KlimaCampus Colloquium

Prof. Helmuth Thomas

Dalhousie University

At the invitation of the Center for Earth System Research and Sustainability (CEN)

Regulation of CO2 air-sea fluxes and pH in the North Sea

KlimaCampus Hamburg

28.05.2015, 3:15 pm, Bundesstraße 53, room 22/23 (ground floor)

Abstract

In 2001, a large scale multiannual study of the CO_2 and pH system of the North Sea has been initiated, comprising basinwide observations in 2001, 2002, 2005, 2008 and 2011, and complementing modelling activities. The - ongoing - studies have been carried out by an international consortium, comprising colleagues from Germany, The Netherlands, Belgium and Canada. These investigations describe the North Sea, as part of the NW European Shelf, as a strong continental shelf pump, facilitated through intense interaction between the deeper northern North Sea and the adjacent North Atlantic. On the other hand, the North Sea's shallow southern part is strongly affected by terrestrial influences such as riverine inputs. These two biogeochemical provinces reveal different CO_2 air-sea flux characteristics: the northern, seasonally stratified region absorbs atmospheric CO_2, driven by the biological pump, where photosynthetically fixed CO_2 is exported to the deeper layers. This organic matter is remineralized and then transported out of the North Sea as CO_2. The southern, permanently mixed region, in contrast, acts, if at all, as a weak source of atmospheric CO_2; photosynthetic organic matter formation and its respiration both occur in the mixed surface layer, allowing temperature to seemingly control CO_2 and pH seasonality. Based on radium (Ra) and stable carbon isotope ^{13}C tracers, our ongoing investigations have identified a further mechanism to regulate the uptake of atmospheric CO_2 in the North Sea: anaerobic degradation of organic matter in shallow sediments, fuelled from land and the Atlantic Ocean, generates metabolic alkalinity and increases the CO_2 and pH buffer capacity of seawater. Sources for this alkalinity are at approximately comparable magnitude, the sediments of the shallow southern North Sea, and the Wadden Sea. The variability of this alkalinity source appears tightly bound to the variability of riverine nitrate inputs into the North Sea. At both the basin wide and annual scales anaerobic alkalinity generation in the southern North Sea irreversibly facilitates 7-10%, or taking into consideration benthic denitrification in the open North Sea, 20-25% of the North Sea's overall CO_2 uptake.