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Interannual variability in the ocean CO_2 uptake along the West Antarctic Peninsula: A decade of year-round observations

Elise Droste[1], Dorothee Bakker[1], Hugh Venables[2], Mario Hoppema[3], Giorgio Dall'Olmo[4], and Bastien Queste[5]

[1]School of Environmental Sciences, University of East Anglia, Norwich, United Kingdom
[2]British Antarctic Survey, Cambridge, United Kingdom
[3]Alfred Wegener Institute, Helmholtz Centre for Polar and Marine Research, Bremerhaven, Germany
[4]Plymouth Marine Laboratory, Plymouth, United Kingdom
[5]Göteborgs Universitet, Göteborg, Sweden

The West Antarctic Peninsula (WAP) has warmed rapidly due to global climate change and there is large interannual variability in winter conditions, especially sea ice duration. Sea ice driven changes in the water column stability and marine biogeochemistry are impacting the CO_2 uptake in this highly productive region. This work extends the Rothera Oceanographic and Biological Time Series (RaTS) to a decade of year-round observations of surface water carbonate chemistry (2010-2020). This spans considerable sea ice variability, allowing assessment of the air/ice/ocean system across a wide range of conditions, including low sea ice cover as is predicted for the region. It includes rare winter-time data that show an unbiased view of annual carbonate processes and how they might be seasonally interconnected and coupled to sea ice dynamics. Even though the coastal region at Marguerite Bay is a net sink of CO_2, the time series is characterised by strong seasonal variability, indicating that this coastal region is a source of CO_2 to the atmosphere during the austral winter and a strong CO_2 sink in the summer. Additionally, we see differences in the net CO_2 uptake between different years. Net annual CO_2 uptake increased between 2014 and 2017 compared to previous years due to longer durations of heavier sea ice cover. Annual CO_2 uptake decreased again between 2017 and 2020, which are years associated to lower sea ice concentration and shorter duration of sea ice cover. We focus on the interannual differences in sea ice concentration and extent and how they are linked to differences in the water column structure, biogeochemical properties, and air-sea CO_2 exchange.