

EGU2020-18139

<https://doi.org/10.5194/egusphere-egu2020-18139>

EGU General Assembly 2020

© Author(s) 2021. This work is distributed under the Creative Commons Attribution 4.0 License.



## Mechanisms driving seawater pCO<sub>2</sub> spatiotemporal variability in the Canary-Iberian Upwelling System

Daniel Broullón<sup>1</sup>, Rita Nolasco<sup>2</sup>, Rosa Reboreda<sup>1</sup>, Jesus Dubert<sup>2</sup>, Marion Gehlen<sup>3</sup>, James Orr<sup>3</sup>, and Fiz F. Pérez<sup>1</sup>

<sup>1</sup>Instituto de Investigaciones Marinas (IIM), Consejo Superior de Investigaciones Científicas (CSIC), Vigo, Spain

<sup>2</sup>CESAM & Department of Physics, Universidade de Aveiro, Aveiro, Portugal

<sup>3</sup>Laboratoire des Sciences du Climat et de l'Environnement (LSCE/IPSL), Université Paris-Saclay, Gif-sur-Yvette, France

Upwelling systems are very productive regions of the ocean that strongly contribute to the local economies holding very different fisheries. These dynamic systems are characterized by a high degree of spatial and temporal variability of biogeochemical properties, including carbon, which is generally poorly represented in coarse-resolution global models. The importance of the marine carbon system characterizing these systems has been demonstrated in different regions from multiple perspectives. For the first time, we evaluate the drivers of the spatiotemporal variability of the seawater partial pressure of CO<sub>2</sub> (pCO<sub>2</sub>) in the Canary-Iberian Upwelling System (25.5-45°N, 5.5-20.5°W) to better understand the inorganic carbon cycle in this highly-productive upwelling region. To do so, we first coupled a regional high-resolution ocean circulation model CROCO with the ocean biogeochemical model PISCES and run a climatological simulation. A first-order Taylor expansion was applied over this simulation to compute the contribution of four variables to the pCO<sub>2</sub> spatiotemporal variability: salinity-normalized dissolved inorganic carbon (sC<sub>T</sub>), salinity-normalized total alkalinity (sA<sub>T</sub>), temperature (T) and freshwater fluxes (FW). Modeled pCO<sub>2</sub> is in agreement with that of recent data-based monthly climatologies (open ocean RMSE: 5.2-10.8 μatm; coastal ocean RMSE: 7.9-18.7 μatm), measured data from the Surface Ocean CO<sub>2</sub> Atlas (SOCAT) (RMSE: 6.6-13.9 μatm) and computed pCO<sub>2</sub> from measured A<sub>T</sub> and pH at the European Station for Time series in the Ocean Canary islands (ESTOC) (RMSE: 5.1 μatm). The spatial distribution of the pCO<sub>2</sub> anomalies relative to the domain mean shows two different areas with opposite anomalies: positive anomalies around the coast in the entire domain and in open ocean south of 33°N and negative anomalies in open ocean north of 33°N. This pattern is mainly driven by the contribution of the T component and a minor influence of sA<sub>T</sub> and FW, with the sC<sub>T</sub> component largely counteracting the effects of the other drivers but contributing to the positive anomaly along the Iberian coast. The seasonal variability is controlled by T and sC<sub>T</sub>, with a minor influence of sA<sub>T</sub> and a negligible importance of FW. The seasonal cycle shows a direct covariation between the T contribution and the ΔpCO<sub>2</sub> (monthly mean minus annual mean of pCO<sub>2</sub>) and an inverse covariation between the sC<sub>T</sub> contribution and the ΔpCO<sub>2</sub> that counteracts the effect of T in the ΔpCO<sub>2</sub> amplitude. A decrease in the ΔpCO<sub>2</sub> amplitude was found from open ocean (depths > 200m) to coastal ocean (depths < 200m) determined mainly by a decrease in the influence of the T driver and, less significant, also by a reduction of the sC<sub>T</sub> contribution. The general agreement

between modeled and observed contributions to  $p\text{CO}_2$  variability at the ESTOC time-series station, in terms of both phase and amplitude, lends credibility to our deconvolution and model, which has been applied across the Canary-Iberian Upwelling System, to assess the processes behind the spatiotemporal variability of  $p\text{CO}_2$ .