Doctoral Research Topics in Marine Sciences

Kiel University and GEOMAR Helmholtz Centre for Ocean Research Kiel

KIEL, GERMANY

2017/2018
Kiel: An Excellent Place for Doctoral Research

In this brochure, you find several doctoral research topics that we hope will attract and inspire you to do a doctorate in marine sciences in Kiel. This list is by no means exhaustive, but gives you a flavor of the diversity of research groups and topics you could work on.

(Please note that these topics do not include funding of a doctoral position.)

Found a topic you would like to work on? How to proceed?

- Your first step is to formulate a short draft of your research ideas. Send this, together with your CV and a motivation letter to the supervisor by eMail. Discuss with this person whether they would agree to take you on as a doctoral candidate.
- Financing is the second step, once you have a supervisor. Are you aware of scholarships or funding programmes that may be available? Discuss funding with your supervisor or contact the graduate school ISOS.

Did you not find the topic you are looking for in this brochure?

- A wide array of potential supervisors is available from areas as diverse as marine biotechnology, law of the sea, fisheries economics, and environmental ethics. A list of scientists, their research topics and expertise is available online in the category "Members" (www.futureocean.org).
- Contact the scientist who fits your interests by sending them a draft of your research ideas, your CV and statement of motivation.
- Once you have a supervisor, finding funding is the next step. Are you aware of scholarships or funding programmes that may be available?
Kiel: An Excellent Place for Doctoral Research

We seek

• Ambitious young scientists, to join our research projects
• Young scientists with a background in a natural science discipline or in any ocean-related field in economy, medicine, mathematics, geography, law, ethics, social sciences or informatics
• Join us if you strive to understand how the ocean sustain our future.

We offer

• A vibrant, dynamic and multidisciplinary research environment
• A network of outstanding, distinguished marine scientists
• World-class research facilities and research infrastructure for ocean exploration
• A comprehensive doctoral programme in Ocean Sciences (see below)

INTEGRATED SCHOOL OF OCEAN SCIENCES (ISOS)

Our graduate school “Integrated School of Ocean Sciences” (ISOS) offers high-level scientific and career-oriented training as well as additional financing for travel and scientific development.

International doctoral candidates will have access to a broad support structure, to a doctoral network and to courses ranging from German language courses to tools applicable for your research.

www.futureocean.org/isos
About us

The Kiel Cluster of Excellence „Future Ocean“ takes a unique interdisciplinary approach to ocean research:

- Over 250 scientists involved
  - Natural and medical scientists, economists, legal and social scientists, philosophers and others
- Four leading centres of multidisciplinary expertise:
  - GEOMAR Helmholtz Centre for Ocean Research Kiel
  - Kiel University
  - Kiel Institute for the World Economy
  - Muthesius University of Fine Arts and Design
- Wide range of projects: from atmosphere to the sea floor, from microplastics to fisheries, from storm surges to social implications of sea level rise

Picture taken by Maike Nicolai, GEOMAR Helmholtz Centre for Ocean Research Kiel (CC BY 4.0)
Doctoral Topics in Marine Sciences

Chemical Oceanography
- Biogeochemistry of atmospheric aerosols and suspended/sinking particulate Fe, Ag, Al, Cd, Cu, Mn, Mo, Ni, Pb, U, Zn in the Indian Ocean. Contribution to the International GEOTRACES Programme
- Quantifying particulate organic carbon and trace metal fluxes, and biological carbon pump efficiency in the oligotrophic Indian Ocean
- Global oceanic emissions of carbon monoxide (CO)
- Nitric oxide (NO) in the ocean
- Deciphering the sources of nitrous oxide by site-specific isotopic signature using off-axis integrated cavity output spectroscopy
- The air- sea exchange of anthropogenic and natural trace gases at the coastal ocean interface

DeepSea Monitoring
- Hydroacoustic water column mapping and monitoring
- Advanced seafloor mapping/classification and spatial extrapolation of material and energy fluxes
- Automated Observations using ‘intelligent’ landers or robotic platforms (AUVs, crawlers, gliders)

Evolutionary Genomics
- Plasmid genome evolution: tracing the birth of a new chromosome
- Evolutionary genomics of foraminifera residing in oxygen minimum zones

Experimental Ecology
- The role of biomolecules and vitamins in marine food web

Marine Aquaculture
- Environmental Impact Assessment of Recirculating Aquaculture System (RAS)

Marine Biogeochemical Modelling
- Anthropogenic perturbations of marine biogeochemical cycles
- Transport of biogeochemical tracers by coherent ocean eddie

Marine Evolutionary Ecology
- Genomics and the origin of marine species

Marine Geosystems
- Nutrient cycling in marine sediments
Doctoral Topics in Marine Sciences

Marine Meteorology
- Relative Roles of the North Atlantic Oscillation and the East Atlantic Pattern in Driving the Atlantic Meridional Overturning Circulation......................... 40
- Improving Climate Models: The Equatorial Pacific Cold Sea Surface Temperature Bias................................................................. 42

Marine Microbiology
- Mining for novel biomolecules and deciphering host-microbe interactions.... 44

Marine Molecular Biology
- Development of CRISPR/Cas mediated gene editing in the marine flatworms *Macrostomum lignano*.......................................................... 46
- Lengthening life with marine products.................................................. 48

Marine Physiology
- Sea urchins as a model organism for pH regulation and calcification......... 50

Marine Molecular Biology
- Simulation, parameter identification and optimization in marine research... 52

Paleoceanography
- Late Pleistocene Drake Passage surface to subsurface oceanography and SE Pacific mode water impact on the S Atlantic......................... 54
Research Topic

A number of trace metals – micronutrients (e.g. Fe, Co) – are critical to life and play a key role in ocean productivity but have sources and biogeochemical cycles in the oceans that are not well constrained. Particles play a key role in the cycles of many elements. Atmospheric deposition of particles forms an important source of trace metals to the surface ocean. In the oceanic water column, particles are a key reservoir for trace metals and play a part in removal of dissolved elements through scavenging. The proposed doctoral research will be conducted in the Southern Indian Ocean, one of the least studied ocean region in the world. The doctoral project will determine the atmospheric deposition of trace elements to the surface ocean. In addition, the project will develop a comprehensive understanding of the distribution, sources, sinks and internal cycling of particulate micronutrient elements in the water column. The S Indian Ocean has varying levels of productivity, with typically low levels of atmospheric deposition. There is a severe lack of data on atmospheric inputs and water column particulate trace elements for this ocean. Nutrient cycles in the Indian Ocean have a global significance because deep waters from the Indian Ocean are transferred southward and subsequently upwell to supply micronutrients to the Fe limited Southern Ocean. This work also has global significance by providing increased understanding of the role of diverse processes in controlling the chemical environment in which ecosystems operate worldwide. The proposed doctoral work will form part of a German contribution to the International GEOTRACES programme and will be conducted on a dedicated GEOTRACES research cruise (S Indian Ocean, FS Sonne cruise, 2019). The main scientific aim of this project is to quantify the sources (aerosols, rivers, resuspension of shelf sediments) and to determine the biogeochemical cycling of particulate trace elements in the S Indian Ocean. 

Biogeochemistry of atmospheric aerosols and suspended/sinking particulate Fe, Ag, Al, Cd, Co, Cu, Mn, Mo, Ni, Pb, U, Zn in the Indian Ocean. Contribution to the International GEOTRACES Programme

Prof. Dr. Eric Achterberg

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Helmholtz Centre for Ocean Research Kiel
Wischhofstr. 1-3
24148 Kiel, Germany

e-mail: eachterberg@geomar.de
Requirements/Qualifications

- Excellent degree in chemistry, physical chemistry or oceanography
- Good background in analytical methods of chemical analysis
- Preferably experience of working in a clean room environment
- Interest in undertaking interdisciplinary research
- Willingness to participate in seagoing expeditions

Important Notice: This topic does not include a scholarship for doctoral candidates. Interested students should bring a scholarship or contact us to find possibilities for funding.

Research group

The doctoral candidate will work within the Marine Biogeochemistry Research Group led by Prof. Dr. Eric P. Achterberg. Our group currently consists of approximately 30 post-doctoral and doctoral researchers investigating the oceanic carbonate system and ocean acidification, and the marine biogeochemistry of trace metals (including speciation), carbon, nutrients, and their interactions with organisms. We develop novel analytical techniques, and apply them to biogeochemical studies. The research is multi-disciplinary and undertaken in collaboration with national and international partners. The facilities available at GEOMAR for the proposed research include clean rooms, voltammeters, HR-ICP-MS (Thermo Fisher Element II XR) with SEAFast for trace element preconcentration, Quadropole ICP-MS (X-series II), microwave, LC-MS (Thermo Fisher Orbitrap), DOC (Shimadzu VCN), pH, DIC and TA analysers.

Prof. Dr. Eric Achterberg has a long track record of work on chemical oceanography and marine biogeochemistry, including working on trace elements, carbonate chemistry, sensor development. He is member of the Scientific Steering Committee of GEOTRACES and will be chief scientist on the Sonne cruise in 2019.

The project will be co-supervised by Dr Tom Browning and Dr Martha Gledhill.

Further information

www.geomar.de/en/mitarbeiter/fb2/ch/achterberg/

www.geomar.de/en/research/fb2/fb2-ch/working-groups/team-water-column-biogeochemistry/
Research Topic

The biological carbon pump (BCP) is an important component of the global carbon cycle. It sequesters CO₂ from the atmosphere and stores it in the ocean interior by coupled production and export processes (Volk and Hoffert, 1985). Organic matter produced in the surface ocean is transported below the euphotic zone via particles sinking. On its way to the seafloor, particulate organic matter (POC) is subjected to continuous microbial degradation, so that only a small fraction (< 1 %) is preserved in marine sediment. With a weaker BCP, the atmospheric CO₂ concentrations would have at least doubled by the end of the last ice age (Sarmiento and Toggweiler 1984). Conversely, higher primary productivity in the surface waters does not guarantee enhanced export or efficient BCP. This is particularly true in the Southern Ocean where surface microbial recycling is strong and zooplankton-mediated export is large (le Moigne et al., 2016). Therefore, quantifying the efficiency of the BCP on both global and regional scales are fundamental for understanding the global carbon cycle.

Traditionally, POC have been collected with drifting sediment traps; the calculated vertical fluxes of POC from sediment trap samples, however, often suffered from complications such as hydrodynamic effects and resolubilization. Despite the first discovery of the particle-reactive feature of ²³⁴Th in 1967 (Bhat et al., 1967), it is not until recent decades when the parent/daughter pair of ²³⁸U/²³⁴Th has been widely used to study particle dynamics and particle export fluxes in various aquatic environment (Figure 1). Recent breakthroughs in ²³⁴Th analytical methods of small volume samples (Pike et al., 2005) have made this tracer particularly useful in studying particle dynamics in the open ocean.

The aim of this project is to quantify fluxes of POC and trace metals on a GEOTRACES cruise across the oligotrophic South Indian Ocean where nutrients are heavily depleted and where no particle fluxes are available thus far. The cruise work will be supplemented by additional subsequent studies that will be directed towards the interests of the student. The student will be working closely with the international team on the GEOTRACES cruise and members of the Marine Biogeochemistry division at GEOMAR.

Further reading:
• Mouw, C. B. et al.: Global ocean particulate organic carbon flux merged with satellite parameters, Earth Syst. Sci. Data, 8, 531-541

Requirements/Qualifications

• Excellent degree in chemistry, physical chemistry or oceanography
• Good background in analytical methods of seawater and particulate digestion
• Competence in written and spoken English
• Interest in undertaking interdisciplinary research
• Willingness to participate in seagoing expeditions
• Fieldwork/laboratory work experience preferable

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Research group

The doctoral candidate will work within the Marine Biogeochemistry Research Group led by Prof. Dr. Eric P. Achterberg. Our group currently consists of approximately 30 post-doctoral and doctoral researchers investigating the oceanic carbonate system and ocean acidification, and the marine biogeochemistry of trace metals (including speciation), carbon, nutrients, and their interactions with organisms. We develop novel analytical techniques, and apply them to biogeochemical studies. The research is multidisciplinary and undertaken in collaboration with national and international partners. The facilities available at GEOMAR for the proposed research include clean rooms, Low-Level Beta counter (Risø), HR-ICP-MS (Thermo Fisher Element II XR) with SEAFast for trace element preconcentration, Quadrupole ICP-MS (X-series II), microwave, LC-MS (Thermo Fisher Orbitrap), DOC (Shimadzu VCN), pH, DIC and TA analyzers.

Prof. Dr. Eric Achterberg has a long track record of work on chemical oceanography and marine biogeochemistry, including working on trace elements, carbonate chemistry, sensor development.

The co-advisor Dr. Ruifang Xie is a junior research scientist funded by the German SFB 754 program and working on marine biogeochemistry. She is especially interested in resolving processes controlling the biological carbon pump efficiency on global scales, and those governing the biogeochemical cycling of micronutrients and their isotopes. She has a track record of successful research combining field and theoretical work.

The co-advisor Dr. Frederic Le Moigne is a junior research scientist studying POC speciation and the interactions between the BCP and future climate change.

Further information

www.geomar.de/en/mitarbeiter/fb2/ch/achterberg/
www.geomar.de/en/research/fb2/fb2-ch/working-groups/team-water-column-biogeochemistry/
Global oceanic emissions of carbon monoxide (CO)

Research Topic
Carbon monoxide (CO) is an important atmospheric trace gas. However, estimates of the open ocean source and coastal pathways of CO are associated with a high degree of uncertainty. In the doctoral project CO shall be measured on various cruises in the Atlantic and Pacific Oceans with a recently developed underway CO measurement system which allows measuring CO in the surface layer with an unprecedented spatial and temporal resolution. Based on these new data sets and a comprehensive compilation of literature data a first global CO emission field will be computed in order to significantly reduce the uncertainty of the global CO emission estimate. Moreover, CO should be measured on a monthly basis at the Boknis Eck Time Series Station, SW Baltic Sea (www.bokniseck.de) to decipher the seasonal and interannual variability of its concentrations and emissions in a coastal system, and to perform simple incubation experiments to decipher potential pathways of CO at Boknis Eck.

The overall objective of the doctoral project is to reassess the global oceanic CO emissions in order to improve the prediction of future CO emissions.

Specific objectives are

- to perform CO measurements in the open and coastal oceans with the new underway CO system developed in the working group of HW Bange (see Arévalo-Martínez et al., Ocean Science, 2013),
- to set up a gas chromatographic system for measurements of CO in discrete seawater samples,
- to perform time series measurements of CO at the Boknis Eck Time Series Station in order to decipher the seasonal/interannual variability of its concentrations and emissions in a coastal system, and
- to perform simple incubation experiments to decipher potential pathways of CO at Boknis Eck.

Prof. Dr. Hermann W. Bange
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24105 Kiel, Germany
email: hbange@geomar.de
Requirements/Qualifications

- Degree in chemical oceanography, marine biogeochemistry or related subjects
- Basic knowledge of analytical methods in marine chemistry (incl. absorption spectroscopy and gas chromatography)
- Willingness to participate in ship cruises
- Basic knowledge of statistical methods

Important Notice: This topic does not include a scholarship for doctoral candidates. Interested students should bring a scholarship or contact us to find possibilities for funding.

Research group

The doctoral candidate will work in the Working Group of Prof. Dr. Hermann W. Bange in the Marine Biogeochemistry Research Division of GEOMAR. Research topics of the WG include (i) marine biogeochemistry of nitrogen, carbon and sulphur in the open and coastal oceans, (ii) biogeochemical time series observations, (iii) oceanic pathways and emissions of trace gases (nitrous oxide, methane, dimethyl sulphide, carbon monoxide), and (iv) measurements of short-lived intermediates of the nitrogen and sulphur cycles (hydroxylamine, hydrazine, nitric oxide, DMSP and DMSO). H. Bange is coordinator the Boknis Eck Time Series Station (www.bokniseck.de). The WG is operating worldwide with a special focus on coastal upwelling systems.
Nitric oxide (NO) in the ocean

The overall objectives of the doctoral topic are
• to investigate the NO distribution in the ocean by on-board measurements during research cruises to the major ocean basins and the Baltic Sea, and
• to identify potential NO production processes by measuring NO production in incubation experiments.

Requirements/Qualifications
• Degree in chemical oceanography, marine biogeochemistry or related subjects
• Basic knowledge of analytical methods in marine chemistry
• Willingness to participate in ship cruises

Important Notice: This topic does not include a scholarship for doctoral candidates. Interested students should bring a scholarship or contact us to find possibilities for funding.

Figure: Overview of nitric oxide (NO) and its direct precursors and reaction products during various microbial processes: 1, NO synthesis and detoxification; 2, nitrification; 3, denitrification; 4, anammox; 5, dissimilatory nitrate reduction to ammonium (DNRA) and 6, nitrite-driven anaerobic oxidation of methane (N-AOM). (NO−3, nitrate; NO−2, nitrite; N2O, nitrous oxide; N2, dinitrogen, NH2OH, hydroxylamine; N2H4, hydrazine; NH4+, ammonium)
Research group

The doctoral candidate will work in the Working Group of Prof. Dr. Hermann W. Bange in the Marine Biogeochemistry Research Division of GEOMAR. Research topics of the WG include (i) marine biogeochemistry of nitrogen, carbon and sulphur in the open and coastal oceans, (ii) biogeochemical time series observations, (iii) oceanic pathways and emissions of trace gases (nitrous oxide, methane, dimethyl sulphide, carbon monoxide), and (iv) measurements of short-lived intermediates of the nitrogen and sulphur cycles (hydroxylamine, hydrazine, nitric oxide, DMSP and DMSO).

H. Bange is coordinator the Boknis Eck Time Series Station (www.bokniseck.de). The WG is operating worldwide with a special focus on coastal upwelling systems.

Further information

www.geomar.de/en/mitarbeiter/fb2/ch/hbange/

www.geomar.de/en/research/fb2/fb2-ch/
Research Topic

Nitrous oxide (N\textsubscript{2}O) is one of the most important greenhouse gases, and its rise in the Anthropocene significantly contributes to global warming and depletion of stratospheric ozone. The marine environment contributes about 25% to the global atmospheric source, with a strong contribution of coastal and marginal seas.

The production of nitrous oxide in marine ecosystems is strongly bound to oxygen-deficient conditions, under which it can be produced during microbial nitrification and denitrification. In contrast, under anoxic conditions, nitrous oxide is consumed, leading to its almost complete depletion in anoxic water bodies. The interplay of sources and sinks is difficult to assess by water column distribution patterns alone. Very recently, new cavity enhanced absorption techniques became available that enable using the site-specific nitrogen stable isotopic signature of nitrous oxide (with one N in the centre position and one on the terminal position of the linear molecule) as a marker of the production pathway.

In this project, the isotopic signature of nitrous oxide will be explored in various ways, with a strong focus on the Baltic Sea waters. The Baltic Sea is the 2nd largest brackish water system, and consists of several interconnected sub-basins characterized by different degree and variability of oxygen deficiency. Field sample collection is facilitated through long-term monitoring programmes such as the HELCOM monitoring by IOW and the monthly sampling at the Boknis Eck time series station (www.bokniseck.de) by GEOMAR. High resolution N\textsubscript{2}O vertical profiling will be possible through recent technical innovation. Experimental work in the field will include detailed studies of the nitrous oxide distribution at several selected long-term monitoring sites in the Baltic Sea. The main microbial key organisms for nitrification and denitrification are cultivated at the IOW and can be used for enrichment experiments under variable forcing conditions in complementary lab studies. The isotopic signature will be determined using a state-of-the-art LGR isotopic N\textsubscript{2}O analyser.

Deciphering the sources of nitrous oxide by site-specific isotopic signature using off-axis integrated cavity output spectroscopy

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Prof. Dr. Gregor Rehder
Leibniz Institute for Baltic Sea Research Warnemünde (IOW)
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18119 Rostock; Germany
email: gregor.rehder@io-warnemuende.de
Requirements/Qualifications

- Excellent degree in chemical oceanography, marine chemistry, environmental chemistry, marine biogeochemistry/microbiology or marine geochemistry
- Good background and strong interest in analytical methods
- Basic knowledge in microbiological methods and/or nitrogen cycle studies is requested but is not mandatory
- Strong interest in interdisciplinary research
- Willingness to go to sea
- Good English language skills (oral and written)
- Willingness to fulfil part of the thesis’ work in Warnemünde and in Kiel, hosted and supervised within two internationally renowned trace gas working groups.

The successful candidate will be enrolled as a doctoral candidate at Kiel University.

Important Notice: This topic does not include a scholarship for doctoral candidates. Interested students should bring a scholarship or contact us to find possibilities for funding.

Please send your application, preferably by e-mail, to:
Gregor Rehder (gregor.rehder@io-warnemuende.de)
and
Hermann Bange (hbange@geomar.de)

Research group

The doctoral candidate will work in the Trace Gas Biogeochemistry group within the division of Marine Chemistry at IOW, Warnemünde, led by Prof. Dr. Gregor Rehder, and in the Working Group of Prof. Dr. Hermann Bange in the Marine Biogeochemistry Research Division of GEOMAR, Kiel. The two PIs will jointly supervise the doctoral thesis.

The Trace Gas Biogeochemistry working group at IOW focuses on research related to the marine cycles of carbon dioxide, methane, and nitrous oxide, with a strong focus on interdisciplinary approaches bridging chemical oceanography, physical oceanography, and microbiology. G. Rehder is PI of the BALTIC VOS line between Helsinki and Lübeck, a core component of the German contribution to the ocean component of the ICOS RI.

Topics of the WG at GEOMAR include (i) marine biogeochemistry of nitrogen, carbon and sulphur in the open and coastal oceans, (ii) biogeochemical time series observations, (iii) oceanic pathways and emissions of trace gases (nitrous oxide, methane, dimethyl sulphide, carbon monoxide) and (iv) measurements of short-lived intermediates of the nitrogen and sulphur cycles. H. Bange is coordinator the Boknis Eck Time Series Station in the Eckernförde Bay, SW Baltic Sea (www.bokniseck.de). The WG is operating world-wide.

G. Rehder and H. Bange work together in the SCOR working group 143 “Dissolved N₂O and CH₄ measurements: Working towards a global network of ocean time series measurements of N₂O and CH₄,” as well as in the Integrated project BONUS INTEGRAL „Integrated carboN and Trace Gas monitoRing for the bALTic sea”, which will provide the framework for this doctoral project.

Further information

www.geomar.de/en/mitarbeiter/fb2/ch/hbange/
www.geomar.de/en/research/fb2/fb2-ch/
www.io-warnemuende.de/gregor-rehder-en.html
Research Topic

The chemistry of the atmosphere is changing radically. While the most commonly discussed change is increasing CO₂, there is a wide range of other trace gases that are chemically or radiatively active in the atmosphere and which are subject to change. These gases have short atmospheric lifetimes, and hence have regional impacts which may have global consequences. Ocean surface processes can exert critical controls on fluxes of these gases to and from the atmosphere, thus impacting climate and atmospheric chemistry, both regionally and globally. The gases include alkanes (e.g. butane), organic nitrates (e.g. methyl nitrate), halogenated volatile organic compounds (e.g. bromoform, iodine-containing gases), sulfur-containing compounds (e.g. dimethyl sulfide), and other volatile organic compounds (e.g. acetone and methanol). The impacts range from formation of aerosol affecting cloud cover or radiative transfer over the destruction of tropospheric and stratospheric ozone, to controls on the atmosphere’s ability to rid itself of pollutants. The gases, if coming from the atmosphere may have also important consequences to the biogeochemistry in ocean waters.

Emissions of anthropogenic and natural trace gases at coastal sites potentially impact climate, air quality, and human health as well as ecosystem functioning. The trace gas cycling needs to be explored in order to close gaps in the understanding of concentration variation, emission strengths, sources and effects. Our ability to predict and quantify marine emissions and associated processes is limited, in part because surface seawater sources and sinks of these compounds are often obscure and poorly quantified.

For example, brominated, iodinated and chlorinated short-chained alkanes (halocarbons) are produced naturally in the surface oceans by different biological and photochemical processes. Their air-sea exchange is an important source of halogens contributing to tropospheric chemistry and to ozone depletion in stratosphere. Strong source regions of the compounds near coastlines and in upwelling regions are generally linked to macro algae and phytoplankton. In addition anthropogenic sources such as oxidative water treatment of industrial effluents, waste-, drinking- and recreational water can be locally significant. Their environmental impact is suggested to increase globally, greatest in coastal areas. There is still considerable uncertainty about the environmental distribution and the surface ocean cycling of these and other reactive trace gases, especially at the coastal interface.
We do high quality water and atmospheric trace gas measurements of a suite of compounds and have acquired many trace gas data from open ocean regions in recent years. The gases include alkanes, chlorinated, brominated and iodinated alkanes, several CFC’s, Halons and alkyl nitrates. We are currently developing the technology of drones to sample air in regions which are difficult to access, as the coastal surf zone and in order to obtain undisturbed water samples of the upper ocean. Also we are extending our analytical capabilities to quantify a large range of compounds.

The successful applicant will be involved in the current existing analysis of the trace gases in air and water, in order to calculate air-sea fluxes of natural and anthropogenic compounds of interest and understand their environmental cycling and sources. The analysis involves the purge-and-trap with GC/MS single ion monitoring technique. The work will take place in coastal tropical and subtropical marine environments and on research vessels, influenced both by natural and anthropogenic emissions of trace gases and their oceanic input. With the obtained data, oceanic trace gas sources and sinks and their atmospheric transport will be investigated.

**Requirements/Qualifications**

- excellent degree in chemical oceanography or similar studies in environmental sciences
- good background in analytical methods of sea water and atmospheric analysis
- preferentially background in mass spectrometry and purge and trap techniques
- preferentially background in statistical evaluation and handling of large data sets
- willingness to carry out an analytical challenging dissertation
- marked interest in doing research in a multidisciplinary research field

**Research Group**

The doctoral candidate will work in the Chemical oceanography group led by Professor Arne Körtzinger and will be co- and mainly supervised by Dr. Birgit Quack, who is working in the field of air-sea exchange of halogenated trace gases and their atmospheric consequences since 20 years. The group of the PI has extended expertise in GC/MS techniques and the analysis of volatile compounds in both the atmosphere and ocean. Her general interest in the air-sea exchange and the sources of halogenated trace gases from the ocean is currently expanding to other groups of anthropogenic and marine volatile organic compounds.

[Prof. Arne Körtzinger](#)  [Dr. Birgit Quack](#)

**Further information**


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Research Topic

Hydroacoustic water column and seafloor mapping surveys commonly use single and multibeam echo sounder systems as two separate tools. Developments in multibeam technology now allow to record water column data as well, making them comparable and jointly analyzable with calibrated single beam information. Quantitative studies and monitoring of backscatter targets in the water column is of great interest for e.g. mapping bubble release in relation to natural CH₄, seep sites (for oil & gas exploration, GHG input into the atmosphere), anthropogenic monitoring around abundant gas wells or CCS sites as well as evaluating the spatial and temporal change of sediment plumes generated during deep sea mining of Mn-nodules or massive sulfide deposits. Our hydroacoustic studies are supported by optical methods for validation and we are looking for both, interested doctoral candidates who either want to extend these technologies and/or want to use them to understand underlying processes. Repeated field studies around Kiel as well as abroad will be part of the research.

Requirements/Qualifications

Knowledge in acoustic or visual processing is required. Depending on the desired focus, either a background in the Earth sciences (investigating processes and relationships) or a background in computer science is required (investigating novel methodologies, mapping and processing concepts). In any case, very good communication skills and the willingness to learn and contribute beyond one’s own discipline in an interdisciplinary research team of scientists and engineers.

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Left: Gas seepage (North Sea). Right: Multibeam echo sounder image of bubble streams.
Research group

The DeepSea Monitoring Group studies short- and long-term changes of seafloor processes and develops novel methodologies for investigation. In particular, we use hydroacoustic and optical technologies linked with sophisticated post-processing and calibration techniques and combine these methods with geochemical analyses of the water column, the sea surface and the atmosphere. In order to tackle large scale real-world problems, we also contribute to GEOMAR’s efforts for making smarter autonomous underwater robots.

The project will mainly be supervised by Prof. Jens Greinert and Dr.-Ing. Kevin Köser.

Further information

www.geomar.de/en/mitarbeiter/fb2/mg/jgreinert/
www.geomar.de/en/research/fb2/fb2-mg/deepsea-monitoring/
Research Topic

Optical and acoustic investigations (e.g. ARA or Bayesian backscatter analyses) are of course also ideal tools to jointly map the seafloor from large to very small scale. By applying machine learning techniques, very detailed information from visual observations and automated image analyses can be extrapolated spatially using different hydroacoustic data layers (bathymetry, bathymetric derivatives, backscatter) giving a much better understanding about the small scaled geological and biological heterogeneity at the ocean seafloor. When investigating geochemical or physical material and energy fluxes from point data, their extrapolation based on statistically valid correlation with a spatially available data set will greatly advance our understanding about large scale fluxes and budgets, which are currently mostly lacking. Next to methodological/statistical considerations, we will apply such methodologies in upcoming cruises dealing with organic matter transport to the seafloor and carbon turnover offshore the Cape Verdes as well as in the Pacific in relation to deep sea mining environmental questions.
Requirements/Qualifications

Knowledge in acoustic or visual processing is required. Depending on the desired focus, either a background in the Earth sciences (investigating processes and relationships) or a background in computer science is required (investigating novel methodologies, mapping and processing concepts). In any case, very good communication skills and the willingness to learn and contribute beyond one’s own discipline in an interdisciplinary research team of scientists and engineers.

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Further information

www.geomar.de/en/mitarbeiter/fb2/mg/jgreinert/

www.geomar.de/en/research/fb2/fb2-mg/deepsea-monitoring/
Automated Observations using ‘intelligent’ landers or robotic platforms (AUVs, crawlers, gliders)

Requirements/Qualifications

Knowledge in acoustic or visual processing is required. Depending on the desired focus, either a background in the Earth sciences (investigating processes and relationships) or a background in computer science is required (investigating novel methodologies, mapping and processing concepts). In any case, very good communication skills and the willingness to learn and contribute beyond one’s own discipline in an interdisciplinary research team of scientists and engineers.

Important Notice: This topic does not include a scholarship for doctoral candidates. Interested students should bring a scholarship or contact us to find possibilities for funding.

Research Topic

To understand processes in the oceans, often long-term and/or repeated observations across several tidal, monthly or seasonal cycles are required. Here we are interested in automated monitoring concepts from landers and robotic platforms as AUVs that detect changes, identify or classify (objects on) the seafloor, find ‘interesting’ locations or events and follow autonomously gradients. GEOMAR currently invested in two new AUVs with an open software structure that we plan to become truly autonomous, meaning intelligent vehicles that communicate among each other for exchanging data, their position and jointly undertake complex multi-parameter missions.

From left to right: GasQuant Lander (with sonar) and BubbleBox (with stereo cameras) Right: GEOMAR’s AUV Abyss is one of several deep sea robots that can visually or acoustically map the seafloor.
Research group

The DeepSea Monitoring Group studies short- and long-term changes of seafloor processes and develops novel methodologies for investigation. In particular, we use hydroacoustic and optical technologies linked with sophisticated post-processing and calibration techniques and combine these methods with geochemical analyses of the water column, the sea surface and the atmosphere. In order to tackle large scale real-world problems, we also contribute to GEOMAR’s efforts for making smarter autonomous underwater robots.

The project will mainly be supervised by Prof. Jens Greinert and Dr.-Ing. Kevin Köser.

Further information

www.geomar.de/en/mitarbeiter/fb2/mg/jgreinert/

www.geomar.de/en/research/fb2/fb2-mg/deepsea-monitoring/
Plasmid genome evolution: tracing the birth of a new chromosome

This dissertation project utilizes a very recent approach to investigate whether plasmids can evolve towards becoming a secondary chromosome. Experimental evolution studies with bacteria will be performed, where the conditions for the transition to a chromosome will be created. The phenotypic and genetic changes (employing latest state of the art genomics and metagenomics) will be followed in real time. This doctoral project will be supervised by Prof. Dagan and co-advised by Dr. Hammerschmidt within the Genomic Microbiology Group at the Institute of Microbiology.

Plasmid evolution. (5) The transition of the plasmid into a secondary/additional chromosome can potentially be facilitated by adaptation processes in both, the host chromosome and the plasmid; (Figure taken from Hülter et al 2017).

Research Topic

Utilizing experimental populations of unicellular bacteria, the selective causes, and underlying mechanisms of the evolution of bacterial chromosomes will be investigated.

A diverse range of bacteria, many of which live in marine environments, is known to harbour multiple chromosomes. It is a highly debated topic where these additional chromosomes came from, and which selective advantage they confer – particularly in comparison to bacteria that harbour multiple plasmids. Whereas plasmids are independent units that confer advantage to the host as they carry beneficial genes, e.g. resistance genes against antibiotics, additional chromosomes encode for essential genes and are hence indispensable for the bacterial cell. The main difference however is that plasmids replicate independently within the host cell, whereas the replication of additional chromosomes is tightly linked to the host cell cycle. This aspect ultimately ties the fates of both entities together so that they can only replicate and participate in evolution as a single unit.
Requirements/Qualifications

- Enthusiastic about science
- Background in evolutionary biology, genetics, genomics, microbiology and/or bioinformatics
- Experience in laboratory work
- Willingness to carry out labour-intensive laboratory experiments
- Excellent interpersonal skills

Important Notice: This topic does not include a scholarship for doctoral candidates. Interested students should bring a scholarship or contact us to find possibilities for funding.

Research group

The doctoral candidate will work in the group of Prof. Dr. Tal Dagan at the Institute of Microbiology. Prof. Dagan’s group is international and multidisciplinary with a research focus on microbial genome evolution. The doctoral candidate will be supported through expert knowledge, e.g., culturing bacteria, genetic manipulation, and bioinformatics. The group is equipped with a modern lab and office space including the required conditions for molecular microbiology work at an S1 security level. The doctoral candidate will have access to all the relevant technology platforms that are present at the Centre for Molecular Biosciences at Kiel University and will employ the latest state of the art genomics and metagenomics analyses.

The co-advisor Dr. Katrin Hammerschmidt joined the group in 2015, having previously worked at Massey University, New Zealand, The University of Sheffield, UK, and the Max Planck Institute for Evolutionary Biology, Germany. She is an evolutionary biologist by training and is interested in understanding the underlying causes and mechanisms of evolution, with a current focus on the evolution of life cycles and individuality. Dr. Hammerschmidt has ample experience in designing, performing, and analysing experimental evolution studies in bacterial populations.

Contact

Please send your application, preferably by e-mail, to:

Dr. Katrin Hammerschmidt
Genomic Microbiology Group
Institute for Microbiology
Christian-Albrechts-University Kiel
ZMB, Am Botanischen Garten 11
24118 Kiel, Germany

e-mail: khammerschmidt@ifam.uni-kiel.de

In this application, please also provide at least two scientific contacts with full postal and email addresses for the request of reference letters

Further information

www.mikrobio.uni-kiel.de/de/ag-dagan

www.mikrobio.uni-kiel.de/de
Research Topic

Benthic foraminifera are microbial eukaryotes populating sediments of aquatic environments. Several species were shown to perform denitrification, a rare metabolic capacity among eukaryotes. Due to their facultative anaerobic lifestyle and their high density in oxygen minimum zones (OMZ), foraminifera play an important role in the marine Nitrogen cycle. However, the mechanisms of foraminiferal denitrification are yet unknown and a contribution of associated bacteria has been suggested. Our current research comprises the analysis of genomes and transcriptomes sequenced from a foraminiferan species sampled in a hypoxic environment in Gullmarfjord (Sweden). Our results indicate that denitrification is performed, at least in part, by foraminifera-encoded proteins. This constitutes evidence for a rare eukaryotic pathway for nitrate respiration. Recently, we sampled several thousand individuals of additional foraminifera species found in an OMZ (Peru). The doctoral candidate will work on the computational analysis of genomes and transcriptomes extracted from those samples. The goal of the study is to identify genes encoding for denitrification proteins for foraminifera found in OMZs, a main source of global free nitrogen. Furthermore, the data set will be a valuable source to study other aspects of the understudied group named foraminifera, including the evolution of mitochondria and rare eukaryotic metabolic traits. Our previous results on denitrification give a first glance of mechanisms on nitrogen loss by foraminifera. The doctoral candidate will have the opportunity to contribute to the understanding of foraminiferal denitrification in OMZs, which may revolutionize our understanding regarding the eukaryotic contribution of the marine nitrogen cycle.

Prof. Dr. Tal Dagan
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Evolutionary genomics of foraminifera residing in oxygen minimum zones

Picture: Denitrifying foraminiferan Globobulimina turgida.
Photo credit: Dr. Alexandra-Sophie Roy
Requirements/Qualifications

- Excellent degree in Bioinformatics or Computational Biology. Alternatively, a degree in Microbiology or Molecular Biology with a strong focus on bioinformatics.
- Experience in scripting or programming languages (e.g., Perl, Python)
- Background in next-generation sequencing (NGS); hands-on experience in NGS analysis including quality check, assembly and annotation.
- Background in handling of huge data sets and statistics (e.g., R or Matlab)
- Ability to work as part of a team as well as independently
- Good communication skills in English and a creative approach to problem-solving
- Hands-on experience in comparative genomics and phylogenomics is an advantage
- Background and interest in eukaryotic evolution is a plus

Important Notice: This topic does not include a scholarship for doctoral candidates. Interested students should bring a scholarship or contact us to find possibilities for funding.

Research group

The doctoral candidate will work in the Genomic Microbiology group led by Prof. Tal Dagan. The research interest of the group is on microbial genome evolution. The current focuses include the study of DNA acquisition dynamics in natural environments, experimental evolution on plasmids and the evolution of phenotypic diversity in cyanobacteria. The group encompasses both computational and experimental scientists with a focus on links between computational and experimental research.

The research project on the evolution of denitrification started in 2014 and is a highly collaborative efforts of researchers from different study directions within the Collaborative Research Center 754 „Climate-Biogeochemistry Interactions in the Tropical Ocean“. The co-advisor Dr. Christian Woehle has been working in the project since July 2014 and has a strong background in bioinformatics. He is interested in the evolution of microbial eukaryotes using computational methods including NGS and comparative genomics.

Contact

Please send your application, preferably by e-mail, to:

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cwoehle@ifam.uni-kiel.de

In your application, please also provide at least two scientific contacts with full postal and email addresses for the request of reference letters.

Further information

www.mikrobio.uni-kiel.de/de/ag-dagan
www.mikrobio.uni-kiel.de/de
The role of biomolecules and vitamins in marine food web

Prof. Dr. Ulrich Sommer
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Research Topic

Life is evolved from the sea, yet our understanding of the importance of biomolecules remains speculative. We want to address this gap by conducting a series of lab-works as well as field investigations to track the transfer of biomolecules such as fatty acids, amino acids and vitamins among marine trophic levels. We will focus on both comb jellies and scyphomedusae especially because a) they belong to the basal metazoans and therefore traits involving in their population success sheds new light on our understanding of how trade-offs have shaped their population and b) there is an evidence that their population may be expanding globally which is linked to some ecological and economical damages.

Recently, we found a plastic response of the benthic form of the scyphomedusae to high temperature by feeding them with a vitamin-rich food type (Chi et al in prep.). This study provides new insights into the “assumed” global increase of jellyfish (JF) under climate warming that yet has not considered the role of food quality into account. The purpose of this project is to investigate the effect of food quality (regarding accumulations of biomolecules and vitamins) on the pelagic phase of the JF in response to the global warming. Two types of JF (scyphomedusae and comb jelly) will be cultured under different temperatures and food qualities and fitness- measurements such as growth rate, sexual maturity and reproduction rates will be recorded. Energy transfer among different food levels (phytoplankton-zooplankton-JF) will be estimated as well. All lab-based information will be translated into the field by taking a biweekly sampling and conducting the same type of measurements. At the end of the project, we want to gain a full picture of JF optimum tolerance range best supporting bloom conditions under global warming scenarios.

Figure 1. (a.) Survival tolerance curves of A. aurita polyps under different temperature regimes (solid line) and food quantity (dotted line), food quality (dot-dashed line) effects. (Chi et al. prep to be submitted to L&Q)
Requirements/Qualifications

The candidate has to have a strong background in marine biochemistry. The second important skill to acquire is dealing with culturing and rearing marine organisms. Other important qualifications are listed below:

- Excellent M.Sc. degree in Marine Chemistry, Marine Biology or any relevant fields.
- Basic skills in statistics.
- Willing to participate in field cruises.
- Demonstrate interest in lab works.
- Sufficient fluency in written, verbal and interpersonal communication skills in English.

Important Notice: This topic does not include a scholarship for doctoral candidates. Interested students should bring a scholarship or contact us to find possibilities for funding.

Research group

The project will be co-supervised by Dr. Jamileh Javidpour. The doctoral candidate will mainly work in the Jellyfish Ecology working group is a part of the research division “Marine Ecology” (https://www.geomar.de/en/mitarbeiter/fb3/eoe/eoe-n/jjavid/jellyfish-ecology/) at the GEOMAR Helmholtz Centre for Ocean Research Kiel.

Contact

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Further information

www.geomar.de/en/mitarbeiter/fb3/eoe/eoe-n/usommer/
Aquaculture is one of the fastest growing food production industries. However, Aquaculture is highly criticized on its impacts on the environment. The rapid growth of aquaculture from the production of fish and shrimp need to be developed, in such a way that impacts from systems of production align with sustainable development goals. However, there are still major methodological challenges to limit the environmental impacts of aquaculture. Recently developed recirculation aquaculture system (RAS) has been promising in dealing with most of the impacts of aquaculture. The development and optimization of such production systems is need further research with the aim of achieving sustainable production. Several recent environmental assessment studies of seafood production have utilized life cycle assessment (LCA) method. The LCA is used to address the environmental impact of products and/or activities by assessing systematically the impact of each material and process in a system. Consequently, LCA has shown its potential in assessing impacts throughout a product’s life (i.e. cradle to grave) from raw material acquisition, processing, manufacturing, use, and finally its disposal. The overall objective of these projects will be to evaluate and compare the environmental impacts of RAS and intensive aquaculture systems. Successful candidates will learn on how to develop LCA model and characterize impact categories related to aquaculture production. In addition, the students will be exposed to various alternative production models for comparison and sensitivity analysis.

Requirements/Qualifications

Seeking two highly motivated students with interest in research of RAS aquaculture and environmental science of fish production leading to a PhD. Required M.S. in aquaculture, fisheries, agriculture, environmental sciences, biology, industrial ecology, or closely related fields. Application prerequisites include a completed M.S. degree and sufficient English language.

Important Notice: This topic does not include a scholarship for doctoral candidates. Interested students should bring a scholarship or contact us to find possibilities for funding.

Environmental Impact Assessment of Recirculating Aquaculture System (RAS)

Prof. Dr. Carsten Schulz
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Research Topic

Aquaculture is one of the fastest growing food production industries. However, Aquaculture is highly criticized on its impacts on the environment. The rapid growth of aquaculture from the production of fish and shrimp need to be developed, in such a way that impacts from systems of production align with sustainable development goals. However, there are still major methodological challenges to limit the environmental impacts of aquaculture. Recently developed recirculation aquaculture system (RAS) has been promising in dealing with most of the impacts of aquaculture. The development and optimization of such production systems is need further research with the aim of achieving sustainable production. Several recent environmental assessment studies of seafood production have utilized life cycle assessment (LCA) method. The LCA is used to address the environmental impact of products and/or activities by assessing systematically the impact of each material and process in a system. Consequently, LCA has shown its potential in assessing impacts throughout a product’s life (i.e. cradle to grave) from raw material acquisition, processing, manufacturing, use, and finally its disposal.
Description

The project will be involved within the main research focus at the Institute of Animal Breeding and Husbandry, Kiel University and Gesellschaft für Marine Aquakultur (GMA). Students will be using life cycle assessment (LCA) method for identifying alternative production systems in the production of fish that is environmentally sustainable. Students will need 3 years for completing their research.

Research group

Prof. Dr. Carsten Schulz is a Professor and Chair of Marine Aquaculture at Kiel University. At the same time, he also serves as a scientific supervisor of a public research company called Gesellschaft für Marine Aquakultur (GMA) mbH in Büsum, Germany. He is also a member of the Cluster of Excellence “Future Ocean” in Kiel. His research interests are mainly focused on biological and technological innovations in aquaculture and its influence on the environment. Prof. Dr. Schulz was awarded the ISH-Transferprämie prize for his efforts in facilitating business and science knowledge transfers.

The project will be co-supervised by Dr. Biniam Samuel-Fitwi who is a postdoctoral researcher at Kiel University. He is an associate member of the Cluster of Excellence “Future Ocean” in Kiel. His research interests span a broad range within the field of food production, with special emphasis on life cycle assessment (LCA) of food production, incorporation of ecosystem design in food production, and sustainable development of aquaculture.

Location

Institute for Animal Breeding and Husbandry, Kiel University and Büsum, Germany

and

Gesellschaft Für Marine Aquakultur (GMA)
GMA was founded 2004 in Büsum (North Germany) as a research and development institution for aquaculture. It has in its facilities state-of-the-art recirculating aquaculture system (RAS) and undertakes several basic and applied research projects. One of the strong activities of GMA is the science and technology transfer of sustainable aquatic animal breeding and husbandry. GMA is owned by Erwinigungsgesellschaft Brunsbüttel (egeb), Kiel University (CAU), the Fraunhofer-Gesellschaft and the GEOMAR Helmholtz-Centre for Ocean Research Kiel.

Further information

www.agrar.uni-kiel.de/en/faculty/deanery/deans/prof-dr-carsten-schulz
www.tierzucht.uni-kiel.de/de/startseite
Research Topic

Human activities have induced large modifications in the physical and chemical properties of the ocean leading to surface warming, deoxygenation, acidification and increased dust and nitrogen deposition. These changes are expected to alter the cycling of marine nitrogen, an essential nutrient controlling marine biological production, by impacting directly on the magnitude of marine N₂ fixation and marine denitrification. The combined effect of these stressors on the N inventory is not known, and the response of the marine ecosystem to changes in the N-cycle remains to be explored.

The project objective is to investigate the combined effects of multiple stressors on the cycling of marine nitrogen and assess the impact on marine ecosystems, the global carbon cycle and human activities based on marine resources. The successful candidate will set up, analyse and expand global biogeochemical models currently in use in our research group. The candidate will have the opportunity to work in a highly dynamic and interdisciplinary research environment having access to a broad range of training opportunities within the Integrated School of Ocean Sciences (ISOS).

Requirements/Qualifications

Doctoral candidates must be highly motivated in studying marine biogeochemical cycles and using numerical modelling tools. The candidate must hold a Master degree (or equivalent). Experience in numerical modelling and programming language is desired.

Important Notice: This topic does not include a scholarship for doctoral candidates. Interested students should bring a scholarship or contact us to find possibilities for funding.

Anthropogenic perturbations of marine biogeochemical cycles

Prof. Dr. Andreas Oschlies
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Doctoral Topic in Marine Biogeochemical Modelling
Research group

The biogeochemical modelling research unit lead by Prof. A. Oschlies, carries out interdisciplinary research on the interactions between physical-chemical and biological processes at different spatial and temporal scales. Main tools are numerical models of different complexity that are continuously being developed.

The co-advisor Dr. Angela Landolfi works in the biogeochemical modelling group combining both experimental and modelling approaches to investigate the biogeochemical cycling of biologically active elements in the ocean (C, N, P).

The co-advisor Dr. Wolfgang Koeve has been working in the field of coupled elemental cycles [C:N, orgC:CaCO₃] from local to global scales using a mix of sea going studies, data base analysis and global modelling. In the recent years he focused on ocean acidification impact on the CaCO₃ cycle, evaluation of global models and nitrogen cycling in OMZ regions.

Further information

www.geomar.de/en/mitarbeiter/fb2/bm/ aoschlies/

www.geomar.de/en/research/fb2/fb2-bm/ research-topics/
Transport of biogeochemical tracers by coherent ocean eddies

The project objective is to investigate and quantify the efficiency of mesoscale eddies to coherently transport waters with their biogeochemical properties, with the focus on ocean regions of major tracer fronts, such as the Southern Ocean. The successful candidate will run a biogeochemical-circulation model, identify eddies in the simulations and add dye tracer for instance in the cores of eddies, with the goal to investigate the efficiency of eddies to transport biogeochemical tracers across tracer gradients. The physical effect of long-distance transport will be compared to concurrent biophysical impacts of eddies affecting sink and source terms of biogeochemical tracers. Potential parameterization approaches may be explored to represent the effect in coarse resolution climate models.

The candidate will have the opportunity to work in a highly dynamic and interdisciplinary research environment having access to a broad range of training opportunities within the Integrated School of Ocean Sciences (ISOS).

Snapshot of chlorophyll.- provided by CSIRO Marine Research, under the auspices of the SeaWiFS Project, NASA/Goddard, Space Flight Center and GeoEye.

Research Topic

Ocean vortices of scales of the order of 100 km (“mesoscale eddies”) are an inherent part of ocean circulation. They are known to be important for biogeochemical tracer distributions in the ocean because they act to reduce tracer gradients, hence homogenizing spatial tracer variability, through mixing. Contrary, another effect of mesoscale eddies on tracers is far less understood: the ability of coherent eddies to transport water and its tracer properties in their core laterally across tracer gradients. With this impact, eddies have the potential to be effective over much larger distances than their typical spatial scale and to act upgradient, i.e. enhancing tracer gradients.

It is of interest to the Earth system modelling community if this effect should be represented in numerical models which do not explicitly resolve ocean mesoscale eddies.

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Requirements/ Qualifications

Doctoral candidates must be highly motivated in studying ocean dynamics and marine biogeochemical tracers, programming and using numerical modelling tools. The candidate must hold a Master degree (or equivalent). Experience with a programming language, a plotting software, large datasets and numerical modelling is desired.

Important Notice: This topic does not include a scholarship for doctoral candidates. Interested students should bring a scholarship or contact us to find possibilities for funding.

Research group

The biogeochemical modelling research unit lead by Prof. A. Oschlies, carries out interdisciplinary research on the interactions between physical-chemical and biological processes at different spatial and temporal scales. Main tools are numerical models of different complexity that are continuously being developed.

Ivy Frenger has been working in the field of oceanography and marine biogeochemistry, using observational and modelling approaches to understand the characteristics and local effects of ocean mesoscale eddies, and the large-scale implications.

Further information

www.geomar.de/en/mitarbeiter/fb2/bm/aoschlies/

www.geomar.de/en/research/fb2/fb2-bm/research-topics/
Genomics and the origin of marine species

Prof. Dr. Oscar Puebla
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Research Topic
Recent evolutionary radiations such as Darwin’s finches, East African cichlids or Heliconius butterflies have served as model systems to understand how novel variation and new species arise. These systems, clearly in the early stages of divergence, have stimulated research into the behavioral, ecological, and genetic bases of reproductive isolation that have arguably transformed our understanding of the origins of biodiversity. However, no analogous classic radiation comes to mind in the largest ecosystem on earth, the ocean.

The overarching goal of our research is to develop the hamlets, simultaneously hermaphroditic reef fishes from the tropical western Atlantic (Figure 1), into a model system for the study of marine speciation. This endeavor builds on over a decade of work on the hamlets, with an explicit yet not exclusive focus on genetics.

This doctoral project builds on the recent assembly of a chromosome-level genome for the hamlets and the resequencing of >100 individuals with high coverage. It will consist in performing genome-scale analyses to uncover the genomic bases of speciation in the hamlets, but importantly to also take the next step with the development of a hamlet breeding program, fluorescence in situ hybridization experiments and genome editing with CRISPR/Cas.

Figure 1. From upper left to lower right: barred hamlet (*Hypoplectrus puella*), black hamlet (*H. nigricans*), butter hamlet (*H. unicolor*), shy hamlet (*H. guttavarius*), golden hamlet (*H. gummigutta*), yellowbelly hamlet (*H. aberrans*), indigo hamlet (*H. indigo*), blue hamlet (*H. gemma*), and tan hamlet (*Hypoplectrus sp*). Photographs from Reef Fish Identification, New World Publications, © 2002, Paul Humann.
Requirements/Qualifications

- Fluency in English, written and spoken.
- Bioinformatic skills for the genomic analyses.
- Laboratory skills for the experimental part.
- Experience breeding fishes would be a plus.

Important Notice: This topic does not include a scholarship for doctoral candidates. Interested students should bring a scholarship or contact us to find possibilities for funding.

Research group

The Marine Speciation group is led by Prof. O. Puebla (Research Unit Evolutionary Ecology of Marine Fishes, Research Division Marine Ecology, GEOMAR, Kiel, Germany). See http://www.puebla-lab.org/ for more info.

Further information

www.geomar.de/en/research(fb3/
Nutrient concentrations in seawater are controlled by sediments consuming nitrate and releasing phosphate and iron into the water column. The fluxes of these dissolved nutrients across the seabed are affected by oxygen conditions in ambient bottom waters and additional factors such as the deposition of marine and terrestrial particles. Against this background, the doctoral candidate will take part in research cruises to the Baltic Sea and other seas to measure benthic fluxes at the seabed and to take sediment cores for on-shore geochemical analysis. He/she will evaluate the data using numerical transport-reaction modeling. Models will be calibrated and employed to predict benthic fluxes under changing environmental conditions.

Requirements/Qualifications

The student should have a solid background in chemistry/geochemistry/biogeochemistry and mathematics (differential equations).

Important Notice: This topic does not include a scholarship for doctoral candidates. Interested students should bring a scholarship or contact us to find possibilities for funding.
Research group

Marine surface sediments act as a dynamic interface between oceans and geological reservoirs. They are inhabited by a rich microbial ecosystem regulating the exchange of matter across the seabed. Biogeochemical cycles in the ocean, the composition of seawater and the formation of seabed resources are strongly affected by the fluxes between surface sediments, the overlying water masses and the underlying geological reservoirs. Understanding the mechanisms and feedbacks that are controlling these fluxes is the major challenge for research unit Marine Geosystems. The research unit develops and applies advanced technologies to determine the fluxes across the seabed and the biogeochemical turnover in marine sediments. These include lander systems for in-situ flux measurements, microbial rate measurements, molecular studies and numerical modeling to predict benthic turnover under dynamic boundary conditions. New elemental and isotopic proxies are applied to better understand mineralization processes and geochemical sediment-water interactions.

Further information

www.geomar.de/en/mitarbeiter/fb2/mg/kwallmann/

www.geomar.de/en/research/fb2/
Relative Roles of the North Atlantic Oscillation and the East Atlantic Pattern in Driving the Atlantic Meridional Overturning Circulation

Prof. Dr. Mojib Latif
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Research Topic

The Atlantic Meridional Overturning Circulation (AMOC; Figure) is a major oceanic current system, which transports huge amounts of heat from low to high latitudes and has a major influence on climate. AMOC influences have been suggested on Atlantic hurricane activity, regional sea level, surface air temperature and precipitation on land areas adjacent to the North Atlantic Ocean, and on the Asian Monsoon systems. The leading mode of atmospheric variability in winter is the North Atlantic Oscillation (NAO). The NAO consists of a north-south dipole of anomaly centers spanning the North Atlantic between 35°N and 40°N. It is well established that the NAO has the potential to drive decadal to multi-decadal variability of the AMOC [e.g., Park et al. 2016]. The East Atlantic (EA) pattern is the second prominent mode of low-frequency SLP variability over the North Atlantic, and appears as a leading mode in all seasons. The EA pattern is structurally similar to the NAO, and consists of a north-south dipole of anomaly centers spanning the North Atlantic from east to west. The anomaly centers of the EA pattern are displaced southeastward to the approximate nodal lines of the NAO pattern. Recently, it has been suggested that the EA pattern also influences the AMOC, but in a different manner than the NAO. Here we wish to investigate the relative roles of the NAO and EA pattern in forcing decadal to multi-decadal AMOC variability.

The work will be conducted by analyzing long control integrations of climate models participating in the Coupled Model Intercomparison Project phase 5 (CMIP5, Taylor et al. 2012) and by conducting dedicated numerical experiments with the Kiel Climate Model (KCM, Park et al. 2009). The goal of the study is to quantify the influences of the NAO and EA pattern on the AMOC variability.

References

Requirements/Qualifications

The successful candidate should hold a Bachelor (8 semesters) or Master’s degree in Physics, Oceanography, and Meteorology or in another area of Applied Physics. Good English skills are required.

Important Notice: This topic does not include a scholarship for doctoral candidates. Interested students should bring a scholarship or contact us to find possibilities for funding.

Research group

The doctoral candidate will work in the Climate Modelling Group of GEOMAR’s Research Division Ocean Circulation and Climate Dynamics led by Prof. Dr. Mojib Latif.

The Earth’s climate arises from a complex interplay between the oceans, the atmosphere, sea and land ice, the vegetation, the biogeochemical cycles, and the solid Earth, and the influence of external factors. The feedbacks between the different climate subsystems and the variability of the climate system on different timescales are only partly understood. Climate modelling provides a useful tool to investigate variability and feedbacks in a systematic way. The performance and sensitivity of climate models can be tested against instrumental observations and paleo reconstructions. Modelling efforts cover the whole range of climate fluctuations from past climate variability to future climate evolution taking into account natural drivers and anthropogenic influences. Research topics comprise: internal climate variability at seasonal to centennial time scales, seasonal to decadal predictability, simulation of past climate variation, anthropogenic climate change, climate model development.

Further information

www.geomar.de/en/mitarbeiter/fb1/me/mlatif/
www.geomar.de/en/research/fb1/fb1-me/

Prof. Dr. Mojib Latif
Research Topic

The tropical Pacific is characterized by strong ocean-atmosphere coupling. Such coupling is at the heart of the El Niño/Southern Oscillation (ENSO) phenomenon, the leading mode of tropical interannual variability which has global climate impacts. The most important process in ENSO is the Bjerknes Feedback in which the equatorial upper ocean heat content affects atmospheric circulation via sea surface temperature (SST) perturbations. Despite rapid progress during the recent years, state-of-the-art climate models still depict severe deficits in simulating ENSO, which is often linked to too cold equatorial Pacific SST. The cold SST bias perturbs the atmospheric feedbacks operating in ENSO (Bayr et al. 2017) and is one reason for the too weak phase locking of ENSO to the annual cycle (Wengel et al. 2017). The origin of the equatorial Pacific cold SST bias is still under debate. It already exists in ocean-only simulations with prescribed observed atmospheric forcing, but it becomes much more significant in coupled simulations with an interactive atmosphere model. On the other hand, atmosphere model simulations with prescribed observed SSTs also show deficits in the atmospheric feedbacks operating in ENSO. This suggests that the biases in the ocean model and in the atmosphere model reinforce each other when the models are integrated in coupled mode. When an atmosphere and an ocean model are coupled, the physical parameterizations need to be adjusted, specifically the atmospheric convection scheme (Mauritsen et al. 2012). Bayr et al. (2017) and Wengel et al. (2017) demonstrate that the parameters in the convection scheme have a huge influence on the simulated tropical climate and its variability. For example, the strength of the equatorial Pacific cold SST bias is very sensitive to the choice of the parameters. However, the
mechanisms behind this large sensitivity remain unclear. In this project, we wish to untangle the atmospheric and the oceanic contribution to the equatorial Pacific cold SST bias and understand in detail the relevant processes.

The work will be conducted by analyzing existing simulations with the Kiel Climate Model (KCM, Park et al. 2009) and stand-alone (uncoupled) integrations of its individual model components, the ECHAM5 atmosphere model and the NEMO ocean model. These results will be compared to those from climate models participating in the 5th phase of the Coupled Model Intercomparison Project (CMIP5, Taylor et al. 2012). The goal of the study is to enhance our understanding of the mean-state biases, and their influences on ocean-atmosphere coupling and ENSO. We hope that the study will enhance the representation of ENSO and its global teleconnections (including the influence on the Asian Monsoon systems) in climate models.

References

Requirements/Qualifications
The successful candidate should hold a Bachelor (8 semesters) or Master’s degree in Physics, Oceanography, and Meteorology or in another area of Applied Physics. Good English skills are required.

Important Notice: This topic does not include a scholarship for doctoral candidates. Interested students should bring a scholarship or contact us to find possibilities for funding.

Research group
The doctoral candidate will work in the Climate Modelling Group of GEOMAR’s Research Division Ocean Circulation and Climate Dynamics led by Prof. Dr. Mojib Latif. The Earth’s climate arises from a complex interplay between the oceans, the atmosphere, sea and land ice, the vegetation, the biogeochemical cycles, and the solid Earth, and the influence of external factors. The feedbacks between the different climate subsystems and the variability of the climate system on different timescales are only partly understood. Climate modelling provides a useful tool to investigate variability and feedbacks in a systematic way. The performance and sensitivity of climate models can be tested against instrumental observations and paleo reconstructions. Modelling efforts cover the whole range of climate fluctuations from past climate variability to future climate evolution taking into account natural drivers and anthropogenic influences. Research topics comprise: internal climate variability at seasonal to centennial time scales, seasonal to decadal predictability, simulation of past climate variation, anthropogenic climate change, climate model development.

Further information
www.geomar.de/en/mitarbeiter/fb1/me/mlatif/
www.geomar.de/en/research/fb1/fb1-me/
Marine microbes are highly diverse and have endured extended evolutionary processes of physiological adaptations under the influence of a variety of ecological conditions and selection pressures. They harbor an enormous potential of metabolic diversity with still unknown, and probably new physiological characteristics, and are thus rich sources for the isolation of novel bioactive compounds. Ultimately, we aim to exploit the unique mechanisms of marine organisms, which have evolved to prevent biofilm formation in nature, for the development of novel anti-biofilm strategies particularly based on novel peptides or peptidomics for future solutions inhibiting biofilm formation on medical and industrial surfaces.

The aim of the doctoral project would be to discover novel marine peptides for future use in innovative anti-biofilm technologies. To achieve this goal we propose to generate metagenomic libraries from microbial consortia and expression libraries from different marine organisms (corals and sponges) that will be screened for quorum quenching and quorum sensing activities using established reporter gene constructs. Besides biofilm inhibition, compounds will be screened for inhibitory effects on cancer cell growth.

Another doctoral project would be to focus on the understanding of a metaorganism. One model system is the widely distributed jelly fish *Aurelia aurita*, which shows a di-phasic life cycle alternating between free-living pelagic sexual (medusa) and sessile benthic asexual (polyp) phases. We mainly focus on the microbial microbiota associated to the surface of *A. aurita* evaluating (i) the role of the environment, genetic background, external disturbance and challenge by opportunistic pathogens for the establishment and specificity of the microbiota, as well as (ii) the functional role(s) of the associated microbiota for the host. Ultimately we aim to get detailed insight into the interactions between the host and its microbiota including potential impacts of viruses in the metaorganism.
Requirements/Qualifications

- Excellent Masters degree in Microbiology, Biochemistry or Molecular Biology
- Solid background in microbiology, molecular biology, biochemistry
- Advanced laboratory experience
- Ability to interact and communicate with peers in an interdisciplinary research setting
- Excellent communication skills in English, written and oral

Important Notice: This topic does not include a scholarship for doctoral candidates. Interested students should bring a scholarship or contact us to find possibilities for funding.

Research group

The main research interests of Prof. Schmitz-Streit are to understand (i) regulation of nitrogen metabolism on the molecular level in Prokarya (Bacteria and Archaea), (ii) the marine nitrogen cycle, (iii) the interaction of Archaea with the human innate immune system and biofilm formation on living and non-living surfaces. Aiming to identify novel enzymes and drugs from marine environments her lab is further mining for novel genes by metagenomic approaches for potential biotechnological and medical use. Her lab provides an interactive and interdisciplinary working environment, in which the working group works on different scientific questions and aspects in close collaboration with other institutes in Kiel and around the world, applying sophisticated and state-of-the-art technologies. Within the Integrated School of Ocean Sciences (ISOS) doctoral candidates are trained interdisciplinary in several molecular aspects of marine sciences.

Further information

www.mikrobio.uni-kiel.de/de/ag-schmitz-streit
www.mikrobio.uni-kiel.de/de
Development of CRISPR/Cas mediated gene editing in the marine flatworms *Macrostomum lignano*

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Research Topic

The goal of this research topic is to construct transgenic marine flatworms (*Macrostomum lignano*) to study stress dependent signaling systems in this model organism. The simple, genetically tractable marine invertebrate, the flatworm *Macrostomum lignano*, lives in coastal environments and can easily be adapted to lab cultures. *Macrostomum* can cope with a number of different stressors, but the underlying mechanisms are not understood. A major aim of this study is to establish and utilize novel approaches for gene editing. A special focus should be on the CRISPR/Cas system that should be employed to produce either knock-out animals or to introduce reporter constructs. CRISPR/Cas mediated gene editing offers the unique possibility to manipulate non-model organisms such as *Macrostomum lignano* in order to characterize the stress sensing system as well as those factors that lead to the high stress resistance. Moreover, a toolbox for gene editing in this highly interesting marine model organism should be developed and made available for other projects utilizing this organism.

Requirements/Qualifications

- excellent degree in Biology, Biochemistry or Molecular Biology
- strong background in Molecular Biology
- good skills in laboratory work
- background in Genetics and Microscopy
- desirable  
- high motivation to conduct research in an international and interdisciplinary work group

Important Notice: This topic does not include a scholarship for doctoral candidates. Interested students should bring a scholarship or contact us to find possibilities for funding.
Research group

The doctoral project will be jointly supervised by Prof. Dr. Thomas Roeder (Kiel University) and PD Dr. Ulf Bickmeyer (AWI Bremerhaven). Thomas Roeder is a full member of the Kiel Future Ocean Cluster of Excellence and Professor at the Zoological institute at Kiel University. Ulf Bickmeyer is Research Scientist at the Alfred Wegener Institute, Helmholtz Centre for Polar- and Marine Sciences. Whereas the research focus of Thomas Roeder is in the field of general molecular biology and generation of transgenic animals, Ulf Bickmeyer is an expert in physiological studies and the use of high-end microscopic technologies. Both, Kiel University as well as the AWI Bremerhaven provide excellent research environments for doctoral candidates.

Further information


Aging is an inevitable consequence of metazoan life. Usually, aging is accompanied by a number of negative changes comprising decreased reproductive and movement ability, impaired metabolic functions, as well as the increase of the risk of suffering diseases. Only very few interventions have been shown to reproducibly increase life- and healthspan. Among them, dietary restriction is the most important one. Caloric or dietary restriction is defined as a diet composed of about 60-70% of the caloric intake seen under ad libitum feeding. In a great variety of organisms ranging from yeast to primates, this intervention increases life- and healthspan. Alternative approaches that are based on induction and usage of dietary restriction associated effects are thus highly relevant. One major aim of these studies is the identification and usage of compounds that mimic dietary restriction like effects. One relevant source of these compounds are marine products such as algae. Algae have been an important component of diets in countries located in east Asia such as Japan, parts of China or Korea that show highest lifespans worldwide. Thus, algal products are believed to be an ideal source for these health promoting compounds. Algae are important natural sources of health care products and dietary supplements as they contain many biologically active compounds that could be used as functional ingredients. Interestingly, studies in our laboratory identified a series of algal extracts that reproducibly extend lifespan in experiments using the model organism Drosophila melanogaster as a read-out. These extracts were the only ones out of approximately 1000 plant and algal extracts tested showing this effect. One of these algal extracts is from Saccorhiza polyschides, a large brown algae often found in the lowest part of the shore and it is the largest seaweed found in Europe. In this work, Saccorhiza polyschides and other algae will be employed as an additive of the diet of a model organism Drosophila melanogaster to evaluate its potential to be utilized as an anti-age dietary supplement. These studies are devoted to identify the active principle responsible for lifespan extension and to find optimal ways to deliver them. Moreover, other models should be employed to show the general usefulness of these dietary supplements.
Requirements/Qualifications

- excellent degree in Biology, Biochemistry or Molecular Biology
- strong background in Molecular Biology
- good skills in laboratory work
- background in Genetics and Microscopy desirable
- high motivation to conduct research in an international and interdisciplinary work group

Important Notice: This topic does not include a scholarship for doctoral candidates. Interested students should bring a scholarship or contact us to find possibilities for funding.

Research group

The doctoral project will be supervised by Prof. Dr. Thomas Roeder (Kiel University). Thomas Roeder is a full member of the Kiel Future Ocean Cluster of Excellence and Professor at the Zoological institute at Kiel University. The research focus of the interdisciplinary research group of Thomas Roeder is in the field of general molecular biology and generation of tailored animals models for a number of research topics, mostly using the fruit fly Drosophila melanogaster as a model. Identifying ways to lengthen life is one major goal of this research agenda.

Kiel University provides an excellent research environment for doctoral candidates.

Further information

www.molphys.uni-kiel.de/en

Prof. Dr. Thomas Roeder
Sea urchins as a model organism for pH regulation and calcification

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Research Topic

Marine species, especially single cell organisms and freely swimming larval states, are exposed to the infinite extracellular space of the ocean. Their physiological processes can be disrupted by alterations in the external milieu of this extracellular space. For example, the massive anthropogenic generation of CO₂ lowers the pH in their habitat and challenges acid base balance and calcification.

In our working group we want to understand the physiological mechanisms in marine model organisms, e.g. sea urchins. Our lab focuses on following research questions:

• How do organisms respond to ocean acidification in regulating their cellular pH?
• What controls and regulates cellular membrane transport?
• How is membrane transport characterised pharmacologically?
• How does the selectivity and regulation of tight and septate junctions take place?

For this, we apply electrophysiological methods (e.g. Patch-clamp or Ussing chamber), molecular methods (e.g. RNA/DNA preparation, Protein analysis, Immunohistochemistry) or Fluorescence imaging (e.g. [pH]).

If you are interested in answering questions in the field of pH regulation, epithelial transport and calcification in sea urchins contact us.

Further reading

Figure: Sea urchin larvae during in vivo measurement; Stumpp, M., et al. (2013); Nat Clim Change, 3, 1044-1049.
Requirements/Qualifications

- A Master’s degree in Natural Sciences
- Qualifications in electrophysiology, molecular biology and cell biology would be advantageous
- High motivation and interest in interdisciplinary research areas
- Interested in exploring new things
- Very good communication skills in English

Important Notice: This topic does not include a scholarship for doctoral candidates. Interested students should bring a scholarship or contact us to find possibilities for funding.

Research group

Markus Bleich’s group is interested in epithelial transport in marine model organisms and mammals. Essential research questions are mechanisms of pH regulation, control and regulation of cellular membrane transport and function of tight and septate junctions. Applied methods are from the field of electrophysiology, molecular biology and fluorescence imaging. The Institute of Physiology is part of the Medical Faculty at Kiel University and conducts several projects within the Cluster of Excellence „The Future Ocean“. This multidisciplinary network of scientist within the Cluster of Excellence provides an ideal background for translational perspectives from man to marine organisms and vice versa.

Further information


www.physiologie.uni-kiel.de/en
Research Topic

To a great extent, climate and marine research rely on modeling and model simulations. Most climate models are formulated or translated in the language of mathematics: They are written as ordinary or differential equations. These equations are the basis for all kind of simulations, ranging from paleo reconstructions over sensitivity studies for process understanding to prognostic runs. From the viewpoint of applied mathematics and computer science, there arise many both exciting and challenging questions: Are the model equations well-defined? What about existence and uniqueness of solutions? What is the appropriate way to solve the equations numerically, i.e., to perform a simulation? And how can the solution process be accelerated, maybe using the newest developments in computer science as GPU computing? How can the models be optimized by identifying parameters that generate realistic output? How to assess different models? And how to optimize climate and ocean management?
Requirements/Qualifications

- degree in (Applied) Mathematics, Computer Science, Physics or related
- strong background in numerical mathematics
- strong background and affinity to programming
- optional: background in optimal control of differential equations
- willingness to work in an interdisciplinary group

Important Notice: This topic does not include a scholarship for doctoral candidates. Interested students should bring a scholarship or contact us to find possibilities for funding.

Research group

Thomas Slawig is an applied mathematician and Professor for Algorithmic Optimal Control at Kiel University. Together with the other groups working in Applied Mathematics, his research group is integrated in the Department of Computer Sciences at Kiel University, in close contact with the Mathematics Department. He is a full member in the Cluster of Excellence „Future Ocean“ in Kiel.

His research interests include optimal control of partial differential equations, numerical mathematics, and high performance computing, especially in the field of climate and ocean science. A main focus of his group’s research is the parameter identification of marine ecosystem models, describing the interaction of biogeochemical tracers with the ocean circulation. Since these models are very time-consuming in simulation and optimization runs, the efficient usage of mathematical algorithms and parallel hardware is crucial. The research is conducted in close cooperation with groups from GEOMAR Helmholtz Centre for Ocean Research Kiel and other university departments. In addition, the group is also engaged in the development of apps for mobile devices, with different applications.

Thomas Slawig’s group consists of 4-6 doctoral candidates and several BSc+MSc candidates, mostly from applied mathematics and computer science.

The Department of Computer Science

In 1971, our department was founded as one of the first departments of Computer Science in the Federal Republic of Germany and has since been the focal point of research and educational activities in Computer Science at Kiel University. Currently, the department consists of 19 working groups, covering all central aspects of computer science, business information technology and parts of algorithmical and numerical mathematics. Additionally, the workgroups are engaged in numerous externally funded projects.

Further information

www.algopt.informatik.uni-kiel.de/en
Late Pleistocene Drake Passage surface to subsurface oceanography and SE Pacific mode water impact on the S Atlantic

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Research Topic

Tracing the Drake Passage (SE Pacific) surface and subsurface oceanography and mode water dispersal on glacial/interglacial timescales. PhD reconstructing past seasurface to subsurface temperature and salinities to deduce oceanographic frontal movements and thermocline variations in relation to mode water formation processes and its exchange between Pacific and Atlantic.

The South East Pacific is the principal formation area of Subantarctic Mode Water (SAMW) and Antarctic Intermediate Water (AAIW). The SAMW is formed north of the Subantarctic Front via the deepening of mixed layers during wintertime convection. The SAMW becomes progressively colder, fresher, and denser as it approaches the Drake Passage, forming the coldest and densest variety of SAMW known as AAIW. SAMW and AAIW are exported to the lower thermocline in the Subtropical Gyres of Southern Hemisphere oceans. These water masses play a fundamental role in ventilating the modern thermocline of the subtropical South Ocean gyres as well as transporting heat, salt and nutrient from the Southern Ocean to lower latitudes, via processes such as “oceanic tunneling” on glacial–interglacial time–scales.

To date, the enhanced Southern Ocean Intermediate Waters (SOIWs) presence during cold periods in mid and low latitudes of the East Pacific has been explained by invoking either latitudinal displacement and/or stronger Southern Westerly Wind. An opposite situation, i.e. increased formation of SOIWs during warm periods, has been proposed in the South West Pacific off New Zealand. These regional differences emphasize further need of geographical constraint in the data-poor Southern Ocean, in order to better understand the spatial pattern of SOIW formation and dispersal even into the South Atlantic.

Doctoral project

The proposed doctoral project will tackle the above mentioned research topics by deciphering the geochemical signatures of planktonic microfossil (foraminifera) calcite selected from sediment cores recovered in 2016 from Drake Passage. (Isotope)geochemical proxies are relevant tools to reconstruct past ocean conditions, for example, ocean temperatures and salinities, thermocline variations, meltwater/freshwater discharge, water column stratification and ventilation, and modewater formation processes. Main focus will be on the analyses of stable oxygen (δ18O) and carbon isotopes (δ13C), and elemental ratios (Mg/Ca, Na/Ca, Ba/Ca, Sr/Ca, Cd/Ca) from shallow and deep living planktonic foraminifera.
Requirements/Qualifications

- excellent degree in chemical paleoceanography, or marine geology
- advanced background in analytical methods (e.g., MAT253, ICP-OES, ICP-MS)
- preferentially background in preparing scientific publications
- proven knowledge in spoken and written English language
- willingness to carry out a demanding PhD project within a large research initiative
- interest in performing ambitious research in an interdisciplinary and international setting

Important Notice: This topic does not include a scholarship for doctoral candidates. Interested students should bring a scholarship or contact us to find possibilities for funding.

Please send your application, preferably by e-mail, to:
Prof. Dr. Dirk Nürnberg (email: dnuernberg@geomar.de)
In your application, please also provide two reference letters from previous supervisors/cooperating experts.

Research group

The candidate will mainly work at GEOMAR Kiel, using the isotope and trace metal laboratories of the Research Unit Paleoceanography. The state-of-the-art (mass) spectrometric infrastructure at GEOMAR will be available to the doctoral candidate and will guarantee the successful accomplishment of the envisioned study. The supervision will be done by Prof. Dr. Dirk Nürnberg, co-supervised by Dr. Frank Lamy. The close collaboration with AWI Bremerhaven will allow intense sojourns in the collaborating working group of Dr. Lamy. Further intense collaboration is agreed with Prof. Carina Lange (Univ. Concepcion, Chile) and Prof. Dr. Helge Arz (IOW Warnemünde).

DN and FL are senior scientists at GEOMAR and AWI cooperating since long. DN is head of the working group “paleotemperatures” and head of isotope and trace metal labs at GEOMAR. FL is proponent and chief scientist of RV Polarstern cruise PS97 to the Drake Passage (https://www.youtube.com/watch?v=421zC92RUlg&feature=youtu.be), and an internationally renowned paleoceanographer.

Further information

www.geomar.de/en/mitarbeiter/fb1/po-z/dnuernberg/
www.geomar.de/en/research/fb1/fb1-p-oz/research-topics/
The Host Institutions

Kiel University

Kiel University is the only full university in the state of Schleswig-Holstein. It is home to more than 24,000 students as well as 2,000 university teachers and researchers. Creating links between the different scientific cultures is the top priority at Kiel University. Scientific research at the University is multi-layered and complex. One of four foci is marine and geological sciences, uniting researchers from all faculties.

www.uni-kiel.de

GEOMAR Helmholtz Centre for Ocean Research Kiel

GEOMAR Helmholtz Centre for Ocean Research Kiel is one of the world’s leading institutes in the field of marine science. With a total staff of 1,000, the institute investigates the chemical, physical, biological and geological processes of the seafloor, oceans and ocean margins and their interactions with the atmosphere. Many of GEOMAR’s fundamental research results are applied in industry. These include discoveries of marine drugs, marine aquaculture, marine mineral resource exploration and assessment, technologies for sustainable development and extraction of natural gas from submarine gas hydrate deposits, storage of carbon dioxide in solid form below the seafloor, and the development of deep-sea equipment and vehicles.

www.geomar.de

Association for Marine Aquaculture (GMA)

The GMA builds and operates its own aquaculture research and development facility (circulation systems) in the Büsum location. The GMA also supports internal and external projects concerning applied research and development in the areas of fish breeding and cultivation. A further emphasis is the dissemination of knowledge and technology concerning breeding and cultivation of organisms in brackish and salt water.

www.gma-buesum.de
Kiel Institute for the World Economy

The Kiel Institute for the World Economy 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. It advises decision makers in politics, economics and society, and keeps the interested public informed on important matters of economic policy.

www.ifw-kiel.de

Muthesius University of Fine Arts and Design

The Muthesius University of Fine Arts and Design in Kiel is Germany’s northernmost and youngest school of higher education. Thanks to an innovative course structure, the University’s concept features a diverse programme of curriculum options in the fields of fine art, spatial strategies and design. The interdisciplinary course structure, which links all fields at the Art University, thus providing the students with a great diversity of subject areas. As a result, new interdisciplinary projects can be undertaken.

www.muthesius-kunsthochschule.de