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Reconstruction of the surface marine carbonate system at the Western Tropical Atlantic

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The Western Tropical Atlantic is a crucial region when it comes to understanding the CO_2 dynamics in the tropics, as it is subject to large inputs of freshwater from the Amazon River and the ITCZ rainfall, as well as the input of CO_2-rich waters from upwelling of subsurface water. This study aims to reconstruct the surface marine carbonate system from 1998 to 2018 using sea surface temperature (SST) and sea surface salinity (SSS) data from the PIRATA buoy at 8°N 38°W and describe its variability in time. Two empirical models were used to calculate total alkalinity (TA) and dissolved inorganic carbon (DIC) from SSS. From these two parameters and SST data, it was possible to calculate pH and CO_2 fugacity (fCO_2) values. Only DIC, pH and fCO_2 showed a statistically significant trend in time, where DIC showed an increase of 0.717 µmol kg^{-1} $year^{-1}$, pH decreased 0.001394 pH units $year^{-1}$, and fCO_2 had an increase of 1.539 µatm $year^{-1}$. Two different seasons were observed when data were analyzed: a dry season from January to June, when SSTs were lower (around 27°C) and SSS was stable around 36, matching the period when the ITCZ is over the South American continent, Amazon river plume is restricted to western shelf areas and Equatorial upwelling is more active, and a rainy season from July to December, when SSTs were higher (around 28.5°C) and SSS had higher variability (from 31 to 36), matching the period when the ITCZ is at its northern range, the Amazon plume is spread eastwards through the North Brazil Current's retroflection and the Equatorial upwelling is less intense. Along with that, TA, DIC and pH varied positively with SSS, with higher values (TA around 2350 µmol kg^{-1}, DIC around 2025 µmol kg^{-1} and pH around 8.060 pH units) during dry season and lower values (TA around 2300 µmol kg^{-1}, DIC around 1990 µmol kg^{-1} and pH around 8.050 pH units) during rainy season. On the other hand, fCO_2 varied positively with SST, with lower values (around 385 µatm) during dry, upwelling season and higher values (around 390 µatm) during rainy season, showing that both SSS and SST variability play an important role in the CO_2 solubility in the region.