EGU22-2412
https://doi.org/10.5194/egusphere-egu22-2412
EGU General Assembly 2022

Variability of the air-sea CO2 exchange in the Strait of Gibraltar based on measurements from a VOS line.

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The spatio-temporal variability of the surface CO_2 system and its air-sea fluxes were studied in the Strait of Gibraltar based on high-resolution underway field data collected between February 2019 and March 2021 by a surface ocean observation platform (SOOP) aboard a volunteer observing ship (VOS). The surface CO_2 distribution was strongly influenced by the seasonal and spatial variability in the depth of the Atlantic-Mediterranean Interface layer and by upwelling of deep-water drove by the tidal and easterly winds. The variability of the CO_2 fugacity ($fCO_{2,sw}$) and fluxes were mainly driven by temperature despite the significant influence of non-thermal processes in the southernmost part. The thermal to non-thermal effect ratio (T/B) reached higher values values in the northern section (>1.8) compared with the southern section (<1.30) due to the enhancement of biological activity and vertical mixing related to the seasonal wind-induced upwelling along the African coast. The $fCO_{2,sw}$ increased with temperature by 9.02 ± 1.99 µatm ºC (r^2=0.86) and 4.51 ± 1.66 µatm ºC (r^2=0.48) in the northern and southern sections, respectively. The annual cycle (referenced to 2019) of total inorganic carbon normalized to a constant salinity of 36.7 (NC_T) was attended. The net community production processes described 93.5-95.6% of the total NC_T change, while the contribution of air-sea exchange and horizontal and vertical advection was found to be minimal (<4.6%). According to the seasonality of air-sea CO_2 fluxes, the region behaved as a strong CO_2 sink during the cold months and as a weak CO_2 source during the warm months. The Strait of Gibraltar acted as annual net CO_2 sink, with higher net ingassing along the southern section (-1.01 mol C m^{-2}) compared to the northern section (-0.82 mol C m^{-2}). The calculated average CO_2 flux for the entire area was -7.12 Gg CO_2 yr^{-1} (-1.94 Gg C yr^{-1}).

Keywords: Air-sea CO_2 fluxes, CO_2 system, VOS line, Surface Ocean Observation Platform, Strait of Gibraltar.