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Vulnerability of Polar Oceans to Anthropogenic Acidification: Comparison of Arctic and Antarctic Seasonal Cycles

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Polar oceans are chemically sensitive to anthropogenic acidification due to their relatively low alkalinity and correspondingly weak carbonate buffering capacity. Here, we compare unique observations of the complete annual cycles of the CO_2 system at an Arctic (Amundsen Gulf) and Antarctic site (Prydz Bay). The Arctic site experiences greater seasonal warming (10 vs 3°C) and freshening (3 vs 2), and has lower alkalinity (2220 vs 2300 μmol/kg), and lower summer pH (8.15 vs 8.5). Despite a larger uptake of inorganic carbon by summer photosynthesis, the Arctic carbon system exhibits smaller seasonal changes than the more alkaline Antarctic system. In addition, the excess surface nutrients in the Antarctic may allow mitigation of acidification by lowering CO_2 with enhanced summer production driven by iron inputs from glacial and sea-ice melting. These differences suggest that the Arctic system is more vulnerable to anthropogenic change due to lower alkalinity, enhanced warming, and nutrient limitation.