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Vertical export of particulate organic carbon in the Ría de Vigo (NW Atlantic upwelling system): the role of physical forcing and phytoplankton community structure

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The aim of this work was to study the efficiency of the Ría de Vigo ecosystem (NE Atlantic upwelling system) in the export of particulate organic carbon (POC) from the photic zone as a fundamental issue to understand the capability of the ocean in the sequestration of anthropogenic CO2. During two years (2003-04 and 2007-08), water column and sediment trap samples were seasonally monitored in two stations located in the central channel of the Ría.

The results presented here reveal that the high POC fluxes (394-1928 mg m-2 d-1) registered at the base of the photic zone are strongly controlled by both the hydrodynamic processes that affected the Ría and phytoplankton community structure. Our data show that during spring and summer, the existence of upwelling events driving the positive circulation inside the Ría, favour the offshore POC export, reaching values as high as 61% of the total primary production. Otherwise, the nutrient-rich subsurface upwelled waters trigger the rapid development of large diatoms that are highly efficient in the vertical transfer of POC from the photic zone. On the contrary, during autumn and winter, when downwelling and mixing processes occurs, the POC material collected in the sediment traps are mainly associated to resuspension processes. During that time, the primary production rates are minimal and the phytoplankton community structure is mainly associated to small solitary cells that remain in suspension in the water column and therefore reduce the organic carbon fluxes escaping from the photic zone.

Besides its regional importance, this study will contribute to understand how the strong hydrodynamical and biological seasonal variations in these very high productive systems are affecting the interpretations given by the actual global ocean organic carbon export models.