Geophysical Research Abstracts
Vol. 16, EGU2014-10752, 2014
EGU General Assembly 2014

Drivers on carbon dioxide emissions from the Scheldt river basin

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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 CO_2 to the atmosphere at a significant rate for global CO_2 budgets. Yet, mechanisms underlying this CO_2 emission to the atmosphere remain poorly understood and seldom modelled mechanistically.

For this application a module describing the carbonate system and CO_2 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 CO_2 (pCO_2) and air-water CO_2 flux was simulated for the year 1997 when data of dissolved inorganic carbon (DIC), total alkalinity (TA) and pCO_2 are available for model validation. The model reproduces reasonably well the seasonal and spatial variations of the DIC, TA and pCO_2 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 CO_2 to the atmosphere. Results show that the longitudinal variations of pCO_2 are mainly controlled by the importance of air-water CO_2 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 pCO_2, 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 CO_2 exchange in the river. In particular, model application evidences the sensitivity of the simulated CO_2 fluxes to the description of human activities on the watershed.