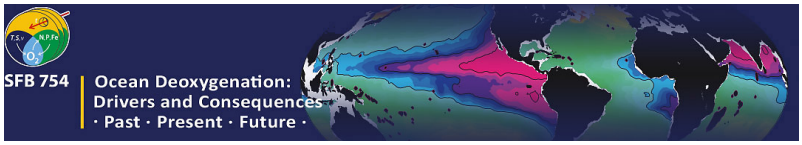
Ocean Deoxygenation Conference | Kiel 2018



Sunday 02 September 2018 - Friday 07 September 2018

Audimax | Kiel University

Scientific Programme

There are ten scientific topics:
Prediction and Monitoring
Ecosystem Impacts
Ventilation and Oxygen Supply
Microbial Communities and their Impact on Biogeochemical Cycles in Oxygen Minimum Zones
Major Upwelling Systems
Physiological Effects of Oxygen and Interactions with Multiple Stressors
Impacts on Fisheries / Socioeconomics
Coastal Systems: From Understanding to Management
Ocean Deoxygenation - how the Past can Inform the Future
Biogeochemical Cycles: Feedbacks and Interactions

Each topic will invite three keynote speakers for plenary talks in the morning as well as host different oral and poster sessions in the afternoon. Below you can find the abstracts and convener teams of the different topics.

In addition, the conference committee has invited as special keynote Prof. Dr. Londa Schiebinger, Stanford University, who is a leading international authority on gender and science. Over the past thirty years, Schiebinger's work has been devoted to teasing apart three analytically distinct but interlocking pieces of the gender and science puzzle: the history of women's participation in science; gender in the structure of scientific institutions; and the gendering of human knowledge.

01 Prediction and Monitoring

Conveners:
Birgit Schneider (Institute of Geosciences, Kiel University, Germany)
Mojib Latif (GEOMAR Helmholtz Centre for Ocean Research Kiel, Germany)
Arne Körtzinger (GEOMAR Helmholtz Centre for Ocean Research Kiel, Germany)
Osvaldo Ulloa (Oceanography Department, University of Concepción, Chile)

The content of dissolved oxygen in the ocean is sensitive to climate variability and climate change. Due to the strong temperature dependence of its solubility, oceanic oxygen is expected to decline in a future warming ocean, which was already demonstrated by earth system models. Observations of oceanic oxygen trends over several decades indicate that also oxygen minimum zones in the subsurface ocean are affected, showing an intensification (further oxygen decrease) and/or expansion of their spatial extent.
In this session we invite studies on the detection and quantification of oceanic oxygen change on timescales up to multidecadal. We welcome contributions on a range of spatial scales, from focused studies on certain oceanic regions to the global ocean oxygen budget, using observational data, model results, and ideally a combination of both.

Keynote speakers in this session: **Laure Resplandy | Stephanie Henson | Nicolas Gruber**

02 Ecosystem Impacts

Conveners:
Denise Breitburg (Department of Biology, University of Maryland, College Park, US)
Helena Hauss (GEOMAR Helmholtz Centre for Ocean Research Kiel, Germany)
Patricia Ayon (IMARPE, Callao, Peru)

Declining oxygen in the open ocean and coastal waters (systems strongly influenced by their

watershed) has the potential to greatly alter marine ecosystems. Whether due to global warming, high nutrient loads, or a combination of the two, low oxygen affects distributions, interactions, and physiology of both pelagic and benthic species, resulting in profound changes in biodiversity, food webs and ecosystem structure and functioning. Effects may be direct (such as respiratory stress) or indirect (such as changes in nutrient inventories and stoichiometry), and variation among species in their tolerance and response to low oxygen can play an important role in determining consequences. Even seemingly subtle changes in oxycline depth can have large impacts due to interactions with other habitat structuring factors such as light levels, nutrient availability, and biomass distributions. This theme session will explore effects and implications of declining and low oxygen in both coastal and oceanic systems. We welcome presentations that consider organismal, community, food web and ecosystem-level effects of oxygen declines, and that focus on any component of marine systems from microbes to apex predators.

Keynote speakers in this session: **Lisa Levin | Alf Norkko | Arnaud Bertrand**

03 Ventilation and Oxygen Supply

Conveners:
Véronique Garcon (LEGOS, Toulouse, France)
Lothar Stramma (GEOMAR Helmholtz Centre for Ocean Research Kiel, Germany)
Oscar Pizarro (Department of Geophysics, University of Concepción, Chile)
Xavier Capet (LOCEAN, IPSL, Paris, France)

Ocean oxygen observations for five decades since 1960 indicate a decrease of about 2% of the global ocean oxygen inventory and climate models predict continuous deoxygenation of the global ocean in the future. In the open ocean changes in ventilation and oxygen supply are considered to be major drivers of trends in the oxygen inventory. Global warming and wind changes seem to be the major causes. Changes in temperature, winds and currents will alter physical processes. In addition biological processes can influence the oxygen and nutrient distribution. Superimposed on the oxygen trends are climate modes, like the Pacific Decadal Oscillation in the Pacific, the North Atlantic Oscillation in the Atlantic, the Indian Ocean Dipole in the Indian Ocean or the Southern Annual Mode. So far it is mostly unknown what the contribution of the climate modes on the oxygen inventory and multi-decadal trends is.
In this session we are seeking oral and poster contributions on large-scale distribution and variations of oxygen and nutrient distribution, on the pathways of ventilation either related to a regional context (in particular OMZs) or the implied mechanisms (e.g. zonal jets in the tropics, mid/high latitude subduction). We welcome also investigations on how existing pathways and processes are being perturbed by climate variability in the ocean from observations and modelling, and presentations which relate the oxygen changes to observed and modelled biogeochemical variations.

Keynote speakers in this session: **Peter Brandt | Ivonne Montes | Laurent Bopp**

04 Microbial Communities and their Impact on Biogeochemical Cycles in Oxygen Minimum Zones

Conveners:
Anja Engel (GEOMAR Helmholtz Centre for Ocean Research Kiel, Germany)
Klaus Jürgens (Leibniz Institute for Baltic Sea Research Warnemünde, Germany)
Tina Treude (Department of Atmospheric and Ocean Sciences, University of California, Los Angeles, US)

Oxygen minimum zones (OMZs) in the ocean are created by microbial respiration during organic matter degradation. They host a diverse range of microorganisms that are capable to grow under reduced oxygen or even anoxic conditions. Depending on the availability of oxygen and other electron acceptors, microbial communities display a variety of heterotrophic and autotrophic processes that influence marine element cycling, notably of carbon, nitrogen and sulfur, but also for trace metals. Understanding the complex interplay between oxygen sensitivity of microbial processes and other controlling factors, such as the availability of organic and inorganic substrates, temperature and pH, is essential to estimate the role of OMZs in biogeochemical cycling. This session invites presentations on all aspects of microbial life under reduced oxygen conditions. We welcome field, experimental and modelling studies that give insight into the role of bacterial and archaeal communities in OMZs, their growth and losses, contribution to biogeochemical transformations, as well as technical innovations to investigate microbial life under hypoxic conditions.

Keynote speakers in this session: **Osvaldo Ulloa | Bess Ward | Bo Thamdrup**

05 Major Upwelling Systems

Conveners:
Hermann W. Bange (GEOMAR Helmholtz Centre for Ocean Research Kiel, Germany)
Sören Thomsen (GEOMAR Helmholtz Centre for Ocean Research Kiel, Germany)
S. Wajih A. Naqvi (Environment and Life Sciences Research Centre, Kuwait Institute for Scientific Research, Salmiya, Kuwait)

Coastal upwelling systems (including eastern boundary and northern Indian Ocean upwelling systems, EBUS and NIOUS, respectively) play a key role in the global carbon and nitrogen cycles and are of local relevance due to their high productivity and the associated fisheries. The major coastal upwelling systems are usually associated with pronounced oxygen minimum zones (OMZ) and are characterized by a complex interplay of physical, biological and chemical processes (in sediments, water column and atmosphere). These systems are driven by various physical processes ranging from mesoscale eddies, submesoscale filaments and fronts down to internal waves and microscale turbulence which are important for the transport of oxygen and thus ventilation of the OMZ. This, in turn, determines occurrence of O₂-sensitive biogeochemical processes in the water column and sediments of OMZ. Recent increase in computational power and new techniques such as multi-nesting approaches made it possible to increase the resolution of regional ocean general circulation models down to some hundred meters. New observational techniques such as airborne, underway, and autonomous technologies allow for high-resolution adaptive multidisciplinary campaigns. Recent progress in biological/microbial techniques and application of new chemical sensor techniques allow deciphering of biogeochemical patters with unprecedented high resolution. Both observational and modelling studies investigating all physical, biological and chemical aspects of the major coastal upwelling systems and associated OMZ (incl. EBUS and NIOUS) are welcome.

Keynote speakers in this session: **Marina Lévy | Damian Arévalo-Martínez | Carolin Löscher**

06 Physiological Effects of Oxygen & Interactions with Multiple Stressors

Conveners:
Lisa Levin (Integrative Oceanography Division, Scripps Institution of Oceanography, La Jolla, US)
Rainer Kiko (GEOMAR Helmholtz Centre for Ocean Research Kiel, Germany)

Oxygen availability has been a driving force for marine life over geological timescales, and today we can observe how its variability creates heterogeneity in space and time. For most organisms, oxygen is essential for survival, but for some it is toxic. In OMZ regions, oxygen becomes limiting and therefore structures the marine ecosystem strongly. For example, some protists thrive under anoxia and employ anaerobic mechanisms, whereas other protists and many metazoans might avoid low oxygen regions. Some zooplankton and nekton organisms migrate into and out of hypoxic or anoxic parts of the water column while other planktonic and benthic organisms can survive prolonged hypoxia. These capabilities are underlain by physiological adaptations, and ultimately act to structure species distributions. Hypoxia tolerance also strongly depends on temperature, environmental carbon dioxide levels and possibly other abiotic stressors, and changes in these factors can have ecosystem-wide effects.
We invite contributions that deal with the physiological effects of oxygen - including interactions with temperature, carbonate system parameters and other stressors - on individual performance of benthic and pelagic protists and metazoans from the gene to population level. Issues of interest for this session include (i) mechanisms by which organisms adapt or acclimate to variations in oxygen levels at the cellular to organism level, (ii) how this leads to differences in physiological capacity (iii) impacts on the functional and behavioral attributes of marine organisms, and (iv) how the features can be parameterized for biogeochemical model development.

Keynote speakers in this session: **Denise Breitburg | Brad Seibel | Tom Fenchel**

07 Impacts on Fisheries / Socioeconomics

Conveners:
Karin Limburg (College of Environmental Science and Forestry, State University of New York, Syracuse, US)
Martin Quaas (Department of Economics, Kiel University, Germany)

Declining oxygen in the world’s oceans is expected to have a significant impact on fisheries as well as other socioeconomic activities over the 21st century. In fact, change may already be detectable in terms of reduced biomass production, loss or diminution of species, losses of shellfish beds and coral reefs, and changes in fish stock locations as species are forced to flee low oxygen water masses, for example. This session will explore the effects of spreading deoxygenation on fisheries, tourism, coastal communities, and other aspects of societal well-being. Papers are welcome on topics ranging from fisheries assessments, to economic, ecological-economic, and social-ecological-systems analyses.

Keynote speakers in this session: **Kenny Rose | Michele Casini | Rashid Sumaila**

08 Coastal Systems: From Understanding to Management

Conveners:
Marilaure Gregoire (Department of Astrophysics, Geophysics and Oceanography, University of Liège, Belgium)
Katja Fennel (Department of Oceanography, Dalhousie University, Halifax, US)
Minhan Dai (College of Ocean & Earth Sciences, Xiamen University, China)
Renato Quinones (Interdisciplinary Center for Aquaculture Research, University of Concepción, Chile)

In the coastal ocean, encompassing the river-estuary-sea continuum, low-oxygen zones have spread exponentially since the 1960s and have been reported for hundreds of systems worldwide. This primarily results from the proliferation of eutrophication as a consequence of the increased river exports of nitrogen, phosphorus and carbon during the last decades. In some regions, the oxygen levels are so low that living organisms and biogeochemistry are altered, leading, in some cases, to mass mortality events. In extreme cases, anoxia occurs with the production of hydrogen sulphide which is toxic to multicellular organisms. In addition to deoxygenation, the coastal zone faces many other stressors like warming, acidification, and fishing. These stressors in combination with deoxygenation will affect coastal ecosystems in ways that are not well understood with potential consequences that are currently ignored in environmental and resource management.
The session aims to overview recent developments and understanding, by inviting observational, experimental and modelling studies of the deoxygenation process in the coastal zone. Themes of particular interest include:
- Observing oxygen: development of new sensors for the coastal zone (e.g. improvement of detection limits, spatial and temporal resolution, observation from space of anoxic events), establishment of an observing system for the coastal zone (e.g. alarm system, variables that need to be monitored conjointly with oxygen)
- Mapping oxygen: data availabilities for the global coastal zone, coastal climatologies, new methodologies
- Assessing the consequences on biogeochemical cycling of oxygen deficiency: impact on the cycling of major elements, production of greenhouse gases (e.g. CH₄, N₂O), nitrogen fixation, development of feedback loops (e.g release of sediment phosphorus)
- Assessing the consequences of oxygen deficiency on individual organisms: multi-stressor impacts, development of particular species (e.g. invasive species, cable bacteria), trait selection
- Assessing the consequences of oxygen deficiency at the scale of the ecosystem: from individuals to ecosystem and fisheries: how to scale up?
- Modelling oxygen: processes and scales of importance, coupling between systems (e.g. development of an approach offering a seamless coupling between the river-estuary-sea continuum, coupled ocean-atmosphere models, benthic-pelagic coupled models), models addressing the impact of blue growth activities (e.g. aquaculture development)
- Predicting oxygen: predictive capabilities, forecasting oxygen in operational oceanography, modelling the risk, ensemble approaches, scenarios of changes
- Recovering from oxygen deficiency in a globally changing environment: management strategies that succeeded or failed to recover from oxygen deficiency, combination of different stressors (e.g. warming, acidification, fishing)
- Communication to stakeholders: information needed (e.g. saliency, robustness, richness), cost-benefit analysis, best practices of interactions

Keynote speakers in this session: **Daniel Conley | Nancy Rabalais | Jianping Gan**

09 Ocean Deoxygenation - How the Past can Inform the Future

Conveners:
Martin Frank (GEOMAR Helmholtz Centre for Ocean Research Kiel, Germany)
Babette A.A. Hoogakker (The Lyell Centre, Heriot Watt University, UK)
Samuel L. Jaccard (Institute of Geological Sciences, University of Bern, Switzerland)

Anthropogenic warming is expected to drive oxygen out of the ocean, as seawater temperature will rise and the upper ocean will become more stratified. Widespread deoxygenation will have an impact on marine habitats as well as major biogeochemical cycles, with O₂ being a key factor controlling the cycling of carbon, nitrogen, phosphorous, and redox sensitive elements.

While recent observations appear to confirm this prediction, the changes have so far remained subtle and may at least partly be the result of natural decadal variability. Beyond the instrumental record, paleoceanographic reconstructions extend much further back in time, and can provide an independent perspective on changes in oxygen concentrations and their drivers, such as ocean circulation and export production changes.
We welcome contributions addressing past changes in ocean oxygenation (global, regional, local) since the Cretaceous. This includes assessments of associated consequences on nutrient cycling, such as nitrogen and trace metal inventories, as derived from model simulations and/or sedimentary reconstructions.

Keynote speakers in this session: **Eric Galbraith | Zunli Lu | Dimitri Gutierrez**

10 Biogeochemical Cycles: Feedbacks and Interactions

Conveners:
Eric Achterberg (GEOMAR Helmholtz Centre for Ocean Research Kiel, Germany)
Laura Bristow (Department of Biogeochemistry, Max Planck Institute for Marine Microbiology, Bremen, Germany)
Caroline Slomp (Faculty of Geosciences, Utrecht University, Netherlands)

Oxygen concentrations in the ocean are decreasing with potential major consequences for marine life. In the open ocean, natural variability and global warming are key contributors to the expansion of oxygen deficient zones (ODZs). Coastal dead zones are mostly the direct result of increased anthropogenic inputs of nutrients. The nutrient inputs are fueling algal blooms that, upon their demise, drive an enhanced oxygen demand in bottom waters. In both the open and coastal ocean, variations in oxygen concentrations are known to induce major changes in the pathways of organic matter remineralization. For example, low oxygen is known to enhance nitrogen removal through denitrification and anammox, while phosphorus is typically recycled more efficiently. Iron release from sediments is characterized by a “window-of-opportunity” where oxygen concentrations are low but bottom waters are not yet sulfidic. Observations with new analytical techniques and modelling studies are revealing a role for previously overlooked processes and (potential) linkages and feedbacks between elemental cycles in low oxygen areas, such as cryptic sulfur cycling and anaerobic methane oxidation, which are directly or indirectly linked to the nitrogen cycle. In order to gain an integrated picture and make reliable projections of element cycles and their fluxes and interactions in ODZs of the future ocean, we require a mechanistic and quantitative process understanding of biogeochemical processes in low oxygen areas of the ocean.
This session invites presentations from observational, experimental and modeling standpoints on the biogeochemistry of ODZs and areas suffering from coastal hypoxia. Contributions focusing on the cycling and / or interactions of carbon, nitrogen, phosphorus, iron and sulfur and the emerging research areas of methane and N₂O production and emission in ODZs are particularly welcome.

Keynote speakers in this session: **Wei-Jun Cai | Donald Canfield | Tom Jilbert**