EGU21-12710
https://doi.org/10.5194/egusphere-egu21-12710
EGU General Assembly 2021

Seasonal and spatial variability of the CO2 system parameters in the Northeast Atlantic based on measurements from a surface ocean observation platform.

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The seasonal and spatial variability of the CO_2 system parameters and CO_2 air-sea exchange was studied in the Northeast Atlantic Ocean between the northwest African coastal upwelling and the oligotrophic open-ocean waters of the North Atlantic subtropical gyre. Data was collected aboard a volunteer observing ship (VOS) from February 2019 to February 2020. The seasonal and spatial variability of CO_2 fugacity in seawater ($fCO_{2,sw}$) was strongly driven by the seasonal temperature variation, which increased with latitude and was lower throughout the year in coastal regions where the upwelling and offshore transport was more intense. The thermal to biological effect ratio (T/B) was approximately 2, with minimum values along the African coastline related to higher biological activity in the upwelled waters. The $fCO_{2,sw}$ increased from winter to summer by 11.84 ± 0.28 µatm°C^{-1} on the inter-island routes and by 11.71 ± 0.25 µatm°C^{-1} along the northwest African continental shelf. The seasonality of total inorganic carbon (C_T) normalized to constant salinity of 36.7 (NC_T) was studied throughout the region. The effect of biological processes and calcification/dissolution on NC_T between February and October represented >90% of the reduction of inorganic carbon while air-sea exchange described <6%. The seasonality of air-sea CO_2 exchange was controlled by temperature. The surface waters of the entire region acted as a CO_2 sink during the cold months and as a CO_2 source during the warm months. The Canary basin acted as a net sink of -0.26 ± 0.04 molC m^{-2} yr^{-1}. The northwest African continental shelf behaved as a stronger sink at -0.48 ± 0.09 molC m^{-2} yr^{-1}. The calculated average CO_2 flux for the entire area was -2.65 ± 0.44 $TgCO_2$ yr^{-1} (-0.72 ± 0.12 TgC yr^{-1}).