The variability of the surface CO_2 system and air-sea exchange in the Northeast Atlantic based on VOS data.

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Abstract: The seasonal and spatial variability of the CO_2 system parameters and air-sea CO_2 exchange was studied in the Northeast Atlantic through the Northwest African coastal transitional area between the Canary Islands and the Strait of Gibraltar. High spatio-temporal resolution data were collected by a Surface Ocean Observation Platform (SOOP) aboard a volunteer observing ship (VOS) from February 2019 to February 2020. The variability of the CO_2 fugacity in seawater ($fCO_{2,sw}$) was strongly driven by the seasonal pattern of the sea surface temperature (SST), which increased with latitude and was lower throughout the year in the high-intense coastal upwelling areas. The $fCO_{2,sw}$ increased from winter to summer by 11.84 ± 0.28 µatm $ºC^{-1}$ in the Canary archipelago and by 11.71 ± 0.25 µatm $ºC^{-1}$ along the northwest African continental shelf. The thermal to non-thermal effect ratio (T/B) was approximately 2, with minimum values along the African coastline explained by higher biological activity in the upwelled waters. The factors controlling the seasonality of total inorganic carbon (C_T) normalized to constant salinity of 36.7 (NC_T) were assessed. The effect of net community production on NC_T between February and October represented >90% of the reduction of inorganic carbon while air-sea CO_2 exchange described <6%. The seasonality of air-sea CO_2 fluxes was driven by SST fluctuations. The surface waters of the entire region acted as a strong CO_2 sink during the cold months and as a weak CO_2 source during the warm months. A net annual CO_2 sink behaviour was observed in both the Canary basin (-0.26 ± 0.04 mol C m^{-2} yr^{-1}) and the northwest African continental shelf (-0.48 ± 0.09 mol C m^{-2} yr^{-1}). The calculated average CO_2 flux for the entire area in the Northeast Atlantic was -2.65 ± 0.44 Tg CO_2 yr^{-1} (-0.72 ± 0.12 Tg C yr^{-1}).

Keywords: CO_2 system, air-sea CO_2 exchange, Northeast Atlantic, Surface Ocean Observation Platform, VOS line.

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