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 (A₂) and total dissolved inorganic carbon (C₂) were made using a closed-cell titration (SOP 1 recommendations, Dickson et al. 2007).
- Partial CO₂ pressure in seawater (pCO₂2sw) was determined from A₂, C₂, temperature and salinity data using CO2calc.
- Atmospheric pCO₂ (pCO₂2atm) was obtained from Palmer Station.
- From ΔpCO₂ 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.

Findings

A₂ and C₂ 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).

pCO₂2sw 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.

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

Figure 2. Distribution of the carbonate system parameters on the water surface of the Gerlache Strait in February 2015. A) Total alkalinity (µmol kg⁻¹); B) Total dissolved inorganic carbon (µmol kg⁻¹); C) pH (total scale); and D) Water pCO₂ (µatm).

Conclusions

The Gerlache Strait showed significant spatial variation in pCO₂2sw 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.

References


