



Macroplastics Pollution in the Southern North Sea – Sources, Pathways and Abatement Strategies

Interim Report 2017/18 (short version)

Translated into English
by

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1. Introduction

The pollution of our oceans with persistent plastic debris has become a global and increasing environmental concern with far-ranging effects on marine ecosystems. The coastline and beaches of Lower Saxony and its islands are particularly affected.

Since 2016, an interdisciplinary consortium at the Carl von Ossietzky University in Oldenburg has been funded by the Lower Saxony Ministry for Science and Culture in order to provide solid, scientific knowledge of the sources, pathways and accumulation zones of plastic litter. This team consists of physical oceanographers, geoecologists, biologists and environmental planners.

Using simple wooden drifters and high resolution, numerical modelling, the consortium researches the dispersal of floating macroplastics (i.e. visible plastic fragments and objects) and accumulation areas within the German Bight and the Wadden Sea. The selected models will also enable backtracking of particles, thereby identifying the main regional sources, e.g. shipping lanes, rivers, tourism. Furthermore, coastal sensors and observation systems are employed to gather data of hydrodynamic parameters. A concept for monitoring and analysing litter data along the North Sea coast will also be devised with a particular focus placed on litter entry via the rivers. In addition, the general public can actively participate in the collection of litter data via a web-based registration system for reporting the wooden drifters.

Overall, the consortium will provide sound, scientific data on the level of plastic pollution along the Lower Saxony coastline and in the German Bight, and aims to develop plans for abatement strategies.

2. Work Packages

The „Macroplastics“ research team consists of five work packages with staff members from both the ICBM (Institute for Chemistry and Biology of the Marine Environment) and the IBU (Institute for Biology and Environmental Sciences). The individual work packages are connected through mutual research questions and tasks (Fig. 1). Transdisciplinary work approaches are the result of collaborating and exchanging information with local groups and authorities (e.g. NLWKN, the Wadden Sea National Park, associations of owners of dyked land etc.), environmental organisations (e.g. Mellumrat e.V., Verein Jordsand e.V., Schutzstation Wattenmeer e.V. etc.) as well as the active involvement of the general public and further stakeholders of the coastal community (e.g. tourism organisations, shipping companies, the fishing industry etc.).

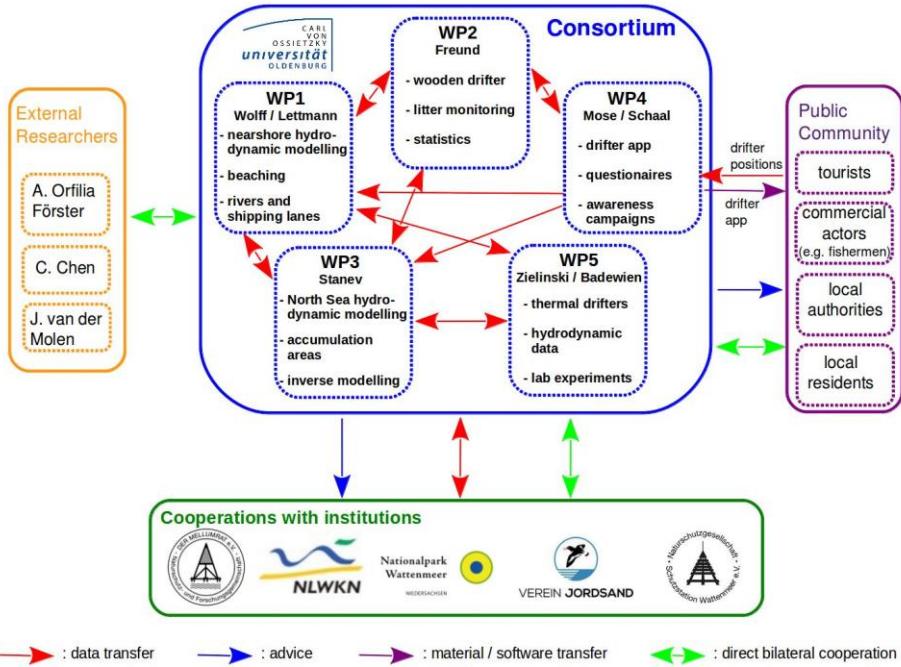


Fig. 1: Organisation chart of the research project “Macroplastics Pollution in the Southern North Sea – Sources, Pathways and Abatement Strategies“.

a) **WP 1 – Nearshore Hydrodynamic Modelling**

Key focus of WP 1 is the high-resolution numerical modelling of the southern North Sea. Of particular interest is the coastal zone for which the regional model COAWST (Coupled-Ocean-Atmosphere-Wave-Sediment Transport) is used. COAWST couples the ocean model ROMS (Regional Ocean Model) with the wave model SWAN (Simulating Waves Nearshore). The goal is to develop a numerical model with which it is possible to describe and model the drift behaviour of plastic litter at the sea surface and in accumulation zones. In order to do so, it is important to understand the beaching processes of surface-near plastic fragments as well as the role of wave transport on plastic debris drift.

The necessary modifications and validation trial runs of existing models which were scheduled for the first year of the project are either ongoing or completed. Some first modelling attempts of trajectories of surface-drifting particles showed good results after being tested against GPS-drifters that are also used as part of the project (Fig. 2). In October 2017, a larger field experiment was undertaken in cooperation with WP 5 and WP 2 to record the beach topography and wave field of Spiekeroog (BLEX, s. Chapter 4). Based on these measurements, modelling approaches will be devised to describe beaching processes.

Drifter Positions from 05.10.-18.10.2016

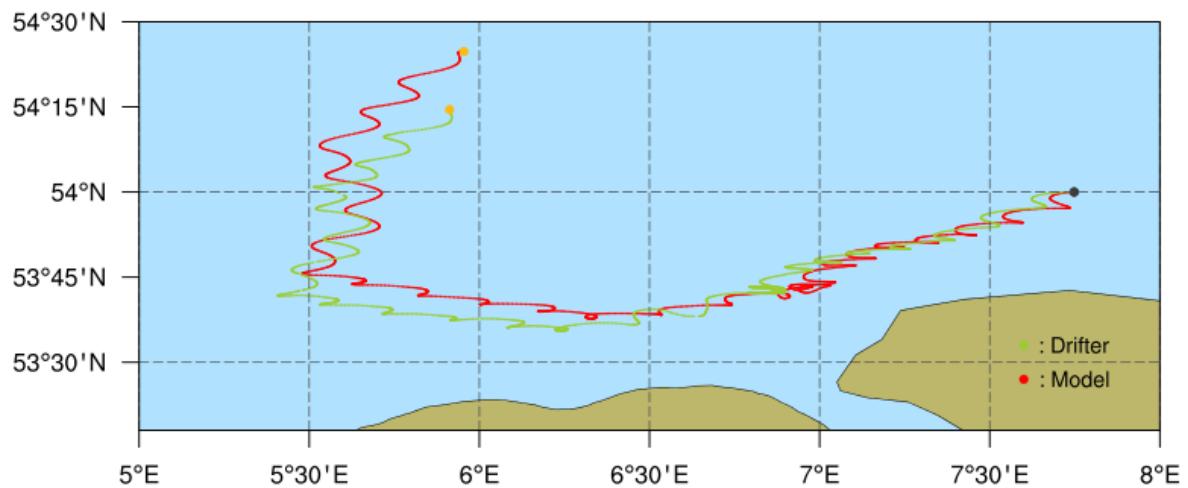


Fig. 2: Modelling attempt of the trajectory of a model drifter (red line) compared to the actual trajectory of a deployed GPS-drifter (green line; credit: M. Ricker).

In the fourth quarter of 2017, rivers were already integrated into the coastal model. This step was initially planned for a later point in time. As a model region, the Weser estuary as well as the Weser itself (between Bremerhaven and Bremen) were chosen for this approach.

b) WP 2 – Monitoring, implementation and investigation of approaches for the quantification of marine litter

Using blocks of wood (wooden drifters; Fig. 3), this work package aims to simulate floating plastic litter in an environmentally friendly but relatively accurate way. The drifter experiment is thereby a central link between the work packages within the project and the general public (see Chapters 3, 4 and 7). For that reason, it was supposed to enter the first test phase by the third quarter of 2016. The choice of material, i.e. the wood as well as the branding irons, the production of the actual drifters, and the necessary application processes to receive all required field permits (from local and regional nature conservation authorities, waterways and shipping authorities, the maritime police, port authorities, NLWKN, and the Wadden Sea National Park Administration) turned out to require more time than expected. On 11 October 2016, the first batch of wooden drifters was released. This event was accompanied by members of the press and was positively received by the public on a regional and national level.



Fig. 3: The wooden drifters that are deployed during the course of the project (credit: R. Schöneich-Argent).

Aside from organising and coordinating the wooden drifter experiment as well as data analyses, networking with local NGOs and authorities was crucial. The checking and validation process of the extensive litter data sets, provided by collaborating NGOs, has been completed so that the statistical analyses as well as the comparison between the recorded litter quantities and drifter reports can now begin.

Parallel to the work in WP1, WP2 also started to devise a litter monitoring procedure, particularly designed for river banks, for which the Ems and Weser were selected. Trial runs will eventually be extended to the Elbe as well.

c) **WP 3 – Marine litter in the North Sea**

While WP 1 focuses on high-resolution processes in coastal areas, WP 3 aims to identify mesoscale systems in the open North Sea that could influence the circulation and accumulation of litter. To do so, the parameters that enable potential accumulation zones and that influence their temporal stability have to be described first. Another important question that needs to be answered: Which litter sources contribute what kind of quantities to which accumulation area in the North Sea?

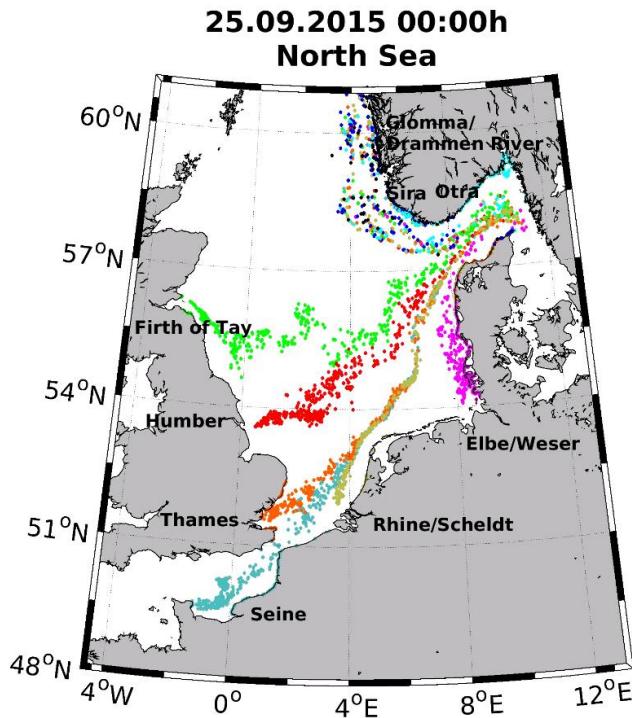


Fig. 4: Simulation of particle drifters using the North Sea model FOAM AMM7, (credit: M. Ricker & E. Stanev).

Convergence zones that surface-floating litter cannot cross could play an essential role in answering this question. There are a few indications that such convergence zones exist in the German Bight. The plan is to further elucidate not only this phenomenon in the course of the project but also the three-dimensional circulation patterns of the entire North Sea with all its regional features, as these may influence litter drift very differently.

During the first phase of the project, a model of the North Sea and the European northwest continental shelf (NEMO - Nucleus for European Modelling of the Ocean) was implemented (Fig. 4). Similar to WP 1, WP 3 was able to couple the NEMO model with a wave model. With this coupled model, the trajectories of various deployed GPS-drifters were successfully simulated. After the model was validated, forward and backward-simulations of floating litter were conducted.

d) WP 4 – Socio-behavioural patterns of polluters, participatory abatement strategies and citizen science

Apart from examining the sources, pathways, beaching processes as well as accumulations zones of marine litter along the North Sea coastline and offshore, the consortium aims to develop active measures and abatement strategies together with local stakeholders.

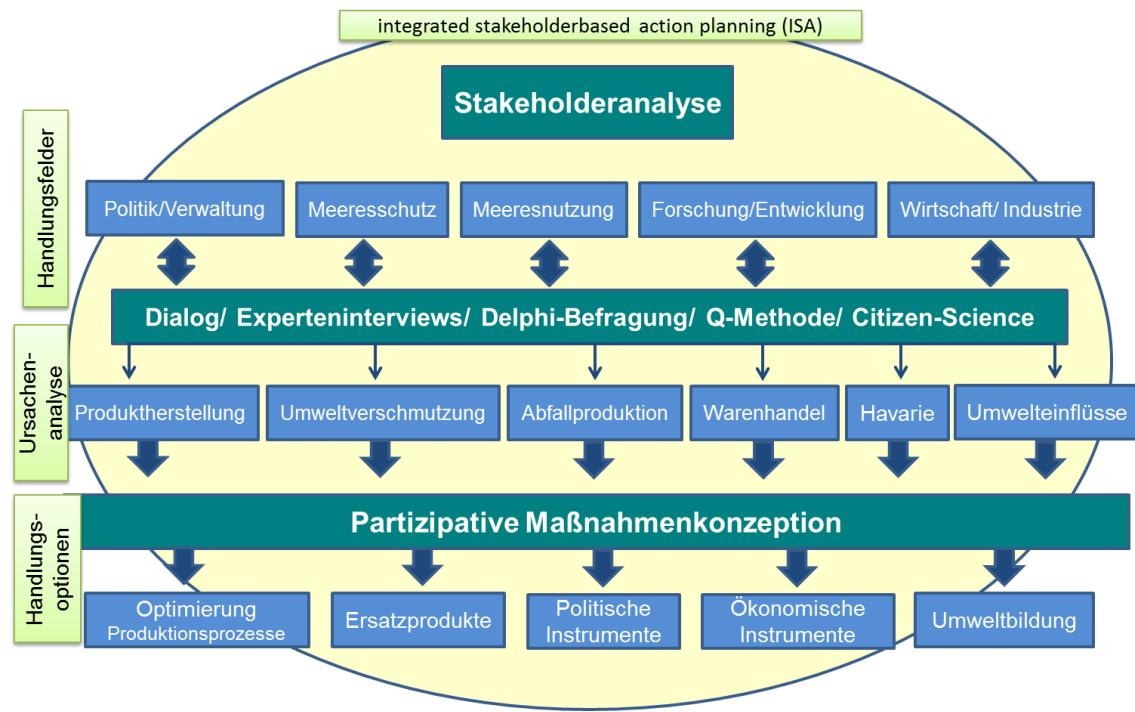


Fig. 5: Visualised concept of integrating relevant stakeholder groups into the development of measures (credit: K. Stephan & P. Schaal).

At first, basic research identified the spatial structure and distribution of potential litter source points/polluters along rivers and the North Sea coast of Lower Saxony. The hotspot map that was compiled also helped to select the release points of the wooden drifters (Fig. 7). This work was supported by a literature search and the compilation of a list of stakeholders that are connected to, involved in, or affected by plastic pollution. This search for sources was conducted (trans)regionally by using the snowball-sampling-technique with experts (Fig. 5).

In a next step, experts will now be selected and subsequently interviewed with central questions, e.g. how awareness-raising means can help change and improve the current situation regarding litter entering the oceans. In collaboration with WP 2, WP 4 contacted locally active members of the public in the North Sea and Baltic region regarding beach cleanups and improving the use and availability of data for awareness campaigns (s. Chapter 7).

e) WP 5 – Coastal Observation

The physical parameters that influence the beaching processes of drifting particles, in this case drifting debris items, are not yet entirely understood. The work of WP 5 therefore deals with experiments and measurements that record the transport and beaching of plastic litter in the surf and coastal zone. High-resolution spatio-temporal measurements of transport and accumulation areas are also conducted (s. Chapter 4).

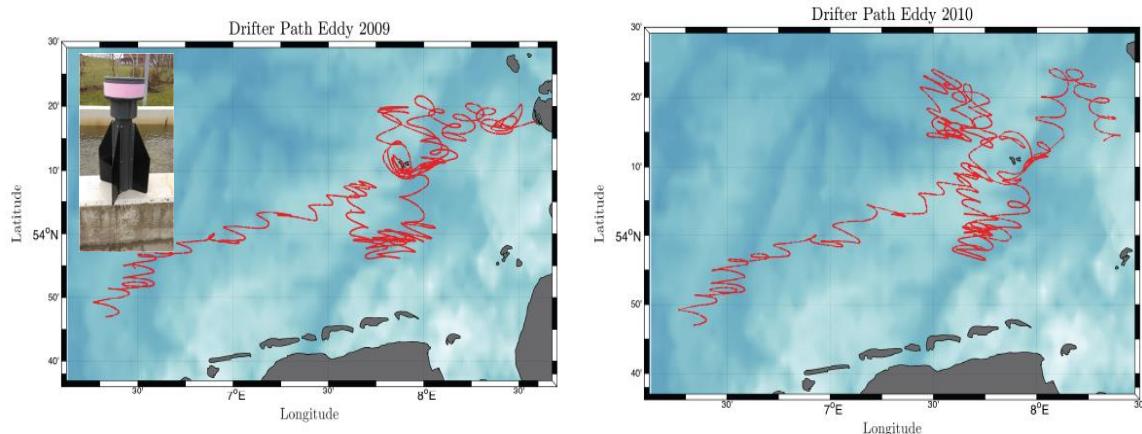


Fig. 6: Trajectories of two drift buoys in March/April 2017 over the course of 33 (left) and 43 (right) days. The small photo shows one of the deployed second generation GPS drift buoys (credit: J. Meyerjürgens).

The wooden drifter experiment clearly provides information on the location and date of the release and finding of each block. However, the exact drift path of each individual drifter remains unknown. In addition to the experiments conducted by WP 5, the idea therefore came up to develop GPS-drift buoys that are suitable for shallow water use and which would provide reliable data on drift paths.

Two types of drift buoys were constructed. There were successfully deployed during several field excursions from the research vessel *FS Heincke* (cruise HE473 and HE498), the research boat *Otzum* as well as during field experiments on Spiekeroog (s. Chapter 4). Overall, 20 high-resolution data sets within the German Bight were compiled (Fig. 6). These data provide valuable clues and suggestions for the ongoing and future work of WP 1, 2 and 3, and should therefore be continued as well as expanded, e.g. into the river systems, over the course of the project.

3. Wooden drifters and the website

Parallel to the first wooden drifter being released in October 2016, the report portal on the project website had to be up and running, as this large-scale field experiment would not be possible without the active participation of the general public (s. also Chapter 2 b and d). The necessary work of constructing the system and maintaining the homepage is coordinated by WP 4. Extensive modifications of an existing GeoCMSHotSpot module were implemented in order to allow for anonymous reporting of drifters.

The majority of drifters are reported via the homepage. Any technical errors but also recommendations for improving the system that reach the project team (via www.macroplastics.de) are tested for their feasibility and, if possible, implemented. The plan to develop an own reporting app for smartphones was cancelled as the cooperation with the NGO Schutzstation Wattenmeer e.V. (R. Borcherding) enabled the integration of a drifter report option into the existing “BeachExplorer” ID-app. Drifter reports from this app are regularly integrated into the project’s own web-based system.

Drifter reports that reach the project via e-mail, phone calls or standard mail are added to the system by project staff. In addition to the maintenance of the system, further tasks are data validation and safeguarding as well as the development of analysis tools that website visitors may use (e.g. dynamic cluster maps, search and zoom functions that enable the identification of individual drifters).

During the past four drifter release campaigns along the Lower Saxony coast and within the three river systems Ems, Weser and Elbe (Fig. 7), approx. 34,500 wooden drifters have been released to date. The fourth release in October 2017 provided the first data comparison with the very first release in October 2016 (Fig. 8).

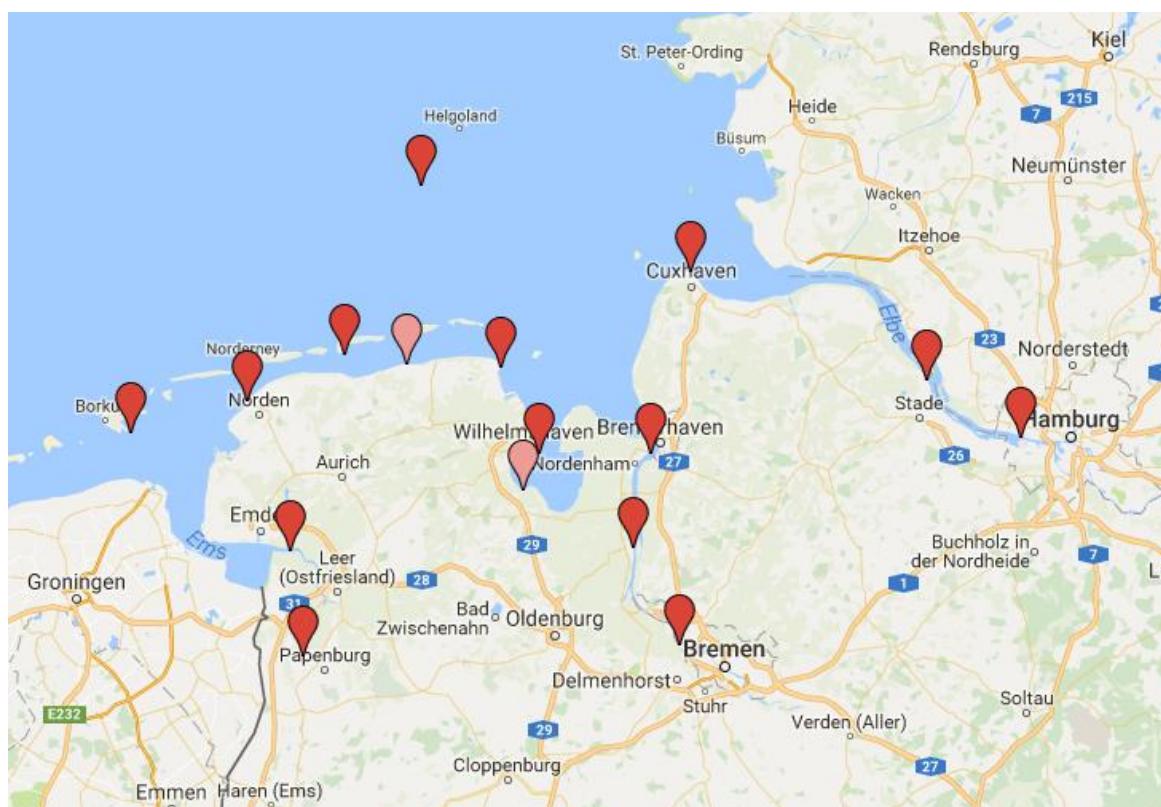


Fig. 7: Release points of the wooden drifters. The points coloured in rosé indicate alternating releases in Neuharlingersiel and Dangast instead of Langeoog and Wilhelmshaven, respectively. The offshore release point near Heligoland is representative of all offshore releases in the North Sea (credit: R. Schöneich-Argent).

It was possible to conduct the offshore releases during field trips aboard the research vessel *FS Heincke* (releases near Borkum, Heligoland and at the northern border of the German EEZ) as well as in collaboration with the NIOZ institute (Koninklijk Nederlands Instituut voor Onderzoek der Zee) on Texel (a near- and an offshore release in Dutch waters). These releases should visualise and increase our knowledge of the drift paths of litter items originating from the main shipping lanes.

Experiments with drifting objects are well-established and have been/still are widely used in the past and present. The scale of this drifter experiment in the North Sea, however, is unique. Thus there were no initial reference values that could predict the success of this approach. A comparable experiment on Hawaii¹ indicated that a report rate of approx. 25% seems plausible. Up until 6 December 2017, 17,673 drifters were reported by the public, i.e. a report rate of over 50%: a result that by far exceeds all expectations.

So far, approx. 14,517 drifters (41%) were reported once; all others were found twice or more times at different locations. The drifter experiment therefore offers a superb platform for members of the general public to not only become informed on an important research and environmental topic but also to be the vital part of a science project. Without the wide-scale public support, this experiment would not be feasible.

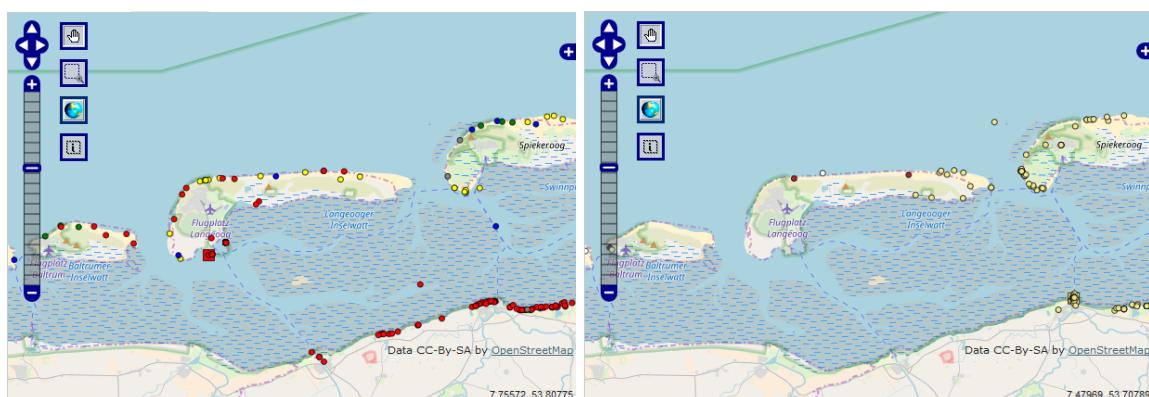


Fig. 8: Screenshots showing the details of various drifter reports on Langeoog from the 4th quarter of 2016 (left) and of 2017 (right), respectively. The different colours indicate various release points (screenshots from <http://portal.macroplastics.de/index.php?page=drifter-meldung>).

Most of the drifter reports that reach the project team via the homepage, e-mail, postcards and letters are very positive and regularly answered by project staff. This encouraging feedback shows that the project has a fitting orientation and is thus well-received in society.

The finding sites of the reported drifters are located along the entire southern North Sea coastline, ranging from the West Frisian Islands to the northern tip of Denmark near Skagen. The drifter with the furthest distance travelled to date was released in Wilhelmshaven and washed ashore in southern Norway. The detailed analysis of the drifter reports will be a central element in the upcoming work of the team. Some key questions are, for instance, the connection between release and finding location and the locally documented litter quantities, or a better understanding of the influence of wind and extreme weather events on the dispersal and beaching of drifting items.

4. Project BLEX (Beach Litter EXperiments) on Spiekeroog

As part of this project, a wave radar (WAMOS) was bought in order to continuously monitor and record the wave field in the surf zone, particularly during the storm season. The data that have been acquired serve the purpose of validating and improving extant drift models. After an initial search and a difficult and lengthy permit application process, a suitable location for the field setup was found. Upon a successful test phase at the ICBM-branch in Wilhelmshaven, the system was brought to Spiekeroog in October 2017 and has since been recording data, being located on the grounds of the protestant youth club (Fig. 9). The deployment over the winter season 2017/18 is planned until spring 2018. Simultaneously, a mobile weather station by the company Thies was set up in order to co-record meteorological parameters. Both systems have been running smoothly since their installation.



Fig. 9: WAMOS wave radar on Spiekeroog (credit: J. Meyerjürgens).

In order to monitor and record currents and wave parameters along the coastline of Spiekeroog (as a model region), further sensor systems (ADCP, 2 wave sensors) have been anchored on the 10 m-mark. The beach topography was also recorded in detail via GPS with the help of the IBU working group *Hydrogeology and Landscape Hydrology*. During a field excursion to Spiekeroog from 17-26 October 2017, experiments were conducted by project staff members. The attempt was to understand the drift behaviour of the wooden drifter blocks, especially in terms of wave impact, using small GPS-drifters. The drift paths and reported beaching spots of the GPS-drifters closely resembled those of the wooden drifters. This is an important knowledge gain for further modelling work.

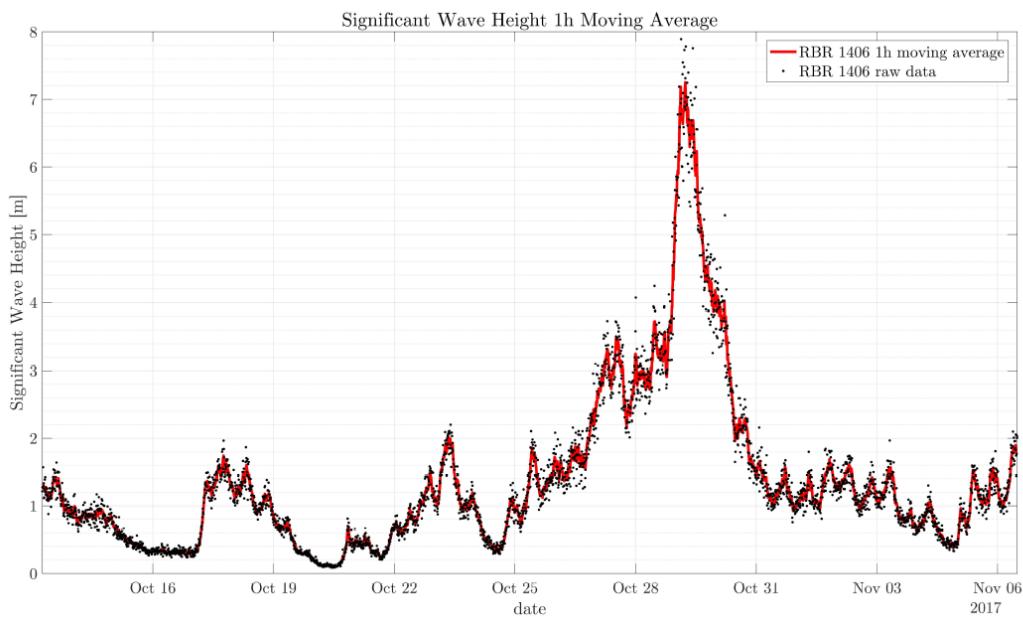


Fig. 10: Recorded wave height during storm „Herwart“ during der BLEX campaign on Spiekeroog (credit: J. Meyerjürgens).

5. Theses

A key objective of this research project is to integrate the topic of marine pollution into existing degree modules and sessions by creating new teaching formats and topic overlaps in order to include university students at an early stage into the research tasks and processes. The successful realisation of this objective at a fairly early stage of the project is reflected in the number of ongoing and completed bachelor's as well as master's theses.

The subject of marine pollution has become a part of the lecture series in the university degrees Bachelor in Environmental Sciences, Master in Marine Environmental Sciences, Master in Environmental Modelling, Master in Sustainable Economics and Management, Master in Marine Sensor Systems and Bachelor in Marine Technology. The topic is also taught in seminar sessions and internship.

a) Bachelor's theses

- BUTTER, MICHAEL (2017): Entwicklung eines thermalen Oberflächen-Drifters für den Einsatz im Küstenbereich – BSc Meerestechnik, Jade Hochschule.
- KRUSE, MAJA (2018): Quantitative und qualitative Analyse von Makromüll entlang eines Nordseezuflusses am Beispiel der Ems - BSc Umweltwissenschaften, Uni Oldenburg.
- LEIBING, KATHARINA (2018): Quantitative und qualitative Analyse von Makromüll entlang eines Nordseezuflusses am Beispiel der Weser - BSc Umweltwissenschaften, Uni Oldenburg.
- MARTIN, MARIA C. (2017): Einflussfaktoren der Müllverteilung und -zusammensetzung an zwei regionalen Touristenzielen: Wilhelmshaven und Dangast – eine GIS-basierte Analyse - BSc Umweltwissenschaften, Uni Oldenburg.
- REIMANN, PATRICK (2017): Untersuchung von Fronten in der Deutschen Bucht Seereise 2016 mit FS Heincke - BSc Meerestechnik, Jade Hochschule.
- RÖTTGEN, MORITZ (2018): Einbau von Makroplastik in Gelege ausgewählter Brutvögel auf Mellum - BSc Umweltwissenschaften, Uni Oldenburg.
- SACHS, NICO (2018): Schiffsentsorgungssysteme für Abfälle nach MARPOL Annex V – BSc Umweltwissenschaften, Uni Oldenburg.

b) Master's theses

- BARRELET, JOHNA (2018): Dolly ropes: Who are the stakeholders to tackle this special problem (working title) – MA Sustainable Economics and Management, Uni Oldenburg.
- BREITBACH, MICHELLE (2018): Identifikation von Strömungsmustern durch Driftexperimente in der Nordsee – MSc Marine Sensorsysteme, Uni Oldenburg.
- HEINRICH, PHILIPP (2017): Particle Tracking und Finite-Time Lyapunov-Exponenten in der deutschen Bucht – MSc Physik, Uni Oldenburg.
- LANGNER, JANINA (2018): Characterizing the North Sea coastline to interpret the reported observations of wooden drifters – MSc Nachhaltigkeitswissenschaften, Uni Lüneburg.
- STUMPF, KIM (2017): Räumliche Wahrnehmungs- und Verhaltensmuster in Bezug auf marine Plastikabfälle – MSc Geographie, Uni Würzburg.
- WÜLLNER, TIM (2018): Near-shore high-resolution hydrodynamic modelling in front of a barrier island in the southern North Sea – MSc Umweltmodellierung, Uni Oldenburg.

c) Research internships

SCHÖNUNG, MICHAEL (2017): Vorbereitungen zur Modellierung der Strömung und des Transportes von Plastikmülls eines ausgewählten Flusssystems (Weser) – MSc Umweltmodellierung, Uni Oldenburg.

ŘEHÁČEK, DAVID: Validierung von Meldungen und kartographische Arbeiten am Meldeportal für Driftermeldungen im Web-GIS, Doktorand der Universität Prag (Tschechische Republik), IAESTE-Austauschprogramm des DAAD.

d) External PhD thesis

UNGER, BIANCA: Meeresmüll in der Nord- Und Ostsee: raum-zeitliche Verteilung und Vorkommen in Meeressäugern. PhD at the Tierärztlichen Hochschule Hannover, Institute for Terrestrial and Aquatic Wildlife Research – Büsum, Prof. Dr. Ursula Siebert, Dr. Helena Herr. Second examiner: H. Freund.

e) Internships and work experiences

SIMKE ONKES	student internship	Aug/Sep/Oct 2016
PATRICIA GIERGA	student internship	Feb/Mar 2017
SARAH SOMMERHALDER (CH):	work experience	Jul/Aug 2017
LAURA NIEMEYER	student internship	Dec 2017 - Feb 18
KATHARINA SCHMIDTMANN	student internship	Feb/Mar 2018
MORITZ RÖTTGEN	student internship	Mar/Apr 2018

6. Publications

ADEN, C. & STEPHAN, K. (2017): Web-based Citizen Involvement in Research into Pathways and Hotspots of Marine Litter in the Southern North Sea. – In: CAR, A., STROBL, J., JEKEL, T. & GRIESEBNER, G. (Hrsg.): GI Forum Journal for Geographic Information Science, 2, 60-77.

SCHÖNEICH-Argent R., RICKER M., MEYERJÜRGENS J., HAHNER F., STEPHAN K. (2017): Projekt Makroplastik in der südlichen Nordsee – Ein Zwischenbericht. Natur- und Umweltschutz, Band 16 (Heft 1), 26-29.

SCHÖNEICH-ARGENT R., STEPHAN K., RICKER M., HAHNER F., MEYERJÜRGENS J. (2016): Plastik – Rohstoff, Wertstoff, Abfallprodukt und globales Problem - Wissenschaftler-Team der Carl von Ossietzky Universität Oldenburg erforscht die Wege des Plastikmülls in der Nordsee. Natur- und Umweltschutz, Band 15 (Heft 2), 64-67.

STANEVA, J., RICKER, M., KRÜGER, O., BREIVIK, O., STANEV, E., & SCHRUM, C. (2017): Particle transport model sensitivity on wave-induced processes (Vol. 19, p. 2968). Presented at the EGU General Assembly Conference Abstracts, Vienna.

7. Collaborations within and outside the university

Academic and non-academic collaborations

Already early on in the project, partnerships were formed to enable the scientific exchange and collaboration with universities and research institutes outside of Oldenburg. Project staff also started playing an active role in committees/panels that address the litter issue on a political and societal level. Furthermore, cross-institutional cooperation was fostered to logistically tackle certain project aspects.

The large number of wooden drifters is not produced by student assistants in the university's own workshop, as was initially planned. Instead, after extensive consultation and discussion, the Gemeinnützige Gesellschaft für Paritätische Sozialarbeit mbH (GPS; a non-profit organisation for parity and social-service work) received the production contract. The GPS workshop in Jever carries out the manufacturing work with handicapped citizens. They have since been a highly enthusiastic and very reliable partner (Fig. 11).

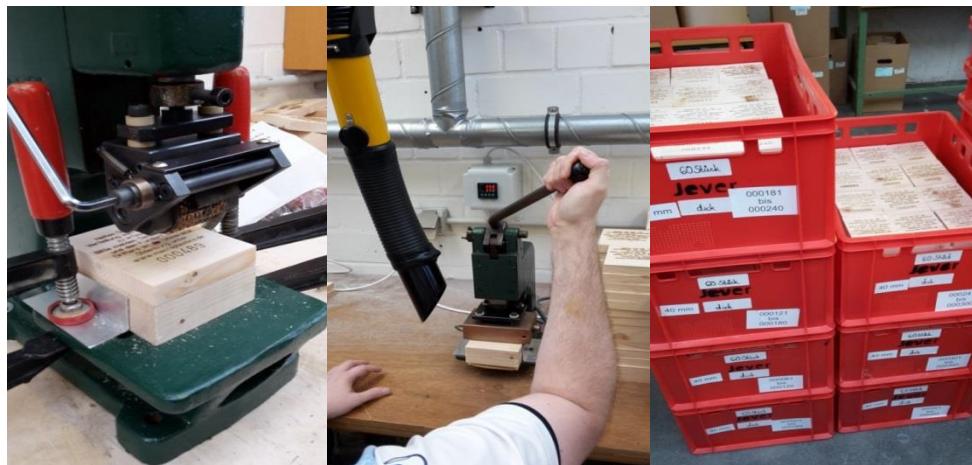


Fig. 11: Production of the wooden drifters at the GPS in Jever (credit: R. Schöneich-Argent).

The collaboration with GPS provides not only a social benefit and enrichment for the project work. The open days at the workshop, most recently on 26 November 2017, also provide a platform to promote the research project as well as to raise awareness for litter pollution, which the general public readily embraces.

On 18 March 2016, the „Round Table Against Marine Litter“ was called into action by the Federal Minister for the Environment, Barbara Hendricks, the Lower Saxony Minister for the Environment, Stefan Wenzel, and the president of the Federal Environmental Agency, Maria Krautzberger, at the Lower Saxony state office in Berlin. Goal of this committee is to coordinate national actions against marine litter pollution and to support projects that work towards this goal. Since the first meeting of this panel, staff members of the Macroplastics project have been actively participating in the working groups “sea-based litter sources” and “awareness and outreach work” and were also involved in the compilation of the first interim report that was published in September 2017 and is available online.

Aside from partaking in the regular panel meetings of these working groups, the Macroplastics Project of the University of Oldenburg played a leading role in the sub-working group that deals with reducing existing marine litter in the environment. An informative and detailed list of already running campaigns against the Top 10 Beach Litter Items was prepared which was presented at the 4th meeting of the round table and at the presentation of the round table’s interim report in Berlin in September 2017. The Round Table Against Marine Litter is now moving into its second phase which the Macroplastics Project will continue to be involved in.

Whilst introducing the project to the BLANO panel “Litter in the Sea” at the Federal Agency for Hydrography and Shipping in Hamburg on 22 March 2016, project members already established contact with Lars Gutow from the AWI in Bremerhaven as well as Bianca Unger from the Institute for Terrestrial and Aquatic Wildlife Research of the University of Veterinary Medicine Hannover. Both collaborations deal with the analysis and simulation of litter data that were collected either ship-based at sea or aircraft-based during the harbour porpoise monitoring. Preliminary analyses and the coupling with current models of the open North Sea have already provided some promising results. These calculations were conducted in cooperation with J. Staneva, J. Schulz-Stellenfleth and S. Grayek from the Helmholtz-Centre for Materials and Coastal Research in Geesthacht.

The project is also the only German institution to have participated in the EU-financed project RIMMEL (Riverine and Marine floating macro litter Monitoring and Modelling of Environmental Loading). Participating organisations and scientists conducted regular monitoring sessions at river estuaries and record floating litter. In the now completed project, smaller streams that lead into the North Sea were monitored; the data were in turn forwarded to the coordinating scientists in Bologna. After the RIMMEL project was terminated in October 2017, technical reports and some first results are now being prepared for publication. The collected data of multiple European rivers, also outside the North Sea region, are available to project participants for further analyses. Continuing on from this successful project, the rivers Ems, Weser and Elbe will now be monitored, using the same software. Furthermore, the respective Macroplastics staff are aiming to collaborate with one of the previous RIMMEL coordinators, Daniel G. Fernández (now University of Cadiz, Spain).

Monitoring and recording litter data along German coastlines is carried out by public authorities, e.g. in Lower Saxony the NLWKN (Niedersächsischer Landesbetrieb für Wasser-, Küsten- und Naturschutz, i.e. the Lower Saxony Water Management, Coastal Defence and Nature Conservation Agency) as well as by local environmental organisations, e.g. the Mellumrat e.V., the Verein Jordsand e.V. or the Schutzstation Wattenmeer e.V., that have already been engaged in this activity for several years, if not decades.

The collected data sets offer a unique database to quantitatively and qualitatively evaluate changes in the litter abundance and composition. The aforementioned efforts are further supported by a number of public cleanups along the coast. Here, the focus is placed on the awareness aspect and passing on information as well as the cleaning itself, rather than to qualitatively assess the collected litter. These important data are unfortunately lost for scientific evaluation purposes although they could play an important role in filling data gaps on a spatial level. The most common reason for why the collected litter is not further assessed by volunteers is the slightly complicated and time-consuming method of recording the data when using the OSPAR monitoring protocol. Over the course of this project, the team collaborates with the ISUS Foundation (on Norderney) and volunteers on Borkum and in Minsen (district Wangerland) in order to compile and test an easy-to-use litter identification guide and protocol that will be evaluated during cleanups in 2018. The goal is to ensure an easy understanding and use but also usefulness in terms of scientific analyses.

The long-term data sets that were provided by the NGOs have mostly been harmonised, validated and transferred into a consistent format. With statistical tools, clearly focused research questions and analyses can now be asked and carried out. In early 2018, before the monitoring season, this system will be introduced to representatives of the NGOs and recommended for future use.

8. Media and public awareness

The topic „marine litter“ including the aspects of macro- and microplastics has moved more and more into the focus of public perception and news reports. Therefore, it is not surprising that the media have indeed been very interested in the research project “Macroplastics in the Southern North Sea”, in particular the wooden drifter experiment. This becomes particularly visible when looking at the ICBM press review (Fig. 12 and 13). The Macroplastics project clearly dominated the focus of press reports with 52% in 2016 and still 31% in 2017. Aside from the classic print media that introduced the project nationally, various TV outlets (NDR, 3Sat, Arte, FRF, OL1, Spiegel TV etc.) and radio stations (NDR Info, DLF, Radio Bremen etc.) have also broadcasted information on the project.

A detailed list of the project’s extensive press and PR work is attached in the appendix of the report. This work is carried out by the scientific staff in addition to their research tasks.

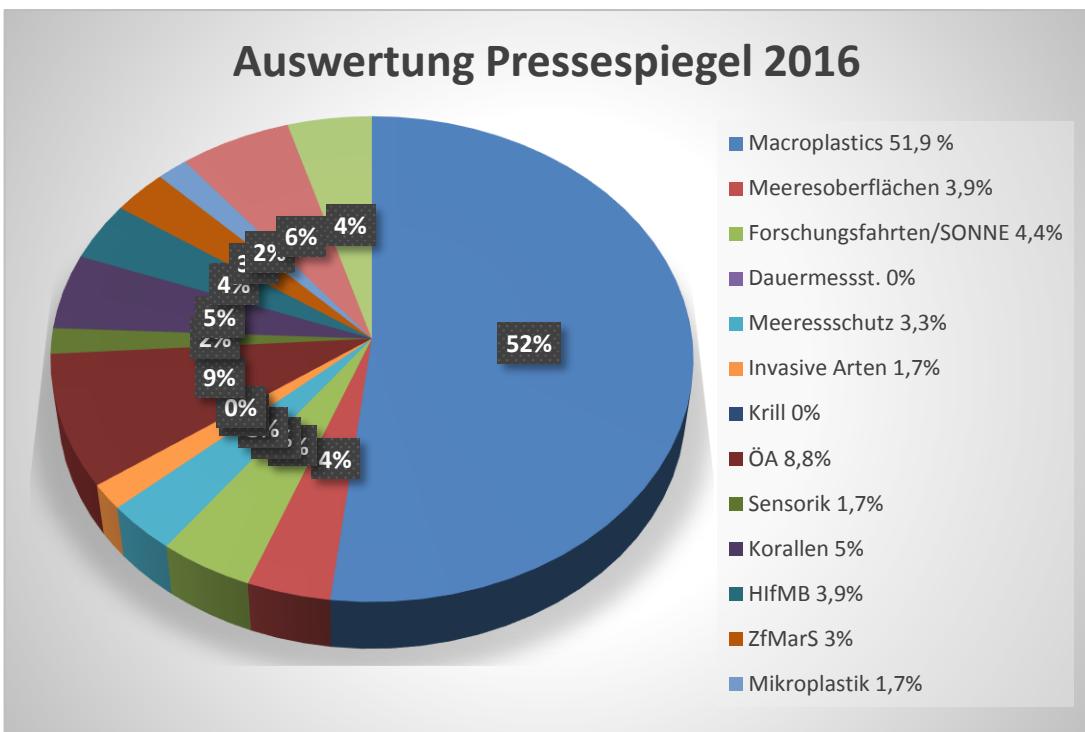


Fig. 12: ICBM press review for 2016 (credit: S. Riedlinger / ICBM PR department).



Fig. 13: ICBM press review for 2017 (credit: S. Riedlinger / ICBM PR department).

After the start of the project, the team immediately began to implement the approach of raising awareness of the topic of marine litter pollution and strengthening the connection between scientific research and the public through various activities. The most important step was the development of the project homepage (www.macroplastics.de). This website is primarily used for reporting drifters and for displaying the release and finding locations (s. Chapter 3). The project's PhD students however also inform interested readers about their ongoing work and important project activities that are worth sharing via a blog.

Project staff actively participate in giving public talks, supporting beach cleanups for example on Wangerooge and Mellum, and helping with the evaluation of *Fishing for Litter* samples (Jever). They also regularly run information booths, for instance at the boat and water sports show "Boot 2017" in Düsseldorf ("Love your Ocean"), the Lower Saxony Science and Research Day at the Schloss Herrenhausen in Hannover, the Wadden Sea Forum in Den Helder or in various national park museums along the Lower Saxony coast. The project has also become well-known outside the North Sea region. Project presentations and discussion rounds were already held in the Baltic Sea region, i.e. on Rügen and in Warnemünde.

Project members also used a special opportunity of knowledge transfer at the historic-ecological education centre (HÖB) in Papenburg. As part of the Lower Saxony Children's Academy in March 2017 and the Lower Saxony Junior Academy in October 2017, the topic of litter pollution was conveyed to and discussed with an interested group of school students between the age of 5 and 16. Participating students were given the chance to learn about this environmental issue in depth during the school holidays and to express their impressions and thoughts in a creative way, outside of the usual mainstream education (Fig. 14).



Fig. 14: Collage dealing with the topic of marine litter; compiled during the „Juniorakademie 2017“ in Papenburg (credit: K. Brunnhofer).

Internationally, the project's visibility was further boosted in 2017 by contributing several video clips and props to the Ocean Plastics Lab (OPL) of the BMBF (Federal Ministry of Education and Research). This exhibition was inaugurated by the Federal Minister of Education and Research, Prof. Dr. Johanna Wanka, in Turin, and was also open to the public in Paris for two weeks in November 2017. Further stops of the exhibition are planned in Canada, Belgium and Berlin. Aim of the exhibition is to increase the public's knowledge and awareness for the issue of marine litter.

Furthermore, an informative clip was produced by the PR and press department of the ICBM (S. Rixinger) as a contribution to the German exhibit pavilion at the COP23, the 23rd UN climate conference in Bonn. It was screened during the conference and introduces the research project.

On an international level, project staff participated in and contributed talks to the European Geosciences Union (EGU) conference in Vienna (STANEVA, J., RICKER, M., KRÜGER, O. BREIVIK, O., STANEV, E. & SCHRUM, C.: Particle transport model sensitivity on wave-induced processes; MEYERJÜRGENS, J., BADEWIEN, T., SÜLTENFUß, J. & ZIELINSKI, O.: Tritium as a tracer for the discrimination of water bodies in the German Bight), the FVCOM Workshop 2017 at the Shanghai Ocean University in China (WOLFF, J.-O., GRASHORN S., LETTMAN, K., BADEWIEN, T., & STANEV E.: Wave energies and wave-induced longshore currents in FVCOM – circulation in front of barrier islands), the GODADE Ocean View Summer School on Mallorca, the GeoInformatics Forum 2018 in Salzburg as well as the Maritime Spatial Planning Conference in Las Palmas on Gran Canaria.

In March 2018, project staff will participate in the 6th International Marine Debris Conference in San Diego which is organized by UNEP (United Nations Environment Programme) and NOAA (US National Oceanic and Atmospheric Administration). Two presentations were accepted by the organising committee: "A wooden, scientific 'message in a bottle' - German university team researches sources and dispersal of macroplastics through large-scale public participation experiment" and „Citizen Involvement in a HotSpot Survey about Pathways of Marine Debris”

Lastly, it should be noted that the project „Macroplastics Pollution in the Southern North Sea“ has been well-received by politicians on a communal, state and national level. Visits by Lower Saxony Minister for Science and Culture, Dr. Gabriele Heinen-Klajić, on 3 August 2016, in celebration of the start of the drifter campaigns, by the SPD parliamentary group (ecology committee), led by Mr. Holger Ansmann (MdL), by Mr. Hans-Werner Kammer (MdB, CDU), Dr. Anton Hofreiter (MdB, Bündnis90/Die Grünen) and Mr. Peter Meiwald (MdB, Bündnis90/Die Grünen) are indicative of that. All political visitors were keen to discuss the topic of marine pollution at the ICBM-branch in Wilhelmshaven.

