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Links between phytoplankton, CO2 emissions and water properties

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Changes in seawater chemistry already emerging in Portuguese coastal waters and trends predicted by the end of the century, might cause shifts in current algal communities and alter the structure and biodiversity of coastal ecosystems. May 2002 sampling in Tagus and Sado estuaries adjacent coastal shelf (SW Portugal) was an example of that. This period was characterized by a moderate but persistent upwelling and low Tagus river discharge (46 m^3 s^{-1}) favouring a weak plume and elevatedpCO_2 values. These conditions strongly influenced the phytoplankton community. The spring bloom occurred at Tagus plume and close to Lisbon Canyon, where large sized phytoplankton, dominated by chain-forming diatoms, reached values up to 1000cells ml^{-1}, while dinoflagellates reached a local peak over the canyon (>20 cells ml^{-1}). Spatially differentiated from the main phytoplankton bloom, a development of the intermediate sized species *Coccolithus braarudii* (up to 60 cells ml^{-1}) occurred, associated with the thermally stratified water-mass localised in Tagus Bay. While diatoms proliferated throughout turbulent waters, coccolithophores developed under more stable conditions, being not directly affected by anthropogenic inputs and associated with relatively low nutrient levels. The same trend was also observed for the small sized phytoplankton, which abundance (>10^6 cells ml^{-1}) increased from inshore to the deeper surface mixed layer offshore where light was dimmer and nutrient concentrations lower. The small sized phytoplankton was made up of cyanobacteria *Synechococcus*-like and eukaryotes reaching, respectively, 721 and 466 cells ml^{-1}.

Regarding the relative importance of each phytoplankton size group in terms of carbon, cocolithophores and small sized phytoplankton represented, respectively, 2% and 0.2% of the total phytoplankton biomass. Despite the low percentage in terms of particulate organic carbon, cocolithophores played an important role in terms of $CaCO_3$ and CO_2. It was estimated an amount of ∼5 tons of $CaCO_3$ produced in the upper 30 m of water resulting in a emission of CO_2 of 7.4 mmol m^{-2} d^{-1}, which indicates that the calcification process constitutes an additional source of CO_2 to the water and, eventually, to the atmosphere.

Our findings illustrate the sensitivity of the phytoplankton species composition in the shelf system under study to climate variations and also its importance in the carbon cycle. Thus, if phytoplankton community is vulnerable to this type of perturbations, one may expect impacts on higher trophic levels that involve specific trophic links.Please fill in your abstract text.