Geophysical Research Abstracts
Vol. 15, EGU2013-10618, 2013
EGU General Assembly 2013

A cost-efficient biogeochemical model for estuaries: a case-study of a funnel-shaped system

Chiara Volta (1), Sandra Arndt (2), and Pierre Regnier (1)

(1) Department of Earth and Environmental Sciences, Université Libre de Bruxelles, Bruxelles, Belgium (cvolta@ulb.ac.be),
(2) School of Geographical Sciences, University of Bristol, Bristol, United Kingdom

The hydrodynamics exerts an important influence on the biogeochemical functioning of estuarine systems. Comparative studies have long recognized this tight coupling and, for instance, have attempted to correlate key estuarine biogeochemical processes to simple hydrodynamic properties, such as the residence time or the tidal forcing. Yet, these correlations fail to resolve the estuarine spatio-temporal variability and do not provide powerful means to disentangle the complex interplay of multiple reaction and transport processes. In this context, reaction-transport models (RTMs) are useful tools to resolve the variability inherent to the estuarine environment. They ideally complement field observations, because their integrative power provides the required extrapolation means for a system-scale analysis over the entire spectrum of changing forcing conditions, including the long-term response to land-use and climate changes. However, RTM simulations are associated with high computational costs, especially when the biogeochemical dynamics are to be resolved on a regional or global scale. Furthermore, specific data requirements, such as boundary conditions or bathymetric and geometric information may limit their applicability. Here, a generic one-dimensional RTM approach which relies on idealized geometries to support the estuarine physics is used to quantify the biogeochemical dynamics. The model is cost-efficient and requires only a limited number of readily available input data. The approach is applied to a case-study of a funnel-shaped estuary (The Scheldt, BE/NL) and is tested by comparing integrative measures of the estuarine biogeochemical functioning (e.g. Net Ecosystem Metabolism, integrated CO_2 fluxes) with those derived from observations (Frankignoulle et al., 1996, 1998) and highly-resolved model simulations (Vanderborght et al., 2002; Arndt et al., 2009). The method provides a robust quantitative tool to carry sensitivity and uncertainty analyses and to investigate the estuarine biogeochemistry at the regional scale.