Dissolved inorganic carbon dynamics and air-sea carbon dioxide fluxes during coccolithophore blooms in the Northwest European continental margin (northern Bay of Biscay)

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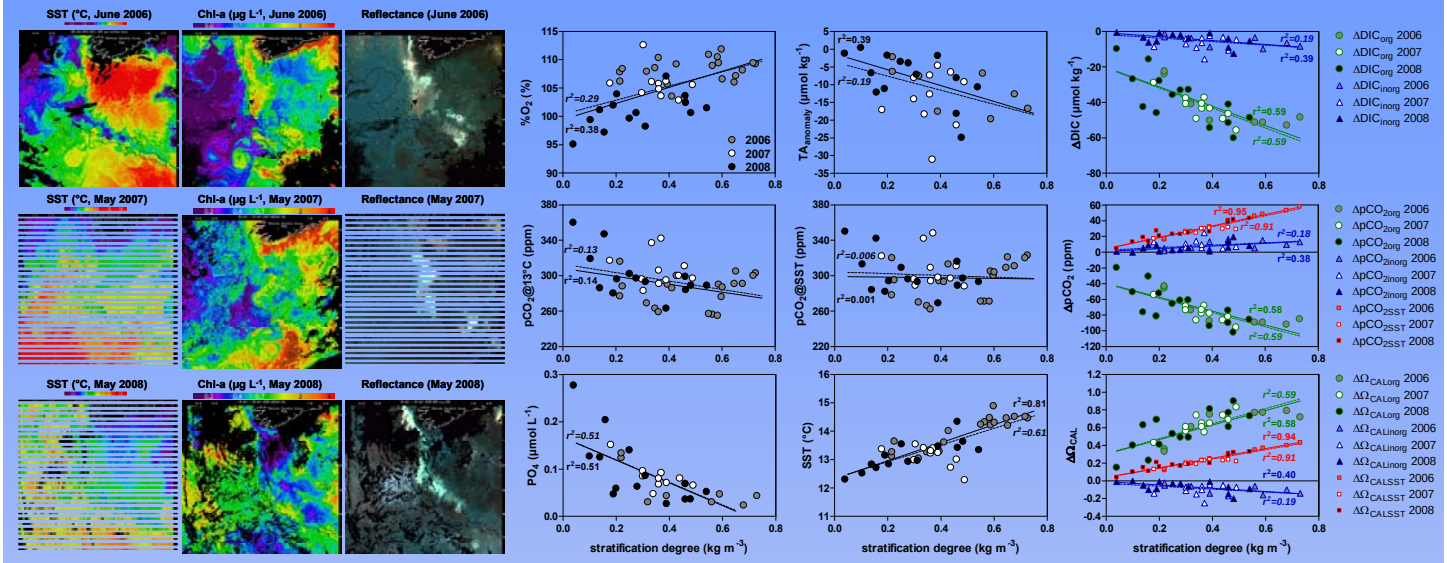

We conducted three cruises in the northern Bay of Biscay carried out in June 2006, May 2007, and May 2008, during which, blooms of the coccolithophore *Emiliania huxleyi* occurred. These cruises were carried out after the main spring diatom that peaks in mid-April. Hence, the area was generally characterized by low inorganic nutrients. Yet, at the continental shelf break the generation internal tides leads to upwelling. The cold, nutrient rich upwelled water at the shelf break moved over the shelf, warmed and stratified and then became depleted in nutrients, constraining the bloom close to the shelf break. Hence, stratification allows to reconstruct the bloom development from upwelled less stratified waters to older and more stratified waters.

The patterns of the variables in surface waters as a function of the stratification degree were remarkably consistent considering that data from 3 cruises carried out in different years were merged together . The increase of $\%O_2$ and decrease of PO_4^{3-} were consistent with organic carbon production during the bloom development (increasing stratification). The pattern in TAanomaly was consistent with $CaCO_3$ production during the bloom development (increasing stratification) of mixed phytoplanktonic communities. pCO_2@13°C showed a decreasing pattern with stratification, indicative that the net effect on pCO_2 of organic carbon production dominated over the net effect of calcification. The pattern with stratification of pCO_2@SST has lower statistical significance than that of pCO_2@13°C due to the increase of SST with stratification and subsequent effect on the CO_2 solubility and pCO_2@SST.

The effect on DIC, pCO_2 and Ω_{CAL} in surface waters of net community production (NCP, indicated as Δ*org) and net community calcification (NCC, indicated as Δ*inorg) was estimated based on the changes between the surface layer (0-20 m) and the deep layer (80m to seafloor) of nutrients and of TA, respectively. The effect of SST change on pCO_2 and Ω_{CAL} was also evaluated (indicated as Δ*SST). Results show that the effect of NCC on seawater inorganic carbon chemistry was overwhelmingly lower than the effect of NCP. For pCO_2 and Ω_{CAL}, the effect of NCC was also overwhelmingly lower than the effect of SST change.

Finally, we evaluated the air-sea CO_2 fluxes and effect of NCC in decreasing the CO_2 sink that in the study area that on average was small, ~12%. If this finding is confirmed in other oceanic regions, it would imply that the potential feed-back on increasing atmospheric CO_2 of the projected decrease of pelagic calcification due to thermodynamic CO_2 "production" from calcification is probably minor, compared to the potential feed-back related to the increase of NCP and carbon export.

European Geosciences Union General Assembly, 2-7 May 2010