Introducing dynamic benthic fluxes in 3D biogeochemical model : an application on the Black Sea North-Western shelf

A. CAPET, M. GRÉGOIRE
Laboratoire d'océanology, University of Liege, Belgium

J.-M. BECKERS
GHER, University of Liege, Belgium

F. MEYSMAN, K. SOETART
NIOO-KNAW, The Netherlands

While benthic and sediment processes are now recognized as major components of the shelf biogeochemical budget, their representation in 3D biogeochemical model has for long been oversimplified [*Soetaert et al.,* 2000].

These oversimplified formulations of the bottom boundary conditions prevent to account for the response of diagenetic processes to the environment. The consequent absence of spatial and temporal variability of benthic/pelagic fluxes may lead to mis-evaluation of important terms in the biogeochemical budgets (e.g. Oxygen, Nitrogen, Carbon, Phosphate). More importantly, feedbacks mechanisms within the ecosystem response to eutrophication may be overlooked, such as, for instance, the sensitivity of benthic denitrification to the oxygen content in the bottom waters.

The GHER-ECO 3D biogeochemical model is extended with a refined benthic component explicitly accounting for the effect of organic matter transport, deposition and resuspension and for the influence of the environmental conditions on the diagenetic pathways.

A semi-empirical approach allows to reproduce the variability and feedbacks driven by benthic diagenesis without the computational burden of a vertically resolved sediment layer. This simplification allows to use the coupled model for the long term runs (several decades) required to appreciate the slow dynamics introduced by the accumulation of organic matter in the sediment layer during the years of high riverine discharge.

The extended model has been implemented for the Black Sea North western shelf [*Capet et al.,* 2012]. After a presentation of the main assumptions used to construct the benthic module, results are analyzed with a focus on (1) spatial and seasonal variability of benthic diagenesis and consequent benthic/pelagic exchanges, (2) comparison to in-situ estimates of benthic/pelagic dissolved fluxes, (3) implication in biogeochemical budgets and eutrophication issue. Inherent limitations of the semi-empirical approach are discussed in the perspective of the current challenges addressed to biogeochemical models.

REFERENCES

Soetaert, K., Middelburg, J. J., Herman, P. M., and Buis, K., 2000. On the coupling of benthic and pelagic biogeochemical models, *Earth Sci. Rev.* 51(1-4), 173201

Capet, A., Beckers, J.-M., and Grégoire, M., 2012. Seasonal hypoxia in eutrophic stratified coastal shelves: mechanisms, sensibilities and interannual variability from the North-Western Black Sea case, *Biogeosciences Discuss.*, 9, 18397-18445

GeoHydrodynamics and Environment Research Lab., University of Liege, Sart Tilman B5, B-4000 Liege.