Drivers on carbon dioxide emissions from the Scheldt river basin

Nathalie Gypens (1,2), Paul Passy (3), Josette Garnier (2,4), Gilles Billen (2,4), Marie Silvestre (3), and Alberto V Borges (5)

(1) Université Libre de Bruxelles, Ecologie des Systèmes Aquatiques, Bruxelles, Belgium (ngypens@ulb.ac.be), (2) UPMC, UMR Sisyphe 7619, Box 123, 4 place Jussieu, 75005, Paris, France, (3) CNRS FIRE FR-3020, Box 123, 4 place Jussieu, 75005, Paris, France, (4) CNRS UMR Sisyphe 7619, Box 123, 4 place Jussieu, 75005, Paris, France, (5) Université de Liège, Unité d’Océanographie Chimique, Institut de Physique (B5), B-4000, Belgium

Inland waters are a key component of the global carbon (C) cycle that transport organic and inorganic C from the terrestrial biosphere to the coastal ocean and emit CO2 to the atmosphere at a significant rate for global CO2 budgets. Yet, mechanisms underlying this CO2 emission to the atmosphere remain poorly understood and seldom modelled mechanistically.

For this application a module describing the carbonate system and CO2 air-water exchange was added to the biogeochemical Seneque/Riverstrahler model describing transformation of C, N, P, Si occurring within hydrological networks. The model was applied to the human impacted Scheldt basin and the evolution of the partial pressure of CO2 (pCO2) and air-water CO2 flux was simulated for the year 1997 when data of dissolved inorganic carbon (DIC), total alkalinity (TA) and pCO2 are available for model validation. The model reproduces reasonably well the seasonal and spatial variations of the DIC, TA and pCO2 within the 5 main rivers of the Scheldt basin where data are available. At the annual level, the studied rivers act as major sources of CO2 to the atmosphere. Results show that the longitudinal variations of pCO2 are mainly controlled by the importance of air-water CO2 exchange. However, the choice of the parameterization of the gas transfer coefficient does not appear critical for this particular system. Biological activity also locally modulates the longitudinal variations of pCO2, while diffuse inputs from the watershed determine the initial conditions in the river without significantly altering the patterns observed from the upstream to the downstream. Both diffuse and punctual sources of C and TA are important drivers of the CO2 exchange in the river. In particular, model application evidences the sensitivity of the simulated CO2 fluxes to the description of human activities on the watershed.