Improved representation of dust-nutrient deposition to the ocean for the Earth System Models

MESKHIDZE*, N. AND M. S. JOHNSON

North Carolina State University, Raleigh, USA, *nmeskhidze@ncsu.edu, msjohns2@ncsu.edu

With the development of comprehensive Earth System Models (coupled climate-carbon models with land and ocean biogeochemistry) there is an increased need for improved representation of atmospheric fluxes of essential nutrients, i.e. iron (Fe), phosphorus (P), and nitrogen (N) to the surface oceans. These micronutrients have a controlling effect on marine ecosystem productivity and therefore can influence the global carbon cycle and climate. Today it is well established that models that consider interactive representation of aerosol-climate-carbon cycle do better job in predicting future climate. Since Fe at the dust source regions is thought to be primarily in an insoluble form with increasing bioavailability through the interaction of mineral particles with acidic trace gases, it is believed that anthropogenic activities may exert sizable influence on micronutrient fluxes to the ocean.

In this study the state-of-the-art dust-nutrient dissolution scheme has been implemented in the global 3-D chemistry transport model GEOS-Chem. The Fe-dissolution module of Meskhidze et al. (2005) [1] was updated to consider dust-mineralogy in different desert regions, Fe-organic acid (oxalate) interaction, the photoreductive dissolution of Fe containing minerals (hematite, goethite and aluminosilicates), and the redox cycling between relatively more soluble ferrous, Fe(II) and highly insoluble ferric, Fe(III) forms of iron. Dissolution of P containing minerals is carried out using acid-based chemistry [2], while nitrate production occurs through the deposition of gas phase nitric acid on mineral dust. Our calculations using dust-nutrient dissolution scheme show high temporal and spatial variability in nutrient deposition fluxes over the ocean. Preliminary results indicate (see Fig. 1) that simplified Fe dissolution schemes, with the prescribed amounts of soluble iron, are unable to capture the complex nature of micronutrient deposition to the surface ocean. Our study reveals that in order to properly account for the effects of anthropogenic activities on ocean biogeochemical cycles, next generation Earth System Models should consider implementation of more comprehensive modules for nutrient mobilization from mineral dust.

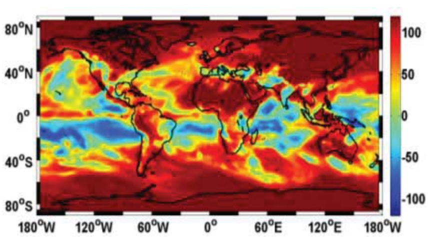

Figure 1: Percent difference (1% - model)/model in soluble Fe deposition during January 2009.

[1] Meskhidze *et al.* (2005) *J. Geophys. Res.* **110**, 1-23.
[2] Nenes *et al.* (2011) *Atmos. Chem. Phys*. **11**, 6265–6272.

Influence of zostera meadows on geochemistry and meiofauna of the sediment of a tidal lagoon (Arcachon Basin): new technical approaches

EDOUARD METZGER[1*], DIDIER JEZEQUEL[2], EMMANUELLE GESLIN[1], FLORIAN CESBRON[1], LAURIE CHARRIEAU[1], MARIE-LISE DELGARD[3], BRUNO DEFLANDRE[3], FRANS JORISSEN[1], AND PIERRE ANSCHUTZ[3]

[1]Univ. Angers, LPGN-BIAF, OSUNA, Angers, France, edouard.metzger@univ-angers.fr (* presenting author)
[2]Univ. Paris Diderot, Sorbonne Paris Cité, IPGP, France
[3] Univ. Bordeaux, EPOC, UMR 5805, Talence, France

Tidal lagoons are by definition very dynamic environments. Sediments from such environments are very heterogeneous especially because of direct action of living organisms (i.e. bioturbation). The intertidal flats of Arcachon basin are highly covered by seagrass meadows of *Zostera noltii*. The seasonnal dynamics of these meadows enhance the lateral heterogeneity of the sediment by influencing sedimentation and organic matter accumulation. The present study shows preliminary results from very new techniques which were applied to understand the relationship between the root system of seagrass and meiofauna such as foraminifera. Those are able to respire oxygen and nitrate as well as bacteria. Our hypothesis is that roots bring oxygen to the anoxic sediment maybe generating nitrate-rich microenvironments. Since foraminifera are able to denitrify, we suppose that some specialized taxa can gather in such environments.

Methodologically, our goals are: i) to document at a submillimetric scale and in 2 dimensions relevant redox species (e.g. H_2S, Fe(II), PO_4, NO_3) in the pore waters using combined DGT-DET gels and in the solid phase by X microflurescence; ii) to describe foraminiferal species related to documented microenvironments using a highly discriminant staining technique for living specimen (i.e. CTG fluorogenic probe). The metabolism of anoxia tolerant taxa is quantified using microchambers equiped with microsensors.

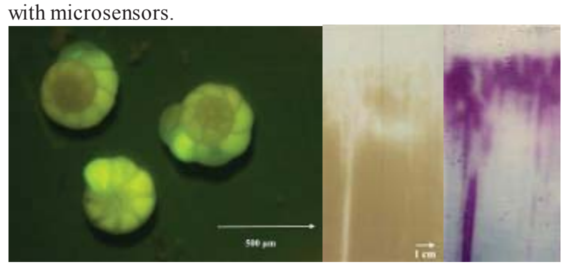

Figure 1: CTG Fluorescent foraminifera observed using an epifluorescence binocular (left) and 2D DET images (right): H_2S in brown, Fe(II) in pink and PO_4 in blue

2D DET gels show very heterogeneous redox layers which are very influenced by burrowing organisms and seagrass root webs. The first results seem to show that foraminferal densities are also influenced by the root web related to sedimentary redox interfaces. Anoxic sediment is dominated by *Eggerella* sp. which ability to denitrify is presently being assessed in the laboratory.