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Surface pCO_2 distribution and its controlling factors on the Drake Passage and the Scotia Sea in December 2001

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Surface measurements of pCO_2, TCO_2, alkalinity, and nutrients were made on the Drake Passage and the Scotia Sea in December 2001. Surface pCO_2 concentration along the Scotia Sea Line (WS-Line) ranged from 370-420 μatm and increased across the Polar and Scotia Fronts by about 10-20 μatm, while the surface pCO_2 along the Drake Passage Line (DP-Line) ranged from 380-400 μatm and have no significant change across the front. Seasonal warming from winter to the study period forced an increase of 0.08 to 0.27 μatm d^{-1} in surface pCO_2; the higher values were observed at the stations close to the Polar Front. The air-sea exchange decreased surface pCO_2 along the WS-Line but increased surface pCO_2 along the DP-Line. It suggests that the area around the WS-Line supposed to be a weak CO_2 source, while the area around the DP-Line acted as a CO_2 sink during the study period. The surface pCO_2 changes by biological production were several times higher at the WS-Line than those at the DP-Line. Physical mixing also promoted an increase of surface pCO_2 along both lines. South of Scotia Front, mixing was the dominant process of surface pCO_2 change. It suggests the possibilities of lateral and vertical transport of CO_2-rich water masses from the Weddell Sea and the deep ocean to the surface. Our results suggest that the major factors affecting the surface pCO_2 distribution were the biological production and physical mixing at the WS-Line, while seasonal warming at the DP-Line during the study period.