The climate sensitivity of oceanic oxygen

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The warming of Earth's climate is expected to lead to a widespread loss of oxygen from the ocean, exacerbating the localized effects of coastal eutrophication. The mechanisms responsible for climate-forced deoxygenation – changes in gas solubility, ventilation of the ocean interior, and respiration of organic matter – are spatially heterogeneous, so the susceptibility to oxygen loss varies greatly among water masses. Moreover, the wide range of time scales involved in the adjustment of the oceanic oxygen distribution, coupled with the presence of strong internally generated variability greatly complicate the detection and attribution of trends. This talk will synthesize the current evidence for and understanding of changes in oceanic oxygen from model simulations, modern ocean observations, and the geologic record. A central conclusion is that the low latitude ocean, where the biological constraints from low oxygen are most profound, are also intrinsically most sensitive to climatic perturbations. Given the long transit times from thermocline outcrops to the tropical oxygen minimum zones, the response of oxygen in those regions to climate warming must either be slow to arrive, or else driven by local rather than remote climate trends. This suggests that if an expansion of the tropical oxygen minimum is already underway, its climatic origin is likely to be found in tropical winds rather than high latitude stratification. The major uncertainties and implications for ecosystems and biogeochemical cycles will also be discussed.

Benthic nitrogen fluxes and denitrification in Bering Sea shelf sediments.

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Abstract

Benthic-pelagic coupling is hypothesized to be quite strong in the in the highly Bering Sea shelf ecosystem and primary production of the system is thought to be nitrogen limited[1]. Nevertheless, sedimentary denitrification and benthic nutrient fluxes and their seasonal trends are poorly characterized. Through the Bering Sea Ecosystem Study (BEST) program, we measured benthic fluxes of N_2 and dissolved inorganic nitrogen species, the extent of coupled nitrification/denitrification, and the water column nitrate deficit (using N**[2]) on the Bering Sea shelf in the spring and summer 2009 – 2010. We found that sedimentary denitrification is widespread over the shelf and is fuelled mostly through coupled nitrification/denitrification, the net balance of sedimentary DIN flux is negligible over the shelf, and that water column N** varies widely according to season and year. In the summer, N** appeared to be strongly affected by non-Redfieldian uptake of inorganic nutrients by phytoplankton in the spring bloom; in the winter, N** was strongly affected by sedimentary denitrification. Our findings indicate that the estimate of total N loss in the Bering Sea shelf should be revised upwards by at least 50% to 5.2 – 6.2 Tg N y^{-1}. In addition sediments appear not to be a large source of remineralized nutrients for primary production over the shelf, hence sedimentary denitrification exacerbates N-limitation of the ecosystem.

[1] Grebmeier et al. (2006) *Nature* **311**,1461-1464
[2] Mordy, et al (2010) *Mar.Chem.***121,** 157-166