

Spatial variability of CO₂ fluxes in the Gerlache Strait, Antarctica, during austral summer 2015



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Background

Understanding the processes of exchanges between ocean and atmosphere is extremely important when studying the global climate. In this context, the Southern Ocean presents an important role in CO₂ fluxes comprehension, due to its large oceanic area, low temperature and considerable seasonality.

Methods

- Water samples from the Gerlache Strait were collected in February 2015 (austral summer) during NAUTILUS I cruise.
- Measurements of total alkalinity (A_T) and total dissolved inorganic carbon (C_T) were made using a closed-cell titration (SOP 1 recommendations, Dickson et al. 2007).
- Partial CO₂ pressure in seawater (pCO_{2sw}) was determined from A_T , C_T , temperature and salinity data using CO2calc.
- Atmospheric pCO_2 (pCO_{2atm}) was obtained from Palmer Station.
- From ΔpCO_2 and wind speed data (ECMWF-NOAA), CO₂ flux was calculated using Wanninkhof (1992) exchange coefficient.

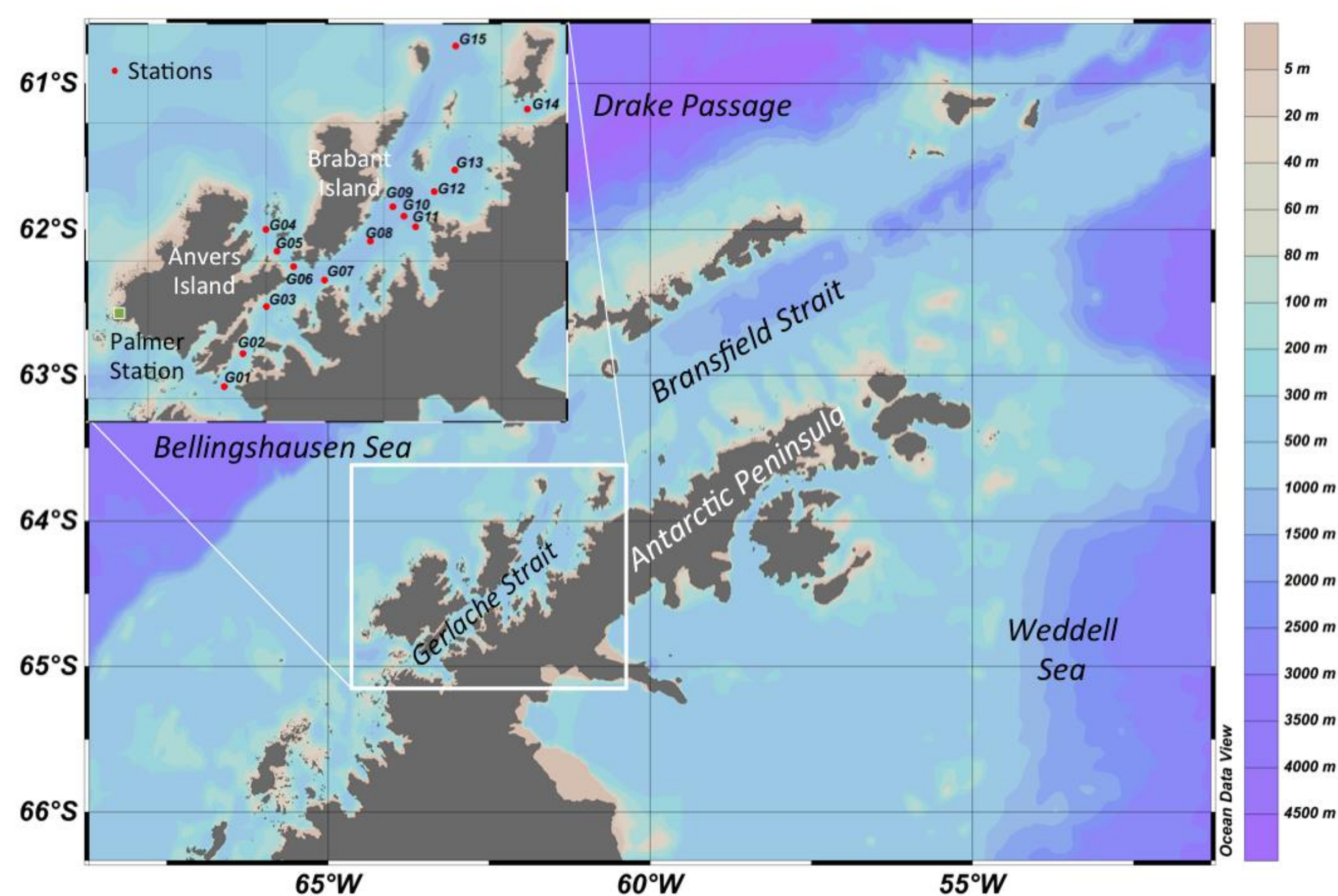


Figure 1. Map of the Gerlache Strait region, Antarctica. The red dots represent the position of the oceanographic stations sampled during NAUTILUS I cruise, in February 2015.

References

- Álvarez *et al.* (2002). Spatio-temporal variability of air–sea fluxes of carbon dioxide and oxygen in the Bransfield and Gerlache Straits during austral summer 1995–96. *Deep Sea Research II*.
- Carrillo & Karl (1999). Dissolved inorganic carbon pool dynamics in northern Gerlache Strait, Antarctica. *Journal of Geophysical Research: Oceans*.
- Dickson *et al.* (2007). Guide to Best Practices for Ocean CO₂ Measurements.
- Legge *et al.* (2015). The seasonal cycle of ocean-atmosphere CO₂ flux in Ryder Bay, west Antarctic Peninsula. *Geophysical Research Letters*.
- Lenton *et al.* (2013). Sea-air CO₂ fluxes in the Southern Ocean for the period 1990–2009. *Biogeosciences Discussions*.
- Robbins *et al.* (2010). CO₂calc: A user-friendly seawater carbon calculator for Windows, Mac OS X, and iOS (iPhone).
- Takahashi *et al.* 2009. Climatological mean and decadal change in surface ocean pCO_2 , and net sea-air CO₂ flux over the global oceans. *Deep-Sea Research II*.

Findings

A_T and C_T showed different patterns along the Gerlache Strait responding to the influence of waters with distinct origins (i.e. warm waters from the Bellingshausen Sea and salty and cold waters from the Bransfield Strait).

pCO_{2sw} data ranged between 310 and 560 μatm , with the lowest values on the southwest region, a sheltered area influenced by ice melting and continental input.

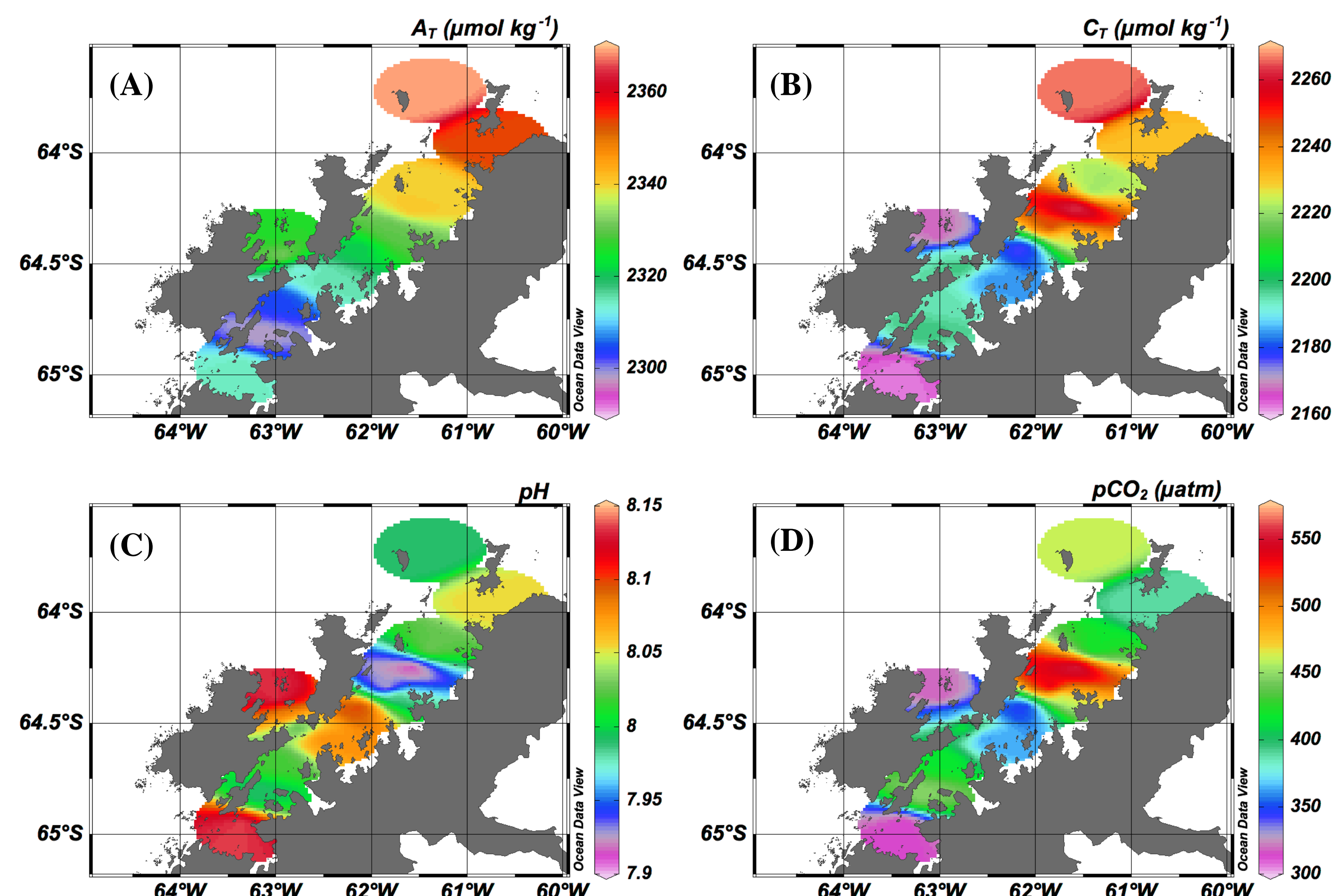


Figure 2. Distribution of the carbonate system parameters on the water surface of the Gerlache Strait in February 2015. A) Total alkalinity ($\mu mol kg^{-1}$); B) Total dissolved inorganic carbon ($\mu mol kg^{-1}$); C) pH (total scale); and D) Water pCO_2 (μatm).

In general, the Gerlache Strait region acted as a weak source of CO₂, with a mean flux of $1.2 \pm 4.9 mmol m^{-2} d^{-1}$. However, two distinct patterns were seen: the southwest area showed an average uptake of CO₂ ($-1.2 \pm 3.3 mmol m^{-2} d^{-1}$), whereas the northeast area acted mainly as a source of CO₂ to the atmosphere ($3.6 \pm 5.2 mmol m^{-2} d^{-1}$).

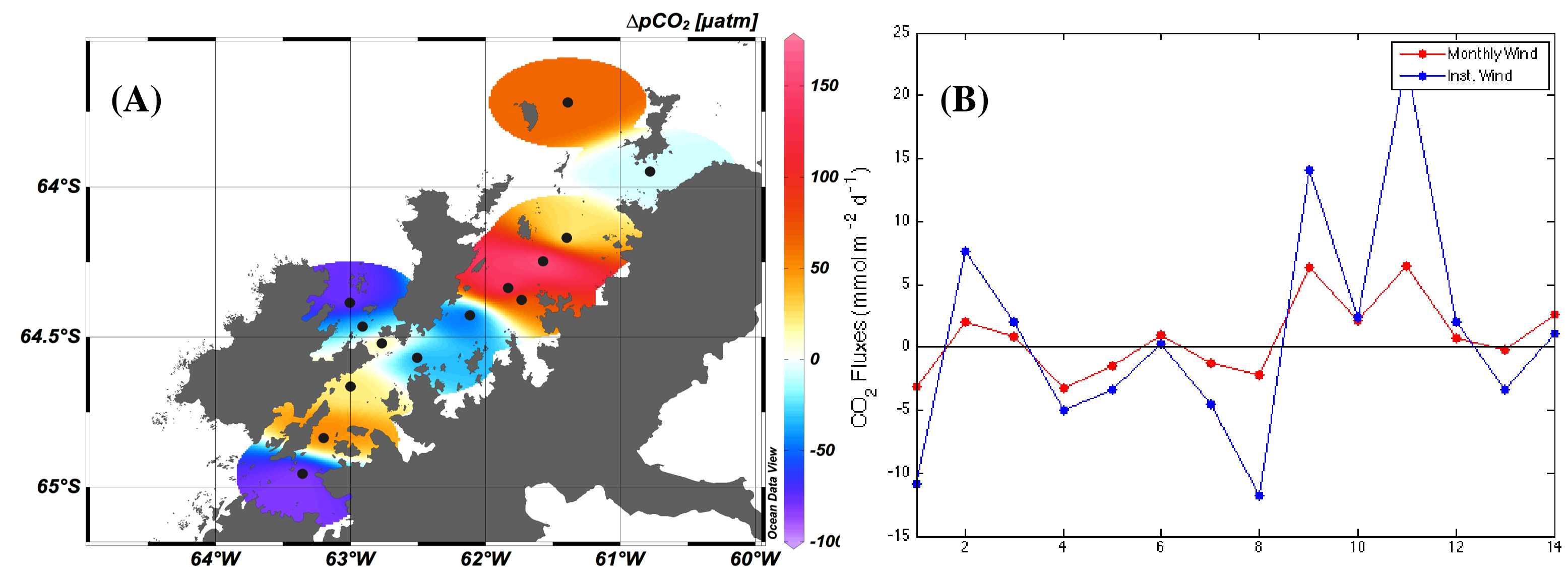


Figure 3. A) Distribution of ΔpCO_2 ; B) CO₂ fluxes calculated using instantaneous wind data acquired at the time of the sampling and monthly average wind data for the Gerlache Strait region on February, 2015.

Conclusions

The Gerlache Strait showed significant spatial variation in pCO_{2sw} values. As a coastal area with high biological production and strong seasonality, this region represents an important spot for studies involving CO₂ fluxes and its temporal and spatial variations.



This study contributes to the Brazilian Ocean Acidification Network activities –

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