



future ocean  
KIEL MARINE SCIENCES

**Focus on Fisheries**

New concepts for a sustainable  
marine resource management

**Education and Career**

Opportunities for young scientists

**Research in Marine Science**

From acidification to coastal research

# Future Ocean Research 2011/2012





## Dear Friends of the Future Ocean,

A year has passed since we've published the last report - and what a year! Since 2009 we had been discussing and preparing for the renewal proposal due in 2011. Now the new Future Ocean goals had to be finalized and cast into a proposal making use of what we had achieved during the first five years, as well as creating a strong perspective for the upcoming years. Also - a perspective for the years after the Future Ocean should not be forgotten. All this was superbly mastered, a strong proposal was submitted, and it has been successful, as we know now.

But other things have been happening as well. We've started two new strategic initiatives. One of these is focussing on Internationalization, creating a better visibility of Kiel Marine Sciences to the international community, by promoting our location and attracting more foreign

researchers to Kiel. These efforts were started by numerous appearances of the cluster at conferences, e.g. the American Geoscience Union's Fall meeting in San Francisco and the European Geoscience Union's meeting in Vienna. We've also defined new strategic partnerships abroad in Canada, USA and China, which will help us to broaden our view on the research there, and create opportunities to exchange personnel.

Secondly we've started a new initiative on promoting medium career level scientists by founding the Integrated Marine Postdoc (IMAP) Network in Kiel. The network targets a deficit identified during the first phase of the Future Ocean, where our focus was on the support for PhD students, as well as tenure track professorships. To close the gap of career support towards the postdoc level is an important aspect of our vision of the ideal

research location. The quick growth of the network illustrates, that we are on the right track, and postdocs are appreciating the opportunities available through the IMAP.

Altogether we are sincerely proud to be able to continue to work on our view of a world class research location in marine sciences. We hope you enjoy reading about the highlights in this report.

Sincerely,

Martin Visbeck

Speaker of the Cluster of Excellence  
The Future Ocean

# Table of Contents

03 Editorial

## Perspectives

06 Interview Martin Visbeck: New Approaches to Research

## Focus On

- 12 When Science Meets Everyday Life
- 14 Fisheries Research in the Cluster of Excellence The Future Ocean in Kiel
- 18 The Future Ocean Atlas – an Integrative Project for the Future Ocean
- 19 Overfished but Still on the Plate
- 20 Fisheries and International Governance

## Research

- 24 Mechanisms of Intracellular  $\text{CaCO}_3$  Crystalization in Hemocytes of *Mytilus edulis*: Sensitivity of Bivalve Calcification to Ocean Acidification
- 26 The Occurrence and Relevance of Nitrogen Fixation in Sediments of Oxygen Minimum Zones
- 28 Does the Rise of Slime Foster an Oceanic Jelly Carbon Pump?
- 31 Metabolical Cholerics: Teasing Marine *Actinomycetes*
- 32 The Political Economics of the European Common Fisheries Policy
- 33 Local and Global Patterns in Fisheries-Induced Evolution
- 34 Quantifying the Release of Greenhouse Gases During Sill Intrusion in Sedimentary Basins
- 36 Effects of Ocean Acidification on Nitrogen Fixers and the Cycling of Nitrogen within Natural Communities
- 37 Legal Implications of the Common Heritage Principle for Future Ocean Governance: A Conceptualization Regarding Marine Living Resources
- 38 Sediment Trapping in River Dammed Systems: An Example of the São-Francisco Delta (Brazil)





## Science News

- 42 GEOMAR becomes Helmholtz Institute, Sino German Cooperation, Stakeholder Dialogue, Dräger Workshops, AvH Fellowships and other

## Education & Career

- 50 School Programs: 360° Dome Production, New School Book, Kids University, Student Laboratory
- 52 Kiel - A Great Place to do a PhD
- 54 Started: The IMAP Network

## People

- 58 Interview: Nele Matz-Lück - Lawyers and the Ocean
- 60 ISOS Alumni Portrait: Dr. Maike Kramer
- 60 Prestigious Honours for Heidrun Kopp, Ulf Riebesell and Wolf-Christian Dullo
- 61 Visiting Scientist Liya Jin

## Events

- 64 Diving into the Secret World of the Ocean
- 65 Marine Scientists from Kiel Write About Their Visions for the Ocean in 2100
- 66 ISOS Events
- 67 The Future Ocean Exhibition
- 68 Future Ocean at Expo 2012 in Korea
- 69 Kiel - City of Young Scientists 2011
- 70 Promoting Kiel Marine Sciences at International Conferences
- 72 Active Stakeholder Dialogue – Disseminating New Knowledge Where it's Needed

## Reports

- 76 Towards New Shores
- 77 Family and Employment, Data Management, Project Statistics, Founding Institutions

## Appendix

- 84 Members, Panels, Projects, Contacts

# New Approaches to Research: The Multidisciplinary Network of Kiel Marine Sciences

An interview with Professor Martin Visbeck, Speaker of the Cluster of Excellence The Future Ocean since 2007 and physical oceanographer at the GEOMAR Helmholtz Centre for Ocean Research Kiel, about the achievements of the past six years and the future goals of Kiel Marine Sciences.




---

“There is no other institution in the world that approaches marine science in as interdisciplinary a manner as we do.”

Professor Martin Visbeck,  
Speaker of the Cluster of Excellence The Future Ocean.

---

In June 2012 the Kiel Cluster of Excellence the Future Ocean was awarded a second five-year funding period which will last until October 2017. The decision brings with it considerable further funding for high profile international research on integrated marine sciences at Kiel University and its partner institutions. In the second funding period, Kiel marine scientists will build on the successes of the past few years and venture into new areas.

## What are the major results of the first funding period?

We are able to look back at remarkable success in the past few years. Our interdisciplinary approach to the global challenges of ocean change and ocean risk and opportunities was ambitious, but absolutely future-minded. We had identified new research topics that could best be addressed with an interdisciplinary approach. Thirteen new junior research groups were established to investigate topics such as climate change, impacts on the ocean, ocean resources or legal and economic challenges. The new groups together with the local proponents have established possibly the most integrated marine research profile worldwide in Kiel.



Welcome to the Future Ocean exhibition in the zoological museum in Kiel.

### What does that mean? What is so special about investigating Marine Sciences in Kiel?

We have used the funds of the German Excellence Initiative to close the gaps between pockets of excellence in the Kiel research landscape. Before Future Ocean there were few economists or lawyers dealing with the new challenges of marine science. But their knowledge is essential to answering the key questions about new opportunities and challenges of the changing ocean in close collaboration with natural scientists. A particularly striking example is that we have developed new concepts for sustainable marine resource management options, for example in the area of fishing practices within the EU based on the joint consideration of ecological, economic and legal aspects.

### What has changed at Kiel University since the Future Ocean started its work?

Kiel University publicly declared Marine Science as one of four research foci in 2009 and awarded tenure nine times for professorships held by Cluster working group leaders. That gives Kiel

Marine Scientists the power to sustain integrated and collaborative research. The Future Ocean network is increasingly internationally recognized and has definitely improved the visibility of Kiel University, GEOMAR and the Institute for the World Economy as a world-leading research partnership for integrated marine sciences. With the funding of the second phase we will have the chance to further strengthen and enhance our profile.

### What are the consequences for the structural development of Kiel University?

In Kiel a structural transformation towards new concepts of connecting differing scientific cultures has started. Disciplines are growing together and university and non-university institutions are joining forces for integrated research and knowledge transfer. But we also recognized needs for urgent action, and thus established programs on career planning for our young scientists and for building up new and long-term cooperation with international partners in the USA, Canada and China. The Future Ocean Network has proven to be a unique platform for creating synergies.

“ Within the Future Ocean Network we want to develop and implement a solid framework for career and personal development.”

#### What is the greatest strength of Kiel Marine Sciences?

The integrative concept has proven to be scientifically inspiring and successful. In Kiel we provide an academic framework that is fruitful for all marine related research. The way we have managed to crack open borders between disciplines allows us to phrase and respond to questions in a way that was not possible before. Legal questions and their framework now make sense to earth scientists, climate models are enhanced to include aspects of physical chemistry, fisheries economics is studied taking ecological models into account. Being able to work on the big questions together while bridging disciplines makes working in Kiel an exciting and unique experience for all of us involved.

#### What are the future objectives for the second funding period?

There are several: Of course the Future Ocean should produce the best integrated science possible. Being at the forefront of marine research is key to the project and will enhance the reputation within Germany, Europe and beyond. But Future Ocean should also take a leading role in strengthening and expanding its opportunities to communicate and exchange knowledge with societal actors such as politicians, industry, NGOs and civil society. The overall aim is to put into practice our innovation cycle, where an improved ocean system understanding and scientifically based predictions and scenarios provide crucial information to decision makers on the use of ocean resources, associated ocean governance and environmentally sound management practices. At the same time ocean governance options demand specific and deeper knowledge in certain areas of fundamental marine sciences. The third general objective is to improve science support. This means in particular the provision of excellent and effective research facilities (staff and equipment) and career support for postdocs and PhD students.

#### A new focus of the Cluster is the strong support of young scientists, so called early career postdocs. Why?

Supporting postdocs at all stages in their careers is a strategic long term goal. In the German scientific environment we are missing well developed and defined career paths for young scientists that prepare them for a range of career options from staff scientist to independent soft money supported scientist or a teaching career within a professorship. One of the challenges for the next generation



Martin Visbeck with an underwater glider, his favorite research equipment.

is the dramatic decrease of the so called “Mittelbau” positions, scientists responsible for research, education and laboratories within a research group. The lack of well defined career options might lead to a loss of qualified next generation scientists in the Mittelbau, which will be felt eventually at all levels of research and education. Within the Future Ocean Network we want to develop and implement a solid framework for career and personal development through mentoring, specific training, and of course developing systems for increased financial security.

#### What are the first concrete steps of the Cluster in this direction?

Just before the official start of phase II we advertised the possibility to come to Kiel and work with us on your most exciting research project. Out of a pool of more than 80 ideas we invited more than 40 scientists from around the world to present their projects to us in early October. After an inspiring two day symposium with parallel presentations we awarded 20 postdocs projects for up to five years and are looking forward to a new and fresh wind in our network.

#### What are the effects of interdisciplinary research of Future Ocean for the research community of the state of Schleswig-Holstein?

With interdisciplinary research we can start providing answers over the full range from basic to applied science. Some of the projects are relevant for industrial application while others lead to better knowledge-based political decisions or policies. We can provide sound information with a much broader disciplinary spectrum



Participants of the Young Scientists Conference, an annual networking meeting of PhD students and postdoctoral researchers from Hamburg, Bremen and Kiel.

than we had before, and the better we understand the key research questions and approaches of other disciplines, the more relevant the conclusions from our own research can be. During the second phase it will be particularly important to expand our disciplinary base into political science and environmental ethics. Collaborative projects with these disciplines will be key to broadening our perspectives on issues relating to sustainable ocean development. We are hopeful that recommendations and conclusions from our research can be applied to issues of direct relevance to humans and societies.

### You mentioned “Internationalization” as one of the Future Ocean goals. What do you do in this respect?

All scientists in the cluster have their own international networks. In addition to that we are in the process of establishing premier cooperations on an institutional basis with a handful of centers worldwide with the goal of establishing long-term relationships. We envision easy exchange opportunities for students and researchers at all levels. Our activities include joint workshops, co-education of PhD students, professional exchanges, and using the network for benchmarking our goals in scientific and organizational development.

### What is your personal wish for the future of Kiel Marine Sciences?

I am very excited about the opportunity to establish the Kiel Academy for Interdisciplinary Marine Sciences (KAIMS). The Academy should become the platform where the scientists of

today’s Future Ocean cluster can continue to collaborate post 2017. KAIMS should also provide non university researchers and scholars from other countries but also other sectors of society with the possibility to come together and co-design new research questions, propose those to a wide range of funders and then come together again to co-produce new knowledge. KAIMS can also benefit from the various institutional advantages of the participating institutions such as Kiel University and GEOMAR. In summary, from my perspective we all are privileged to have the opportunity to work in such a wonderful environment. I see it as my personal responsibility to safeguard what we have accomplished and evolve the cluster into a new and even more integrated future.

Thank you very much for your time.





# Focus On

Of course if we make good things, it is not only to the credit of science; it is also to the credit of the moral choice which led us to the good work. Scientific knowledge is an enabling power to do either good or bad — but it does not carry instructions on how to use it.

*Richard P. Feynman*

# When Science Meets Everyday Life

In the Cluster of Excellence The Future Ocean, an interdisciplinary team of experts is researching sustainable fisheries management. The results are of particular interest for politics.

The resource economists are in the third floor of a high rise building of Kiel University, right in the city centre of Kiel. Seven kilometers away, the marine biologists from the GEOMAR Helmholtz Centre for Ocean Research enjoy the view of the Kiel Fjord and the passing Baltic ferries. And the scientists from the Institute for the World Economy? They work right around the corner from GEOMAR, also at the Kiel Fjord, only a kilometer further up the road.

Those who work with the interdisciplinary Cluster of Excellence The Future Ocean have to be willing to travel. Numerous times a week, the scientists commute from one location to another, giving lectures, discussing research hypotheses. The Cluster provides four bicycles for its colleagues. It makes for a faster commute and is fun at the same time. Probably no other research association in Germany, if not in all of Europe, has so much expertise on the subject of fisheries as the Cluster in Kiel. The Cluster of Excellence The Future Ocean has existed since 2006. In the summer of 2012, the confirmation for five more years of funding was given. The Cluster combines the knowledge of four Institutions: the Kiel University, the GEOMAR Helmholtz Centre for Ocean Research, the Institute for the World Economy and the Muthesius Academy for Fine Arts and Design. One of the Cluster's focal points is the topic area "Living Resources – Fisheries Management". 18 scientists, including professors, post docs and PhD students



Stakeholder dialogue at the Foreign Ministry, Berlin.



View from RV Poseidon leaving GEOMAR for a research expedition.

work here together. Internationalization is especially important for Kiel: Lectures and seminars are mainly given in English; every fifth member has a foreign background. In the long run, it is the goal that at least every third scientist will come to Kiel from abroad. The Cluster is expanding the cooperations with Columbia University in New York and Dalhousie University in Halifax, Canada. With a healthy self confidence, the Cluster speaker Martin Visbeck, Professor of physical oceanography at GEOMAR, sees Kiel listed in the top ten most important marine research sites.

One could say that the fisheries industry is only a marginal topic. Thus it is easy for Kiel to be highly "ranked". Nevertheless, here at the Baltic, they do many things differently from other universities. This brings success, scientific recognition and political relevance. At least four disciplines deal with fisheries: economics, biology, law and geography. Resource economists meet marine biologists, environmental ethicists work with business economists. Together they carry out studies that are then published in international scientific journals.

The marine biologist Rainer Froese, who has been at GEOMAR for decades, is fervent

about the "wonderful teamwork". Amongst many other things, Froese initiated Fishbase, the largest fish database in the world. With the founding of the Cluster of Excellence, Froese's horizon widened: on top of the usual biological approaches to sustainable fisheries came approaches from the side of economics and law.

Together with his colleague, the resource economist Martin Quaas from the Kiel University, Froese recently developed a concept that evaluates the degree of overfishing not only from a biological point of view but also from an economical perspective. Shadow interest rate is the name of the indicator that up to now played no role in their department. Instead of only concentrating on biologically relevant factors such as stock density and mortality, economic factors are now also flowing into the evaluation of overfished stocks. Professor Quaas and biologist Froese show that fishermen can generate large revenues in future, if they reduce their fishing quota today.

The scientists in Kiel now also integrate legal aspects into marine research, an unusual feat when compared to the general, international research landscape. In a recently published study, marine biologist Froese and lawyer



Research on sustainable fisheries has to take all aspects of the fishery process and production into account.

Alexander Proelß analyze the legal consequences when a non-profit, international organization awards an ecological label to a fisheries company that does not abide by specific internationally agreed criteria. The study is important for all consumers buying fish in the supermarket, as it inspects the credibility of ecological labels such as Marine Stewardship Council and Friends of the Sea. Research such as this was the reason for the breakthrough and the sudden media attention. Politicians, people in business and NGOs are now taking advice from Kiel experts. Resource economist Quaas visits Berlin often, informing members of the German federal parliament about fisheries. Marine biologist Froese is regularly invited to Brussels, where the European Commission is revising their fisheries policies. This is where scientific advice is needed. What are the effects of a set fishing quota on the stocks (biology), on the costs of fisheries (economics) and the regional economies (social economics)? Currently, evolutionary biologist Thorsten Reusch, together with the economist Quaas, is researching the economical effects from a genetics perspective. The gene pool of a stock changes when only large fish are removed. In

the long term, the average size of the fish will decrease. This, in turn, will affect the revenue, as smaller fish fetch lower prices.

The scientists from Kiel can now offer politicians and specialist officials holistic answers – in this particular case for the regulation of fisheries management and the mesh size of fishing nets. “Through our work, we can offer politics options for action” says Cluster Speaker Visbeck.

Meanwhile science has gone through a change, believes Visbeck. The fear of contact

between science and politics have been overcome by now. For Visbeck it is important to do relevant research.

He would now, without a problem, sit at a table with politicians, Greenpeace and the German Deep Sea Fishing Association and ask: What are you interested in? The answers can be given by the fisheries experts from Kiel. Their work is scientifically independent, yet politically relevant.

*Author: Marlies Uken, IJP Research Grant 2012*



Kiel's Remote Operated Vehicle (ROV) can retrieve samples from up to 6000 m water depth.





# Fisheries Research in the Cluster of Excellence The Future Ocean in Kiel

Living marine resources is one of the key research fields within the Cluster of Excellence The Future Ocean. The close cooperation of research groups from different disciplines provides an excellent basis for an interdisciplinary approach to science. In summer 2012 the Cluster provided specific opportunities to further broaden the Kiel perspective and to communicate its science.

## Semester Topic Summer 2012 – Sustainable Fisheries

The international network leads to high visibility well beyond Kiel. The semester topic “Sustainable Fisheries” in the Summer Semester 2012 came at the right time. The European Commission started a reform of the common fisheries policy in 2009 with the publication of a green book and a following open consultation. The result of the consultation was taken up by the commission in the decision to draft a new proposal, which is now being discussed in the European Parliament and the Council of Ministers. The result of these discussions will lead to a final document to be published in early 2013.

## 2048 – What will be the status of the world’s fish stocks?

Worm et al. (Science, 2006) predicted that all fish stocks will be collapsed by the year 2048. Their prediction was based on the extrapolation of a statistical model (regression of percentage of collapsed fish taxa over time). The paper was intensely discussed. The semester topic has brought together scientists from all disciplines to take a different approach to assessing the status of the world’s fish stocks in the future ocean, focusing on the processes that affect fish stocks. We look at the different drivers of change for the fish stocks, predict how they will evolve by using a suite of simulation models, and assess how their interaction will affect the fish stocks. The motivation for taking the year 2048 as the reference point is not only the Worm et al. paper, but 35 years in the future is also a sensible time frame for prediction. It is far enough in the future that we might already be seeing the impacts of climate change, acidification and evolution of

fish stocks. On the other hand it is also close enough to the present to allow predictions with regard to economic and management variables.

## Workshop - Managing Genetic Diversity in Fish?

Human activities and notably fisheries shape the oceans’ ecosystems, biodiversity and genetic diversity through several forces. (1) Fishing affects marine biodiversity by selectively fishing down populations, with cascading effects caused by ecosystem interactions. (2) A selection gradient is imposed on the exploited fish populations, as harvesting is size-selective. A rapid evolution of the population reaction norm has been reported for several exploited fish stocks. (3) The demographic decline reduces genetically effective population sizes and genetic diversity of exploited fish populations. All of these processes may have important consequences for economically efficient and sustainable management. Hypotheses of particular interest are: (a) fishing selects against economically more valuable traits; and (b) ecosystems may become less resilient against disturbances and prone to regime shifts. This may be due to loss of evolutionary adaptability, reduction in size and prey spectrum, or loss of stabilizing ecosystem interactions.

The workshop brought together 19 international experts in the fields of genetics, evolutionary ecology, fisheries sciences and resource economics to discuss the potential and limits of managing genetic diversity aimed at economically efficient and sustainable use of marine ecosystem services.



Participants of the international workshop on managing genetic diversity



Mussel farm in Tanzania, Africa

### Summer School - Equity and Efficiency in Fisheries

Traditionally, fisheries science and resource economics have been concerned with studying the consequences of overfishing and possible solutions, where overfishing means inefficiently high catches and inefficiently low stock sizes of fish. More recently, the distributive effects of overfishing (e.g. exploi-

tation of West African waters by European and Chinese fleets) and fisheries regulation (e.g. by means of individual transferable quotas, ITQs) have also garnered significant public and scientific interest. The summer school was attended by 14 PhD candidates, who listened to lectures from four renowned resource economists and fisheries scientists. The lively discussions focused on the questions of efficiency and inter- and intragenerational distributive effects of managing natural resource use, in particular fisheries.

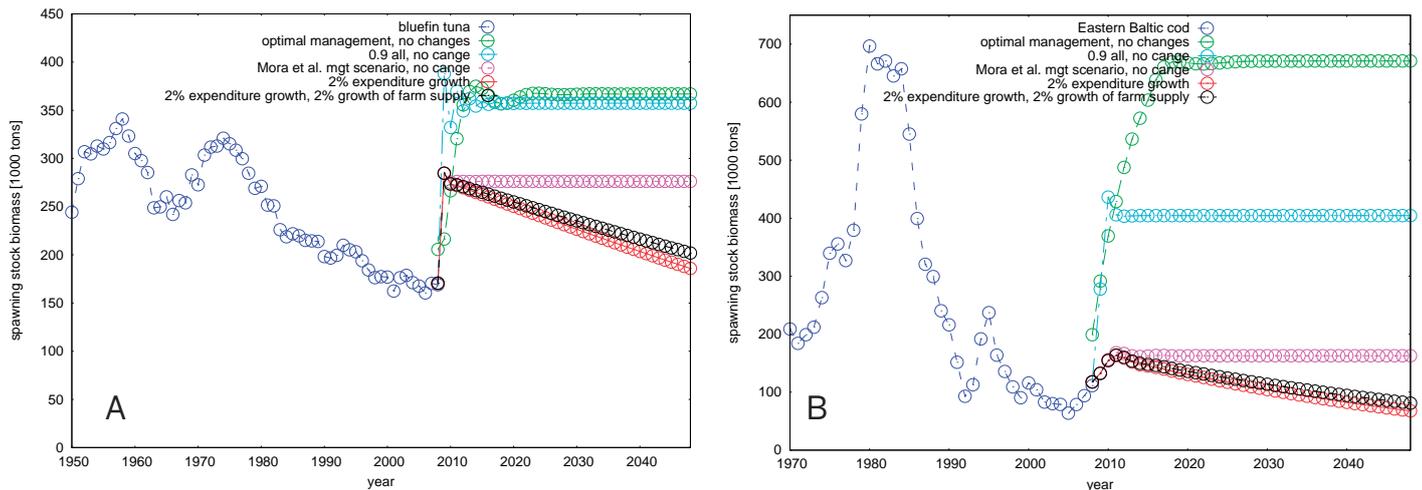
### Ecological-Economics at the World Fisheries Congress and the Conference of the International Institute for Fisheries Economics and Trade

Two special sessions were held at international conferences. The first session was held at the World Fisheries Congress (WFC) in Edinburgh, Scotland, from 7 – 11 May 2012. The session “Sustainable Fisheries: Ecological –Economic Modelling Tools to be

Used in Integrated Fish Stock and Fisheries Management” focused on the biological parts of integrated models. The second session “Coupled Economic-Ecological Models for Ecosystem-Based Fishery Management: Exploration of Trade- Offs Between Model Complexity and Management Needs” at the conference of the International Institute for Fisheries Economics and Trade (IIFET) from 16 – 20 July 2012 in Dar es Salaam, Tanzania, highlighted the economic components of coupled models in presentations and a panel discussion. Whereas the WFC session had a high variety of different models, the IIFET session focused primarily on management issues of a longer-term strategic nature such as the implications of climate change, fundamental regime change, or the role of forage species in an ecosystem.

### Special Game Session at the Conference of the International Institute for Fisheries Economics and Trade

There is a growing realization of the potential of games and experiments as powerful tools not only for research, but also for education and outreach. Experiments are particularly powerful and useful for fisheries economists



because (a) they can vividly illustrate some fundamental concepts and (b) are effective at testing the relative merits of various fishery management proposals. Fisheries economists have developed a great assortment of games and experiments for a wide variety of applications. However, many fisheries economists are unfamiliar with games and experiments and their potential applications. This two-part special session had a pair of complementary objectives: (a) to demonstrate a range of games and experiments to IIFET members unfamiliar with these methods to communicate their potential for education, outreach and research; and (b) to provide an opportunity for existing developers and users of games and experiments to share new ideas for applications in fisheries.

Figure 4 Based on stock assessment data, we developed age-structured bio-economic models for three Atlantic cod stocks and three Atlantic tuna stocks. The model was used to test the effect of management effectiveness, the effect of changing supply of farmed fish and a change in the willingness to pay higher prices, i.e. changes in expenditures for fish. Management effectiveness mirrors the performance of the management system taken from Mora et al. (2009). Farmed fish is supposed to have an effect through elasticity in demand, i.e. consumer will substitute higher price of wild fish by buying farmed fish. Five scenarios have been developed. The first scenario assumes optimal management for all stocks, i.e. an effectiveness of 1, taking price interactions into account, but assuming fixed costs, fixed expenditures for fish over time, i.e. the willingness to pay for fish is not changing, fixed supply of farmed fish, here salmon and sea bass, and fixed environmental conditions. The second scenario is the same as the first, but assumes a management effectiveness of 0.9. The third is the same as the first, but takes the current management effectiveness from Mora et al. (2009). The fourth is the same as the third, but assumes a 2% increase in expenditures for fish per year and the fifth is the same as the fourth, but assumes a 2% increase in farmed fish supply per year. The figures show the results for Bluefin tuna (A) and Eastern Baltic cod (B). The largest effect on the results has the management effectiveness.

#### Authors

Jörn Schmidt, Martin Quaas

#### Semester Topics

Semester topics are one outreach measure of the Future Ocean to promote certain topics of interest to groups within and outside the Cluster of Excellence. Special activities illustrate certain scientific topics. These activities could include scientific workshops, summer schools, public lectures, seminars for certain stakeholder groups, conferences or other outreach activities that would support a special topic. The topics already scheduled are Fisheries and Overfishing (summer semester 2012), Mineral Resources (winter semester 2012/13) and Ocean and Coastal Hazards (Summer Semester 2013). One of the outcomes of each topic will be contributions to upcoming issues of the World Ocean Review.



# The Future Ocean Atlas – an Integrative Project for the Future Ocean

A project such as the Future Ocean, striving to combine data and knowledge from different disciplines should develop platforms able to combine this knowledge within a single entity. The Future Ocean Atlas is a project pursuing this goal, combining data from different disciplines in order to create new links among them.

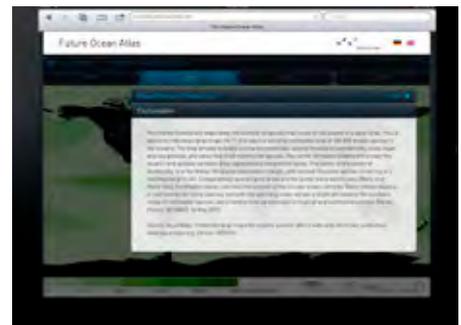
## Combining Global Data

The Future Ocean is a very interdisciplinary project, combining many scientific disciplines, which have traditionally conducted independent research. How can the results of this disciplinary and interdisciplinary research be combined? The answer may be: within an interactive mapping application, displaying data and findings from various sources within the Future Ocean.

The Future Ocean Atlas strives to bring together many components in a unifying framework, presenting the results in an easy to understand interface. The discovery of new knowledge should arise from the combination of independent results. The Future Ocean Atlas tries to address these challenges with a new cross-cutting platform, combining the results of all Cluster projects in standardized global maps.

## Atlas Based on AquaMaps

To date the atlas contains current and future global maps produced by our oceanographers, geologists and meteorologists. Building on the foundation of AquaMaps, an application developed by fishery biologists, it will show current and future global species distribution maps for over 10,000 species including algae, molluscs, fish, marine mammals and sea birds. Economists are providing maps that show profitability of fishing based on the value of the exploited species and the cost of fishing at a certain locality. Lawyers show the legal boundaries, conventions, and management regimes applicable to the various parts of the ocean; the risk experts show predictions of sea level rise, probability of volcanic activities or exposure to tsunamis; the geneticists map parasite-host interactions and the occurrence of certain genes; marine medicine maps the occurrence of

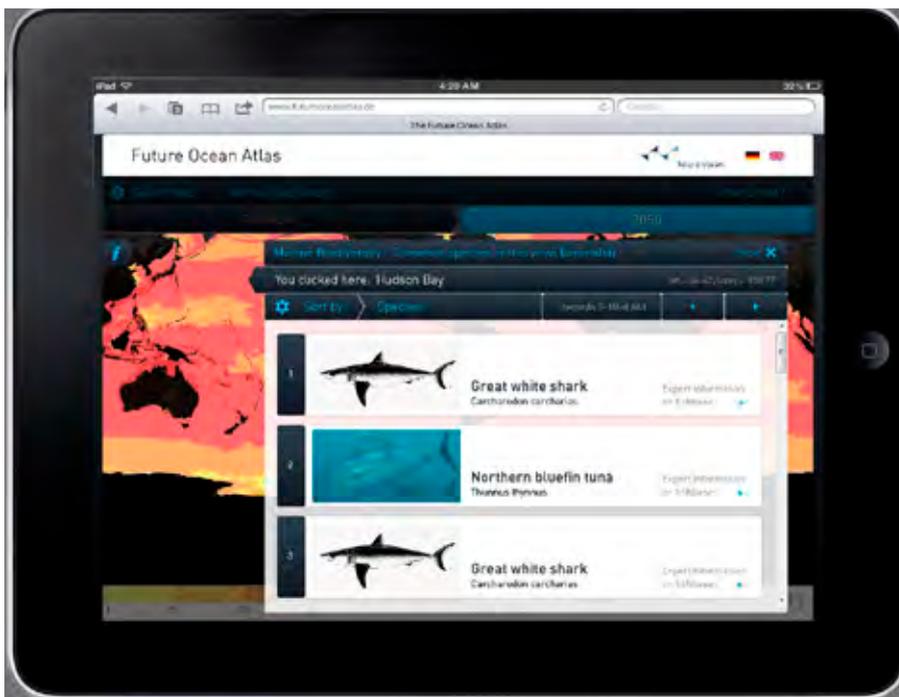


The novel graphical interface allows an intuitive handling

their target organisms and of certain traits. Because the various maps follow common standards, they can be combined to derive new insight into combinations of data.

## Coming in 2013 - a New Tool

A new interface has been developed already. For the interested public, the Atlas provides a novel intuitive graphical interface to scientific information: it displays maps, with which, clicking on a particular region, it is possible to find out ocean temperatures, wave-height, wind, depth, species with pictures, fishing activities, shipping traffic, risks, minerals, rules and regulations together with explanatory information about the data it was derived from and what this may actually mean. For the general public the porting of the mapping application to be available on smart phones is planned, giving users the opportunity to investigate ocean information wherever they are. This project is still in its prototype stage but we have high expectations of developing it into a tool, which will allow the public to research the Future Ocean with us!



The new Future Ocean Atlas will show maps for more than 10,000 species.

## Project Team

Rainer Froese, Miriam Kaschner

# Overfished but Still on the Plate

A new study in the journal *Marine Policy* reveals: nearly 30 percent of fish products with the Marine Stewardship Council (MSC) or Friend of the Sea (FOS) certification come from overfished stocks.



## Can Seals be trusted?

Three quarters of the marine fish stocks worldwide are regarded as overfished or fished to sustainability limits. Numerous fish stocks have even collapsed already due to exceedingly high catch quotas. Which fish and seafood can still be eaten? Consumers often trust the recommendations of independent seals of approval. The most well known of these in Germany is the environmental seal MSC, Marine Stewardship Council. The seal promises products from sustainable fisheries and certifies fisheries companies that practice environmentally friendly and sustainable fishing. The less well known seal Friend of the Sea (FOS) also provides some guidance for consumers when purchasing fish. How trustworthy are these seals of approval and can consumers really fully rely on these certifications?

## Products with seals still overfished

In a study published in the journal *Marine Policy*, the fisheries biologist Dr. Rainer Froese, GEOMAR, Helmholtz Centre for Marine Research Kiel, and the Law Professor Alexander Proelß, Trier University, took an in-depth look at the two seals MSC and FOS. The results are alarming. Among the certified products, by FOS 19 percent and by MSC 31 percent came from overfished stocks and those that are not being fished sustainably.

“Only about half of the MSC certified products come from proven healthy stocks with adequately low fishing pressure. About a third of the certified fish stocks were too small and simultaneously overfished. The remaining stocks were either too small, overfished or there was no information available”, Rainer Froese, author of the study, summarizes the results of the investigation.

## Seals cannot be held accountable

What legal consequences does an international non-profit organization face for certifying a fishing business that does not comply with internationally determined criteria? With UNCLOS (United Nations Convention on the Law of the Sea) the international community has agreed in principle on the preservation and the sustainable management of fish stocks. The commitments in UNCLOS have been further clarified in the UNFSA (United Nations Fish Stocks Agreement). “Despite these recognized rules, certification agencies cannot be held accountable if the companies they certify violate international standards, unless national law contains relevant provisions, for example for native fish which are regarded as overfished.” says Professor Alexander Proelß from Trier University, who contributed to the interdisciplinary study as a member of the Kiel Cluster of Excellence The Future Ocean. “Only under very specific

conditions can states forbid the import of fish products from overfished stocks.” continues Proelß.

## Certifications must be revocable

Thus consumers cannot completely rely on the seals of approval. There are no sanctions for non-compliance with recognized standards and certificates do not have to be revoked if fishing businesses no longer fulfill the evaluated criteria. “The certifiers must tighten their criteria and then demand compliance. The seal of approval must be revoked for overfished stocks.” demands Rainer Froese. Despite all the criticism, the researchers’ message to consumers is clear: The seals of approval do help the consumer in choosing environmentally-friendly fish products. “The products from MSC and FOS are better than uncertified goods. The probability that the fish come from sustainable fisheries is three to four times higher with the MSC or FOS seal than for seafood from untested companies”, asserts Froese.

Original work: Froese, R., Proelß, A. Evaluation and legal assessment of certified seafood. *Mar. Policy* (2012), <http://dx.doi.org/10.1016/j.marpol.2012.03.017>

# Fisheries and International Governance

## United Nations Consultations on Deep Sea Fisheries

The implementation of the United Nations resolution on the impact of bottom fishing on deep sea vulnerable habitats and long term sustainability of deep sea fish stocks was the topic of a UN workshop on September 15-16, 2011. The workshop was held at the UN Headquarters in New York during the first round of informal consultations on the draft resolution on sustainable fisheries. Jörn Schmidt from the Sustainable Fisheries group of the Future Ocean was invited by the International Ocean Institute (IOI) to participate in this event. The workshop concluded that although landings from deep waters are few compared to global landings, the impacts of deep sea fishing may be significant, as damage to certain deep sea habitats appears to be long-lasting and recovery will take decades or more. A report is available at [http://www.un.org/ga/search/view\\_doc.asp?symbol=a/66/307](http://www.un.org/ga/search/view_doc.asp?symbol=a/66/307)



United Nation Headquarters in New York

## Representing ICES in the UN Ad-Hoc Working Group

The Future Ocean sustainable fisheries group represented by Jörn Schmidt served as a representative of the International Council for the Exploration of the Sea (ICES) at the Ad Hoc Working Group of the Whole under the auspices of the United Nations General Assembly in February 2011. The Ad Hoc Working Group of the Whole recognizes the need for regional workshops and agrees on the need for communication systems. The meeting set a process in motion, which should lead to regular assessment reports on the state of the global marine environment, including socio-economic aspects, similar to the IPCC reports. The first of these reports should be published in 2014. The World Ocean Review, published by maribus and the International Ocean Institute in collaboration with Future Ocean scientists, was introduced to the participants and was received very well by the delegates.

## Cluster Experts Consult on EU Common Fisheries Policy Reform

Rainer Froese, Future Ocean member at GEOMAR Helmholtz Centre for Ocean Research Kiel, consulted the European Parliament on the reform of the Common Fisheries Policy at a workshop in Brussels, Belgium. Attendees included representatives of the Directorate General on Maritime Affairs and Fisheries with their Commissioner Maria Damanaki. Rainer Froese presented Cluster research conducted together with colleagues from the departments of Economics and International Law at Kiel University on Sustainable Fisheries. They emphasized that the legal basis for fisheries management is already laid out in the United Nations International Convention on the Law of the Sea

from 1982 and the United Nations Fish Stock Agreement from 1995. After successful implementation of these agreements in New Zealand, Australia and the USA, the European Union has now to follow. Froese presented results from his work, demonstrating generic harvest control rules for European fish stocks that would lead to a fourfold increase of fish biomass and a corresponding increase in the total allowable catch of 63 percent. The net revenue of fishing could be fivefold. Froese criticized the alternative suggestion of the International Council for the Exploration of the Sea (ICES) as insufficient and not in accordance with experience gathered in New Zealand, Australia and the USA.



Fishery biologist Rainer Froese speaks at a workshop on the reform of the Common Fisheries Policy in Brussels.



The World Ocean Review is a compilation of current knowledge on many aspects of current ocean science.

## World Ocean Review presented in the European Parliament in Brussels

Within the framework of an event organized by the Seas and Coastal Areas Intergroup of the European Parliament on April 19, 2011, the publication World Ocean Review (WOR, [www.worldoceanreview.com](http://www.worldoceanreview.com)) was presented to the European Parliament in Brussels. In their opening remarks EU Commissioner for Maritime Affairs and Fisheries, Maria Damanaki, and Dr. Awni Behnam, Assistant Secretary General of the United Nations, referred to the uniqueness of this publication and expressed their conviction that the WOR has initiated discussion on ocean climate change in a similar way as the IPCC Report has for climate change in general – and that thus finally the oceans and human-ocean interaction will be shifted into the public focus.

“I believe that this report will stimulate and underpin debate on the oceans in the same way that the Intergovernmental Panel on Climate Change assessments stimulates debate on the climate. I look forward to listening to and joining in these debates. I

look forward to a time when the way we treat oceans - and the way we treat our fish - are as high on the political agenda and in the public debate as climate change is today. I look forward to the day when politicians treat the ocean in the same multidisciplinary way that you have treated the science of oceans. We must adopt a long-stretching vision. We must make the 21st century a time of renewal. And we can.” Maria Damanaki said. Nikolaus Gelpke, publisher, and Martin Visbeck, Speaker of the Kiel Cluster of Excellence The Future Ocean, who initiated the WOR together, explained the background and the development of the project and summarized the scientific findings of the research areas covered by the WOR. Questions on the interaction of climate and ocean, the scientific basis of overfishing and the current fisheries policies were addressed in the talks by Mojib Latif and Martin Quaas. The event was moderated by Isabella Lövin, member of the European Parliament and vice president of the Seas and Coastal Areas Intergroup.

## Regional UN Workshop on Marine Assessments in Brussels

At the 2002 World Summit on Sustainable Development in Johannesburg, SA it was decided that the ocean should be put under permanent review. The UN's short name for the project—Regular Process—emphasizes the importance of conducting this assessment regularly, with an initial plan of an ocean review every five years. The result of the first cycle – 2005 to 2009 – is the Assessment of Assessments (AoA), a collection of all marine assessments worldwide. The second cycle started at the end of 2009 with the goal of publishing the first integrated marine assessment at the end of 2014. The whole process will require the support of many contributing scientists. One measure being taken to inform the community is the organization of regional workshops. The regional workshop for the North Atlantic took place in Brussels from 27-29 June, 2012. All regional conventions and Intergovernmental Organizations, including ICES, represented by Future Ocean member Jörn Schmidt, attended the event and presented their work and possible contributions to the process. The nomination of experts will be conducted by the national representatives to the UN by the end of September 2012.



Delegates from the European Parliament learn about overfishing and management plans with the EcoOcean computer game.

## EcoOcean – Competing in Sustainability

On 25-26 October, 2011 a special event took place at the European Parliament in Strasbourg. In breaks between the meetings, delegates gathered around the EcoOcean game table designed by researchers from the Future Ocean. Players teamed up in

groups of four to try to fish the highest profits while maintaining their fish stocks as sustainably as possible. Participants were able to compete in a contest initiated by the Fish for the Future initiative ([www.fishforthefuture.eu](http://www.fishforthefuture.eu)) promoted by the Swedish delegate Isabella Lövin, member of the Committee on Fisheries of the European Parliament.



# Research

It doesn't matter how beautiful your theory is, it doesn't matter how smart you are. If it doesn't agree with experiment, it's wrong.

*Richard P. Feynman*

# Mechanisms of Intracellular $\text{CaCO}_3$ Crystalization in Hemocytes of *Mytilus edulis*: Sensitivity of Bivalve Calcification to Ocean Acidification.

Ongoing ocean acidification negatively influences calcification in marine bivalves. To better predict their sensitivity it is essential to improve our understanding of the cellular mechanisms behind shell formation. Mineralization of  $\text{CaCO}_3$  has been hypothesized to occur either in cells of the mantle epithelium or circulating hemocytes. Work by Mount et al. (2004) concluded that hemocytes of the Eastern Oyster (*Crassostrea virginica*) not only mineralize calcite crystals intracellularly, but also transport them to the growing shell front. In this project we examined the role of hemocytes vs. mantle tissue in shell mineralization of the blue mussel (*Mytilus edulis*) using cellular and molecular techniques, as well as a novel shell regeneration assay.

## Cell biology

Initial work focused on microscopic imaging of hemocytes. Hemocytes were sampled from the extrapallial fluid, the body fluid in direct contact with the shell, from rapidly growing mussels. Using classical staining techniques, we identified the three primary groups of hemocytes described in the literature. (i) hyalinocytes, (ii) basophilic granulocytes and (iii) eosinophilic granulocytes (Fig. 1). In vivo microfluorometric experiments illustrated that granulocytes have significant acid-base regulatory capacity and contain numerous vesicles with different pH – a prerequisite for efficient shuttling of protons that are generated during the calcification process (and during immune responses) out of the cell into the extracellular medium (Fig.

2a). Calcein staining experiments were used to visualize  $\text{CaCO}_3$  crystals located in vesicles using confocal laser scanning microscopy. However, no crystals could be identified (Fig. 2b). Similarly, when investigating hemocytes under polarized light, no strongly refractive material ( $\text{CaCO}_3$  crystals) could be documented (Gutowska et al., in prep). In order to further substantiate these findings, we used molecular biological techniques to investigate the expression of genes known to be involved in biomineralization.

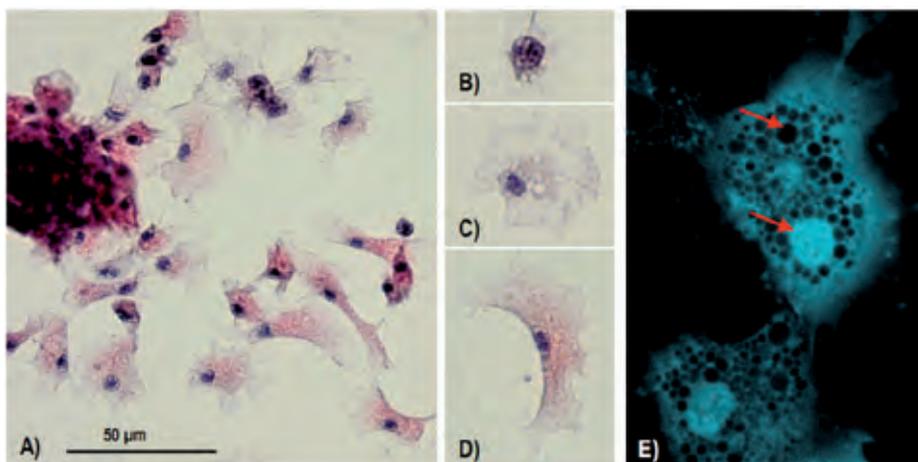
## Molecular biology

Using 454 next-generation sequencing techniques available through the molecular biological platform of the Cluster, we sequenced transcriptomes of various tissues

(outer mantle regions, inner mantle tissue regions, hemocytes, mixtures of remaining tissues). Sequencing of 2.4 million reads resulted in the identification of ca. 75,000 unique gene sequences (Philipp et al. submitted). In order to identify genes that are specific for the biomineralization process, we searched for unique genes that are exclusively expressed in tissues known to be involved in shell formation, particularly the outer and inner mantle tissues. Filtering for genes that are expressed at least 10 times higher in mantle vs. any other tissue, we found that the outer mantle region contains >300 gene transcripts that are specific for this tissue. Comparing these sequences with internet databases, we found that >200 of these genes are significantly similar (tblastx <e-10) to genes known to be involved in biomineralization in other bivalve and gastropod species. Among these were shematrin-like, perlwapin-like, perlucin-like and nacrein-like and other organic matrix genes, as well as chitinases and tyrosinases (Hüning et al. in prep.). Only 10% of these genes were expressed in the inner mantle region (the central part that is relatively far away from the growing shell margin), while none of the calcification-specific genes were expressed in hemocytes. Subsequently, we used a recalcification assay to investigate the involvement of hemocytes in shell regeneration.

## Shell regeneration assay

In order to promote shell regeneration, we drilled holes with a diameter of ca. 1 mm through the central region of mussel shells. This shell region is directly above the inner mantle region, which, during rapid shell length growth, does not express most of the calcification-related genes. During pilot experiments (work in progress), we could demonstrate that the mantle forms an organic layer



**Figure 1** Hemocytes were examined histochemically and with polarized light microscopy to identify cell types and locate reflectance of potential intracellular  $\text{CaCO}_3$  crystals. Hematoxylin and eosin stained hemocytes from *M. edulis*.

**A** Typical appearance of cell type distribution and aggregation in the extrapallial fluid. Representative cells of the three primary groups **B** hyalinocyte **C** basophilic granulocyte **D** eosinophilic granulocyte.

Intracellular  $\text{CaCO}_3$  crystals were not detected with polarized light microscopy in hemocytes of *M. edulis*. Acid-base regulatory capacity and pH of vesicular compartments was examined microfluorometrically with confocal microscopy. **E** Granulocytes loaded with the pH sensitive dye BCECF-AM, arrows indicate vesicles with differing pH. Hemocytes were found to have significant acid-base regulatory capacity in in-vivo experiments.

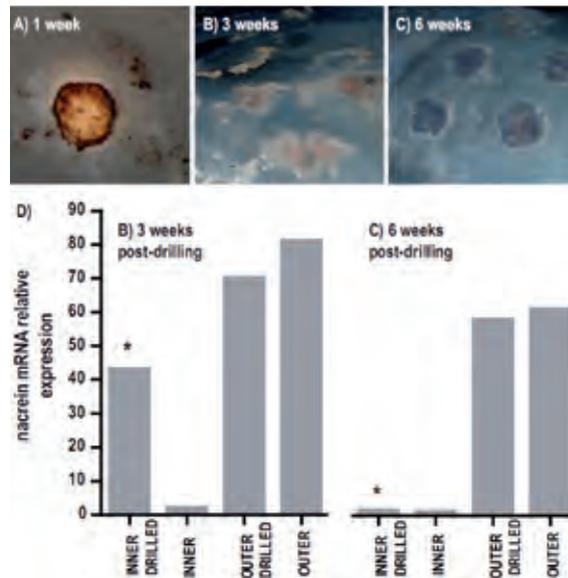
that constitutes the first barrier, isolating the body fluids from seawater. Subsequently, CaCO<sub>3</sub> is produced and deposited on the organic layer. Using quantitative real-time PCR, we could demonstrate, that some calcification - related genes that are typically exclusively expressed in the outer regions of the mantle, are expressed during shell regeneration in inner regions of the mantle tissue underlying the holes (Fig. 3). This indicates that also during shell repair, mantle tissue has the primary role of formation of organic matrix components for shell regeneration. Whether hemocytes participate in transport of organic and inorganic material from the mantle to the shell front remains open to investigation.

## Conclusions

Cellular and molecular biological evidence points to the mantle tissues as the main organ responsible for biomineralization in mussels (Gutowska et al., in prep.). Thus, hemocytes do not appear to have as prominent a role in mussel shell biomineralization as in oysters. It is possible that mussel hemocytes could play a role during initial stages of shell regeneration, or during repair of small inner shell regions that have dissolved during exposure to acidic seawater (Melzner et al. 2011). Further research will focus on visualization of hemocytes during the shell regeneration process. Our work with a novel shell regeneration assay has documented a previously undescribed plasticity in tissue specific localization of biomineralization related gene expression. These findings are in line with recent studies that conclude a diverse suite of cellular mechanisms supports biomineralization in molluscan genera. We conclude that differing sensitivities of molluscs to ocean acidification can partially be explained by varying susceptibilities of specific cellular calcification pathways to changes in seawater carbonate chemistry.

## Networking

In order to study the pH regulatory capacities of hemocytes, we collaborated with G. Wikfors, NOAA Milford Laboratory, Connecticut, USA, with the help of a jointly supervised Diploma student (C. Krome, CAU Kiel). In order to generate the extensive transcriptomic information necessary for identifying the calcification related gene sets, we heavily cooperated with the working groups of F. Melzner (A1) and E. Philipp and P. Rosenstiel (B2), by sharing costs and work effort. A close cooperation with colleagues



**Figure 2** Shell documentation and gene expression results following the progression of recalcification over the 6 week time course of the shell regeneration assay.

**A** Initial organic layer that is attached to the inside of the shell to isolate the body fluids from seawater incursion. **B** Extensive organic layers covering three drilled holes 3 weeks post induction. **C** Calcification of the organic layers covering four holes 6 weeks post induction. Regenerated shell material is evident as CaCO<sub>3</sub> crystals covering the brown organic layer. **D** Changes in relative expression of nacrein, a biomineralization specific organic matrix protein. At the 3 week time point nacrein expression is specifically elevated in the inner mantle region of the drilled shell half (\*). This correlates with the production of the brown organic layer that forms the initial barrier. At the 6 week time point the drilled holes have been recalcified and nacrein expression levels have returned to control levels (\*). Under regular shell growth conditions organic matrix proteins involved in biomineralization are primarily synthesized in the outer mantle region.

from the AWI Bremerhaven (A. Hüning, M. Lucassen) was set up in order to study mantle genes related to biomineralization processes in more detail.

## Outlook

The project is closely coordinated with research activities in the first phase of the BMBF funded sub-project 3.1.3 (Cellular mechanisms of calcification in molluscs; Melzner, Gutowska, Bleich, Lucassen) within the larger BIOACID program (2009-2012). The research topics of Future Ocean project CP0946 will likely be continued in 2012-2015 using BIOACID funding. A pre-proposal has been submitted for a consortium within the framework of BIOACID II that focuses on bivalve sensitivity to elevated seawater temperature and increasing pCO<sub>2</sub>. Work originating from Future Ocean project CP0946 was instrumental for outlining this pre-proposal.

## Publications

(including submitted and in prep.)

- 1 Krome C. (2009). Intracellular pH regulatory ability of oyster hemocytes during acute acidification. University Kiel (supervised by Wikfors, Gutowska, Melzner, Bleich)
- 2 Melzner F, Stange P, Trübenbach K, Thomsen J, Casties I, Panknin U, Gutowska M.A. (2011) Interactive effects of food supply and seawater pCO<sub>2</sub> on calcification and internal shell dissolution in the blue mussel *Mytilus edulis*. PLoS ONE 6(9): e24223. doi:10.1371/journal.pone.0024223
- 3 Philipp E.E.R., Kraemer L., Melzner F, Poustka A., Thieme S., Findeisen U., Schreiber S., Rosenstiel P. (2012) Massively parallel RNA sequencing identifies a complex immune gene repertoire in the lophotrochozoan *Mytilus edulis* PLoS ONE (in revision)
- 4 Hüning A., Melzner F, Thomsen J., Gutowska M.A., Krämer L., Rosenstiel P., Pörtner H.O., Philipp E.E.R., Lucassen M. [submitted] Impacts of seawater acidification on mantle gene expression patterns of the blue mussel; implications for shell formation and energy budget
- 5 Hüning A., Gutowska M.A., Trübenbach K., F. Melzner F., Bleich M. (in prep.) The role of mantle tissue vs. hemocytes in biomineralization of the mussel *Mytilus edulis*

## Project Team

Magdalena A. Gutowska, Heinrich Terlau, and Markus Bleich

# The Occurrence and Relevance of Nitrogen Fixation in Sediments of Oxygen Minimum Zones

The aim of this study is to determine if dinitrogen ( $N_2$ ) fixation is occurring in marine oxygen minimum zone (OMZ) sediments and if so, whether this process is linked to sulfate reduction via  $N_2$ -fixing sulfate-reducing bacteria or coupled to other microbial metabolic pathways.

The core questions of this project are

- ▶ To what depth in the sediment is  $N_2$ -fixation occurring?
- ▶ Is the observed nitrogenase activity associated with the incorporation of nitrogen into microbial biomass or does it serve another purpose?
- ▶ How high are rates of benthic  $N_2$ -fixation within and outside OMZs and how relevant is the process for nitrogen and sulfur cycling?
- ▶ Is  $N_2$ -fixation coupled to sulfate reduction and/or other microbial processes?
- ▶ What implications could seafloor warming and a spreading of OMZs have on local nitrogen and sulfur cycles?

## Current state of the project

Starting in April of 2010, monthly research excursions to a seasonally hypoxic region of the Baltic Sea (Eckernförde Bay, Northern Germany) were conducted to determine if benthic  $N_2$ -fixation would vary over the course of a year as oxygen concentrations,

temperature, and organic matter availability also varied. During each monthly cruise, CTD casts were performed to gather profiles of oxygen concentrations, temperature, and salinity in the water column. Subsequently, sediment cores were collected for three main purposes: 1) detailed analyses of benthic geochemistry (e.g.  $NH_4^+$ ,  $NO_3^-$ ,  $SO_4^{2-}$ ,  $H_2S$ , DIC, TNCS), 2) microbial rate measurements ( $N_2$ -fixation, sulfate reduction), and 3) molecular analyses (e.g. CARD-FISH, HISH-SIMS, monitoring key functional genes by PCR amplification). We also returned to Eckernförde Bay in October 2011 to gather sediment that we used in an experiment to determine if temperature played a large role in affecting these microbial rates, as opposed to just oxygen concentrations or organic matter availability affecting rates. To date, all geochemical analyses and microbial rate measurements have been performed, as well as varying levels of CARD-FISH, HISH-SIMS, and amplification of *nifH* by nested PCR followed by cloning and sequencing as well as

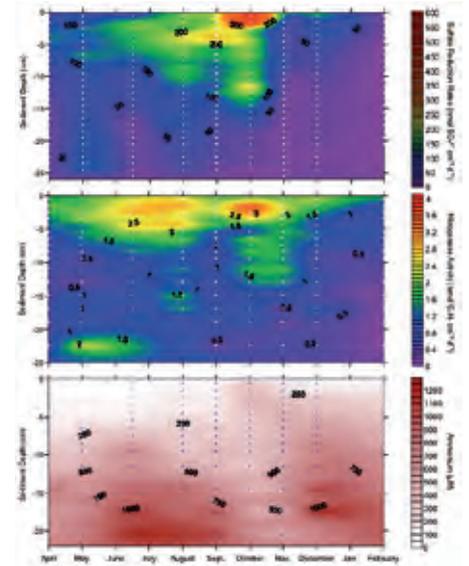
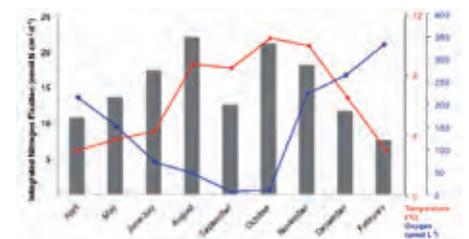


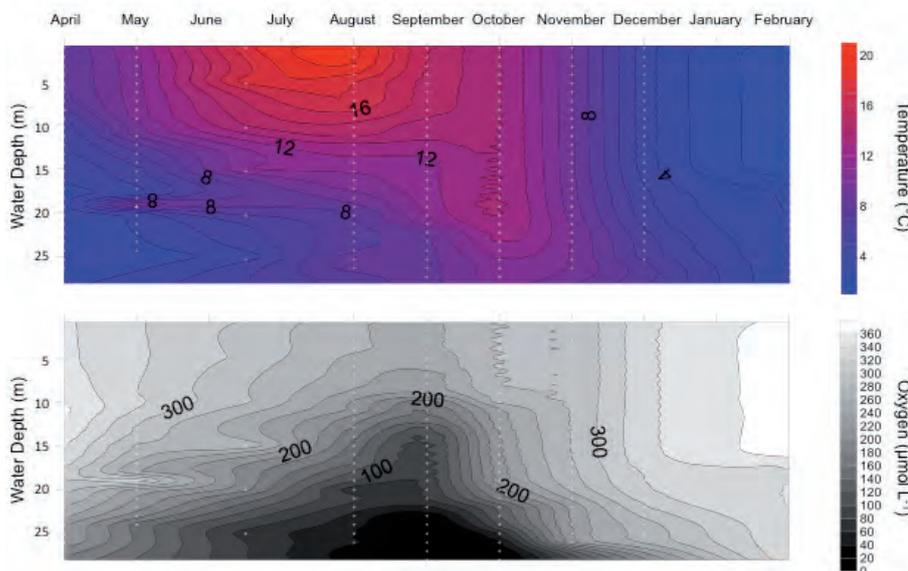
Figure 2 Seasonal variations in sulfate reduction rates (top), nitrogenase activity (middle), and pore water ammonium concentrations (bottom) in the sediments at Eckernförde Bay. Due to length of  $N_2$ -fixation cores, June/July sampling only went to 20 cm sediment depth and August sampling went to 18 cm sediment depth.

Figure 3 Depth integrated (to 18 cm)  $N_2$ -fixation rates for Eckernförde Bay sediments, overlaid with bottom water temperature (red) and oxygen concentrations (blue).



quantitative PCR. Currently, we are working to conclude the remaining molecular analyses and have begun drafting manuscripts that should be submitted within the year. One manuscript has been published in *Biogeosciences Discussions* and is currently (Fall 2012) in revision. The manuscript is part of a *Boknis Eck Time Series Station Special Issue*, guest edited by H. Bange and T. Treude. Additionally, in March and April 2011, we joined a research cruise (SFB754) to the OMZ located off the coast of Mauritania. Onboard, we performed  $N_2$ -fixation, iron reduction and sulfate reduction rate measurements, as well as  $^{15}N_2$  incubations and sampling for molecular analyses, which will be completed in 2012/2013.

Figure 1 Seasonal variations in water column temperature (top) and oxygen concentrations (bottom) in Eckernförde Bay.



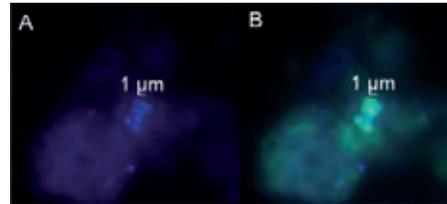


## Results & Discussion

As expected, temperature and oxygen concentrations in the water column in Eckernförde Bay varied greatly over the course of the year (Fig. 1). The highest bottom water temperatures coincided with the lowest bottom water oxygen concentrations in the months from August through November. During these same months, the highest sulfate reduction rates (SRR) and the highest nitrogen activities (NA) were seen in the sediments (Fig. 2). Interestingly, the lowest ammonium concentrations were seen at the same time as the highest SRR and NA. Over the course of the year, integrated rates of  $N_2$ -fixation (down to 18 cm) were negatively correlated to bottom water oxygen concentrations and positively correlated to temperature (Fig. 3). The one exception to this finding is the integrated rate from September. However, during this month, large amounts of dead worms were discovered at the sediment surface, suggesting that other environmental factors may be at play during this time. Results from analysis of *nifH*, the key gene for  $N_2$ -fixation, amplified by nested PCR on samples collected in September identified mainly proteobacteria and novel *nifH* clusters, termed Boknis Eck (BE) clusters 1-6 (Fig 4.). Results also indicate that there are several sulfur reducing bacteria present in Eckernförde Bay sediments that have the genetic capability to perform  $N_2$ -fixation (Fig. 4). In particular, our samples contained organisms closely related to *Desulfonema limicola*, *Desulfovibrio vulgaris*, and *Sulfurospirillum multivorans*. Using this information, we began CARD-FISH analysis of sediments collected in August (the month that had the overall highest integrated  $N_2$ -fixation

Figure 4 (left) Neighbor-joining phylogenetic tree of *nifH* sequences (this study, provided by C Löscher and I Salonen) and closest protein matches by tblastx. Our samples are indicated by Sept, followed by the sediment depth in cm (e.g. 3-4), followed by the clone number. BE1-6 stands for Boknis Eck Clusters 1-6t.

Figure 5 (below) Cluster of *Desulfovibrio* spp. seen during CARD-FISH analysis using DAPI (A) and after labeling with the DSV698 probe (B).



rates) using the DSV698 probe directed against 16SrRNA, a probe used to detect the presence of *Desulfovibrio* spp. Results confirm that there are *Desulfovibrio* spp. in substantial quantity in the uppermost layers of sediment (Fig. 5). *Desulfovibrio* spp. have previously been shown to perform  $N_2$ -fixation in culture studies (e.g. Riederer-Henderson and Wilson, 1970). It is therefore possible that these organisms could be responsible for some of the  $N_2$ -fixation within Eckernförde Bay sediments. Sediments from Eckernförde Bay were incubated with  $^{15}N_2$  in the hopes of seeing incorporation of  $^{15}N$  into biomass, which would indicate  $^{15}N_2$ -fixation. The sediments were then filtered, labeled with the DSV698 CARD-FISH probe and those cells determined to be *Desulfovibrio* were subjected to Nano Secondary Ion Mass Spectrometry (NanoSIMS), this total process previously being referred to as HISH-SIMS. Preliminary results from the first attempt at NanoSIMS (Fig. 6), suggest that *Desulfovibrio* cells contain elevated levels of  $^{15}N$  in their biomass when compared to background measurements, indicating possible  $^{15}N_2$ -fixation. However, more samples need to be measured

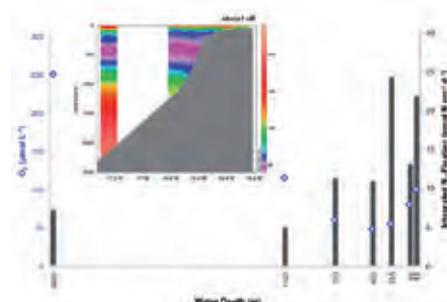


Figure 7 Integrated benthic  $N_2$ -fixation rates (gray bars) and bottom water oxygen concentrations (blue diamonds) along a depth transect off the coast of Mauretania, a developing OMZ region. A contour plot of water column oxygen concentrations is inserted within the graph for a more comprehensive overview of the region.

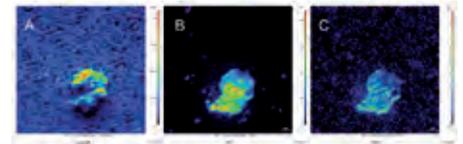


Figure 6 Images from the first NanoSIMS measurements of Eckernförde Bay sediments. (A) shows the cells on the filter during measurement, (B) shows levels of  $^{32}S$  within the cells, and (C) shows levels of  $^{15}N$  within the cells.

prior to making any substantial conclusions and we are scheduled to return to the MPI in 2012/2013 for additional NanoSIMS measurements.

Initial results of benthic  $N_2$ -fixation rates measured using acetylene reduction along a depth transect off the coast of Mauretania, a developing OMZ region, indicate that  $N_2$ -fixation is also occurring in these sediments (Fig. 7). The Highest rates were seen in sediments beneath low oxygen waters, at approximately 239 m water depth. Rates decrease down the slope of the transect as oxygen levels increase, however  $N_2$ -fixation rates were still detected in sediments at approximately 3000 m water depth. Sulfate reduction rates and  $^{15}N_2$  incubation samples from these locations are still being processed, following which, samples will be selected for molecular analyses, including CARD-FISH, PCR, and HISH-SIMS.

## Outlook

Because all fieldwork was completed in 2011, the first through third quarters of 2012 was dedicated to concluding any remaining laboratory work, to finishing data analyses, and to writing and publishing results. During the first and second quarters of 2012, occasional trips to the MPI-Bremen were made to conduct HISH-SIMS analysis on both Eckernförde Bay and Mauretania samples. The project officially ended in Fall 2012, when the Humboldt fellowship of V. Bertics ended. However, some interesting research lines will be completed within a new PhD study (J. Gier, start August 2012) as part of the SFB754.

## Selected Publications

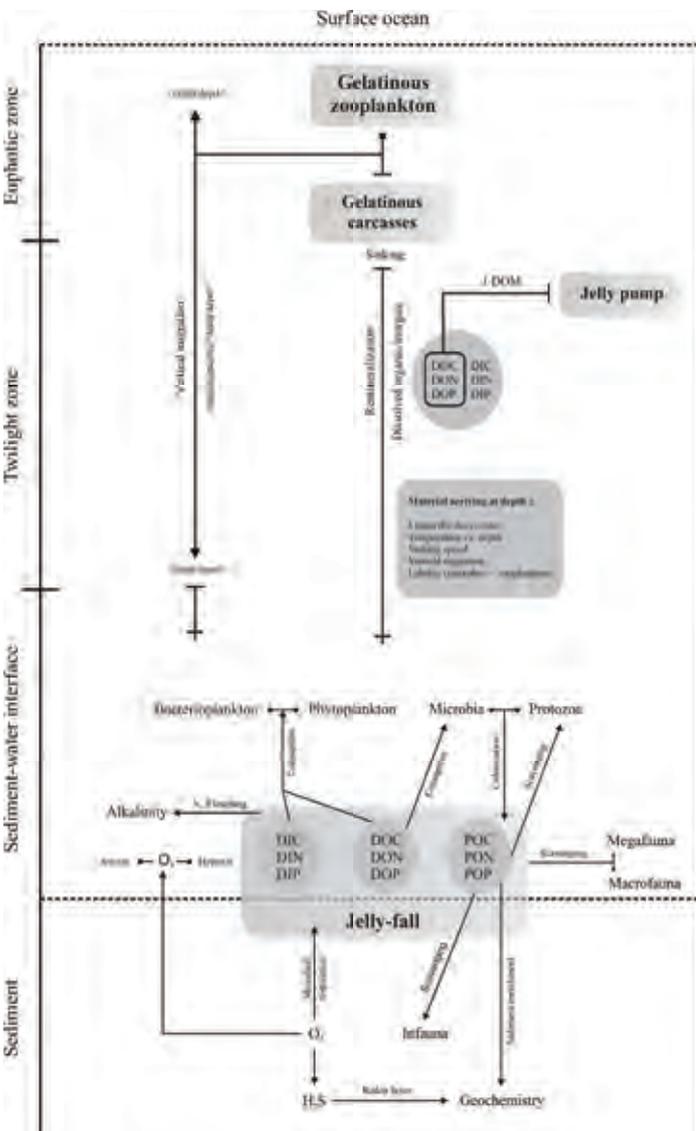
VJ Bertics, CR Löscher, I Salonen, AW Dale, R A Schmitz, T Treude (2012): Occurrence of benthic microbial nitrogen fixation coupled to sulfate reduction in the seasonally hypoxic Eckernförde Bay, Baltic Sea, *Biogeosciences Discuss.*, 9, 6489–6533

## Project Team

Tina Treude (GEOMAR), Ruth Schmitz-Streit (Christian-Albrechts University), Victoria Bertics (Humboldt Post-doctoral Fellow at GEOMAR)

# Does the Rise of Slime Foster an Oceanic Jelly Carbon Pump?

Gelatinous zooplankton are critical indicators of marine ecosystem change. Population explosions are linked to shifts in climate (among other factors), and have large ecological impacts and still unknown biogeochemical implications on top-down and bottom-up processes. After their proliferation, they disappear from the surface waters and we have very little information on their fate and on the transfer of organic matter (jelly-POM) to the seabed (Figure 1). Traditionally, particulate organic matter (POM) is regarded as the only source of carbon sinking in the water column, governing chemical gradients and thus driving the ocean's biological pump (Buesseler and Boyd 2009).



**Figure 1** Conceptual model of common processes identified in jelly-falls according to field work and empirical studies, from the sinking and start of re-mineralization in the euphotic/twilight zone to the deposition at the seabed followed by decomposition and scavenging.

## Introduction

Sinking POM varies in size and composition, originating in every trophic level as exudates, detritus, fecal material, aggregates, biogenic carbonates or the carcasses of the organisms themselves (Turner 2002). The remineralization profile of POM generally depends on the sinking speed (McDonnell and Buesseler 2010) and the decay rate (Kriest and Oschlies 2008). At the organism-level, the contribution of gelatinous zooplankton to POM export has been mainly assessed for detrital particles/fecal pellets (Turner 2002) and mucous sheets (Robison et al. 2005). The carcasses of organisms themselves (mainly from Cnidaria and Thaliacea) have rarely been studied and thus not included in biogeochemical models. Yet, there is growing evidence of substantial sedimentation events in the last decades, so called "jelly falls" (Lebrato et al. in review), that can deposit large amounts of biomass on the seafloor (Billett et al. 2006). Remineralization of gelatinous material releases dissolved organic matter (J-DOM) (Hansson and Norrman 1995), constituting a „jelly-pump“ (Condon et al. 2010) (Figure 1). Inorganic nutrients are also released (Tinta et al. 2010) and oxygen is consumed (West et al. 2009). Thus, a jelly-fall and its re-mineralization may have biogeochemical impacts similar to that of phytodetrital material or sinking particles, although the different biochemical compositions (C:N:P ratios) and the absence of mineral ballast imply different chemical and stoichiometric relationships (Pitt et al. 2009).

## Current state of the project

The first part of this project provides a qualitative assessment of historical and present records of jelly-falls and the environmental context in which they were studied. We provide a definition and a model conceptualization of a general jelly-fall within the biological pump (including a synthesis of the factors triggering them) (Figure 1). We also assess the seasonality of jelly-falls, and the benthic organisms that have been observed feeding on the material. We discuss the possible consequences of an increase in gelatinous biomass in the ocean of tomorrow and provide a summary of the observational techniques and platforms that are or may be available in the future to study jelly-falls and their biogeochemical feedbacks.

The second part of the project is based on the organic matter attenuation concept (Buesseler and Boyd 2009), studying the re-mineralization of gelatinous material

to predict the fraction arriving at a given reference depth and/or at the seafloor (so-called jelly-POM export flux ratio). We present a new model parameterization describing two processes of different complexity: (1) the relationship between water column temperature and decay rate  $[k(T)]$  for gelatinous material, and thus a temperature-dependent re-mineralization time (referred to as  $t_{0.01}$ ), and (2) the jelly-POM export flux ratio  $[M(z_1)/M(z_0)]$ , namely the proportion of the jelly-POM that originates from depth  $z_0$  and arrives at a depth  $z_1$  while sinking at velocity  $C$ . A new aspect of our work is that we use POM re-mineralization profiles governed by the vertical thermal gradient. We also extend the use of an existing particle-based parameterization involving multiple size classes (Kriest and Oschlies 2008) by allowing for variations of the decay “constant”,  $k$ . We then compare the modelled jelly-POM export flux ratio with that predicted by the Martin curve (Martin et al. 1987) using the VERTIGO project data at the ALOHA station in the Pacific Ocean (Buesseler et al. 2007). Model-data and model-model differences are analyzed and discussed, establishing the theoretical grounds for further exploration of the jelly-POM re-mineralization concept.

To address the third part of the project we used a 46-year old data set to provide a quantitative assessment of the mechanisms driving the increase of gelatinous populations in the Mediterranean Sea. Data were derived from oceanographic surveys and pluriannual coastal records of jellyfish in the Mediterranean Sea over the period 1960 to 2005. In each region we assessed the hydroclimatic variability during the same years. Hydroclimate indices were computed using monthly anomaly fields of ocean-atmosphere variables (e.g. 500 hPa geopotential height, sea surface temperature (SST), precipitation, sea level pressure, and long-wave radiation) from the Climate Diagnosis Center Reanalysis. Structural changes in the hydroclimatic signal were investigated on a global proxy for the Mediterranean Sea. The signal was seasonally de-trended and significant changes were detected through a cumulative process of ordinary least squares residuals.

The role of warming, as indexed by SST, in the long term changes of jellyfish was quantified by means of random effect meta-analysis.

## Results and implications

Jelly-falls occur predominantly after spring and during early summer in temperate and subpolar latitudes. In tropical areas and e.g. in the Mediterranean Sea they seem to occur after periods of upwelling. This probably makes jelly-falls a highly predictable carbon pulse to the seabed, similar to phytodetritus after the spring bloom (Lampitt 1985). Once the organisms die, they start sinking from a death depth  $z_0$ , which varies according to their vertical migration patterns. Thus,  $z_0$  is complex in time and space. This situation is similar to the variability around the depth of the euphotic zone  $E_z$  studied by Buesseler and Boyd (2009). Information on the depth band where particles (jelly-POM or not) start



sinking is critical for our predictions of the strength of the biological pump. We define the jelly-POM material that is sinking as  $M$ , which decays over time according to a temperature-dependent decay rate  $k(T)$  following  $dM/dt = -k(T) M$  ( $-k(T)$  is then substituted by an equation determined empirically from  $k$  vs. temperature in different species). Substituting the temperature dependence of this equation into  $k(T)$  and integrating over time from  $t_0$  to  $t_1$  yields:

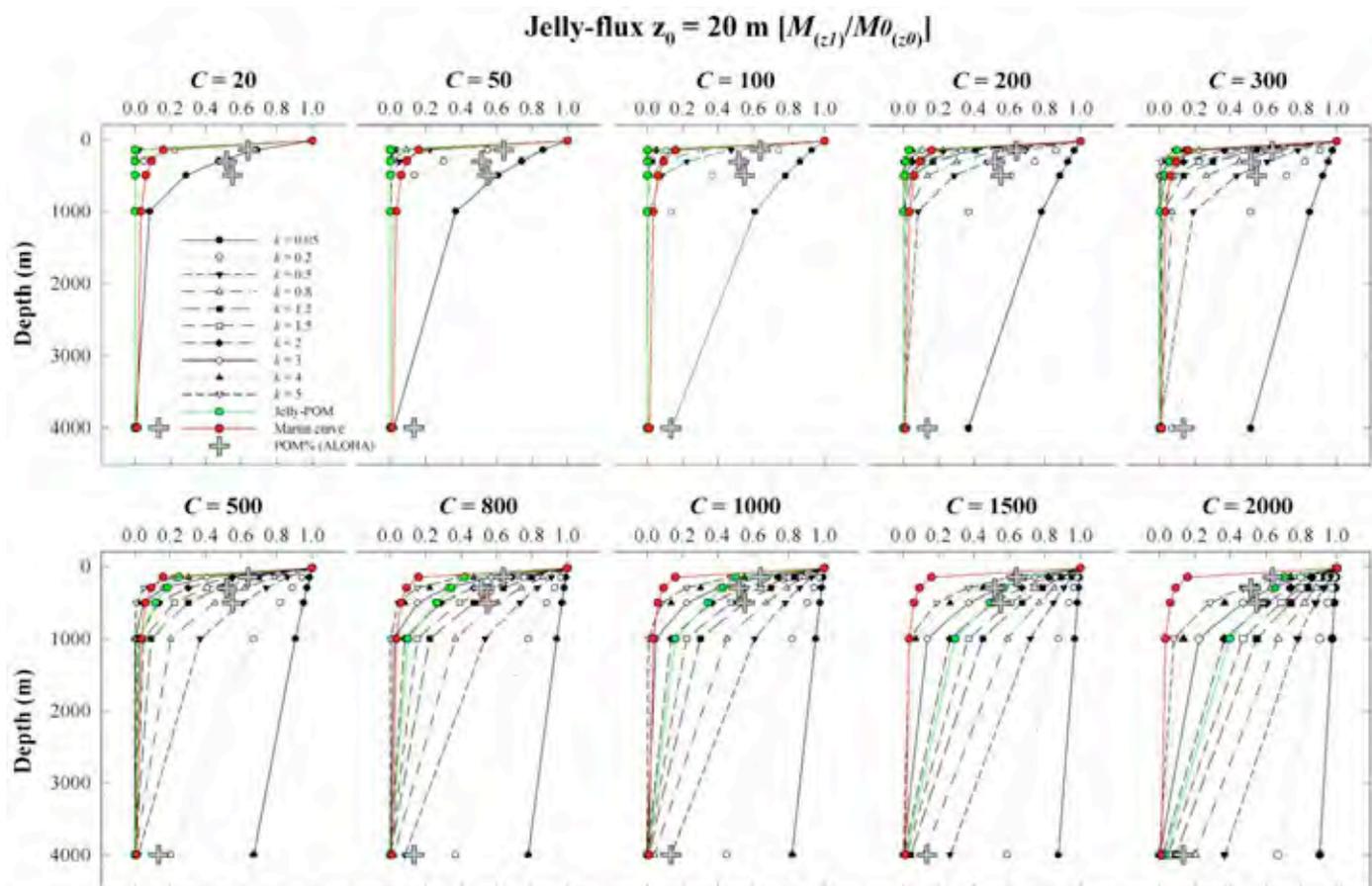
$$M_{(z_1)}/M_{(z_0)} = e^{\left[ \frac{-0.140e^{-0.1917095}}{0.145 K_1 C} \left( 1 - e^{0.145 K_1 M t} \right) \right]}$$

The jelly-POM flux ratio depends on the temperature gradient between  $z_0$  and  $z_1$  (seabed/reference depth), the sinking speed  $C$  and the time  $\text{fit}$  ( $t_1 - t_0$ ) it takes for the material to arrive at  $z_1$ .

The results of our model simulation using the ALOHA station data suggest that varying the sinking velocity and the decay rate  $k$  is enough to simulate the predictions of a particle based model (Kriest and Oschlies 2008) and the jelly-POM model (Figure 2). The Martin curve can only simulate jelly-POM remineralization and/or the particle-based model below  $C = 200 \text{ m day}^{-1}$  and a  $k > 0.5 \text{ day}^{-1}$ . The particle-based model uses constant decay rate data with varying sinking speed, which need to be changed over a large  $k$  spectrum ( $0.05$  to  $5 \text{ day}^{-1}$  in this case) to be able to mimic the  $k(T)$  temperature dependency of the jelly-POM model (Figure 2). The larger differences between our new model and Kriest and

Oschlies (2008) are observed in the euphotic/upper twilight zone ( $< 500 \text{ m}$ ), where the thermocline causes a rapid transition of  $k(T)$  values, and thus the particle-based model overestimates POM%. This is caused by the assumption of a constant  $k$  with depth independent of the thermal gradient. The results presented here indicate that by varying the sinking velocity and the decay rate we can mimic POM% sediment trap field results (Buesseler et al. 2007), independently of the particle size and origin (Figure 2). Re-mineralization rates of ordinary detritus have been made functions of ambient temperature in some models (e.g. Schmittner et al. 2008), and

this could be easily expanded to a gelatinous detritus component. The jelly-POM parameterization format could also be borrowed to model other POM compartments always that  $k$  vs. temperature data are empirically determined. Some process-oriented formulations of flux-attenuation suggest using a single  $k$  of the particle flux vs. depth with an exponential decrease with time (Lutz et al. 2002). This results in a large flux attenuation in the first 1000 m, which does not fit sediment trap data. The same occurs in our formulations if we do not use appropriate sinking speeds, and/or  $k$  data (Figure 5 (Kriest and Oschlies 2008)) comparable to temperature dependencies. The evolution over time of  $k$  data



must include a temperature dependency as we propose mimicking vertical profiles accounting for  $f_{jz}$  (in this study) and  $f_{jEz}$  (Buesseler and Boyd 2009). Temperature dependencies using  $k$  values could also help to avoid the use of different remineralization length scales in the separation of particles into at least two size classes (Armstrong et al. 2009). In reality the size spectrum is much larger than we currently measure in sediment traps. The use of our formulations would enable us to introduce the same equation format in a single model from different organisms.

On the assessment of the Mediterranean Sea hydroclimate vs. jellyfish abundance we find that not only competing hypothesis based on eutrophication can benefit gelatinous organisms. An increasing water turbidity and increase in smaller phytoplankton and zooplankton biomass should lead to hypoxia and eutrophication events that may favour jellyfish. However, this is not currently shown in our analyses, we rather find a dependency on the warmer and weakly mixed waters, which coupled with enlarged fishing effort promote their growth. After the early 1980s, the compound effects of rising temperatures and fishing led to a new configuration

where population size variations have been dominated by recurrent outbreaks. In this configuration, the jellyfish response showed non-linear dynamics manifested by boosted variance and larger bloom events. Underlying mechanisms of such non-linear dynamics are likely related to density dependent feedback in the population dynamics of jellyfish resulting from the combination of faster population growth under higher temperatures (Prieto et al. 2010) and from lower mortality due to both advantageous environmental conditions (Palomares and Pauly 2009) and predation and competition release.

#### Project Team

Mario Lebrato & Andreas Oschlies (GEOMAR),

Figure 2 A comparison of the jelly-POM export flux ratio  $[M(z)/M0(z_0)]$  with the Martin curve (Martin et al. 1987) and a particle-based parameterization (Kriest and Oschlies 2008). Results are presented for 5 depths with the flux normalized to 20 m. 10 sinking rates are used ranging from 20 to 2000  $m\ day^{-1}$ . The depth ( $z_0$  and  $z_1$ ) and temperature ( $Tz_0$  and  $Tz_1$ ) data are from the VERTIGO project at the ALOHA station ( $22^\circ\ 45'\ N$ ,  $158^\circ\ W$ ) (Table 2). The POM% data originate from neutrally buoyant sediment traps (Buesseler et al. 2007).

#### Selected Publications

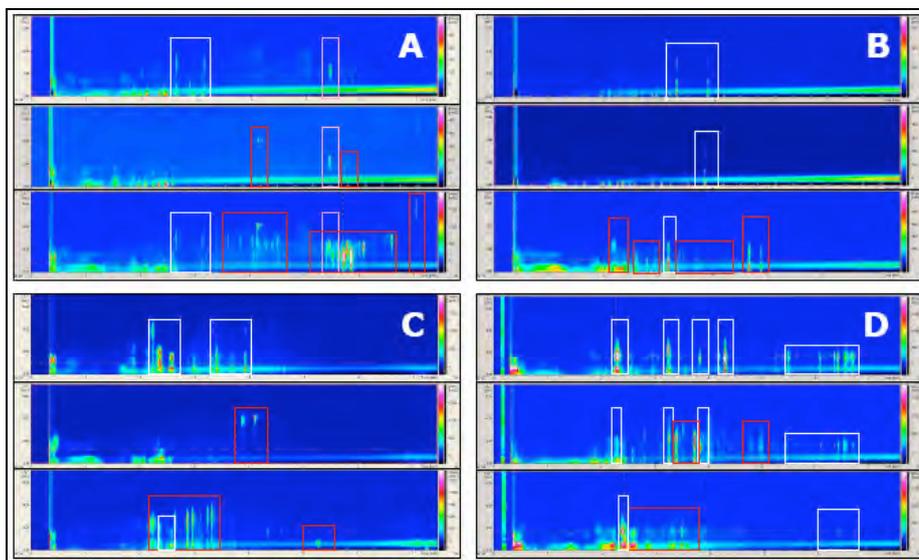
1 Lebrato, M., Pitt, K. A., Sweetman, A. K., Jones, D. O. B., Cartes, J. E., Oschlies, A., Condon, R. H., Molinero, J. C., Adler, L., Gaillard, C., Lloris, D. and Billett, D. S. M.: Jelly-falls historic and recent observations: a synthesis to drive future research directions. Submitted to *Hydrobiologia*.

2 Lebrato, M., Pahlow, M., Oschlies, A., Pitt, K. A., Sweetman, A. K., Jones, D. O. B. and Molinero, J. C.: Depth attenuation of organic matter export associated with jelly-falls. Submitted to *Limnology and Oceanography*.

3 Molinero, J.-C., Hidalgo, M., Coll, M., Batistic, M., Bonner, D., Casini, M., Yahia, O. D., de Puellas, M. L. F., Kamburska, L., Lebrato, M., Licandro, P., Lopez-Lopez, L., Lucic, D., Malej, A., Melin, F., Prieto, L., Siokou-Frangou, I., Zervoudaki, S. and Yahia N. D.: Jellyfish unveil harmful synergies of climate and fisheries in the Mediterranean Sea. Submitted to *PNAS*.

# Metabolical Choleric: Teasing Marine *Actinomycetes*

Research on bioactive compounds has two major aspects. The first relates to the multiple biological functions bioactive compounds can fulfill. They may play a role in cellular communication, signaling and in the defense against predators and pathogens and may shape the structure of marine microbial communities. The second major aspect deals with the potential use of bioactive compounds in pharmaceutical applications, for crop protection, cosmetics and as food additives.



**Figure 1** Metabolite spectra of different strains of *Actinomycetes* (A-C) and one *Proteobacterium* (D) in three media. Upper row of each figure: standard medium, middle row: taxon-specific medium, lower row: adapted media. A: *Micromonospora* sp., Mediterranean deep sea sediment; B: *Streptomyces* sp. Baltic Sea, coastal shore; C: *Microbacterium* sp., Baltic Sea, coastal shore; D: *Pseudomonas* sp., Baltic Sea, coastal shore. White frames represent known structures, red frames represent new metabolites as dereplicated from the UV-spectra. Yellow box in (A), represents a new compound in a advanced stage of structure elucidation.

## Introduction

Since the ocean is the largest but least explored habitat on earth - current estimates are that less than 0.01% of marine microorganisms are known (Simon & Daniel, 2010) - it is very promising to examine their biodiversity for new microorganisms and bioactive compounds. Besides using the original compounds, there is a great benefit in finding new lead structures and pharmacophores (Mayer et al., 2010).

In this project we are examining how isolated micro-organisms communicate among each other. We use sediments of the Greenland Sea and for comparison other marine habitat samples. Here, I show the influence of genus specific adapted media on secondary metabolite production of marine bacteria.

Most marine isolates are cultivated in standard growth media to obtain and examine secondary metabolites. However, genomic results indicate a larger potential for syntheses. The application of conditions that are designed based on environmental and/or genomic data is rarely done and studied. Fiedler and Goodfellow (2010) showed a taxon-specific adaptation of cultivation broth for the stimulation of secondary metabolite production in *Actinomycetes*. Within our lab we cultivated three different marine *Actinomycetes* and one *Proteobacterium* in these media to distinguish between taxon-specific and habitat-specific aspects.

Figure 1 show the change within the metabolite spectrum depending on the applied medium. For the *Actinomycetes*, a notable

increase in the production of metabolites was shown for the taxon-specific medium, which could be enhanced by factors of the natural habitat ("adapted" medium). The taxon specificity of the effect was observed regardless of the habitat specific influence (i.e. depth) of the original samples. Cultivation in standard media leads to interesting compounds as well. Hence, the application of a broad diversity of media yields the highest diversity of compounds. Provision of marine biopolymers was not enhancing secondary metabolite production.

## Outlook

There are several further questions which to be examined. (1) How can rational growth media design regarding the natural habitat increase the production of secondary metabolite leading to the metabolical potency and a broad range in the diversity of compounds? (2) Are these metabolites also used for communication for intraspecific as well as for interspecific purposes? Is this kind of communication unilateral or bilateral? Can this knowledge about this communication be used to improve the production of new metabolites? (3) Can the results from the Mediterranean/Baltic Sea habitats be transferred to the cultivation of microorganisms of the Greenland Sea? (4) What further fields of applications can be found for these metabolites?

Answering these questions may in the future lead to the identification of new bioactive substances with a potential for medical applications.

## References

- Simon, C., & Daniel, R., *Applied and environmental microbiology* (2010), p. 1153-1161.  
 Mayer A.M.S. et al., *Trends in Pharmacological Sciences* 31 (2010) p. 255-265 and Newman, D. J., Cragg, G. M, J. *Nat. Prod.* 2012, 75, p. 311-335  
 Imhoff, J.F. et al, *Biotechnology Advances*, Volume 29, Issue 5, September-October 2011, Pages 468-482  
 Goodfellow M, Fiedler HP., *Antonie Van Leeuwenhoek*. 2010 Aug;98(2):119-42

## Project Team

Jan Oesterwalbesloh, Johannes F. Imhoff, Tina Treude, Dr. Antje Labes, Dr. Jutta Wiese (all GEOMAR), Wolfgang Blaschek (CAU)

# The Political Economics of the European Common Fisheries Policy

According to the European Commission 88 % of European fish stocks are overfished. A third of those are outside safe biological limits. Hence, overfishing is a major problem in the EU. The Common Fisheries Policy (CFP) of the European Union has been introduced to reduce the overfishing problem in European waters.

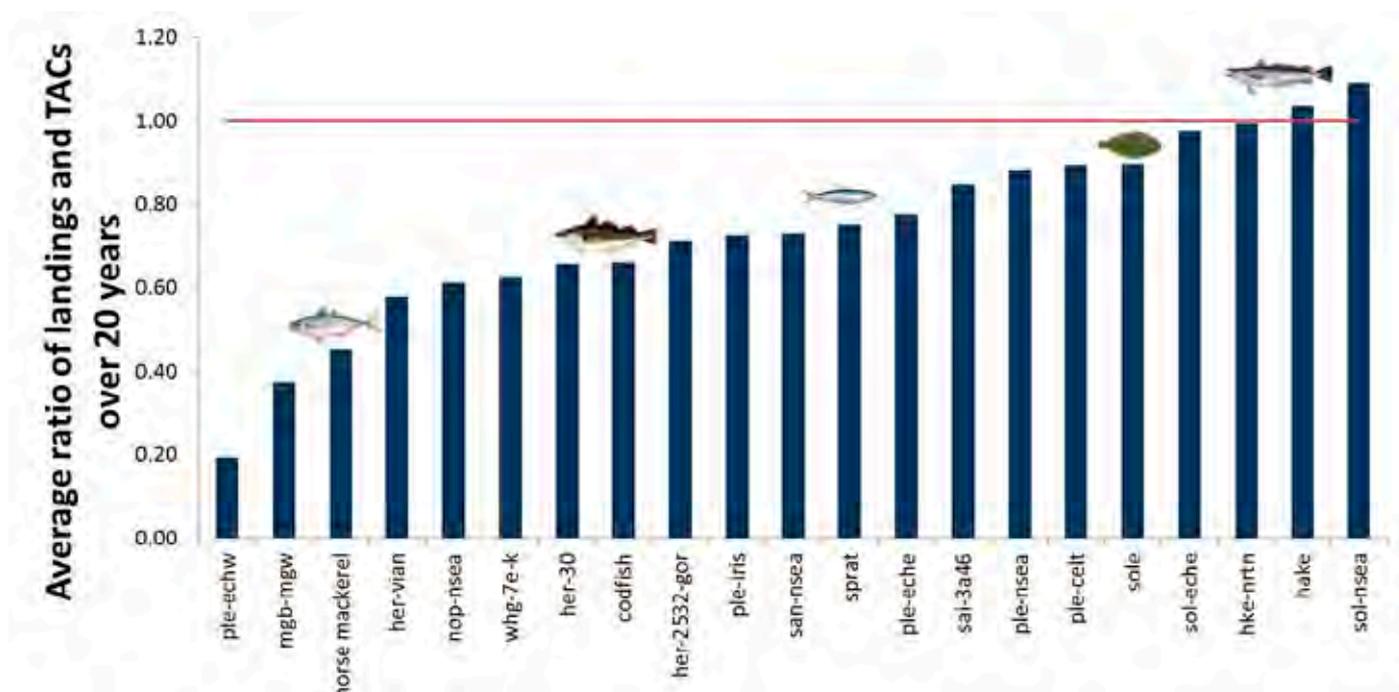


Figure 1 Indicator for inefficient fisheries management. For the TAC to be restrictive and efficient the ratio of landings and TACs should be 1. Empirically this is not the case. A ratio below 1 indicates a TAC that is too high and therefore inefficient.

Although the CFP has been in existence for several decades now there has not been any remarkable success. The main reason for this is that the most important instruments of the CFP, the total allowable catches (TAC), are often set too high to have any restrictive impact on fisheries. The ministers in the European Council are responsible for that failure because they make decisions on the binding TACs. It is my aim to find out why ministers pass non-restrictive regulations for TACs and how this problem can be solved with an alternative institutional set-up.

My first approach to answer the first question is a dynamic non-cooperative model that describes the situation in the council. The crucial assumption is that there are two groups of ministers. One prefers sustainable fishery and votes for low TACs while the other acts less sustainably and supports high TACs. TACs are fixed annually by the current

majority in the Council and hold for one year. The annual update induces uncertainty about future fishing restrictions because the ministers do not know which majority will rule in the next period and how it will decide. The model shows that this uncertainty motivates an increase of TACs if the current majority is of the less sustainable kind. Then, the possibility of a change in majority in the next period implies the risk of stronger fishing restrictions for the current majority. Hence, those ministers try to compensate potential losses due to stronger fishing restrictions in the next period by allowing higher catches in the current period. This is what I refer to as the common pool problem in the Council of ministers.

An alternative approach will be to focus on lobbies on national level and their impact on the decisions in the Council. I am building my modelling analysis on previous models

that explain the influence of lobbying in other politic fields.

Finally, using the insights of the two approaches described above I am studying how a modified institutional set-up could promote a more successful CFP and more sustainable fisheries. Specifically, I am considering the recent proposal of the Commission for more regionalized decision-making.

## Presentations

- 1 Centre for Environmental and Resource Economics (CERE) conference, 19-21 June, 2012, Ulvön, Sweden;
- 2 International Summer School "Equity and Efficiency in Fisheries" 4 September, Kiel, Germany.

## Project Team

Julia Hoffmann

## Progress Report

# Local and Global Patterns in Fisheries-Induced Evolution

Fisheries-induced evolution (FIE) refers to genetic changes in fish populations that are induced by the exploitation of fish stocks. “Fishing out the big ones” in particular selects for fish that reproduce early (i.e., at low size or age) (Fig. 1), and decreasing size and age at maturity related to genetic changes have now been observed in many fish stocks.



Figure 1 (top) Two mature cod males (45 cm and 24 cm) caught during the May 2012 Bornholm Basin fisheries cruise of our group. Average size at maturity has shown a declining trend in this stock.

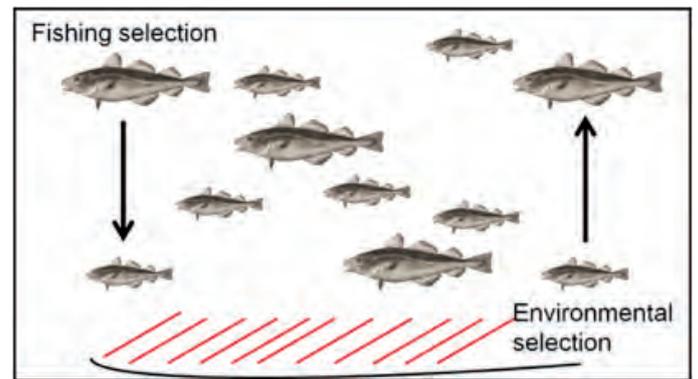


Figure 2 Potential selection pressures on Bornholm Basin cod. Size-selective fishing should select for small size and early maturity, whereas high mortality of eggs of small individuals (which have lower buoyancy and sink into anoxic layers) should favor large size.

At the same time, understanding of FIE remains incomplete, as (1) the economic and ecological impacts, as well as (2) the role of

environmental selection relative to fishing induced selection, are not well understood.

This project aims to address these knowledge gaps. Regarding (2), I am exploiting a unique long-term (1986-today) integrated data-series of the most economically valuable fish stock in the Baltic Sea, Bornholm Basin (BB) cod, that has been collected by our group over the past 26 years. It comprises >60.000 individual fish data sets including otoliths, egg and larval abundances, and fine-scale oceanographic (salinity, oxygen, temperature) and food web information. The BB stock has experienced heavy fishing that should in principle lead to fisheries-induced evolution, but the peculiar environment of the BB, with its combination of low salinity ( low water density) and anoxic deep water layers on the spawning grounds, can lead to complete loss of eggs with low buoyancy. Selection should then favor large females, which have larger

eggs with higher buoyancy. How is BB cod faring under two selection pressures that are opposing each other (Figure 2)?

Initial project steps have aimed at making the full potential of this data set accessible. This includes database completion, optimization of DNA yields from otoliths to allow genomic approaches, population biology of samples to confirm temporal stability of BB stock designation and a continuation of cruises to extend the data series (Figure 3). To speed up genetic work, we have established a collaboration with Dr. E. Nielsen's group at the DTU Aqua, the National Institute of Aquatic Resources, an institute at the Technical University of Denmark (DTU), which has worked extensively on cod genetics. Secondly, with oceanographers and fisheries biologists at GEOMAR, we are now analyzing temporal trends in the annual proportion of yearly egg production in Bornholm Basin by a cod size class that is “doomed” due to anoxia, to determine the strength of environmental selection pressure.

## Project Team

Jan Dierking, *Evolutionary Ecology of Marine Fish group, GEOMAR Kiel*



Figure 3 The role of environmental selection relative to fishing induced selection, is not well understood.

## Progress Report

# Quantifying the Release of Greenhouse Gases During Sill Intrusion in Sedimentary Basins

The Earth has experienced several warming episodes in the geological past such as the end-Guadalupian event (~260 Ma), the end-Permian event (~252 Ma), the Toarcian event (~183 Ma) and the Paleocene-Eocene Thermal Maximum (55Ma). A possible geo-forcing for such events is the formation of Large Igneous Provinces (LIPs).



The Dekkan Traps are prominent large igneous provinces (LIPs). This photo was taken near Pune, Western India (source: Wikipedia).

## Introduction

The resulting contact metamorphism of sediments in basins where sills or dikes are emplaced during these events can release large amounts of  $\text{CH}_4$  and  $\text{CO}_2$  into the atmosphere due to thermal cracking of organic matter present in sediments. However, previous models of sill intrusions in sedimentary basins have largely ignored the effect of fluid flow.

The aim of this study is to develop a numerical flow model to study the effects of fluid flow on the release of greenhouse gases ( $\text{CH}_4$ ) during sill emplacement in sedimentary basins and to determine if the release rate is sufficient to trigger warming episodes experienced in the geological past e.g. during the Paleocene-Eocene Thermal Maximum (55Ma).

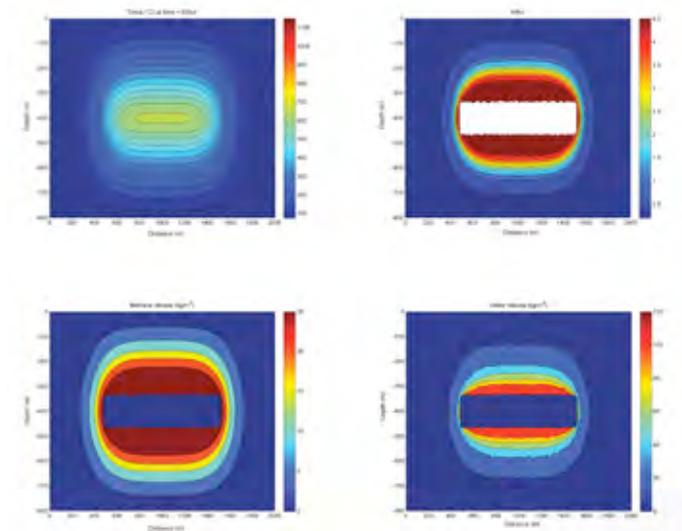
## Simulating the Flow

We have developed a 2-D porous flow model to investigate the release of greenhouse

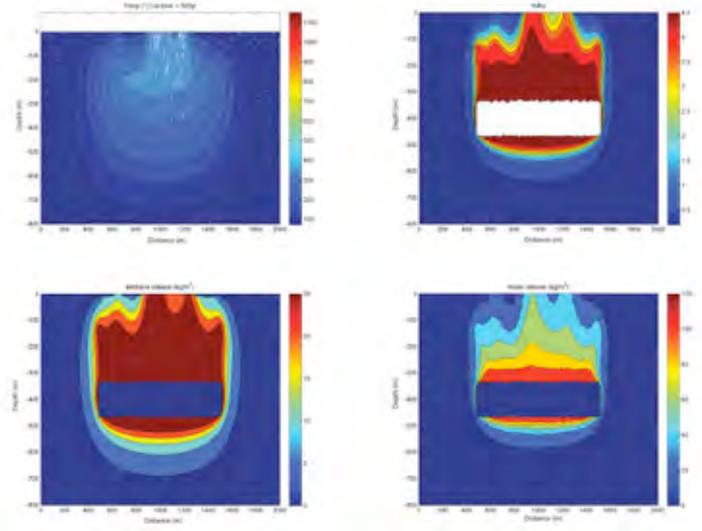
gases during sill intrusion in sedimentary basins. The sediment composition is an average pelite and mineral reactions are based on phase relations obtained by equilibria modeling. Contact metamorphism of the sediments results in devolatilization reactions releasing water as well as  $\text{CH}_4$  and  $\text{CO}_2$  into the fluids due to loss of total organic carbon (TOC). The contact aureole thus formed can be compared to the observed vitrinite reflectance to compare the thermal evolution of the basin. Feedbacks into the flow model include the latent heat of crystallization during sill cooling and dehydration reactions as well as fluid release.

The simulation depicted in Fig. 1 is a simple heat diffusion model based on previous work by Aarnes et al., 2010 (GCA). The plot shows the results for temperature, vitrinite reflectance, methane and fluid release (from left to right). It consists of a 2-D Finite element method (FEM) domain representing a

sedimentary basin that is 2000 m wide and 800 m deep at a temperature of  $75^\circ\text{C}$ . The sedimentary basin has a chemical composition of an average pelite with an initial TOC content of 1%. A sill is instantaneously emplaced in the basin at a temperature of  $1150^\circ\text{C}$  and the simulation is run for a period of 500 years. Thermal energy is diffused as time progresses and heats up the sedimentary basin resulting in devolatilization reactions that release fluids and is based on equilibrium thermodynamics. Additionally, the temperature increase causes thermal cracking of the organic matter present in the sediments thereby resulting in a decrease in the TOC content and release of methane. The resulting vitrinite reflectance, which is generally used to determine the thermal history of a sedimentary basin is calculated using the EASY % $R_o$  method, which is based on the Arrhenius equation using a set of 20 parallel first order equations. The thermal



**Figure 1** The above simulation is a heat diffusion model for a sill emplaced in sediments based on Aarnes et al., 2010. The plot shows the results for temperature, vitrinite reflectance, methane and fluid release (clockwise from top left).



**Figure 2** The above simulation uses the same parameters as the previous simulation [Fig. 1] but also resolves fluid flow. The plot shows the results for temperature with fluid flow vectors (white arrows), vitrinite reflectance, methane and fluid release (clockwise from top left).

cracking front follows the diffusion profile and results in a symmetric thermal aureole around the emplaced sill.

Figure 2 shows the results of the simulation after 500 years for temperature, vitrinite reflectance, methane and fluid release (from left to right). This simulation uses the same parameters and methodology as the simulation based on the work of Aarnes et al., 2010. The key difference is a porous flow solver that accounts for fluid flow and thereby heat advection in the sedimentary basin. The flow model also accounts for the release of fluids during dehydration reactions. The resulting

thermal aureole pattern around the emplaced sill is very different from the simulation where only heat diffusion takes place. The sill cools more rapidly than the diffusion model due to the influx and circulation of cold fluids into the interior of the model domain. Initially, as the fluids present below the sill are heated, they become buoyant and move outwards and upwards towards the sill edges. Additionally, fluids above the sill become buoyant and start convecting after some time resulting in plume-like structures which vent at the surface. The thermal maturation of sediments, therefore, does not take place

symmetrically around the sill but occurs mostly in the upper part of the domain where hot fluids rise towards the surface.

## Results and Outlook

Preliminary results show that fluid flow can indeed change the way we understand how sill emplacement affects the host sedimentary basin and results in greenhouse gas release. The next steps in this project will examine the following:

1. Quantify the effect of multiple interacting sills on the generated thermal aureole and compare it to the diffusive model.
2. Study the effect of structural variations such as faults, impermeable sediment layers etc. on fluid patterns and vent locations.
3. Add a mass conservation equation for methane to accurately track the movement of released methane in the fluid. This will also determine the rate of methane release into the atmosphere over the period of hydro-thermal activity.

## References

- 1 Aarnes, I., Svensen, H., Connolly, J. A. D. & Podladchikov, Y. Y. How contact metamorphism can trigger global climate changes: Modeling gas generation around igneous sills in sedimentary basins. *Geochimica Et Cosmochimica Acta* 74, 7179-7195, doi:10.1016/j.gca.2010.09.011 (2010).

## Project Team

Karthik Iyer, Lars Rüpke



One of the World Heritage Sites, the Putorana Plateau, is composed of the Permian flood basalts of the Siberian Traps, which appeared ~250Ma ago [source: Wikipedia].

## Progress Report

# Effects of Ocean Acidification on Nitrogen Fixers and the Cycling of Nitrogen within Natural Communities

Nitrogen fixing (diazotrophic) cyanobacteria have been described as the gate-keepers of marine productivity (Berman-Frank et al. 2003), since the availability of fixed nitrogen controls productivity in vast areas of the global ocean. It is therefore crucial to understand how changes in diazotrophic cyanobacteria metabolism might influence marine primary production in the future ocean through changes in fixed nitrogen availability and cycling.

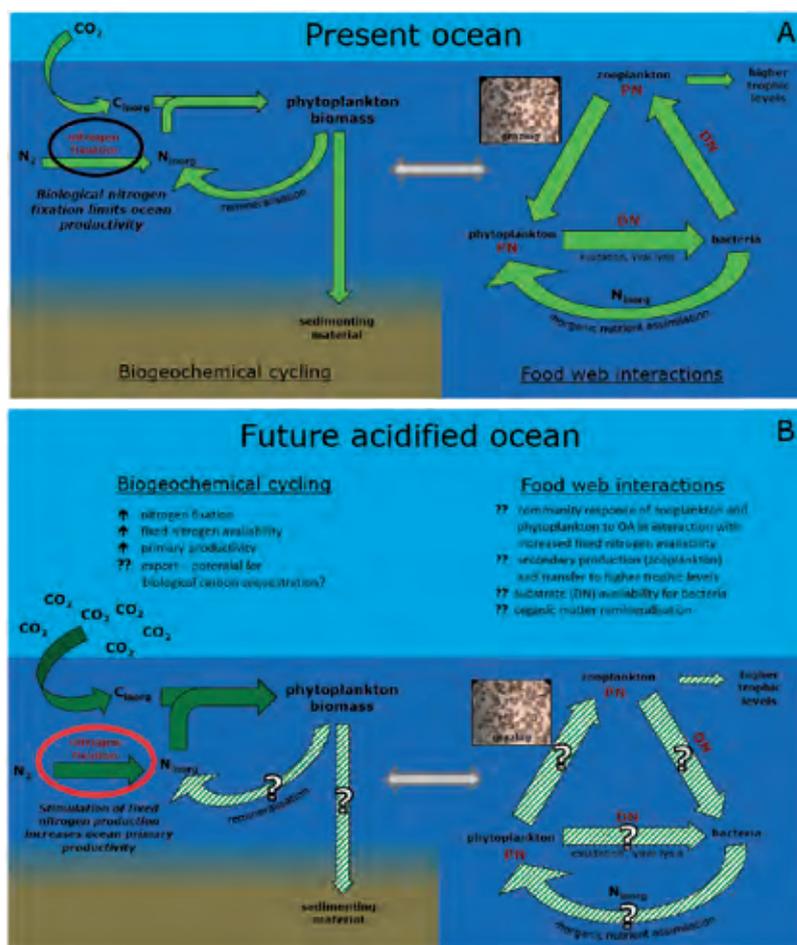
## Introduction

The response of diazotrophic organisms in future ocean acidification scenarios has been investigated in laboratory studies. These studies indicate a general increase in fixed nitrogen production and carbon fixation with increased  $p\text{CO}_2$ . This project aims to take the next step from single species laboratory experiments to the natural diazotrophic community response to examine whether lab results are also reflected in natural settings.

Therefore the projects' goal is to determine the rates of uptake and cycling of nitrogen (N) within natural communities affected by  $p\text{CO}_2$ . It also strives to investigate the fate and distribution of newly fixed N in naturally occurring plankton communities where diazotrophs are key species and how these processes will be affected by ocean acidification.

## Current Status

A recent field experiment in the Baltic Sea off the Finnish coast investigated the response of the natural diazotrophic community to a  $p\text{CO}_2$  range projected for the future. New nitrogen fixed by diazotrophic cyanobacteria



was tracked through the nitrogen cycle by addition of  $^{15}\text{N}$  labelled seawater to pelagic mesocosms to observe any differences between the present ocean and the projected acidified ocean (see Figure B above). The isotope label can only be introduced to the food web by diazotrophic organisms through nitrogen fixation allowing specific tracing of newly fixed nitrogen into different nitrogen

## Outlook

In order to progress with the project additional mesocosm experiments with a similar approach are planned to compare a eutrophic (Baltic Sea) with an oligotrophic system (Gran Canaria) at the beginning of 2014. Supporting culture experiments will study the mechanistic response of key individual species.

## Project Team

McAllanah Paul, Ulf Riebesell, Hermann Bange (all GEOMAR)

# Legal Implications of the Common Heritage Principle for Future Ocean Governance: A Conceptualization Regarding Marine Living Resources



Fish stocks need time to recover, but there are hardly any incentives for fishermen to reduce catches.



The United Nations building in New York, USA (source: Wikipedia)

The common heritage of humankind principle currently applies to the deep seabed and the moon. Its geographical application is therefore large but these areas are obviously not the most cultivated by humankind. In that regard, the principle has much potential in providing protection to other parts of the ocean. The main question for the present project to answer is consequently to what extent the common heritage of humankind and its interaction with other principles of international law of the sea and environmental law could provide enhanced protection for the ocean's living resources.

To discover new opportunities for future ocean governance, this project investigates the interaction of the common heritage principle with the freedom of the high seas, the precautionary approach, an holistic approach to the ecological system, intergenerational justice, and the idea of trusteeship,

always taking into account the overarching idea of sustainable development.

Notwithstanding the potential success of applying the common heritage of humankind, a reverse side of transforming resource-rich areas in common space definitely exists. One of the main theories in this field is the tragedy of the commons. Particular characteristics of the fishing industry reflect this scheme. There is hardly any incentive for an individual fisherman to reduce his or her catch at a certain point in time with the objective of catching more later on. Namely, a stock of fish needs time to recover and is subject to the risk of collapse if this possibility is not provided. However, most of the fisherman's colleagues will not hesitate to take this risk.

The effects of the common heritage of mankind principle on entitlements to exploit marine living resources in the high seas requires an analysis not only of the current

regime for marine living resources in the high seas for which the 1982 United Nations Law of the Sea Convention provides nothing but a framework. Regional instruments and soft-law conservation approaches also need to be taken into consideration. Whether a change in the organizational structure of international fisheries management towards the common heritage of humankind would provide for more sustainable conservation schemes is as of yet still hypothetical. This project will help to solve this important question.

#### Project Team:

*Rijk van Doorn, Nele Matz-Lück,  
Martin QuaaS*

## Progress Report

# Sediment Trapping in River Dammed Systems: An Example of the São-Francisco Delta (Brazil)

The São-Francisco River drains Brazil's fourth largest river catchment (640,000 km<sup>2</sup>). The river is 2700 km long with seven dams housing hydro-electric power plants erected on its course. The construction of these dams has led to a number of questions about possible side-effects: How much do dams affect the hydrodynamics of river basins, how do they influence the salt intrusion into the estuaries and do they influence other estuarine processes? This project investigates these questions by analyzing the water structure and suspended sediment load (origin and grain size) according to water level and physical parameters such as temperature, salinity, and current velocity.

## Introduction

The economic development of the São Francisco River area (Northeastern Brazil) has increased tremendously since the 1950s with the construction of a series of seven river dams along its course. Since the last dam was completed (Xingó) (1987-1994), strong coastal erosion rates reaching a maximum of 98.6 m/year have been recorded at the river mouth. This circumstance led to the destruction of one coastal village (Fig.1) in the late 1990s.

## Field Campaign

To understand the impact of the dam on sediment transport, a scientific survey was conducted in Fall 2012. The work aimed to compare the effects on different parts of the São Francisco River catchment by investigating the river mouth, one unchanged part of the river course upstream, and part of the Xingó dam reservoir (Fig. 2).

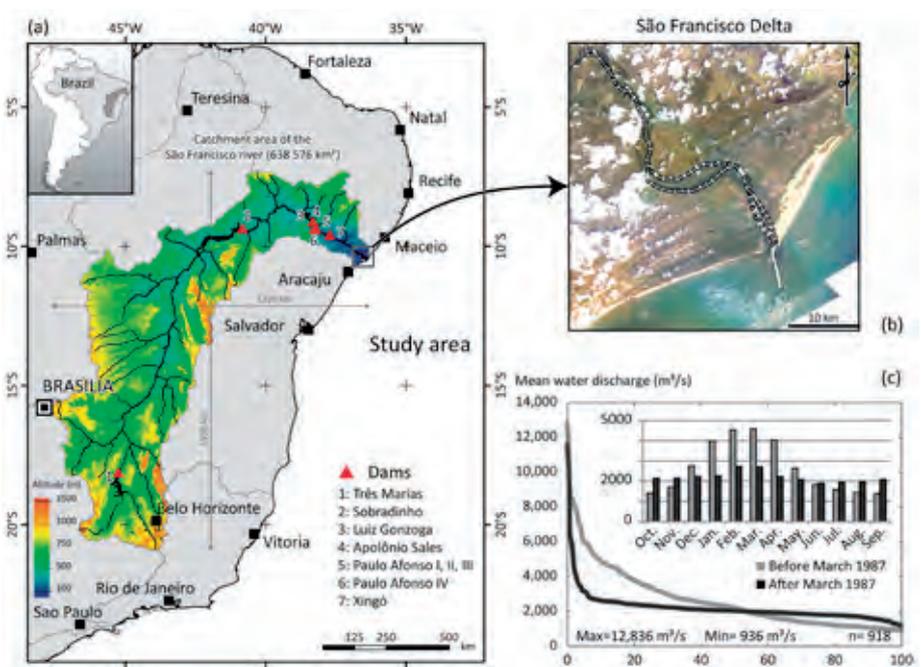


Figure 1 Location map and river-discharge of São Francisco Delta

The first part of the study was conducted in the distal portion of the delta. Bathymetric and sonar data was recorded and seismic profiles were measured to accurately determine the morphology, structure and

dynamics of the river bottom. Grab samples were retrieved for ground truthing. A detailed analysis of the water column was also performed by analyzing physical parameters and suspended matter in the river. These data

will allow the quantification of the sediment transport of the river and determine the impact of the reduced flow due to the dams located upstream. The second part of the study took place about 70 km upstream



Figure 2 Aerial photographs of the São Francisco River mouth taken in a) 1994 and b) 2010. Red circles represent the position of the lighthouse relative to the shoreline; and c) photograph of the destroyed Cabeço Village taken in 1998. Pictures by José Maria Landim Dominguez, Brazil.

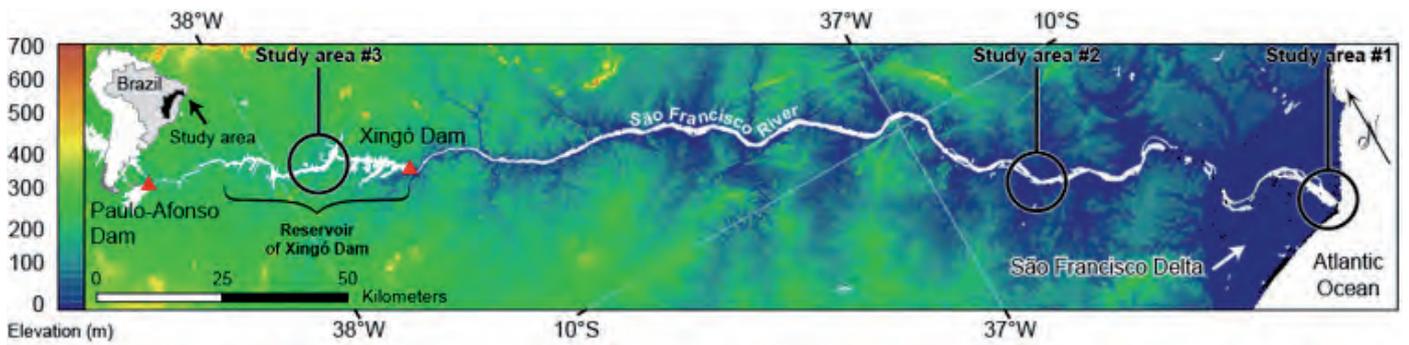


Figure 3 Location map and river-discharge of São Francisco Delta and the three study areas considered. Credit: Digital Elevation Model: Shuttle Radar Topography Mission (SRTM) <www.amiotek.com/srtm>

from the mouth. A similar protocol as in the previous location was followed to determine the effects of pure riverine water discharge on sediment transport in comparison to measurements made at the mouth under tidal influences. Finally, a third area within of the Xingó reservoir was investigated. Acoustic devices such as side scan sonar and parametric echo sounders were deployed to examine whether the reservoir retains sediment, and if so, how much.

### Initial Results

Since the construction of the Xingó Dam in March 1987, the river discharge is artificially regulated at around 2,000 m<sup>3</sup>/s (Fig. 1). At the same time an intrusion of saltwater has been measured in the delta up to 9 km upstream. The salinity stratification is enhanced by the river bed morphology. A maximum turbidity zone is present at the salt/fresh water interface (Fig. 2). The mode of grain size distributions varies as a function of the water

salinity and the water depth. The relationship of suspended particulate matter (SPM) and light transmission shows that two kinds of particles are present in the water column. One type of particle is more light transmissive than the other at an equal volume. It can be assumed that Laser In-Situ Scattering and Transmissometry (LISST) analyses are able to distinguish single suspended particles from aggregates (flocs). The measured size of single grains matches with grain size of the sandy river bed (quartz grains). A combination of Acoustic Doppler Current Profile (ADCP), Conductivity Temperature Depth (CTD) and LISST parameters display a three layered water column: an upper brackish layer and a saltwater layer subdivided in two layers according to velocity and current direction parameters. The grain size distribution of the brackish layer seems to display flocculation processes: the volume of large particles is increasing as the volume of smaller particles is shrinking.

### Conclusion

It can be shown that river damming on the São Francisco River negates seasonal variations by inducing lower water discharge (and consequently lower current velocity). This enhances salt wedge intrusion up to 9 km upstream which is supported by the shape of the river bed morphology. Estuarine processes taking place in the river mouth area are demonstrated by the differentiation in particle size according to salinity and water depth, the existence of a maximum turbidity zone and the indication of flocculation processes with differentiation between single grains and particle flocs at interfaces of the water column. The delta of São Francisco consequently turned into an estuary following the reduction of water discharge caused by river damming.

### Project Team

Camille Traini, Karl Stattegger

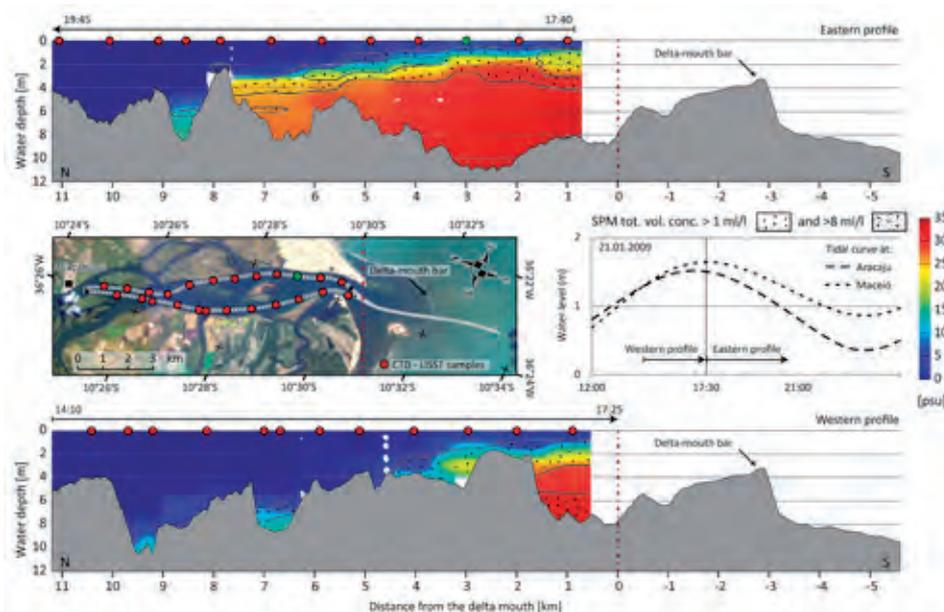


Figure 4 Correlation between salinity and maximum suspended-sediment concentration



# Science News

For a successful technology, reality must take precedence over public relations, for Nature cannot be fooled.

*Richard P. Feynman*

## Marine Research in Kiel is Heading Towards New Shores

On 1 January 2012 the former Leibniz Institute of Marine Sciences (IFM-GEOMAR) converted into GEOMAR Helmholtz Centre for Ocean Research Kiel due to the transition of the institute into the Helmholtz Association. The change provides challenges and opportunities to further strengthen the national as well as the international role of Kiel marine sciences.

The Helmholtz Association is a community of 18 scientific-technical and biological-medical research centres. These centres have been commissioned with pursuing long-term research goals on behalf of the state and society. GEOMAR contributes with its specific expertise in ocean and deep sea research to the research field Earth and Environment of the Helmholtz Association. The director of GEOMAR, Professor Peter Herzig, is looking forward to the changes and perspectives of the new centre. "With our research agenda and in particular the technologies for deep sea research we are unique in the Helmholtz Association", Professor Herzig explains. "GEOMAR will play a central role in earth

system research in the Helmholtz Association. Up to now, research on global oceanic processes and deep sea research was not present in the Helmholtz portfolio", Herzig continues. Together with the Alfred Wegener Institute for Polar and Marine Research, the German Research Centre for Geosciences, the Helmholtz Centre Geesthacht and the Helmholtz Centre for Environmental Research, GEOMAR forms the basis of the research field "Earth and Environment". In addition, some success has already been accomplished in other areas of Helmholtz funding. Amongst them a new Helmholtz Young Investigators Group in the area of gas exchange between ocean and atmosphere,

a German-Russian research group on climate extremes and a professorship in the framework of assuring excellence in the area of Marine Geodynamics. Of particular importance for GEOMAR is the continuation of the very successful cooperation with the Kiel University. A first and very important success was the approval of the grant for the second phase of the Collaborative Research Centre (SFB) 754 Climate Biogeochemical Interactions in the Tropical Ocean of the German Research Foundation (DFG). The next milestone is the continuation of the very successful Cluster of Excellence The Future Ocean that provided a much broader basis for marine sciences in Kiel. On the long term, Kiel wants to establish an even larger network for marine research.

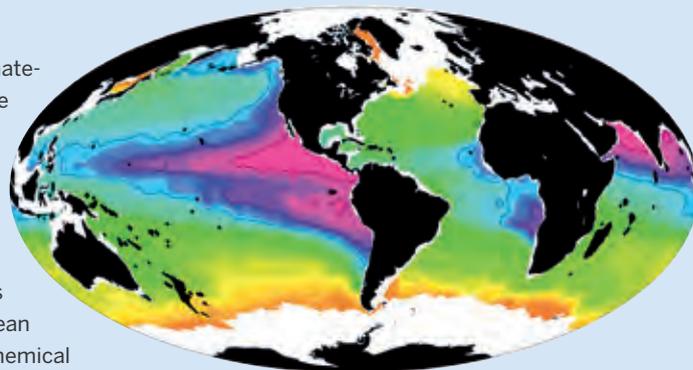


Dr. E. Huthmacher (BMBF), Dr. C. Andreßen (eh. Land S.-H.), Prof. P. Herzig (GEOMAR-Direktor), Prof. J. Mlynek (Helmholtz Association)

## The Study of Oxygen Minimum Zones in the Oceans Continues

DFG consents to a second phase of the Collaborative Research Centre 754 in Kiel until 2015

The scientists of the Collaborative Research Centre SFB 754 Climate-Biogeochemical Interaction in the Tropical Ocean have reached the second phase. The German Research Foundation (DFG) confirmed the funding of 11.4 million Euros for another four years until 2015. Thus the scientists from Kiel University and GEOMAR can continue their research on changes of the oxygen distribution in the ocean, partly caused by the climate, and their effect on ecosystems and global flow patterns for materials and component substances. All tropical oceans have oxygen minimum zones. The distribution of oxygen in the ocean is controlled by a close interaction of physical, biological and geochemical processes. These processes have been the focus of the SFB 754 for nearly five years. Observations indicate a general decline in oxygen levels in the ocean. The regional and temporal patterns of this decline and the mechanisms causing the decline are as yet mostly unknown. Not only are water samples being analyzed chemically and biologically, tank experiments are being carried out under controlled environmental conditions. Sediment samples help to understand the variability of the oxygen distribution under former climatic conditions. Teaming up with a work group specialised in modelling, the various collected data will help



The Atlantic and Pacific oxygen minimum zones (OMZs) are most intense along the eastern boundary. In addition, tongues of low oxygen waters appear to spread westward in the northern and southern hemisphere but are separated by some increase in oxygen along the equator.

improve current climate models.

Further Information on the Collaborative Research Centre 754:

<http://www.sfb754.de/en/>

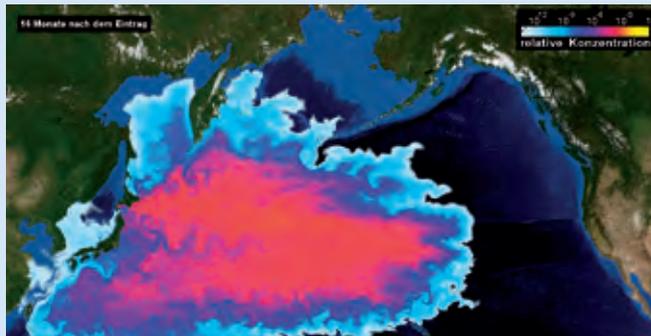
## The Consequences of Fukushima

After the disaster at Japan's Fukushima nuclear power station radioactive water is being released into the Pacific. What will happen to this water and the radioactive material over time?

This question is of concern to many people. By model calculations scientists from the Cluster of Excellence The Future Ocean are trying to find an answer. However, future prognoses are uncertain: neither the precise concentration of radioactive substances in the water released nor the actual chemical composition is known right now.

There are many scenarios you can test in a computer simulation. In the case under consideration it is important to know that radioactive substances all decay at different rates. This physical property is described as radioactive half-life. The faster the rate of decay of a certain radioactive substance, the lower is its radioactive half-life and the faster it will eventually degrade, although the by-products of decay may be radioactive or toxic themselves. For example, iodine-131 has a radioactive half-life of 8 days whereas cesium-137 has a radioactive half-life of about 30 years. To predict the distribution of radio-

active substances by ocean currents we need to consider that it is impossible to forecast ocean currents accurately or in great detail, since, for example, wind in the atmosphere



Model Simulation on the long-term dispersal of  $^{137}\text{Cs}$  released into the Pacific Ocean near Fukushima by Behrens, Schwarzkopf, Lübbecke and Böning.

will affect the currents. The ocean currents running on larger regional and longer time scales enable scientists to compute an average current using mathematical models. A transport matrix method (TMM) developed by Khatiwala, Visbeck and Cane (Ocean Modeling 2005) providing average currents for calculations and future prospects is being applied within the Future Ocean Cluster. The advantage of this method is a long-time period

calculation by mean time effort. However, the method lacks detailed resolution especially at the outset of the release. The above-mentioned method is being used for a better understanding of biogeochemical processes in the ocean (e.g. photosynthesis, development of marine ecosystems).

To optimally adapt such models to real data, the calculation is based on averaged ocean currents. Thereby it is possible to simulate the distribution of a trace element in the ocean. Concerning radioactive substances the ratio of current velocity and radioactive half-life plays an important role. The simulation models based on TMM are flexible enough to handle a plurality of ecosystem models as well as a combination of these models with models of radioactive decay. Due to their high flexibility, these models can be easily enhanced to fit a particular scenario.

The input of radioactive cesium-137, idealized from mid-March 2011 for a period of three months, at the Fukushima site will distribute into the Pacific Ocean during the years up to 2020. Only the upper water layer is depicted, distribution in lower water layers will be similar. Cesium-137 has a radioactive half-life of about 30 years whereas iodine-131 has a radioactive half-life of 8 days. Thus, traces of iodine-131 vanish in a short time and will not be distributed widely into the ocean. On the contrary, cesium-137 will take a couple of years to arrive at the North Atlantic coastline on the one hand, but on the other hand will neither have degraded completely nor have been evenly distributed by the ocean currents by 2020.

## The German Chancellor on a Visit to Kiel and GEOMAR



Physical oceanographer Martin Visbeck demonstrates to Federal Chancellor Angela Merkel how a glider moves through the ocean.

On 27 March 2012, German Chancellor Angela Merkel visited the state capital Kiel and the Helmholtz Centre for Ocean Research (GEOMAR). During her stay Chancellor Merkel remarked on the success of the Excellence Initiative for top notch research using Marine Sciences at GEOMAR and Kiel University as an example: "Especially noteworthy is the cooperation with Kiel University, with the Cluster of Excellence, which is, of course,

very important in promoting cooperation here in the region. Schleswig-Holstein has distinguished itself as a research location for marine research and as a location of maritime development as a whole, has always sent out a clear signal and stated clearly, we want to create the future here. Because we know that our future lies in the minds of the people, in education, in research and in development Schleswig-Holstein can be very proud of the fact that this institution is one of the contributions of the country to international research."

## Delegation from Zhejiang University Visits Kiel

In March 2012 the presidential board of Kiel University welcomed a delegation from the Chinese partner university Zhejiang to the Campus. The goal of the visit were talks about intensifying the cooperation between the two universities, in particular in the field of marine sciences.

The Zhejiang University (ZJU) and Kiel University (CAU) plan to intensify their cooperation in particular in the areas of marine sciences, such as oceanography, marine biology, geology and, ocean engineering and technology. The Chinese



The partnership reaches new dimensions: Zichen Chen (at right), University Council Zhejiang University, and CAU-Vicepresident Thomas Bosch (at left) with the former Secretary of State Schleswig Holstein Cordelia Andreßen (at center) at the signing ceremony of the Letter of Intent.

partners are about to found a new campus and research labs expanding on their existing expertise in coastal science and engineering. The new campus will be located at Zhoushan, about three hours east of Hangzhou near the East China Sea coast. Zhejiang University and Kiel University signed a letter of intent in March on collaboration in these areas, which will also involve Future Ocean scientists and expertise. A more detailed agreement is planned for a later date in 2012.

Both parties also plan to increase the exchange of personnel, as well as to offer opportunities for graduate students and postdoctoral researchers. An initial research visit took place in Kiel from December 2011 to May 2012 by Dr. Xue-Gang Chen, who visited the ICP-MS lab of Dieter Garbe-Schönberg in order to work on samples from Taiwanese shallow hydrothermal vent systems. Kiel University and the Future Ocean are looking forward to more international cooperation with their Chinese partners from Zhejiang University.

## Marine Research Bridging Europe and Asia

### Sino-German Centre for Collaboration in Marine Sciences (SGMS) hosts summer school and workshop in China

To learn from and with one another – from the 5th to 17th of September 2011 the Sino-German Centre for Collaboration in Marine Sciences (SGMS) organized its first summer school and a joint workshop in the city of Qingdao, China, at the coast of the East China Sea. The focus of the two events, which had around 50 participants from China and Germany, was the examination of the seas' changing environment and the predictions of possible changes in future decades. The German partners were the Kiel University, the GEOMAR Helmholtz Centre for Ocean Research, the University of Bremen with the MARUM – DFG-Research Centre and the Leibniz Centre for Tropical Marine Ecology (ZMT).

The summer school was opened by Professors Weiran Li and Lixin Wu from the Ocean University of China (OUC), Prof. Justus Notholt from Bremen and Avan Antia from Kiel. In a workshop following the opening, first research objectives were identified and future project proposals developed. The subjects of the workshop covered areas such as marine technologies, ocean dynamics, the exchange of greenhouse gases between the ocean and the atmosphere, marine ecosystems, and the influence of the changing oceans on coastal regions.

Under the umbrella of SGMS and financed by Sino-German Center for Research Promotion in Beijing, the 2nd Sino-German Symposium on Marine Sciences was held at

Kiel University on 17 and 18 September, 2012. The theme of this year's symposium was: Advances in Observation and Modelling of Biogeochemical and Oxygen Dynamics in the Ocean.

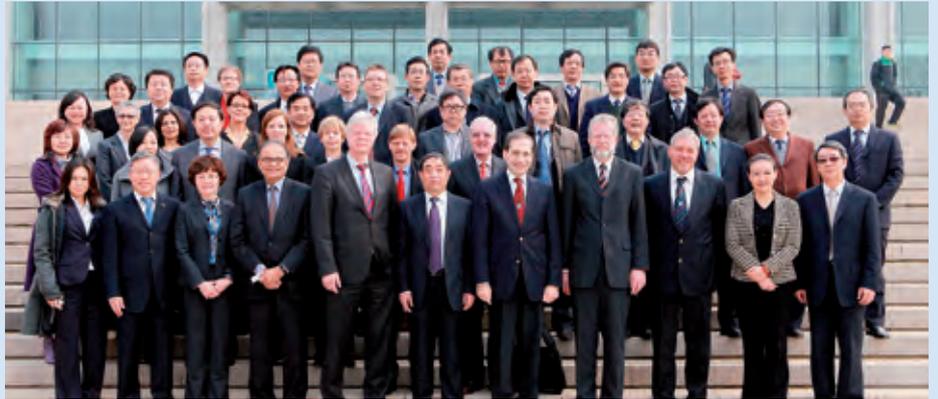


Attendees of the first Sino-German summer school 2011 in Qingdao (China).

## New Center for Sino-German Cooperation

Marine Sciences in Kiel, Bremen and Qingdao (China) join forces

The ocean knows no boundaries. When exploring the influence of the world's oceans on climate, developing strategies for sustainable fishery or discovering the unknown environment of the deep sea, international collaboration is essential. Therefore Kiel University, the GEOMAR Helmholtz Centre for Ocean Research Kiel and the Leibniz Center for Marine Tropic Ecology in collaboration with the University of Bremen have launched a joint initiative for education and research with the Ocean University of China (OUC) in Qingdao. The result of this initiative is a permanent institution: the Center for Sino-German Cooperation in the



The Chinese-German group celebrated the opening of the Sino-German Center for Cooperation in the Marine Sciences in Qingdao, China.

Marine Sciences (SGMS). In February the Center was officially opened at the OUC in Qingdao. The SGMS will make cooperation opportunities a regular feature in future (see article in the lower left). The education initiative for marine sciences will be supported by Kiel's Integrated School of Ocean Sciences (ISOS) from the Cluster of Excellence The Future Ocean, with its reputable doctoral education. Establishing this initiative had

been financially supported by the Federal Ministry of Education and Research (BMBF) and the Ministry of Education of the People's Republic of China. In addition, the initiative offers an English language Chinese-German masters program in the marine sciences. Moreover it will serve as the link for all future cooperation in teaching and research in the area of marine science between the partners in China and Germany.

## Cape Verde: Science and Conservation at Loggerheads?

The answer is a clear “no” – science and conservation must work hand-in-hand, and for this the science must be clearly and understandably presented to the public, non-governmental organizations (NGOs) and other stakeholders. This belief drives marine evolutionary biologist Chris Eizaguirre in his studies on the genetic diversity of the Cape Verde loggerhead sea turtle *Caretta caretta*. Chris and his grad student Victor Stiebens are part of an international group of scientists focussing on the Cape Verde Islands, one of the largest natural laboratories for marine and atmospheric observations and a hot spot for climate studies, as well as a strategic partner of Kiel marine scientists. In the fertile waters off the islands, some of the last, largest, oceanic populations of loggerheads meet to mate and nest.

Chris and Victor's early efforts to work alone to get the samples they needed led to sticky political situations and uncomfortable late night encounters with (armed) poachers, clearly a suboptimal situation.

Chris decided to enlist the efforts of an NGO, local people, schoolchildren and researchers at the Instituto Nacional de Desenvolvimento das Pescas im Mindelo. The first step was to make his team visible as scientists with a mission. He called for the help of multimedia producer Sonja Arend from Future Ocean's Integrated School of Ocean Sciences, who created an animated, interactive website explaining why researchers tag turtles, take skin samples for DNA analysis and what they do with this information. Interested readers can test their knowledge with a short quiz and, most importantly, get involved. “The visibility gained with this website has been crucial in making inter-



Volunteers marking turtles at Cape Verde.

national volunteers aware of our project” says Chris. And it did work! For the third summer over 60 volunteers, working in shifts, patrolled the beaches, marking turtles and locating their nests. They are enlisted in a scientific project that brings turtle biology and conservation together in a unique way. “We want to be seen as the scientists on the scene, and we use the website to educate people about our science” says Chris “The next step is to take this work into the classroom, offering hands-on biology lessons for Cape Verde students”. One more component in a flourishing international cooperation.

## Rio Plus 20

Future Ocean Speaker Ralph Schneider is Guest at the CDU/CSU Congress on Rio+20



Future Ocean co-speaker Ralph Schneider with federal chancellor Angela Merkel at the CDU/CSU preparatory conference for Rio +20.

On the 24th of October, 2011, the CDU/CSU parliamentary group hosted a congress titled Rio +20 - New Momentum for International Protection of the Oceans. In addition to Chancellor Angela Merkel and other prominent government representatives, the parliamentary faction's invitation was accepted by international experts such as the EU Commissioner for Fishery Policy Maria Damanaki and numerous representatives from science, business and NGOs. About 200 experts took advantage of this opportunity to discuss conflicts of usage and proposed solutions for the protection of the oceans, EU fishery policies

and international protection efforts. Prof. Ralph Schneider, representing the Cluster of Excellence the Future Ocean and director of the Geological Institute of Kiel University, presented the World Ocean Review, a cooperative publication by the Cluster and the Journal *mare* at the congress. "Marine science research in Kiel is in an excellent position. We want to make recommendations on how risks in and to the ocean can be better assessed in future", said Ralph Schneider in his speech. "Management and handling options, which are scientifically based, play an important role for us here. For this reason we want to discuss our research more intensely in a dialogue with lawmakers and business." Chancellor Merkel also showed her enthusiasm, "Professor Schneider presented the World Ocean Report 2010 here. I would like to thank the initiators and the Cluster of Excellence The Future Ocean in Kiel very much for this work, as it opens our eyes to the diverse threats to the oceans worldwide, but also in our own surroundings in the North and Baltic Seas. The scope of dangers ranges from climate change to pollution to resource use and overfishing."

## Dräger Foundation and the Future Ocean: Partners in Stakeholder Dialogue

In 2011 the Future Ocean helped organize and contributed to the first conference in the Dräger Symposium Series Sustainable Oceans: Reconciling Economic Use and Protection. The conference titled "The Use of the Oceans' Energy Resources, Risk Management, and the Need for Regulation" took place in June 2011 in Hamburg, Germany. The goal of the conference series was to quickly incorporate current scientific discoveries into political action.

Building on the Dräger Foundation's XVII Malente Symposium in 2008 "More than Water – Oceans and Global Responsibility", the Foundation has been planning further conferences devoted to the subject of Sustainable Oceans: Reconciling Economic Use and Protection. The first of these

events took the form of a high-level expert conference with about ninety international participants from the fields of politics, business, academia, international organizations, and non-governmental organizations (NGOs).

One of the key questions of the first conference was how the oceans can be researched and how their resources may be utilized while at the same time protecting them from the consequences of unfettered exploitation. Economic benefits need to be weighed against the costs, which – especially in the case of deep-sea mining – must include a realistic assessment of the potential risks and the costs of establishing an efficient international system of crisis management.

This applies not only to the economic

exploitation of marine resources in coastal regions, which is subject to national law, but in particular also to areas outside national territorial waters, where there are currently no internationally binding laws – despite the United Nations Convention of the Law of the Sea (UNCLOS) – which would allow the prevention, control and/or punishment this type of unrestricted and ecologically risky exploitation. There is, in other words, an urgent need to expand international law to include these areas and to implement enforcement mechanisms with a view to preserving the balance between business and ecology. A coordinated, comprehensive and transparent offshore management regime is necessary, especially when it comes to the use of energy and other mineral resources.

# Post Doctoral Fellowships

Sponsored Jointly by the Alexander von Humboldt Foundation and the Cluster of Excellence the Future Ocean

A strategic partnership between the Future Ocean and the German Alexander von Humboldt (AvH) Foundation was established in 2009 in order to attract high profile international young investigators to Kiel as Alexander von Humboldt Fellows. The AvH Foundation views this partnership with the Future Ocean as an innovative model for future cooperation with other institutions in Germany.

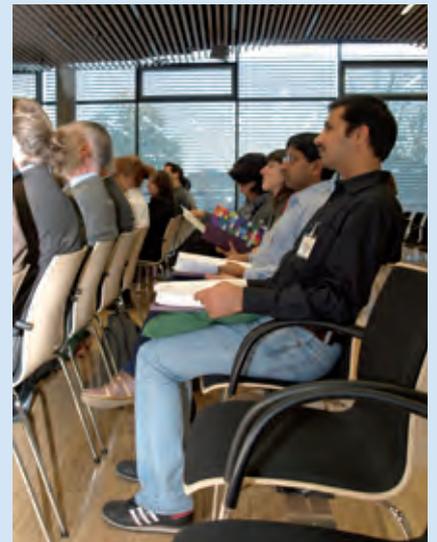
Prospective candidates submit applications to the AvH Foundation, which conducts the selection process. Since 2010 a number of Future Ocean related proposals have been submitted to the selection committee, several of which were successful. Dr. Mohammad Heidarzadeh Kolaei from Iran started his research in Kiel in the summer of 2012 working on hazards related to deep sea slides in Sebastian Krastel's group at Kiel University. Four others are expected to begin their research soon in various working groups. Isobel Yeo from Great Britain will work with Colin Devey on deep sea vents, Xiaonan Ma from China, a physical chemist, will join Friedrich Temps' group for two years. Ira Didenkulova from Estonia will carry out her research project jointly at the University of Bremen and in the working group of Andreas Lehman at GEOMAR in Kiel. Most recently the committee chose to fund Zhimian Cao, who will be working with Martin Frank on a paleoceanographic project as the next Alexander von Humboldt Future Ocean Fellow.

Selected candidates will be offered membership in the Integrated Marine Postdoc Network (IMAP) in Kiel, but will also have access to the long term benefits the Alexander von Humboldt foundation offers to its fellows, such as language courses and continued networking support long after the research project has been finished. In addition,

Humboldt fellows have the opportunity to return to their host institution in future to continue collaboration with colleagues there.

Why do we work with the Humboldt-Foundation?

The answer is simple: because we are dedicated to sustainability – in the ocean, but also in regard to education and research contacts. The Alexander von Humboldt Foundation is an expert in connecting scientists worldwide. Every year, the Foundation enables over 1,900 international researchers to pursue their research projects in Germany. The Foundation maintains a network of well over 23,000 Humboldtians from all disciplines in 130 countries worldwide - including 43 Nobel Prize winners. The Future Ocean actively promotes these fellowships and encourages foreign researchers to contact us to explore the possibilities of a Kiel-hosted research grant through the Alexander von Humboldt foundation.



Participants at an AvH Foundation networking meeting 2011 in Kiel, Germany.

During the conference, the foundation of a European Ocean Commission was encouraged. Close collaboration with the existing U.S. Ocean Commission on Ocean Policy is foreseen so that international cooperation can help in finding solutions to global issues such as marine pollution and rapid climate change.

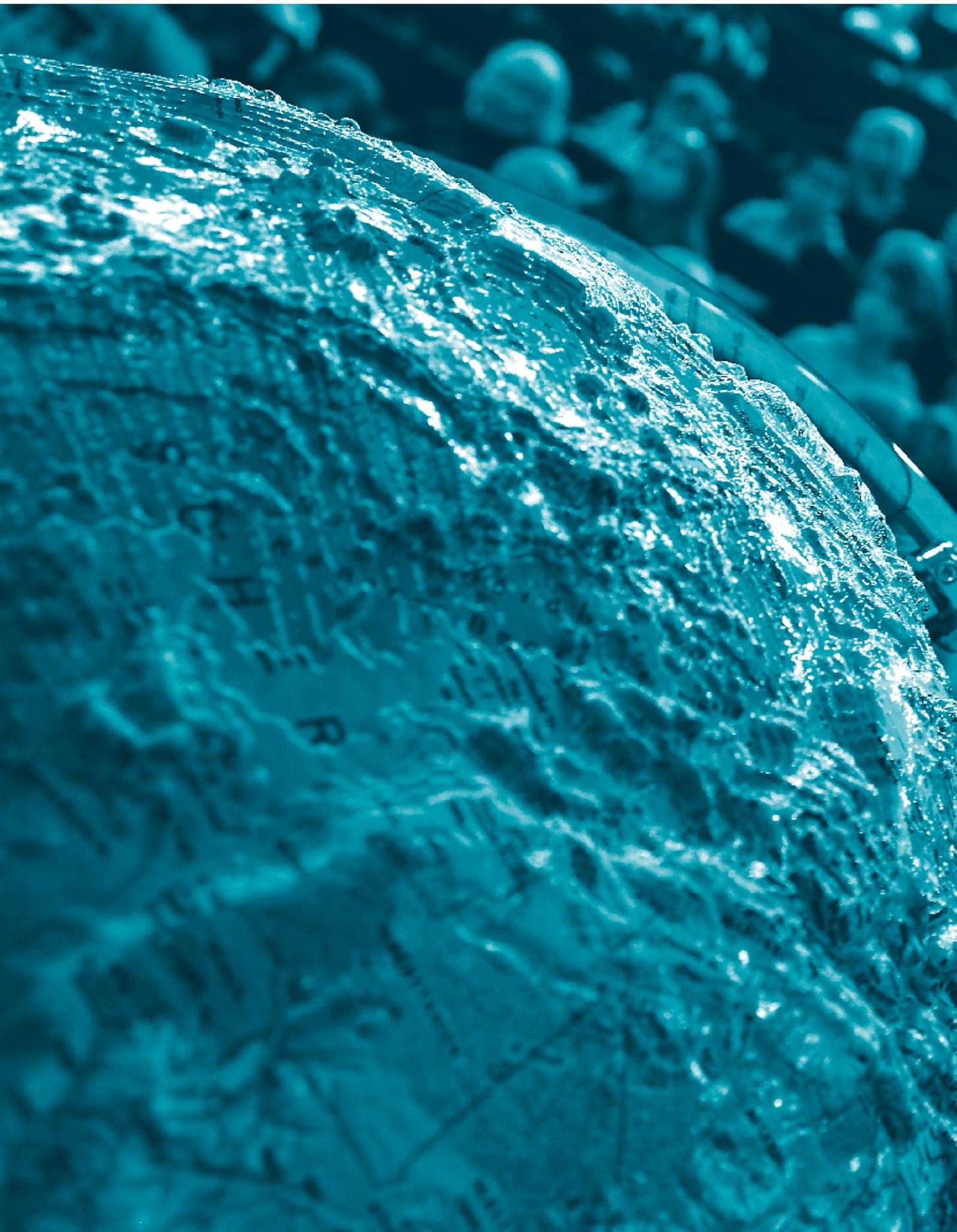
The Future Ocean serves as a cooperation partner of the Dräger Foundation in this conference series and was represented in Hamburg by several Cluster members as invited speakers and in the panel discussions. The Future Ocean presented the EcoOcean sustainable fisheries simulation game to the various international stakeholders from politics, NGOs, research and industry. The game sparked several interesting discussions which centered not only around the topic of the European Union's fisheries policy and overfishing but also on innovative methods for disseminating information to the public.

The conference series will continue with conferences in New York, USA, in 2012 and Lisbon, Portugal, in 2013. A summary of the results of the 2011 conference is available

for download at <http://www.draeger-stiftung.de/en/foundation-programs/conferences-2011/sustainable-oceans.html>



Future Ocean Speaker Martin Visbeck explains the EcoOcean game on sustainable fisheries to stakeholders during the Dräger Symposium 2011 in Hamburg, Germany.



# Education & Career

We have found it of paramount importance that in order to progress, we must recognize our ignorance and leave room for doubt. Scientific knowledge is a body of statements of varying degrees of certainty — some most unsure, some nearly sure, but none absolutely certain.

*Richard P. Feynman*

# 360° Dome Cinema Production for Children: Little Polar Bear Lars and Climate Change

Lars – The Little Polar Bear is in Kiel. The Mediendom (media dome), a 360° dome cinema at the University of Applied Sciences in Kiel and the Cluster of Excellence The Future Ocean have developed a dome presentation based on the picture book *The Little Polar Bear and the Whales* by Hans de Beer. In this adventure, Lars saves the whales from whale hunters and a dangerous situation caused by a melting glacier. The latest production of the Mediendom presents the constellation of the Great Bear (Big Dipper) to children aged five to eight and introduces

them to the threatened habitat at the North Pole using the story of Lars as a foundation. The children learn more about the polar bears and why their habitat is threatened by climate change. The production recently received an award by the German Commission for UNESCO for its particular contribution to the concept of education for sustainable development. The distinction is awarded to initiatives conducting projects imparting knowledge about sustainable development and motivating children and adults to think and act sustainably.

## A New Schoolbook Brings the Ocean into the Classroom

In the school text book *Abenteuer Weltmeere* (adventurous oceans) researchers from the Future Ocean and teachers from around Kiel explain the ocean in a scientific context to students of grades 9 and 10. How will the oceans change and what causes these changes? What drives ocean currents? Why are the oceans the biggest storer of carbon? – These are only some of the questions analyzed by oceanog-

raphers and teachers and to which they have developed interesting experiments and easy-to-understand texts for classroom use. The schoolbook covers various topics such as the geography and geology of the oceans, chemical, physical and biological oceanography, global warming, sea level rise and coastal protection. It contains chapters on plate tectonics, the global carbon cycle as well as measurement methods in oceanography and invasive species. To date it is only available in German.



## Record Attendance at the Kids' and Students' University

From 21st September to 7th December 2011, approximately 2,100 students poured into the Audimax of the Kiel University for a total of six lectures of the fourth kids' and students' university. This broke the record mark of 1,800 attendees set two years before. A diverse mixture of topics from marine and geo-sciences to 3-D technology in movies and TV attracted young future researchers aged between eight and sixteen. Once again the Future Ocean organized the event for the university. The purpose of the lecture series is to introduce fields of current research to children at an early stage. Therefore most professors included references to the young audience's daily lives. The handouts produced for each lecture, live recordings and photographs which have been fascinating so many kids between 2008 and 2012 can be downloaded from the cluster's website. All topics are summarized and further information on the different research areas is offered. The concept has proved to be successful. The kids' and students' university has become a constant attraction for students, teachers, parents and professors alike. Sponsors are the foundation of the Förde Sparkasse, the Leibniz Institute for Pedagogy and Science (IPN), the Kieler Nachrichten, and the children's magazine Geolino.



Attracting the next generation of scientists at the Kid's University of Kiel

## Setting up a Student Laboratory: The Kieler Forschungswerkstatt

In the future all activities for school children conducted by the faculty of Mathematics and Natural Sciences at the Kiel University will be combined in the Kieler Forschungswerkstatt (Kiel Research Workshop). The aim is to support children and teenagers in general as well as to promote excellence in high school education. This includes improving teacher training and the communication between science and society. The student laboratory, which is being set up by Katrin Knickmeier from the Future Ocean, aims to heighten curiosity about science and its phenomena for pupils of all ages. The program consists for example of taster days for school classes, long term support for talented teenagers and teacher training.

The official opening took place in mid-October 2012. Soon the new program with diverse elements of marine science education for pupils of all ages will start. [www.forschungs-werkstatt.de](http://www.forschungs-werkstatt.de)



Minister President Torsten Albig opened the Research Lab for pupils.

## Kiel - A Great Place to do a PhD



Rommel Maneja works on calcification.

### Truly International

Rommel Maneja has been around. His Erasmus Mundus Stipend took him from the Philippines to Spain, Portugal and Norway. For his PhD in Kiel, he obtained a Marie Curie Stipend within CalMarO, a multinational training project, to work on calcification in fish and cephalopods.

The most important feature of his research in Kiel is a unique setup for carbon dioxide manipulation experiments available at GEOMAR. Additionally, he greatly appreciates the multidisciplinary support within the Cluster and within its graduate programme, the Integrated School of Ocean Sciences. "To understand calcification of marine organisms, you also have to understand

calcium carbonate structures, microchemistry, animal physiology and paleoclimate to name a few. And within the Cluster there are lots of specialists available," he says.

Although he feels that "it can get tough, if you don't speak Deutsch", he experiences the Kiel scientific community as multicultural and open and always received a helping hand when he needed one. He, his wife and their infant son feel comfortable and at home in Kiel and enjoy the international atmosphere. "In Kiel there are lots of foreigners and there are also lots of Filipinos", he says and smiles. Before he came to Germany, he was warned that it was hard to make German friends. "It's not true. You find your space and friends, just as in any other place - once you've found your circle, you'll always be invited for a barbecue."

### A "Mini" Proposal with Maximum Impact

Andrea Frommel is a high flyer; while still a PhD student, she first-authored a paper in Nature Climate Change, demonstrating severe tissue damage in cod larvae exposed to a high CO<sub>2</sub> environment. Andrea asked herself, "Could differences in gene expression explain the morphological and histological patterns she was observing?" She realised early on that she was on to a good thing, and decided to use the miniProposal scheme of her graduate school, the Integrated School of Ocean Sciences (ISOS) to pursue her idea. Miniproposals support PhD students to realize smaller projects outside their thesis, yet having direct relevance to it. By applying, Andrea took the opportunity to step into a completely different field: Genetics.

Andrea teamed up with a fellow ISOS PhD candidate who had complementary expertise and a doctoral colleague at AWI who had developed the gene primers required. After getting the OK of her supervisor, she planned, budgeted, wrote and submitted the proposal and was awarded the grant. In addition to getting exciting results that are being published, Andrea considers the miniproposal as crucial in promoting her post-doctoral career. First, the genetic methods she learned added to her scientific profile "I



Mesocosms in Espesgrend - Andrea Frommel measuring pH-values.

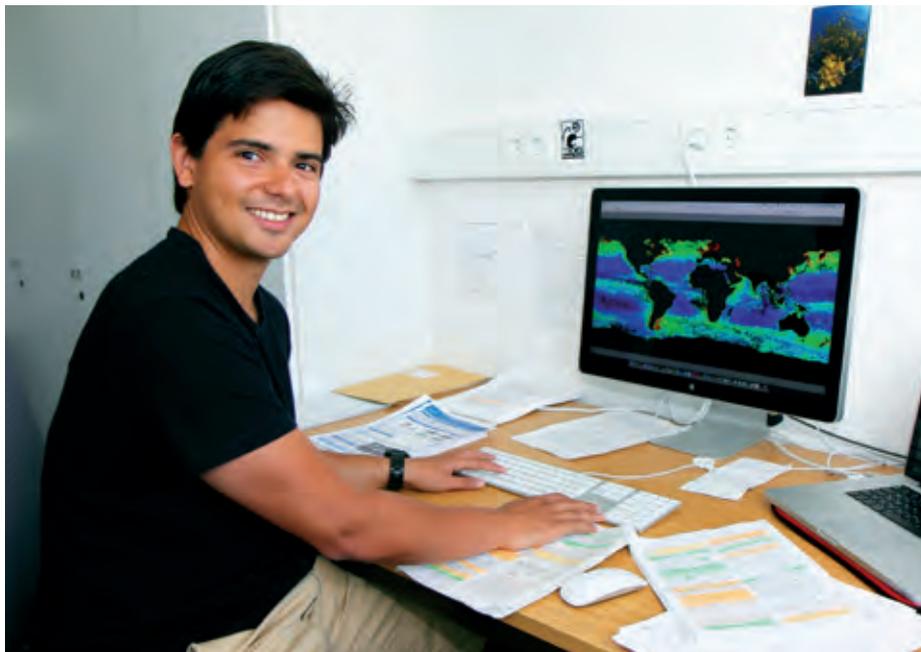
wish I could have done several miniproposals to explore various additional fields," she says. Additionally, she sees the grant writing experience she gained as essential to her winning a competitive Postdoc grant at the Sven Lovén Center at Gothenburg University in Sweden. The contacts made to the lab in Sweden arose during a conference that was supported by the ISOS. "Without the ISOS

support, I could not have attended as many conferences and would not have met so many people, including my new employer."

Finally, she considers the miniproposal an ideal framework for exploring possible future research directions: "I might have realized that I don't enjoy genetic work at all. Having the opportunity to approach the field in a smaller framework was perfect for me!"

## Freedom of Choice

Lionel Artega from Venezuela is a biogeochemical modeler working on his PhD project “Combining satellite and model analyses to describe phytoplankton growth” at GEOMAR. After doing his Masters in Biological Oceanography in Kiel, he chose to enroll with his supervisors in the PhD programme of the Integrated School of Ocean Sciences (ISOS). One important reason he chose Kiel for his PhD was the spirit of scientific freedom he felt here. His current supervisor not only offered him a PhD position within the Cluster, he also supported him in looking for alternative PhD positions, leading to a true freedom of choice. Although he first considered the fact that the ISOS, in contrast to other PhD programmes, does not have a compulsory curriculum as a disadvantage, he now is convinced of the contrary: “In the end, I have the opportunity to do whatever I want. If you have the commitment, having the choice is even better!”



Lionel Artega appreciates the spirit of scientific freedom in Kiel.

## Microbiologist on Board

Microbiologists spend most of their time in the lab, looking at tiny microscopic organisms. That is what PhD candidate Irene Müller, a member of the Integrated School of Ocean Sciences (ISOS), does – most of the time. But sometimes she exchanges her lab coat for gumboots and heads off to sea on board a research vessel, fishing for jelly fish and the bacteria living on their surface.

In her PhD project at the Institute of General Microbiology in the group of Prof. Ruth Schmitz-Streit she investigates how the bacteria use chemical signalling to coordinate their gene expression patterns and how their hosts interfere in that communication.

It is the bridging of traditional microbiology and marine science that she perceives as very enriching. “Through my contacts to marine scientists within the Cluster I can bring background knowledge into my working group. I feel that this is a unique feature that characterizes me and my research.”

This interdisciplinarity and the opportunity to network with other researchers within the Cluster and the ISOS were important for her

decision to do a doctorate in Kiel. Knowing several PhD students enrolled in ISOS and “seeing that they had an exceptional network”, she decided to write a proposal for her PhD

project and was successful. “Being supported within the Cluster is very important for my research. There are always many people I can rely on” she says.



Irene Müller in her microbiology lab.

## Started: The IMAP Network for Early Career Postdocs

Following a recommendation of the Future Ocean Advisory Board, early career postdocs and research scientists in non-permanent positions met late 2010 for the first time to exchange ideas and opinions about common challenges and ways to tackle them. This led to the formulation of a position paper in which the current situation and ideas, suggestions and requests were formulated. Soon a dynamic network developed, providing a structure to bring these postdocs together and facilitating the communication with other Future Ocean bodies. In early 2011 by-laws were set up outlining the mission and setting the guiding rules on membership and organization. Two co-speakers (male and female)

were elected with equal rights who represent the network as members in the Executive Board. The name IMAP (Integrated Marine Postdoc Network) was introduced into the proposal for the second Cluster phase. The intention was to establish this network as a central structure in the Cluster of Excellence. The main aim of the IMAP network is to provide a strong and attractive environment for young researchers in interdisciplinary marine sciences and to support the members of the network in their career development on different possible tracks between PhD, senior researcher and/or professorship. Measures include e.g. career mentoring, training, and funding. The members of the IMAP network

meet regularly to discuss and inform each other, but also to develop ideas on interdisciplinary scientific cooperation among them. Currently the network has 27 members (2012).

- ▶ First measures to support career development were started in 2011. These included selected soft-skills courses: Grant Writing, Leadership and Management Skills Seminars.
- ▶ A postdoc project application call was issued in April 2011 to support positions for two years; a 2-day IMAP network retreat took place in October 2011 (see below).



IMAP supports scientists in finding their way through the jungle of an early career.

## Inspiring Exchange at the IMAP Retreat

A highlight for the IMAP network in 2011 was surely the 2-day postdoc retreat which took place on 14-15 October, 2011. The retreat was organized by the co-speakers of the network and supported financially as well as with personal contributions by the Cluster of Excellence. Ten postdocs followed the invitation to the Guesthouse Samain in

Loose, Germany. The participants spent two inspiring days exchanging thoughts on scientific and organizational, but also personal matters. On the first day, the current status and future directions of the network were discussed. Each postdoc presented his/her topic and projects to the group. Presenting the research foci did not only reveal how diverse

the topics within the Future Ocean are, but also where (interdisciplinary) cooperation could be established between the postdocs. In the evening, Future Ocean Speaker Martin Visbeck joined the group. A relaxed social evening was spent with ice-breaking interactive games that challenged everyone's marine scientific knowledge, triggering many interesting discussions. The next day was devoted to more formal discussions of the future directions of the Future Ocean and the IMAP network with Martin Visbeck, Emanuel Söding and Nancy Smith from the cluster's management office, providing strong and valuable administrative support for the IMAP network through their work in 2011.

Overall, the IMAP retreat was a very positive and inspiring meeting which helped to strengthen the network and give it a good push to go further. The retreat with its scientific discussions and personal exchange was very motivating and it helped to develop a strong feeling of affiliation with the Future Ocean as well as between the postdocs in the IMAP network.



Participants of the first network meeting of early career postdocs.

### Kristian Lass, Kiel University

I am a (physical) chemist by training, and my current field of work is the vibrational spectroscopic investigation of the sea surface nanolayer. I am working at the institute of physical chemistry of the Kiel University, with cooperations in the marine chemistry department of GEOMAR. The IMAP network to me is a very valuable instance for establishing



and maintaining relationships with fellow postdocs over the boundaries of projects, fields of work and workgroups. It opens up the possibility to identify and articulate needs and interests of the postdoc community (e.g. soft-skills training) and paves the way for community efforts like the organization of the Young Scientists Conference in 2012. Furthermore, such an organization is a great institution for keeping alumni contacts, be it for the purpose of continued scientific collaboration ("networking") or just for maintaining contact to people I have once been working together with.

### Jan Dierking, GEOMAR Helmholtz Centre for Ocean Research Kiel

I am a marine ecologist by training, and particularly interested in fundamental (e.g., mechanisms of speciation) and applied (e.g., conservation, fisheries management) research focusing on fishes. My current work assesses fisheries induced evolution (i.e., genetic changes in fish populations induced by fishing pressure) in Baltic cod. My home base as postdoc



is the Evolutionary Ecology of Marine Fishes group at GEOMAR, but expertise of economists and oceanographers, as well as geographers is important for my projects. Indeed, to me, the interdisciplinary nature of the Cluster and the possibility to find such expertise nearby is one of the big benefits of the Future Ocean. A second one is the postdoc network IMAP, even more so than I expected when I entered in 2011. Workshops, retreats,

and financial support for lab exchanges, projects etc. are one positive side of the coin, but even more important to me are the exchanges with other young researchers at a similar career level, with similar problems and issues, during the regular IMAP meetings and events. I also feel that IMAP gives us postdocs a stronger voice in the academic system.

### Daiju Narita, Kiel Institute for the World Economy

I am an environmental economist and am researching on the economics of climate change. My research includes ocean-related themes, such as economic assessment of ocean acidification, and the Future Ocean Cluster provides me with various useful resources to carry out my research. For an environmental economist, it is an advantage to have access to a platform that enables us to interact with natural scientists on a continual basis. IMAP is a great network for me to get to know people from different disciplines at a similar career stage, from whom I get many new ideas and with whom I share a variety of concerns in career development. I also like the fact that IMAP offers many training courses of practical professional skills. Although I personally do not have any research projects directly associated with IMAP yet, I think that IMAP has a good potential to become a forum to connect postdocs from different fields and promote interdisciplinary research projects. Such a capacity of the network might be developed further in the future.



### Barbara Neumann, Jörn Schmidt, Kiel University

The IMAP network has great potential to support postdoctoral researchers on non-permanent contracts and to help in shaping their personal careers. The measures offered to the postdocs are an



extremely valuable support for building expertise and standing in their field, developing open minded and inspiring academics, and last but not least contributing to excellent interdisciplinary science in the Future Ocean. IMAP postdocs have had the chance to profit from the network in many ways during the first five years of the Future Ocean already. We, however, consider it as equally important to strategically discuss and bring forth the visions that stand behind the renewal proposal of the cluster with regard to the situation and possible career tracks of postdoctoral researchers within the academic system. By developing new medium to long-term career perspectives with the University, both sides will profit: The academic landscape by addressing the issue of the disappearing mid-level faculty (Mittelbau) and young researchers by providing more planning security for a successful academic career development. These challenges provide a great chance to the Cluster and the IMAP network in shaping a future orientated research environment in Kiel.



# People

I was born not knowing and have had only a little time to change that here and there.

*Richard P. Feynman*

# Lawyers and the Ocean

An interview with Professor Nele Matz-Lück on the role of International Maritime Law in the Cluster of Excellence The Future Ocean

*When ocean researchers in Kiel talk about integrative marine sciences and include areas in their natural sciences research which, traditionally, have little to do with marine science, this often involves the Law of the Sea. In the five years that the Cluster of Excellence The Future Ocean has existed, the Chair at the Walther Schücking Institute for International Law at Kiel University has been a constant in the natural science research network. Professor Nele Matz-Lück joined the Future Ocean in 2011. She conducts research on sustainable fisheries and the use of marine resources.*



## You have been a professor for International Maritime Law for about a year. Why did you decide to join The Future Ocean?

I was familiar with the Cluster's research long before I applied. What impressed me most was that interdisciplinary work in Kiel is successful. I am convinced that, especially between marine scientists and maritime lawyers, direct intercommunication is important. As a maritime lawyer I can contribute a great deal to the Cluster's research. Moreover I get suggestions as to how I can integrate scientific questions and approaches in my own research.

## What do you associate with Kiel Marine Sciences? And what role does Kiel as a location play for the Law of the Sea?

Kiel Marine Sciences has become a special term for me, a term that reaches far beyond natural sciences. It is still the exception that economists, medical scientists and lawyers are included in ocean research. Law of the Sea, which is already well anchored in Kiel, has thus experienced a perceptible upsurge, which also has an immense effect on the public image of maritime law research.



### **The Law of the Sea and International Law play a large role in many Cluster topics. Which are especially interesting for research?**

Nearly all cluster topics like Resources, Ocean Governance or Evolving Ocean have a law component. In the cluster's first semester topic on sustainable fisheries management for example, the question regarding regulation and its effects is fascinating. We examine why the European Union's fisheries regulations fail and what role law plays in management approaches. From our point of view there are already promising approaches, for example in New Zealand.

### **What are these like?**

In New Zealand the resource fish is now passed over to the fishermen as a kind of property right that can be traded. Thus we see a higher interest in handling fish in a sustainable way since the fishermen identify with their fish stock.

### **What is research in Maritime Law actually like? Research vessel expeditions and laboratory experiments are probably not as common in the Faculty of Law.**

In our research we mostly concentrate on legal texts, literature analysis and evaluations of judicial decisions and state practice in order to assess legal regulations and make suggestions for further developments – ultimately we evaluate how effective legal regulations can be. Of course it is difficult to trace whether a functioning model is due to legal regulations or has other causes.

### **What consequences do single issues and analyses have on the development of the Law of the Sea in general?**

Many questions that we examine in the Cluster of Excellence are also generally interesting for Maritime Law and International Law, as they are often questions regarding enforceability and fundamental regulations such as how law functions between nations. However, we also recognize the limits of International Law, for example in managing global resources.

### **Mineral resources will be the focus of the winter semester 2012/2013. What role does the Law of the Sea play here?**

I look at this issue especially from the perspective of environmental conservation and environmental regulations that must be followed when mining the sea's resources, less on the allocation of property rights, since we have a central authority for this, at least for the deep seafloor. Yet the question as to who regulates environmental damage and who is liable is interesting.

### **When talking about protecting the ocean, a lot is lumped under the fashionable term "sustainability". What importance does this term have from a judicial standpoint?**

The term sustainability has, in my opinion, not really been infused with judicial meaning. Just because something is supposed to be sustainable, a lawyer does not yet know what nations are allowed to do or not do. It is still a vague word. The same also fundamentally

applies to the much used "precautionary principle", which tells me just as little about what I can or cannot do. In future international institutions in particular must anchor legal positions internationally.

### **On what levels are climate change and the resulting effects on the ocean being discussed? Do international conferences such as Rio+20 lead to solutions?**

That depends on the subject. When it directly involves climate change, measures that at least reduce climate change, can only be decided in international conferences, especially those with the contracting countries of climate agreements. In the case of Rio+20, those that expected agreements or even only proposals for legally binding instruments were, in my opinion, disappointed. Although the climate change problems have by no means decreased since the first conference in 1992, the skepticism regarding new, basic and legally binding agreements and the transfer of sovereign rights to organizations (and their funding) is considerably higher. Rio+20's outcome document is a suitable summary of current problems regarding the ocean and a reference to judicial and political regulation approaches but does not formulate actions. Therefore the statement is informative but not innovative.

### **The Cluster of Excellence will strengthen its dialogue with decision makers from politics, industry, NGOs and education in future. How can International Law contribute to this?**

From a legal perspective we can have an influence by pointing out means – or even in part limits – to certain questions and thus strengthen the relevance and effectiveness of non-governmental institutions. Intensifying the dialogue is the right way to go. And the Cluster has the ability to establish contacts to politics as, for example, the World Ocean Review demonstrates. The Cluster as an institution commands more recognition than a single university department.

### **In the Cluster of Excellence the promotion of young scientists is of particular importance in all disciplines. Have you noticed interest from other disciplines in your subject area?**

Happily, yes. I held my Law of the Sea lecture last summer semester in English. We have only about 20 students in our area and the lecture was well-attended with around 60 students during the entire semester – with students from the natural sciences, political science and environmental science and from geology. Our "Current Issues in International Law" on current legal questions is also very well received.

Thank you very much for your time.

# ISOS Alumni Portrait – “I believe I do my bit”

## Life after the PhD



PhD Alumna Maike Kramer

*Dr. Maike Kramer is a marine biologist and alumna of Future Ocean's Integrated School of Ocean Sciences (ISOS). During her PhD she spent lots of time in icy conditions studying the organisms living in sea ice. It was worth the effort: In 2011 she was awarded the Annette-Barthelt-Prize for outstanding research in marine sciences for her thesis titled 'The role of sympagic meiofauna in Arctic and Antarctic sea-ice food webs.' Being out in the Arctic she*

*experienced the consequences of climate change and its dramatic impact on marine life, drawing a personal conclusion: "I see it as my responsibility as a polar researcher to spread the word and to do something about it". And now she does: She traded the ice for a well tempered office at the German Federal Agency for Nature Conservation (BfN) in the section Marine and Coastal Conservation.*

### Maike, how did you come to work there?

I began my studies because I wanted to protect the oceans. But very early on I got in touch with basic research, enthusiastically dived into it and enjoyed it. However, towards the end of my doctorate my original motivation came back to me and I started looking for a suitable job.

### What is the biggest difference to your time as a PhD candidate?

As a PhD candidate, I was free with regard to how I organised my day and work. In a governmental agency a lot is predetermined by other factors, but I have learned to deal with that. What took longer to get used to is the way communication is organised in an agency. At university, you can basically talk to everyone irrespective of their status level. In an agency if you want information from other levels in the hierarchy you have to take it up the chain of command. It took quite a while until I got used to it.

### As a PhD candidate you participated in the ISOS. How did you benefit from that?

What I learnt in the course on Communicating Science to the Public really helped. It taught me to explain my research in an understandable and interesting way to non-specialists. I use that skill almost every day

as quite often I have to talk to people who are not experts in my field. I benefited a lot from the seminar on international law of the sea that gave me an understanding of the international legal framework. This makes my current task a lot easier because a big part of it is directly linked to international law and treaties.

And what really helped me was talking with people from outside academia e.g. at Career Evenings. That gave me the courage to leave academia to try out another field.

### What have you learned at the agency that you didn't learn in science?

To better separate professional and private life. If one day I return to science – that is not out of the question – I will balance this better than before.

### So, going back to your initial scientific intention: Do you believe you make a difference, do you protect the oceans?

Yes, I do believe I do my bit. Through coordinating projects, for example, dealing with implementation of the Marine Strategy Framework Directive I ultimately contribute to the protection of the oceans.

## Prestigious Honours for Marine Scientists from Kiel



Wolf-Christian Dullo received the Werner Heisenberg Medal from the Alexander von Humboldt Foundation.

### Wolf-Christian Dullo received the Werner-Heisenberg Medal

The marine geologist Wolf-Christian Dullo from the GEOMAR Helmholtz Centre for Ocean Research Kiel, was decorated with the Werner-Heisenberg Medal for his work in the advancement of international, scientific collaboration. He previously received the Gottfried Wilhelm Leibniz Prize of the DFG in 2002. This occasioned the Humboldt Foundation to include him in their jury panel. The Werner-Heisenberg

Medal is named after the renowned German physicist who was the first president of the Alexander von Humboldt Foundation.

### Ulf Riebesell is awarded the Leibniz Prize by the DFG

Ulf Riebesell, professor for biological oceanography at the GEOMAR Helmholtz Centre for Ocean Research Kiel, was awarded the Gottfried Wilhelm Leibniz Prize 2012 for his research concerning the development of the ocean. The marine scientist from Kiel was one of the first to study the effect of acidification and temperature rise of the oceans on marine organisms and ecosystems. He is the father of the mesocosms, enormous test tubes that drift freely, with which the scientist could

# Visiting Scientists

## Visiting Researcher Liya Jin will miss Kiel's fresh air and the free research atmosphere

Liya Jin is a climate researcher with many years of experience analyzing climate model and climate proxy data. He has worked with different models examining mainly climate processes during the Holocene.

From 2009-2011 Liya Jin joined the climate modeling group led by Birgit Schneider at the Institute of Geosciences of Kiel University within the Cluster of Excellence Future Ocean. Recently he performed a series of modeling experiments using the Kiel Climate Model (KCM) concerning multi-time scales of climate change, e.g. Holocene, Eemian et al. From May to August 2012, Liya Jin was invited by Mojib Latif from the Helmholtz Centre for Ocean Research GEOMAR to carry out research on Asian summer monsoon changes during the Holocene by analyzing KCM results. These results are compared with paleo-proxy data to understand the role of the Earth's orbital forcing and ocean in past climate change. "This time to visit GEOMAR is an extension of my previous work with scientists at the CAU and GEOMAR," Liya Jin says. Liya Jin appreciates the outstanding research facilities (such as the powerful computer workstation) at GEOMAR and Kiel University, which are state of the art and make his research work highly efficient. His visit to GEOMAR brings him to a famous international research

institute in the field of marine sciences. "Working with those innovative scientists in the institute, you will have opportunities to do leading research work." Liya Jin mentions. "I was impressed very much during my stay at Mojib Latif's group by the free research atmosphere. New ideas arising in ones mind after an active exchange and discussion of a topic would not

be a surprising." In his home institute, the Key Laboratory of Western China's Environmental System, Lanzhou University, Liya Jin is now undertaking several research projects on paleoclimate simulations related to an application of KCM within the National Basic Research Program of China funded by the state Ministry of Science and Technology of China. In a proposed project for 2013 to the National Natural Science Foundation of China (NSFC), collaborative research wit Mojib Latif is planned. The project will make use of KCM to understand mechanisms in Holocene climate changes over central and monsoonal Asia.

Even back in China Liya Jin will miss Kiel as a quite cool city in summer. "The fresh air, walks along the seaside, Kiel's beautiful beach, sailing and comfortable climate in summer will be missed." Jin summarizes. We look forward to welcoming Liya Jin in Kiel again in the future!



Climate researcher Liya Jin likes Kiel.



DFG President Matthias Kleinert (right) congratulates Ulf Riebesell at the award ceremony.

demonstrate how in the Norwegian fjords and in the Arctic the pH value of the oceans is sinking. The acidification of the oceans has a particularly harmful effect on calcareous organisms.

### Honors for three marine scientists at EGU 2011

At the annual meeting of the European Geosciences Union (EGU) in Vienna, Austria, three marine scientists from Kiel were honored for excellent research. The geophysicist Heidrun Kopp held the high-profile CF Gauss Lecture on a study of subduction zones and their role in earthquakes and tsunamis. The subduction process is associated with volcanism and frequent, often strong earthquakes. Recent



Ulf Riebesell, Heidrun Kopp and Andreas Oschlies from the GEOMAR Helmholtz Centre for Ocean Research in Kiel received honors at the European Geoscience Union Meeting 2011 in Vienna.

examples include the earthquake off Sumatra on 26 December 2004, the earthquake in Chile on 27 February 2010 and the Tohoku quake off Japan on 11 March 2011. The CF Gauss Lecture is organized by the German Geophysical Society (DGG) at the annual meeting of the EGU. The invited personality presents the latest developments in Geophysical Research. Earlier, the marine biologist Ulf Riebesell from GEOMAR received the Vladimir Ivanovich Vernadsky Medal of the EGU for his outstanding achievements in the field of marine biogeochemistry. The award is named after the Russian-Ukrainian geologist Vladimir

Ivanovich Vernadsky, who is considered the founder of biogeochemistry. Furthermore, the oceanographer Andreas Oschlies, professor of biogeochemical modeling at the GEOMAR Helmholtz Centre for Ocean Research Kiel received the Georg Wüst price 2011 of the German Society for Marine Research. This distinction is awarded every two years and is supported by the international journal *Ocean Dynamics*. It is named after the oceanographer Georg Adolf Otto Wüst (1890-1977) who was the first to identify the complete flow system of the Atlantic.



# Events

In this age of specialization men who thoroughly know one field are often incompetent to discuss another. The great problems of the relations between one and another aspect of human activity have for this reason been discussed less and less in public.

*Richard P. Feynman*

# Diving into the Secret World of the Ocean

The Future Ocean – A new permanent exhibit in the Zoological Museum in Kiel



Sunfish are among the largest of the ray-finned bony fish. They grow up to 3.3 meters in length and can weigh up to 2 tons. They are rarely found in the Baltic Sea.

On 29 June the Zoological Museum of Kiel University (CAU) opened a new permanent exhibition called The Future Ocean. A collaboration between the Future Ocean, the Zoological Museum of Kiel University, the Muthesius Academy of Fine Arts and the GEOMAR Helmholtz Centre for Ocean Research, has resulted in a second permanent exhibition by the Cluster of Excellence - the first one being in the International Maritime Museum in Hamburg. For Wolfgang Dreyer, Head of the Zoological Museum, the new exhibition sets a milestone in positioning the museum once again towards maritime issues. The exhibition of around 70 sq. meters on the second floor of the Martin Gropius building deals with current topics of the Future Ocean such as fishery, sea level rise, ocean acidification and ocean circulation. Tried and proven exhibition modules, complemented by unique exhibits from the Zoological Museum,

allow visitors to dive into the mysterious world of the seas. Ralph Schneider, vice speaker of the Cluster of Excellence The Future Ocean views the exhibits by the marine scientists as a modern medium of scientific communication: "It is important for us to communicate the

results of modern marine science research over a long term with exhibitions such as this one. With the Zoological Museum we have attracted a strong partner for this at a location which has a long tradition. Here worldwide marine science research was born. The scientifically recognized definition of



Pupils read messages from bottles with information on marine research topics.

the word plankton, common throughout the world, was coined here, for example."

The exhibition is open from Tuesday to Sunday including national holidays. See details at

[www.zoologisches-museum.uni-kiel.de/](http://www.zoologisches-museum.uni-kiel.de/)

# Marine Scientists from Kiel Write About their Visions for the Ocean in 2100

“The Ocean is our Future. Kiel Marine Scientists on a Time Trip to 2100”



Science and Arts - a fruitful combination.

The Ocean is our Future - this is the title of one of the recent publications of the Cluster of Excellence The Future Ocean. This time, however, it is not about research facts. 14 marine scientists from Kiel have written about their professional and personal views on the ocean. Included are climate researchers, zoologists, mathematicians, oceanographers, biologists, economists and geologists who share one thing in common: They have developed a vision of the ocean in 2100. The scientist's predictions are, nevertheless, as diverse as the colours of the sea: some dramatic, others pessimistic, sometimes optimistic or connected to a wish. On the 14th of February 2012, Martin Visbeck, Wolf-Christian Dullo and Sebastian Krastel presented their visions to the public. The reading took place in the Atelierhaus in Ansharpark, Kiel, Germany, together with the artist group called Blauschimmer. The



Co-authors of the publication: researchers Wolf-Christian Dullo, Martin Visbeck and Sebastian Krastel meet the artists Kerstin Mempel (l) and Corinna Kraus-Naujeck (r).

artists Kerstin Mempel and Corinna Kraus-Naujeck illustrated the booklet. “It is our goal to convince our readers in different ways about the beauty of the ocean” says Martin Visbeck, Speaker of the Cluster of Excellence The Future Ocean. “Our stories are meant

to help people realize that we need to treat our environment in a more conscious and sustainable way.” The publication is available in German and English, and can be ordered from the Future Ocean office by e-mail to [press@futureocean.org](mailto:press@futureocean.org).

# ISOS Events

One of the Integrated School of Ocean Sciences (ISOS) crucial concerns is to sensitize young researchers to the challenge of applying science in contemporary society. By networking personally with invited guests from industry, policy making, NGOs or other research institutions they train the ability to synthesize information and get input for life after their PhD.



Richard van Noorden from Nature Publishing and Klaus Wallmann share the podium for the discussion "Say no to CO<sub>2</sub>!".

## Involving Stakeholders: ISOS Panel Discussion on Renewable Energies

Does it make sense to implement renewable energies at any price? Do economic criteria serve ecological goals? Moderated by Cluster PhD candidate Wilfried Rickels, economist Till Requate from Kiel University, parliamentarian Ingrid Nestle from Bündnis90/ Die Grünen and Greenpeace climate expert Andree Böhling shared the platform at GEOMAR. With lively participation of Cluster scientists and PhDs they discussed their viewpoints regarding the use of photovoltaics and the Renewable Energy Sources Act. The event was part of the ISOS lecture series 'The Big Questions'.

## Marine Conservation on the isle of the bold and the beautiful

Successfully protecting the marine environment involves many disciplines. Profound biological knowledge is required, legal aspects, administrative regulations, economic interests and more have to be taken into account. Due to the variety this is an exciting area for many PhD candidates of the Cluster particularly with regard to their future career choice.

The ISOS workshop Marine Conservation on Sylt, created on demand of the PhD candidates, combined state-of-the-art research with insights into different vocational fields. Scientists from the Cluster, representatives of the World Wildlife Fund (WWF) and the International Union for Conservation of Nature (IUCN), a consultancy and

the German Federal Agency for Nature Conservation (BfN) came together in the Wadden Sea Station in List, Germany, in an interactive workshop. The different perspectives created a colorful and comprehensive idea of marine conservation.

## NATURE in Kiel

How to make a good paper excellent is something many scientists keep wondering about. In order to give a boost to young scientist's writing skills Heike Langenberg, chief editor at Nature Geoscience London, came to Kiel. More than 40 Postdocs and PhD candidates took the opportunity to benefit from her experience in presenting scientific results.

Richard van Noorden, assistant news editor at Nature took a detailed look at the "publish or perish" dilemma. In his talk „Do Metrics Matter?“ he discussed the value of bibliometric indices such as the impact factor of the Hirsch-Index, wondering whether they really depict scientific performance adequately.

„Say no to CO<sub>2</sub>!“ was the somewhat provocative title of the subsequent panel discussion. It focussed on the communication of scientific findings to the public, taking geo-engineering and carbon capture and storage as examples.

# The Future Ocean Exhibition

One of the major goals of the Future Ocean remains bringing the ocean and information on ocean research to where the people are. Therefore the Future Ocean maintains a set of exhibition modules, displayed at various locations.



Exhibition coordinator Gerd Hoffmann-Wiek explains the topography of the seafloor.

## The ocean comes to the Rhine Kiel Marine Sciences at the Day of German Unity in Bonn

On the Day of German Unity in Bonn, the Cluster of Excellence "The Future Ocean" and the GEOMAR Helmholtz Centre for Ocean Research Kiel invited all visitors to an exciting excursion into the world of the oceans. From the 1st until the 3rd of October 2011, Kiel Marine Sciences presented current topics in marine research in the Schleswig-Holstein tent on the Länder mile. A bright orange lander, a deep sea observatory, pointed the way into the Schleswig-Holstein tent between Adenauerallee and the banks of the Rhine. Here guests dived

into a dark, mysterious deep sea atmosphere to learn more about the opportunities and dangers in our world's oceans. The Cluster of Excellence demonstrated its interdisciplinary research approach, which extends far beyond the traditional boundaries of natural sciences.

The travelling exhibition "The Future Ocean" was set up especially for the Kiel Cluster of Excellence and has fascinated around 200.000 visitors and school classes up until now. The goal is to fill people with enthusiasm about the ocean. The artistic design of the Kiel Muthesius Academy of Fine Arts aims to facilitate access to Marine Research through a variety of sensory perceptions. The Future Ocean develops mobile exhibition modules in order to cover individual topics as a whole.



Coming next: the celebration of the Day of German Unity will take place in Munich in 2012.

## Presently there are permanent exhibitions in:

- ▶ Hamburg in the International Maritime Museum. Leading marine research institutes present their work on Deck 7 of the Museum which is in the Old Warehouse District.
- ▶ Kiel in the Zoological Museum. Under the slogan "A Dive into the World of Kiel's Marine Research", current topics such as fishery, rise of sea level, ocean acidification and ocean circulation are discussed on the 1st Floor.

# Future Ocean at Expo 2012 in Korea

German Pavilion with exhibits on overfishing and ocean observation



The deep sea diorama visualizes and informs visitors on many aspects of marine environmental issues.



Future Ocean Speaker Martin Visbeck visits the exhibition in Korea.

On May 12th the World Expo will open its doors in the South Korean city of Yesou. The numerous country pavilions of the Expo will provide information on the “Living Ocean and the Coasts,” the theme of this year’s exposition. Kiel Marine Scientists have provided information and exhibits for the “Habitat” area of the German pavilion. The global ocean observation network ARGO demonstrates the challenge of gathering comprehensive data in the world’s oceans. The exhibit is displaying one of the probes as an interactive model and provides information about the role of long-term observatories. EcoOcean, the computer game of the Cluster of Excellence The Future Ocean, is meant to motivate Expo visitors to fish sustainably.



Visitors enjoying the hospitality of the German pavillion at the Expo in Korea, 2012.

# Kiel - City of Young Scientists 2011

The celebrations brought together schools, local research institutes, students and teachers to celebrate a happy science festival on the banks of the Kiel Fjord.



Impressions from the Science Festival at the Hörn Campus in Kiel in summer 2011.

In March 2010, the city of Kiel was awarded a special distinction as the German City of Young Scientists 2011. The Cluster of Excellence the Future Ocean was involved in the application, which stood under the slogan "On expedition with a research vessel through Kiel's schools" and convinced the jury which consisted of representatives from the Körber, Robert Bosch and German Telekom foundations. With this project, the three foundations intend to capture the interest of children and teenagers for science. Therefore they award the prize to cities that strengthen collaborations between schools and scientific institutes. The city of Kiel, together with scientific partners, initiated a total of 47 projects where teachers and pupils from the 8th grade and higher take part in research on interesting phenomena and themes. The climax of the activities was the Science Festival on the 26th of May 2011. All of the 47 school projects presented their research results in a camp at the Hörn, including nine scientific projects on climate and oceans.



# Promoting Kiel Marine Sciences at International Conferences

Kiel Marine Sciences aims to be among the leading locations in Marine Sciences in the world. The Cluster of Excellence the Future Ocean strives to integrate and merge related activities at Kiel University, the Helmholtz Centre for Ocean Research Kiel (GEOMAR), the Institute for the World Economy (IfW), the Muthesius Academy of Arts and its national and international partners.



The Future Ocean booth at the Ocean Sciences Meeting, Salt Lake City, 2012.

The international visibility, exchange and cooperation of the Marine Sciences in Kiel are an important measure of the overall success of the Future Ocean and an important factor for the development of early career scientists. Consequently, the Future Ocean is constantly on the lookout for highly qualified scientists to actively participate in and contribute to Future Ocean research and education. The Future Ocean organizes various activities to promote Kiel Marine Sciences in the international science community, advertise positions and stipends and attract foreign researchers to Kiel. Future Ocean booths at scientific conferences provide information on Cluster activities, research topics and research opportunities in Kiel. Strong cooperation partners such as the German Science Foundation (DFG), the Alexander von Humboldt Foundation and other Excellence Clusters e.g. CliSAP in Hamburg, MARUM in Bremen, help to increase visibility and recognition of the Future Ocean Cluster in these activities even more.

## European Geoscience Union

In April 2011 and again in April 2012 the Future Ocean exhibited at the annual meeting of the

European Geosciences Union (EGU) in Vienna, Austria. More than 10.000 scientists from over 95 countries gather at this annual international conference. The booth served as an important meeting and communication point, attracting current and former researchers from Kiel to stop by and learn about new research and devel-

opments in Kiel. In 2011 the sustainable fisheries simulation computer game EcoOcean was featured at the booth and attracted many interested visitors. The Annual Report was distributed and the newly

released English language World Ocean Review was promoted. Other publications with information on research in Kiel were also distributed. Future Ocean promoted fellowships from our cooperation partner, the Alexander von Humboldt Foundation. Several young researchers were encouraged to apply for Alexander von Humboldt postdoc fellowships with a host in Kiel. Overall the presence of the Cluster at the conference increased recognition of and identification with the Future Ocean.

At the EGU in 2012 Future Ocean exhibited at a joint booth with the Cluster of Excellence CLiSAP from Hamburg (Germany). The close contact of two Excellence Clusters in marine science in northern Germany enabled a straightforward and simple cooperation which tied our communities together in a single booth. The ROV Model ROMP from Thomas Brandt (GEOMAR) and Warner Brückmann (GEOMAR) attracted many visitors to the booth.



A tough job - discussing the advantages of research in Germany with future postdoctoral researchers from Hawaii, USA.



Explaining opportunities in Kiel to interested young scientists from all over Europe.

### American Geoscience Union

In December 2011 the Future Ocean exhibited at the annual Fall Meeting of the American Geophysical Union (AGU) in San Francisco, the largest earth science event taking place annually in the USA, with over 21.000 participants and about 250 exhibitors. The booth was visited by over 100 persons daily, who were provided with information about the Future Ocean in conversations and in the form of printed media: various cluster flyers, brochures and the Annual Report, as well as the World Ocean Review. Again the booth provided a central meeting point for many of the over 50 Cluster members present at the conference.

### Ocean Sciences Meeting

In February 2012 The Future Ocean organized a booth at the biannual Ocean Sciences Meeting of the American Geophysical Union (AGU), the Oceanographic Society (OS) and the American Society of Limnology and Oceanography (ASLO) in Salt Lake City, USA. In order to better promote the World Ocean Review a quiz based on the Review was developed and presented at the Ocean Sciences conference. This proved to be a great attention getter and increased interest in the publication and the Cluster.

### Outlook

Overall, recent participation in scientific conferences and exhibitions has proven very effective in promoting Kiel and Germany as a premier location for cutting edge research in marine sciences. The fact that Future Ocean now partners with its fellow clusters from Hamburg and Bremen in Northern Germany and with the German Science Foundation (DFG) in these efforts creates synergies among the partners and will lead to even more interesting and cost effective representation. Based on the success so far we plan to continue exhibiting at conferences on a regular basis in future.



Promoting the Future Ocean at career events at the European Geoscience Union's Meeting in Vienna, 2012.

# Active Stakeholder Dialogue – Disseminating New Knowledge Where it's Needed

In recent years, the Future Ocean has generated a great amount of new and exciting information in many areas of marine research. Management plans for fishing have been developed, ocean system models have been advanced and refined, suggestions on how to tackle many socioeconomic challenges have been formulated by our researchers. Who are the stakeholders interested in this newly generated knowledge and what pathways do we use to communicate this information to our stakeholders, and civil society?



Attendees of the Kiel Marketplace range from industry, ministries and NGOs to researchers from German research institutions.

One of the central goals of the Kiel Cluster of Excellence The Future Ocean is, to ensure that the results of the research conducted in the project are useful for stakeholders. This effort is not new, and has traditionally been called transfer to application, meaning that engineering developments and technical inventions should be turned into patents and exploited by the local or regional industry. For projects in marine science this is a difficult task, as the Future Ocean predominantly conducts basic research, with few technological developments. But - Future Ocean does generate a lot of information which is useful for those working on questions concerning our environment and socioeconomic factors. These include politicians in ocean affected areas, the maritime industry, and organizations tasked with developing solutions to environmental challenges, such as climate change, sea level rise and global warming. Consequently, the Cluster

suggests ways decision makers can react to climate change, for example. Thus we have begun to intensify dialogue with stakeholders from politics, industry and civil society in Schleswig-Holstein, Germany, the EU and beyond. Our activities range from projects, involvement in committees and networks to international initiatives (EU Maritime Action Plan, IPCC Report). For most activities the Future Ocean follows its traditional strategy of seeking competent working partners. While Future Ocean typically provides scientific background information and inspiration on relevant environmental topics, the partners provide access to their communities, promoting commonly organized events which bring together science and industry and/or science and environmental organizations.

### Regional and national stakeholders

For activities targeted at maritime industry groups and local politics in the state of

Schleswig-Holstein the Cluster cooperates closely together with the Chamber of Commerce and Industry. Thus the Future Ocean contributed to the workshop series Exploring Research in 2011 and 2012 with events on advanced deep sea technologies and biotechnology.

A similar target group is addressed with the event series Kiel Marketplace which supports networking between science, industry and politics and offers a forum for information exchange on current topics. The Cluster organizes the Marketplace jointly with the Maritime Cluster Schleswig-Holstein, a representation of the local maritime economy. Topics covered in 2011 included Marine Mineral Resources, Marine Pollution, and Ship Emissions.

In addition, an expert workshop on noise in the sea was organized on behalf of the Ministry for Agriculture, Environment and Rural Areas in Schleswig-Holstein. According to the EU

Marine Strategy Framework Directive (MSFD, Meeresstrategie-Rahmenrichtlinie), noise is environmental pollution. With the MSFD the EU aims to restore good conditions in maritime areas by 2020.

On a national level the Cluster was invited to present some of its main publications and reports to the CDU federal parliamentary group meeting, where Chancellor Merkel was present (see page 46 in this report). This included the World Ocean Review, a 240 page compilation of information on the current state of the oceans, produced in cooperation with the Maribus foundation and the International Ocean Institute. The Cluster also supported the workshop "Meer oder weniger" on the state of the oceans organized by the Heinrich Böll Foundation in August 2011 in a political education framework setting.

In addition the Cluster contributed to a number of counselling events organized by the state or federal government including a workshop to prepare a National Master Plan on Maritime Technologies, a parliamentary evening in Bremen, and a workshop on deep sea mining organized by the federal Ministry of Environmental Affairs.

### Targeting the General Public

A number of events are organized on a regular basis to promote Future Ocean research and findings to the general public, most of them have been highlighted earlier in this publication. One important event is the annual exhibition on the travelling museum ship *MS Wissenschaft*, where the Cluster partners with federal institutions. The *MS Wissenschaft* is sponsored by the German Ministry of Education and Research, and has been touring 36 cities in Germany and Austria to promote various scientific topics. In 2012, the Year of Science, the focus of the exhibition is on the topic of sustainability. Alongside issues such as climate change, sustainable energy supplies and water management, the Cluster's exhibits on sustainable fishery will be shown.

### Intergovernmental Organizations and NGOs

As illustrated on pages 21 and 22 numerous Future Ocean researchers are working closely with intergovernmental organiza-

tions; actively participating in United Nations counseling panels, communicating with the European Union directorates, for example. Cluster researchers also serve on numerous international stakeholder panels, and the results of recent research have been included in the updated IPCC report currently in preparation.

### Outlook

Although not all of these initiatives are organized centrally within the Cluster, this overview demonstrates that the Future Ocean is in close contact with its stakeholders on all levels. This proves to be a fruitful process for all involved: the target groups receive relevant information on research topics of interest, allowing them to formulate arguments for discussion based on real scientific expertise. The organizations we partner with, like e.g. the International Ocean Institute (IOI), the chamber of commerce, the Heinrich Boell Foundation and others can provide their members with contacts normally far beyond their reach, and can thus act as brokers between their members and the marine research. And the Future Ocean learns which topics are of interest for the various groups, in order to better understand which of the pressing socio-economic questions most need to be discussed. We will therefore continue to identify and open new paths of stakeholder communication in order to make the best use of the research conducted by Kiel Marine Sciences.



Industry fairs offer unique opportunities for young researchers to discuss their research with company representatives. Often these contacts lead to employment or further research cooperations.



Future Ocean is frequently present at major marine industry fairs, like Oceanology International in London, UK.





# Reports

We are at the very beginning of time for the human race. It is not unreasonable that we grapple with problems. But there are tens of thousands of years in the future. Our responsibility is to do what we can, learn what we can, improve the solutions, and pass them on.

*Richard P. Feynman*

# Towards New Shores in the Second Phase of The Future Ocean

The Future Ocean has been conducting excellent interdisciplinary marine research since Fall 2006. After five years of outstanding performance the renewal proposal has been submitted in September 2011. We are happy to report, that it was successful in June 2012.

## Introduction

The second phase of the German Excellence Initiative is running from Fall 2012 into Fall 2017 and the Future Ocean has been successful again with a strong proposal. Activities in the second phase will build upon the success of the first phase running from 2006-2012. The project will continue to strengthen and expand interdisciplinary research in the Kiel Marine Sciences. After the establishment of 13 new research groups at the University Kiel, the GEOMAR Helmholtz Centre for Ocean Research Kiel and the Institute for the World Economy three new overarching research activities have been identified: Ocean system understanding will research how the ocean-atmosphere-biosphere-geosphere system works. Ocean prediction and scenarios will use knowledge gained from the system understanding to create environmental scenarios based on simulations and assumptions about the future. In the research theme Sustainable ocean

management researchers will use the results of models to develop plans and devise policies to sustainably manage the oceans. These concepts must be based on a robust ethical concept of sustainability. Eleven research topics are concerned with natural resources in the sea as well

as biological diversity and gas exchange between the ocean surface and the atmosphere. Newcomers to the research team at Kiel University are scientists from political science and environmental ethics, who will work more intensively on questions of societal relevance, for example, the respon-

sible use of marine resources or the question of worldwide governance structures.

## An Important Step for Kiel Marine Sciences

The project comes with considerable further funding for top international research in the marine sciences in Kiel. "This decision is not only an acknowledgement of our expertise in marine research. It demonstrates above all, that we are following the right path with our Kiel Concept of connecting differing scientific cultures," says Professor Thomas Bosch, Vice President of the Kiel University. "Innovative research means research across the boundaries of different disciplines. We will continue to broaden this approach. There is no other institution in the world that approaches marine science in as interdisciplinary a manner as we do," says Professor Martin

Visbeck, Speaker of the Cluster of Excellence The Future Ocean. "Only with such a broad range of topics as those we cover in the Cluster of Excellence The Future Ocean can the ocean be explored in its entire depth." With the new research fields Kiel scientists want to provide

above all a scientific basis for sustainable ocean management. "In future with our research results we will better address the needs of decision makers from politics, industry and science. Only together we can develop ideas and new paths toward environmentally sound use of the oceans";



The members of the Future Ocean gather at the annual retreat.

explains Visbeck. "To this aim we will engage in dialogue more intensively than we have up to now."

## Structural Developments Ahead

Last but not least the Future Ocean is tasked with enhancing the research environment in Kiel in all levels. This includes particular efforts in internationalization, establishing contacts to international partners e.g. in Canada, the USA, China and Japan. It also includes continuing to focus on the education and careers of young scientists. This has been accomplished very successfully by the Integrated School of Ocean Sciences (ISOS) for PhD students. During the second phase these efforts will be extended to the group of postdoctoral researchers with the foundation of the Integrated Marine Postdoc (IMAP) network. This network will strive to shape the career paths of young researchers in order to define straightforward professional tracks within the German scientific system. With these initiatives we hope to make Kiel an even more attractive place to pursue a scientific career in marine sciences.

With this tailwind the Future Ocean is now optimistically heading into the second phase. We are looking forward to new scientific findings, exciting developments and successful operations at Kiel Marine Sciences.



# Future Ocean Data Management: Developments in 2011

The Kiel Data Management Team (KDMT) is a joint group from GEOMAR, the Cluster of Excellence The Future Ocean, SFB 574 and SFB 754. Its aim is to provide ONE central place for data description, data storage and data archiving for all marine sciences in Kiel, independent of project status but with specific access restrictions for each project. This system is aimed at preparing data for paper publication, data exchange within the project and data publication.

## Introduction

The Future Ocean is partner of the Kiel Data Management Infrastructure (KDMI), a cooperation of large-scale projects at GEOMAR and Kiel University aimed at building up a sustainable support platform for marine sciences in Kiel.

The KDMI offers data management solutions for metadata description, data exchange and publication. The main goal is to provide private working platforms to working groups and projects including the possibility of sharing information on research activities with external partners and to enhance cooperation and outreach. The linkage between data and print publications is an essential objective and is provided by linking the online data and publication repository OceanRep to the expedition/numerical model database, the Ocean Science Information System.

The Kiel Data Management Team (KDMT) participates in overarching data integration projects like the Marine Network for Integrated Data Access (MaNIDA) to achieve harmonization in data access in marine sciences and the PubFlow project aiming to develop new generic solutions for workflows within publication processes.

## Current State

In the web based data management portal (<http://portal.geomar.de>) about 350 active registered users were collaborating in more than thirty projects and working groups at the end of 2011. These communities provide private and public web pages, wikis, blogs and separate document exchange platforms for internal and/or public communication and include the Ocean Science Information System (OSIS) as well as publication lists provided by the OceanRep repository. OSIS brings together information from about thirty model experiments and about ten expeditions within the context of Future

Ocean. Additionally the OSIS search for geographical location, time or instrument gives access to more than 1000 expeditions carried out in Kiel marine sciences. The tracks of these expeditions can be visualized with GoogleEarth including publication and data links. More than 1000 publications for Future Ocean are listed in OceanRep, partly with full text and linkages to expeditions and numerical models. Furthermore, the first implementation of the innovative concept to record workflows from data creation to data publication is now online: a generic database for recent hydro-chemistry measurements on water bottle samples during research cruises for 2008 to 2011.

## Future Aims

Apart from expeditions and numerical models, the description and data of experiments will be included in OSIS, offering the possibility of linking experimental data to print publications and sharing data.

The expansion of the OceanRep data and publication repository will be extended to include CAU institutes and working groups, including customized layouts for Future Ocean. Links to other data repositories, e.g. PANGAEA, will be included as well.

The KDMT is prepared to pursue development and realization of the workflow concept in close cooperation with the Department of Computer Science at Kiel University.



Figure 1 Data can be discovered and selected through a new Google Earth interface.

## Date Management Team

Hela Mehtens, Pina Springer, Andreas Czerniak, Dirk Fleischer, Carsten Schirnick

## Contact

[datenmanagement@geomar.de](mailto:datenmanagement@geomar.de)

Web: <https://portal.geomar.de/web/guest/kdmi>

<https://portal.geomar.de/web/guest/about-us>

# Family and Employment

The central management is assigned the task of implementing family friendly and gender equal working conditions at Kiel University and its partner institutions. Kiel University itself is a certified family friendly employer; however, the Cluster provides additional services for its members and employees.



Offering extra day care: every day with a Future Ocean dedicated nursery school and on demand during Future Ocean meetings.

## Rationale

To enable young parents to return to their jobs as quickly as possible the Future Ocean fills the existing gap in childcare for children between one and three years of age. For this reason the Cluster provides day care facilities for Cluster members with children in this age group in collaboration with the university's family office. Cluster members and employees have prioritized access to these facilities and consequently an early return to their jobs after the birth of their children.

While the Cluster has considered scheduling meetings exclusively at family-friendly times, this could not yet be accomplished as demands vary too much. Business meetings in the afternoon are considered family unfriendly for some, because they have to be looking after the kids, while family friendly for others, because the partner has an easier time in taking over the supervision. This is a constant matter of discussion. Consequently, standard child care is offered nearby the meeting place whenever possible during major meetings, conferences, workshops and symposia.

It is difficult for medium sized universities to guarantee dual career options for accompanying partners. Nevertheless, the Cluster offers support with a dual career option for hires at the professorial level. Support in this case means, that the administration, together with its counterparts at the university and the GEOMAR Helmholtz Centre for Ocean Research, will make an effort to create suitable project positions for partners working within Future Ocean disciplines or identify suitable positions within the university wherever possible. Due the size of the university these efforts cannot always be successful, however, they raise the likelihood that potential employees will feel welcomed in Kiel.

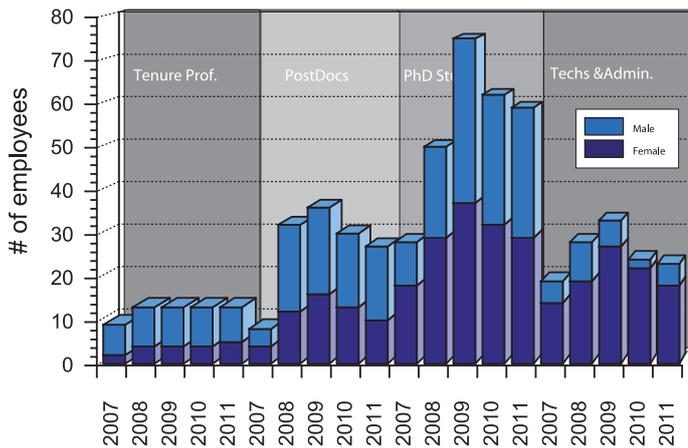
In addition, the Cluster provides standard DFG family support measures such as student and contractual support for pregnant women when they, for health reasons, cannot work in their usual working environment during pregnancy, and time off for parental leave. In general, family issues are a permanent matter of controversial discussions. We consider this important, as the opinions vary.

The discussions let everyone rethink their personal situation and allows the Cluster to offer individual solutions. As a result the Future Ocean is in general recognized as a very family friendly employer, appreciated by its employees and project partners.

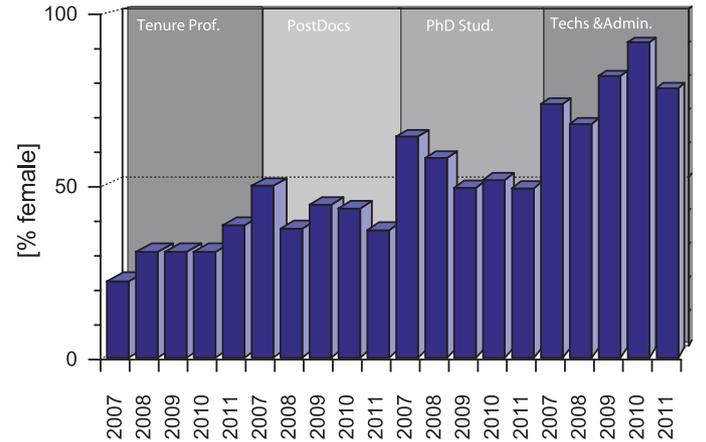
## Future Ocean promotes gender equality

During its first phase the Future Ocean made some progress in hiring female scientist and supporting them in their careers. We were successful in tenuring three female professors and improved in involving female scientists in all our committees.

We are, however, still lacking an adequate number of female scientists in leadership positions in Kiel Marine Sciences. We still have significantly more male than female scientists on all podia. We are still spending our precious time convincing our colleagues that the support of parents does not mean the support of women in science automatically – and vice versa.



**Figure 1** Distribution of male and female employees within defined employment groups.



**Figure 2** Percentage of female employees hired with the Future Ocean within defined employment groups.

### Results in 2011

In spring 2011 nine of the junior professorships created by the Cluster were tenured. Three of the positions were given to females improving the gender balance at the high level of Kiel Marine Sciences. The Cluster took part in the evaluation of a study by Prof. Anita Engels, Hamburg University, and her colleagues on measures to support gender equality in the excellence initiative. This led to very helpful recommendations for the renewal proposal in 2011. A group of female and male scientists of the Cluster has suggested measures e.g. a mentoring program, for improving gender literacy in all aspects of the network, with special focus on the postdoc level. And last but not least in fall 2011 the Cluster organized a two day seminar on Roles and Rules with gender specialist Mylena Kösten. Female scientists from both Kiel University and GEOMAR got new insights into the power mechanisms and behavioral contexts in science and training for working with more success and fun in a "male world".

### Following equality standards

In order to push for a fair and equal treatment of men and women in marine research the Cluster is committed to supporting DFG gender equality standards promoting a) continuity, b) transparency, c) competitiveness and d) future orientation, as well as e) competency in its gender measures. For this purpose the Future Ocean regularly publishes its personnel structure by male/female ratio as illustrated in figures 1 and 2. Figure 1 shows the personnel structure since 2007 for the four groups: tenure track professors, postdocs, PhD students and technical and administrative staff. While the overall number of personnel has decreased slightly from 138

(71 female) in 2010 to 122 (62 female) in 2011, the proportion of male to female workers has remained approximately the same (53% in 2010 vs. 51% in 2011) during recent years. Consequently the overall picture is about the same as in the years before, with the percentage of male/female employees broken down by groups approximately the same as in the previous two years (Fig. 1). The number of tenure track professors could be raised due to the refilling of the position for international law with a woman. The overall picture is now pointing into a positive direction with 38% tenure track professor positions occupied by women and 37% on the postdoc level, compared to a federal average of 16% for female professors. On the other hand women are overrepresented in administrative and technical positions, making up 78% of Cluster employees in this category.

### Outlook

The measures on family and employment will continue to focus on a better publicity of measures and offers for employees, as many may not be familiar with what the Cluster offers and provides in terms of family support. We do also expect, that the Cluster's increased activities in the field of career advancement on the postdoc level may have an impact on the numbers of woman continuing to stay in research. We will give details on this in future issues of this report.

# Project Statistics

To monitor the project, the Future Ocean collects project data on a regular basis. These are financial, personnel, and funding data, as well as information on publications, attendance at meetings and the exchange of scientific personnel. The data collected on the project shows the initial setup, networks and growth of the research groups. In 2011 the end of phase 1 of the cluster is clearly visible in the budget spending, while the new research groups continue to form the back bone of the project. Consequently the number of visitors grew, as did the number of publications.

## Monitoring

Each year the Future Ocean conducts an online survey among its members and employees, to compile data on publications, participation in workshops and meetings, visits to external institutions, and incoming visitors from external institutions. The survey also collects data on the use of the platforms, ISOS course offerings, family and employment measures, networking within the Cluster and with other institutions, within Germany and abroad. The surveys are conducted using an online survey tool, which allows setting up questionnaires as custom made forms. Subsequently the data is compiled and plotted by the central service office and is discussed and analyzed by the Future Ocean quality management panel. The quality management panel reports findings and recommendations to the Cluster council and to the Executive Committee to allow adjustments to the overall Future Ocean strategy and plan for a successful future. The financial data of the Cluster are compiled from the financial reports of the four project partners and evaluated in the controlling section of the Future Ocean central service office. The data is organized in a way that

allows viewing data and drawing conclusions according to the overall employee structure and gender balance, but also relative to the major funding schemes of the Future Ocean.

## Budget and Funding

The first funding phase of the Future Ocean lasted until Oct. 31, 2011. From Nov 1, 2011 until Oct 31, 2012 the Cluster entered an interim funding phase, which was necessary to allow the funding agency to synchronize the various large scale excellence projects and conduct a common review and proposal procedure. Consequently for 2011 the budget was effectively split into two parts: 10 months from Jan 1 to Oct 31, 2011 and a second phase following Nov. 1, 2011. This report will cover only the first phase, as the fiscal report for the interim phase has not yet been available for this publication.

The total budget up to Oct. 31, 2011 was about 4.2M €. In addition a deficit of ~0.6M € was carried over from 2010, while a sum of ~0.8M € was pre-assigned from the 2012 budget. This resulted in a total budget of ~4.4M €, nearly the same as in 2010, if accounted for just 10 months. See figure 1 for a summary of the

expenses in 2007-2011. Overall the amount spent for personnel was nearly the same at 3.4M € (73%). About 0.55M € were spent on investments and consumables, which is about 50% less than in 2010 (0.95M €). About 440,000 € (10%) were spent on other items like workshops, and retreats, meetings and outreach activities, travel grants for outgoing and incoming visitors, equal opportunity and other measures. In addition some activities, like Alexander von Humboldt fellowships and some activities related to internationalization were supported by Kiel University and the state of Schleswig Holstein.

The Future Ocean continued to spend funds mainly for its newly established Junior Research Groups (JRGs) and internal research projects. However, the total budget of the JRGs grew slightly less, as most groups entered a phase where third party proposals generated funds, and the proportion of Cluster funding became less important for them. Their total budget went from about 3.4M € for 12 months to about 2.7M € (for 10 months). As management phased out most Cluster projects towards summer 2011 the amount spent on other research declined by about 17% to 0.71M € (16% of the total budget). This is a straightforward and expected development, as the projects funded in 2008 and 2009 were concluded during late 2010 to the middle of 2011. Only a few projects from the final funding rounds were still active at the end of 2011. New projects were not started before winter 2011. Money spent on the central service projects, public outreach, graduate education and others grew slightly from 780,000 € in 2010, to 1M € in 2011. No major investments in research infrastructure platforms were made in 2011.

What was the money spent for? The JRGs

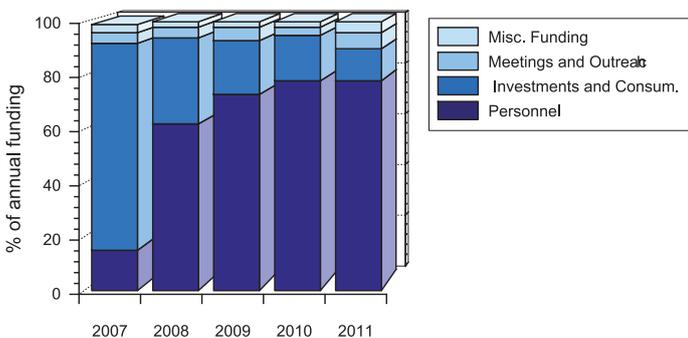


Figure 1 Percentage of funds spent by funding categories.

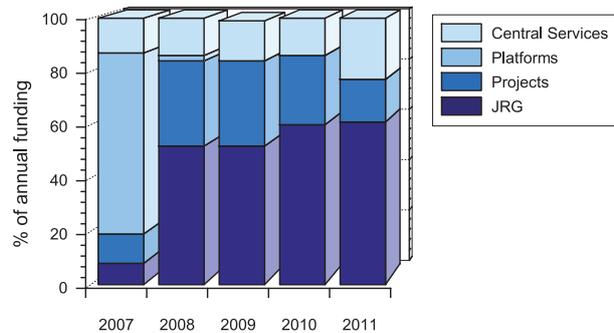


Figure 2 Percentage of funds spent by project categories.

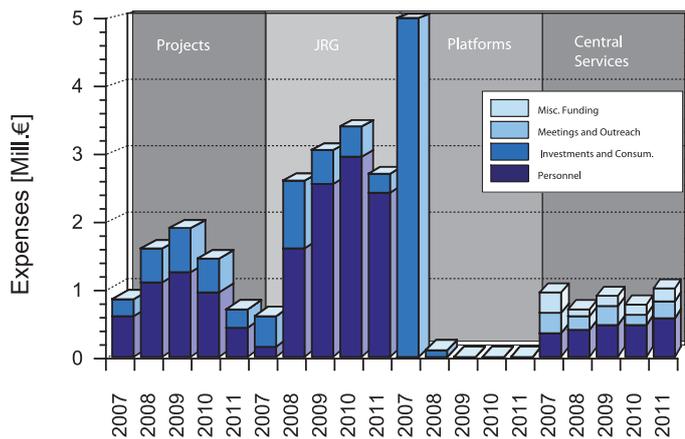


Figure 3 Funds spent during the project lifetime by categories.

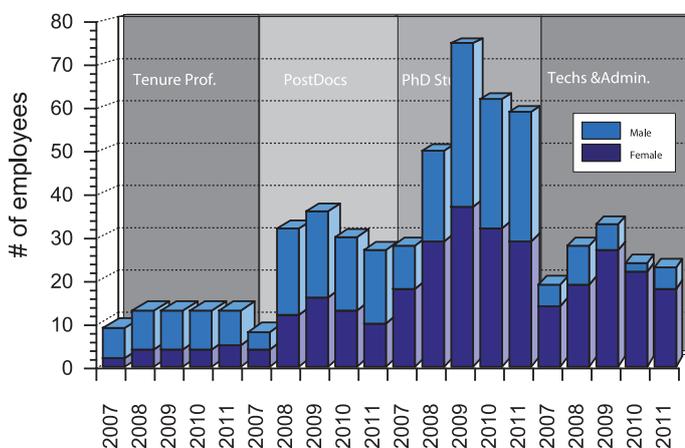


Figure 4 Personnel structure during the course of the project.

continued to fund personnel (Fig 1). Merely 12% was spent for consumables mainly to sustain the personnel. Overall the personnel costs were kept stable, and account for about 78% of the total budget in 2011. Personnel costs are a constant and allow reliable long-term planning for the project. It is, however, difficult to adjust the direction of the project as most money is bound long-term. The Future Ocean research projects, on the other hand, start and end in waves, and therefore regularly free up a certain amount of funding. Relatively few investments were made in 2010.

Other expenses included costs for administrative infrastructure, public outreach activities, graduate education and support for numerous workshops, retreats and the symposium. Significant money was spent for science mobility activities such as inviting guests to Kiel for research, but also travel support for researchers to attend conferences, like the AGU Fall Meeting 2011 in San Francisco, The EGU in Vienna, and the Ocean Science Meeting in Salt Lake City. All of these conferences were also covered with booths

number of the largest group by far, the PhD students, has declined further due to Cluster projects ending. On the other hand, the JRG groups hired more PhD students, effectively shifting several of them from projects to other third party funds in their research groups. Still the net number is negative. This diagram does not reflect the position left vacant by Alexander Proelß. Some members of his group finished their projects during 2011, while in the meantime the vacant position has been filled by Prof. Nele Matz-Lück. She has already begun to set up a new research group, which will be fully operable within early 2012, resulting in a very smooth transition in this area.

### National and International Insti-

by the Future Ocean, in order to begin to intensify internationalization effort.

### Personnel

Despite the stable amount spent on personnel, the number of Future Ocean employees decreased slightly from 138 to 122 in 2011. The overall gender balance was about equal: 62 were women, 60 men. For details on gender distribution see the respective chapter below. Employees can be grouped in four categories: junior professors on tenure track, postdoctoral researchers, PhD students and technical and administrative staff. The structure is illustrated in figure 4. It can be noted that the

### tional Networking

An important measure of external exchange for any research location is the rate of interaction of scientists with external colleagues and institutions. For the proposal in summer 2011 we had analyzed the most important partners in terms of co-publications. The results for the international partners are pictured in figure 5. As in the past the most important national partners of the Future Ocean were the Alfred Wegener Institute in Bremerhaven, the Clusters of Excellence Marum in Bremen and Clisap in Hamburg, including their respective universities, who consequently have been highlighted as collaboration partners in the submitted continuation proposal.

### International Exchange

Incoming visitors and visits to foreign institutions by Future Ocean scientists are an important benchmark for international cooperation. In 2011 Future Ocean scientists welcomed 63 registered visitors in total, significantly less than in 2010 (86). These numbers must, however, be evaluated very carefully, as there is no central registration for visitors, nor is there a uniform definition of who counts as a visitor and who doesn't. The most important countries in terms of the number of visitors were, as in 2010, China and the USA followed by the UK, Russia and France. According to the number of visiting days, colleagues from China stayed the longest with Spain, Tanzania, Argentina, and France following closely. Looking at the number of visits Future Ocean members and employees made abroad, the USA, Chile, the UK and Argentina have been visited the most. This is also reflected by the total time spent abroad. These numbers illustrate how well integrated the Future Ocean and its members are within the international

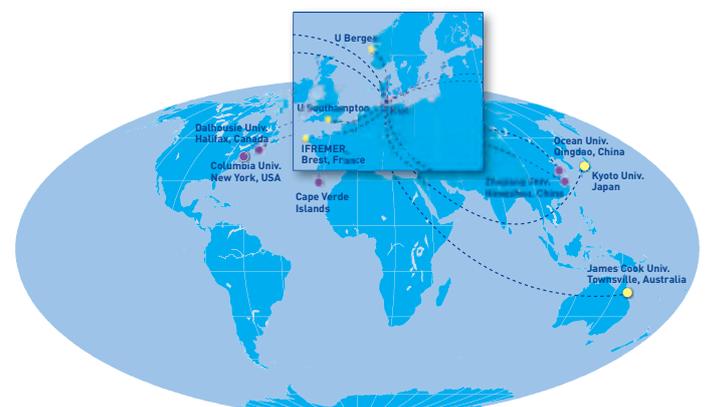


Figure 5 The most important partners in research according to the numbers of co-publications.

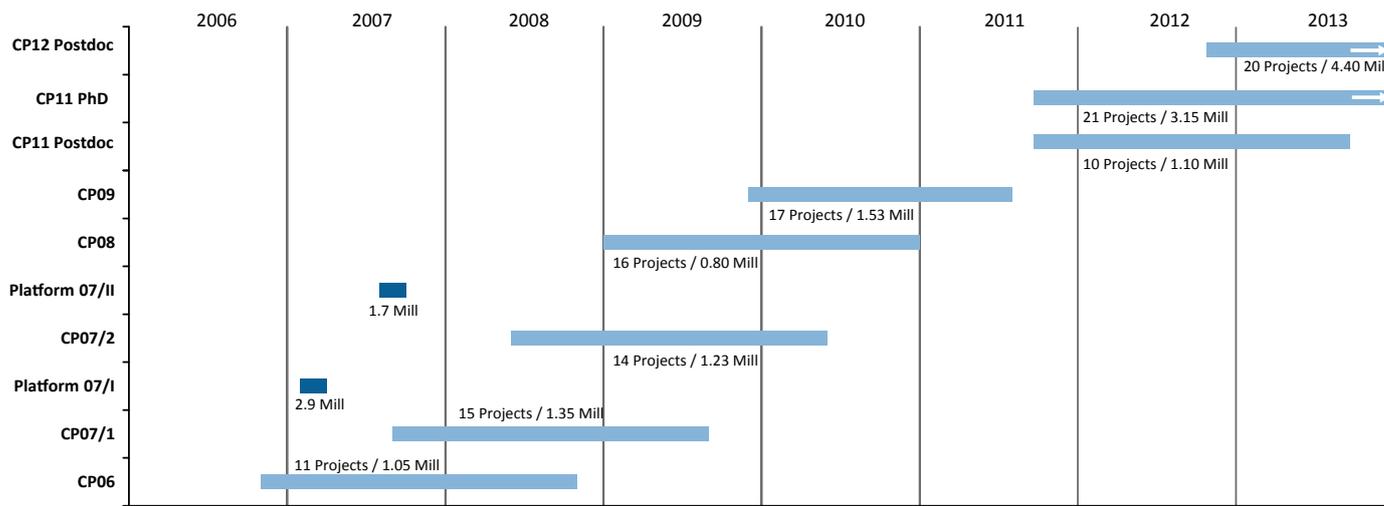


Figure 6 Timing and volume of advertised cluster project rounds.

science community. The project cultivates an extensive exchange of research, knowledge, and personnel with foreign colleagues on all levels, actively contributing to the forefront of marine science.

## Publications

The most important benchmark factor for evaluating people, projects or institutions is related to publication statistics. In 2011 we recorded 502 publications in total, the most important journals being *Geochemistry*, *Geophysics*, *Geosystems*, the combined set of *Nature Publications* (*Nature/Nature Geosciences/Nature Genetics/ Nature Methods*), *Earth and Planetary Science Letters* and *PLoS ONE* with over 10 articles each. The fourteen journals in which Cluster members most frequently published are summarized in Figure 9. Although the spectrum of these journals is still strongly biased by the earth science community, which has the strongest representation in the Future Ocean, the representation of life sciences in the project is growing. It must be noted, taking the complete publication list into account, that these span the whole spectrum of research conducted in the project, from oceanography to law, from geoscience to economics, from medicine to mathematics, hence these numbers can at best give a vague idea of where Future Ocean is publishing – in reality the spectrum is as broad as the expertise of its members.

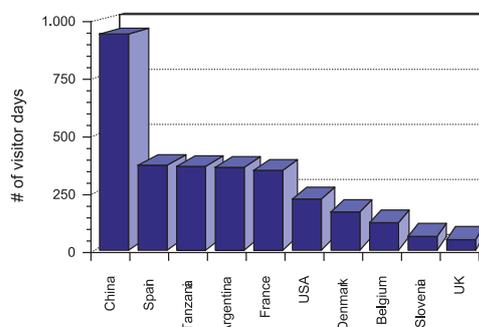


Figure 7 Number of days visitors stayed with members of the Future Ocean by country.

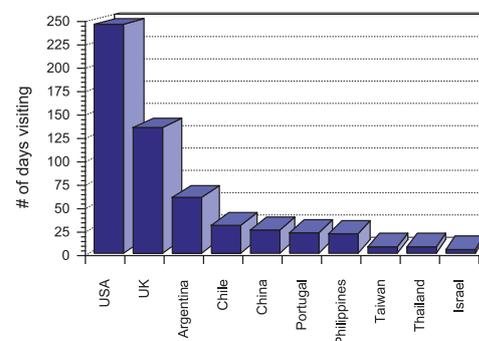


Figure 8 Visitor days by members of the Future Ocean to outside universities and institutions.

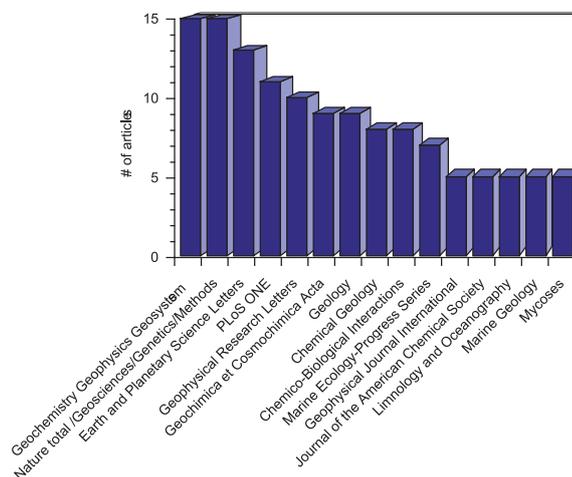


Figure 9 The most important publication venues in 2011.

# 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 22,000 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 nearly 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.

## GEOMAR Helmholtz Centre for Ocean Research Kiel

GEOMAR Helmholtz Centre for Ocean Research Kiel is the successor of 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.

## 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.

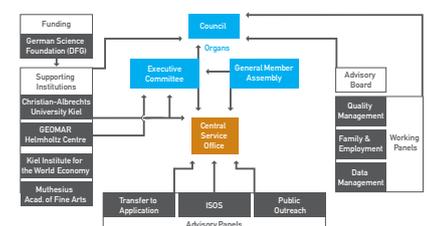
## Muthesius Academy of Fine Arts and Design

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.

## 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 consists of 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 IfW, as well as the Speaker and Vice-Speaker of the Executive Committee. An external Advisory Board acts as an independent quality-control and advice body to evaluate the progress of the project. It consists of ten leading scientists, both national and international, 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 the public outreach and technology transfer activities and the Integrated School of Ocean Sciences (ISOS).



# Panel Membership

## Executive Committee

Name	Institution*
Behrmann, Jan	GEOMAR
Bleich, Markus	CAU
Bosch, Thomas	CAU
Braack, Malte	CAU
Ernst, Rainer W.	MKHS
Fouquet, Gerhard	CAU
Friedl, Birgit	CAU
Herzig, Peter	GEOMAR
Latif, Mojib	GEOMAR
Quaas, Martin	CAU
Reusch, Thorsten	GEOMAR
Schmitz-Streit, Ruth	CAU
Schneider, Ralph R.	CAU
Schulz, Rüdiger	CAU
Snowder, Dennis J.	IFW
Srivastav, Anand	CAU
Temps, Friedrich	CAU
Visbeck, Martin	GEOMAR
Wallmann, Klaus	GEOMAR
Werner, Iris	CAU

## Advisory Board

Name	Institution
Betz, Gregor	Universität Karlsruhe
Brügge, Bernd	Bundesamt für Seeschifffahrt und Hydrographie (BSH)
Bücker, Christian	RWE Dea AG, GeoSupport Center
Gelpke, Nikolaus	mare dreiviertel verlag
German, Chris	Woods Hole Oceanographic Institution Chief Scientist for Deep Submergence
Gruber, Nicolas	Swiss Federal Institute of Technology Zurich
Johannesson, Kerstin	Universität Göteborg
Joye, Samantha Mandy	Universität Georgia
Keeling, Ralph	Scripps Institution of Oceanography, UCSD
King, Matthew	European Commission, Directorate General for Maritime Affairs and Fisheries
McKenzie, Judith	Swiss Federal Institute of Technology Zurich
Miller, David	James Cook Universität
Saito, Yoshiki	Institute of Geology and Geoinformation (IGG), Geological Survey of Japan (GSJ), AIST
Sterner, Thomas	Universität Göteborg
Zahn, Rainer	Universitat Autònoma de Barcelona (UAB)

## Cluster Council

Name	Institution*	Name	Institution*	Name	Institution*
Behrmann, Jan	GEOMAR	Körtzinger, Arne	GEOMAR	Schulz, Manfred	MKHS
Berndt, Christian	GEOMAR	Krastel, Sebastian	GEOMAR	Schulz, Rüdiger	CAU
Bleich, Markus	CAU	Latif, Mojib	GEOMAR	Schrottke, Kerstin	CAU
Böning, Claus	GEOMAR	Melzner, Frank	GEOMAR	Slawig, Thomas	CAU
Bosch, Thomas	CAU	Odendahl, Kerstin	CAU	Snowder, Dennis J.	IFW
Braack, Malte	CAU	Oschlies, Andreas	GEOMAR	Sommer, Ulrich	GEOMAR
Devey, Collin	GEOMAR	Peterson, Sonja	IFW	Srivastav, Anand	CAU
Dullo, Christian	GEOMAR	Quaas, Martin	CAU	Stattegger, Karl	CAU
Duscher, Tom	MKHS	Rehdanz, Katrin	IFW	Temps, Friedrich	CAU
Ernst, Rainer W.	MKHS	Requate, Till	CAU	Treude, Tina	GEOMAR
Fouquet, Gerhard	CAU	Reusch, Thorsten	GEOMAR	Vafeidis, Athanasios	CAU
Frank, Martin	GEOMAR	Riebesell, Ulf	GEOMAR	Visbeck, Martin	GEOMAR
Friedrichs, Gernot	CAU	Rosenstiel, Philip	CAU	Wallmann, Klaus	GEOMAR
Gorb, Stanislav	CAU	Rüpke, Lars	CAU		
Hasselbring, Willi	CAU	Sachs, Stefan	MKHS		
Herzig, Peter M.	GEOMAR	Schmitz-Streit, Ruth	CAU		
Hoernle, Kaj	GEOMAR	Schneider, Birgit	CAU		
Klepper, Gernot	IFW	Schneider, Ralph R.	CAU		

\*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	Titel	Duration
CP0602	Bleich, Markus	CO <sub>2</sub> -induced Ocean Acidification: Biological Responses and Adaptations	24 months
CP0603	Eisenhauer et al.	Boron Isotopes as a Proxy for pH decrease an pCO <sub>2</sub> increase	0 (Investment)
CP0605	Froese et al.	Managing Cod and Sprat in the Central Baltic Sea - A bio-economic multi-species approach with Stochastic regeneration functions	24 months
CP0608	Luttenberger et al.	dearX - XML Technology for marine Data Exchange, Archiving and Retrieval	12 months
CP0609	Macke et al.	The role of light fluctuations on ocean heating and photosynthesis	24 months
CP0610	Piepenburg et al.	Synergetic effects of temperature, pH and salinity on the metabolism of benthic organism	12 months
CP0611	Schmitz-Streit et al.	Complex Barriers and Microbiota in the Ocean: implications for human barrier disorders	24 months
CP0612	R. Schneider et al.	Radiocarbon dating of fossil biogenic as an indicator of age differences in surface and subsurface water masses in the past ocean	12 months
CP0614	Srivastav et al.	Mathematical and Algorithmic in Modeling Marine Biogeochemical Cycles	24 months
CP0618	Zimmermann et al.	Beyond Mineral Resources - The International Legal Regime and Regulation of New Uses of the Deep Sea Bed	24 months
CP0619	Latif et al.	Development of a Coupled Climate/Ocean Biogeochemistry Model	24 months
CP0063	Körtzinger	Data Mining	6 months
CP0702	Bosch et al.	Transgenic Aurelia allow functional analysis of genes involved in control of tissue homeostasis and biological barriers	24 months
CP0704	Schulz-Friedrich et al.	Carbon acquisition in coccolithophores: molecular basis and adaptive potential	12 months
CP0706	Wahl & Schmitz-Streit	Complex barriers: The biotic control of marine biofilms on algal surfaces	24 months
CP0709	Maser et al.	Marine Steroid Pharmaceuticals to Control Human Diseases	24 months
CP0710	Eisenhauer et al.	VARAN -Variations of Trace Element Fluxes induced by Ocean Acidification at Ca <sup>2+</sup> - Channels/ Ca <sup>2+</sup> - ATPases	24 months
CP0713	Oschlies et al.	A new computational framework to efficiently integrate biogeochemical models from seasonal to multi-millennial time scales	24 months
CP0717	Thomsen et al.	Complex barriers and microbiota in the Ocean	24 months
CP0718	Klepper et al.	Economic valuation of the ocean's role in the carbon cycle and consequences for abatement and mitigation strategies	24 months
CP0721	Braack et al.	Parameterization of near surface vertical mixing processes by multiscale methods	24 months
CP0722	Sommer et al.	Building up the capacity for δ <sup>34</sup> S measurements from organic samples by continuous flow isotope mass spectrometry	24 months
CP0724	Braack & Schneider	3-D Simulation of Thermohaline Convection in the Ocean's Crust with Adaptive Finite Elements	24 months
CP0725	Schönfeld et al.	Changing habitats of calcareous plankton in the Greenhouse World	24 months
CP0726	Wallace et al.	Improved Methods for Nitrogen Isotope Studies with Specific Application at the Tropical Eastern North Atlantic Time-Series Observatory, Cape Verde	24 months
CP0727	Rosenstiel et al.	Deciphering transcriptomal responses to environmental stimuli in simple aquatic model organisms by massive parallel sequencing technology	24 months
CP0730	Oschlies et al.	Modeling chemosensor-aided foraging in zooplankton	24 months
CP0732	Koch et al.	3-D Modeling of Seafloor Structures	8 months
CP0734	Oschlies et al.	Carbon and Nitrogen Cycle Dynamics	18 months
CP0737	Luttenberger et al.	An XML-based workbench for marine and biological data (XDataCollection)	6 months
CP0739	Oschlies et al.	Neural-network based coupling of benthic and pelagic components of biogeochemical ocean circulation models	12 months
CP0743	LaRoche et al.	Bioprospecting of Deep-Sea genetic resources	24 months
CP0745	Dullo et al.	Biogeochemical Studies on the effects of ocean acidification	6 months

ID	Author	Titel	Duration
CP0746	Weinberger et al.	A transcript profiling tool to investigate synergistic effects of non-biotic and biotic changes	15 months
CP0747	Karstensen et al.	Glider swarm Project	18 months
CP0751	Requate et al.	Alternative Scenarios for European Fisheries Management	12 months
CP0752	Wahl et al.	The neglected bottleneck: Early life stage ecology in times of global change	24 months
CP0753	Weinrebe	Iceflow activity revealed from submarine morphology - mapping glacial-morphological manifestations of a retreating ice-front	12 months
CP0754	Piepenburg et al.	Ecophysiological consequences of ocean warming and acidification	12 months
CP0758	Friedrichs et al.	The Potential of Field Measurement of Surface Water pCo <sub>2</sub>	24 months
CP0765	Melzner et al.	Gene expression patterns in sea urchin embryos: Establishing a model system for biological and marine medical research in the context of global change	12 months
CP0801	Schönfeld & Spindler	Foraminiferal shell loss in the Flensburg Fjord (SW Baltic Sea). Living benthic communities under the risk due to acidification?	10 months
CP0802	Zimmer	Bacterial symbionts of an invasive species in a warming sea: <i>Mnemiopsis leidyi</i>	12 months
CP0805	Bosch et al.	Developing a novel framework for understanding evolutionary adaption to changing environments: comparative transcriptomics of disparate members of marine Cnidaria	6 months
CP0809	Reusch & Waller	Pipefish-parasite interactions under global warming	12 months
CP0810	Bialas et al.	OBS-Thermo: co-registration of geophysical data at hydrothermal vents - a first step to a new ocean bottom observatory	14 months
CP0811	Meier & Kinkel	Planktonic calcifiers in the Baltic Sea: adaption to carbonate undersaturation in calcifying dinoflagellates?	15 months
CP0812	Quaas et al.	Tradable Fishing Grounds	8 months
CP0813	Oschlies et al.	Can different feeding strategies help to resolve the paradox of the plankton?	6 months
CP0815	Mayerle	The effects of sea level rise and climate change on long-term morphodynamics in the German Wadden Sea	24 months
CP0816	Melzner & Körtzinger	Seasonal carbonate system variability in Kiel Bay and correlated physiological performance of local blue mussels	12 months
CP0818	Weinberger & Treude	Consequences of seafloor warming and salinity decrease for macroalga-microbe interactions	12 months
CP0819	Lehmann & Bumke	Detailed assessment of climate variability of the Baltic Sea area for the period 1970-2008	24 months
CP0820	Vafeidis et al.	Shipping induced sediment resuspension in the port of Venice: a case study of the effects of forced Shallow water waves	12 months
CP0822	Wallmann et al.	Assessing the risk of leakage from submarine CCS	15 months
CP0823	Rosenstiel & Schreiber	Establishment of marine invertebrate cell cultures as a tool for immune system and environmental stress research	25 months
CP0824	Wallace et al.	Air-sea flux measurements of trace gases with atmospheric pressure chemical ionization time of flight mass spectrometry (APCI-TOF-MS)	12 months
CP0901	Martin Wahl et al.	Missing Baselines and Ecological Noise	18 months
CP0906	Anna Bockelmann et al.	Effects of global change on Labyrinthula-infection in eelgrass <i>Zostera marina</i>	18 months
CP0910	Hermann Bange et al.	A novel system for continuous high-resolution measurements of atmospheric and dissolved N <sub>2</sub> O	20 months
CP0911	Tina Treude et al.	The occurrence and relevance of nitrogen fixation in sediments of oxygen minimum zones	18 months
CP0912	Sebastian Krastel et al.	Submarine landslides and associated tsunami risk: Combining observations and an integrated modeling approach	18 months
CP0915	Peter Linke et al.	Novel, non-invasive investigation of seafloor warming on oxygen and heat fluxes from the benthic boundary layer into the water column	18 months
CP0918	Friedrich Temps et al.	Photolysis of Carbonyl Compounds in Seawater: Primary Products, Quantum Yields, and Loss Rates in Natural Sunlight	15 months
CP0923	Rainer Kiko et al.	The role of zooplankton in tropical oxygen minimum layers: physiological adaptation and contribution to fluxes of carbon and oxygen	12 months
CP0924	Priska Schäfer	The bryozoan <i>Flustra foliacea</i> - impact of ocean acidification on benthic organisms	18 months
CP0927	Andreas Oschlies et al.	Does the rise of slime foster an oceanic jelly carbon pump?	18 months

ID	Author	Titel	Duration
CP0931	Rainer Froese et al.	Winners and Losers in the Future Ocean	12 months
CP0932	Anton Eisenhauer et al.	Magnesium Isotope Fractionation in Planktic Foraminifera as a Proxy for Sea Surface pH Variations	12 months
CP0933	Till Requate et al.	Experimenting with marine protected areas in an ecological-economic fishery model	12 months
CP0937	Nils Andersen et al.	Stable isotope fingerprinting of marine organisms	18 months
CP0938	Torsten Kanzow et al.	A glider fleet to observe sub-mesoscale physical-biogeochemical coupling in the tropical ocean	20 months
CP0943	Kerstin Schrottke et al.	Response of tidal basins to sea-level rise and climate change	18 months
CP0946	Magdalena Gutowska et al.	Mechanisms of intracellular CaCO <sub>3</sub> crystalization in hemocytes of <i>Mytilus edulis</i> : sensitivity of bivalve calcification to ocean acidification.	18 months
CP1101	Dierking, Jan	Local and global patterns in fisheries-induced evolution	24 months
CP1103	Gutowska, Magdalena	Evolution of calcification in extant coccolithophores	24 months
CP1104	Iyer, Karthik	Quantifying the release of greenhouse gases during sill intrusion in sedimentary basins using numerical flow models	24 months
CP1105	Krebs-Kanzow, Uta	Detecting the fingerprint of the Atlantic meridional overturning circulation on decadal to millennial time scales	24 months
CP1106	Christian Lass	Titel	.. months
CP1108	Rickels, Wilfried	Carbon Sinks - Carbon Leakage	24 months
CP1109	Traini, Camille	Deltaic coasts endangered by riverine sediment trapping Example of the São-Francisco delta (Brazil)	24 months
CP1110	Voss, Rüdiger	Pathways towards ocean sustainability: Management concepts for Baltic fisheries	24 months
CP1120	Froese, Rainer	The Future Ocean Atlas	8 months
CP1130	Vielstädte, Lisa	Impact of sub-seabed CO <sub>2</sub> storage on marine ecosystems: reactive transport of CO <sub>2</sub> through surface sediments	36 months
CP1131	Andersen, Christine	Controls on hydrothermal vent site locations along Mid Ocean Ridges - potential improvements for Submarine Massive Sulphide exploration strategies	36 months
CP1132	Gross, Felix	Seismogenic faults, landslides, and associated tsunamis off Southern Italy contributing to the research topic 'From ocean hazards to coastal preparedness'	36 months
CP1133	Schweers, Johanna	Biogeochemical studies on greenhouse gases in organic-rich sediments	36 months
CP1134	Dumke, Ines	Investigation of large-scale methane releases induced by increasing temperatures from global warming and break-up magmatism	36 months
CP1136	Müller, Irene	Ocean Innovation	36 months
CP1137	van Doorn, Rijk	Governing future oceans	36 months
CP1138	Mackert, Till	Improved sea-floor representations in ocean models	36 months
CP1139	Hoffmann, Julia	The Political Economy of the European Common Fishery Policy	36 months
CP1140	Becker, Meike	Field Measurements of Surface Water pCO <sub>2</sub> and δ <sup>13</sup> C(CO <sub>2</sub> ) in the North Atlantic using Cavity Ringdown Spectroscopy and a 'Voluntary Observing Ship'	36 months
CP1141	Paul, Allannah J.	New nitrogen production in diazotrophic cyanobacteria and the effect on community carbon sequestration	36 months
CP1142	Poggemann, David	Role of intermediate water variability in the Caribbean and Gulf of Mexico in deglacial climate change	36 months
CP1143	Pondorfer, Andreas	Valuing marine ecosystem services: A television viewing choice model	36 months
CP1145	Vassele, Valentina	Shoreline changes at Macaneta Peninsula, Mozambique and mitigation alternatives	36 months
CP1146	Dreshchinskii, Alexander	The sea surface microlayer	36 months
CP1148	Reimer, Joscha	Optimal experimental design in marine research	36 months
CP1149	Oesterwalbesloh, Jan	Investigation of bacterial and fungal communication and secondary metabolites of micro organisms in the sediment of the greenland sea	36 months
CP1150	Miersch, Lothar	Transcriptome comparison of different <i>Emiliania huxleyi</i> morphotypes: identification of calcification related genes and determination if they are under selective pressure in a changing ocean.	36 months

# Science Support of the Cluster of Excellence The Future Ocean

## Speakers of the Cluster of Excellence

**Prof. Martin Visbeck**  
Speaker  
Phone +49 431 . 600 4100  
E-mail mvisbeck@geomar.de

**Prof. Ralph Schneider**  
Speaker  
Phone +49 431 . 880 1457  
E-mail schneider@gpi.uni-kiel.de

**Dr. Kirsten Schäfer**  
Assistant to the Speaker  
Phone +49 431 . 600 1952  
E-mail kischaefer@geomar.de

## Project Management

**Dr. Emanuel Söding**  
Cluster Management  
Phone +49 431 . 880 1604  
E-mail esoeding@uv.uni-kiel.de

**Wiebke Martens**  
Project Assistance  
Phone +49 431 . 880 3030  
E-mail wmartens@uv.uni-kiel.de

**Sabine Hilge**  
Accounting Specialist  
Phone +49 431 . 880 2978  
E-mail shilge@uv.uni-kiel.de

## Public Outreach

**Friederike Balzereit**  
Public Outreach Management  
Phone +49 431 . 880 3032  
E-mail fbalzereit@uv.uni-kiel.de

**Dr. Katrin Knickmeier**  
School Programs Coordinator  
Phone +49 431 . 880 3031  
E-mail kknickmeier@uv.uni-kiel.de

**Mette Lüning**  
Electronic Media Specialist  
Phone +49 431 . 880 5476  
E-mail mluning@uv.uni-kiel.de

**Annika Wallaschek / Susanne Zeunert**  
Exhibitions Coordinator  
Phone +49 431 . 880 4726  
E-mail awallaschek@uv.uni-kiel.de

## Knowledge & Technology Transfer

**Annette Preikschat**  
Transfer to Application Coordinator  
Phone +49 431 . 880 4308  
E-mail apreikschat@uv.uni-kiel.de

## Integrated Marine Postdoc Network (IMAP)

**Dr. Gesche Braker**  
Postdoc Network Management  
Phone +49 431 . 880 6550  
E-mail gbraker@uv.uni-kiel.de

## Integrated School of Ocean Sciences (ISOS)

**PD Dr. Avan Antia**  
ISOS Management  
Phone +49 431 . 880 2685  
E-mail aantia@uv.uni-kiel.de

**Angelika Hoffmann**  
ISOS Project Assistance  
Phone +49 431 . 880 1559  
E-mail ahoffmann@uv.uni-kiel.de

**Kerstin Hoffmann / Dr. Nina Bergmann**  
ISOS Project Management  
Phone +49 431 . 880 4837  
E-mail nbergmann@uv.uni-kiel.de

**Sonja Arend**  
ISOS Multimedia Production  
Phone +49 431 . 880 2653  
E-mail sarend@uv.uni-kiel.de

## Internationalization

**Dr. Nancy Smith**  
Internationalization Coordinator  
Phone +49 431 . 880 4933  
E-mail nsmith@uv.uni-kiel.de

## Picture Credits

All figures and photographs courtesy of the Cluster of Excellence "The Future Ocean" or its partners Christian-Albrechts-Universität zu Kiel, GEOMAR Helmholtz Centre for Ocean Research Kiel, Institut für Weltwirtschaft, Muthesius Kunsthochschule zu Kiel, except the following:

Special thanks to our partner's photographers: Uli Kunz (Kunzgalerie), Maike Nikolai, Jan Steffen and Andreas Villwock (GEOMAR Helmholtz Centre for Ocean Research Kiel), Jürgen Schauer & Karen Hissmann (Jago Team GEOMAR).

Pictures from external photographers:

Rio+20: CDU/CSU-Bundestagsfraktion, Steven Rösler; EcoOcean fishing simulation in Strasbourg October 2011: Eva Winqvist; Aquarium: Madeleine Gulyas, Susanne Paasch; Chancellor Merkel and Ralph Schneider: F. Dott; Leibniz Award Ulf Riebesell: DFG, David Ausserhofer; Sino-German Cooperation: Ocean University of China, Qingdao; Dräger Foundation/EcoOcean: Dräger Stiftung, Lübeck; 360° Dome Cinema Production: Jan Köster; Kids University, School Lab, ISOS: Anna Thielisch/Hamburg; Interview Nele Matz-Lück: Deutsches Maritimes Institut (DMI) e.V.; Exhibition Zoological Museum: Siv Dittrich/Kiel; Oceanology International: Trevor Smeaton/London; Sao Francisco River Photos: José Maria Landim Dominguez, Brazil. Many thanks to all of you!

## Imprint

### Editing & Production

Emanuel Söding, Friederike Balzereit,  
Nancy Smith

### Layout

Sonja Dierk, Sarah Schindler

### Printing

Universitätsdruckerei  
Christian - Albrechts - Universität zu Kiel  
Wilhelm-Seelig-Platz 3-5  
24118 Kiel

### Future Ocean Office

Cluster of Excellence The Future Ocean  
Christian - Albrechts - Universität zu Kiel  
Christian - Albrechts - Platz 4  
24118 Kiel, Germany  
Tel. +49 (0) 431 . 880 16 04  
Fax. +49 (0) 431 . 880 25 39  
info@futureocean.org  
www.futureocean.org

Published December 2012

---

The Cluster of Excellence 80 The Future Ocean is funded within the framework of the Excellence Initiative by the German Research Foundation (DFG) on behalf of the German federal and state governments. Founding institutions of the Cluster of Excellence are the Christian-Albrechts-Universität zu Kiel (CAU), the GEOMAR Helmholtz Center for Ocean Research Kiel, the Institute for the World Economy at the Universität Kiel (IfW) and the Muthesius Academy of Fine Arts and Design.



future ocean  
KIEL MARINE SCIENCES

Cluster of Excellence The Future Ocean  
Christian-Albrechts-Universität zu Kiel  
Christian-Albrechts-Platz 4  
24118 Kiel, Germany  
[info@futureocean.org](mailto:info@futureocean.org)  
[www.futureocean.org](http://www.futureocean.org)



muthesius  
kunsthochschule

