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Physical-Biogeochemical Interactions that Alter the Uptake of Atmospheric CO_2 in the Barents Sea

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The Barents Sea is characterized by significant calcification rates during summer promoted by intense coccolithophore blooms that peak during August. Coccolithophores, among which Emiliania huxleyi (E. huxleyi) is the most abundant and widespread species, are considered to be the most productive calcifying organisms on Earth. They inhabit the surface layer (MLD 20m) in highly stratified waters where light intensity is high. E. huxleyi often forms massive blooms in temperate and sub-polar oceans. Coupling of the coccolithophore organic carbon and carbonate pumps interact to consume (photosynthesis) and produce (calcification) CO_2. The so-called Rain Ratio, defined as the ratio of particulate inorganic carbon (PIC) to particulate organic carbon (POC) in exported biogenic matter, determines the relative strength of the two biological carbon pumps and influences the flux of CO_2 across the surface ocean - atmosphere interface. Here we use a combination of satellite ocean color algorithms, coupled ice-ocean model products, an SST-dependent pCO_2 algorithm, and gas exchange parameterization to describe the seasonal and decadal variability of the air-sea CO_2 flux in the Barents Sea. Model-derived SST and SSS (1955-2008) are used in conjunction with the pCO_2 algorithm and carbonate chemistry to derive decadal trends of sea-air CO_2 flux, pH and calcite saturation state. Phytoplankton and calcite production have strong spatial variability. Nutrient supply, biomass and calcite concentrations are modulated by light and MLD seasonal cycle. The size, intensity, and location of coccolithophore blooms vary from year to year, but the peak bloom is always in June in the Central Basin of the sub-polar North Atlantic (45^oW - 10^oW, 50^oN - 65^oN) and August in the Barents Sea. Calcification rates range from 5% to 27% of net primary production. The Barents Sea PIC production is about twice that of the Central Basin. Predicted freshening and warming of polar seas may increase stratification, thus favoring an increase in coccolithophore bloom development.