
# NEWSLETTER 2013 | 04

## Sonderforschungsbereich 754

Climate – Biogeochemistry Interactions in the Tropical Ocean

SFB 754


## Publications

### 2013 (September – December)

**Kriest, I. and Oschlies, A. (2013) Swept under the carpet: organic matter burial decreases global ocean biogeochemical model sensitivity to remineralization length scale. Biogeosciences Discuss., in press, 10, pp. 10859-10911. doi:10.5194/bgd-10-10859-2013**

The interaction between sinking and remineralization of organic matter, benthic fluxes and burial is not always simulated consistently in global biogeochemical models. This work investigates how representation of these processes impacts simulated benthic-pelagic fluxes, nutrient and oxygen distributions. Global model configurations with benthic burial simulate oxygen well over a wide range of particle sinking speeds, making the model more robust with regard to uncertainties about the remineralization length scale. While all model types show an almost identical fit to observed pelagic particle flux, comparison to observational estimates of benthic fluxes reveals a more complex pattern. Based on a combined metric of dissolved tracers and biogeochemical fluxes, two model descriptions of burial are identified as suitable candidates for further experiments and model refinements.

**Grasse, P., Ehlert, C. and Frank, M. (2013) The influence of water mass mixing on the dissolved Si isotope composition in the Eastern Equatorial Pacific. Earth and Planetary Science Letters, 380, pp. 60-71, doi:10.1016/j.epsl.2013.07.033**

Silicon isotopes are a powerful tool to investigate the cycling of dissolved silicon (Si). In this study the distribution of the Si isotope composition of dissolved silicic acid ($\delta^{30}Si(OH)_4$) was analyzed in the water column of the Eastern Equatorial Pacific (EEP). Samples were collected at 7 stations along two meridional transects from the equator to 14°S at 85°50'W and 82°00'W off the Ecuadorian and Peruvian coast. Surface waters show a large range in isotope compositions $\delta^{30}Si(OH)_4$ (+2.2‰ to +4.4 ‰) with the highest values found at the southernmost station at 14°S. This station also revealed the most depleted silicic acid concentrations (0.2 µmol/kg), which is a function of the high degree of Si utilization by diatoms and admixture with waters from highly productive areas. Samples within the upper water column and the OMZ at oxygen concentrations below 10 µmol/kg are characterized by a large range in $\delta^{30}Si(OH)_4$, which mainly reflects advection and mixing of different water masses. Deep water masses (>2,000 m) in the study area show a mean $\delta^{30}Si(OH)_4$ of +1.2±0.2‰. The distribution of $\delta^{30}Si(OH)_4$ signatures in deep waters of the Pacific is considered to be mainly a consequence of the mixing of several end member water masses including Lower Circumpolar Deep Water (LCDW) and North Pacific Deep Water (NPDW).

**Somes, C. J., Oschlies, A. and Schmittner, A. (2013) Isotopic constraints on the pre-industrial oceanic nitrogen budget. Biogeosciences, 10 (9), pp. 5889-5910. doi:10.5194/bg-10-5889-2013**

The size of the bio-available (i.e. "fixed") nitrogen inventory in the ocean influences global marine productivity and the biological carbon pump. Despite its importance, the pre-industrial rates for the major source and sink terms of the oceanic fixed nitrogen budget, $N_2$ fixation and denitrification, respectively, are not well known. These processes leave distinguishable imprints on the ratio of stable nitrogen isotopes, $\delta^{15}N$, which can therefore help to infer their patterns and rates. Here we use $\delta^{15}N$ observations from the water column and a new database of seafloor measurements to constrain rates of $N_2$ fixation and denitrification predicted by a global three-dimensional Model of Ocean Biogeochemistry and Isotopes (MOBI). Sensitivity experiments were performed to quantify uncertainties associated with the isotope effect of denitrification in the water column and sediments. They show that the level of nitrate utilisation by water

## SFB 754 Colloquia & more

**SFB 754 ANNUAL MEMBERS MEETING**
December 19, 2013, at 9:30 h

**SFB 754 COLLOQUIUM, UPDATE ON SUBPROJECT A4: OXYGEN SUPPLY TO THE TROPICAL NORTH EAST ATLANTIC OMZ**
January 8, 2014 at 8:30 h

**SFB 754 ANNUAL RETREAT 2014**
February 17 & 18, 2014

## News

**TORSTEN KANZOW** accepted a professorship appointment at the AWI Bremerhaven (Oct 2013). Division: Climate Sciences, Head of Observational Oceanography

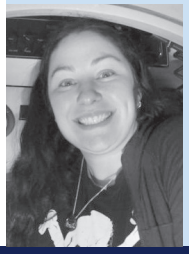
**TINA TREUDE** accepted a professorship appointment at the UCLA University of California, Los Angeles (Oct 2014). Department of Earth, Planetary and Space Science und Department of Atmospheric and Ocean Science

**TORSTEN KANZOW, LOTHAR STRAMMA, TOSTE TANHUA, SUNKE SCHMIDTKO** contributing Authors in the IPCC WGI Fifth Assessment Report (AR5)

**SYMPOSIUM PROCEEDINGS "MICROBIAL ECOLOGY AND BIOGEOCHEMISTRY"**
Moore Foundation, Chile, March 2013
available on the SFB 754 homepage under news

**TEBKE BÖSCHEN (A6)** – PhD Thesis Completion: Planktonic and Benthic Foraminifers as Geochemical Proxies Recording Hydrographic Changes in the Eastern Equatorial Pacific (Oct 2013)

**MOURNING FOR VICTORIA "VICKY" BERTICS**
Victoria (Vicky) Bertics, age 31, passed away in Boston, Massachusetts, after a courageous battle with cancer on Saturday, Sept. 28, 2013. Vicky devoted her work to the geobiological processes in the seabed. With the support of the SFB 754, she studied the benthic nitrogen fixation in the oxygen minimum zone off Mauritania. Vicky loved going to sea and welcomed the opportunity to participate in several dives with international submersibles.



column denitrification in suboxic zones and the fractionation factor for benthic denitrification are crucial processes that determine global ocean $\delta^{15}N$. The model experiments that best reproduce observed seafloor $\delta^{15}N$ support the middle to high-end estimates for the net fractionation factor of benthic denitrification (εBD=2–‰). Assuming a balanced fixed nitrogen budget, we estimate that pre-industrial rates of $N_2$ fixation, water column denitrification, and benthic denitrification were between 195–350 (225), 65–80 (76), and 130–270 (149) Tg N/yr, respectively, with our best model estimate (εBD=2‰) in parenthesis. Although uncertainties still exist, these results suggest that marine $N_2$ fixation is occurring at much greater rates than previously estimated and the residence time for oceanic fixed nitrogen is between ~1,500–3,000 years.

**Pahlow, M., Dietze, H. and Oschlies, A. (2013) Optimality-based model of phytoplankton growth and diazotrophy. Marine Ecology Progress Series, 489, pp. 1-16. doi:10.3354/meps10449**

The notion that excess phosphorus (P) and high irradiance favour pelagic diazotrophy ($N_2$ fixation) is difficult to reconcile with diazotroph behaviour in laboratory experiments and also with the observed distribution of the marine diazotroph Trichodesmium, e.g., in the relatively nitrogen (N)-rich North Atlantic Ocean. Nevertheless, this view currently provides the state-of-the-art framework to understand both past dynamics and future evolution of the oceanic fixed N inventory. In an attempt to provide a consistent theoretical underpinning for marine autotrophic $N_2$ fixation, we derive controls of diazotrophy from an optimality-based model that accounts for phytoplankton growth and $N_2$ fixation. Our model reproduces observed behaviour of a range of ordinary phytoplankton species and Trichodesmium. The model predicts that (1) the optimal strategy for facultative diazotrophy is switching between $N_2$ fixation and using dissolved inorganic nitrogen (DIN) at a threshold DIN concentration; (2) oligotrophy, especially in P and under high light, favours diazotrophy; (3) diazotrophy is compatible with DIN:DIP supply ratios well above Redfield proportions; and (4) communities of diazotrophs competing with ordinary phytoplankton decouple emerging ambient and supply DIN:DIP ratios.

**Mollier-Vogel, E., Leduc, G., Böschen, T., Martinez, P. and Schneider, R. (2013) Rainfall response to orbital and millennial forcing in northern Peru over the last 18 ka. Quaternary Science Reviews, 76, pp. 29-38. doi:10.1016/j.quascirev.2013.06.021**

This study present a high-resolution marine record of sediment input from the Guayas River, Ecuador, that reflects changes in precipitation along western equatorial South America during the last 18ka. Log (Ti/Ca) derived from X-ray Fluorescence (XRF) is used to document terrigenous input from riverine runoff that integrates rainfall from the Guayas River catchment. This study find that rainfall-induced riverine runoff has increased during the Holocene and decreased during the last deglaciation. Superimposed on those long-term trends, this study find that rainfall was probably slightly increased during the Younger Dryas, while the Heinrich event 1 was marked by an extreme load of terrigenous input, probably reflecting one of the wettest period over the time interval studied. The rainfall variability on orbital and suborbital timescales is different from western to eastern South America. Orbital forcing caused an antiphase behavior in rainfall trends between eastern and western equatorial South America. In contrast, millennial-scale rainfall changes, remotely connected to the North Atlantic climate variability, led to homogenously wetter conditions over eastern and western equatorial South America during North Atlantic cold spells.

**Teuber, L., Kiko, R., Séguin F. and Auel, H. (2013) Respiration rates of tropical Atlantic copepods in relation to the oxygen minimum. Journal of Experimental Marine Biology and Ecology, 448, pp. 28-36. doi:10.1016/j.jembe.2013.06.012**

Zooplankton respiration plays an important role in the carbon cycling of pelagic ecosystems. The rate of oxygen consumption in zooplankton is affected by the physical environment, vertical distribution range and species-specific behavior. Especially in tropical oceans, oxygen minimum zones (OMZs) may influence zooplankton metabolic processes and vertical distribution and thus structure zooplankton communities. This study present respiration rates of tropical Atlantic copepods in relation to environmental factors, especially $O_2$ concentration, and species-specific characteristics. Copepods were sampled during two research stays on the Cape Verde Island São Vicente in March/April and May/June 2010. Minimum $O_2$ concentrations of 51 µmol/kg ($pO_2$ of 4.25 kPa) at 400 m depth were recorded within the OMZ. Mass-specific respiration rates were highest in surface-dwelling organisms and decreased with increasing depth. Temperature- and body mass-corrected respiration rates did not decrease with increasing depth indicating that neither depth of occurrence, nor current hypoxic conditions within the OMZ had a fundamental, persistent effect on zooplankton respiration.

**Navarro, J., Coll, M., Somes C. J. and Olson, R. J. (2013) Trophic niche of squids: Insights from isotopic data in marine systems worldwide. Deep-Sea Research Part II-Topical Studies in Oceanography, 95, pp. 93-102. doi:10.1016/j.dsr2.2013.01.031**

Cephalopods are an important prey resource for fishes, seabirds, and marine mammals, and are also voracious predators on crustaceans, fishes, squid and zooplankton. Because of their high feeding rates and abundance, squids have the potential to exert control on the recruitment of commercially important fishes. In this review the available information for two intrinsic markers ($\delta^{15}N$ and $\delta^{13}C$ isotopic values) are synthesized in squids for all oceans and several types of ecosystems to obtain a global view of the trophic niches of squids in marine ecosystems. In particular, this study aimed to examine whether the trophic positions and trophic widths of squid species vary among oceans and ecosystem types. The results showed that squids occupy a large range of trophic positions and exploit a large range of trophic resources, reflecting the versatility of their feeding behavior and confirming conclusions from food-web models.

## Conferences
### 2014

**OCEAN SCIENCES MEETING 2014**
February 23 – 28, 2014, Honolulu, Hawaii

**46TH INTERNATIONAL LIÈGE COLLOQUIUM: LOW OXYGEN ENVIRONMENTS IN MARINE, ESTUARINE AND FRESH WATERS**
Session (A. Oschlies): Deoxygenation in a global change context
May 5 – 9, 2014, Liège, Belgium

**IMBER OPEN SCIENCE CONFERENCE 2014**
Session (A. Oschlies, V. Garcon, L. Stramma): Climate-biogeochemistry interactions associated with open-ocean oxygen minimum zones
June 23 – 27, 2014, Bergen, Norway