Progress of the decadal scale anthropogenic CO_2 in the Southern Ocean

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In this study, large CO_2 disequilibrium (C_{diseq}) was found in the range of −70 to −10 μmol kg^{-1} in the Southern Ocean (SO). When we tried to formulate this C_{diseq}, C_{diseq} had a strong correlation with the potential water temperature (θ) ($C_{diseq} = 1.766\theta - 45.07$; R = 0.71, RMSE = 9.05 μmol kg^{-1}). This equation was applied to the vertical data obtained in the cruise of KARE22_UM-18-08. From the distributions of C_{diseq} and anthropogenic CO_2 (C_{ant}) in the north-south direction, we found that a large amount of C_{anth} is absorbed from the atmosphere to the ocean surface in high-latitude where high-density seawater exists.

Then, we constructed simple equations to predict dissolved inorganic carbon (DIC) and pH with high precision in the entire SO (south of 30° S) by using a hydrographic general dataset for dissolved oxygen, water temperature, salinity, and pressure. To estimate ΔC_{ant} variation in the SO, we applied a new method (that combined the parameterization technics with observational data (*Watanabe et al.*, 2018)) to high-resolution grid data constructed based on ship-based observations from 1990 to 2017. As a result, we determined the ocean uptake of C_{ant} in the SO over the past two decades. DIC increases by anthropogenic effect account for 60% of the variation of DIC in the SO.

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