future ocean
KIEL MARINE SCIENCES

FUTURE OCEAN RESEARCH

2013/2014

Focus on

Dangerous Ocean

Coastal Change

Education and Career

Opportunities for young scientists

Research in Marine Science

From acidification to coastal research

Dear Reader,

The last two years have been scientifically exciting and rewarding. We see a lot of interest around the globe in integrated marine science in general and our work in Kiel in particular. Our publications are read and cited and some of them are influential in those parts of society concerned with the human-ocean interface. Europe has seen the common fisheries reform, to which several Kiel based publications have contributed toward a more sustainable outlook for European fisheries. The report "The Future We Want" resulting from the Rio+20 anniversary has a historically high number of references to the future of our ocean. And the post 2015 development agenda has established a proposal of 17 sustainable development goals, one of which focuses on the ocean and seas. Some of our work on ocean sustainability has been quite influential in this positive development of defining a global ambition towards a more sustainable marine development agenda.

We have launched 29 new projects in that context and hired 15 new early career scientists, who were selected from more than 80 applicants. They bring their ideas and projects to our groups and enrich our activities. At the same time we have seen some of our key scientist move on to other exciting opportunities. Both are excellent signs of a vibrant globally connected scientific community.

The postdoctoral network, IMAP, has grown to more than 90 early career scientists and is very active in promoting integrative science but also in alleviating some of the short comings in the German science support system. The PhD network, ISOS, has stabilized at about 140 PhD students and is beginning to develop and nurture an alumni community.

We have published another World Ocean Review on Marine Resources and converted our large ocean exhibit into a more portable modular marine science exhibition, the "Future Ocean Dialogue". It is meant to serve the international community and was touring Brazil for six months in 2014. Our semester topic on dangerous oceans and coastal risks attracted a large number of colleagues to conferences and a summer school in Kiel.

Structurally we are heavily engaged in shaping the next phase of the future of integrated Marine Sciences in Kiel. At the university level a cross faculty research focus, Kiel Marine Science (KMS), was formally approved and Ralph Schneider appointed as its founding director. KMS is now in a position to bundle all marine related research across all faculties at Kiel University - a big step forward. The GEOMAR Helmholtz Centre for Ocean Research Kiel has completed its transition from a Leibniz Association institute to a Helmholtz centre and received an excellent review of its 5 year OCEAN program. The other two smaller Future Ocean partners, the Institute for the World Economy (IfW) and the Muthesius Academy for fine Arts (MKHS), continue to make valuable and complementary contributions to our integrated research agenda.

I encourage you to glance through this report and maybe stop here or there to take a closer look. If you find activities that appeal to you, topics you want to know more about, to discuss or would like to cooperate in, feel free to contact me or the scientists, who are leading those activities. We always welcome feedback and any comments you may have!

Sincerely,

Martin Visbeck

Speaker of the Cluster of Excellence "The Future Ocean"

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FOCUS ON DANGEROUS OCEAN / COASTAL CHANGE

Intelligence is the ability to adapt to change.

Stephen Hawking

SYMPOSIUM ON SLOPE SLIDES

Continental Slopes in Motion – Threatened Coasts?

Tsunamis are among the most powerful natural disasters worldwide. In the last ten years alone there were six major events of this kind around the globe. The most devastating was the tsunami of December 2004, which laid waste to the coasts of the Indian Ocean killing more than 200,000 people and the March 2011 tsunami in Japan, which cost almost 20,000 people their lives and destroyed the Fukushima nuclear power plant. Most of these giant waves have been and will be triggered by earthquakes: But not all of them. For about ten years, scientists have been looking at different possible cause – so called slope slides in the ocean. Just as a snowboard on a mountain can trigger an avalanche, in the ocean entire slopes of the continental margin can plunge thunderously into the deep and cause large tidal waves. Georesearchers have now found a series of clues for tsunamis that, in the course of Earth's history, have been caused by slope slides.

One of the best known events is the Storegga slope slide which took place on the southwest coast of Norway about 800 years ago.

At that time in a gigantic movement a huge piece of the continental slope broke off. The amount of sediment would have been enough to cover Schleswig-Holstein with sand one 100 meters thick. The resulting wave reached a height of about 20 meters in the Shetland Islands and up to six meters at the Scottish coast; dimensions similar to the 2011 tsunami in Japan.

Today, little is known about the occurrence of slope slides. What certainly is understood is that slope slides are often triggered by earthquakes, however not every earthquake results in a slope slide.

Participants of the Symposium on Slope Sides, right: Dr. Mohammad Heidarzadeh, Earthquake Research Institute, University of Tokyo

Apparently there are stable and unstable slopes. The conditions that make a slope unstable are yet well understood. Therefore scientists today are investigating continental slopes in order to better understand their restless nature. During the 6th International Symposium on submarine slope slides (Symposium on Submarine Mass Movements and Their Consequences) from the 23rd to 25th September 2013, 130 scientists from 30 nations discussed their current research results on this topic.

This edition of the symposium, the world's most important meeting of its kind, was organized by the Cluster of Excellence "The Future Ocean" and the GEOMAR Helmholtz Centre for Ocean Research Kiel and took place for the first time in Germany.

More than 50 presentations were given and several discussion panels took place in which the researchers contributed their knowledge on this topic, which is still incomplete. The main reason: Large slope slides are relatively rare events, usually occurring only every few hundred or even a thousand years. Up to now no one has ever observed a slope slide live. And there is still no way to predict slope slides. The only way to understand slope slides, therefore, is to interpret the clues found on the ocean floor, to search, so to speak, for evidence in historical mudslides.

Therefore, in the past few years in different countries extensive drilling on slopes has been carried out - both in intact as well as in collapsed slopes. The objective is to find out when a slope is weakened. Of particular interest are the so-called "weak layers" i.e. unstable sediment layers, where the slope at some point starts to slide. "While earthquakes are the most common causes of slope slides, weak layers are thought to determine the form of the slope slide. The composition of the weak areas is still unclear as is the question of whether they were already weak when they were affected by an earthquake or whether there are other reasons for their motion ", summarizes Professor Sebastian Krastel-Gudegast from the Institute of Geosciences at Kiel University and the organizer of the conference. To date, there is no way to detect the weaknesses. There are therefore several theories on the failure of the slopes. It is believed, that a slope slide can occur if the sediment collapses, as the Geomar researcher Morelia Urlaub assessed in her presentation. The decisive factor is thought to be the ratio between the so-called pore pressure in the sediment and the hydrostatic pressure that the water causes as it rests on the sediment. In plain English: when the force of the water on the sediment is less than the force inside the slope that pushes the sediment particles apart, then a slope can break and slide away.

It is possible that in sediments with large quantities of carbonate shells from plankton organisms, the carbonate shells at some point

collapse and are compressed due to the pressure in the sediment. In this case the sediment settles abruptly from the top down and the pore pressure between sediment particles suddenly increases. Due to this impulse the slope could slide.

Not only are the possible triggers of slope slides to date unclear. The movement of the slope itself is also not yet well understood. This may well be a crucial element affecting whether or not a tsunami occurs. Does the slope move in a single large movement as it did in Norway? Thereby churning up hundreds of thousands of cubic meters of sediment mass? Or does the slope crumble slowly? Professor Peter Flemings from the University of Texas asks these questions in his laboratory experiments lectures. His perception is that large masses of sediment can be set in motion when a steep slope begins to slide. Flemings filmed such a breaking off with a sand model in a water tank and measured the pore pressure in the sediment. He noted that the slope slide motion is continuous. The slide eats up the slope, so to speak. Flemings explanation: If a slope begins to slide, the heavily compressed sediment at the edge of the break off may then expand and also slide.

As other researchers demonstrated in their talks, on different coasts worldwide, many slope edges reach right up to the coast. As Italian researchers have shown, this is the case at the airport in the city of Nice. In the past few years during many excursions with sonar equipment the researchers have probed the Italian coast in detail and now have a very detailed high-resolution map of the coastal sea bed, which can be retrieved from the internet site www.magicproject.it. Their aim was to accurately capture the slope structure in this earthquake prone region. This map is the basis for a targeted future investigation of the seabed at particularly interesting or potentially vulnerable points.

The fundamental problem in the study of earthquakes and slope slides is that these events are so rare, and thus only few records of measured data are available. Earthquakes have been only measured over the last 100 years. Accordingly, good data is lacking. To date earthquakes can't be exactly predicted, but only with certain probabilities. It is even more difficult to predict the occurrence of slope slides. "Predictions on whether and when an earthquake will cause a slope to slide are like playing the lottery," said Professor Michael Strasser from the Geological Institute at the ETH Zurich, in a conversation at the event. "With the small amount of data available, we find ourselves still in the age of old peasants' proverbs."

In the past few years Strasser has been leading the first campaign to drill in slides triggered by earthquakes. With new measurement methods and technically advanced drilling systems, the researcher and his colleagues have approached the continental slopes off the coast of Japan, where the tectonic plates collide with each other and earthquakes often occur. "Soon we hope to have important findings on the frequency of earthquake triggered slope slides," said Strasser.

The geologist, like many of his colleagues, takes sediment samples from drilling ships to determine the age and examine the stratification of the slope slide in detail.

They want to find out, how and why a slope starts to slide and whether the slope slide could have been the cause of a historical catastrophe or tsunami.

During the symposium it became clear that there is more than drilling and buried indicators from the past. It is actually possible to observe slide phenomena in nature in real time - but on a comparatively small scale. John E. Hughes from the University of New Brunswick in Canada investigated the movement of sediment in a Canadian River Delta in detail with the use of a sonar device. As it turns out, there is a daily occurrence of sediment slides due to the tides. These slides are so strong that they can move concrete blocks placed on the delta bed. Hughes presented films of sonar recordings of the flowing sediments. Other shots showed how slope slide areas deepen and then fill with sediment in tidal rhythm. Hughes could not look completely into the river bed, however, due to sediment turbulence. Thus sediment movement is not yet understood in detail.

His lecture made it clear that thanks to new high-resolution sonar methods, such as multibeam sonar, it is possible today to analyze slope slide phenomena.

Of course, the situation in a river bed is only comparable in part with large scale slope slides. Weak locations and the trigger mechanisms of marine slope slides can only be really understood if the slopes are examined in detail and slope slides recorded live. Sebastian Krastel-Gudegast assumes that measuring instruments can be used to gather such data by directly inserting them into drill holes in the slopes. Pressure or acceleration sensors could log the slope slide motions. Presumably one would not have to wait long for a slope slide because, as we know, slope slides occur very often. The very large slope slide which triggers large tsunamis is fortunately only a millennium occurrence - and thus very rare.

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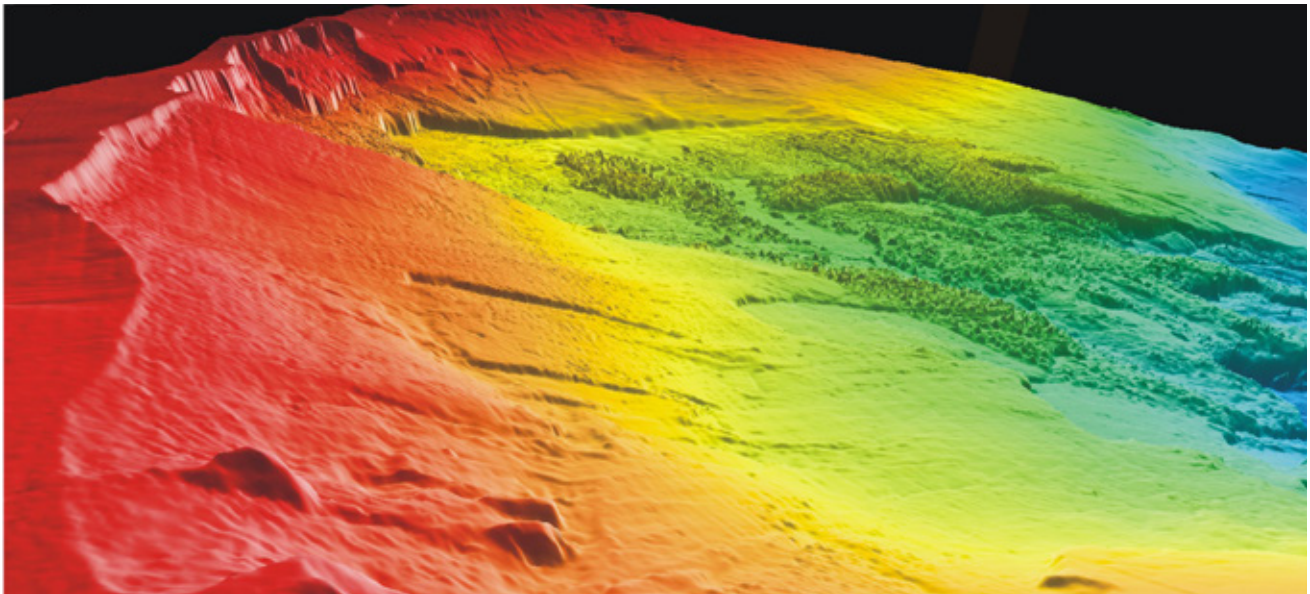
View from the north to the Storegga landslide some 50 miles off the coast of Norway which changed the Norwegian continental shelf over a distance of more than 300 km 8100 years ago.Graphics/Image: Christian Berndt, GEOMAR



Summer School "Coastal Hazards"

Within the framework of the Future Ocean semester topic "Dangerous Ocean", a one-week summer school took place in Kiel for PhD students and postdocs. Dramatic events from the recent past, such as the Sumatra tsunami in 2004, hurricane Katrina in 2005 or the earthquake and subsequent tsunami in Japan 2011, have shown that the ocean holds diverse and concrete threats to densely populated coastal zones. The reconstruction of different past catastrophic events using geological and geophysical methods confirms the scientists' perception that coastal zones have always been high-risk settlement areas. The summer school "Coastal Hazards" aimed at providing insights into modern strategies and scientific techniques. The five day course was shaped by various international lecturers with acknowledged expertise in their field. The course comprised lectures and practical work in the laboratory and in the field. It was attended by 23 students from ten countries among them Thailand, China, USA, Pakistan, Indonesia and others.

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Professor Karl Stattegger and Michael K. Orbach, Professor of the Practice Emeritus of Marine Policy, Duke Marine Lab, Beaufort (USA) informing students at the summer school.

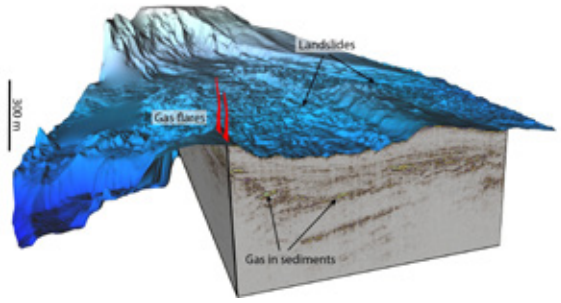
"Dangers from the Ocean – How Can We Handle the Risks and Prepare for Coastal Change?" – Public Lecture Series at Kiel University

Super storms, storm floods, global sea level rise, floods and tsunamis resulting from earthquakes in the ocean: Extreme marine disasters are becoming more frequent. They affect not only local residents but also the global community and the economy with its sensitive, near-coast industrial plants.

The damage done by these marine disasters is often much higher than predicted by classical risk analyses and is reaching new dimensions, especially in densely populated coastal areas, as shown by the Tohoku earthquake in Japan in March 2011. The public lecture series, organized by the Cluster of Excellence "The Future Ocean" highlighted current research issues covering the origin and the global consequences of natural hazards from the ocean, as well as possible adaptation strategies for the affected coastal states. Topics of the lectures were earthquakes at submarine plate boundaries, historical storm floods, volcanic eruptions and super storms. The focus was not solely on the Tohoku-Oki earthquake in Japan, but also the threat posed to the Canary Islands by slope failures and to Venice, the lagoon city, by sea level rise. Internationally renowned scientists such as Mojib Latif (GEOMAR), Jochen Zschau (German Research Centre for Geosciences GFZ) and Anselm Smolka (Munich Re) held inspiring lectures during this series. The lecture series introduced the Future Ocean semester topic focus on the "Dangerous Ocean", which concluded with the 6th International Symposium on Submarine Mass Movements and their Consequences. Here researchers from geosciences, economics and law along with coastal engineers examined threats from the ocean including the effects on the coasts and the resulting societal consequences.

In Fragile Balance

German-New Zealand research team discovers previously unknown methane deposits while studying unstable submarine slopes. Similar to landslides in the mountains, submarine landslides in the ocean form the continental margins and can also cause natural disasters such as tsunamis. The causes for landslides may be manifold and are being investigated around the world. The area off the east coast of New Zealand is particularly well known for such events. Slides with dimensions of up to 15 kilometers in length and 100 meters in thickness have been observed here.



3-D seismic image of the sea floor off the east coast of New Zealand. Clearly visible are large deposits of landslides, but also gas leaks and free gas in the sediment. Graphic image: Sebastian Krastel, University of Kiel

Scientists from Germany and New Zealand discovered surprisingly large gas hydrate and methane deposits while investigating the slopes on a multi-week expedition with the New Zealand research vessel RV Tangaroa. Scientists from Kiel University, Future Ocean and GEOMAR travelled to the other end of the world in April 2014 to investigate the causes of landslides off the east coast of New Zealand together with their New Zealand colleagues at the National Institute of Water and Atmospheric research (NIWA).

The scientists discovered clear signs of free gas in the sediment, as well as indications of large deposits of methane hydrate. The team identified a total of 99 natural gas leaks in an area of 50 square kilometers, from which gas bubbles rise up to 250 meters high in the water column. This is probably the densest concentration of gas openings on the ocean floor around New Zealand and differs greatly from resources previously known. So far such seeps have only been observed in deeper water and in the context of plate tectonic processes. The new sites, however, are located in very shallow water and at the edge of the continental slope.

With the help of the new 3-D seismic system, an accurate picture of the composition of individual layers of the sea floor could be drafted. This technology is currently the best for representing gas distributions, so-called fluid systems in the sea floor. The area that was investigated with the 3-D seismic survey is one of the largest surveyed so far. The preliminary findings suggest that optimal data material for researching the causes of landslides and the nature of instable slopes has been collected. These results are particularly interesting because methane hydrates dissolve when the temperature changes in the ocean and could thus destabilize continental slopes.

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Use of 3-D seismic system "P-Cable" on board of the New Zealand research vessel RV Tangaroa. Photo: Sebastian Krastel, University of Kiel

Coastal Change — Impacts and Challenges for Coastal Zones

The development and utilization of coastal zones, the areas at the transition between land and sea, has greatly increased during recent decades and coastal zones are undergoing tremendous socio-economic and environmental changes. In most regions, population growth and urbanization rates are significantly higher in coastal areas than in the non-coastal hinterland, driven by rapid economic growth and coastward migration - a trend which is expected to continue in future. Three recent publications pick up on these pressing issues.

Future projections suggest that the number of people in the low-elevation coastal zone (LECZ) – a widely accepted definition of the coastal zone for coastal exposure studies comprising all land adjacent to the sea below 10 m of elevation - is likely to exceed one billion people by 2060 and could even reach 1.4 billion. The number of people potentially exposed to 1-in-100 year coastal flood events could more than double in the same time span and reach 411 million people by 2060.

Population growth and urbanization in coastal areas increases pressure on coastal resources, including space and the natural environment, and results in greater exposure of people and assets to environmental risks. Additional pressure from climate change and related effects such as sea-level rise further exacerbate this exposure and result in a range of impacts, including coastal inundation and flooding; saltwater intrusion; loss of coastal

wetlands and coastal erosion. These multifaceted and complex effects and interactions challenge coastal systems and regions, affecting individuals, communities and the meta-level of environmental governance, and raise questions, such as: How do coastal systems respond to combined pressures from natural and anthropogenic forcings? What are the effects of coastal change? What should we prepare for in the future? How can we adapt to changing conditions and increasing risks and build resilient coastal communities? How can we manage the multiple problems affecting coastal zones and engage stakeholders in these processes? And how can we foster and monitor sustainable development of coastal zones?

Kiel Marine Science has a strong focus on interdisciplinary research, bringing together experts from the fields of marine sedimentology, coastal engineering, coastal impact, vulnerability and risk assessment, law, and economics, who conduct research on coastal systems, looking at physical and socio-economic processes.

Examples of interdisciplinary research include studies on the definition of maritime boundaries under changing baselines due to sea-level rise, a global assessment of future population change in the coastal zone taking into account different socio-economic and environmental scenarios, and contributions to the current debate about focussing one of the UN's Sustainable Development Goals on ocean and coasts. The latter example links adaptation to coastal change to the question of sustainable development and forward-looking coastal and ocean governance. Coastal societies and economies strongly interact both with coastal systems and the ocean. As many coastal and ocean pressures have land-based sources, planning for and monitoring of sustainable development of ocean and coasts, as discussed by Visbeck et al., 2014b, needs to take into account these interactions and linkages. Interdisciplinary research and collaboration is required to effectively define sustainability goals, set targets, select indicators and develop reliable scoring algorithms for implementation and monitoring (Visbeck et al., 2014a, Rickels et al., 2014).

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Coastal Risks and Sea-Level Rise Working Group,
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Photos: Barbara Neumann

Tetrapodes for coastal protection near Hörnum on the island of Sylt, German North Sea Coast

Across the Disciplines - Marine Science at Kiel University

In Autumn 2012 the Kiel University Board founded the institute Kiel Marine Science (KMS), Centre for all Interdisciplinary Marine Science. Since then, Kiel Marine Science has been the umbrella organization for the individually operating marine sciences research groups at Kiel University and combines the expertise of more than 70 researchers across the different faculties.

Kiel University has a long tradition in the marine sciences, in particular at the Institute for Geosciences which has several working groups in the research areas marine geochemistry and petrology, paleoclimate research and modelling, marine geophysics and coastal research. Moreover, over the past few years active interdisciplinary research has come into existence, which enjoys high recognition across different subjects and faculties, as well as beyond national boundaries.

Working groups from seven faculties of Kiel University are examining marine science research areas, among them fields such as computer science, economics, medicine and international law. The Faculty of Humanities is making an equally important contribution to the connection between humankind and the ocean.

Thus research is not only limited to strategies on how to use marine resources in a sustainable and responsible way or studies on marine hazards and risk factors, but strong emphasis is also put on the economic, legal and ethical impacts of this use of the ocean as a common property. In this and many other areas Kiel Marine Science have become a pioneer in the interdisciplinary presentation and transfer of knowledge from fundamental research to the development of models up to the implementation of management concepts, for example in the field of fisheries management. The aim is to further develop this cross-disciplinary research in the future, to foster and anchor it in an institutional framework. This framework is the Centre for Interdisciplinary Marine Science, Kiel Marine Science (KMS). Scientific partners of KMS support the research at Kiel University: the Research and Technology Centre (FTZ) in Büsum with its broad spectrum of research at the coasts of Northern Germany and in international projects, the Kiel Institute for the World Economy (IfW), the University Hospital (UKSH) or the Society for Marine Aquaculture (GMA) in Büsum. Furthermore, the members of KMS take part in major research projects with non-university partners, such as the GEOMAR Helmholtz Centre for Ocean Research Kiel.

The universities are at the "heart" of the science and research system in Germany. This is how the german Science Council has assessed the role of universities. They ensure the profound education of excellent early career scientists, they drive innovation and shape the societal life in the countryside and the city.
The same holds true for Kiel University, in particular in the field of marine sciences. Research and education in the field of marine sciences play an important role for the federal state of Schleswig-Holstein, have impacts beyond regional borders and are a driver for successful science and technology transfer.

We have ambitious plans for the coming years. The founding members of KMS, whose profiles you can find in this brochure, are aiming to expand marine sciences, a core research area at Kiel University, and to further develop its profile. Joint activities, for example in coastal research or in the establishment of an interdisciplinary network in aquaculture, are the first pillars of interdisciplinary ocean research in the broader sense and we are looking forward to new initiatives which will come to life in our Centre in the future.

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Kiel Marine Science

Kiel Marine Science, the Centre for Interdisciplinary Marine Science at the Christian-Albrechts-Universität zu Kiel, represents the university's marine and geoscientific research focus. Kiel Marine Science funds interdisciplinary studies of marine scientific topics from the past, present and future. The research network brings together activities of more than 25 research groups from 17 institutes. A particular focus lies in the exploration of risks and uses of the coastal zones. With their interdisciplinary research, the marine sciences at Kiel University contribute to the understanding of processes in the ocean and to the development of strategies for sustainable use and preservation of the ocean system. Colleagues from natural science work together with scientists from economics, medicine, law, engineering and IT on issues concerning the ocean's role in global change. Furthermore, marine scientists at Kiel University are connected through research and teaching with other university institutes such as the Research and Technology Center West in Büsum (FTZ Büsum), the Society for Marine Aquaculture (GMA) and the Gustav-Radbruch-Network for Philosophy and Ethics of the Environment. Close cooperation in research and education also exists between KMS and the GEOMAR Helmholtz-Centre for Ocean Research Kiel.

RESEARCH

I am just a child who has never grown up. I still keep asking these 'how' and 'why' questions. Occasionally, I find an answer.

Stephen Hawking

Seismogenic Faults, Landslides and Associated Tsunamis Offshore from Southern Italy

A new hydro-acoustic dataset was collected during RV Meteor Cruise M86/2 in order to investigate the geodynamic and tectonic setting of Mt. Etna's offshore eastern flank and other related submarine hazards. Especially on offshore Mt. Etna, the data reveals an obvious connection between subsurface structures and their surface expressions. Therefore, a 3-D seismic dataset was acquired next to a prominent amphitheater structure off eastern Sicily. In its central parts, the 3-D seismic volume hosts major ridge like features at the seafloor, dividing the funnel shaped sedimentary system of the Valle di Archirafi from the crest of the amphitheater, which is correlated to a local structural high.

The crest of this amphitheater is characterized by a "domino style" imbricated block system dipping towards the steep scar of the amphitheater. The Valle di Archirafi can be described as a depositional system, collecting sediments from the subaeral flank of Mt. Etna. The distinct boundary between this depositional System of the Valle di Archirafi and the structural high is characterized by the central NW striking ridge system, which is underlain by a positive "flower structure" of shallow dipping normal and thrust faults. This fault system is interpreted as a key tectonic feature controlling the morphological surface expressions of the structural high, the amphitheater structure as well as the depositional system of the Valle di Archirafi. These faults represent a right lateral oblique strike slip fault system, affecting the setting in a horizontal and vertical manner, leading to the complex seafloor morphology in the 3-D seismic working area.

Introduction

The entire geologic and geodynamic setting of the onshore and offshore eastern flank of Mt. Etna has been recently greatly discussed in literature (e.g. Pareschi et al. 2006; Chiocci et al. 2011; Argnani et al. 2012; Gross et al. 2014) as it controls the slope instability of Mt. Etna's eastern flank. General deformation patterns and indications for slope instability were mapped on offshore Mt. Etna (Chiocci et al. 2011; Argnani et al. 2012), which might contribute to submarine landslides in this area (Pareschi et al. 2006; Gross et al. 2014). The prominent amphitheater, observed in the central sector of Mt. Etna's eastern flank, and its typical morphological expression at the seafloor has been interpreted as the remnant of an ancient slope failure event (Chiocci et al. 2011).

Nevertheless, a lack of high-resolution seismic data in this area has made reliable constraints impossible. To contribute to solving this issue, a new dataset was acquired in a German-Italian Cooperation during RV Meteor-Cruise M86/2 from December 2011 – January 2012. A key purpose of this cruise was to acquire a new high-resolution 3D seismic volume directly next to the prominent amphitheater structure, observed offshore eastern Sicily using GEOMAR's P-Cable 3-D seismic system.

The central questions to be addressed by the new data set include:

- What are the prominent ridge-like features observed at the edge of the amphitheater structure?
- How do these features fit into the overall tectonic setting?
- Is there a connection between the amphitheater and these ridges?
- Can we establish a new model for Mt. Etna's flank instability?

Methods

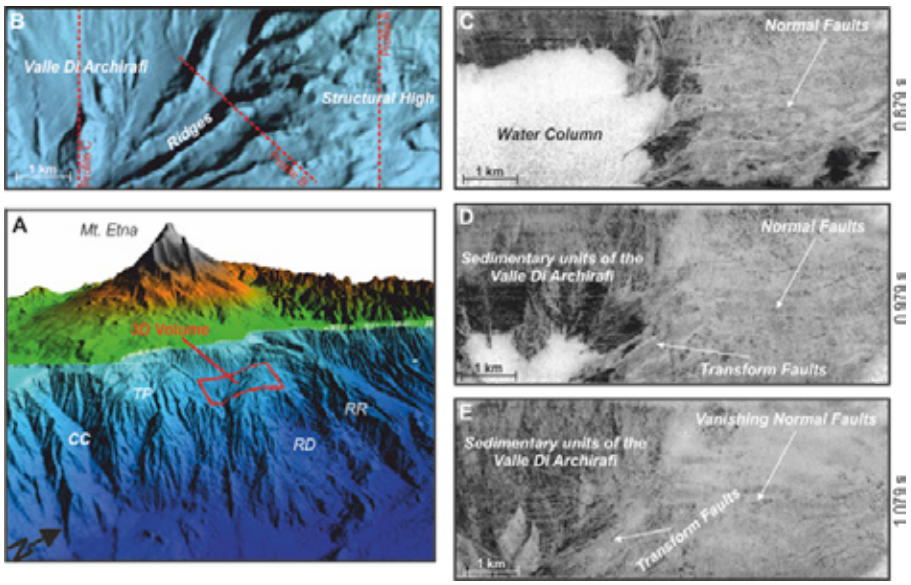
A variety of hydroacoustic and seismic data including 2-D / 3-D reflection seismic, multibeam swath bathymetry and PARASOUND echo sounder data were acquired during M86/2. All data were processed using specific software by a cooperation of staff from Kiel University and GEOMAR. Interpretation of all data has been carried out with the help of IHS Kingdom Suite.

Results & Discussion

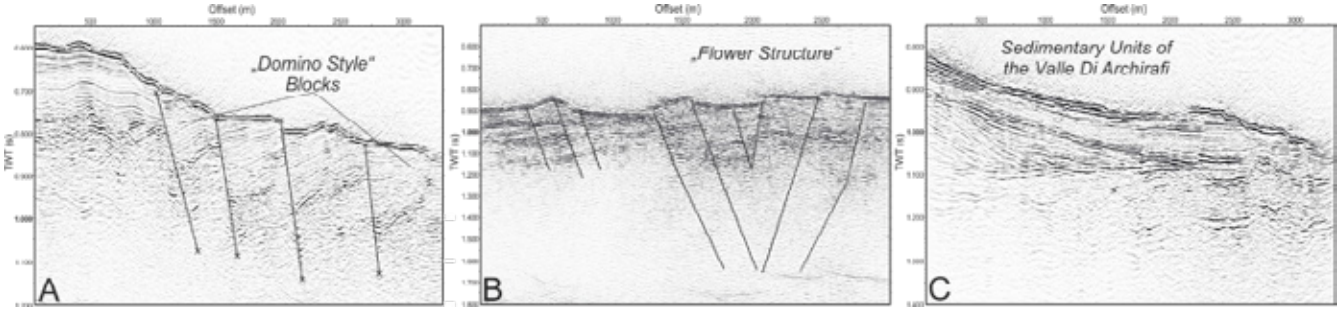
The seismic 3-D volume at the eastern flank off Mt. Etna can be divided into the southern regime with the funnel shaped Valle di Archirafi and the northern regime with the structural high, which is characterized by reworked ridges at the seafloor (Figure1).

Valle Di Archirafi hosts major sedimentary units, which are interlayered by high amplitude reflectors (Figure2). These units are associated with riverine sediments, as well as volcaniclastic material evacuated from the eastern flank of Mt. Etna. Especially debris generated during the Valle de Bove sector collapse (ca. 8000 yr B.P.), is imaged as a near surface, high amplitude reflector package in the dataset (Figure 2).

The northern region is dominated by relatively well-stratified sedimentary units, which are reworked by a fault system, dipping towards the scar of the amphitheater. These faults can be traced in accordance with the general trend of the northern reworked ridges exposed at the seafloor (Fig.1). In general, the entire fault system can be described as an imbrication of laminated segments. These laminated, well-stratified "blocks" exhibit an extensive deformation and rotation (Figure 2).



1 Overview on the survey area. Mt Etna is Europa's largest active volcano, located on top of continental crust. The area of collected 3-D seismic data is marked as a red box. CC=Catania Canyon, TP=Timpe Plateau, RD=Riposto Depression, RR=Riposto Ridge B) Bathymetric map of the 3-D seismic survey area. The 3-D volume can be divided into a Southern Part – the Valle Di Archirafi – and a Northern Part – The Structural High. The two settings are separated from each other by northward trending ridges. C-E) Similarity maps generated from the 3-D seismic volume at different depths including interpretation.



2 Profile across the structural high in the northern area of the 3-D seismic dataset. It hosts a major block system, with individual blocks being imbricated against each other. The individual blocks show a general dip towards the scar of the amphitheater. B) The central section of the 3D cube. Ridge-like features are the surface expression of a positive flower structure, which is an indication for transpressive strike slip movement in this area. This section illustrates the transition between the Northern and the Southern part of the 3-D data volume. C) Valle Di Archirafi and its sedimentary units. The data show prograding sequences, interlayered by chaotic seismic facies, which are interpreted as submarine mass movement deposits.Locations of profiles are shown on Fig. 1.

The structural high is separated from the Valle Di Archirafi (Figure 1) by a transpressive fault system (Figure 2). This fault system forms a positive flower structure, which is outcropping at the seafloor. Its surface expression form prominent north striking ridges, which are observed in the bathymetry. The boundary between the depositional system of the Valle Di Archirafi and the Structural High is a direct consequence of the right lateral oblique strike slip motion. Therefore, we suggest that the general morphology of the amphitheater (Figure1) is controlled by this fault system and is not merely the remnant of an ancient slope failure as proposed by Chiocci et al. (2011).

Outlook

Based on new insights derived from 3D and 2D seismic data, a new model for Mt. Etna's instable eastern flank will be proposed. Future work will concentrate on the hazard assessment in the area and the evaluation of different mechanisms contributing to slope instability and slope failures at Mt. Etna and volcano edifices.An overview has been published as "Evidence for submarine landslides offshore Mt. Etna, Sicily" (Gross et al. 2014).

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Project: CP1132
Project Team: Felix Gross
Research area: **R6** – Research Area Dangerous Ocean

Field Measurements of Surface Water pCO_2 and $\delta^{13}C(CO_2)$ in the North Atlantic Using Cavity Ringdown Spectroscopy and a Voluntary Observing Ship

The North Atlantic is an area with high biological productivity and a distinct seasonality. For several biogeochemical parameters such as the stable carbon isotope ratio, the seasonal cycle is still underdetermined. Our work during this project helps to fill this gap by installing a commercially available CRDS (Cavity Ringdown Spectroscopy) analyzer on a Voluntary Observing Ship (VOS) that sails across the subpolar North Atlantic between Europe and North America. Starting in May 2012 we have been able to obtain more than two years of good underway isotope ratio data. This dataset provides a good look into the seasonal variations in the carbon-13 budget which gives us the opportunity to get a new estimation of the carbon fluxes between surface ocean and atmosphere, biological matter und the underlying water masses.

Introduction

The North Atlantic Ocean plays a major role in climate change due to its importance in CO_2 uptake and thus natural carbon sequestration. The CO_2 concentration in its surface waters varies on seasonal and interannual timescales and is mainly driven by air-sea gas exchange and biological production/respiration. During the past 30 years substantial progress was made in observing the CO_2 variability in the surface ocean by using underway measurements onboard voluntary observing ships (VOS). But the understanding of the underlying processes is still afflicted with a high degree of uncertainty. Isotope measurements of dissolved CO_2 as a good tracer for mass flow between different reservoirs can help to improve quantification of these processes. The limitation of using isotope data lies in the significant effort involved in sample collection for the Isotope-ratio mass spectrometer (IRMS) analysis and the resulting scarce number of available data.

Research Questions

The main aim of this project was to obtain a full seasonal cycle of the stable carbon isotope signatures of dissolved inorganic carbon (DIC) in the surface ocean and to get a good estimation of the carbon fluxes inside the surface layer. Moreover, the applicability of CRDS for measurements onboard commercial vessels was to be assessed.

A Brief Explanation of the Applied Methods

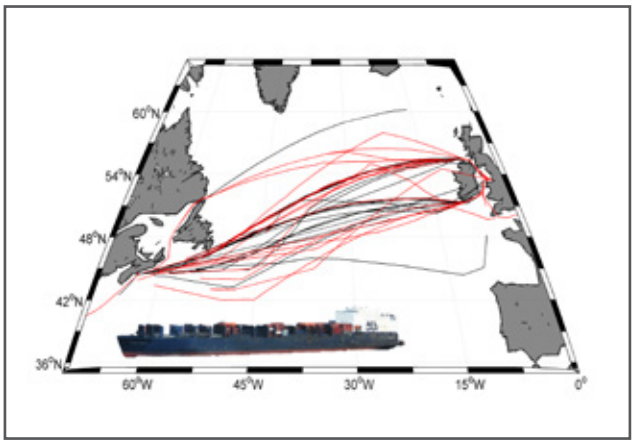
A commercial CRDS analyzer (G2131-i, Picarro, USA) was combined with a classical-equilibrator based pCO_2 system (GO/Neill system, Pierrot et al., 2009). Due to measuring the time constant of the intensity loss instead of measuring the intensity loss itself, the CRDS technology provides the possibility of highly precise determination pCO_2 and $\delta^{13}C(CO_2)$ determination. For measuring pCO_2 this instrument can reduce the calibration effort considerably compared to the common non-dispersive infrared analyzer (NDIR) method at improved data quality. In contrast to the common method for $\delta^{13}C(CO_2)$ determination, IRMS, it is possible to install the CRDS analyzer onboard a ship which provides the possibility of data with a higher spatial, and temporal resolution.

Preliminary Results

The CRDS and NDIR measurements of pCO_2 show a good match. Due to different calibration procedures of both methods, they show a final offset of less than 0.5 µatm. An offset-plot shows small spikes that are visible only at sharp concentration gradients. These spikes are an artefact of the longer gas line to the CRDS analyzer and different sampling rates. This good agreement combined with a much reduced calibration effort makes the CRDS analyzer capable of replacing the common NDIR method.

For $\delta^{13}C(DIC)$ measurements we have good data from 27 trans-Atlantic crossings from 2012 to 2014 (Fig. 2). Unfortunately, we encountered a few problems with the system in late summer 2012 and 2013. Therefore, most of the data fall into the period between March and July. Here a trend is visible with minimum values in late winter and spring, whereas high primary production causes increasing isotope values during summer with a maximum in late summer.

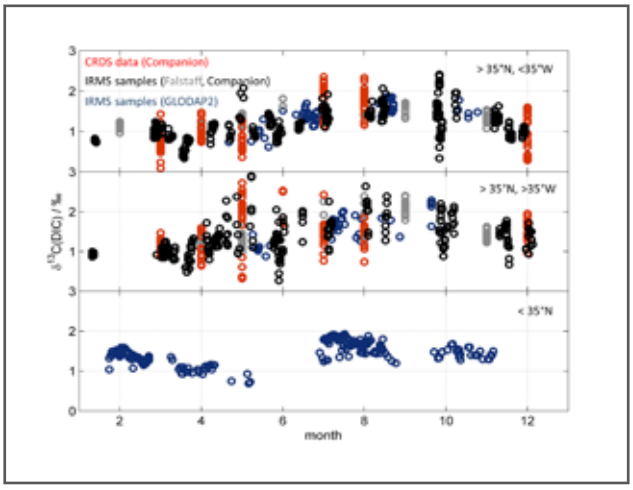
This seasonality is similar to that detected by discrete IRMS samples. In order to get a good overview of the existing $\delta^{13}C(DIC)$ dataset in the North Atlantic the existing GLODAP2 dataset was combined with major data holdings from earlier research cruises and data from the VOS line merchant vessel Falstaff and Atlantic Companion. After making this dataset internally consistent by a systematic crossover analysis and subsequent corrections following internally developed and accepted protocols and tools (Tanhua et al., 2010) a clear seasonality is visible. This seasonality was divided into a northeastern, a northwestern and a southern part and then compared to the CRDS data (see Fig. 3). The northeastern part of the dataset shows a much more pronounced seasonality than the southern and the northwestern part.



1 Cruise tracks of M/V Atlantic Companion measuring underway pCO_2 (black and red) and $\delta^{13}C(CO_2)$ (red).

Outlook

In order to look into the seasonal dynamics of the upper ocean cycle of the subpolar North Atlantic and to also separate its physical and biological drivers, the seasonal cycle of $\delta^{13}C(CO_2)$ will be divided into time periods in which one of the main processes (e.g. air-sea gas exchange, primary production, respiration) is the determinant influence on the inorganic carbon pool. By knowing the isotopic composition of the respective carbon source or sink (atmosphere, organic matter/POM) a budget for the surface ocean inorganic carbon will be determined. Moreover, the seasonality of $\delta^{13}C(CO_2)$ will be compared to the seasonal variations in the other parameter that are measured onboard (continuous underway data of pCO_2, $\delta^{13}C(CO_2)$, and CH_4 as well as discrete samples of TOC/TN, POC/PON, $PO^{13}C$, Chl a, nutrients, DIC/TA, $H_2{}^{18}O$.



3 Seasonal cycle of $\delta^{13}C(DIC)$ data calculated from CRDS d13C(CO2) data (red) and from discrete samples taken on the VOS line merchant vessel Falstaff (gray) and Atlantic Companion (black) and from the GLODAP2 dataset (blue).

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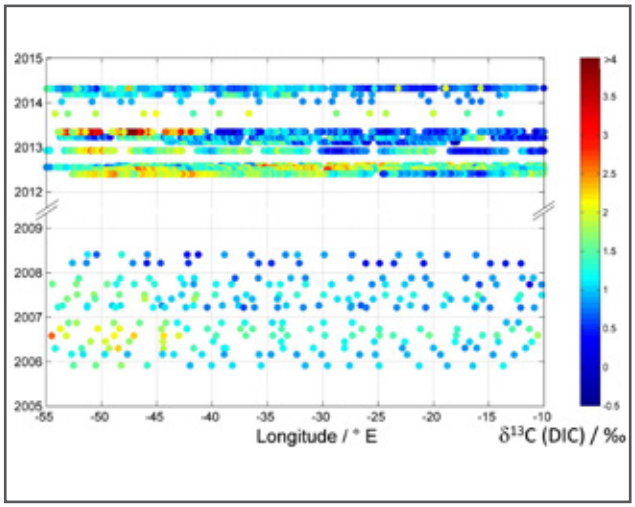


2 Longitude-time distribution of the $\delta^{13}C(DIC)$ data measured by CRDS (2012 - 2014) and IRMS (2005-2007).

Project: CP1140

Project Team: Meike Becker, Gernot Friedrichs, Arne Körtzinger

Research area: **R10 Ocean Observation**

Potential Fate of Microplastics in the Marine Water Column

Plastic pollution of the oceans has resulted in a pronounced accumulation of small plastic particles with a size below five millimetres, so-called microplastics, in the marine environment. Despite the abundance of these microplastics, no information about their interactions with biogenic particles in the water column is available. In the present research project interactions between microplastics and biogenic particles, microorganisms and copepods in the marine water column and their potential influence on the export of microplastics from surface ocean waters are studied. The first results indicate that microplastics are rapidly colonised by bacteria and single-celled algae and strongly interact with biogenic particles resulting in the formation of relatively large aggregates.

Introduction

In the last decades nearly all marine ecosystems and biotopes worldwide, including those in very remote ocean areas, have been polluted with plastic. Among the plastic particles and debris found, so-called microplastics are most abundant. Microplastics are smaller than five millimetres and originate from industrial discharge of plastic granulates and pellets or from degradation of larger plastic litter due to weathering and mechanical forces. Today, microplastics are ubiquitous in the marine environment making it very likely that the organisms and biological processes in the ecosystems and biotopes are affected by these plastic particles. Relatively much knowledge of the concentrations of microplastics in pelagic ocean areas exists, and field and experimental studies have demonstrated that microplastics are ingested by pelagic organisms. However, to the best of our knowledge, no information about interactions between microplastics and biogenic particles in the water column is available. The present research project hypothesises that such interactions considerably influence the fate of the microplastics and the dynamics of the biogenic particles in the marine water column. To test this hypothesis the project work addresses the following main research questions: ***1*** – Do microplastics aggregate? ***2*** – Are microplastics involved in the aggregation processes of biogenic particles? ***3*** – Do biofilms form on the surface of microplastics? ***4*** – Does biofilm formation on the surface of microplastics increase the stickiness and thereby the aggregation potential of microplastics? ***5*** – Does aggregation of microplastics and biogenic particles influence the sinking rates and the residence times of microplastics in the water column? In addition, this project aims at increasing the knowledge of the ingestion of microplastics by copepods.

Applied methods

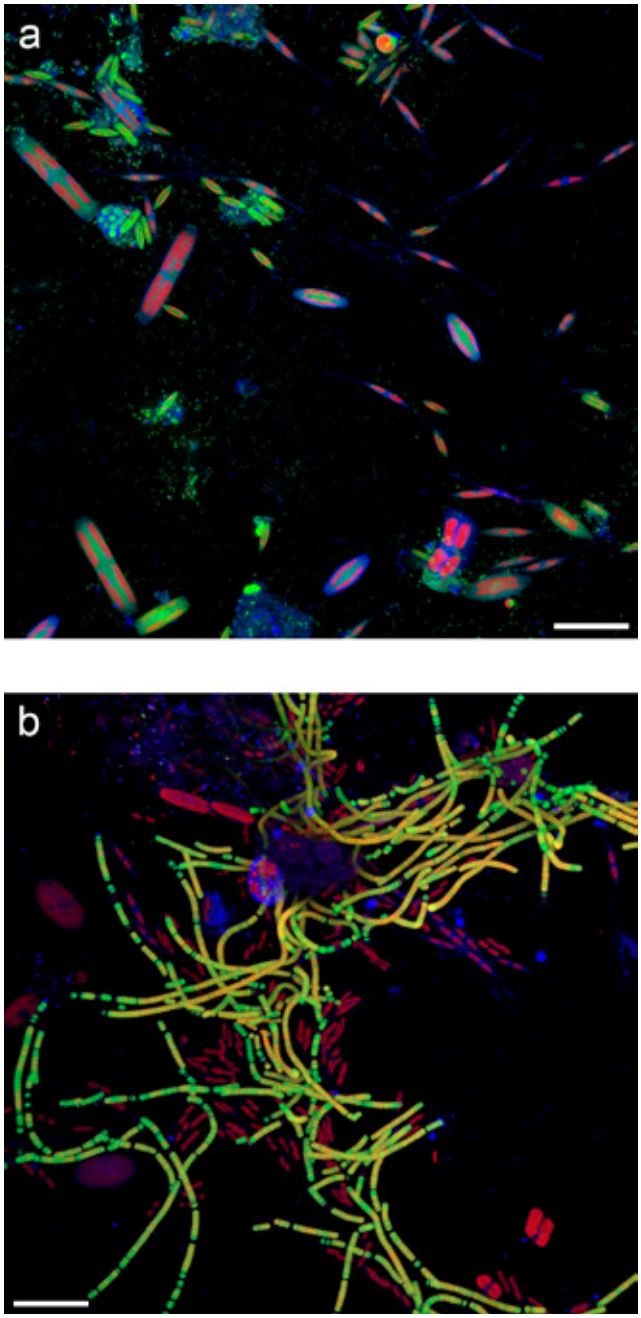
Different types of plastics were exposed to seawater from the Kiel Fjord, and the biofilm formation on the plastics was studied with confocal laser scanning microscopy (CLSM). In this context, the structure and the composition of the biofilms were visualized using autofluorescences and specific fluorescence dyes and markers. The respective staining and visualization methods had been tested and proved to be successful before the experiments started.

Seawater samples from the Kiel Fjord were incubated in roller tanks together with industrial polystyrene beads. (Polystyrene is one of the plastics that are commonly found in the marine environment.).As controls, seawater samples without polystyrene beads, filtered seawater with polystyrene beads and artificial seawater with polystyrene beads were incubated. At the end of the experiments the number of polystyrene beads included in aggregates and the number and size of the aggregates were determined. In addition, the biofilm formation on the surface of the polystyrene beads was analysed with CLSM.

Preliminary Results

Biofilm formation took place on all types of plastics exposed to seawater in the Kiel Fjord. Bacteria and single-celled algae, mainly diatoms, rapidly colonised the plastics, and subsequently in part pronounced matrices of extracellular polymeric substances developed – *Figure 1*.

In the roller tank experiments the polystyrene beads formed relatively large aggregates together with the biogenic particles and were covered by biofilms at the end of the experiments. The particle aggregation in the presence of the polystyrene beads was faster and more pronounced compared with that observed between biogenic particles only. No aggregate formation took place in the tanks with polystyrene beads and either filtered seawater or artificial seawater. The results clearly indicate that microplastics interact with microorganisms and biogenic particles and are strongly involved in the natural particle aggregation processes in the water column.



1 Confocal laser scanning micrographs showing biofilms that formed within eight (a) and twelve (b) days on polystyrene plates exposed to seawater in the Kiel Fjord in summer. Red = chlorophyll-containing structures, green = DNA-containing structures, blue = polysaccharide-containing structures. Scale bars = 30 µm.

Outlook

In a series of scheduled experiments the aggregation of microplastics with biogenic particles will be studied in further detail. The focus will be on the still open research questions whether the biofilm formation on the surface of the microplastics influences the aggregation behaviour of the microplastics and whether the aggregation of microplastics with biogenic particles has an impact on the export of microplastics from the surface layer of the oceans. To answer these questions, microplastics will be exposed to seawater for defined time periods before the experiments, and then the stickiness and the aggregation potential of the microplastics as a function of the degree of biofilm formation on the surface of the microplastics will be evaluated. In addition, the sinking rates of aggregates composed of biogenic particles and microplastics will be compared with those of aggregates consisting of biogenic particles only and those of single microplastics. Further experiments will analyse the ingestion and egestion of microplastics by copepods to gain knowledge of the potential influence of these processes on the fate of microplastics in the water column.
In a final step, the results will be incorporated into a particle aggregation model and a size-based plankton model estimating (1) vertical settling velocities of microplastics for a range of detritus concentrations and (2) residence times of microplastics in surface waters under typical oceanic conditions.

Project: CP1350
Project Team: Jan Michels (GEOMAR), Kai Wirtz (HZG)
Research area: **R8 Evolving Ocean**

The Role of Intermediate Water Variability in the Caribbean and Gulf of Mexico in Deglacial Climate Change

The oceans response at intermediate depth to abrupt climate cooling phases during the last deglaciation, namely the Younger Dryas and Heinrich 1 Event, has been a focus of several recent studies (e.g. Pahnke et al., 2008; Huang et al., 2014; Xie et al., 2014; Gebbie et al., 2014). Nonetheless, the intermediate water dynamics across the last deglaciation remain controversial. This study reveals new information of the water mass geometry during the past 35 kyr BP using a benthic/planktonic multiproxy approach on downcore records from the Caribbean and Gulf of Mexico.

We analyse calcitic tests of benthic/planktonic foraminifera (protista) from various intermediate depth locations for Mg/Ca, Cd_w, $\delta^{18}O_{sw}$, $\delta^{13}C$ and εNd in order to improve our understanding of the intermediate water mass distribution and variability between 400 and 1000m water depth on millennial timescales. We here present results from paleo-salinity ($\delta^{18}O_{sw}$), temperature (Mg/Ca) and nutrient distribution (Cd_w), documenting the southward penetration of Glacial North Atlantic Intermediate Water (GNAIW) replacing the North Atlantic Deep Water (NADW) during the Last Glacial Maximum (LGM). Furthermore our data indicate a gradual shift from GNAIW influenced conditions during the LGM to Antarctic Intermediate Water (AAIW) dominated conditions throughout the Holocene and today.

Introduction

The Atlantic Meridional Overturning Circulation (AMOC) is characterized by two major branches. The surface branch brings warm, saline water masses via the Gulf Stream into the north, while the subsurface branch carries cold water back into the Southern Ocean. As the Caribbean and the Gulf of Mexico (GoM) are the sourceregion of the warm, saline waters travelling northward, and are coevally affected by both northern and southern intermediate water masses, they are ideal locations to reconstruct past AMOC changes in relation to climate change.

Research questions

In this study we aim to reconstruct intermediate water mass changes in response to weakened or enhanced AMOC during the last deglacial period with a focus on abrupt cooling events, namely the Younger Dryas (YD, 12.9-11.7 ka BP, Blockley et al., 2012) and Heinrich 1 Event (H1, 18-15.5 ka BP, Bard et al., 2000). Previous studies are contradictory as to whether the Antarctic Intermediate Water has migrated far to the north during time intervals of reduced AMOC (Pahnke et al., 2008, Pena et al., 2013) or whether its northward migration has been reduced (Came et al., 2008; Xie et al., 2012; Huang et al., 2014). We intend to reconstruct the vertical and lateral expansion/dilatation and interdynamics of the AAIW and GNAIW/ NADW during the transition from the Last Glacial Maximum to the Holocene, at the highest temporal resolution and by applying a suite of complementary isotope (geochemical) proxies.

Approach

Overall, we focus on six sediment cores from the Caribbean and the Gulf of Mexico, retrieved from intermediate water depths between ~700 and ~1350 m – Figure 1a and 1b. By deciphering the (isotope) geochemical signature of benthic foraminifers, we are able to reconstruct intermediate water mass temperature (Mg/Ca, Mg/Li), salinity (which is approximated from the reconstructed, ice-volume- and temperature-corrected stable oxygen isotope of seawater, $\delta^{18}O_{ivf\text{-}sw}$), nutrient distribution (Cd_w,), intermediate water ventilation (stable carbon isotopes $\delta^{13}C$) and potential source area change (εNd) at millennial timescales. So far, we have accomplished ~650 Quadrupole ICP-MS measurements (Cd/Ca, Mg/Ca, Mg/Li), ~1000 Finnigan MAT253 measurements (stable isotopes, $\delta^{18}O$, $\delta^{13}C$), and 10 Nu Plasma MC ICP-MS measurements (εNd).

Results

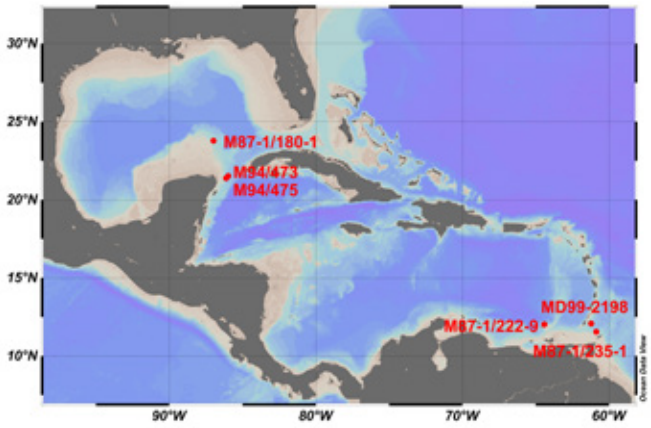
Preliminary results of benthic Cdw measured on the benthic foraminifera Uvigerina peregrina from core M78-1/235-1 from 852 m water depth and core MD99-2198 from 1330 m water depth point to a pronounced two-step shift between the Last Glacial Maximum (LGM) and the Holocene with low nutrient conditions before 21 ka BP, followed by a gradual increase towards high nutrient conditions after 11 ka BP. While the benthic Cdw do not show distinguished changes during the abrupt cold phases, our oxygen isotope data indicate major shifts towards lighter values during both the YD and H1. The Mg/Ca-derived temperatures for the intermediate water depth show no major change apart from small-scale fluctuations close to the error of temperature estimation. These preliminary results point to a gradual shift from GNAIW-dominated conditions at intermediate water depth during the LGM, to more AAIW influenced conditions throughout the Holocene.

The discrepancy between $\delta^{18}O$ and Cdw may be caused by two possible reasons: On the one hand, we do not have the same data resolution in both datasets. Especially for the YD and H1, the Cdw records are incomplete. Therefore we resampled the sediment cores and gained high resolution samples for every cm during these intervals. These samples are currently in preparation. On the other hand, this contradiction may also be caused by the interaction of two water masses other than AAIW/NADW. Especially the influence of Glacial North Atlantic Intermediate Water (GNAIW), which is supposed to have replaced NADW during glacial times with weak AMOC, is under discussion. Gutjahr et al. (2008) proposed more radiogenic εNd values (-9,7) during the LGM compared to NADW today (-13 to -14). Hence, the radiogenic difference between AAIW and GNAIW would be too small to distinguish between those two water masses using only εNd. Using a multiproxy approach, we will be able to distinguish exactly between Southern Source Waters (SCW) and Northern Source Waters (NCW), at least with our high resolution time series in YD and H1.

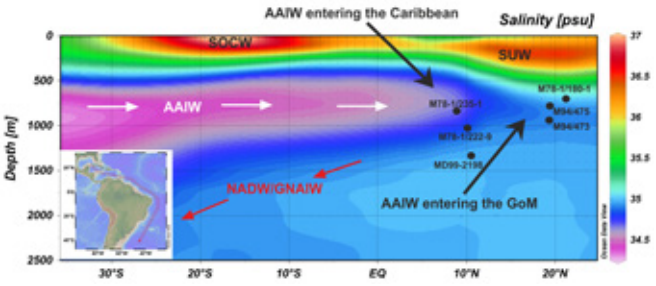
Outlook

Measurements of stable oxygen and carbon isotopes ($\delta^{18}O$, $\delta^{13}C$), element/Ca-ratios (e.g., Mg, Sr, Fe, Mn, Li), and εNd during YD and H1 are currently in progress to increase the temporal resolution of our proxy records. The additional εNd measurements will take place at the University of Oldenburg in collaboration with Dr. Katharina Pahnke.

Project: CP1142
Project Team: David-Willem Poggemann, Dirk Nürnberg, Martin Frank, Ed Hathorne
Research area: **R9 Ocean Controls**



1a Bathymetric map of Gulf of Mexico and Caribbean, indicating the core locations analysed in this study (red dots and labels).



1b S-N trending salinity profile from ~40°S to ~25°N indicating positions of sediment cores analysed in this study and water masses in the Caribbean and Gulf of Mexico: Antarctic Intermediate Water (AAIW), North Atlantic Deep Water (NADW), Glacial Northatlantic Intermediate Water (GNAIW), Subtropical Underwater (SUW), Southern Ocean Central Water (SOCW). Sediment cores are indicated at the correspondent water depths.

Production and Emission of Climate-Relevant Gases in Organic-Rich Sediments

Methane (CH_4) and nitrous oxide (N_2O) are potent greenhouse gases that are approximately 25 and 300 times more effective in trapping heat, respectively, than carbon dioxide (CO_2). Microbial processes in marine sediments have been studied intensively, showing production of CH_4 and N_2O during anaerobic microbial respiration (methanogenesis and denitrification, respectively; Cicerone and Oremland, 1988; Seitzinger et al, 1980). However, the contribution of sediments to the atmospheric CH_4 and N_2O pool is still unknown. Especially in areas featuring hypoxia (O_2 conc. < 63 µM) or oxygen minimum zones (OMZ, O_2 conc. < 22µM) anaerobic microbial processes can be more dominant in surface sediments (Cicerone and Oremland, 1988), which can have an effect on CH_4 and N_2O emissions from the sediment (Naviq et al, 2010).

In the present study, benthic production of these gases was evaluated in marine organic-rich sediments at three different sites (Gulf of Mexico, Pacific coast off Peru, Southwestern Baltic Sea), of which the last two feature very low oxygen concentrations in the water column. The site off Peru was inside an OMZ and the time-series station in the Southwestern Baltic Sea featured seasonal hypoxia. The focus of this study was set on shallow sediment layers to predict potential gas emissions into the water column.

Research questions

Core questions of this study are:

- What is the distribution of CH4 and N2O in the surface sediment and the water column?
- What is the production rate of CH4 and N2O in marine, organic-rich surface sediments?
- Are there relevant gas fluxes from the sediment to the water column due to greenhouse gas production?
- Do production and emission rates of CH4 and N2O show any seasonal or spatial variations?

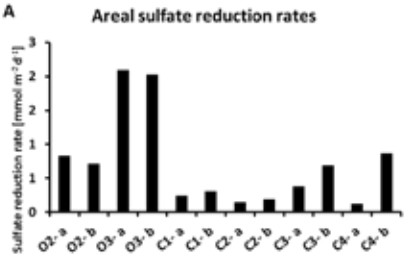
Results & discussion

1. Site: Gulf of Mexico — In collaboration with Prof. Samantha Joye at the University of Georgia, research on denitrification and sulfate reduction rates in sediments from the Gulf of Mexico (GOM) was conducted during April-July 2012. Due to the high abundance of natural oil seeps in the GOM, the microbial community is likely to be better adapted to oil than anywhere else (Atlas and Hazen, 2011). It is thus interesting to study the effect of oil degradation on biogeochemical processes in the sediment.

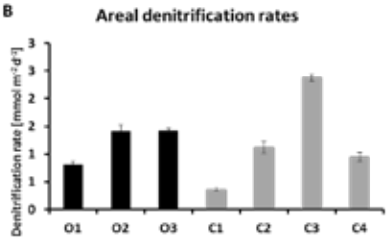
Results (Figure 1) showed higher sulfate reduction rates at three oily sites but higher denitrification rates and N_2O porewater concentrations at the four control sites, leading to the assumption that denitrification at the oily sites was inhibited by either the oil itself or by the high sulfate reduction rates. Although a potential of N_2O production coupled to denitrification was confirmed for the control sites, more research in this field is recommended.

2. Site: Oxygen Minimum Zone off Peru-East Pacific — Samples were taken along a depth transect (70 - 1000 m water depth) in the OMZ off Peru (Meteor cruise M92, SFB754) in January 2013. The Peruvian OMZ is one of the shallowest and most intense OMZs and shows high N_2O accumulation in the water column (Farias et al, 2009). Due to the pronounced anoxic conditions, anaerobic processes (including denitrification and methanogenesis) are favored in sediments. Thus, produced gases like N_2O or CH_4 potentially diffuse more easily into the water column.

Rates of methanogenesis (CH_4 production) and denitrification were determined in surface sediments (top 40 cm). Methanogenesis was measured by the increase in headspace CH_4-concentration over time and denitrification was measured with the acetylene-inhibition method after addition of either 20 µM or 500 µM nitrate. Low but distinct methanogenesis activity was detected in OMZ surface sediments (data not shown) irrespective of the presence of sulfate (~ 28 mM), even though this process is thought to be mainly exclusive from the sulfate-reducing zone (Martens & Berner, 1974). However, methane profiles and incubations with radio-labeled substrate revealed methanogenesis activity at sediment depths > 300 cm, suggesting that the majority of methane is produced in deeper sediment layers bellow the sulfate reduction zone. Potential denitrification actvity was found in most surface sediments along

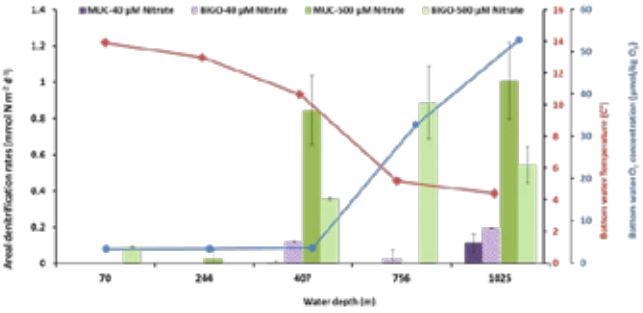


1a Areal sulfate reduction rates integrated over 0-25 cm sediment depth in oily (O1-O3) and control sites (C1-C4), shown in duplicates (a, b).



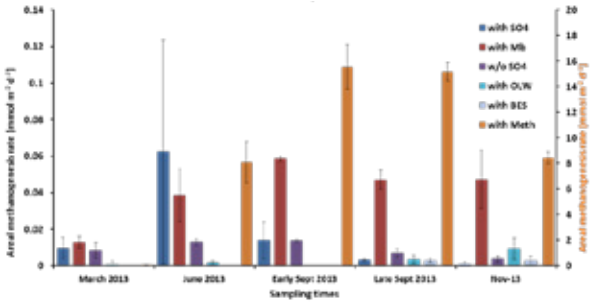
1b Mean (n = 3) areal denitrification rates integrated over 0-5 cm sediment depth. Error bars = standard deviation.

Potential areal denitrification rates



2 Peruvian OMZ study: Potential areal denitrification rates (integrated over 0-2 cm sediment depth) in multicorer sediment cores (MUC) and in sediment cores taken from a lander system (BIGO) along a depth transect at 12° S. Shown in mean (n=3) with standard deviation. Denitrification rates were determined applying two different nitrate concentrations (40 and 500 µM). Bottom water temperature at the respective depths is plotted in red, bottom water O2 concentration is plotted in blue.

Areal methanogenesis rates



3 Eckernförde Bay study: Areal methanogenesis rates integrated over 0-3 cm sediment.depth Note that rates after methanol addition (orange bars) corresponds to the right orange y-axis. Treatments of the experiments were as follows (see legend for color coding): 1) with sulfate (SO4), 2) with molybdate (Mb, inhibitor of sulfate reduction), 3) w/o sulfate (SO4), 4) with over-laying water (OLW), 5) with 2-bromoethane-sulfonate (BES, inhibitor of methanogenesis) 6) with Methanol (Meth)

the OMZ depth transect (Figure 2). However, denitrification was mainly detected in samples with the addition of a high nitrate pool (500 mM), while 40µM nitrate resulted in only a weak or no signal. Potential denitrification rates were found to be higher outside the OMZ, where nitrate-storing sulfur bacteria (Thioploca) were absent, pointing to a potential competition between nitrate reducers. Stable isotope experiments revealed no indication of denitrification after 40 µM ^{15}N- nitrate addition. We therefore postulate a competition between the sulfur bacteria Thioploca and common denitrifiers, where Thioploca has an advantage due to a faster nitrate-uptake and storage rate compared to denitrifiers. Hence, in the presence of Thioploca rather the production of ammonium via dissimilatory nitrate reduction to ammonium (DNRA) than denitrification is fueled by nitrate.

3. Site: Eckernförde Bay-Southwestern Baltic Sea — Seasonal sampling at the time series station Boknis Eck in the Eckernförde Bay (Southwestern Baltic Sea, Bange et al, 2011) was conducted in 2013 on board F.S. Littorina and F.B. Polarfuchs and will be continued in 2014. The characteristic of this station is the seasonal development of hypoxia and thus the possibility to study biogeochemical processes sensitive to dissolved oxygen (Bange et al, 2011). Methanogenesis activity was detected in surface sediments (< 30 cm depth) throughout the year and was stimulated further after the addition of methanol (Oremland & Polcin, 1982) (Figure 3). Treatments with the addition of molybdate (an inhibitor of sulfate reduction) prompted in an increase in methane production. In summary, the results suggest that methanogens are probably outcompeted by sulfate reducers concerning the competitive substrates (hydrogen and/or acetate), but that the observed methanogenesis activity is coupled to non-competitive substrates such as methanol. However, experiments with radio-labeled bicarbonate demonstrated low methanogenesis activity in the surface sediments, showing that methanogens and sulfate reducers might coexist (e.g. in micro-niches) in Eckernförde Bay-surface sediments. Highest CH_4 emission rates from the sediment into the water column were detected in November 2013, which coincided with the highest measured methanogenesis rate with deep water addition. Interestingly, methanogenesis rates with methanol addition showed the highest peak in early September 2013, which might be a hint that the community composition of methanogens shifts seasonally.

Outlook

In 2014, sampling will continue at Boknis Eck until September to focus on experiments with stable isotope probing to investigate potential N_2O production during denitrification (addition of ^{15}N-nitrate) and to further follow methane production from methanol (addition of ^{13}C-methanol).

In addition, molecular analysis are starting in collaboration with Prof. Ruth Schmitz-Streit (Microbiology department of the University Kiel), to detect the functional genes for denitrification and methanogenesis via qPCR (qualitative polymerase chain reaction) in surface sediments from Eckernförde Bay.

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Project: CP1133

Project Team: Johanna Maltby, Tina Treude with Samantha Joye (University of Georgia), Herrmann Bange, Mark Schmidt, Ruth Schmitz-Streit, Stefan Sommer.

Research area: R7-Ocean Interfaces

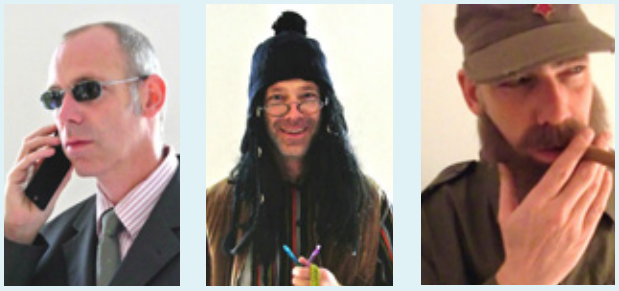
Successful, and Commonly Accepted Fisheries Management Needs Economics

Modern resource management faces trade-offs in the provision of various ecosystem goods and services to humanity. For fisheries management to develop into an ecosystem-based approach, the goal is not only to maximize economic profits, but to consider equally important conservation and social equity goals (Figure 1). We introduced such a triple-bottom line approach to the management of multi-species fisheries.

We applied a coupled ecological-economic optimization model to address the actual fisheries management challenge of trading-off the recovery of collapsed cod stocks versus the health of ecologically important forage fish populations. Our Baltic case study shows a practical example of how an ecosystem-based fisheries management will be able to offer society options to solve common conflicts between different resource uses. Approaches like ours, adding equity considerations to the traditional trade-off between economy and ecology, will greatly enhance credibility and hence compliance to management decisions, a further footstep towards healthy fish stocks and sustainable fisheries in the world ocean.

Furthermore, we addressed the influence of drivers of global change on fisheries management. Ocean acidification (OA) is one important element of future climate change, influencing the worlds' marine ecosystems. Coastal fisheries in high latitudes might be heavily affected due to a predicted strong decrease in ocean pH in these regions. The ecological, economic and social consequences of OA need to be quantified case-by-case, to form the basis for informed discussions between experts, politicians, and the general public. For the first time, we quantified the costs of OA for a mass spawning, commercially important fishery. Using a novel bio-economic modeling approach, we provided evidence for the need of adapting fisheries management under increasing OA, and investigated trade-offs between social, ecological and economic objectives. Such trade-offs are shown to amplify under increasing OA, imposing further challenges on management of small-scale coastal fisheries.

MMSY: Trade-offs in fisheries managment?



Profit | Conservation | Equity?

1 Managers must be able to wear different hats in order to achieve sustainability in multi-species fisheries.

Introduction

The legal basis for fisheries management is the ecosystem approach to fisheries management, (EAFM) as laid out by the United Nations Convention on the Law of the Sea. The EAFM requires equal considerations of social, economic and ecological factors, i.e. sustainable use of the resource according to the Brundlandt report. The advice for decision makers thus needs to be based on sound science including all aspects and visualize potential trade-offs explicitly. Such approaches, adding equity considerations to the traditional trade-off between economy and ecology, will greatly enhance credibility and hence compliance to management decisions, a further footstep towards healthy fish stocks and sustainable fisheries in the world ocean.

A central issue in ecosystem-based management (EBM) is to identify potential trade-offs among multiple ecosystem goods and services. Although the science underlying EBM is well developed, in particular regarding evaluation of trade-offs, and concepts for cross-sectorial approaches exist, implementation is largely lacking. This is exemplified by fisheries management that in many parts of the world, and the European Union (EU) in particular, is still conducted on a species-by-species basis, ignoring a wealth of studies showing the importance of direct and indirect species interactions in marine food webs. Furthermore, existing social-ecological knowledge and ecological-economic modeling are often disregarded during the decision making process, despite fisheries being a profoundly social and economic enterprise.

The challenge of EBM lies in balancing a number of potentially conflicting interests related to resource use, their equitable distribution and conservation. Such "triple-bottom line" solutions are commonly seen as the ideal outcome of conservation and management. However, while conservation planning is now beginning to consider equity, issues of socio-economic equity have not been adequately addressed in fishery management plans. This is unfortunate, because management that fails to consider the fair distribution of benefits that ecosystems provide, e.g. equity in allocation of fishing rights, causes low acceptance and compliance and ultimately overfishing through illegal, unregulated and unreported (IUU) fishing. Successful fisheries management will also have to address additional stress factors arising from global climate change.

Research questions

During the first year of the project, we focused on **(i)** multi-species and multi-user aspects as well as **(ii)** climate change effects on sustainable fisheries management.

(i) Using a coupled ecological-economic optimization model

framework we first derived the profit maximizing management solution for a multi-species fishery, using the Baltic cod-herring-sprat system as a case study. Then, we explored two different management approaches for protecting the sprat stock for its ecological value, one based on profit maximization only, and an alternative considering equity between demersal and pelagic fishing sectors.

(ii) We used an ecological-economic model to determine the effect of increasing CO_2 levels on optimal management of Norwegian coastal cod. We determine trade-offs between different management objectives, i.e. changes in harvest (as relevant for consumers), stock size (ecology), profits (capital holder), as well as fishing effort (a proxy for employment possibilities).

Methods

(i) We developed and applied a combined three-species, age-structured ecological-economic model. The age-structured multi-species population dynamics are described as in standard fisheries stock assessment.

Data and estimation of model parameters are mainly based on International Council for the Exploration of the Sea (ICES) stock assessment data (ecological data) and the Scientific, Technical and Economic Committee for Fisheries (STECF) of the European Commission (economic data). The model incorporates the effects of the discount factor, the representative fisherman's aversion against intertemporal income fluctuations, the social aversion against inequality of incomes for the three different fisheries, the non-market benefits derived from ecosystem services provided by the sprat spawning stock. We use the widely recognized Gini coefficient that is often used in empirical work to describe equity in the distribution of profits between fisheries, i.e. between the cod, herring and sprat fisheries.

(ii) Considering the potential impact of ocean acidification on fisheries requires scaling from physiological responses to population- and ecosystem-level processes.

A simple way to do so is to modify the parameters of growth, mortality and reproduction in a single-species model. Here we concentrated on the modification of the parameters of the stock-recruitment relationship to be used in an ecological-economic optimization model.

Results

(i) We show that cod recovery strategies based on profit maximization may cause the risk of stock collapse for forage species with low market value, such as Baltic sprat. Economically efficient conservation efforts to protect sprat would be borne exclusively by the forage fishery, challenging resource use equity between fishing sectors. Optimizing equity instead of sprat biomass would reduce potential profits of the overall Baltic fishery, but may offer an acceptable balance between overall profits, species conservation and social equity.

(ii) By adapting fishing mortality (and related effort), yields and profits in the Norwegian coastal cod fishery could largely be maintained, but at the costs of reduced stock size and employment (Figure 2). Explicitly visualizing these ecological, economic and social trade-offs will help in defining realistic future objectives. Our results can be generalized to any stressor (or stressor combination), which is decreasing recruitment success. The main findings of an aggravation of trade-offs will remain valid. This might be of special relevance for coastal stocks with limited options of avoiding future conditions and subsequently for coastal fisheries, which are often small scale local fisheries with limited adaptation possibilities.

Outlook

It is planned to keep up the highly relevant work on multi-species and ecosystem aspects as well as global drivers of change, including economic drivers of change. In addition we strive to increase the important aspect of international networking.

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Project: CP1206

Project Team: Rüdiger Voss

Research area: **R3 Ocean Resources**

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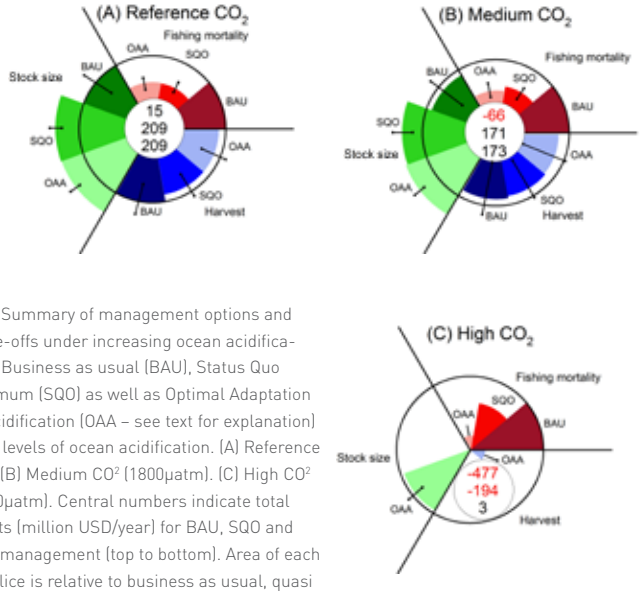

2 Summary of management options and trade-offs under increasing ocean acidification. Business as usual (BAU), Status Quo Optimum (SQO) as well as Optimal Adaptation to Acidification (OAA – see text for explanation) for 3 levels of ocean acidification. (A) Reference CO^2. (B) Medium CO^2 (1800µatm). (C) High CO^2 (4200µatm). Central numbers indicate total profits (million USD/year) for BAU, SQO and OAA management (top to bottom). Area of each pie slice is relative to business as usual, quasi sustainable values 2000–2012 (black circle), with error bars from sensitivity analysis.

Sea Turtles' First Days of Life: A Sprint and a Ride Towards Safety

Rebecca Scott, 'Future Ocean' postdoc working at the GEOMAR Helmholtz Centre for Ocean Research, Kiel, has published a new study describing how advances in the miniaturization of tracking technology have enabled a research team coordinated by her to witness first-hand the dispersal and behavior of baby sea turtles during their first day at sea.

With new nano-sized acoustic transmitters, scientists from GEOMAR, the Turtle Foundation and Queen Mary University of London were able to follow the pathways of loggerhead turtle hatchlings from Cape Verde. The tiny animals quickly swim through predator-rich coastal waters and are then dispersed by nearby ocean currents.

According to the study, the local oceanic conditions are believed to drive the evolution of some unique swimming behaviors. The results habe been published in the current issue of the Proceedings of the Royal Society B. Loggerhead turtles (Caretta caretta) from Cape Verde start their lives with a swimming sprint and a ride on favorable ocean currents. In this way, they escape quickly from predator-rich coastal areas and make their way to the safer open ocean where they spend several years feeding and growing. In this study, tiny acoustic transmitters provided direct insight into these pathways for the first time. Until now, scientists were not able to follow new-born sea turtle hatchlings very far. Hatchlings essentially disappear into the sea until many years later when the lucky survivors return to the place where they were born to breed. But with new techniques like nano-tags and ocean models we are able to see where the tiny young animals go. This is important because the dispersal experiences of hatchlings drive the development of their behaviors into adulthood.

In cooperation with the Turtle Foundation at Boa Vista, Cape Verde, the scientists collected hatchlings from two beaches in the northwest and southern tip of the island. Acoustic transmitters with a five millimeters wide and twelve millimeters long streamlined shape that weigh 0,4 grams in water were glued onto the shell of eleven hatchlings. The turtles were then followed at sea using a boat and acoustic receiver for up to eight hours and 15 kilometers. In addition, the swimming behavior of 16 hatchlings were monitored in "hatchling swimming pools" for several days using data loggers made by engineers at GEOMAR. The turtles swam continuously during their first 24 hours after hatching and then switched to a pattern of activity at daytime and inactivity at night.

Due to the close proximity of offshore currents in this region, it seems the Cape Verdean hatchlings can sleep more at night than hatchlings from other places. Deep oceanic water and favorable currents, which then determined the travel directions and speeds of the Cape Verdean turtles are situated very near to their nests. Therefore, it is very beneficial for turtles if local oceanic conditions drive the evolution of swimming behaviors that are unique to different nesting locations to ensure their best survival outcomes. It seems that turtles are born with these unique locally adapted behaviors.

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Rebecca Scott, GEOMAR, rscott@geomar.de

Sea turtle hatchling with tiny acoustic transmitters.

Art, Design and Science – Science Visualization Becomes Core Research Area at the Muthesius Academy of Fine Arts and Design

Nowadays, the mediation of scientific research is a topic that has been discussed at great length and refers to quite different phenomena. The spectrum ranges from the communication of science with an unspecific but general public (e.g. science marketing and science journalism) to knowledge transfer from the internal scientific discourse, to the dialogue with society about science and the efforts toward the legitimization and the popularization of science.

... In the core research area science visualization (SCI.VI.) in the Centre for Media of the Muthesius Academy of Fine Arts and Design Kiel, a specific perspective on the phenomenon of mediation of science is being studied: the artistic-creative use of scientific works and academic research, as well as the analysis of the resulting findings. For several years the Muthesius Academy of Fine Arts & Design (MHK) has successfully set itself the task of finding communicative solutions in the area of the multiple presentation formats of scientific knowledge. While the possibilities for progressive sensorial media realization have long been neglected by the scientific community, this is a special competence area of fine arts and design. With the new core research area "scientific research visualization" at the Muthesius Academy of Fine Arts & Design, the Academy is in particular expanding and intensifying its cooperation with the Cluster of Excellence "The Future Ocean" in this area. The focus is on existing and potential artistic and design methods for connecting arts and science: How do we interpret scientific findings in an artistic way? How can we approach scientific work in an artistic way so that it becomes emotionally and visibly accessible? Which forms of expression are known to the arts and to design that represent scientific research findings accurately but also bring them to life – in a visual, auditory, tactile, kinesthetic way or through performances?

Science as a brand – Corporate design and exhibitions as a bridge for the mediation of science

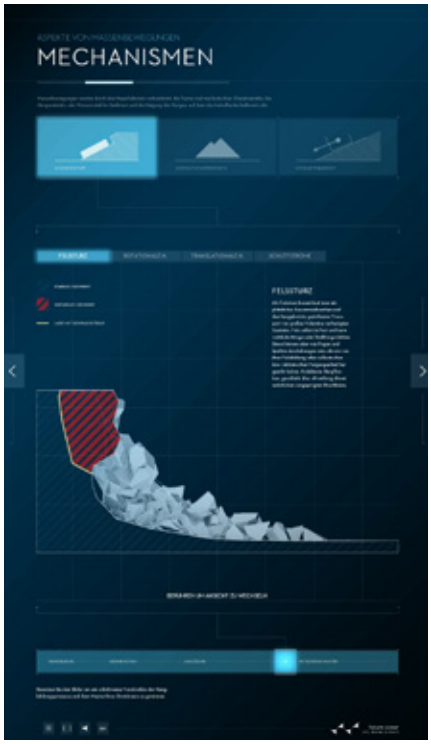
In recent years the cooperation between ocean scientists and artists/designers has centered, in particular, on the overall conception and realization of exhibitions for different occasions, as well as the development of a visual image to represent the Cluster adequately in the media.

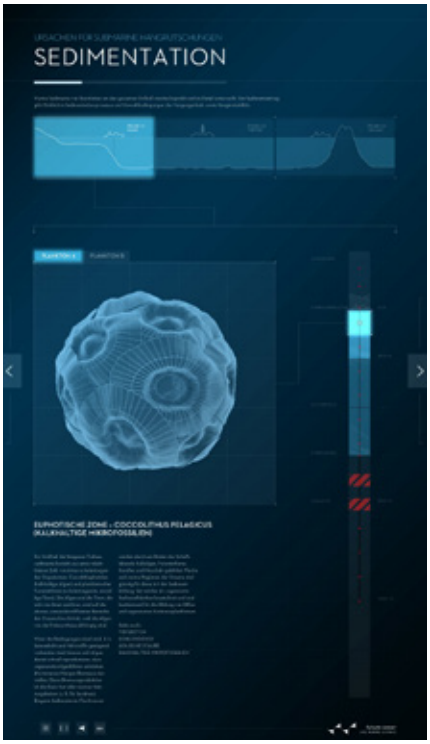
The tasks included, among others, exhibitions in the Deutsches Museum München (German museum Munich) and in the Paul-Löbe-Haus (Paul Löbe house), the development of the corporate design and the official homepage of the Cluster, diverse print products, films, interactive games, as well as analogue and digital exhibits. In this way the image of the Cluster has been decisively shaped and scientific activities have been prepared and made accessible for different kinds of target groups. These activities were primarily initiated and coordinated by the professors Manfred Schulz (scenography and installations), Stephan Sachs (film) and Tom Duscher (corporate design and interactive media) and realized in close cooperation with the Public Outreach Office.

Artistic approaches for knowledge transfer – a new research area develops

For the Muthesius Academy of Fine Arts and Design it became apparent that knowledge transfer, the continuation of teaching and the methodological research targeted at studying artistic forms of expression for the transfer and interpretation of scientific topics should become a future research task of the Muthesius Academy of Fine Arts and Design.

The academy submitted their own research project to the Cluster. The aim was, on the one hand, to study the socio-cultural aspects of a sustainable use of the ocean and, on the other hand, to methodologically study and promote the dialogue between science and arts. This new core area has been embedded into the research field "Our Common Future Ocean (R1)". The cooperation within the Cluster of Excellence "The Future Ocean" is now aiming at the conceptualization of its own approach to the heterogeneous field of science knowledge transfer and the systematic study of different artistic-creative phenomena (such as, information graphic visualizations, auditory installations, interactive projections, cinematic interpretations, performative installations, scenographic interior design or exhibitions). ▸





"Next Generation Interactive Scientific Poster" – digital presentation of research results

In this framework new and uncommon projects soon demonstrated potential and possibilities. Under the direction of Prof. Tom Duscher a tandem of science (Dr. David Völker) and information design (Konrad Rappaport) studied whether the classical printed poster as a medium of science transfer is still up-to-date. The complexity and the short update cycles of the content – texts, images, graphics and tables –used for the mediation of scientific research, often no longer find sufficient space on a conventional poster or lead to a situation where content and statements are not being mediated in a clear and concise way. The comprehension and the reach of research results are declining. Through the interactive poster, scientific topics benefit from attractive visualization with a significantly improved transparency. The research should explain itself and have sustainable effects, i.e. the observer decides on the depth of the information and the duration of the mediation. The first result of this project was presented several times in 2014, for example, during the EGU in Vienna (European Geosciences Union, May 2014) or within the framework of the symposium "Port of Knowledge" (Science Center Kiel, June 2014). The interactive poster was awarded the internationally renowned design award "Red Dot" of the design centre of North Rhine-Westphalia and gained the highest distinction "Best of the Best".

„Translating the Blue" – an artistic view on research expeditions

Equally successful, the film project „Translating The Blue"from Prof. Stephan Sachs, funded by the Cluster of Excellence", had its premiere in July 2014. In his film essay he studies the ocean. Starting from images, which were shot during a research expedition to the South Atlantic, the film studies the different forms of approaching reality. The main protagonist is the ocean. It is always present, in all kinds of different forms of appearance, in images and sound. The ocean is also the research topic of the scientists. For this, image-producing processes, based on mathematical calculations, are indispensible. Models, attempts to translate - including the poetic - are central topics of the film. This happens on different overlapping levels of the film: from a film description at the beginning of the film to a German-English collection of terms from oceanography and arts to the question addressed to a scientist concerning the beauty of formulas.

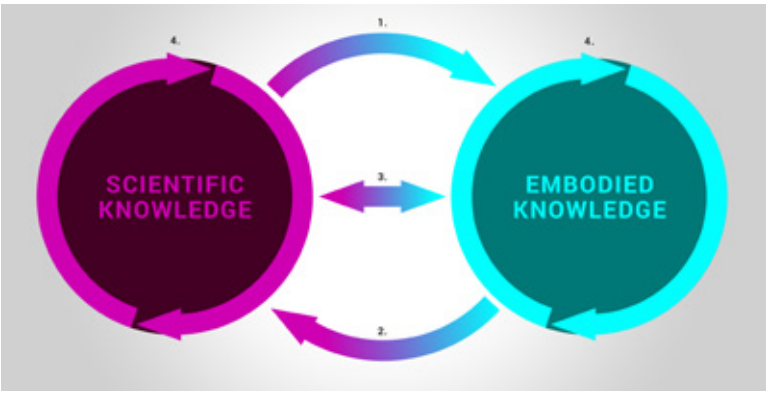
In order to continue to develop new and innovative formats of science communication and to initiate further projects, in October 2013 in the framework of the second phase of the Cluster, two newly established positions for a scientific researcher and an artist researcher were filled by Sebastian W. Hoggenmüller (sociologist) and Michel Magens (information designer). As a complement to their research they two new employees are offering a seminar with the title "Science Meets Art: conveying science in new ways", which was open to both students of the Muthesius Academy and Kiel University. The weekly seminar was accompanied by individual lecture events, in which the research of external guests and university members was presented and discussed together.

The goals of the lectures were:

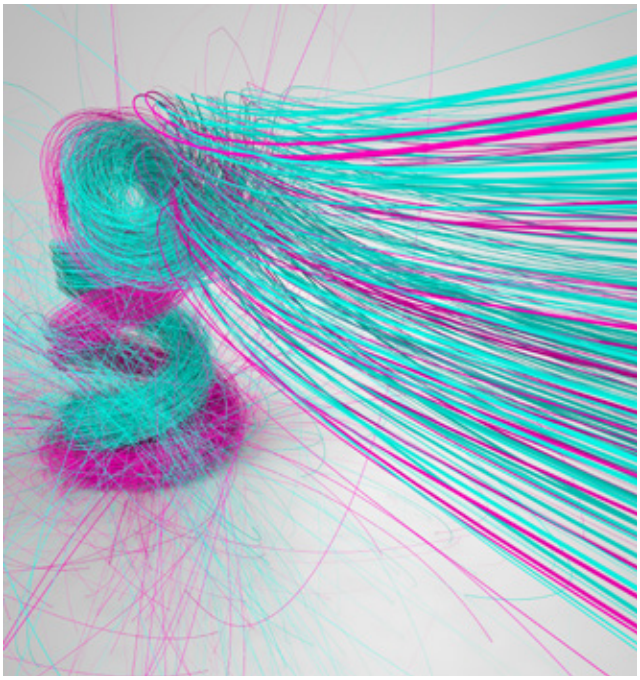
1. Collective research and analyzation.
2. Identification of concrete problems in the artistic-creative work with scientific subject areas and seeking adequate approaches and strategies to solve these problems.
3. The conception of mini projects that deal with scientific research (e.g. Future Ocean, Fraunhofer, Komale, self-initiated).

Initial work, in close cooperation with the students, focused on defining the central concepts and the theoretical framework. In a further step the special attention was paid to the systematization and ordering of the practical field of research. On the basis of studies of artistic-creative formats and projects, a categorization was inductively created, that pointedly underlines the essential and structural features in order to put object of research in concrete terms by means of manifold empiricism and to pursue the meaning of the sensorial realization of scientific knowledge.

We differentiate essentially four possibilities for the relationship between art and science.



Model of mutual knowledge exchange between artistic and scientific research.



This visual symbolizes the integrative collaboration between art and science. (more: science-vis.muthesius-kunsthochschule.de)

The first possibility raises the topic of the communicative connection of art to science as a linear progression. Sensory knowledge emerges on the basis of scientific knowledge when artists/designers work on or process scientific design with their work and projects.

The second possibility is that science connects to art. From this point of view scientists let themselves be inspired by artistic-creative works. Thus, for example, in the field of technical innovations or in the framework of scientific research, in which concrete problems (can be) are solved by means of artistic competence and methods. The third possibility is, that science and art work together on a topic of project. The relationship is explicitly dialogical, where the inventories of knowledge of the two cultures reciprocally and in part directly influence each other – in the sense of an iterative process.

In the fourth possibility art and science devote themselves to the same topic, develop their results separately and independently of one another. This is especially fruitful for questions which focus on the similarities and differences of the differing results.

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Discovery of a New Gas Seepage Process

Global warming is not only taking place on land, but is also affecting the oceans. One major concern is that temperature increase may spread to the seafloor into regions where so called methane gas hydrates are hosted in the seabed. These ice-like gas hydrates currently represent the largest source of organic carbon on Earth, but they are very sensitive to temperature increase.

Introduction

Alarming data with significant methane gas hydrate melting have already been reported from the terrestrial realm causing significant input of methane into the atmosphere and thus attributing to the overall greenhouse gas budget. Indications of methane gas hydrate thawing on the seabed as a consequence of global warming is currently under debate.

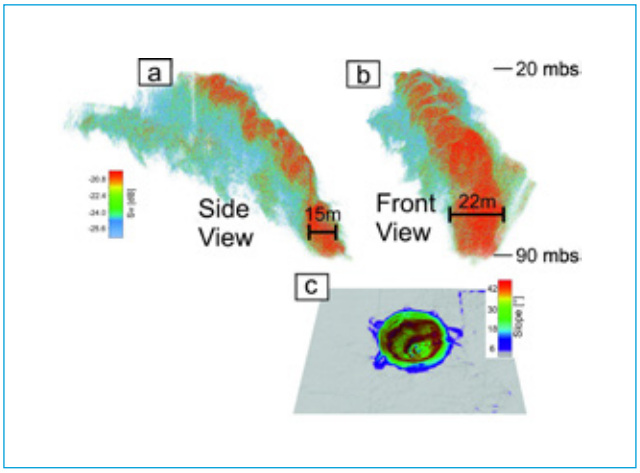
If submarine ice-like gas hydrates melt, methane gases trapped therein can be released from the seabed, e.g. in the form of rising gas bubbles entering the water column. This project researches, whether such bubbles can reach the atmosphere, and if bubble transport represents an effective mechanism for methane transport from the seabed into the atmosphere. To date the process is poorly understood and we expect different behavior at various water depths and environmental settings.

With modern sonar technology, rising gas bubbles in the sea and associated processes can be visualized and investigated in detail. Even a single gas bubble of a few millimeters diameter can be identified in sonar images with ship-based systems. Triggering mechanisms for gas bubble release, hydrodynamic processes of bubble rise, and overall impact of seabed released gases can be investigated with modern sonar technology in great detail.

Unraveling the governing gas bubble transport mechanisms will not only help to better understand potential natural hazards, but will also help to improve gas leakage detection and monitoring that are important for safe operation of marine oil and gas recovery operations.

Goals

There are large uncertainties in the understanding of the greenhouse gas methane and the carbon dioxide emission by bubble release from the seabed and their potential impacts for the environment. To evaluate these emissions, modern hydroacoustic and visual observation techniques were applied to visualize the fate of gas bubbles in the water column. To achieve this a comprehensive dataset gathered with a modern multibeam echosounder at an anthropogenic borehole leakage site in the North Sea was analyzed. The results reveal a very distinct mismatch between numerical methane gas bubble dissolution simulations and field observations. By thorough evaluation of raytraced 3D hydroacoustic data a new process could be discovered that is likely to play a major role in the mismatch between numerical simulations and observation. We found that intense gas leakage is governed by a massive spiral vortex motion in the water column (Figure 1) that has never been reported before.



1 High backscattering water column soundings in a perspective 3D view. The orientation of the bubble spiral (red) goes towards northwest/up into the field of view (b) 90°degree azimuthal offset presentation (c) Color-coded gradient draped onto the bathymetry. Red color indicated a spiral pattern. Note different scaling between the plume and the crater (publication currently under review in a special issue JMPG).

Construction of the Bubble Box

To further investigate this hitherto unknown phenomenon, an optical in situ observation system was constructed which could support the acoustic observations. The new device (Bubble Box, Figure 2) was developed in the SUGAR II project and extended in this project and was deployed at a natural volcanic CO2 gas release site off Italy by an ROV in the ECO2 project. Using the Bubble Box, precise gas flux rates and rise velocities can be evaluated. Further, the 3D movement of the surrounding seawater could be visualized by the release of a colorant tracer revealing a spiral vortex plume formation again. Further investigations are needed to better understand the circumstances under which such spirals develop and to estimate their overall importance for the fate of the released gases.

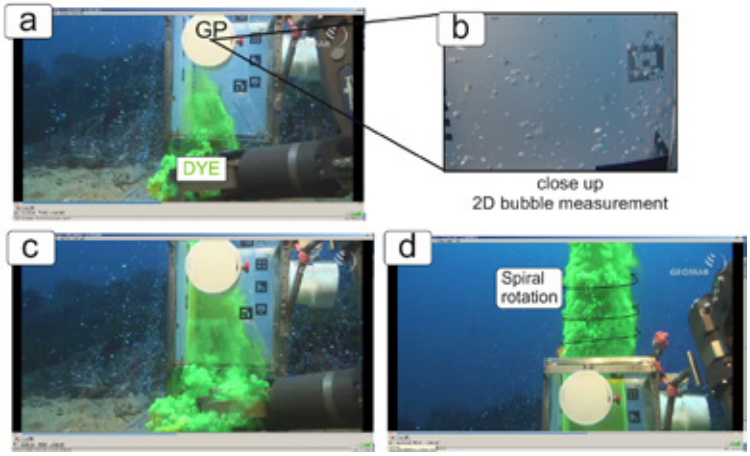
The transport of gas bubbles is not only important to estimate the fate of the gas, but also consideredas a potential transport mechanism for nutrients and methane oxidizing microbes feeding depleted open waters. Results from the collaboration work for the DFG project BUBBLE SHUTTLE demonstrated that gas bubbles indeed serve as a very efficient transport carrier for microbes. A follow up project is currently under preparation to clarify the magnitude of bubble-mediated bacteria transport and oxidizing potential on the overall fate of the gases.

Both processes, bubble-mediated transport of methane oxidizing bacteria, and spiral gas bubble motions are likely to significantly reduce the vertical transport potential of gas bubbles in the water column. On the other hand, at least some natural CO2 release sites reveal a contradictory behavior, i.e.

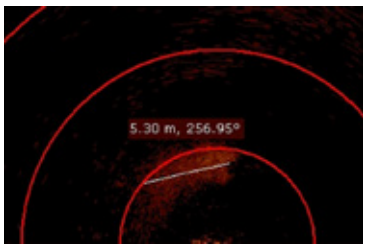
Outlook

The newly discovered seepage related processes might help to better understand the fate of marine gas release from the seabed, e.g. why did the methane released together with oil at the Macando spill only reach higher levels in the water column? We will further pursue multidisciplinary evaluation of gas seepage sites to disclose all important governing processes associated with such gas releases from the seabed. A comprehensive understanding of the governing of seepage processes is vital to establish sophisticated detection and monitoring strategies. Our new findings are certainly valuable in terms of a more complete understanding of gas leakages from the seabed.

Project: CP1207
Project Team: Jens Schneider von Deimling
Research area: **R3 Ocean Resources**



2 Deployment of the Bubble Box box at 60m water depth showing (a) ROV camera observation of initial colorant release (b) pictures taken by the GoPro (GP) camera with backlit illuminated gas bubbles within the bubble box. Squares in lower left corner are 1cm, large squares on the right 4cm. (c) ROV camera observation of colorant tracer experiment shortly after (a) and a few seconds later (d) showing the vertical evolution of a gas bubble plume with spiral formation (only detectable in video sequence).



3 Acoustic images gathered with the ROV mounted KONGSBERG MS 1000 with 625kHz showing the bubble plume at (a) 47m and (b) 16m water depth with respective plume across dimension. Semi-circle distance is 3m.


ND-Filter

SCIENCE NEWS

We are in danger of destroying ourselves by our greed and stupidity. We cannot remain looking inwards at ourselves on a small and increasingly polluted and overcrowded planet.

Stephen Hawking

Fast-Sinking Jellyfish Could Boost the Oceans' Uptake of Carbon Dioxide

Experiments show high sinking speed for dead gelatinous plankton species

Mario Lebrato working at sea, Photo: Mario Lebrato

How much more carbon dioxide (CO2) will the oceans be able to take up? To find out more about the efficiency of this ecosystem service, scientists estimate the sinking velocities of organisms involved in the biological pump. Increasing numbers of gelatinous plankton might help in mitigating the CO2 problem. In field and laboratory experiments scientists from GEOMAR have shown that dead jellyfish and pelagic tunicates sink much faster than phytoplankton and marine snow. Jellies are especially important because they rapidly consume plankton and particles and quickly export biomass and carbon to the ocean interior. Carbon dioxide from the atmosphere dissolves in seawater, where various species convert it to organic carbon and other organic components during photosynthesis. Jellyfish and pelagic tunicates live on smaller plankton and thus consume organic carbon. When they sink to the seafloor at the end of their life cycles, they take the carbon from the surface waters with them, provide it as food to organisms at the bottom or store it in deep water layers after decomposition. As a result, more CO2 can be dissolved in the oceans. Additionally, calcifying organisms incorporate the inorganic carbon in their calcium carbonate shells directly. They also contribute to the biological pump.

To assess the efficiency of the biological carbon pump, data on sinking velocities of the different species are necessary. Together with colleagues from Germany, Spain, the United Kingdom and the United States, Mario Lebrato, Biological Oceanographer in Andreas Oschlies' group at GEOMAR, conducted field and laboratory experiments with gelatinous plankton remains. Their article in the international journal "Limnology and Oceanography" describes for the first time the sinking speed of organic remains from jellyfish and pelagic tunicates. Together with a previous article in the same journal that calculated biomass export efficiency for these organisms for the first time, these new data allow robust estimates of global carbon export associated with gelatinous plankton.

The sinking speed of jelly remains of about 500 to 1600 meters per day is very much higher than expected, Lebrato sums up. Fast sinking means that the biomass and its constituents reach the deeper ocean layers without major degradation, where microbial decay releases CO2 that can be stored without direct contact with the atmosphere for millennia. Also, fast sinking provides high quality food resources for benthic organisms, which have already been observed actively feeding on jelly remains. On continental shelves and slope areas, biomass may reach the seabed within a day or less.

Because of their large jelly populations, occupying at times hundreds of square kilometers in the oceans, combined with a high sinking speed, carbon is delivered to the seabed in large quantities. These findings will help to answer the question of whether jelly organisms could play any major role in the carbon cycle. At the same time, the data available up to now are scarce and scientists have just started to comprehend the fundamental properties that will allow us to better understand the role of jellyfish and pelagic tunicates in the global carbon cycle.

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Dr. Mario Lebrato, GEOMAR, mlebrato@geomar.de

Red Dot Award for Interactive Scientific Poster

The Muthesius Academy of Fine Art and Design has received the internationally renowned Red Dot design award with the additional distinction "Best of the Best" for the interactive digital poster used to communicate research topics for the Kiel Cluster of Excellence "The Future Ocean".

The interactive scientific poster, developed jointly by communication designers from the Muthesius Academy of Kiel and marine scientists from the Cluster of Excellence "The Future Ocean", was awarded the internationally renowned design award "Red Dot" from the design center NRW. The Red Dot jury also awarded the "Best of the Best" distinction for top design quality. The interactive scientific poster is thus among the entries which particularly impressed the international jury by their uniqueness.

The interactive poster consists of a 55 inch touch monitor, similar to a giant smart phone, which responds to finger movements. "The award makes us very proud. We also see the interactive scientific poster as an outstanding example of the cooperation between communication designers and oceanographers," says Tom Duscher, Professor for Interactive Media at the Muthesius Academy in Kiel, who initiated and lead the new project. "With such expressive formats we want to find new ways of communicating complex research topics. The Red Dot award is both a motivation and an incentive for us to visualize research in an unusual way."

The communication designer Konrad Rappaport and his team together with marine scientists from the Cluster of Excellence "The Future Ocean" worked for about a year on the digital scientific poster for the topic 'Submarine Landslides'. A first version of the 'Next Generation Scientific Poster' project was presented last fall at an international conference and has been developed further since then. Today, the interactive scientific poster is being used worldwide at scientific marine conferences and public events. "Submarine landslides"can trigger tsunamis. They are still among the most underestimated natural hazards and are a subject of research in the Cluster of Excellence "The Future Ocean". The scientific content of the topic is presented with elaborate graphics, film sequences and animations. The objective of the digital poster is to devise a graphically creative and at the same comprehensible presentation of complex scientific content. A clear structuring of the topic as well as an easily understandable user concept were main tasks of the communication designer. The poster is designed in such a way, that the viewer can decide on the depth of information. The design team successfully managed the rather difficult balancing act of making a complex scientific topic understandable to the ordinary person and at the same time developing a futuristic look with interactive elements.

Links

www.futureocean.org/poster

about the interactive Poster / Next Generation Scientific Poster

Prof. Tom Duscher, Center for Media,
Muthesius Academy of Fine Arts and Design, td@muthesius.de
Konrad Rappaport, info@konradrappaport.de

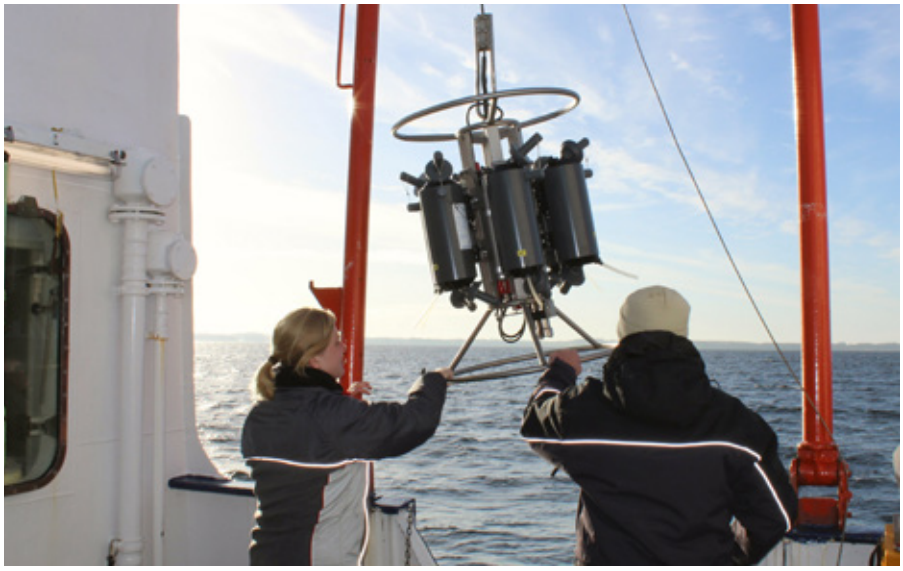
Konrad Rappaport (left), designer from the Muthesius School of fine Arts and David Völker (right), geologist from the Helmholtz Centre for Ocean research, GEOMAR, present the award winning interactive scientific poster at a conference in Kiel.

INTERNATIONAL OCEAN SAMPLING DAY IN KIEL

Researchers at GEOMAR and Kiel University Participate in a Global Measurement Campaign

On Saturday, 21 June 2014 Kiel took part in the first "Ocean Sampling Day" (OSD). Marine scientists took water samples at over 170 locations worldwide to investigate the distribution and genetic diversity of microorganisms in the water. Scientists from the GEOMAR Helmholtz Centre for Ocean Research Kiel, Kiel University and the joint Cluster of Excellence "The Future Ocean" also participated in this measurement campaign, the largest of its kind.

What do Hawaii, Bermuda and Eckernförde Bay have in common? All three – along with about 170 other places around the world – are part of a worldwide scientific project. Researchers around the globe took seawater samples on the international "Ocean Sampling Day". The samples will be analyzed regarding the composition of microorganisms using standardized methods. Thus, researchers will obtain a global view of the genetic diversity and distribution of microbes in the sea. "These microscopically small creatures are among the oldest forms of life. They also play an important role in the climate system of the earth. Without them there would, for example, be no atmosphere suitable for humans", says the marine biologist Carolin Löscher from the Institute of General Microbiology at Kiel University. "It is thus important to learn more about these organisms", adds the marine chemist Dr. Hermann Bange from GEOMAR Helmholtz Centre for Ocean Research Kiel. Together they head a team of researchers and technicians that took water samples at the mouth of Eckernförde Bay for the OSD.



Standardized water samples are taken monthly at Boknis Eck since 1957. Photo: Mirja Dunker, GEOMAR

For this purpose, the research vessel *LITTORINA* started with the scientists to the time series station Boknis Eck on Saturday morning. "We take monthly samples there, anyhow, to investigate the amount of nutrients in the water, how much oxygen is present, how severe the growth of algae is and also which microbes occur", explains Professor Bange, who coordinates the monitoring station. Even without the Ocean Sampling Day, Boknis Eck is an established name in international marine research. "The sampling there has been running almost continuously since 1957. Thus, Boknis Eck is one of the longest continuously active time series stations of its kind", explains Hermann Bange. Continuous measurements of this type over a long period are important, for example, to distinguish natural variations in the environment from man-made changes.

Apart from the few, long time series measurements that exist worldwide, the Kiel scientists see the chance for a global snapshot of the microbial diversity in all world oceans and marginal seas in Ocean Sampling Day. "That is the reason why we decided promptly to participate in the OSD when we heard about the project", emphasizes Löscher. The scientists from Kiel are in good company. Other renowned time series stations such as the Hawaii Ocean Time Series (HOTS) or the Bermuda Atlantic Time Series (BATS) support the OSD, as well.

The Ocean Sampling Day was launched by the EU-funded project Micro B3 (Marine Microbial Biodiversity, Bioinformatics and Biotechnology). It is coordinated by Prof. Dr. Frank Oliver Glöckner, Professor of Bioinformatics at Jacobs University in Bremen and investigates microorganisms invisible to the human eye and their importance to the marine ecosystem. In addition to colleagues from science, the organizers of the OSD also encourage interested citizens to collect their own data. Instructions and more information can be found on the website www.oceansamplingday.org

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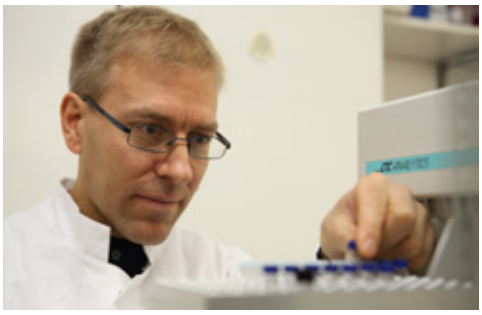
Prof. Dr. Hermann Bange, GEOMAR, hbange@geomar.de
Dr. Carolin Löscher, Institute of General Microbiology, Kiel University, cloescher@ifam.uni-kiel.de

TRACKING MARINE FOOD SOURCES

Isotope Specialist from Kiel Develops a Method to Identify the Origins of Nutrients in Marine Food Webs

Oceans cover nearly 75 percent of the earth's surface and have always been an important source of food and resources. Yet overfishing, pollution and mismanagement threaten marine ecosystems and thus one of the earth's most important resources. We can help to restore these ecosystems by understanding how they work and what affects them. Marine ecosystems have a multitude of organisms that depend on each other for food and nutrients.



Researchers know surprisingly little about where marine animals obtain their nutrients because the origins of nutrients used to be untraceable once they had been digested. An international research team including scientists from Kiel's Cluster of Excellence "The Future Ocean" has introduced a new method based on stable isotopes that can trace one of the most essential compounds for life, protein amino acids, back to their original source. These findings were published in the international journals PLOS ONE and ESA Ecology in fall 2013.

To address the issue of tracing the source of amino acids, Thomas Larsen of "The Future Ocean" collaborated with researchers from California and Alaska to develop a method that can determine where animals obtain these essential nutrients. They discovered that all life forms leave traces or 'fingerprints' in amino acids during biosynthesis. With these fingerprints, which are based on naturally occurring isotope variations, it is possible for the first time to distinguish between algal, bacterial, fungal and plant origins of amino acids through tissue samples. This discovery makes it possible to find out what animals have been feeding on without observing them directly or examining their stomach content.

"The new fingerprinting tool is particularly well suited for investigating foraging habitats and nutrient sources in marine animals," Thomas Larsen points out. The newly developed method was applied in a study of the University of Hawaii on the feeding ecology of the green turtle Chelonia mydas living in the central Pacific Ocean. For these endangered marine turtles it is critical to gain insight into their feeding habits and this requires a minimally invasive method. Here the fingerprinting method proved to be superior to more intrusive methods such as applying GPS devices to the animals. From previous observations it is known that Chelonia mydas migrate between inshore areas and the open ocean. Juvenile animals stay offshore in the pelagic zone, whereas adult turtles move to coastal habitats. These different habitats are reflected in different diets: In inshore areas, turtles feed on plant based foods such as macroalgae, while pelagic turtles feed on animal based foods such as jellyfish. With the new fingerprinting method it has now become much simpler to determine where the turtles have fed. The study showed that the migration patterns and feeding ecology of these turtles are more complex than previously assumed.

An unknown aspect of the turtles' nutrition was revealed in this study for the first time: microbes living inside the turtles' guts synthesize essential amino acids that are passed on to their host. But only turtles feeding on plant based foods receive microbial supplementation of amino acids. It appears that the microbes responsible for the fermentation and digestion of less digestible foods in the turtle's gut also help in compensating for the nutritional insufficiencies of low quality foods. This microbial supplementation leaves a distinct fingerprint that can show with high certainty whether adult turtles have recently moved from inshore to pelagic habitats and vice versa. It is not well known how often and why adult turtles migrate to the open sea. A possible explanation could be to take on additional energy supplies from animal based foods for breeding. As these observations run contrary to the common understanding of marine turtles' nutritional habits, this study demonstrates the fingerprinting method's potential, not only to explore the complex relationships between a host and its intestinal microflora, but also to better understand the foraging habits and habitat requirements of marine species.

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Thomas Larsen, Leibniz Laboratory for Isotope Research, Kiel University, tl@leibniz.uni-kiel.de


Antarctic Intermediate
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GENDER

Perfect numbers like perfect men are very rare.

Rene Descartes

1st Workshop of the Earth Science Women's Network in Germany

From September 17-19, 2014, about 60 female scientists from advanced PhD level up to junior professors, met in Kiel for an international workshop of the Earth Science Women's Network (ESWN) on 'Leadership and networking skills and career development'. This workshop was realized following the initiative of Dr. Yiming Wang, a researcher in Geosciences and member of the postdoc network IMAP. "In June 2012, I participated in a similar Professional Development Workshop 'Skills for Networking and Communication' offered by ESWN in Madison, Wisconsin, USA. This workshop inspired me in a fundamental way and changed my perspectives about networking and communication. I realized good networking skills are an essential tool for female scientists to build a supportive community and advance their careers". Yiming Wang's workshop experience promoted the idea to bring this awareness to more women at the early stages of their scientific careers and Kiel, being in the center of internationally collaborative marine research, is an ideal location for such a workshop. The first workshop on networking and career development under the ESWN umbrella for women scientists in Europe was jointly organized and funded by the Cluster of Excellence and the Women's Executive Board (WEB) of GEOMAR Helmholtz Centre for Ocean Research. It was also with additional support by the Women Equality Commission and the Faculty of Mathematics and Natural Sciences of Kiel University.

The goals of the workshop in Kiel were firstly to establish the breeding ground for informal peer mentoring and support by providing the tools to facilitate professional collaborations among women scientists as well as with other partners in academia and secondly to empower women working in the STEM disciplines to find their individual paths to successful careers in leadership positions.

To promote women role models and mentoring during the workshop, a panel discussion facilitated an open dialogue between workshop participants and role models who currently hold leadership positions in academia and science management. The panelists offered unique insights into their own career paths and development, work-life balance, mobility, gender biases, and mentoring. Yiming Wang summarizes "we have received overwhelmingly positive feedback from most of the participants, who are inspired and motivated for their academic career and also eager to apply the tools from the workshop in their own working environment".

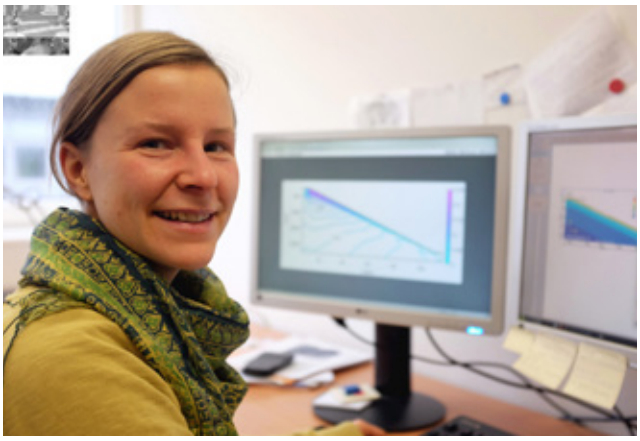
Yiming Wang, Marine Climate Research Group, yw@gpi.uni-kiel.de

Networking for More Women in Leading Research Positions

How can the aim of gaining more women for leading research positions be supported by programs funded in the Excellence Initiative? German clusters of excellence and graduate schools have found very different approaches and implemented a variety of measures to recruit and support women scientists. In order to share experiences, coordinators for gender measures from all over Germany were invited to the Future Ocean Cluster. On September 17, 2014 a group of 11 colleagues discussed specific structures, gender equality plans and practice examples. Ruth Kamm presented the cluster's mentoring programme via:mento_ocean. In December, via:mento_ocean was chosen by the DFG as an exemplary and innovate measure for promoting female postdoctoral researchers and was integrated in the toolbox of gender equality measures. It was highlighted that via:mento_ocean is the only disciplinary mentoring-programme conducted in English in Germany.

Ruth Kamm, Project coordination via:mento ocean, rkamm@fb.uni-kiel.de

The New via:mento_Ocean Supports Female Postdoctoral Researchers in Marine Sciences



In July 2013, the mentoring program via:mento_ocean for female postdoctoral researchers in marine sciences was initiated. It offers the nine participants individual career development through exchange with an experienced mentor working as a professor or permanent senior scientist at any university or non-university research institute. The one-to-one mentoring approach is complemented by networking opportunities for the mentees. Accompanying trainings focusing on topics such as career planning or job application are open to all interested female postdoctoral researchers working in marine sciences in Kiel.

One of the participants is Dr. Morelia Urlaub. She summarizes her experience as follows:

'Having arrived at Kiel just a month before the kickoff of via:mento_ocean, it was perfect timing to help me to integrate into my new research environment and face the challenges of my new position at GEOMAR. Participation in the program also provided the perfect opportunity to meet with other female scientists in the field of marine sciences in Kiel and to establish a local network.

An introductory workshop helped to single out the key aspects that we - the mentees - wanted to focus on in the mentoring relationship. Within the group of mentees these topics were surprisingly diverse, including career advancement in general and in particular in the German system as well as work-life balance. With my key topics in mind and a recommendation from a colleague I rapidly identified a suitable mentor, who was willing to build a mentoring relationship. To date we have met three times, with different topics for each meeting. I was truly impressed by how serious my mentor took his role; how much time and attention my questions and concerns received. Our inspiring discussions ranged from broad and general issues of scientific careers to specific ongoing and future projects. I appreciated an independent opinion from someone with extensive experience.

Besides the mentoring relationship, I also strongly benefited from connections to other mentees in the group. Regular network meetings provided the possibility not only to exchange experiences with mentoring, but also to share and discuss issues that arise in our daily work life in a small women-only group. Although via:mento_ocean's official time is nearly over, I am very certain that the relationship built with my mentor as well as those with other mentees will continue. I therefore highly recommend participation in a mentoring program to all junior researchers who are looking for additional contacts in the community, who want to strategically approach their future career in academia, and who are interested in networking with peers.'

Dr. Morelia Urlaub works as a postdoctoral researcher in RD4 'Geodynamics of the Ocean Floor' at GEOMAR, where she is responsible for coordinating submarine landslide research. Her research focuses on the release mechanisms of large submarine mass movements. She joined the Future Ocean Cluster as an associate member in 2013.

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Interview Tanja Hentschel: Professional employee selection

A Success Factor in Academia?

Excellent research needs excellent scientists. Therefore, one of the Clusters' gender equality policy aims is to increase the participation of women in cutting edge research by strengthening gender equality in its research community. One instrument to attract female scientists independent of their career level is a professionalized employee selection that takes different aspects of diversity, including gender, into account. For this reason the equal opportunity office organized a workshop on making fair employment decisions through professionalized employee selection during the annual cluster retreat in 2014. In the following interview Tanja Hentschel explains how common pitfalls can be avoided.

In 2011 Tanja Hentschel started working in the project "Selection and Evaluation of Leaders in Business and Academia", led by Prof. Claudia Peus, Chair of Research and Science Management at TU München. During the 2014 Cluster Retreat Tanja Hentschel presented the latest project findings and showed how gender balance and diversity in academic research teams can be increased and why this is beneficial for scientific work.
In Summer 2015 a volume regarding professional employee selection in academica co-edited by Tanja Hentschel will be avaliable.

Can working groups in science benefit from more diversity?

Recent studies show that the percentage of women in top management teams is related to objective performance measures. In some studies researchers find that diverse teams have a higher potential for innovation – which is crucial for scientific work.

However, the benefits of diversity need to be earned: For diversity to lead to positive team outcomes, it is important to highlight the similarities in order to increase the identification within the team. It is also helpful, if team members see a value in diversity.

What are the reasons for the continuing imbalance of men and women in high ranking positions in academia?

The reasons are complex. We can broadly specify factors on three levels that influence the amount of women in top positions in academia: Society, organization, and individual.

To give an example for factors on the individual level, our research shows that women have less self-confidence than men and some women may therefore doubt that they can make it to the top. On the organizational level we find that women have fewer role models and less access to powerful networks in male-dominated fields; and because search committees for professorship positions often rely on networks, it can be harder for women to get hired.

Do you also have examples for factors on the societal level?

For example, women are still the main caretakers of the family and childcare opportunities are often scarce, which is a problem. In addition, a recent study shows that in the natural sciences both male and female professors prefer male over female PhD candidates when qualifications are equal, which can be even more of a problem. The reason for this preference may be gender stereotypical expectations that men perform better in science than women.

What are gender stereotypes?

Gender stereotypes are generalized expectations about what men and women are like. Men are perceived as more agentic than women, e.g. assertive, dominant, and outgoing. Women are perceived as more communal than men, e.g. caring, supportive, and concerned about others.

Which role do these stereotypes play in the context of employee selection in science?

Even though attributes describing women are very positive, they can be the reason why women face problems in the hiring process – especially for high rank positions. People think that a good leader has agentic attributes. Because women are seen as less agentic, people perceive a so-called lack of fit between women and leadership. This may bias people's evaluations of women for leadership positions.

Unfortunately, if women show too much agentic behavior (for example, if they negotiate forcefully) evaluators may penalize them because they have violated the expectation of women to act in a communal way.

What can be done to counter typical pitfalls in the process of employee selection?

It is important to inform decision makers about gender stereotypes and how they affect their evaluations and behaviors. Stereotypes often work subconsciously and can influence our attention, interpretation of behaviors and our memory. We may not be able to fully stop the influence of stereotypes, but if we are aware of their existence and consider that they may be at work in the hiring process, we can weaken their effects.

Most important is a standardized selection process that is transparent for everyone involved.

In your project, you propose seven steps to reach a fair selection process: Requirement profile – Recruitment – Application documents – Work samples – Interview – Decision – Onboarding. What is a requirement profile?

To develop a requirement profile you should answer the following questions before you start recruiting possible candidates: Who am I looking for? What characteristics should the person have? Name no more than eight or ten characteristics that are most important for the position in question. This helps you to look for a candidate who is perfectly fitting to the specific position.

Carry on with a recruitment strategy. Your job advertisement should include the characteristics you are looking for. It should be job specific and written in gender fair language. External recruitment is crucial for diversity.

When you look through the application documents beware of pictures because they impact your assessment of the applicant. Also keep in mind that not everyone in academia is skilled in writing letters of recommendation.

Looking at step four, what might be good work samples in science?

In general, work samples are a good strategy to find out more about the skills of the applicants. You can, for example, have applicants design an experiment, give feedback on a research proposal or give a presentation.

In the following interview ask questions about the characteristics that you are looking for. You can ask about earlier or hypothetical behavior. For example, when you are looking for a candidate who is persistent, you can ask about a situation in which he or she failed at something and how he or she dealt with this failure. But you could also ask your candidate what he or she would do in case a lab experiment fails.

When deciding for a candidate compare what you are looking for with the applicant's characteristics. Also take into account the potential of the applicant to acquire other knowledge and skills.

Finally, when you have hired an applicant make him or her feel welcome in the team (e.g. through a team lunch), and help him or her to get used to the new job.

Do you have a final tip for us?

Be aware of biases in all parts of the selection process.

Interview conducted by Ruth Kamm.
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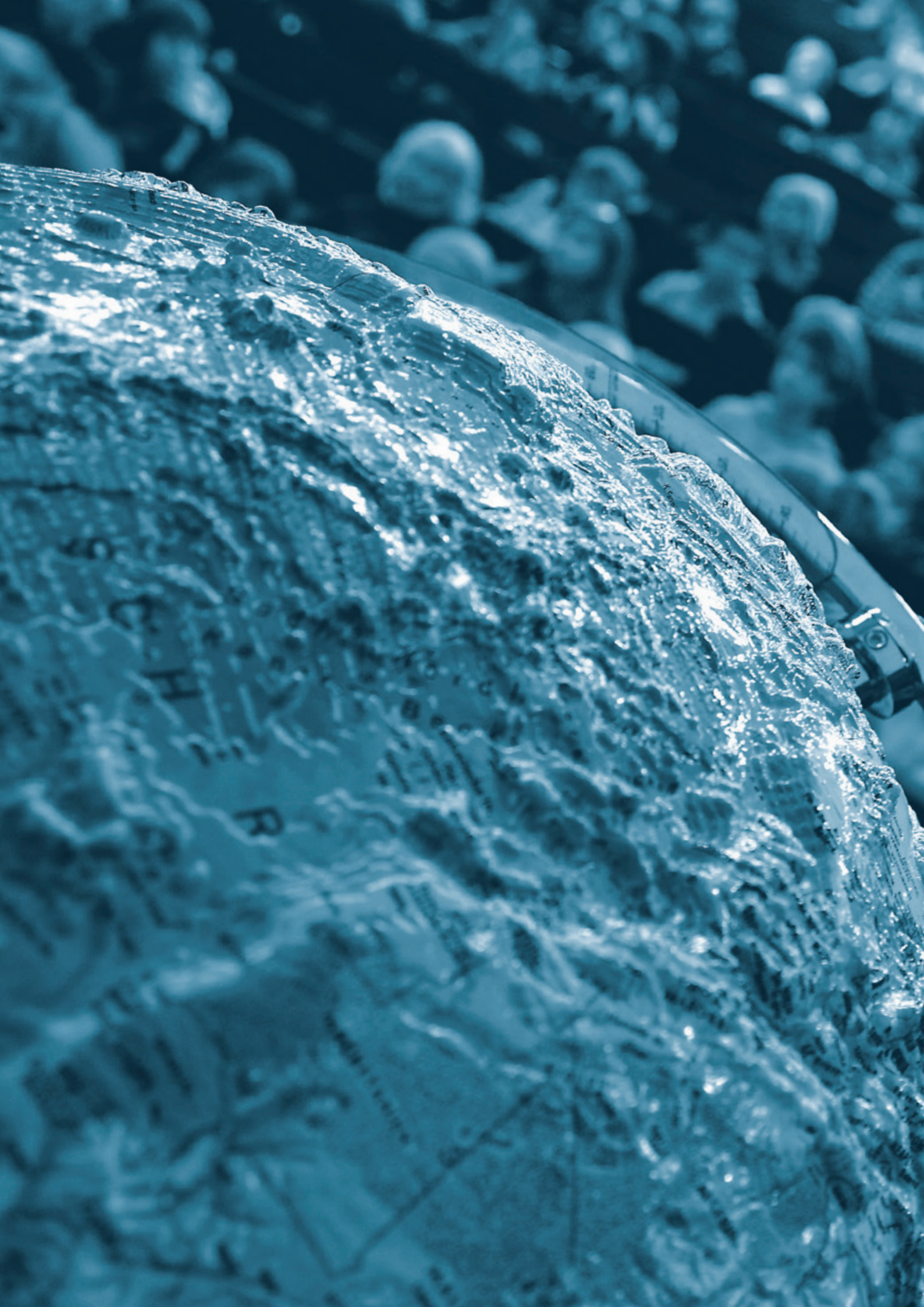


EDUCATION & CAREER

We only have to look at ourselves to see how intelligent life might develop into something we wouldn't want to meet.

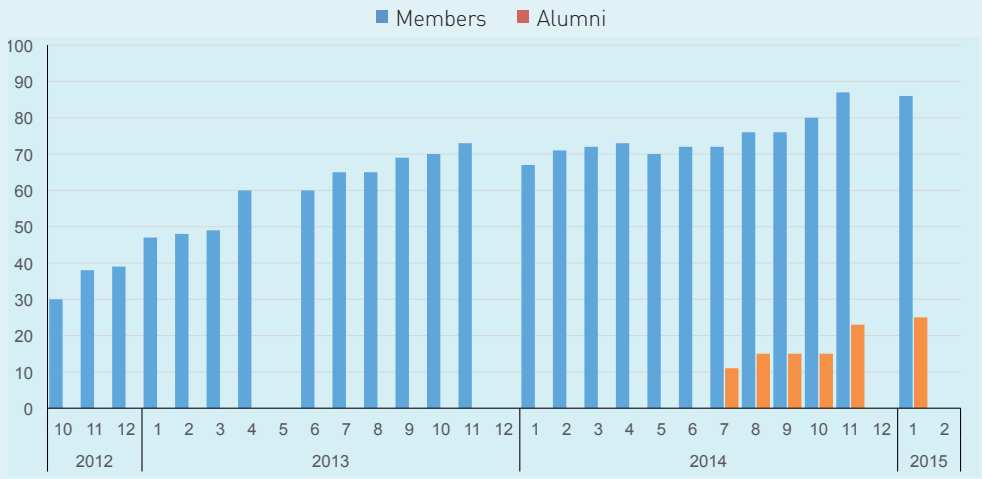
Stephen Hawking

Supporting Career Developments of Young Researchers – The Active Postdoc Network in Marine Sciences

The Integrated Marine Postdoc Network (IMAP) has been growing continuously and has over 85 members now; all members are scientists working on temporary contracts in Marine Sciences in Kiel and have associate member status in the Cluster. Their experience ranges from early career postdocs to scientists already working on temporary contracts for over 10 years or more. Positions for early career postdocs are available on the labor market but the respective contracts are limited from a few months to two years. Postdocs, particularly those at a more experienced level, are essential assets to the German academic system and they are involved in a multitude of tasks. However, in Germany, no employment models exist for experienced, older scientists apart from the classical track to a professorship position. This situation often results in insecurity in terms of career perspectives and the personal situation. Here, the Cluster has offered unique employment opportunities with contracts lasting for three and five years for early career and more experienced scientists, thereby offering more continuity and the opportunity to build one's own research profile. Currently 31 projects and other fixed term postdoctoral positions are funded by the Cluster. For the majority of the postdoctoral scientists, funding of their independently developed projects was awarded following two international calls of the Cluster (2012/2014). In 2014, nine postdoctoral researchers started working on their projects, which allow them to develop their own research agendas and to work independently. This describes the path IMAPs in the majority wish to follow: Building their distinctive research profile in a supportive environment that offers more permanency and more secure employment models. However, for the most part IMAPs actually are ideally seeking positions where they can do excellent research without necessarily aiming at a professorship position in Germany. Hence, apart from providing measures for individual support, the development of strategies towards more secure career paths for experienced scientists at the postdoctoral level in Germany is a major function of IMAP. This initiative has helped in many aspects in developing a University concept for the German Rectors' Conference (HRK). The HRK is currently in the process of collecting concepts from similar initiatives existing at other German Universities to arrive at a nationwide solution which will then improve the situation of individuals but also affect the German academic system as a whole.

Gesche Braker, coordinator of the Integrated Marine Postdoc-Network IMAP, gbraker@uv.uni-kiel.de

IMAP members



Number of Members and alumni in IMAP since 2012

Postdoc Careers and Their Legal Ramifications

Postdocs and Ph.D. students aiming at an academic career need to plan their steps carefully. Therefore, information is needed about how to successfully navigate through national and international funding schemes for temporary positions, for principal investigators and fellowships. Only profound knowledge about career options and the respective legal framework will allow early career researchers to make the right decisions and to plan for the long term. About 100 PhD students and postdocs attended each of two career events at Kiel University that were initiated and carried out by the postdoc network (IMAP) and strongly supported by the university board. In 2013, a Career Day on 'National and international funding opportunities for early career scientists' with invited experts reported on funding schemes for temporary positions for principal investigators and on fellowships available from the German Science Foundation (DFG) and the European Union. In Germany academic career tracks are, for the most part, based on non-permanent employment contracts. This employment situation often lasts for many years and usually involves a number of consecutive contracts. There are several legal provisions regulating this employment situation, often leaving the scientists affected unsure of how these regulations may impact their future career paths. At the information event in 2014 focusing on 'Career paths after PhD in Germany and their legal ramifications' possible career paths for scientists after PhD were highlighted including the various paths leading to a professorship position in Germany. Participants were also informed about the legal regulations relevant to this career track and general legal aspects of non-permanent positions in science in Germany.

Alumni Work in the Cluster Supported with Funding from the Alexander von Humboldt Foundation

How can the involvement of guest researchers from abroad be kept alive after their research stay has ended? Research alumni work has become a fundamental issue at universities and research institutions and also in the Future Ocean Cluster. This issue is thoroughly addressed by the Alexander von Humboldt Foundation with its Research Alumni Strategies initiative, financed by Germany's Federal Ministry of Education and Research. The Cluster, representing Kiel University and its research focus 'Kiel Marine Sciences', has proposed its own tailored researcher alumni strategy and won two prestigious grants of 90,000 € in total to initiate research alumni work and to organize a research alumni meeting abroad.

The Cluster's strategy focusses on the interface of the postdoc network IMAP and internationalization and is being carried out by Gesche Braker and Nancy Smith, the coordinators for IMAP and Internationalization. It primarily involves IMAP members with an international background who are potential future alumni of the Cluster and researchers who have worked in marine sciences in Kiel but now live and work abroad. The initiative started with a conference in Berlin in November 2013 where a delegation of six international IMAP members and the coordinators for IMAP and internationalization took part. Insights into other institutions' successful research alumni work and information on funding opportunities for continuing research collaborations with Germany were valued as highly valuable for both groups, coordinators and future alumni. 'This information is really useful for me' is the summary of Mahasweta Saha, a former DAAD young ambassador in India, who is strongly interested in elaborating opportunities for joint research projects between both countries.

Training postdocs to act as ambassadors of 'The Future Ocean', who inform their students and colleagues about life and research opportunities in Kiel, building a researcher alumni database and networking opportunities among current and future alumni are the foci of the initial phase of the strategy. 'International alumni are important multipliers who can effectively campaign for research institutions' agree Nancy Smith and Gesche Braker. 'However, we also want to foster continuing scientific exchange among researchers who currently work in Kiel and those who have left for new challenges and hence can share their views and new ideas with scientists in Kiel'. There lies the great value of the AvH Foundation support for a conference in the US, in which alumni now living and working in the USA and Canada and international IMAP members´will take part. The conference is planned for September 28-30, 2015. 'With the Earth Institute at Columbia University and its Director for Research, Peter Schlosser as partners we have the unique opportunity to initiate a joint and dynamic interdisciplinary discourse on ocean sustainability. This has the potential to advertise Kiel as the place to work on this important issue' underlines Cluster Speaker Martin Visbeck

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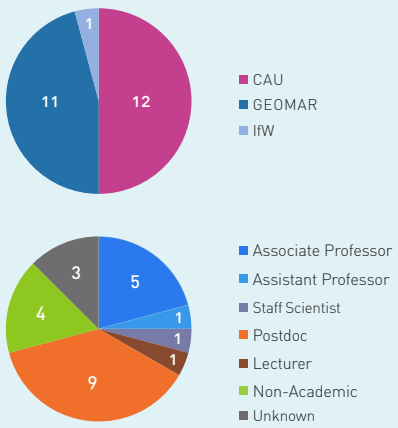

Former host institutions in Kiel (upper) and current positions (lower) of alumni of the Integrated Marine Postdoc Network (IMAP). Most former IMAP members have continued in research at institutions abroad except for two postdocs and the alumni holding positions in the non-academic labor market who now work in Germany.

"Good Scientific Practice and Its Shades of Grey"– A Participatory Discussion at the ISOS

While scientists agree that it is unacceptable to fabricate data or not to cite original ideas, the greyer areas of questionable research practice are a more complex issue. Arguably, research practices that deviate from the ideal are part of most scientists' work. All three Ombudspeople from GEOMAR Christian Dullo, Stefanie Ismar and Christian Berndt as well as Martin Wahl and Henning Bauch set the topics for smaller discussions in individual groups. Honorary authorships were debated as well as a strategy for dealing with data outliers. Scientists often feel caught in the system and struggle to practice ideal research at all times. The scientific system with its fierce competition and publication pressure may set the ground for questionable authorships or shady data analysis. There are no easy solutions - but talking to colleagues and advisors when in doubt about any step in conducting research is a step in the right direction. It is challenging to bring scientists from different research fields together in small groups to debate questionable research practices. The goal, though, of sparking an open and self-critical discussion to help establish a culture of open debate was met.

Sailing the Seven Seas – An Interview with ISOS Alumnus Marius Müller

Marius Müller has seen quite a lot of the world. From his PhD at GEOMAR in 2009 he moved to the Laboratoire d'Océanographie de Villefranche-sur-mer in France for a year. When he applied – "just for fun" for a job at the Institute for Marine and Antarctic Studies in Tasmania, he was accepted and spent three years there. On his way to Brazil to take up a job at the Oceanographic Institute of the University of Sao Paulo, he dropped in on us:

Marius, apparently you enjoy moving around?
Yes, I enjoy going to other places and starting new things - it gives me new perspectives. During my PhD I always felt the pressure to publish in order to succeed. Now I realize that a long publication list doesn't guarantee a job. Being at the right place at the right time and talking to the right people is equally important.

Did you ever consider working outside academia?
No, that was never a question. Working in science is sometimes stressful but the way you can organize your time and work independently is almost unique, and a great luxury.

Tasmania is an exotic destination. But apart from that, how did you benefit scientifically?
It definitely broadened my scientific knowledge and gave me insights into Antarctic research. I worked with ice algae and carbon chemistry and took part in two expeditions to the Antarctic. Bivouacing on the sea ice was a great experience!

So now you have ended up in Sao Paulo.
Right. I chose Brazil for private reasons. I won a grant and now have a three year project where I will continue working on ocean acidification and phytoplankton.

Is there anything you would recommend to PhDs who want to stay in science?
Yes: Follow your own way – there is not the one right way that leads to success!

Life after the PhD – A Doctoral Retreat

Eight invited guests (see the box at right) from a range of professional fields were interrogated on the ups and downs of their career paths by ISOS PhDs at their annual retreat. Set up as a "speed-dating" scenario, many questions about options inside and outside of academia, about family life and work, and about differences in industry, academia and the private sector were answered. The interest in each other was entirely reciprocal; Dr. Christian Bücker enthused: "I got to know a wonderful group of excellent PhD students, and I got the impression that you will all make your way! Have your eyes and mind ready for open doors and step through!"

Even having goals in sight, leaving a lasting impression of your work and yourself on a professional colleague or potential employer in a so-called "elevator pitch" of under a minute is not trivial! PhD candidates took on this challenge, often needing to leave their comfort zones in role-play scenarios and games. As theater coach Kate Simmons took them through the steps of distilling the message and using body-language effectively, the ice, figuratively, broke, allowing an abundance of natural talent to surface. "I learned a lot about life during the PhD apart from science itself. Personal development is a key along with science in one's PhD", a doctoral candidate said after the retreat.

The weather could not have been better; mingling at the campfire, walking along the beach, rope-climbing in high trees and dining together were all part of a winning group experience that combined time to get acquainted with serious thinking about "Life after the PhD".

Invited experts with different career paths

- Dr. Christian Bücker: Head of Research and Development at RWE-DEA
- Dr. Katja Barth: Head of Science Management at the University Administration
- Dr. Malte Prieß (ISOS Alumnus): Consultancy
- Prof. Markus Bleich: Senior Scientist
- Dr. Pablo Lodeiro: PostDoc at GEOMAR
- Dr. Linn Hoffmann: Emmy Noether Awardee
- Dr. Ulf Schweckendiek: Project Development for Schools
- Dr. Rolf Karez: State Environmental Agency

Academia or Industry?

When PhD candidate Tim Stöven called Nina Bergmann at the ISOS with his wish to get a mentor for the ANALYTICA trade fair, she had to dig deep into her bag of tricks, as no scientists from Kiel suited Tim's interests. Nina got Tim there, and this is his report:

"At the final stage of my PhD in chemical analytics, I was undecided whether to pursue a university career or enter industry. To learn more about the world of enterprise, I visited the ANALYTICA trade fair in Munich in the framework of the ISOS "Scientific Fair Mentoring Program". This gave me the opportunity to meet global players as well as medium-size companies while having an experienced mentor at my side.

My mentor, PD Dr. Maiwald from the "Bundesanstalt für Materialforschung" in Berlin, coached me intensively before the event. He said: "Searching for a job is like searching for a flat. At some you stay longer than at others and in some you feel more comfortable than in others, but you always should have a look inside before you move in".

Most company representatives talked openly about company structures and the working atmosphere - information only an insider can have. The fair was a perfect setting for informal networking; I left with new contacts in companies that usually do not advertise their job offerings."

School Programs of the Future Ocean – The Ocean:lab of the Kieler Forschungswerkstatt

In the Ocean:lab at Kiel University students from grade 3 to 13 can experiment and work on different topics in the marine sciences. The "Future Ocean" Cluster of Excellence facilitates the general and specific education and supports teachers' further education and advanced training in the Ocean:Lab.

Marvel, experiment, try out – learning is fun in the Ocean:lab of the Kieler Forschungswerkstatt!

Appropriate to their respective level of study, students get fascinating insights into marine sciences and the working methods of real scientists in the ocean:lab. Offers address entire school classes as well as interested students. Moreover, the programs complement the natural science curricula of schools and are a worthwhile addition to lessons at school.

Marine Science programs:

The Baltic Sea as a natural habitat

The Baltic Sea is a unique natural habitat. Changing abiotic factors, e.g. salt concentration, require high adaptability of the indigenous plant and animal species. The research focus of this program lies on the living creatures of the Baltic Sea which live in a complex relationship to each other. Starting with plankton, student groups examine the different levels of the food web and their relationship to each other. Human intervention in the ecosystem "Baltic Sea" and its consequences are also highlighted in this section.

The Ocean" as an ecosystem and how it is affected by anthropogenic impacts

The ocean is a very complex and exciting ecosystem and habitat. 95 percent of the sea floor have not been or have barely been explored yet and regularly present new research questions to marine scientists. Moreover, economic utilization of marine resources is becoming increasingly important, but at the same time it endangers this sensitive habitat. The program offers an integrated investigation of the ecosystem "ocean" with a focus not only on biological aspects. The interdisciplinary program focuses on both biotic and abiotic factors of the habitat. Building on professional fundamentals, hazards for this habitat are explored thoroughly. Afterwards, reasons as well as ideas for improvements are discussed. In addition to pollution of the ocean through plastic waste and noise, the effects of climate change and eutrophication will play a role in discussions and tasks.

Project about man-made underwater noise pollution and its hazards for harbor porpoise

Man-made underwater noise pollution is an increasing problem for the marine environment, especially marine mammals, such as the harbor porpoise. Its sensible sense of hearing is essential for echolocation, a technique which helps those animals to find prey and for orientation. Their sense of hearing can be impaired temporarily or permanently by underwater noises originating from pile-driving for building offshore wind farms, sonar systems, military-induced underwater explosions, ship traffic and the like.

School students were eager to find out more about underwater noise and how it influences living conditions of harbor porpoises in the Baltic Sea. In the framework of a cooperation between the Institute for Terrestrial and Aquatic Wildlife Research of the University of Veterinary Medicine Hannover and Kiel University several modules on underwater noise pollution have been developed. The project is co-funded by Interreg IVa Syddanmark-Schleswig-K.E.R.N. with means of the European Regional Development Fund (EFRE).

Expedition boxes on this topic can be rented by school classes for free. Projects included:

Theoretical part:

- Sound propagation in liquids (especially salt water)
- Acoustic measurement methods
- Sound in the ocean: natural and artificial (man-made) sound sources

Practical part:

- Identification of different sound sources under water through hydrophone measurements in Kiel Fjord and in Fjord & Baelt Center, Kerteminde, Denmark.
- a module on the reduction of sound emissions is constructed: an air bubble which is used in the wind farm industry to reduce sound emissions in order to protect marine organisms, especially marine mammals.

Teacher Training in marine sciences:

- Two teacher trainings - one especially focused on plastic in the ocean and the preparation for the International Coastal Cleanup Day - were realized. More than 40 teachers were participating. The equipment used was from the expedition boxes, which can be loaned by teachers for project works.

For further information on the expedition boxes, loan and conduct of the experiments, contact Dr. Kartin Knickmeier at the Kieler Forschungswerkstatt: kknickmeier@uv.uni-kiel.de
www.forschungs-werkstatt.de

Teacher training of The Kieler Forschungswerkstatt

The Kids' and Students' University of Kiel University – More than 1,500 Students Have Sniffed Researcher's Air

Arne Körtzinger explains to school children, how long it takes for various materials to decompose in the ocean.

Kiel's kids' and students' university has become a fixed date in the calendar of many school students ages eight to twelve. In autumn 2014 the popular lecture series started in the main auditorium of Kiel University for the seventh time. For 60 minutes the large lecture hall belongs solely to the interested junior researchers. Their parents have to retreat to the foyer of the lecture hall, but can follow the lecture live in the parents' cinema. Between 70 and 100 parents shorten their waiting time here.

The kids' and students' university provides the young listeners with exciting insights into the world of science and, in particular, marine sciences. Topics such as robots for the exploration of ocean currents, the life of octopuses, dangers from the ocean or recent results from climate research regularly are among the most popular lectures. But exciting stories can also be found in other subject areas and so the kids' and students' university increasingly also offers lectures from the research landscape of the entire university. The aim of all lecturers and organizers: Children are curious and are often inspired to experiment themselves by listening to exciting stories of science.

The Cluster of Excellence "The Future Ocean" aims to arouse this interest with the help of the kids' university. In its seventh year the kids' and students' university has once again been organized by the Kiel Cluster of Excellence "The Future Ocean" together with the Leibniz Institute for Science and Mathematics Education at the University of Kiel (IPN) and is supported by Kiel University.

Coastal Cleanup Day 2014 on Kiel's Coast

In 2014 September 20th was international Coastal Cleanup Day and Kiel's citizens were part of it! The aim is to collect waste that has been washed ashore on as many beaches of Kiel's coast as possible. Supported by the Cluster of Excellence "The Future Ocean", the Leibniz Institute for Science and Mathematics Education (IPN) Kiel and private businesses of Kiel, the Coastal Cleanup Day 2014 sent a signal against the growing pollution of oceans and coasts. The Coastal Cleanup Day 2014 took place at numerous other locations on all continents simultaneously. More than 650,000 volunteers all over the world took part in it.

It is impossible to avoid the topic "waste in oceans" in 2014: In particular, plastic waste accumulates in gigantic vortices in the world's oceans. Micro plastic can be found nearly everywhere in the world's oceans, and coasts around the globe are drowning in up to 6.4 million tons of plastic waste per year. The consequences for ocean biocoenoses and food webs are unpredictable. Tiny bits of plastic can even be found in the human body nowadays. To draw attention to this world-wide phenomenon, the US-based non-governmental organization Ocean Conservancy has organized the international Coastal Cleanup Day on the third weekend in September for nearly 30 years. In 2013, 5.5 million tons of waste were collected worldwide on about 20,000 km of coastline.

The Ocean Laboratory of the Kieler Forschungswerkstatt assigned seventeen locations for cleaning up around the Kiel Fjord to teachers and their students, educators and their preschoolers and their teachers, as well as volunteers from associations in Kiel for September 20, 2014. All of them were extensively informed and they removed all sorts of waste from the 15 km of coastline. Everything found was collected, sorted, weighed and documented in standardized lists. The ocean laboratory posted the results in the world-wide data base of the Ocean Conservancy.

Financial and material support for the Coastal Cleanup Day in Kiel this year came from numerous sponsors and partners in the area of science and business. In addition to the Cluster of Excellence "The Future Ocean" and the Leibniz Institute for Science and Mathematics Education (IPN) , in particular local firms made the event possible with their support and helped raise awareness of the Coastal Cleanup on a regional level.

In November the results of the Kieler Participation in the International Coastal Cleanup Day were presented during one week for sustainability in the Municipality of Kiel.

Children help to clean up the beach at Laboe, close to Kiel, at the coastal cleanup day 2014.

PARTNERS

I believe everyone should have a broad picture of how the universe operates and our place in it. It is a basic human desire. And it also puts our worries in perspective.

Stephen Hawking

Future Ocean Meets LabexMER in Brest, France

In November 2014 a delegation of twelve representatives from Future Ocean took part in a two-day workshop and conference with the Cluster of Excellence LabexMER in Brest, France on the topic of "Interdisciplinarity in Marine Sciences: Crossover Experiences from Two Clusters of Excellence".

Six IMAP postdocs and three ISOS representatives spoke about their experiences working in the interdisciplinary environment of the Future Ocean and discussed the advantages and disadvantages of integrating different disciplines in the Marine Sciences with their counterparts in Brest. The workshops were combined with an evening "conférence" – a public discussion at the science center Océanopolis on "Global change and coastal zones: What future for ocean, for men... and for fish? One topic, three voices and multiple perspectives: Barbara Neumann, Jörn Schmidt and Catherine Meur-Férec". The introductory talks here were followed by a lively discussion with the public.

The participants from the Future Ocean were for the most part very pleased with the visit in Brest. In addition to the scheduled talks, all of them were able to meet individually with other scientists in Brest to discuss on-going and future possibilities for collaboration. "I really appreciated the inter-cluster workshop in Brest." commented Dr. Esther Regnier, postdoc in resource economics, "The scientific presentation enabled me to get an idea of what topics are addressed in the different labs." "My overall impression of the meeting between LabexMer and FutureOcean has been very positive." said Siren Rühs, ISOS PhD student at GEOMAR and added "I got the chance to meet Dr. Bruno Blanke, and his working group, who developed the ARIANE modeling tool that is fundamental to

my PhD project... a few weeks research stay at the Laboratoire de Physique des Océans (LPO) in Brest is considered for next year."
The workshops concentrating on the marine sciences take a long-standing cooperation between the sister cities Brest and Kiel to a new level. Here a few of the highlights of the Kiel-Brest partnership:

1964: Partnership Twinning Agreement signed between Brest and Kiel

1973: First general agreement on cooperation between Kiel University and UBO

2001 – present: ERASMUS – 9 bilateral contracts between CAU and UBO including one with the Walther Schücking Institute for International Law (since 2001) and one with GEOMAR (since 2013)

2013: MENTOR (Marine Network for Training of Researchers) network of education and research through cooperation between European post-graduate Schools in Oceanography (Kiel, Bergen, Bremen, Brest and Southampton). Focus on PhD students and training. Shared infrastructure (labs, experimental facilities). Memorandum of Understanding signed in 2013.

2014: July Meeting of Cluster managers and coordinators for internationalization, postdoc network, doctoral program in Kiel.

November Joint workshops and conference with the two clusters LabexMER and Future Ocean in Brest. Participation of Cluster scientists from Geology, Geography, Law, Economics, Biogeochemistry, Marine Ecology, Biogeochemical Modelling and from the Research Department of Kiel University

FOSTER FACILITATE OPEN SCIENCE TRAINING FOR EUROPEAN RESEARCH FP-7 funded project. Brest and Kiel are supporters of the project and scientists from both locations can take part in/host training events.

Further collaboration between the two clusters in the form of a second workshop in 2015 in Kiel, a postdoc exchange and at the PhD level cooperation within the framework of the MENTOR program is also planned for the future.

Nancy Smith, Coordinator Internationalization, nsmith@uv.uni-kiel.dE

Marine Science in a Sino-German Context: A Success Story Continues

Symposium and Summer School

In 2013 the 9th Chinese-German summer school "Dynamics of Atmosphere and Ocean Coupling" was hosted by the Sino-German Centre for Collaboration in Marine Sciences (SGMS) at the Ocean University of China in Qingdao and attracted more than 40 Master and PhD students from Europe and China. The summer school followed the successful format of previous schools presenting talks and practical sessions with an interdisciplinary approach. Moreover, the students were able to attend the 3rd Sino-German Symposium on Marine Sciences, which was held simultaneously in Qingdao. The scientific foci of the two events, which had around 100 participants from China, Germany, the UK and Australia, united a range of disciplines in marine, earth and climate sciences with talks considering the latest research findings in areas like mesoscale ocean dynamics in marginal seas, interdisciplinary research progress of coastal dynamics, regional climate modelling, impacts of climate variations on coastal environment, impacts of climate change on coastal marine life processes.

By integrating scientists of multiple disciplines and from 26 German and Chinese universities and research institutes, these events brought together a wide range of expertise and state-of-the-art scientific knowledge from both countries.

Participants of the 9th German-Chinese summer school in Qingdao (China) gather for a group photo.

Prof. Zhanghua Lou (center) and Prof. Zhi-Guo He (left) from the Ocean College at Zhejiang University visit Karl Stattegger (right), professor for sedimentology at Kiel University for talks about cooperation and mutual developments in marine sciences.

Highlights

Taking further measures to enhance the cooperation between Kiel Marine Sciences and the Ocean College of the Zhejiang University in Hangzhou, China: From 26th March to 1st April, 2014 a delegation from the Zhejiang University paid a visit to CAU and GEOMAR research facilities in order to foster the ties between Kiel and Hangzhou through the establishment of new contacts for future collaborations in both the academic sector and joint research projects.

In 2013/2014 nine CSC scholarships for PhD students from China have been successfully raised by the consultant support of the SGMS. Moreover, in the framework of the recent application call jointly announced by BMBF and SOA, 9 proposals from the Kiel Marine Science community were submitted, two of which were approved by the BMBF.


DEPTHGUIDE
MANIPULATOR

PEOPLE

What I'd really like to control is not machines, but people.

Stephen Hawking

ICES Merit Award for the Best Poster Presentation Goes to Kiel University

Rudi Voss of Kiel University, Germany and his colleagues Martin F. Quaas, Jörn O. Schmidt, and Lorena Fricke were presented with a merit award for the best poster presentation during the International Council for the Exploration of the Sea (ICES) Annual Science Conference 2014 in A Coruña, Spain. The award raised a lot of attention, especially as the group managed to win the prestigious prize for the second time in a row.

ICES is a global organization that develops science and advice to support the sustainable use of the oceans. It comprises a network of more than 4000 scientists from almost 300 institutes, with 1600 scientists participating in activities annually. Over 600 marine scientists gathered for a week-long conference in A Coruña on the topic "Sustainability in a changing ocean" and exchanged the latest and thought-provoking marine research with their peers. A total of 17 thematic sessions covered a wide range of topics, including integrated ecosystem management, marine protected areas, ecosystem dynamics, and ocean acidification. The winning poster was entitled 'Four fish in 2048 -What will be the status of the wild ones?' Using an ecological-economic multi-species model, the researchers assess the importance of economic drivers on changes in future stock status. They simulated (i) technological progress reducing catching costs, (ii) increasing demand for fish, and (iii) higher supply with farmed fish as well as their interplay under different scenarios of management effectiveness. In the model, stock dynamics are interlinked by economic drivers (substitution elasticity in demand), expanding the traditional view of ecological interaction by including market interactions. It is shown that increasing aquaculture production can dampen the pressure on wild stocks. It can, however, only partly counteract the effects of technological progress and increasing demand. The only solution to prevent future stock collapse in four out of six investigated cod and tuna stocks is increased management effectiveness. The jury especially acknowledged the high interest drawn by the poster as well as the dynamic presentation. The combination of an appealing and entertaining comic strip with complex innovative research was striking and made it easy for participants to understand the importance of economic drivers on changes in world fisheries. The work presented is a contribution to the Cluster of Excellence 'The Future Ocean' of Kiel University as well as the BMBF-funded research project BIOACID 2.

Dr. Rüdiger Voss, Kiel University, Department of Economics,
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Rudi Voss explains his award winning poster on Successful, and Commonly Accepted Fisheries Management at the ICES conference in A Coruna, Spain (see also p 26 of this booklet for a report on this project).

International Mobility with P.R.I.M.E.

With his first proposal in the first call of the newly launched Postdoctoral Researchers International Mobility Experience (P.R.I.M.E.) program by the German Academic Exchange Service (DAAD) Jörn Thomsen, postdoc at the GEOMAR Helmholtz Centre for Ocean Research, Kiel, scored a win.

The DAAD call was highly competitive and attracted 344 project proposals of which the 31 best were funded. Jörn Thomsen succeeded with his ideas for a collaborative project between Scripps Institution of Oceanography in San Diego, California, USA and Kiel University. His research project focuses on the still largely unknown mechanisms of acid-base regulation and ammonia excretion in mussels and oysters. The results of this study will contribute to understanding how marine invertebrates cope with environmental stress such as the continuing acidification of the oceans. For this purpose, bivalves will be exposed to different experimental treatments such as different seawater pH levels and ammonia concentrations and their physiological responses will be determined. Starting September 1st, 2014, Jörn Thomsen has the unique opportunity to spend 12 months in the laboratory of Assistant Professor Martin Tresguerres at Scripps to expand his expertise in the field and learn approaches that were not available to him while working in Kiel. Also included in the new funding scheme is a phase of six months following the period abroad to reintegrate into a research group at a German host university. Thus, in 2015 Jörn plans to continue his work in the group of Prof. Markus Bleich, Institute for Physiology at Kiel University and hopes to transfer the new expertise acquired at Scripps to Kiel Marine Sciences.

Jörn Thomsen grows mussels in his lab during his 1-year visit at Scripps Institution of Oceanography, La Jolla, USA.

With the new program and funding from the Federal Ministry of Education and Research (BMBF) and the People Program (Marie Curie Actions) of the European Union, the DAAD provides support for international mobility for postdocs of all nationalities. The program is special in that the postdocs will be employed for the entire funding period of 18 months at the German host University on a regular contract –not a fellowship. Further, the German mentor provides a 6 months perspective for continuing research in Germany following the time spent abroad.

First Future Ocean Capacity Building Workshop June 2013

In June 2013 members of Future Ocean involved in Capacity Building projects joined in the first Future Ocean Capacity Building Workshop to present their projects and discuss the whys and hows of capacity building. The workshop was led by Prof. emeritus Venugopalan Ittekkot of Bremen University and was open to all Cluster members and members of ISOS and IMAP. Prof. Ittekkot is a biogeochemist and was Director of the Leibniz Centre for Tropical Marine Ecology in Bremen from 2000 to 2010. His research interests focus on coastal and oceanic fluxes and cycling of carbon and other nutrient elements under natural and perturbed conditions. Prof. Ittekkot has been involved in capacity building measures for over 40 years and is currently chair of the SCOR Committee on Capacity Building. Prof. Ittekkot opened the workshop with an introduction to capacity building entitled "What is Capacity Building and Who Does it Benefit?" The following projects were presented by members of the Cluster:

- Karl Stattegger – UNESCO Chair in Marine Sciences and Coastal Research
- Arne Körtzinger – GEOMAR in Cape Verde
- Arne Biastoch/Peter Brandt – SPACES Science Partnerships for the Assessment of Complex Earth System projects in southern Africa
- Martin Wahl GAME Global Approach by Modular Experiments
- Kirstin Krüger – Capacity Building cruises on the RV Sonne

Prof. Joao Mugabe of Eduardo Mondlane University in Maputo presented the new Masters program jointly developed with Karl Stattegger and joined in a round table discussion of capacity building measures. A total of about 25 Cluster members participated in the workshops. A second workshop on the topic of Capacity Building in the context of Ocean Governance will take place in 2015.

Nancy Smith, Coordinator Internationalization, nsmith@uv.uni-kiel.de

Prof. Venugopalan Ittekkot from the Center for Marine Environmental Sciences (MARUM) in Bremen talks about measures and opportunities in capacity building at the Kiel University in Summer 2013.

An initial workshop on the merits and opportunities in capacitiy building was organized at Kiel University in 2013. A number of measures were discussed for their impact on sustainable capacity building development.

EVENTS

Not only does God play dice, but... he sometimes throws them where they cannot be seen.

Stephen Hawking

FUTURE OCEAN DIALOGUE: LET'S GO BRAZIL!

The Travelling Exhibition Was Shown in Five Major Cities in Brazil During 2014

Last summer Brazil was especially interesting for Kiel marine scientists not only because of the Soccer World Cup. At the conclusion of the German-Brazilian Year the international traveling exhibition, the "Future Ocean Dialogue", conceived jointly by the Cluster of Excellence "The Future Ocean" and GEOMAR Helmholtz Centre for Ocean Research Kiel, opened its doors in Brazil.

The exhibition project is the result of an invitation from the Foreign Office in Berlin. The modular and easily transportable exhibition, developed in Kiel, is one of the highlights at the conclusion of the German-Brazilian Year 2013-2014 and was organized together with the Brazilian project partner, the DWIH in São Paulo and the DAAD. The goal of the traveling exhibition is to present current questions in marine research with their interdisciplinary solution approaches and, at the same time, advertise Germany and Kiel as excellent places to do research. The target audience includes the interested public, school and university students as well as decision makers from politics, business and science.

With the help of several examples, the exhibition casts a spotlight on changes in the world's oceans and the interdependency between humans and the ocean: The topic Ocean – Climate Buffer? explains the influence of the ocean on the global climate and shows how marine biotic communities react to rising CO2 concentrations. The area Sustainable Fisheries illustrates how sustainable fisheries management can contribute to combatting overfishing in the world's oceans. Global, innovative ocean observation systems as a basis for modern marine research are the topic of the module Ocean Observation. Development of Coastal Zones explains how humans influence the development of the coasts and how sustainable coastal management contributes to solving conflicts over utilization. Waste Accumulation is a very topical subject, which is also addressed in the exhibition. Why does waste accumulate in the ocean, how long does it remain there and what consequences does it have for marine ecosystems? In conclusion the module Resources from the Deep Sea tells how the sea floor is being studied in the search for resources and which resources can be found there. In addition it explains how to legally regulate future use and whether it can be designed in an environmentally compatible way.

The exhibition toured through Brazil during the course of the year; the cities Rio de Janiero in July, Natal in September, Sao Paulo in October and finally Itajai in the South of Brazil are on the list. And when the exhibition container returns to Kiel at the end of 2014, this is just the beginning. The exhibition "Future Ocean Dialogue" is designed in such a way that it can be easily adapted for any international location and thus it will continue to carry the message of Kiel Marine Sciences throughout the world.

Exhibition blog on www.oceanblogs.org/futureoceandialogue;
web presence www.futureocean.org/dialogue

CAMPAIGN REPORT

Activating Sea Memories for a Future Ocean Dialogue

The Future Ocean Dialogue exhibition gathered thousands of visitors in five major Brazilian cities. The modules communicated cutting edge information about oceanographic research and marine policy to a broad public. A joint campaign was promoted in collaboration with the Sea Memories Collective to enable the activation of visitors' maritime memories when envisioning the future of the Ocean. The bridging of ideas was taken forward through artistic expression or structured conversations, resulting in concrete proposals to move the Future Ocean Dialogue forward. This report describes the main outcomes of the campaign and reiterate that it has become clear that a novel national-level organization is needed to bridge existing gaps between scientists, policy makers and society in terms of cutting-edge information about the sea.

In 2014, the Sea Memories Collective and the Cluster of Excellence "The Future Ocean" held a series of activities in the context of the German-Brazil cooperation year. These events were celebrated along with the touring of the Future Ocean Dialogue exhibition in five Brazilian cities, offering opportunities for a parallel campaign between these organizations, entitled "Activating Sea Memories for a Future Ocean Dialogue".

The campaigns' objective was to undertake activities in parallel to the exhibition, enabling the integration of science, arts and public policies in the coastal-marine realm - boosting its impact in terms of public outreach and learning experiences. The intention was to bridge the exhibition attendees' own localized memories of the sea into a reflexive, critical and ludic dialogue about the future of the Ocean. Therefore, the following activities fostered an even more extraordinary visiting experience at the exhibition: additional modules (panels) with information and photos about the Brazilian coastal-marine context, 'Cordel literature' workshops with children, teenagers and other visiting groups; Future Ocean Dialogue Meetings with Brazilian coastal-marine knowledge networks and a music and storytelling spectacle about the past and future of the Ocean.

Next, we will succinctly describe the activities undertaken as well as the general scope of the dialogue facilitated by the Sea Memories Collective team. Seven panels were designed in order to contextualize the exhibition with Brazilian images and information, following aesthetic resonance with the exhibition modules. The first panels provided a general context about the joint campaign and the role of the Sea Memories Collective in bridging visitors memories about the sea to the topics raised by the exhibition. The next set of panels brings the scope for thought necessary to enable such a connection. The arguments presented in print cuts across other parallel activities undertaken by the joint campaign.

In order to plan the future, it is of uttermost importance to understand the past, the changes occurring across Brazilian beaches, rivers, mangroves, coral reefs and with all living creatures here. Scientists, fishers and other people living by the sea all have knowledge about these environments. This precious memory is sheltered in books, encyclopaedias and scientific publications, research laboratories and in the global information network

Visitors with a giant model of Coccolithophorides, planktonic (swimming) micro algae. The exhibition model explains some of the effects and pressures on ecosystems due to ocean acidification.

(internet); tales, stories, songs and experiences lived in all parts of our littoral -- and also transmitted to future generations through oral communication.

The partners of the campaign 'Activating Sea Memories for a Future Ocean Dialogue', acknowledge and respect the importance of all knowledge. For this reason, we believe that scientists, fishers, governmental authorities and other sea lovers can together understand past mistakes so as, also together, to better navigate future generations sustainably. With these words we invited all visitors to take part in this dialogue. To do so, we show next how we are building a Programmatic Agenda for Coastal Marine Networks, as well as some ludic and scientific methodologies we can use to help us converge in this dialogue.

The programmatic agenda sets a general structure for a coastal-marine transformative knowledge network to operate towards the Future Ocean. This common agenda was set during the Ombudsperson of the Sea, a civil society self-governed event held at the People's Summit (Rio de Janeiro, 18th June, 2012) with the objective of creating opportunities to understand the crisis and to promote proactive agendas amongst coastal-marine networks. One of the major outcomes of the Ombudsperson of the Sea event was the creation of the Shared Communication Environment based on Internet and social media mechanisms. Furthermore, a set of 25 propositions for the future were made, some of which were presented to the public at the exhibition. We offered some propositions for consideration and debate, including recommendations. Our panels purposefully focused on sets of issues and recommendations related to the role of Marine Protected Areas (MPAs) as Ocean governance tools. We explain to visitors that MPAs are special maritime spaces located in critical areas that can conserve biodiversity and maintain essential services to mankind (e.g., fisheries, tourism and transport).

Cordel workshops

''Cordels' are popular and inexpensively printed booklets or pamphlets containing folk novels, poems, drawings and songs, which are produced and sold in fairs and by side-street vendors in the Northeast of Brazil. The entire activity (exhibition visit + workshop) took about six hours and was meant to use Cordel literature as a ludic-pedagogic tool for improving readership, writing and creativity. This workshop stimulated transdisciplinary dialogue and contextualized worldviews by giving voice to citizens through artistic and cultural expression. After visiting the exhibition, the Sea Memories Collective provided a general overview into the history of Cordel literature and its basic poetic structuring. Afterwards, each participant was invited to produce his/her own poetry, sharing with others while critically discussing preferred topics of choice.

A total of seven Cordel workshops were held in Fortaleza and Itajaí during the campaign. These events gathered children and teenagers from public schools and their teachers together, the latter being able to be introduced to the methodology for future application.

In Fortaleza, one workshop was held with Cordel professionals from Ceará state. Another noteworthy interaction also occurred after our Cordel workshop in Fortaleza. Firstly, we welcomed for the workshop a group of teenagers from a community-based marine protected area, namely the Prainha do Canto Verde Marine Extractive Reserve. On the weekend following our workshop, we were invited by them to take part in a community celebration of the 5th anniversary of their MPA. The youngsters we welcomed for the Cordel workshop were able to voice-out their work in the official opening ceremony of their festivities.

In Natal, we decided to focus on more spontaneous activities around a 'Cordel space' mounted on with information and material about this Brazilian literary culture, where many visitors were able to sit down, talk with our team and enjoy a reflective moment. It was a positive alternative because we could have a dialogue with many visitors with a more informal approach and by occasional demand. Several important contacts were made with local artists, scientists and other people wanting to connect with our work and therefore we found this approach to be productive as well.

Opening of the ceremony in Itajaí (Santa Catarina state)

Several members and partners of the Sea Memories Collective reside in the city of Itajaí. Therefore, we were able to prepare a special opening ceremony for the exhibition. In partnership with UNIVALI's oceanography department, the opening reception included a musical/story-telling show and a formal talk by the university rector, the municipal secretary of fisheries of Itajaí and a representative of the Sea Memories Collective. The show

Brazilian school children from a small fishing community during a cordel workshop at the Future Ocean Dialogue Exhibition in Fortaleza, Brazil. Some of the cordel booklets made by the pupils can be seen hanging from the line in the upper right corner of the picture.

The Future Ocean Dialogue Exhibition was set up at the Drago do Mare Cultural Center in Fortaleza Brazil in May-Juy 2014.

overall told the story of social-ecological transformations in an idealized beach, providing a general frame and storyline whereby more local facts and figures as well as legends were creatively built and considered. The performance was produced by two key partners of the Collective.

Future Ocean-Dialogue with coastal-marine networks

The Campaign was also concerned with increasing opportunities for a more focused science-policy dialogue within the context of the Future Ocean Dialogue exhibition. Therefore, we promoted three events engaging relevant stakeholders in critical knowledge-cafe type workshops around topics of interest from the exhibition and from Brazilian coastal-marine networks.

The basic methodology of facilitation for the Future Ocean Dialogue was based on three interchangeable axes of dialogue, including:

- What gaps in the science-policy interface need to be addressed for the Future Ocean? What knowledge networks are present in the science-policy interface?
- How can we engage with these networks and channel information to create synergy in the science-policy interface?

In Ceará state, we gathered institutions working with coastal marine issues together, including oceanography and environmental sciences' students from Universidade Federal do Ceará and other local actors from prominent social-environmental NGOs such as Instituto Terramar and Aquasis. A descriptive report was produced to record the memory of issues and opportunities envisioned during the event. However, the major outcome was from a networking perspective, once a social-media based forum was immediately created to enable continued communication. The Sea Memories Collective was able to foster cross-national links with groups concerned with the interface between science and advocacy.

The Future Ocean Dialogue workshop in São Paulo was a complete success and resulted in a white-paper entitled 'A call for a continued Future Ocean Dialogue - From Science to Society'. In October 2014 marine scientists and non-governmental organizations gathered to engage in a discussion on how to improve the knowledge transfer from marine science to the greater Brazilian audience in a way that could ultimately result in social and political change. From impulse lectures and vivid discussions emerged the need for an organizational body to support, improve and handle cross-disciplinary and multi-level communication to strengthen the interface of science and society. The workshop proposed discussions about and ultimately the designation of a novel Brazilian organization that pushes a "Future Ocean" agenda forward by strengthening cross-disciplinary and multi-level communication and practice to improve the interface of science and policy. Furthermore, this novel Brazilian initiative is expected by the participants to work in close cooperation with equivalent initiatives in Germany (e.g. such as the Future Ocean Cluster of Excellence) towards mutual and creative exchange.

In Itajaí (Santa Catarina state), the workshop was held as an activity of the Universidade do Vale do Itajaí (UNIVALI) graduate program in Marine Sciences and Technology. The event brought graduate students, researchers and several members of the Sea Memories Collective together, Itajaí is where most of the group is based. It was a unique opportunity for the group to get in touch with an updated perspective on pressing scientific issues and on-going institutional processes related to the Future Ocean. In all events, a general sense of the need for continued dialogue and connectivity to tackle the science-policy interface remains as the most highlighted outcome. Therefore, the Sea Memories Collective remains very much interested and willing to take forward the Future Ocean Dialogue in the upcoming years and expects to continue to engage the networking and knowledge capital accumulated through the joint campaign outcomes reported here.

Excerpt from a report by Leopoldo Gerhardinger, The Sea Memories Collective, Brazil.

GAIN 2014

The 14th annual GAIN conference took place in Boston (USA) from September 5-7, 2014. GAIN stands for German Academic International Network and is the largest conference outside of Europe for young German scientists conducting research in the USA or Canada who are seeking to get back in touch with German scientific institutions, universities or industry. GAIN 2014 attracted more than 400 young researchers from all scientific areas, especially from Biology, Medicine, Chemistry, Physics, Informatics, Engineering and the Humanities.

The conference focused on the various opportunities for young scientists to continue their careers in Germany and allowed for networking with about 120 high-ranking representatives from academia, politics and industry. Among them were the state secretary of the Federal Ministry of Education and Research as well as representatives of the parties in the Bundestag who gave insights into current and future research funding initiatives and their educational policy agenda. Panel discussions with representatives of German research organizations focused on career perspectives for postdoctoral researchers and answered their questions. Workshops offered practical tips for finding and applying for the right positions in the academic and non-academic labor market. More than 70 exhibitors from German universities, research organizations and industry at the largest talent fair on career opportunities in Germany outside Europe informed about open positions and fellowship programs.

Kiel University with its Clusters of Excellence 'The Future Ocean' and 'Inflammation at Interfaces' as well as the graduate school 'Human Development in Landscapes' also presented its research profile at the conference. 'Kiel University with its focus areas and research networks wants to present itself as an attractive location for young researchers from the USA and Canada. And we want to make the clever people currently conducting research in an international environment aware of our programs,' says Dr. Gesche Braker, Coordinator of the Future Ocean postdoc network IMAP (Integrated Marine Postdoc Network). 'But we also see the conference as a unique opportunity to learn about their critical views from outside the academic system in Germany and what needs to be done for them to decide to return'. The active participation of top-level representatives from German politics and research funding agencies demonstrates that the close contact with young researchers who have collected international experience is extremely valuable in the German academic system, one of those which still offers attractive career opportunities.

Gesche Braker, Coordinator of the Future Ocean Postdoc Network IMAP, gbraker@uv.uni-kiel.de

Nicole Voss from the Kiel University explains opportunities in Kiel to visitors at the stand at the GAIN conference in Boston, USA.

Translating the Blue

In cooperation with the Cluster of Excellence "The Future Ocean" at Kiel University and the Muthesius Academy of Fine Arts the film essay "Translating the Blue" was developed by filmmaker and Muthesius Professor Stephan Sachs. The film made while on a research expedition in the South Atlantic aboard the research vessel L 'Atalante, under the leadership of Prof. Peter Brandt from GEOMAR Helmholtz Centre for Ocean Research Kiel, was finally presented to the public in 2014.

Muthesius professor and member of the Cluster of Excellence "The Future Ocean" Stephan Sachs explores the ocean in his film essay. Based on images taken on a research expedition in the South Atlantic, the film examines the various forms of approaching reality. The main protagonist is the sea, the ocean. It is constantly present in a variety of forms, in picture and sound. It is also the research subject for the scientists. They are oceanographers; they are trying to understand the ocean currents. Here imaging techniques based on mathematical calculations are indispensable. Models, attempts at translation, even poetical translation, are a central theme of the film. This occurs at different intertwining levels: from the image description at the beginning of the film, to the collection of German-English collections of terms from oceanography and art down to asking one scientist about the beauty of the formulas, from old dioramas from natural history museums to fictional letters from aboard a ship, from observations of data collection at sea to a model that predicts the distribution of radioactive cesium in the Pacific from Fukushima.

Stephan Sachs, film / time-based media, Muthesius Academy of Fine Arts and Design, Kiel, sachs@muthesius.de

CELEBRATING THE DAY OF GERMAN UNITY

Kiel Presents a Fascinating Exhibition into the World's Oceans

On October 2nd and 3rd, the official celebrations of the Day of German Unity are annually held in a different German state capital to mark the anniversary of the nation's unification. It remembers when the Federal Republic of Germany and the Democratic Republic of Germany united to create one single, federal Germany on October 3, 1990. In 2013 hosted Stuttgart and in 2014 Hannover atmospheric festival. The event usually attracts more than 500.000 visitors. GAIN 2014 attracted more than 400 young researchers from all scientific areas, especially from Biology, Medicine, Chemistry, Physics, Informatics, Engineering and the Humanities.

On the "Mile of German States" ("Ländermeile") Schleswig-Holstein traditionally presents the exhibition "Exploring the Ocean" and gives exciting insights into the deep sea and current issues in marine science. Schleswig-Holstein is the land in between the seas. But this northernmost state is not only dominated by the seas geographically: The sea plays a major role in business, culture and science as well. This is also reflected in Schleswig-Holstein's presence at the official celebrations of the Day of German Unity. In Schleswig-Holstein's presentation on the Mile of German States, an exhibition of the Cluster of Excellence "The Future Ocean" and GEOMAR Helmholtz Centre for Ocean Research Kiel leads visitors into the dark and mysterious deep sea where they can explore unknown regions of our planet and learn how scientists explore these regions today.

Diving into unknown worlds: The unique "Kiel World Relief" and an unusual globe give visitors a first impression of what the surface of our planet really looks like - even where we can only see water on conventional world maps. Mountains and canyons are not restricted to land alone. Towering mountain ranges and deep trenches also meander through the oceans. They not only present an interesting underwater topography but also tell a lot about the forces acting within the Earth. Surrounding these central exhibits are groups of additional current topics in marine research, some of them presented as interactive modules. Visitors can learn how modern scientists receive information from the ocean interior to better understand natural climate variability and predict future climate changes. One vital topic for many sea creatures is ocean acidification and its effect on the survival of these species. Fishing is also a central issue: How much are fish stocks overfished? What fish can I eat with a clear conscience? And how could fishermen earn more with careful use of existing stocks? Original samples from the sea floor give visitors a direct view of the strange and fascinating world of the seabed: A drill core from the Baltic or a piece of lava from deep waters off the Cape Verde Islands. Original and model versions of complex research equipment give an impression of the technical effort needed to explore and understand the largest habitat on Earth.

Visitors exploring the interactive poster at the exhibition of the Day of German Unity in Hannover, lower Saxony, Germany.

NEW IN 2014 – THE THIRD EDITION OF THE WORD OCEAN REVIEW

Resources from the Sea – Can the Ocean Solve the Resource Problems of the Future?

The "World Ocean Review 3 - Raw materials from the Sea - Opportunities and Risks" (WOR 3), published by the non-profit organization maribus gGmbH with the support of the magazine mare, the International Ocean Institute (IOI) and the Cluster of Excellence "The Future Ocean", describes in detail the known metal and energy commodities in the oceans and illuminates in a scientifically sound and for the layman comprehensible manner the opportunities and risks of mining operations and the use of raw materials in the sea.

The hunger of mankind for raw materials continues unabated. Oil consumption has doubled since the early 1970s, and the demand for mineral resources is increasing with the ever growing use of metals, such as copper, nickel or cobalt, in electronic products like smart phones, solar panels or hybrid cars. The raw material deposits at the bottom of the oceans are coming more and more into the focus of interest. But when will mining become economically feasible? Which environmental risks must be considered? And who then may claim the deposits located in international waters?

The new report provides facts about the amount of known oil and gas reserves and the solid gas hydrate deposits below the seafloor. Furthermore, it elaborates on the potential of mineral resources such as manganese nodules, cobalt crusts and massive sulfides. In addition, the report focuses on the responsibility of the international community for environmentally sound exploitation and the international legal challenge for socially just distribution of resources in international waters.

World Ocean Review discussion: Dr. Philip Bethge (Moderator), Dr. Sven Petersen (GEOMAR), Dr. Christian Reichert (Bundesanstalt für Geowissenschaften und Rohstoffe, BGR) member of the International Seabed Authority ISA and Dr. Gerd Schriever from the Biolab Research Institute.

"The use of the oceans will increase in the future. In order to have environmentally sustainable resource extraction from the sea and from the coastal areas, all stakeholders must work together on achieving sustainable solutions," says Martin Visbeck from GEOMAR Helmholtz Centre for Ocean Research Kiel and speaker of the Cluster of Excellence "The Future Ocean".

In contrast to rapidly renewable resources, such as fish or shellfish, mineral and energy resources are formed only over the course of many millions of years. There is a finite amount of resources which can be extracted only with great technical effort. "When huge business opportunities lurk beyond our perception, there is a risk not only to the environment but also to basic human rights and social justice. In particular, large corporations - which have produced oil in West Africa for many years - saw no need in the past to protect nature or to give the local population a fair shot at participating in the oil-related revenues," says Nicholas Gelpke, publisher of mare and founder of maribus gGmbH.

World Ocean Review

The maribus gGmbH was founded by mare publisher Nikolaus Gelpke in 2008. It serves as a non-profit organization with the objective of raising public awareness of marine scientific relationships and contributing to a more effective marine conservation campaign. Already the first maribus publication, the "World Ocean Review 1" (WOR 1), succeeded in delivering a comprehensive and unique report that showed the state of the oceans and the relationships between the ocean and the ecological, economic and socio-political conditions. To date, approximately 70,000 copies of this overview in German and English have been in demand worldwide. The second edition "The Future of Fish, the Fisheries of the Future" focuses on the future of fish and their exploitation. The third maribus publication, "Raw materials from the Sea - Opportunities and Risks", has continued the cooperation with the partners of the WOR who represent years of commitment to the oceans and top-level academic standards, the International Ocean Institute (IOI), founded in 1972 by Elisabeth Mann Borgese, the Cluster of Excellence "The Future Ocean" and mare - The Magazine of the Sea. The publication is not sold but distributed free of charge, without any profit-making objectives. In addition to the German version, an English edition is also available. The entire publication is published simultaneously on the Internet under *www.worldoceanreview.com*.

KIEL MARINE SCIENCE AT THE KIEL WEEK

Presentations, Exhibitions and Open Ship Offered a Varied Program for Young and Old

Tradition dictates that Kiel Week focuses on the ocean. The regattas on the water play an important part. Yet those interested in life in the water and in the exploration of the oceans don't need to miss out. This is guaranteed by the program offered by GEOMAR Helmholtz Centre for Ocean Research Kiel and the Cluster of Excellence "The Future Ocean".

In 2014 Kiel Week posters spoke for themselves: Kiel is and will always be connected to the sea, whether in terms of sport or science. Those interested in topics on marine research had the chance to enjoy a full program. GEOMAR Helmholtz Centre for Ocean Research Kiel and the Cluster of Excellence "The Future Ocean" offered a varied program with presentations, exhibitions and the traditional Open Ship. The events ran under the motto "The Sea – Our Blue Miracle" and were also part of an event series by the Ministry for Transport and Digital Infrastructure. Renowned Kiel scientists talked about the current status of their marine research in an evening lecture series. Micro plastics and their effects on marine organisms were presented at the exhibition stand "Plastic in the Sea" in the Climate Protection Tent of the City of Kiel. The project GAME (Global Approach through Modular Experiments) at GEOMAR informed Kiel Week visitors about its worldwide research on the important topic of marine sciences here and in the display boxes at the quay in front of the aquarium. Aquarium visitors were able to view the particles which cause such a danger to ocean life up close through a microscope.

Further, young and old alike could playfully learn about sustainable fishing in the exhibition space of the Cluster of Excellence "The Future Ocean" in the Kiel University tent "kieler uni live" on the Kiellinie. The fish lengths game showed visitors how large a cod, plaice, or herring must be in order to have reproduced before landing on our plates. Another highlight is the digital poster on submarine landslides, a joint project between scientists from the Cluster of Excellence and the Muthesius Academy of Fine Arts and Design. On the display resembling a huge iPhone, visitors can learn about how underwater slopes can start to slide, a danger which does not affect Schleswig-Holstein but which can cause tsunamis in other countries, such as Japan.

At the popular "Open Ship" on the research vessel ALKOR the youngest visitors could experience marine science first hand with starfish, crabs, etc. Older visitors could take a look at the technology on board and current research projects. One highlight was the remote controlled underwater robot PHOCA.

Visitors exploring the interactive poster at the exhibition during the Kiel Week 2014.

Katja Kruse, teacher at the Forschungswerkstatt, explains the starfish on a model and living specimens to young visitors during Kiel Week 2014

Promotion of Application-Oriented Research

The Cluster of Excellence "The Future Ocean" covers a broad spectrum of maritime research topics. Many of these topics have applied aspects, which may be developed towards implementation. To support researchers with the first steps in the development of their topics, certain tools have been established. The event series 'Kieler Marktplatz' (Kiel Marketplace) is organized by "The Future Ocean" in cooperation with the Maritime Cluster Northern Germany and aims to bring stakeholders and people from different applied research communities together. A new funding program, the Maritime Technology Platform (MaTeP) was initiated with the goal of encouraging researchers and industry partners to conduct joint projects.

The Cluster of Excellence "The Future Ocean" conducts projects ranging from basic research aiming at understanding the systems related to the marine realm, to predictions of future scenarios and the development of solutions to deal with the challenges predicted by those scenarios. Within this strategy, many projects include applied aspects, which may have the potential to be exploited for the technical solution of a problem, or may warrant a management or political solution if applied in an adequate way. In particular for the transition of a project from basic research toward application, the project needs to be conducted by a joint team with expertise in both areas. It is the goal of the technology and knowledge transfer group, to offer a service allowing researchers and stakeholders to take the opportunity to develop these aspects. The strategy followed here covers two main aspects, getting partners and stakeholders together to discuss pressing topics and offering a tailored funding scheme, to allow researchers to actually conduct these projects with their partners.

Getting people together

The Kiel Marketplace event series, jointly organized by "The Future Ocean" in cooperation with the Maritime Cluster Northern Germany, supports scientists in expanding their networks with stakeholders. The Maritime cluster represents a network of maritime companies in northern Germany, and therefore represents a natural partner organization for this initiative. During these public events presentations on developing maritime issues are presented from scientific, economic and sometimes even a political perspective in short talks. The most recent marketplace, for example, addressed the topic of underwater imaging and image manipulation, a quickly growing topic not only in the maritime industry. With a potential audience of over 1500 people ranging from science, business, ministries and NGOs from Northern Germany, this event is well-suited to inspire talks, connect people and encourage networking among the maritime stakeholder communities.

Iris Hölken, participant in program "trade fair marketing", explains the latest research results for ecologically friendly antifouling coatings for marine applications to a visitor at the stand at OI 2014, London, UK.

Co-Developing Projects

Once partners have identified a mutual interest in the co-development of a project, either through a marketplace or through other established contacts, the question arises how such collaborations can be funded.

For this purpose, the Future Ocean maintains an open regular fast-track call for co-funded proposals as part of its Maritime Technology Platform (MaTeP). Within this call the cluster co-funds 50 % up to a maximum amount of 50.000 € for joint projects between Future Ocean researchers and external partners. Such partners can be either from industry, actors in the public sector, NGOs or a combination of these. The proposals are peer reviewed and granted or rejected with a turnover time of a few weeks.

The main goals of MaTeP are to provide start-up financing for all kinds of applied research, bridge the gap in funding schemes between basic research projects and technology production and marketing and support projects with a potential to develop into larger follow-up, stakeholder-conducted projects. In addition MaTeP aims to support both senior and young scientists in expanding their application-oriented expertise.

Currently MaTeP focuses on two main areas: activities on the sea floor e.g. exploration, raw materials extraction of mineral oil, natural gas or offshore, risk assessment and Marine Life Science e.g. blue biotechnology, bioenergy, aquaculture or bionics. But other topics are not excluded per se. Several projects have been funded within the MaTeP scheme so far. These range, for example, from the study of issue management in the energy-policy area to the development of highly efficient methods for the 3-D characterization of biofouling and the improvement of the accuracy of horizontal drilling on the seafloor. What makes the proposal of these projects different from other projects funded through the main funding agencies? First of all the funding notification from the cluster is issued very quickly – only a few weeks after submission of the proposal. Here some problems have emerged, because unlike projects which are completely funded through a public or private funding body, all industry projects depend on an individually negotiated cooperation agreement between all partners. These agreements cover the issues of intellectual property rights of the developments made in the project, how to deal with certain property rights in the project, the rules of how funds are transferred and spent, or possibly a publication moratorium on the results.

Dr. Steffen Aßmann, participant in the program "trade fair marketing", talks about improving our understanding of the carbonate system at the OI 2014, London, UK.

Tom Kwasnitschka (GEOMAR) explains how 360° imaging techniques can be used for marine research at a Kiel marketplace event in 2014.

In addition, legal issues may need to be solved related to subsidies, when mixing public and private money, taxes or overhead costs to be paid on industry funds. For all these topics, the Future Ocean provides help, together with its partners at the respective research institutions. Through MaTeP a scheme has been developed that allows the proponents, partners and host institutions to deal with all these questions and requirements in a structured way. In order to ensure the efficient administrative implementation of projects, a model contract as well as instructions for the execution of the project have been agreed upon and are communicated with potential proponents. Consequently, the negotiation process between research institutions and industry partners has been eased tremendously during recent calls.

Outlook

While MaTeP was a bit slow to get started partly due to the problems mentioned above, it has developed into an acknowledged and well-accepted funding tool. For each of the three annual proposal calls about 4-6 proposals have been submitted. More than 50% of these have been funded. Some have even reached a stage, where the partner has taken over and is fully funding the project. This demonstrates that co-funding research projects may lead to more stakeholder engagement in our marine research institutions. With its application-oriented expertise, the Cluster of Excellence "The Future Ocean" will establish itself as a competent partner for these interest groups.

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Link Homepage: http://www.futureocean.org/en/matep/index.php

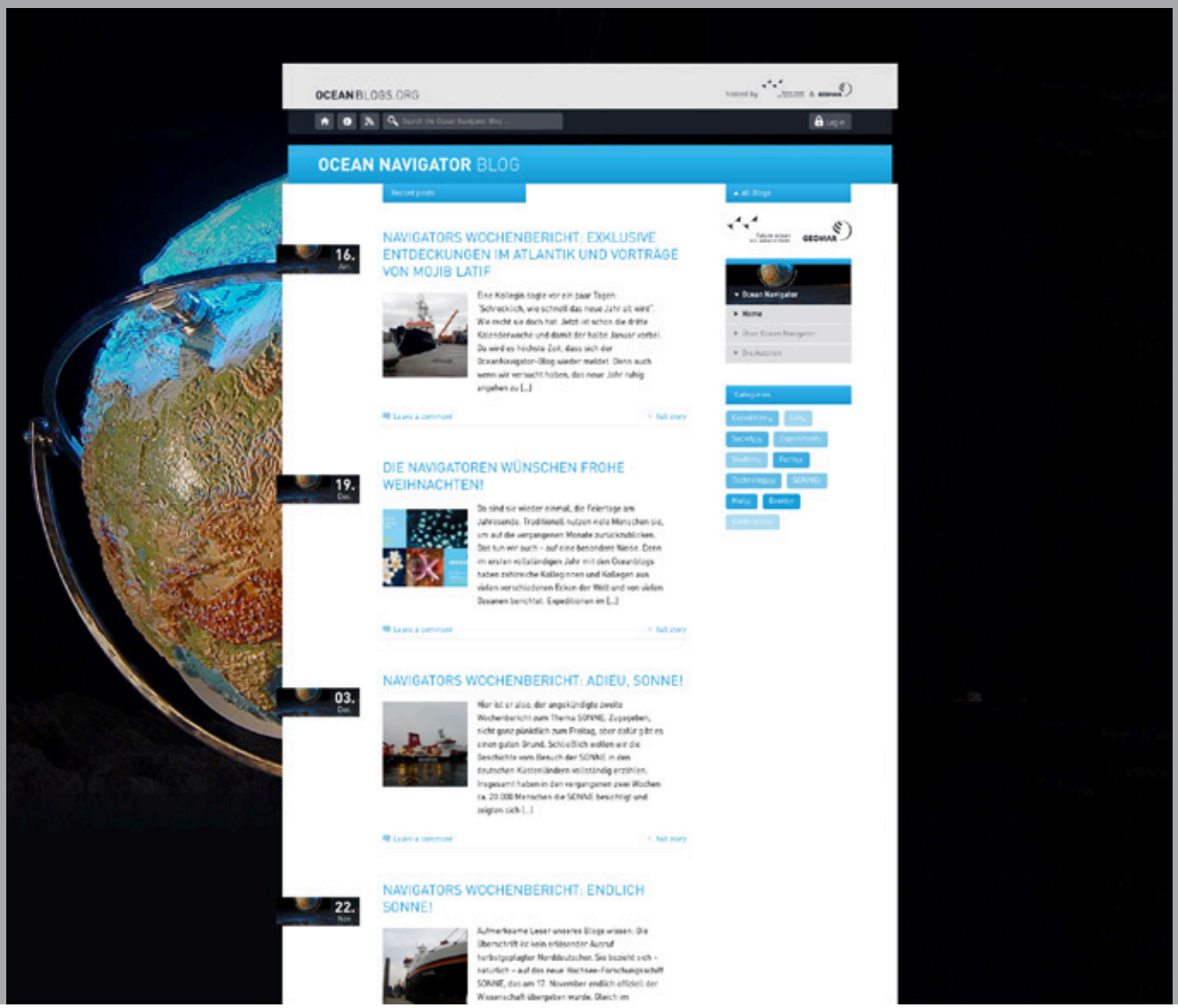
Blogs, Tweets and Films – Kiel Marine Sciences Social Media Approach

Since its launch in autumn 2013, the blogging network Oceanblogs.org, hosted by the Future Ocean and GEOMAR, has become an increasingly successful resource in marine science communication from Kiel. With its focus on a wide variety of topics in marine research, Oceanblogs.org has managed to create a comprehensive and interactive forum over the last one and a half years comprising over 30 individual blogs, roughly 500 posts and an average of about 750 site visits daily. Various content e.g. from natural sciences projects and expeditions, from the Cluster's fields outside of the natural sciences or editorial issues by the public outreach teams are featured on the network. The blog platform serves as the primary social media channel for Kiel marine sciences, as it allows well founded, scientifically precise macro blogging, that merges different functions and target audiences in one comprehensive format. With its focus on subjective, individual views, Oceanblogs.org also encourages interaction: Not only is it possible to keep in touch with the latest news from the marine sciences, but also to share comments, ideas or questions with others – laymen and experts alike. Oceanblogs.org thus serves as an interactive and open scientific forum. Above all, it supports the public outreach efforts of Kiel marine sciences by widening the communication with stakeholders and the public, while also supporting exchange

Two screenshots from the new Future Ocean Blog Portal (oceanblogs.org) hosting over 30 individual marine science blogs and over 500 posts after just one and a half year.

and interaction on different communicational levels. Strategically it aims at increasing the competitiveness of Kiel marine sciences in international comparison with other scientific institutions by raising the awareness and digital reputation of Kiel marine sciences.

To broaden the spectrum of social media communications, the Cluster started its official Twitter-feed @thefutureocean in May 2014. Initially launched on the occasion of the Future Ocean Dialogue exhibition premiere in Brazil, this channel has since developed into a major multiplying and networking tool for all public outreach activities. At roughly 600 tweets and 260 followers in January 2015, it has helped not only to raise international awareness for Kiel marine science issues but also serves the purpose of an aggregator for marine science news from all over the world. A number of important institutions and influential individuals, like Germany's Federal Ministry for the Environment, Amir Dossal – Chairman of Global Partnerships Forum or David Braun – Digital Outreach Director at National Geographic, alongside a great number of fellow institutions from the scientific community have subscribed to the Future Ocean feed, thus incorporating marine science news from Kiel into their extensive networks.



ABOUT THE CLUSTER

Go to Heaven for the climate, Hell for the company.

Mark Twain

The Development in Numbers

As a soft-money funded research project, the Future Ocean operates and plans its activities along timelines defined by the allocation of funds by the funding agencies. Starting in October 2006, the first funding phase lasted for five years until October 2011. This first phase was followed by an intermediate funded year until October 2012. Since November 2012 the Future Ocean is within its second 5-year term, ending in October 2017.

5-year budget plan for 2012-2017

For its second term from 2012-2017 The Future Ocean was granted an overall budget of 28.11 M€ in 2012, with the fiscal years matching the respective calendar years. A rough break down into budget categories for each project year is summarized in table 1. According to this plan about 68% of the total budget will be spent for research projects and groups contributing directly to Future Ocean research. The remaining 32% of the funds are allocated to science support in the wider sense, including investments for instrumentation, support for travel and conferences of researchers, but also support for graduate education, the postdoc network, international and other activities.

k€	2012/2013		2014		2015		2016		2017		Total	
Research	3.45M€	65%	4.08M€	62%	4.18M€	69%	4.01M€	72%	3.36M€	75%	19.08M€	68%
Science Support	1.87M€	35%	2.52M€	38%	1.92M€	31%	1.59M€	28%	1.13M€	25%	9.03M€	32%
Total	5.32M€		6.60M€		6.10M€		5.60M€		4.49M€		28.11M€	

Table 1 Budget 2012-2017

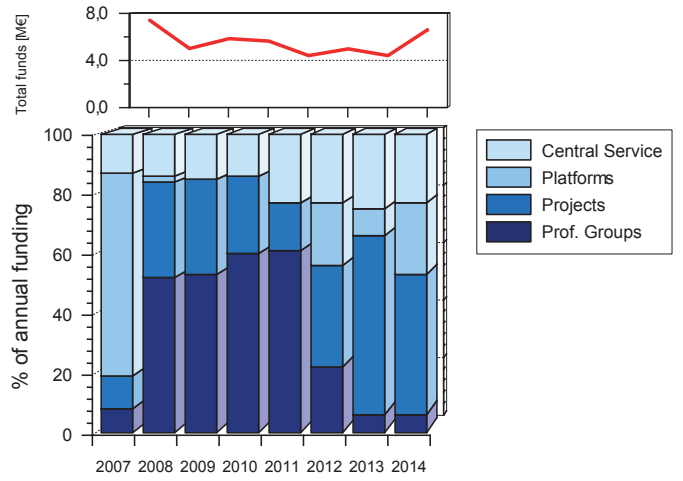


Fig 1 Percentage of funds spent by project categories.

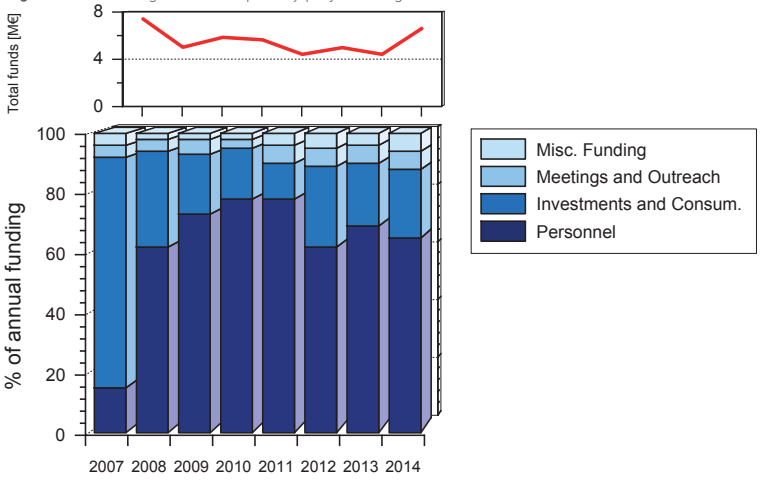


Fig 2 Percentage of funds spent by funding categories.

During the first phase from 2006-2011 about 67% of the budget was firmly allocated to certain activities and the newly installed research groups. The remaning 33% were allocated in a competitive manner through project proposal calls. In contrast less than 20% of the funding has been firmly committed to within the second phase. These 20% commitments have been mainly made to install two new professorships in environmental ethics (Konrad Ott) and law of the sea (Nele Matz-Lück), and to support two others: bioinformatics (Tal Dagan) and aquaculture (Carsten Schulz). In addition certain project relevant administrative activities, like project management, public outreach activities, Postdoc and Phd networks had to be assigned to in advance. This strategic shift is well visible in the distribution of funds as shown in Fig 1, as the large sums spent for the new professors and their research groups phase out in 2012 in favor of a more project and investment (platform) driven strategy. This leads to the possibility of more dynamically allocating money on a competitive basis to the Future Ocean's eleven research topics, emerging special topics of interest and to certain activities within the service section e.g. support for travel, the opportunity to invite guests for research or support for organizing science conferences in Kiel or certain outreach or personnel development activities.

Despite this shift towards competitive research-project driven science, the relative proportion of cost types remains about the same (Fig. 2). About 70% of Future Ocean's budget was spent for personnel in recent years, slightly more than 20% for equipment of all scales. We expect the amount for personnel to increase in the coming years, because the acquisition of instruments, which largely took place through calls for investment proposals in 2012 and 2014, will be less important in the future. These expenses will therefore be shifted towards personnel. This scheme could already be observed during the first phase of the Future Ocean (2006-2011) when there

was a constant rise in the proportion of personnel costs proportion between 2007 and 2011 (Fig. 2).

Budget allocation in 2013/14

The total budget in 2013 was about 4.43 M Euro, rising to 6.6M in 2014. See figure 3 for a break down into expense categories and activities throughout the years in absolute numbers. The years 2013/14 show a steep increase of funds for research projects, while the support for the professor groups declined by about the same proportion. Here again the strategic shift from establishing new professorships and research groups in the first phase, towards a more competitive project driven funding is noticeable.

The Future Ocean platforms are the concept to host common infrastructure, mainly laboratory and seagoing equipment, but also computing equipment and software, accessible to all members of the Future Ocean. Through the platforms, medium to large scale instrumentation was funded during the first phase of the cluster. Consequently large sums were spent early in the project in 2007, while little money was invested in later years. At the beginning of the second phase in 2012 and again in 2014 two calls for medium volume investment proposals of up to 50.000 € were issued. Through proposals from these calls about 2M € was spent for instrumentation, software and high performance computing equipment since 2012. These can only be seen as small peaks, as only about 1M is reflected within the budget numbers shown here, the rest is on order and will appear in the figures from 2015. Furthermore the Future Ocean Platforms of the second phase also host certain scientific service positions. These positions support scientific core tasks, e.g. in scientific computing, modeling and data management. This is reflected in the personnel costs appearing in the platform section since 2012.

Another noticeable development is, that the central service expenses are constantly growing from about 900.000 € in 2007 to about 1.5M € in 2014. The reason for the growth in recent years has been, that in addition to the general cluster administration, public outreach and personnel development tasks, several time limited positions have been funded in this area. These positions support e.g. the Future Ocean Atlas, an initiative maintaining a database on marine fish data and plotting the global occurrence and health of fish stocks and other parameters into a web accessible mapping application. Other initiatives aim to improve the presence of the Future Ocean in social media networks and establish Future Ocean science blogs. Further activities strive to improve science communication through artistic means. Positions for these artistic activities are located at the Muthesius School of Arts. Most of these positions run out or will be re-evaluated during 2015. We therefore expect these numbers to drop in the future. Other factors adding to the increased costs in the central service section in 2014 were the new exhibition Future Ocean Dialogue, and expenses through a new funding tool for industry cooperation projects called the Marine Technology Platform (MaTeP).

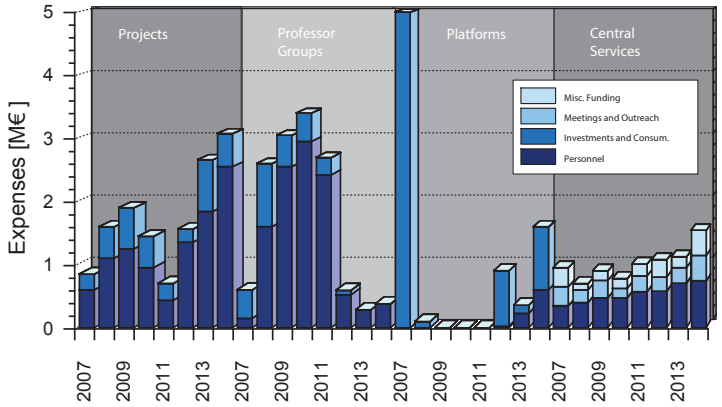
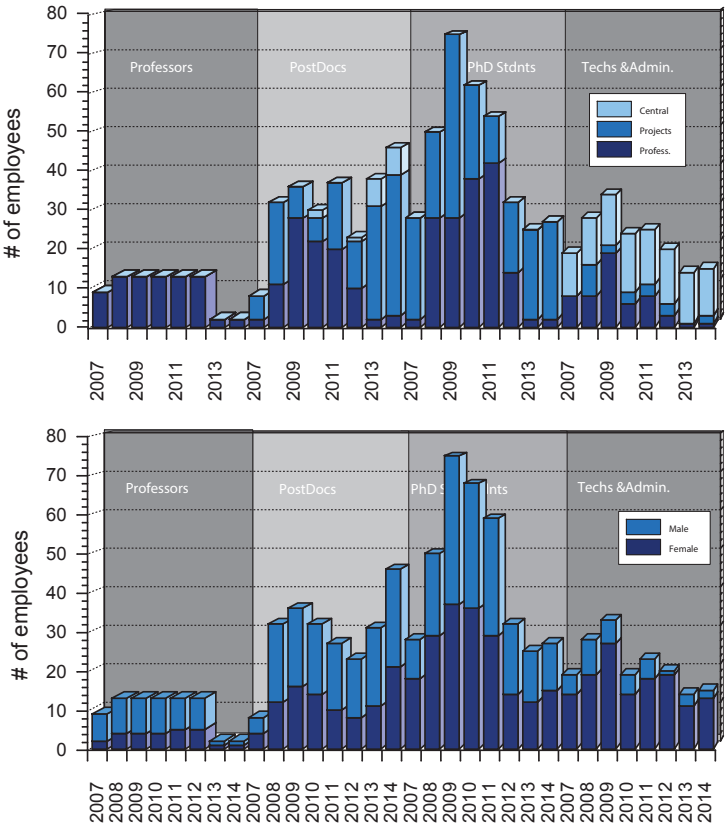


Fig 3 Funds spent during the project lifetime by categories.



Figs 4/5 Personnel structure during the course of the project.

New Future Ocean Research Projects

Since summer 2011 seven calls for project or investment proposals have been started (Fig 6). Many of these projects were started in the previous funding phase before 2012 and are continuing into the current phase. The start, duration and financial commitments of these calls reach into the years 2013/14 and are summarized in Fig 6. Since 2011 almost 14 M € have been committed to 108 research projects. This is about 50% of the total cluster budget for five years. These included 24 PhD projects, 30 postdoctoral projects and ~2.1 M euros for general small scale projects. A list of research projects and abstracts can be found on the future ocean website at *http://www.futureocean.org/cgi-bin/project_data_view.cgi?view=sorted*

After a successful investment round in 2012, another 0,75M€ were allocated by the executive board in 2014 for further investments. These were selected through a competitive call according to certain criteria: a) Strengthen Kiel's integrated marine science, b) Support collaborations and interdisciplinary work and c) Enhance the research capabilities in Kiel. Through this call e.g. special 3-D deep-sea camera equipment, a special microscope upgrade for Raman

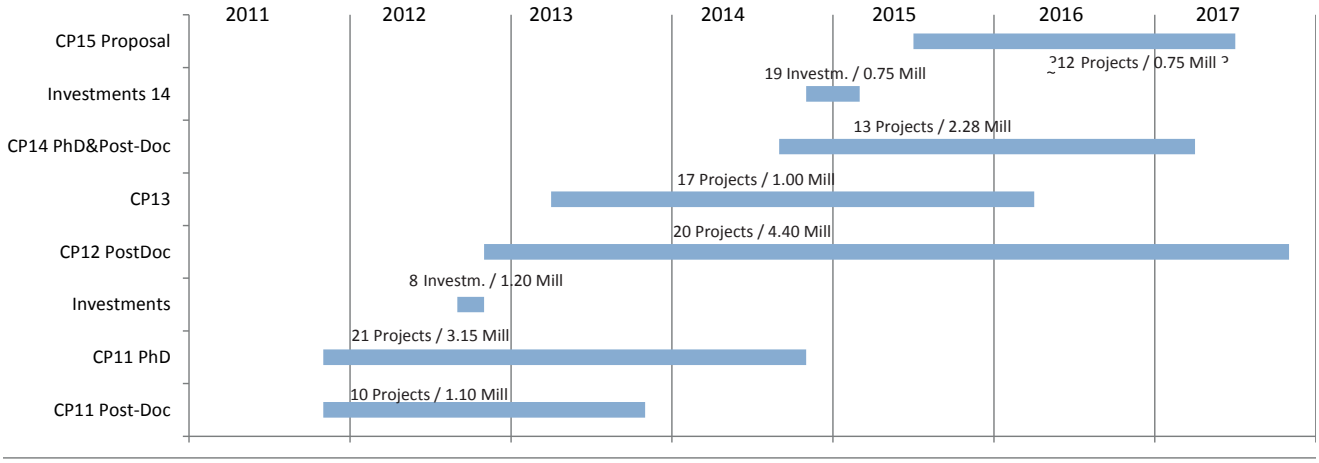


Fig 6 Timing and volume of advertised cluster project rounds.

spectroscopy, software for image processing and other instruments were acquired. Information on all items bought is compiled in a database and published on a website. This enables cluster members as well as collaborators from outside to know what kind of equipment is available at the Future Ocean and may help in initiating new collaborative research.

Personnel

Employees in the Future Ocean have been grouped into four categories: professors, postdoctoral researchers, PhD students and technical and administrative staff (see figure 4). In 2013 and 2014 the total number of Future Ocean employees stayed about constant at 90 persons compared to 88 in 2012. While the project funded up to 157 people at its peak time in 2010, this number has been shrinking constantly to the current level, which we expect to keep or even raise a little bit in the future. There are several reasons for the overall lower number in personnel: 1. the budget of the project has remained about constant since 2007 while the salaries have increased. 2. To promote equal standards throughout the project the cluster decided in 2011 to fund all PhD positions as 75% of a full position, rather than issuing 50% positions, which was the standard in some disciplines. In fact most of the PhD projects now are very similar in cost to postdoc projects. 3. As a consequence of the now more expensive PhD positions, the personnel structure has been shifting from a less expensive PhD position dominated research between 2009 and 2011 towards a more costly project centered structure requesting more postdoc positions. The number of postdocs has been constantly growing since 2012 and is at an all-time high with 46 postdocs currently funded. In contrast the number of PhD positions, 25 in 2013, with a very slight increase to 27 in 2014, is the lowest in the Future Ocean since 2007. 4. Almost 2M € were allocated to investments in 2012 and 2014 and are therefore not supporting any personnel.

All these factors contributed to an in general lower total number of people employed by the Cluster. Provided that fewer investments will be made in the future we expect this number to stabilize at about 100 people in the remaining years.

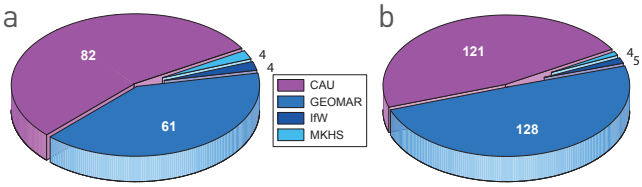


Fig 7 Distribution of full members (a) eligible to vote for Future Ocean gremia and all members (including full and associated members) (b) within the Future Ocean.

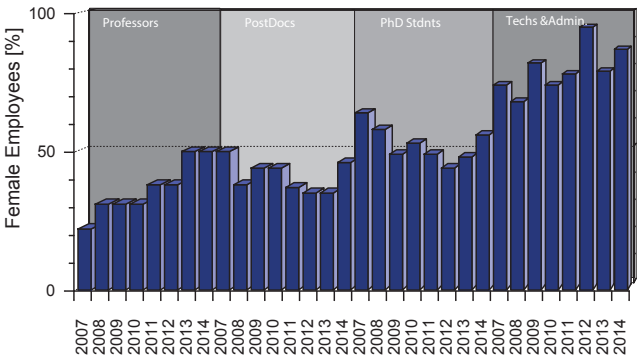


Fig 8 Percentage of women in diffetent status groups witin the Future Ocean.

Member Structure

The Future Ocean assigns two kinds of membership, full and associated members. Full Professors and research group leaders can become full members, while postdocs employed by the cluster or through the working groups of full members are typically accepted as associate members. The only difference between these status groups is, that full members have the right to vote and become elected at the general members assembly. All members, whether full or associate, have the right to submit proposals to proposal calls or apply for funds through any of the other funding lines.

The Future Ocean had 258 members in total at the end of 2014, split into 151 full and 107 associated members. The institutional breakdown as shown in figure 6a reveals, that in total about 50% of the total members are employed by GEOMAR, almost 50% by the university and a minority by the partner institutions IfW and Muthesius Academy of Arts and Design. The breakdown of numbers according to full membership shows though, that the university still supplies the bigger share in the voting bodies of the Future Ocean.

Gender data

Future Ocean has been promoting gender equality since its establishment. We are therefore monitoring the male/female ratio within the project carefully, in order to have records and a control on the gender structure of the Future Ocean. During the first phase, the Future Ocean made some progress in hiring female scientists and supporting them in their careers and we are continuing to do so. The overall number of women in the different status groups is given

in Figure 5. The Future Ocean currently employs 50 women vs. 40 men, which is a proportion of 56% women vs. 44% men, the highest percentage of women during the history of the cluster so far. This number is far from unusual though. The overall number of women has always been over 50% throughout the cluster.

The percentage of women within the different status groups is depicted in figure 8. In 2014 the only status group with a fraction of women below 50% are the postdocs, but with 46% it is well within the natural fluctuation of these numbers.

The numbers of female members within the cluster are shown in figure 9. In total 65 of the cluster's 258 members are female, 193 are male. About 25% of the full members are female, which approximately reflects the percentage of professor positions within our field at the university.

Overall, the measures for supporting women within the cluster seem to work well and women are well represented throughout the positions and gremia of the Future Ocean. Constant activities, e.g. educating cluster members in improved, fair gender neutral hiring processes, aim to maintaining this level in order to enable, that these well-educated women succeed in bringing the management and professors positions into the positive gender proportion we already see at the PhD and postdoc level.

Postdoc Network IMAP

The Integrated Marine Postdoc Network IMAP is Future Ocean's measure of personnel development for people in medium level research positions. Within the last 2 years IMAP grew from 30 members in late 2012 to 86 active members in late 2014 – an impressive growth. The composition of this group is very diverse. Some data are shown in figure 10.

In recent years, people have been joining IMAP but some also have been leaving for new jobs and opportunities. IMAP keeps close contact to its currently 23 alumni members, which are spread all over the world from the US to Japan. This activity provides another way for mid-career scientists to learn from each other.

Integrated School of Ocean Sciences

The Integrated School of Ocean Sciences (ISOS), the PhD network and support structure of the Future Ocean, has grown to 160 members in 2014. Some basic numbers are shown in Fig 11. ISOS comprises 110 german and 50 international members. It is also noticable that the vast majority of ISOS members is female.

Like IMAP, ISOS keeps close track and contact to its alumni, striving to form a network beyond the PhD and informing them about current activities in Kiel.

Publications

The publication data of 2013 have been recorded in the project's publication repository. The repository is accessible at http://eprints.uni-kiel.de allowing review of Future Ocean's output there. In 2013 we recorded 404 new publications related to the Future Ocean. This is less than in 2012, where we recorded 496, but still a solid output for a project of this size. Overall, papers were published in 253 different venues, ranging from PLoS One, to Marine Policy, from Inorganic Chemistry to Animal Feed Science and Technology, from Ecological Modelling to the Journal of Agricultural & Environmental Ethics. This indicates, that the community in the cluster is diverse, spanning a very broad expertise, and therefore a wide variety of journals. The most important publication venues have been compiled in figure 12. It is noticeable, that PLoS One with 14 publications took the lead from Marine Biology, which dropped from 13 to four. In contrast many more articles have been published in Nature and related publications than in 2012. While seven articles were published in Nature / Nature Geoscience / Nature Climate Change in 2012, in 2013 there were 13, and even 17 if Nature Genetics and Nature Communications are included as well. Four articles were published in Science. Overall the output is at a very competitive and productive level. While we haven't yet compiled detailed statistics on it, a quick scan through the publication lists reveals plenty of co-authorships across disciplines, confirming the impression of the healthy, and challenging interdisciplinary research field provided by the Future Ocean.

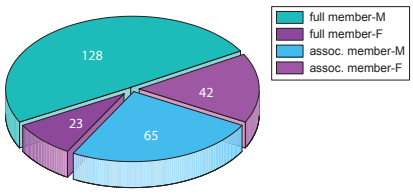


Fig 9 Future Ocean member distribution by gender.

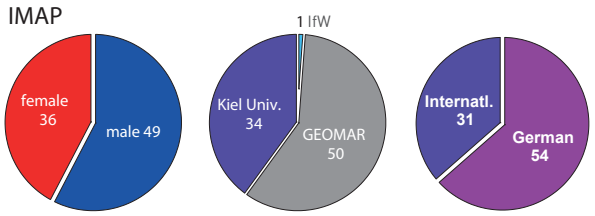


Fig 10 Distribution of IMAP members at the end of 2014 according to gender, host institution and german vs. non-german members.

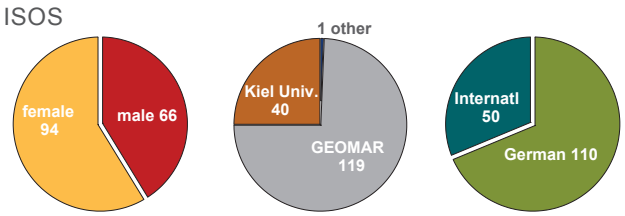


Fig 11 Distribution of ISOS members at the end of 2014 according to gender, host institution and german vs. non-german members.

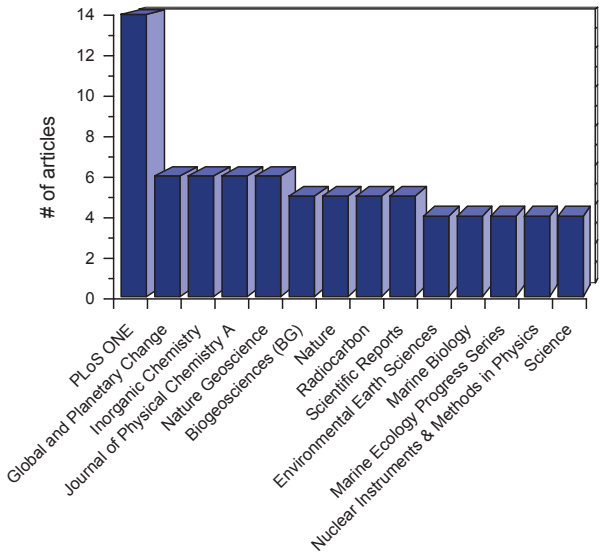


Fig 12 The most important publication venues in 2013.

The Founding Institutions

Christian-Albrechts-Universität zu Kiel

Kiel University is the only full university in the state of Schleswig-Holstein. It is home to more than 24,000 students as well as 2,000 university teachers and researchers. From A for Agricultural Sciences to Z for Zoology, the university currently offers around 80 different subjects of study.

Creating links between the different scientific cultures is the top priority at Kiel University. After all, the reality that is reflected in scientific research is multi-layered and complex and so are the research focuses of the university: marine and geological sciences, life sciences, cultural spaces as well as nanosciences and surfaces. Throughout its 350 year history, the Christian-Albrechts-Universität zu Kiel has been closely linked with the city of Kiel. Together with the university hospital it is now the largest employer in the region.

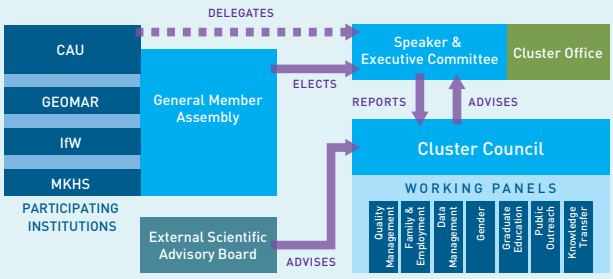
Kiel Institute for the World Economy

The Kiel Institute is one of the major centers for research in global economic affairs, economic policy advice and economic education. The Institute regards research into innovative solutions to urgent problems of the world economy as its main task. On the basis of this research work, it advises decision makers in politics, economics and society, and keeps the interested public informed on important matters of economic policy. As a portal to world economic research, it manages a broad network of national and international experts, whose research work flows directly or indirectly into the Kiel Institute's research and advisory activities.

The Kiel Institute places particular emphasis on economic education and further training and co-operates with the world's largest library in the economic and social sciences.

Organization of The Future Ocean

The Cluster's Executive Committee is responsible for the overall management of the Cluster of Excellence and is accountable to the Cluster Council and the General Assembly. It comprises the Speaker, of the Executive Committee, its Vice Speaker, the two speakers of the research platforms and representatives from the research themes. The Council of the Cluster of Excellence gives advice to the Executive Committee on all strategic decisions, such as scientific priorities, yearly budget planning and monitoring criteria. The Council comprises the two leading proponents of each research topic and research platform, the leader of each JRG, the Presidents of Kiel University and Muthesius Academy of Fine Arts and Design, the Directors of GEOMAR Helmholtz Centre for Ocean Research Kiel and the Institute for World Economy, as well as the Speaker and Vice-Speaker of the Executive Committee. An external Advisory Board acts as an independent quality control and advising body to evaluate the progress of the project. It consists of ten leading scientists, from both German and international institutions, reflecting expertise in all cluster-relevant research fields. Additional members are appointed to evaluate the Cluster's outreach to the general public, stakeholders and industries. The central service office provides necessary support for project management and monitoring activities. It also supports public outreach, internationalization and technology transfer activities, the IMAP work and the Integrated School of Ocean Sciences (ISOS).



GEOMAR Helmholtz Centre for Ocean Research Kiel

GEOMAR Helmholtz Centre for Ocean Research Kiel is the successor to the Leibniz Institute of Marine Sciences (IFM-GEOMAR) which was founded in January 2004 through the merger of the Institut für Meereskunde (IfM) and the Research Center for Marine Geosciences (GEOMAR). The institute is a member of the Helmholtz Association.

The institutes' mandate is the interdisciplinary investigation of all relevant aspects of modern marine sciences, from sea floor geology to marine meteorology. Research is conducted worldwide in all oceans.

The institute has four major research divisions:

- Ocean Circulation and Climate Dynamics
- Marine Biogeochemistry
- Marine Ecology
- Dynamics of the Ocean Floor

The institute operates four research vessels, state-of-the-art equipment such as the manned submersible JAGO, the deep-sea robots ROV KIEL6000, PHOCA and ABYSS as well as several major laboratories, access to high performance computing facilities and an attractive public aquarium.

GEOMAR is one of three leading institutions in the field of marine sciences in Europe. Together with the National Oceanography Centre in the United Kingdom and Ifremer in France, GEOMAR has formed the "G3 group" of national marine research centres.

Muthesius Academy of Fine Arts and Design

Founded on 1st January 2005, the Muthesius Academy of Fine Arts and Design in Kiel is Germany's northernmost and youngest school of higher education devoted to the systematic study of art and design. Thanks to an innovative course structure, the Academy's concept features a diverse program of curriculum options in the fields of art, spatial strategies and design. The history of the Academy began in 1907 with the founding of separate classes in artistic design at the School of Applied Arts, the Muthesius Academy. It is a story of constant, gradual change in both curriculum and academic structure. The newly founded Academy of Fine Arts and Design will offer approximately 400 places for students.

The Art Academy's size enables it to offer project-oriented and practical instruction in small groups – a tradition harking back to the days of the Muthesius Academy – as well as close contact between instructors and students. Modern media play no less important a role than that of the traditional canons of art and design.

Panel Memberships

Executive Committee

Name	Institution*
Berndt, Christian	CAU
Bleich, Markus	CAU
Braack, Malte	CAU
Frank, Martin	GEOMAR
Herzig, Peter	GEOMAR
Hoffmann, Julia	CAU
Kipp, Lutz	CAU
Körtzinger, Arne	GEOMAR
Latif, Mojib	GEOMAR

Name	Institution*
Marandino, Christa	GEOMAR
Menzel, Jan-Lukas	GEOMAR
Neumann, Barbara	IMAP
Pistor-Hatam, Anja	CAU
Quaas, Martin	CAU
Reusch, Thorsten	GEOMAR
Schmidt, Jörn	CAU
Schmitz-Streit, Ruth	CAU
Schneider, Birgit	CAU

Name	Institution*
Schneider, Ralph R.	CAU
Schulz, Rüdiger	CAU
Snower, Dennis J.	IfW
Srivastav, Anand	CAU
Visbeck, Martin	GEOMAR
Werner, Iris	CAU
Zerbst, Arne	MKHS

Cluster Council

Name	Institution*
Behrmann, Jan	GEOMAR
Berndt, Christian	GEOMAR
Bleich, Markus	CAU
Böning, Claus	GEOMAR
Bosch, Thomas	CAU
Braack, Malte	CAU
Dullo, Christian	GEOMAR
Duscher, Tom	MKHS
Frank, Martin	GEOMAR
Friedrichs, Gernot	CAU
Gorb, Stanislav	CAU
Hasselbring, Willi	CAU
Herzig, Peter M.	GEOMAR
Hoernle, Kaj	GEOMAR
Hoffmann, Julia	CAU
Kipp, Lutz	CAU
Klepper, Gernot	IfW
Körtzinger, Arne	GEOMAR

Name	Institution*
Krastel, Sebastian	CAU
Latif, Mojib	GEOMAR
Marandino, Christa	GEOMAR
Matz-Lück, Nele	CAU
Melzner, Frank	GEOMAR
Menzel, Jan-Lukas	GEOMAR
Neumann, Barbara	IMAP
Odendahl, Kerstin	CAU
Oschlies, Andreas	GEOMAR
Ott, Konrad	CAU
Peterson, Sonja	IfW
Quaas, Martin	CAU
Rehdanz, Katrin	IFW
Requate, Till	CAU
Reusch, Thorsten	GEOMAR
Riebesell, Ulf	GEOMAR
Rosenstiel, Philip	CAU
Rüpke, Lars	GEOMAR

Name	Institution*
Sachs, Stephan	MKHS
Schmidt, Jörn	CAU
Schmitz-Streit, Ruth	CAU
Schneider, Birgit	CAU
Schneider, Ralph	CAU
Schrottke, Kerstin	CAU
Schulz, Manfred	MKHS
Schulz, Rüdiger	CAU
Slawig, Thomas	CAU
Snower, Dennis J.	IfW
Sommer, Ulrich	GEOMAR
Srivastav, Anand	CAU
Stattegger, Karl	CAU
Temps, Friedrich	CAU
Vafeidis, Athanasios	CAU
Visbeck, Martin	GEOMAR
Wallmann, Klaus	GEOMAR
Zerbst, Arne	MKHS

Scientific Advisory Board

Name	Institution
Betz, Gregor	University of Karlsruhe
Brügge, Bernd	Bundesamt für Seeschifffahrt und Hydrographie (BSH)
Bücker, Chistian	RWE Dea AG, GeoSupport Center
Gelpke, Nikolaus	mare dreiviertel verlag
German, Chris	Woods Hole Oceanographic Institution
Gruber, Nicolas	Swiss Federal Institute of Technology Zurich
Harrison, Ed	Pacific Marine Environmental Laboratory
Johannesson, Kerstin	University of Gothenburg
Joye, Samantha Mandy	University of Georgia
Keeling, Ralph	Scripps Institution of Oceanography, UCSD

Name	Institution
King, Matthew	European Commission, Directorate General for Maritime Affairs and Fisheries
McKenzie, Judith	Swiss Federal Institute of Technology Zurich
Metaxas, Anna	Dalhousie University
Miller, David	James Cook University
Saito, Yoshiki	Institute of Geology and Geoinformation (IGG), Geological Survey of Japan (GSJ), AIST
Schlosser, Peter	The Earth Institute, Columbia University
Sterner, Thomas	University of Gothenburg
Wu, Lixin	Ocean University of China
Zahn, Rainer	Universitat Autònoma de Barcelona (UAB)

*CAU - Kiel University

*GEOMAR - GEOMAR Helmholtz Centre for Ocean Research Kiel

*IFW - Institute for the World Economy

*MKHS - Muthesius Academy of Fine Arts and Design

Funded Cluster Projects

ID	Author	Title	Start	End
CP0602	Bleich, Markus	CO_2-induced Ocean Acidification: Biological Responses and Adaptions	01.11.06	01.11.08
CP0603	Eisenhauer et al.	Boron Isotopes as a Proxy for pH decresse an pCO_2 increase	01.11.06	01.11.06
CP0605	Froese et al.	Managing Cod and Sprat in the Central Baltic Sea – A bio-economic multi-species approach with Stochastic regeneration functions	01.11.06	01.11.08
CP0608	Luttenberger et al.	dearX – XML Technology for marine Data Exchange, Archiving and Retrieval	01.11.06	01.11.07
CP0609	Macke et al.	The role of light fluctuations on ocean heating and photosynthesis	01.11.06	01.11.08
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