Hydrography Summer Camp 2014

A report by TINA KUNDE

To gain practical experiences, the HafenCity University (HCU) Hamburg offers a project week named ›Hydrography Summer Camp‹ to third semester Hydrography students. This event was integrated into the lectures so that the students can apply and realise all the knowledge they have gained during the last semesters. The following report introduces the tasks and experiences of the students during the Hydrography Summer Camp 2014 as well as the achieved results.

HCU | Hydrography Summer Camp | bathymetry | sediment thickness | survey | wrecks | USV | OpenROV

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Acknowledgements (1)

On behalf of all students participating, I would like to thank Prof. Markéta Pokorná and Tanja Dufek (M.Sc.) for organising the whole Hydrography Summer Camp 2014.
For the hydrography practice on land, in the first instance thanks to the WSA Wedel for providing their localities and support. Furthermore, I would like to thank Prof. Markéta Pokorná, Dipl.-Ing. Udo Freier, Tanja Dufek (M.Sc.), and the two students Inga Thiessen and Simon Mondry for the support and guidance. Special thanks go to emma technologies GmbH, especially to Mareike Kampmeier and Martin Thomas Reincke, for introducing and providing their USV prototype to us, and to MBT GmbH for providing the tide gauge system.

Introduction

Every year in the beginning of the third Master semester, a practical training of two weeks is taking place for the Hydrography students at the HafenCity University Hamburg. The ›Hydrography Summer Camp‹ gives the students the possibility to plan and execute hydrographic surveys to be well-prepared for their further work. In 2014, the practical field training was divided into two parts: one on land and the other one on board of two German research vessels.

Hydrography practice on land …

The first part of the Hydrography Summer Camp 2014 took place from October 6th to October 10th on the premises of the Hamburg Waterways and Shipping Office (WSA) in Wedel. Different projects were prepared and executed by the 14 students under the supervision of Prof. Markéta Pokorná, Dipl.-Ing. Udo Freier and M.Sc. Tanja Dufek. Besides a classical levelling to transfer the altitude from a known benchmark to a newly established GPS point and the tide gauge station Ohmex TideM8 installed by the students, also a vessel survey was carried out. In this vessel survey the locations of different hydrographic sensors and some vessel reference points were surveyed and transformed into a local ship coordinate system. For the levelling, a Leica NA720 with a standard deviation of 2.5 mm for 1 km double levelling and a height accuracy of 1.5 mm was used. The Trimble 5603 DR200+ total station to survey both control and equipment points marked on a small vessel provides an accuracy of ±3 mm + 2 ppm. As already mentioned, a tide gauge monitoring system, kindly provided by MBT GmbH, was set up to gather additional information about the tidal movements of the Elbe. Thanks to the support of emma technologies GmbH the students got the possibility to collect practical experience with an unmanned surface vehicle (USV) prototype. Equipped with a pole-mounted single-beam echo sounder system from Reson and a Haicom GPS receiver it was possible to collect bathymetric data also in the shallow area close to the shoreline and the floating pontoons. The connection of the different USV components was accomplished by the students using QPS QINSy. Additional to the USV, the newly purchased and self-assembled OpenROV of the HCU Hamburg was tested. The students who assembled this remotely operated vehicle during the last months, introduced their work and the handling to their fellow students so that everyone could have a test-ride with it.

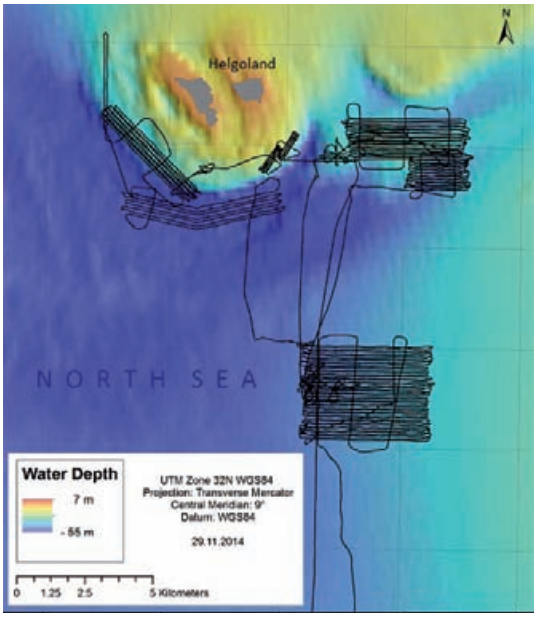


Fig. 1: Overview of the track lines for the cruise HE437

After the first three days of field data collection and other practices, the remaining two days were used for processing and evaluation of the gathered data. While the evaluation of the levelling data could be easily processed with common spreadsheet software, the processing of the vessel survey data challenges the majority of the students because only a few of them already had experiences with this kind of data. By using the intra-university software JGeoPro all measured distances, horizontal and vertical angles were used to determine the sensor positions in a local Cartesian coordinate system. The software JaG3D was used to transform these 3D coordinates of the sensors into a local Cartesian ship coordinate system with the origin coinciding with the installed INS of the vessel. The processing of the single-beam data collected with the USV was routinely performed by using Caris HIPS and SIPS 8.1.

… and on the sea

From November 24th to November 29th two research vessels were chartered for the second part of the Hydrography Summer Camp. The students,

divided into two groups, planned various small projects for these two cruises and did both the line planning and time management to be well prepared for this experience.

Cruise with RV »Heincke«

One half of the third semester students got the possibility to take part on a trip with one of the medium-sized research vessels from Germany, RV »Heincke«, on the cruise HE437. The expedition casted off in Bremerhaven and the vessel entered the port again five days later. Since one of the operating areas of the RV »Heincke« is the North Sea, the research area was located close to Helgoland (Fig. 1). In total, there were seven small areas and ten wrecks to investigate with the installed multibeam echo sounder Kongsberg EM710 and the sub-bottom profiler SES-2000 medium-100 from Innomar. The selection of the research areas took place with the collaboration of the Jacobs University Bremen, the University of Hamburg, the Alfred Wegener Institute (AWI) and the Hamburg Port Authority (HPA). Based on these areas, the students did some additional preparatory work such as line planning and time management during the cruise. Besides the already mentioned equipment, the students used a Valeport Midas sound velocity probe, the inertial navigation system PHINS III from iXBlue, and a Trimble GPS system to acquire all necessary information during the cruise. To use the ship time in the best possible way the students did shift work and so almost all of the planned areas and wrecks could be investigated and also evaluated.

The more detailed data processing was done afterwards by using Caris HIPS and SIPS 8.1 and ISE, but initial evaluations of the data were done during the cruise. Fig. 2 shows impressive soil structures close to Helgoland. The displayed ridges have an average elevation of one metre in comparison to the surrounding sea-floor.

As already mentioned, there were also various wrecks to investigate using the installed instruments. Thanks to the German Maritime and Hydrographic Agency (BSH), the locations of these underwater obstacles were known to the students and it was possible to plan precise survey lines across the wrecks. The one depicted in Fig. 3 is especially interesting: The recordings of the multibeam echo sounder and the sub-bottom profiler are showing the wreck of a sunken submarine in the south of Helgoland. As the point cloud of the multibeam survey shows, the wreck was found in an upright position on the sea-floor and it seems to be almost intact. Complementary to the depth information, also the collected backscatter data were used for analysis and interpretation. To get a closer look into the topsoil layers to evaluate if the wreck is caved in the seabed, the gathered sub-bottom profiles were used. The view in Fig. 3 shows a cross section view of the submarine. The sea-floor, recognisable by the depicted continuous red line, shows no interruptions. The fact that the wreck raises up more than four metres from the seabed clearly proves the necessity of an accurate sea-floor mapping to ensure marine safety.

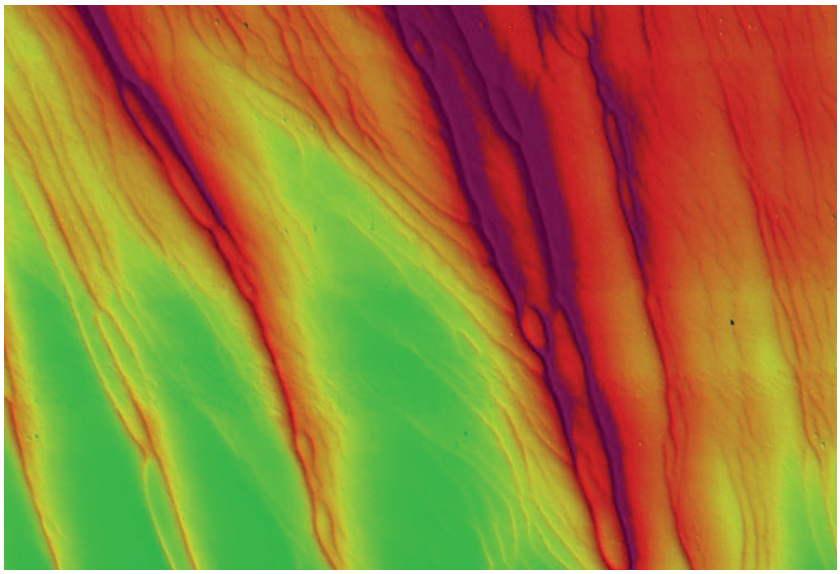


Fig. 2: Soil structures close to Helgoland, observed with the Kongsberg EM710. Grid resolution: 1 m; maximum height of the ridges approximately 1 m

Furthermore, the USBL system GAPS from iXBlue was introduced to the participants of the research cruise. After the set-up of the system the students get familiar with the software and the provided possibilities of the usage. The instrument to locate was a towed transponder which was lowered to different depth. The vessel-fixed transmitting and receiving unit has a known position and by using the knowledge about the range and the bearings, the position of the towfish could be determined and visualised in different ways by the operation software. The relative movement of the transponder to the stopped vessel could be observed by the students in real time. Conclusions about the direction and the speed of the currents could be made.

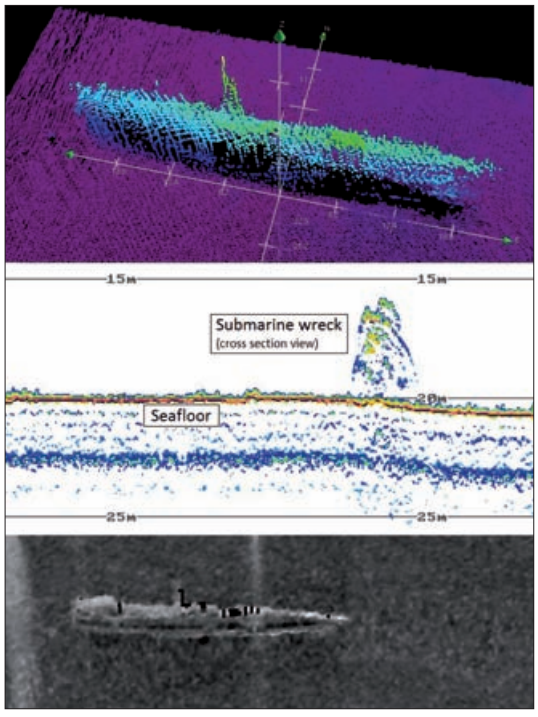


Fig. 3: Wreck of a submarine in the south of Helgoland. 3D-view of a multibeam point cloud created with Caris HIPS and SIPS 8.1. Cross section recorded with Innomar SES-2000 medium-100 and displayed in ISE. Backscatter view in Caris HIPS and SIPS 8.1 to support subsequent analysis

Acknowledgements (2)

For the hydrography practice at sea, thanks to the AWI and the Helmholtz-Zentrum Geesthacht, Centre for Materials and Coastal Research (HGZ) for providing their vessels. For their cooperation and support we would like to thank the University of Hamburg, the BSH and again the AWI. Special thanks go to the Jacobs University Bremen, especially to Prof. Dr. Vikram Unnithan, for his pre-cruise suggestions, recommendation, advice, and support of the HE437 cruise. For the guidance on board thanks to Dipl.-Ing. Marius Cysewski from the HGZ and M.Sc. Tanja Dufek. In this context a special thanks to the crew members and the captains of RV »Heincke« and RV »Ludwig Prandtl« – it was fun sailing with you all!

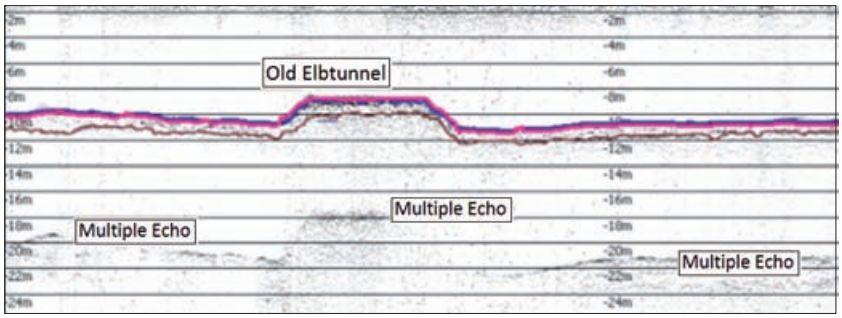


Fig. 4: Sub-bottom view of the old Elbtunnel, Hamburg, collected with Innomar SES-2000 compact

Cruise with RV »Ludwig Prandtl«

Whereas the one half of the students was on the trip with RV »Heincke«, the other half took part on several day-excursions with RV »Ludwig Prandtl« around the river Elbe in Hamburg (Oortkaten) and Wedel. Different to the other cruise, not only the data acquisition itself, but also the set-up of the different systems belonged to the tasks to be done by the students.

On the vessel, the acoustic Doppler current profiler (ADCP) RDI Workhorse Rio Grande from Teledyne was operated to gather information about the water current. Additionally, an SES-2000 compact sub-bottom profiler from Innomar was installed. As a special feature the students could decide, depending on the area of operation, whether they want to use the SES-2000 compact as sub-bottom profiler or as a side-scan sonar.

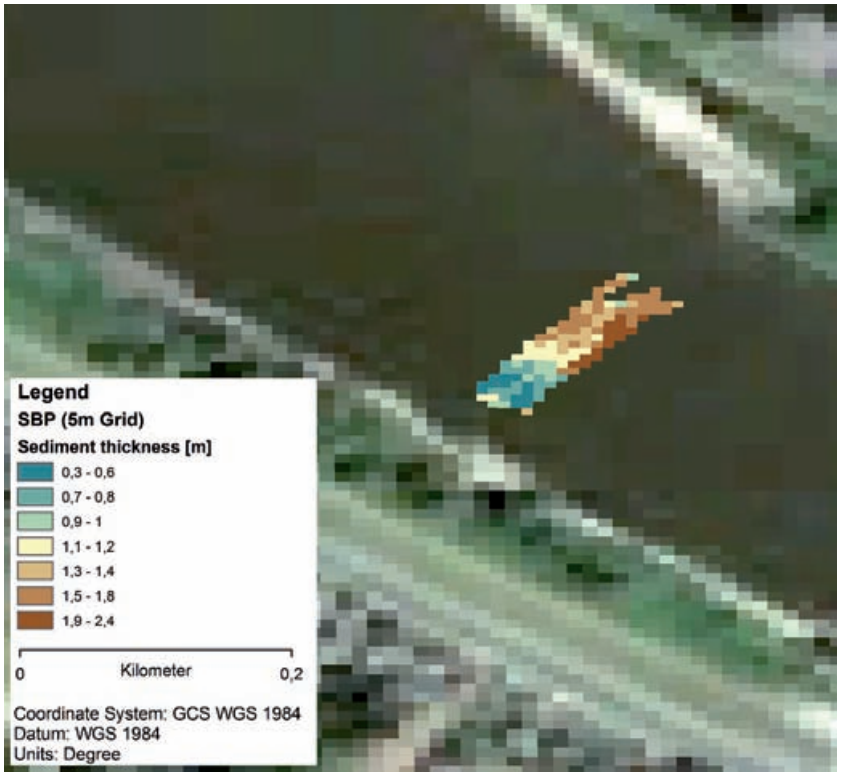
In addition to the above mentioned equipment, the students used a CTD probe and the stationary water probing system FerryBox. Position and motion data was collected with the JNSGyro-4T system from Javad.

Unlike the cruise on the North Sea, the time management was a quite essential part and the planned schedule had to be held as much flexible as possible. Due to the tides and the corresponding effects on the navigability, the operation time was limited. Nevertheless, several specific survey areas could be observed such as the old Elbtunnel at St. Pauli or the harbour area around the Southern Elbe. In addition, some profiles across different parts of the Elbe were planned and surveyed with the installed ADCP. These ADCP profiles and the investigation of suspended sediments in the water flow formed the key aspect of the cruise.

As the cruises with RV »Ludwig Prandtl« were only daily trips, the whole data processing was done afterwards by using Caris HIPS and SIPS 8.1, QPS QINSy, and ISE. To give some impressions of the collected data, Fig. 4 shows a profile across the old Elbtunnel in Hamburg St. Pauli. The top layer of the seafloor was identified by the blue and red line and shows the structure of the sediment-covered tunnel ceiling. Apparently, the tunnel rises above the sea-floor approximately two metres and this way reduces the navigable nautical depth. This echogram also shows the occurrence of multiple echoes which appear in twice the original water depth.

In the area around the Southern Elbe the recorded sub-bottom profiles allowed the students to do an evaluation of a sediment thickness model. By using a five metre raster, the differences between the sediment layers could be calculated. Fig. 5 depicts a small investigated area. It can be seen that the amount of sediment varies: Close to the southwest shore, the sediment thickness of 0.3 m to 0.6 m is very low in comparison to the middle of the Southern Elbe. In the navigable water, the maximum of detected sediment deposits range up to 2.4 m. This indicates a strong influence of the tide-related sediment transport and settlement and the necessity of periodically dredging operations to ensure the access to the port of Hamburg. Several investigations with the ADCP both in the Northern and in the Southern Elbe allow the students further analyses. The evaluation of the total discharge provides a value of approximately 1,200 m^3 per second. The results of the discharge comparison concludes that the Northern Elbe transports 60 % of the sediment masses whereas the Southern Elbe carries the other 40 %.

Fig. 5: Analysis of the sediment thickness based on sub-bottom profiler data for the Southern Elbe close to Oortkaten, Hamburg



Conclusion

In reviewing the whole Hydrography Summer Camp 2014, the students got a widespread view of different tasks a hydrographer has to fulfil. This includes especially the arrangements on land and the system set-up on the vessel – something most of the participants did not do before. These two weeks of small projects of diverse types encouraged the students to share their knowledge and to help each other during the practice as well as during the post-processing steps. ⚓