Geophysical Research Abstracts
Vol. 12, EGU2010-12291, 2010
EGU General Assembly 2010

150 years of ecosystem evolution in the North Sea - from pristine conditions to acidification

Johannes Pätsch (1), Ina Lorkowski (1), Wilfried Kühn (1), Andreas Moll (1), and Alexandra Serna (2)

(1) Institut für Meereskunde, ZMAW, Universität Hamburg (johannes.paetsch@zmaw.de), (2) Institut für Biogeochemie und Meereschemie, ZMAW, Universität Hamburg

The 3-d coupled physical-biogeochemical model ECOHAM was applied to the Northwest European Shelf (47° 41‘ – 63° 53’ N, 15° 5’ W – 13° 55’ E) for the years 1860, 1960 and continuously for the time interval 1970 – 2006. From stable nitrogen isotope analysis in sediment cores of the German Bight in the southeastern part of the North Sea (inner shelf) we found the period before 1860 unaffected by anthropogenic river inputs of nitrogen. After this period the delta15N-ratios significantly increased from ∼6 per mil to more than 8 per mil in recent sediments indicating eutrophication by anthropogenic nitrate mainly from intensive agriculture fertilization. We deduced from the successful simulation of delta15N patterns in recent sediments that during pristine conditions nitrogen loads of the main continental rivers were about 10% of the modern input while the deposition of inorganic atmospheric nitrogen was 28% of the recent atmospheric flux. The 1960-sediment exhibited similar delta15N-values as the recent sediment which allows the conclusion that eutrophication in the German Bight predates the 1960 period of rapidly increasing river loads.

By comparing model results with observational data in the North Sea we analyzed the variability of simulated carbon fluxes (1970-2006) constituting the so called “shelf pump” which transports atmospheric CO2 via biological fixation, vertical export and advection into the adjacent North Atlantic. Even though the highly variable North Atlantic water-inflow which correlated with the North Atlantic Oscillation Index (NAOI) supplied the northern North Sea with strongly varying nutrient inputs, the interannual variability of the strength of the shelf pump was mainly governed by the variability of the southern basin’s biological productivity. The net ecosystem production (NEP) in the southern North Sea varies around zero inducing CO2 exchange with the atmosphere which is near equilibrium. In the northern North Sea the strong positive near-surface NEP support CO2 uptake. The continuous latter effect decreased the pH in this area by 0.09 units over the simulation period (1970-2006) while in the southern area it was variable not showing a significant trend.

Beside these biologically induced carbon fluxes physically- and chemically-driven fluxes were studied. While the first ones prominently corresponded with SST variations the second ones reacted on shifts in the carbonate system. Among others these shifts arise from alkalinity variations induced by production and dissolution of biogenic calcite on the shelf. We intensively investigated several model approaches for these processes to find out those applicable for shelf models.