Temporal patterns of carbon dioxide in the northeastern shelf of the Gulf of Cadiz.

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The variations of the partial pressure of CO_2 (pCO_2) in surface seawaters of the northeastern shelf of the Gulf of Cadiz are being monitored and studied in relation to hydrological conditions, chlorophyll concentrations, and primary production (PP) since March 2003 until present using an extensive dada set of both alkalinity and pH. Monthly or seasonal air–sea CO_2 fluxes are being also calculated. In spring, during the period of complete mixing of the water column, nutrients mainly brought to surface waters by the discharge of large rivers that drain into the basin allow the development of the phytoplankton bloom. PP rates estimated by remote sensing show the highest values that can be observed on annual basis, which normally occur concomitantly with the lowest values of surface pCO_2. The undersaturation registered with respect to atmospheric pCO_2 leads the area to behave as a net sink for CO_2. In late summer and beginning of fall, water stratification, wind relaxation, and the absence of river discharge result generally in a drop in chlorophyll levels, which are accompanied by a reduction in the productivity throughout the entire shelf. A marked increase in surface pCO2 takes place, also in response to high surface seawater temperatures. During this time of the year, the air-sea CO_2 flux reverses towards the atmosphere, and the shelf acts as a source of CO_2 to the atmosphere. As autumn progresses, nutrient concentrations rise as a consequence of fluvial inputs, which in conjunction with a complete mixing in the water column favor the appearance of the second, but less intense, seasonal phytoplankton bloom. PP increases with respect to summer and a decrease in surface pCO_2 is usually recorded. The undersaturation results in a net capture of atmospheric CO_2. Although chlorophyll concentration diminishes during winter in response to the reduction in the incident irradiance, the air–sea CO_2 flux remains directed towards the ocean. The results obtained so far strongly indicate that, on annual basis, the northeastern shelf of the Gulf of Cadiz behaves as a net sink for atmospheric CO_2.

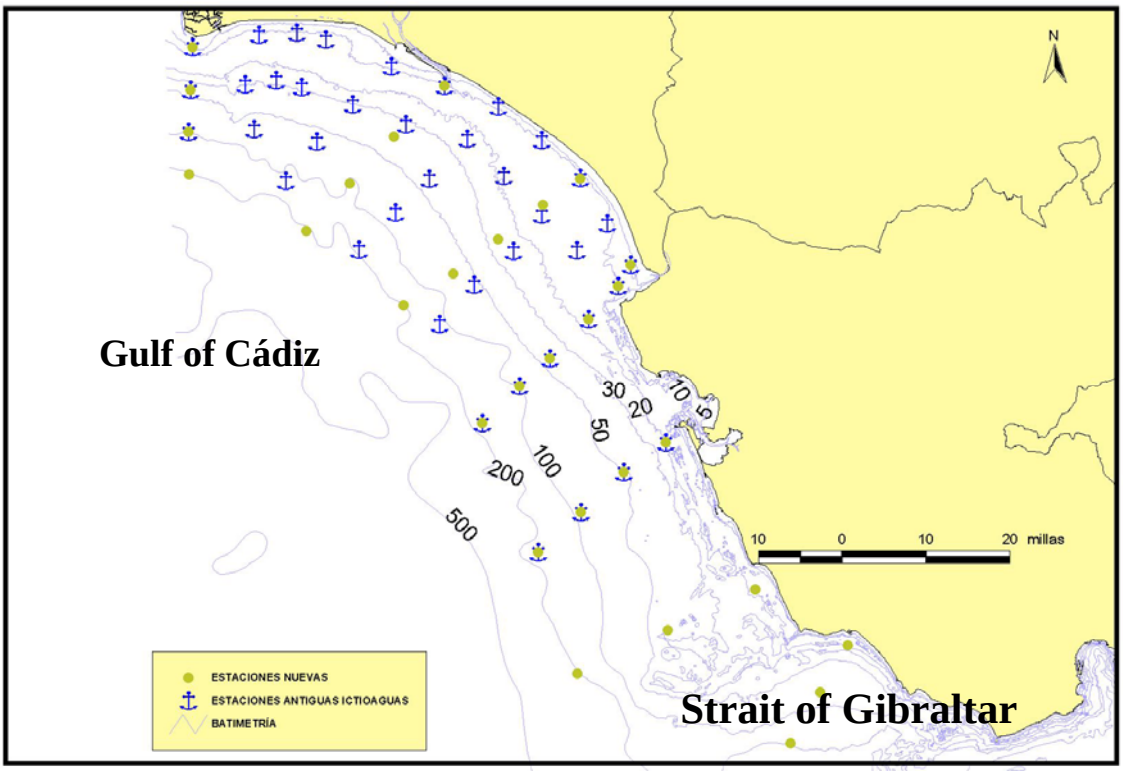

Figure 1. Study area and sampling grid.

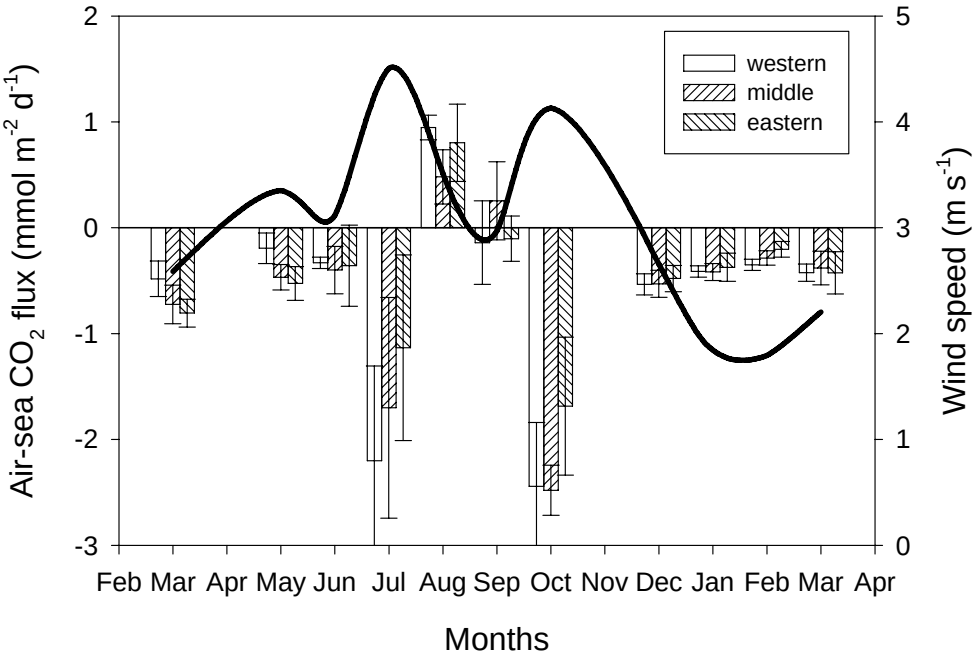

Figure 2. Net air–sea CO_2 fluxes (bars) calculated monthly from March 2003 to March 2004 in three sectors in which the sampling area was divided. Wind speed (solid line) during the days of the sampling cruises is also given.

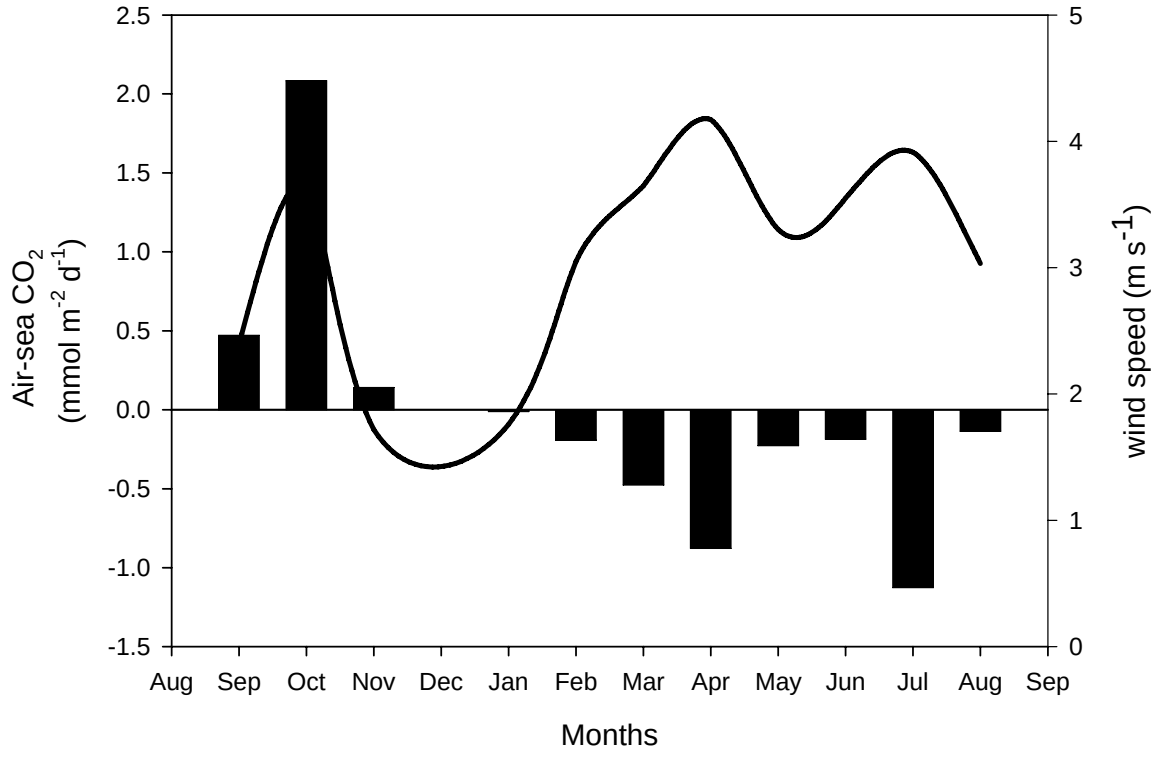

Figure 3. Net air–sea CO_2 fluxes (bars) calculated monthly from September 2005 to August 2006 averaged for the whole sampling area. Wind speed (solid line) during the days of the sampling cruises is also given.