

Author's Accepted Manuscript

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PII: S0278-4343(16)30113-3
DOI: <http://dx.doi.org/10.1016/j.csr.2016.03.013>
Reference: CSR3392

To appear in: *Continental Shelf Research*

Received date: 16 August 2015
Revised date: 27 February 2016
Accepted date: 4 March 2016

Cite this article as: Rosane Gonçalves Ito, Carlos Alberto Eiras Garcia and Virginia Maria Tavano, Net sea-air CO₂ fluxes and modelled pCO₂ in the southwestern subtropical Atlantic continental shelf during spring 2010 and summer 2011, *Continental Shelf Research*, <http://dx.doi.org/10.1016/j.csr.2016.03.013>

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Net sea-air CO₂ fluxes and modelled pCO₂ in the southwestern subtropical Atlantic continental shelf during spring 2010 and summer 2011

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Abstract

Sea-air CO₂ fluxes over continental shelves vary substantially in time on both seasonal and sub-seasonal scales, driven primarily by variations in surface pCO₂ due to several oceanic mechanisms. Furthermore, coastal zones have not been appropriately considered in global estimates of sea-air CO₂ fluxes, despite their importance to ecology and to productivity. In this work, we aimed to improve our understanding of the role played by shelf waters in controlling sea-air CO₂ fluxes by investigating the southwestern Atlantic Ocean (21°–35°S) region, where physical, chemical and biological measurements were made on board the Brazilian R. V. *Cruzeiro do Sul* during late spring 2010 and early summer 2011. Features such as discharge from the La Plata River, intrusions of tropical waters on the outer shelf due to meandering and flow instabilities of the Brazil Current, and coastal upwelling in the Santa Marta Grande Cape and São Tomé Cape were detected by both *in situ* measurements and ocean colour and thermal satellite imagery. Overall, shelf waters in the study area were a source of CO₂ to the atmosphere, with an average of 1.2 mmol CO₂ m⁻² day⁻¹ for the late spring and 11.2 mmol CO₂ m⁻² day⁻¹ for the early summer cruises. The spatial variability in ocean pCO₂ was associated with surface ocean properties (temperature, salinity and chlorophyll-*a* concentration) in both the slope and shelf waters. Empirical algorithms for predicting temperature-normalized surface ocean pCO₂ as a function of surface ocean properties were shown to perform well in both shelf and slope waters, except (a) within cyclonic eddies produced by baroclinic instability of the Brazil

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