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Seasonal variability of fCO2 in the eastern North Atlantic Ocean

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Monthly measurements of fCO_2, temperature, salinity and chlorophyll a were analyzed from July 2005 to April 2008 for the studied area located at the northwest European shelf from 40ºN 10º W to 52ºN 2ºE using volunteer observing ships (VOS). The objective was to gauge the seasonal variability of fCO_2 in surface seawaters, and the seasonal air-sea CO_2 exchange, taking into account the latitudinal transition of relative importance in the temperature and the biological effects on seawater fCO_2 variability, and the dynamic of the upwelling that affects the air-sea fluxes of CO_2. Due to the area of the study covered different hydrographical conditions, the area was divided into three regions. The results showed a complex surface hydrodynamic system, with coast upwelling, vertical mixing processes and fronts affecting the physical, chemical and biological parameters that control the surface distribution of fCO_2. The Galician coast region (40ºN-43.5ºN) acted as an active sink, with a rate of oceanic CO_2 uptake of -2.86 $\pm$ 0.69 mol m^{-2} yr^{-1} in 2006 and -3.75 $\pm$ 0.78 mol m^{-2} yr^{-1} in 2007. Moreover, in upwelling periods, SST decreased by over 6ºC and fCO_2 was strongly affected, indicating that both solubility and biological uptake effects are compensating upwelled CO_2 rich water. Blooms of phytoplankton reduced the fCO_2 in the area. The Biscay Bay region (43.5ºN-48.5ºN) also acted as a homogenous sink of CO_2, with fluxes of -3.79 $\pm$ 0.57 mol m^{-2} yr^{-1} in 2007. However, in 2006, the CO_2 fluxes were closer to equilibrium. These results were explained by changes in the wind fields, with very low wind speeds during 2006, while fCO_2 gradients kept relatively constant. The English Channel region (48.5ºN-52ºN) presented the highest variability observed that indicated the strong influence by river inputs, biological events and the fronts, acting as a sink in winter and spring and as a source in summer and autumn. Annually, the western English Channel acted as a variable source of CO_2, with fluxes of 0.53 $\pm$ 2.50 mol m^{-2} yr^{-1} in 2006 and 0.70 $\pm$ 2.78 mol m^{-2} yr^{-1} in 2007, while in the eastern English Channel acted as an important sink of CO_2, with fluxes of -5.95 $\pm$ 3.97 mol m^{-2} yr^{-1} in 2007, with a strong influence of the biological effects on the area.