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Surface dissolved inorganic carbon dynamics in the Gulf of Biscay (June 2006, May 2007 and May 2008)

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The biogeochemical properties of an extensive bloom of the coccolithophore, Emiliania huxleyi, at the shelf break in the northern Gulf of Biscay was investigated in June 2006, May 2007 and May 2008. We report the results from the surface measurements during all cruises. Seawifs Chlorophyll-a (Chl-a) values in the study area indicate that seasonal cycles of phytoplankton biomass were remarkably similar in 2006, 2007 and 2008 with a first peak in mid-April associated to diatoms and a second peak in late May associated to coccolithophorids. During both cruises, Total Alkalinity (TA) values showed strong non-conservative behavior, indicative of the impact of calcification. TA anomalies were positively related to the degree of stratification, in agreement with the ecophysiology of coccolithophores, whereby these organisms flourish in nutrient depleted and high light availability conditions. The largest TA anomalies were observed in the high reflectance coccolith patch where we also observed an increase in the partial pressure of CO_2 normalized at a constant temperature of 13˚C (pCO_2@13˚C), in agreement with the transfer of CO_2 from the bicarbonate pool during calcification. TA anomalies were of similar amplitude during both cruises, indicating that calcification affected markedly the dissolved inorganic carbon dynamics. During both cruises, pCO_2 values ranged form 250 to 375 μatm and the area was found to act as a sink for atmospheric CO_2. pCO_2@13˚C in the water column was negatively related to TA anomalies in agreement with an overall production of CO_2 related to calcification. Hence, the calcifying phase of the E.huxleyi bloom decreased the sink of atmospheric pCO_2, but did not reverse the direction of the flux. pCO_2@13˚C values in June 2006 lie below the values in May 2007, due to the cumulated impact of primary production on pCO_2, since the 2006 cruise was carried out later in the year than the 2007 cruise.