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Rising CO2 conditions and ocean acidification - a severe threat to high latitude coastal ecosystems

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Since the onset of industrialization various activities of mankind have increased the atmospheric CO2 partial pressure (pCO2) from approximately 280ppm to 380ppm nowadays. Part of this anthropogenic CO2 is taken up by the oceans causing an increase of the oceanic pool of dissolved inorganic carbon (DIC), which in turn causes a readjustment of the CO2-system equilibrium: the dissolved CO2 concentration increases, while the pH and the carbonate ion concentration (CO32-) decrease. Hitherto, little attention has been devoted to the effects of rising CO2 conditions on the CO2 and ecosystems of (higher latitude) coastal oceans. The North Sea, a northwestern European shelf sea, constitutes an ideal site for investigations of these effects and their consequences, since during the recent years comprehensive insight has been gained into the North Sea's carbon cycle. New observations from the North Sea show that between 2001 and 2005 the CO2 partial pressure (pCO2) in surface waters rose faster than atmospheric pCO2. The decline in air-sea partial pressure difference (deltapCO2) reflects partly a theoretically predicted feedback loop also evident in data and models for the entire North Atlantic: the invasion of anthropogenic CO2 reduces the ocean's CO2 buffer capacity and its ability to uptake additional CO2. The hydrochemical and water column conditions cause this effect to be more accentuated in the North Sea as a consequence of advective and in-situ processes. The accelerating decrease of the buffer capacity reflects a decrease of the CO32- concentration and in turn a decrease of the saturation states of Calcite and Aragonite. The reported dependence of the calcification activity on the saturation state implies a severe decline in calcification in the North Sea between 2001 and 2005. Rising CO2 conditions thus exert high pressure on high latitude coastal ecosystems, which last but not least play a crucial role in the world's food supply.