NEWSLETTER
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Sonderforschungsbereich 754
Climate – Biogeochemistry Interactions in the Tropical Ocean

SFB 754

SFB 754 continues with a 3rd phase (2016-2019)

Thanks to everyone for your support and efforts!

Publications

Asteman, I.P. and J. Schönfeld (2015) Recent invasion of the foraminifer *Nonionella stella* Cushman & Moyer, 1930 in northern European waters: evidence from the Skagerrak and its fjords. J. Micropalaeontology, doi: 10.1144/jmpaleo2015-007

The eastern Pacific benthic foraminifer *Nonionella stella* Cushman & Moyer, 1930 was recorded for the first time in the Skagerrak (North Sea) and its fjords. The migration pathway was evaluated, considering both dispersal by propagules and ship ballast tanks. The distribution pattern in the northeastern Atlantic revealed that predominantly southward surface currents along the western European seaboard and Morocco would impede a wide-range dispersal of *N. stella* propagules to the North. Transportation by ship ballast tanks is therefore considered as the possible vector of *N. stella* immigration into northern European seas.

Xu, X., J. Segeschneider, B. Schneider, W. Park and M. Latif (2015) Oxygen minimum zone variations in the tropical Pacific during the Holocene. Geophys. Res. Lett., 42, 8530–8537, doi: 10.1002/2015GL064680

Simulations are performed with a global model of ocean biogeochemistry forced with orbitally driven anomalies of oceanic conditions for the mid-Holocene, known as Holocene climate optimum, to investigate natural variability in the eastern equatorial Pacific oxygen minimum zone (EEP OMZ). While the global mean temperature during the mid-Holocene was likely slightly higher than the 1961–1990 mean, the sea surface temperature in the EEP was slightly lower. Mid-Holocene oxygen concentrations in the EEP OMZ are generally increased, locally by up to 50%, and the EEP OMZ volume was, depending on definition of the OMZ threshold, at least 6% lower. These higher oxygen levels are the combined result of competing physical and biogeochemical processes. The results imply that mechanisms for past changes in the EEP OMZ intensity and extension can differ from the global warming driven decline in oxygen levels observed for the recent decades and predicted for the future.

Chow, J.S., C. Lee and A. Engel (2015) The influence of extracellular polysaccharides, growth rate, and free coccoliths on the coagulation efficiency of *Emiliania huxleyi*. Marine Chemestry, 175, 5-17, doi: 10.1016/j.marchem.2015.04.010

In this study, the efficiency of particle coagulation of the coccolithophore *Emiliania huxleyi* is estimated at different growth rates using Couette flow devices at a natural shear rate. To determine the impacts of chemical and biological factors involved in aggregate formation, it is investigated how variance in organic matter composition, and in particular the presence of extracellular polysaccharides (EP), including transparent exopolymer particles (TEP) and acidic polysaccharides attached to the coccolith surface, affect the coagulation efficiency (α). When *E. huxleyi* was grown in a chemostat at different growth rates, coagulation efficiency increased from ~ 0.40 to 1 as cell growth rates declined and nutrients became more limited. With declining growth rate the concentration of EP and the number of detached coccoliths increased. Overall a close correlation between coagulation efficiency of *E. huxleyi* and the ratio of EP to total particle volume was observed. The minimum value of α of ~ 0.4 determined during this study is higher than estimates published for other phytoplankton cells, and may be related to the presence of EP attached to coccoliths. Based on the findings, it can be suggested that *E. huxleyi* is more prone to form aggregates, particularly during the decline of blooms, when increased production of EP and enhanced shedding of coccoliths coincide. This may be one explanation for why blooms of *E. huxleyi* play an important role in the biological carbon pump, efficiently enhancing the vertical flux of particles, as has been suggested by sediment trap studies.

Salvatteci, R., D. Gutierrez, A. Sifeddine; L. Ortlieb, E. Druffel, M. Boussafir and R. Schneider (2016) Centennial to millennial-scale changes in oxygenation and productivity in the Eastern Tropical South Pacific during the last 25,000 years. Quaternary Science Reviews, 131, 102-117

In the present study a stacked record covering the last 25 kyr from the Eastern Tropical South Pacific (ETSP) oxygen minimum zone (OMZ) is used to reconstruct changes in oxygenation and productivity. A suite of proxies including the presence of laminations, redox sensitive metals (U, Mo, Re, Ni and Cu), total organic carbon and $d^{15}N$ measurements are used. Water column denitrification and sediment redox conditions show pronounced centennial to millennial-scale variability during the last 25 kyr, with oxygenation levels as low as at present. Global cold periods at different timescales such as the Last Glacial Maximum (23-19 kyr BP) and the Little Ice Age (1500-1850 AD) were associated with a weak OMZ and low export production, while warm intervals such as the deglaciation, part of the Medieval Climate Anomaly and the last 100 years are associated with a stronger OMZ and high export production. Water column denitrification and sediment redox conditions were strongly coupled during the last 25 kyr BP apart from one remarkable exception: during the

Antarctic Cold Reversal, sediments were less reducing but the water column denitrification was high resulting in a strong but shallow OMZ. This may have been produced by an enhanced Antarctic Intermediate Water flow. Contrary to expectations and modeling predictions for the next few decades, a weak ETSP-OMZ can be observed during the warm mid-Holocene, which may have been the result of a stronger Walker Circulation that brought oxygen-rich waters to intermediate depths off Peru via Equatorial undercurrents. In combination with other paleoceanographic reconstructions, the results show that oxygenation variability in the ETSP-OMZ was influenced by ocean circulation changes in the Tropical Pacific, high latitude oceanographic and climatic changes, and local productivity.

Kriest, I. and A. Oschlies (2015) MOPS-1.0: towards a model for the regulation of the global oceanic nitrogen budget by marine biogeochemical processes. Geosci. Model Dev., 8, 2929-2957, doi: 10.5194/gmd-8-2929-2015

Global models of the oceanic nitrogen cycle are subject to many uncertainties regarding the representation of the relevant biogeochemical processes and of the feedbacks between nitrogen sources and sinks that determine space- and timescales on which the global nitrogen budget is regulated. These aspects are investigated using a global model of ocean biogeochemistry that explicitly considers phosphorus and nitrogen, including pelagic denitrification and nitrogen fixation as sink and source terms of fixed nitrogen, respectively. The model explores different parameterizations of organic matter sinking speed, oxidant affinity of oxic and suboxic remineralization, and regulation of nitrogen fixation by temperature and different stoichiometric ratios. Examination of the initial transient behavior of different model setups initialized from observed biogeochemical tracer distributions reveal changes in simulated nitrogen inventories and fluxes particularly during the first centuries. Millennial timescales have to be resolved in order to bring all biogeochemical and physical processes into a dynamically consistent steady state. Analysis of global properties suggests that not only particularly particle sinking speed but also the parameterization of denitrification determine the extent of oxygen minimum zones, global nitrogen fluxes, and hence the oceanic nitrogen inventory. However, the ways and directions in which different parameterizations of particle sinking, nitrogen fixation, and denitrification affect the global diagnostics are different suggesting that these may, in principle, be constrained independently from each other. Analysis of the model misfit with respect to observed biogeochemical tracer distributions and fluxes suggests a particle flux profile close to the one suggested by Martin et al. (1987). Simulated pelagic denitrification best agrees with the lower values between 59 and 84 Tg N yr^{-1} recently estimated by other authors.

Fleury, S., X. Crosta, R. Schneider, T. Blanz, O. Ther and P. Martinez (2015) Centennial-scale variations in diatom productivity off Peru over the last 3000 years. The Holocene, 1–12, doi: 10.1177/0959683615612589

The Peruvian coastal upwelling is one of the most productive systems in the global ocean, with important impacts on the carbon cycle. Primary productivity there displays strong variations at the interannual to decadal timescales. However, down-core investigations rarely reach sufficient temporal resolution to assess the response of productivity to climatic variations at these timescales beyond the instrumental and historical periods. Diatom assemblages, sea-surface temperatures (SSTs), and nitrogen and organic carbon contents on a laminated sediment core from the Peruvian continental shelf were analyzed to trace variations in regional productivity over the last 3000 years. The record provides evidence for different climatic and oceanic conditions with more humid and less productive conditions older than 2500 cal. yr BP and drier and more productive conditions younger than 2500 cal. yr BP. The last 2500 years also present much stronger centennial-scale variability with the occurrence of six intervals with higher total diatom abundances and stronger percentages in upwelling-related diatom species, representative of intensified productivity, congruent to lower percentages in benthic diatoms, indicative of reduced rainfall. These six periods were synchronous to intervals of enhanced Walker circulation, suggesting a strong imprint of the Pacific zonal circulation on productivity variations off Peru. The record also demonstrates that SSTs did not vary in phase with productivity, arguing against the idea of regional SSTs controlled by the upwelling intensity, but were rather in agreement to SST records off southern Chile, suggesting that Peruvian SST variations were largely controlled by oceanic currents at southern high latitudes.

Lutterbeck, H.E. and H.W. Bange (2015) An improved method for the determination of dissolved nitric oxide (NO) in seawater samples. Ocean Sci., 11, 937-946, doi: 10.5194/os-11-937-2015

Nitric oxide (NO) is a short-lived intermediate of the oceanic nitrogen cycle; however, due to its high reactivity, measurements of dissolved NO in seawater are rare. Here, an improved method to determine NO concentrations in discrete seawater samples is presented. The set-up of the system consisted of a chemiluminescence NO analyser connected to a stripping unit. The limit of detection for the method is 5 pmol NO in aqueous solution, which translates into 0.25 nmol L^{-1} when using a 20 mL seawater sample volume. The method was applied to measure high-resolution depth profiles of dissolved NO during a cruise to the eastern tropical South Pacific Ocean. It is fast and comparably easy to handle; thus it opens the door for investigating the distribution of NO in the ocean, and it facilitates laboratory studies on NO pathways.

Conferences

AGU FALL MEETING 2015
14-18 December 2015,
San Francisco (USA)

OCEAN SCIENCES MEETING
21-26 February 2016,
New Orleans (USA)

EGU 2016
17-22 April 2016, Vienna (Austria)

SFB 754 Intern

SFB 754 ANNUAL RETREAT
14-15 March 2016, Kiel

WE WISH YOU A MERRY CHRISTMAS AND A HAPPY NEW YEAR!

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