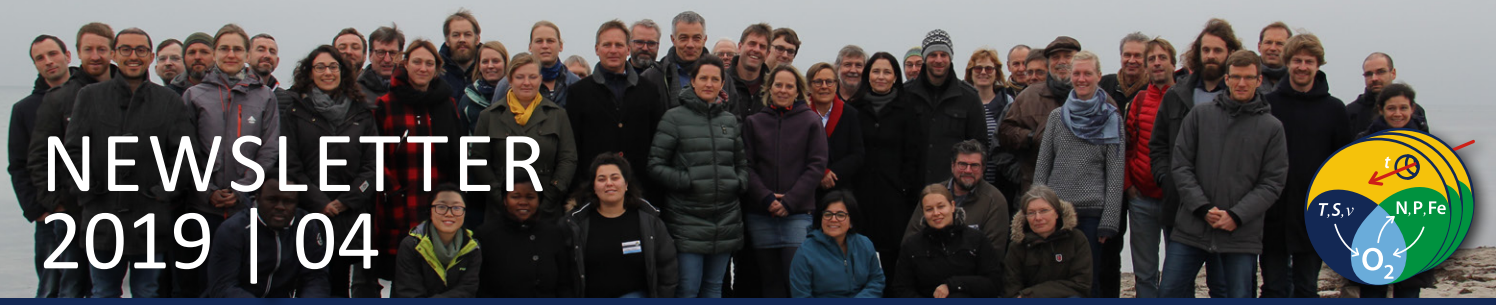


NEWSLETTER 2019 | 04

Sonderforschungsbereich 754

Climate – Biogeochemistry Interactions in the Tropical Ocean

SFB 754

THANK YOU ALL ...

for an amazing SFB 754 time, for great research, inspiring discussions, a fantastic community atmosphere. Even if the SFB 754 is now completed, we are confident that there are many unique and innovative ideas and motivation to move into new research aspects and projects as a legacy of the SFB 754 collaborative research center. **Andreas/Lothar/Chris**

Publications

Rapp, I., C. Schlosser, J.-L. Menzel Barraqueta, B. Wenzel, J. Lüdke, J. Scholten, B. Gasser, P. Reichert, M. Gledhill, M. Dengler and E. P. Achterberg (2019) Controls on redox-sensitive trace metals in the Mauritanian oxygen minimum zone. Biogeosciences, 16, 4157–4182, doi: 10.5194/bg-16-4157-2019

The availability of the micronutrient iron (Fe) in surface waters determines primary production, N_2 fixation, and microbial community structure in large parts of the world's ocean, and thus it plays an important role in ocean carbon and nitrogen cycles. Eastern boundary upwelling systems and the connected oxygen minimum zones (OMZs) are typically associated with elevated concentrations of redox-sensitive trace metals (e.g., Fe, manganese (Mn), and cobalt (Co)), with shelf sediments typically forming a key source. Over the last 5 decades, an expansion and intensification of OMZs has been observed and this trend is likely to proceed. However, it is unclear how trace-metal (TM) distributions and transport are influenced by decreasing oxygen (O_2) concentrations. Here, dissolved (d; <0.2 µm) and leachable particulate (Lp; >0.2 µm) TM data collected at seven stations along a 50 km transect in the Mauritanian shelf region is presented. Enhanced concentrations of Fe, Co, and Mn corresponding with low O_2 concentrations (<50 µmol kg^{-1}) were observed, which were decoupled from major nutrients and nutrient-like and scavenged TMs (cadmium (Cd), lead (Pb), nickel (Ni), and copper (Cu)). Additionally, data from repeated station occupations indicated a direct link between dissolved and leachable particulate Fe, Co, Mn, and O_2. An observed dFe (dissolved iron) decrease from 10 to 5 nmol L^{-1} coincided with an O_2 increase from 30 to 50 µmol kg^{-1} and with a concomitant decrease in turbidity. The changes in Fe (Co and Mn) were likely driven by variations in their release from sediment pore water, facilitated by lower O_2 concentrations and longer residence time of the water mass on the shelf. Variations in organic matter remineralization and lithogenic inputs (atmospheric deposition or sediment resuspension; assessed using Al as indicator for lithogenic inputs) only played a minor role in redox-sensitive TM variability. Vertical dFe fluxes from O_2-depleted subsurface-to-surface waters (0.08–13.5 µmol m^{-2} d^{-1}) driven by turbulent mixing and vertical advection were an order of magnitude larger than atmospheric deposition fluxes (0.63–1.43 µmol m^{-2} d^{-1}; estimated using dAl inventories in the surface mixed layer) in the continental slope and shelf region. Benthic fluxes are therefore the dominant dFe supply to surface waters on the continental margins of the Mauritanian upwelling region. Overall, the results indicated that the projected future decrease in O_2 concentrations in OMZs may result in increases in Fe, Mn, and Co concentrations.

Tuchen, F. P., J. F. Lübbecke, S. Schmidtko, R. Hummels and C. W. Böning (2019) The Atlantic Subtropical Cells Inferred from Observations. Journal of GeophysicalResearch: Oceans, 124, doi: 10.1029/2019JC015396

The Atlantic Subtropical Cells (STCs) are shallow wind-driven overturning circulations connecting the tropical upwelling areas to the subtropical subduction regions. In both hemispheres, they are characterized by equatorward transport at thermocline level, upwelling at the equator, and poleward Ekman transport in the surface layer. This study uses recent data from Argo floats complemented by ship sections at the western boundary as well as reanalysis products to estimate the meridional water mass transports and to investigate the vertical and horizontal structure of the STCs from an observational perspective. The seasonally varying depth of meridional velocity reversal is used as the interface between the surface poleward flow and the thermocline equatorward flow. The latter is bounded by the 26.0 kg m^{-3} isopycnal at depth. This study finds that the thermocline layer convergence is dominated by the southern hemisphere water mass transport (9.0 ± 1.1 Sv from the southern hemisphere compared to 2.9 ± 1.3 Sv from the northern hemisphere) and that this transport is mostly confined to the western boundary. The wind-driven Ekman divergence in the surface layer is more symmetric, being 20.4 ± 3.1 Sv between 10°N and 10°S. The net poleward transports (Ekman minus geostrophy) in the surface layer concur with values derived from reanalysis data (5.5 ± 0.8 Sv at 10°S and 6.4 ± 1.4 Sv at 10°N).

Hoving, H.-T., S. Christiansen, E. Fabrizius, H. Hauss, R. Kiko, P. Linke, P. Neitzel, U. Piatkowski and A. Körtzinger (2019) The Pelagic In situ Observation System (PELAGIOS) to reveal biodiversity, behavior, and ecology of elusive oceanic fauna. Ocean Sci. 15, 1327–1340, doi: 10.5194/os-15-1327-2019

There is a need for cost-efficient tools to explore deep-ocean ecosystems to collect baseline biological observations on pelagic fauna (zooplankton and nekton) and establish the vertical ecological zonation in the deep sea. The Pelagic In situ Observation System (PELAGIOS) is a 3000 m rated slowly (0.5 m s^{-1}) towed camera system with LED illumination, an integrated oceanographic sensor set (CTD-O_2) and telemetry allowing for online data acquisition and video inspection (low definition). The high-definition video is stored on the camera and later annotated using software and related to concomitantly recorded environmental data. The PELAGIOS is particularly suitable for open-ocean observations of gelatinous fauna, which is notoriously under-sampled by nets and/or destroyed by fixatives. In addition to counts, diversity, and distribution

data as a function of depth and environmental conditions (T, S, O_2), in situ observations of behavior, orientation, and species interactions are collected. Here, an overview of the technical setup of the PELAGIOS as well as example observations and analyses from the eastern tropical North Atlantic are presented. Comparisons to data from the Multiple Opening/Closing Net and Environmental Sensing System (MOCNESS) net sampling and data from the Underwater Vision Profiler (UVP) are provided and discussed.

Bayr, T., D. I. V. Domeisen and C. Wengel (2019) The effect of the equatorial Pacific cold SST bias on simulated ENSO teleconnections to the North Pacific and California.C. Clim Dyn (2019) 53: 3771, doi: 10.1007/s00382-019-04746-9

Precipitation in California is modulated by variability in the tropical Pacific associated with El Niño/Southern Oscillation (ENSO): more rainfall is expected during El Niño episodes, and reduced rainfall during La Niña. It has been suggested that besides the shape and location of the sea surface temperature (SST) anomaly this remote connection depends on the strength and location of the atmospheric convection response in the tropical Pacific. This study shows in a perturbed physics ensemble of the Kiel Climate Model and CMIP5 models that due to a cold equatorial SST bias many climate models are in a La Niña-like mean state, resulting in a too westward position of the rising branch of the Pacific Walker Circulation. This in turn results in a convective response along the equator during ENSO events that is too far west in comparison to observations. This effect of the equatorial cold SST bias is not restricted to the tropics, moreover it leads to a too westward SLP response in the North Pacific and too westward precipitation response that does not reach California. Further this study shows that climate models with a reduced equatorial cold SST bias have a more realistic representation of the spatial asymmetry of the teleconnections between El Niño and La Niña.

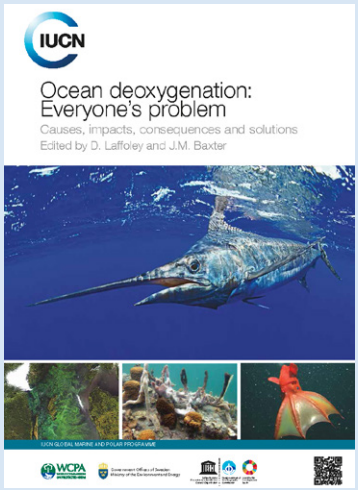
Kiko, R. and H. Hauss (2019) On the Estimation of Zooplankton-Mediated Active Fluxes in Oxygen Minimum Zone Regions. Front. Mar. Sci. 6, 741, doi: 10.3389/fmars.2019.00741

In the Peruvian upwelling system, the mesopelagic oxygen minimum zone (OMZ) is the main vertically structuring feature of the pelagic habitat. Several zooplankton and nekton species undertake diel vertical migrations (DVMs) into anoxic depths. It has been argued that these migrations contribute substantially to the oxygen consumption and release of dissolved compounds (in particular ammonium) in subsurface waters. However, metabolic suppression as a response to low ambient oxygen partial pressure (pO_2) has not been accounted for in these estimates. Our study presents estimates of zooplankton- and nekton-mediated oxygen consumption and ammonium release based on vertically stratified net hauls (day/night, upper 1,000 m). The main crustacean migrants were euphausiids (mainly *E. mucronata*) on offshore stations and the commercially exploited squat lobster *Pleuroncodes monodon* on the upper shelf. Correction for metabolic suppression results in a substantial reduction of both respiration and ammonium excretion within the OMZ core. Ignoring this mechanism leads to a 10-fold higher estimate of DVM-mediated active export of carbon by respiration to below 100 m depth at deep-water stations. The DVM-mediated release of ammonium by euphausiids into the 200–400 m depth layer ranges between 0 and 36.81 µmol NH_4 m^{-2} d^{-1}, which is insufficient to balance published estimates of ammonium uptake rates due to anammox. It seems critical to account for the modulation of zooplankton metabolic activity at low oxygen in order to correctly represent the contribution of migrating species to the biological pump.

Lübbecke, J. F., D. Rudloff, and L. Stramma (2019) Stand-alone Eastern Pacific Coastal Warming events. Geophys. Res. Lett., 46, doi: 10.1029/2019GL084479

A pronounced warm anomaly occurred at the Peruvian coast in early 2017. This "Coastal Niño" caused heavy rainfalls, leading to flooding in Peru and Ecuador. At the same time, neutral conditions prevailed in the equatorial Pacific. Using observational sea surface temperature data sets and an ocean reanalysis product for the time period 1900 to 2010, previous similar events are investigated. Eighteen coastal warming events without corresponding equatorial Pacific warming are identified. Further analysis shows, however, that only four of these events are not connected to the central equatorial Pacific. All other periods of strong coastal warm anomalies are directly followed or preceded by El Niño-like conditions. The "stand-alone" coastal warming events are characterized by comparatively low equatorial heat content. It is therefore hypothesized that the depleted heat content in the equatorial Pacific in the wake of the strong 2015/2016 El Niño prevented the warming to spread westward in 2017.

News



IUCN report on OceanDeoxygenation, 07.12.2019, COP 25, Madrid
https://portals.iucn.org/library/node/48892

Conferences

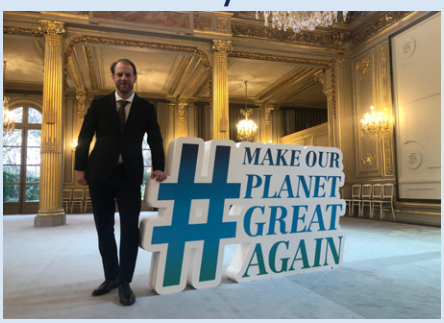
OCEAN SCIENCES MEETING

16-21 February 2020, San Diego (USA)
Sessions:
OB010 - Feedbacks of the biological pump to atmosphere in past, present and future changing climates
OB016 - Marine deoxygenation in a changing climate: drivers, detection, and ecosystem impacts
OB020 - New Tools and Approaches to Constrain the Marine Nitrogen Cycle: From the Surface to the Sediments
OB029 - The role of plankton physiology and ecology for ocean biogeochemistry

EGU

03-08 May 2020, Vienna (Austria)
Sessions:
OS3.1/BG4.17 - Deoxygenation in the marine environment: drivers, trends and challenges (co-organized)

... and finally



Rainer Kiko - Reception in the Elysee Palace, 12th Dec 2019. *Photo: Lars Stemmann*

EDITORIAL
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