' N	007° 30,829' E	23.0
HE586_4-7	CTD	05.10.21 21:33	54° 31,833' N	007° 31,034' E	23.5
HE586_4-8	CTD	05.10.21 22:05	54° 31,916' N	007° 31,200' E	23.4
HE586_4-9	CTD	05.10.21 22:34	54° 31,896' N	007° 30,910' E	22.7
HE586_4-10	CTD	05.10.21 23:04	54° 31,960' N	007° 30,661' E	23.7
HE586_4-11	CTD	05.10.21 23:34	54° 31,989' N	007° 30,378' E	26.1
HE586_4-12	CTD	05.10.21 23:49	54° 32,007' N	007° 30,398' E	24.1
HE586_5-1	CTD	06.10.21 00:27	54° 32,355' N	007° 35,489' E	22.0
HE586_5-2	CTD	06.10.21 01:14	54° 32,438' N	007° 35,548' E	23.3
HE586_5-3	CTD	06.10.21 01:38	54° 32,437' N	007° 35,609' E	22.1
HE586_5-4	CTD	06.10.21 02:04	54° 32,415' N	007° 35,645' E	21.7
HE586_5-5	CTD	06.10.21 02:34	54° 32,296' N	007° 35,390' E	22.4
HE586_5-6	CTD	06.10.21 03:03	54° 32,331' N	007° 35,587' E	21.3
HE586_5-7	CTD	06.10.21 03:35	54° 32,304' N	007° 35,722' E	21.6
HE586_5-8	CTD	06.10.21 04:04	54° 32,349' N	007° 35,808' E	19.9
HE586_5-9	CTD	06.10.21 04:34	54° 32,319' N	007° 35,832' E	21.1
HE586_5-10	CTD	06.10.21 05:04	54° 32,318' N	007° 35,690' E	20.7
HE586_5-11	CTD	06.10.21 05:35	54° 32,314' N	007° 35,824' E	21.8
HE586_5-12	CTD	06.10.21 06:05	54° 32,349' N	007° 35,910' E	22.4
HE586_5-12	CTD	06.10.21 06:08	54° 32,326' N	007° 35,926' E	22.6
HE586_6-1	Drifter	06.10.21 06:14	54° 32,291' N	007° 35,946' E	22.0
HE586_7-1	CTD	06.10.21 09:32	54° 53,986' N	007° 24,691' E	21.5
HE586_7-2	Secdisk	06.10.21 09:52	54° 53,938' N	007° 24,980' E	22.3
HE586_7-3	GRAB	06.10.21 09:53	54° 53,943' N	007° 24,974' E	22.7
HE586_7-4	Profiler	06.10.21 10:02	54° 53,970' N	007° 24,924' E	21.8
HE586_8-2	CTD	07.10.21 05:53	57° 49,743' N	007° 59,662' E	510.6
HE586_8-1	GRAB	07.10.21 06:20	57° 49,804' N	007° 59,879' E	510.5
HE586_8-3	Secdisk	07.10.21 06:43	57° 49,806' N	007° 59,907' E	510.3
HE586_8-4	GRAB	07.10.21 07:18	57° 49,821' N	007° 59,915' E	510.0
HE586_8-5	MUC	07.10.21 07:53	57° 49,822' N	007° 59,886' E	510.1
HE586_8-6	Profiler	07.10.21 08:10	57° 49,825' N	007° 59,941' E	510.4
HE586_9-1	CTD	07.10.21 11:18	57° 59,986' N	008° 30,017' E	515.7

HE586_9-2	Secdisk	07.10.21 11:58	57° 59,583' N	008° 29,513' E	514.7
HE586_9-3	Profiler	07.10.21 12:04	57° 59,510' N	008° 29,435' E	514.2
HE586_10-1	CTD	07.10.21 15:30	58° 19,830' N	008° 54,997' E	369.8
HE586_11-1	ADCP	07.10.21 16:00	58° 19,868' N	008° 54,430' E	254.9
HE586_11-2	Drifter	07.10.21 16:10	58° 19,885' N	008° 55,041' E	271.3
HE586_11-3	Drifter	07.10.21 16:45	58° 17,514' N	008° 58,195' E	402.2
HE586_11-4	Drifter	07.10.21 17:22	58° 14,981' N	009° 01,344' E	406.8
HE586_11-5	Drifter	07.10.21 18:07	58° 12,415' N	009° 04,430' E	415.9
HE586_11-6	Drifter	07.10.21 18:56	58° 09,961' N	009° 07,633' E	97.9
HE586_11-7	Drifter	07.10.21 19:43	58° 07,490' N	009° 10,757' E	21.5
HE586_11-8	Drifter	07.10.21 20:31	58° 05,037' N	009° 14,088' E	18.0
HE586_11-9	Drifter	07.10.21 21:20	58° 02,521' N	009° 17,274' E	524.4
HE586_11-10	Drifter	07.10.21 22:06	58° 00,064' N	009° 20,611' E	447.9
HE586_11-11	Drifter	07.10.21 22:51	57° 57,541' N	009° 23,657' E	243.1
HE586_11-12	Drifter	07.10.21 23:33	57° 55,064' N	009° 26,950' E	151.7
HE586_11-13	Drifter	08.10.21 00:18	57° 52,605' N	009° 30,171' E	98.3
HE586_11-14	Drifter	08.10.21 01:02	57° 50,102' N	009° 33,298' E	61.5
HE586_11-15	Drifter	08.10.21 01:42	57° 47,598' N	009° 36,308' E	30.5
HE586_11-16	Drifter	08.10.21 02:22	57° 45,094' N	009° 39,432' E	29.9
HE586_11-17	Drifter	08.10.21 03:04	57° 42,614' N	009° 42,780' E	36.4
HE586_11-18	Drifter	08.10.21 03:53	57° 39,592' N	009° 46,481' E	26.0
HE586_12-1	CTD	08.10.21 04:25	57° 39,608' N	009° 46,531' E	26.2
HE586_13-1	CTD	08.10.21 07:10	58° 04,781' N	009° 34,212' E	450.8
HE586_13-2	Secdisk	08.10.21 07:49	58° 04,805' N	009° 34,486' E	448.9
HE586_13-3	GRAB	08.10.21 08:12	58° 04,801' N	009° 34,448' E	449.8
HE586_13-4	MUC	08.10.21 08:33	58° 04,799' N	009° 34,476' E	447.7
HE586_13-5	Profiler	08.10.21 08:53	58° 04,767' N	009° 34,456' E	447.1
HE586_14-1	CTD	08.10.21 10:16	58° 00,178' N	009° 20,727' E	448.3
HE586_14-2	Secdisk	08.10.21 11:01	58° 00,004' N	009° 20,955' E	445.7
HE586_15-1	CTD	08.10.21 11:30	58° 02,615' N	009° 17,268' E	529.6
HE586_15-2	Secdisk	08.10.21 11:57	58° 02,607' N	009° 17,297' E	528.4
HE586_16-1	CTD	08.10.21 12:23	58° 05,006' N	009° 14,196' E	16.3
HE586_16-2	Secdisk	08.10.21 12:53	58° 04,809' N	009° 14,247' E	18.3
HE586_17-1	CTD	08.10.21 13:25	58° 07,535' N	009° 10,788' E	18.3
HE586_17-2	Secdisk	08.10.21 13:57	58° 07,452' N	009° 10,849' E	717.1
HE586_18-1	CTD	08.10.21 14:25	58° 09,997' N	009° 07,630' E	649.8
HE586_18-2	Secdisk	08.10.21 15:07	58° 09,837' N	009° 07,748' E	652.7
HE586_19-1	CTD	08.10.21 15:40	58° 12,478' N	009° 04,365' E	413.3
HE586_20-1	CTD	08.10.21 16:30	58° 15,010' N	009° 01,307' E	405.3
HE586_21-1	CTD	08.10.21 17:37	58° 17,338' N	008° 58,098' E	400.1
HE586_22-1	CTD	08.10.21 18:13	58° 19,833' N	008° 54,964' E	267.7
HE586_23-1	ADCP	08.10.21 18:42	58° 19,685' N	008° 55,090' E	309.8
HE586_24-1	CTD	09.10.21 05:52	58° 14,201' N	009° 32,146' E	682.7

HE586_24-2	Secdisk	09.10.21 06:37	58° 14,093' N	009° 32,150' E	680.5
HE586_24-3	GRAB	09.10.21 07:05	58° 14,110' N	009° 32,233' E	680.6
HE586_24-4	MUC	09.10.21 07:39	58° 14,095' N	009° 32,079' E	680.5
HE586_24-5	Profiler	09.10.21 08:05	58° 13,916' N	009° 31,923' E	673.8
HE586_25-1	CTD	09.10.21 14:10	57° 19,837' N	008° 55,539' E	22.4
HE586_25-2	Secdisk	09.10.21 14:25	57° 19,795' N	008° 55,575' E	23.0
HE586_26-1	CTD	09.10.21 17:15	57° 06,294' N	008° 10,516' E	24.7
HE586_27-1	CTD	10.10.21 12:12	54° 02,640' N	006° 16,593' E	27.1
HE586_27-2	Secdisk	10.10.21 12:27	54° 02,607' N	006° 16,355' E	27.0
HE586_27-3	GRAB	10.10.21 12:30	54° 02,601' N	006° 16,331' E	27.1
HE586_27-4	Profiler	10.10.21 12:43	54° 02,581' N	006° 16,095' E	27.1
HE586_28-1	Drifter	10.10.21 13:50	53° 52,334' N	006° 17,426' E	25.8
HE586_28-2	CTD	10.10.21 14:03	53° 52,261' N	006° 17,260' E	25.0
HE586_28-3	Secdisk	10.10.21 14:08	53° 52,247' N	006° 17,229' E	24.7
HE586_28-4	GRAB	10.10.21 14:13	53° 52,234' N	006° 17,200' E	24.7
HE586_28-5	Profiler	10.10.21 14:19	53° 52,211' N	006° 17,122' E	24.4
HE586_28-6	CTD	10.10.21 14:43	53° 52,123' N	006° 16,771' E	24.6
HE586_28-7	CTD	10.10.21 15:04	53° 52,274' N	006° 17,268' E	24.6
HE586_28-8	CTD	10.10.21 16:04	53° 52,126' N	006° 17,326' E	23.7
HE586_28-9	CTD	10.10.21 16:34	53° 52,210' N	006° 17,332' E	23.6
HE586_28-10	CTD	10.10.21 17:04	53° 52,203' N	006° 17,315' E	23.4
HE586_28-11	CTD	10.10.21 17:33	53° 52,177' N	006° 17,345' E	23.1
HE586_28-12	CTD	10.10.21 18:03	53° 52,232' N	006° 17,624' E	23.3
HE586_28-13	CTD	10.10.21 18:34	53° 52,127' N	006° 17,273' E	23.2
HE586_28-14	CTD	10.10.21 19:04	53° 52,177' N	006° 17,360' E	23.4
HE586_28-15	CTD	10.10.21 19:33	53° 52,260' N	006° 17,409' E	23.8
HE586_29-1	CTD	10.10.21 20:18	53° 53,190' N	006° 12,516' E	26.5
HE586_29-2	CTD	10.10.21 21:05	53° 53,246' N	006° 12,500' E	26.8
HE586_29-3	CTD	10.10.21 21:34	53° 53,256' N	006° 12,556' E	27.1
HE586_30-1	CTD	10.10.21 22:04	53° 53,216' N	006° 12,835' E	27.1
HE586_30-2	CTD	10.10.21 22:34	53° 53,240' N	006° 12,713' E	27.6
HE586_30-3	CTD	10.10.21 23:02	53° 53,136' N	006° 12,825' E	27.3
HE586_30-4	CTD	10.10.21 23:31	53° 53,324' N	006° 12,940' E	27.4
HE586_30-5	CTD	11.10.21 00:02	53° 53,311' N	006° 12,952' E	27.7
HE586_30-6	CTD	11.10.21 00:32	53° 53,195' N	006° 12,948' E	27.9
HE586_30-7	CTD	11.10.21 01:02	53° 53,221' N	006° 12,617' E	27.3
HE586_30-8	CTD	11.10.21 01:35	53° 53,261' N	006° 12,466' E	27.2
HE586_31-1	CTD	11.10.21 02:25	53° 52,603' N	006° 20,228' E	25.5
HE586_31-2	CTD	11.10.21 03:03	53° 52,626' N	006° 20,113' E	25.8
HE586_31-3	CTD	11.10.21 03:34	53° 52,664' N	006° 20,047' E	25.7
HE586_31-4	CTD	11.10.21 04:04	53° 52,665' N	006° 20,146' E	3.9
HE586_31-5	CTD	11.10.21 04:34	53° 52,641' N	006° 19,985' E	25.4
HE586_31-6	CTD	11.10.21 05:03	53° 52,548' N	006° 19,898' E	25.3

HE586_31-7	CTD	11.10.21 05:35	53° 52,548' N	006° 19,950' E	24.6
HE586_32-1	Drifter	11.10.21 06:00	53° 52,388' N	006° 15,982' E	25.8
HE586_32-2	CTD	11.10.21 06:40	53° 52,416' N	006° 14,291' E	26.0
HE586_33-1	CTD	12.10.21 06:53	53° 29,695' N	006° 46,706' E	9.0
HE586_34-1	CTD	12.10.21 07:30	53° 29,694' N	006° 46,705' E	8.6
HE586_34-1	CTD	12.10.21 07:31	53° 29,694' N	006° 46,705' E	8.7
HE586_34-1	CTD	12.10.21 08:15	53° 29,687' N	006° 46,687' E	8.7
HE586_34-1	CTD	12.10.21 08:17	53° 29,686' N	006° 46,686' E	8.6
HE586_34-1	CTD	12.10.21 09:27	53° 29,624' N	006° 46,771' E	9.6
HE586_34-1	CTD	12.10.21 09:39	53° 29,626' N	006° 46,775' E	9.6
HE586_34-1	CTD	12.10.21 10:30	53° 29,633' N	006° 46,790' E	10.0
HE586_34-1	CTD	12.10.21 10:58	53° 29,632' N	006° 46,791' E	10.0
HE586_34-1	CTD	12.10.21 13:00	53° 29,622' N	006° 46,783' E	11.5
HE586_34-1	CTD	12.10.21 14:30	53° 29,617' N	006° 46,765' E	11.3
HE586_34-1	CTD	12.10.21 15:31	53° 29,618' N	006° 46,775' E	11.2
HE586_34-1	CTD	12.10.21 17:51	53° 29,691' N	006° 46,697' E	9.8
HE586_34-2	CTD	12.10.21 18:03	53° 29,691' N	006° 46,699' E	9.5
HE586_34-3	CTD	12.10.21 18:26	53° 29,689' N	006° 46,689' E	9.4
HE586_34-4	CTD	12.10.21 18:56	53° 29,690' N	006° 46,693' E	9.3
HE586_34-4	CTD	12.10.21 22:28	53° 29,638' N	006° 46,763' E	10.4
HE586_34-4	CTD	12.10.21 23:01	53° 29,629' N	006° 46,790' E	10.5
HE586_34-4	CTD	13.10.21 02:21	53° 29,624' N	006° 46,779' E	11.2
HE586_34-4	CTD	13.10.21 02:59	53° 29,627' N	006° 46,779' E	11.3
HE586_34-4	CTD	13.10.21 06:20	53° 29,691' N	006° 46,708' E	9.5
HE586_34-4	CTD	13.10.21 06:21	53° 29,691' N	006° 46,708' E	9.5
HE586_35-1	CTD	13.10.21 09:54	53° 46,023' N	006° 47,406' E	13.8
HE586_36-1	CTD	14.10.21 07:40	53° 35,075' N	008° 10,445' E	14.7
HE586_37-1	Drifter	14.10.21 09:25	53° 35,161' N	008° 10,486' E	13.0
HE586_37-2	CTD	14.10.21 10:40	53° 35,211' N	008° 10,594' E	11.5
HE586_38-1	CTD	15.10.21 06:32	53° 36,845' N	008° 09,992' E	16.8
HE586_39-1	Drifter	15.10.21 07:14	53° 34,535' N	008° 09,870' E	15.2
HE586_39-2	CTD	15.10.21 07:42	53° 34,933' N	008° 10,207' E	17.4
HE586_40-1	CTD	15.10.21 10:31	53° 41,922' N	008° 04,019' E	14.3
HE586_41-1	CTD	15.10.21 11:31	53° 41,210' N	008° 04,276' E	11.7
HE586_42-1	CTD	15.10.21 12:31	53° 42,935' N	008° 03,777' E	15.4
HE586_43-1	CTD	15.10.21 13:30	53° 42,269' N	008° 03,993' E	14.3
HE586_44-1	CTD	15.10.21 14:00	53° 42,402' N	008° 03,651' E	13.7
HE586_44-2	ADCP	15.10.21 14:23	53° 42,461' N	008° 03,275' E	12.0
HE586_44-3	CTD	15.10.21 15:52	53° 42,146' N	008° 04,223' E	15.2
HE586_45-1	ADCP	15.10.21 16:05	53° 41,996' N	008° 03,936' E	14.9

7 Data and Sample Storage and Availability

Data will be transferred to the AWI PANGAEA database as soon as they are available and quality-checked. The authors and cruise director submitting data to the PANGAEA data library agree that all data are provided under a Creative Commons license. Some of the datasets have already been submitted to PANGAEA with the cruise identifier HE586 and with the metadata. The CTD profiles are already available online. In addition, the datasets listed in Table 7.1 will be submitted to PANGAEA once the quality controls have been passed and validation has been performed using laboratory analyses.

Table 7.1 Overview of data availability

Type	Database	Available	Free Access	Contact
Master track	PANGAEA	A and B		badewien@icbm.de
CTD-profile data	PANGAEA	C		badewien@icbm.de
ADCP	MSYS	on request		jens.meyerjuergens@uol.de
Drifter	PANGAEA	on request		jens.meyerjuergens@uol.de
Profiler	PANGAEA	on request		jens.meyerjuergens@uol.de
Underway - Ferrybox	PANGAEA	on request		badewien@icbm.de
Secchi Disc	PANGAEA	on request		badewien@icbm.de
MUC	hereon	on request		anna.przibilla@hereon.de

A - **Badewien, Thomas H** **(2022):** Master track of HEINCKE cruise HE586 in 1 sec resolution (zipped, 5.0 MB). *Alfred Wegener Institute, Helmholtz Centre for Polar and Marine Research, Bremerhaven*, *PANGAEA*, https://doi.org/10.1594/PANGAEA.940225

B - **Badewien, Thomas H** **(2022):** Master tracks in different resolutions of HEINCKE cruise HE586, Bremerhaven - Bremerhaven, 2021-10-04 - 2021-10-16. *Alfred Wegener Institute, Helmholtz Centre for Polar and Marine Research, Bremerhaven*, *PANGAEA*, https://doi.org/10.1594/PANGAEA.940226

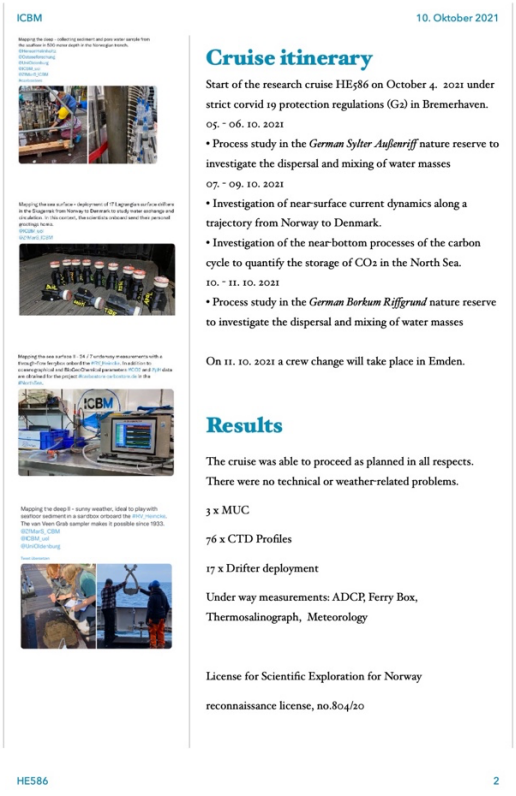
C - **Badewien, Thomas H**; **Hoppmann, Mario**; **Tippenhauer, Sandra** **(2022):** Physical oceanography during RV HEINCKE cruise HE586. *PANGAEA*, https://doi.org/10.1594/PANGAEA.940830

8 Acknowledgements

We like to thank captain Heron Nannen and his entire crew. Their commitment and professional support was the key to this successful expedition. Special thanks go to the entire deck crew for their helpfulness and support. It was done on a very high and natural level. Many thanks for the great working atmosphere on board. We also very much enjoyed the friendly and cooperative atmosphere onboard RV Heincke. The cruise was supported by GPF 20-1_065.

9 Appendices

9.1 Weekly Report and Scientific Party Leg 1



ICBM 10. Oktober 2021

Cruise itinerary

Start of the research cruise HE586 on October 4. 2021 under strict corvid 19 protection regulations (G2) in Bremerhaven.

05. - 06. 10. 2021

• Process study in the *German Sylter Außenriff* nature reserve to investigate the dispersal and mixing of water masses

07. - 09. 10. 2021

• Investigation of near-surface current dynamics along a trajectory from Norway to Denmark.

• Investigation of the near-bottom processes of the carbon cycle to quantify the storage of CO_2 in the North Sea.

10. - 11. 10. 2021

• Process study in the *German Borkum Riffgrund* nature reserve to investigate the dispersal and mixing of water masses

On 11. 10. 2021 a crew change will take place in Emden.

Results

The cruise was able to proceed as planned in all respects. There were no technical or weather-related problems.

3 x MUC

76 x CTD Profiles

17 x Drifter deployment

Under way measurements: ADCP, Ferry Box, Thermosalinograph, Meteorology

License for Scientific Exploration for Norway

reconnaissance license, no.804/20

HE586 2

ICBM 10. Oktober 2021

WEEKLY REPORT

HE586 - Bremerhaven - Emden

04. - 10. 2021 | Dr. Thomas Badewien | No: HE586-1

Aim of the research cruise

During the research cruise, the students of the University of Oldenburg (Master Marine Sensor Technology) will gain a comprehensive insight into the oceanographic measuring methods and working methods on a research vessel as well as into current research topics of the ICBM (Institute for Chemistry and Biology of the Sea).

In addition to the practical training of the students, measurement data is collected and samples are taken for the BMBF-funded research project CARBOSTORE (Carbon Storage in German Coastal Seas - Stability, Vulnerability and Perspectives for Manageability).

The study area covered the German Bight and the Skagerrak in Danish and Norwegian territory.

HE586 1

Figure 9.1: Cruise participant HE586 leg 1: Bremerhaven – Emden

9.2 Weekly Report and Scientific Party Leg 2

ICBM 16. Oktober 2021

WEEKLY REPORT

HE586 - Emden - Bremerhaven

11. - 16.10.2021 | Dr. Thomas Badewien | No: HE586-2

Aim of the research cruise

During the second part of the research cruise, the students of the Emden/Leer University of Applied Sciences (Bachelor - Maritime Technology and Shipping Management) got a comprehensive insight into the oceanographic measurement methods and working methods on a research vessel as well as into current research work in a joint project saimidris of the ICBM (Institute for Chemistry and Biology of the Marine Environment), the DFKI (German Research Centre for Artificial Intelligence) and the Emden / Leer University of Applied Sciences .

In addition to the hydrographic measurements, extensive testing of a newly developed, self-diving Lagrangian surface drifter with sailing function is taking place.

The study area includes the Ems estuary, the Jade and the German Bight.

HE586 1

ICBM 16. Oktober 2021

Cruise itinerary

On 11. 10. 2021 a crew change took place at the port of Emden.

12. - 13. 10. 2021
High-resolution YoYo-profile measurements with the CTD in the Ems estuary - Dukegat Reede
First testing of the new surface drifter

14. - 15. 10. 2021
Hydrographic measurements in the Jade
Extensive testing of the new surface drifter in the Jade
Day guests (students of the Jade University of Applied Sciences - Bachelor Marine Engineering) come onboard the RV Heincke

16. 10. 2021
End of the cruise and arrival at the port of Bremerhaven

Results

The cruise had to be rescheduled due to weather conditions. Measurements and testing of the drifter close to Helgoland were not possible.

390 x YoYo-CTD profiles
10 x CTD profiles
4 x Drifter deployments
1 x Profiler
Under way measurements: ADCP, Ferry Box, Thermosalinograph, Meteorology

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reconnaissance license, no.804/20

HE586 2

Figure 9.2: Cruise participant HE586 leg 2: Emden – Bremerhaven