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The drivers of carbon dynamics in the Southern Ocean

The world's oceans are taking up large quantities of CO_2 and thus play an important role in regulating the global climate. The anthropogenically emitted CO_2 is to a great extend taken up by the Southern Ocean, which makes it a very interesting region to study with regard to future climate change carbon dynamics. A combination of physical forcings, chemical solubility and biological fixation is controlling the carbon uptake and thus the role the Southern Ocean is playing in the remediation of global climate change. To make reliable future climate predictions, it is necessary to understand the mechanisms controlling oceanic carbon budgets and to quantify biological uptake rates.

In my thesis, I used the data of two ocean gliders, autonomous vehicles that can dive and sample surface waters and transmit the data via satellite, to model the biological net community production (NCP), which is a measure for the amount of carbon that is exported to the deep ocean. The model is based on Chlorophyll *a* data sampled by one of the gliders. I compared this time series to the seasonal development of surface water diurnal changes in dissolved inorganic carbon (DIC) concentration to see whether they behave in a similar way, which would support the assumption that carbon dynamics are mainly controlled by the biology. I also looked into the effect other physical forcing mechanisms could have, for example temperature, wind stress and the mixing depth.

The seasonal net community production was found to be of comparable magnitude and seasonal development as the C drawdown, which suggested that the carbon dynamics were mainly controlled by biological processes. The agreements could only be seen when smoothing the time series with a filter. There were no similarities visible when looking at the data without the filter, as the variability from day to day was very high. The agreements between both time series were found to be stronger in summer than in spring though. Looking into the other drivers for C dynamics, it showed that NCP and the DIC flux were not compared by the same processes, which was especially evident during spring, where wind and the mixed layer seemed to drive the flux of CO_2 but not the biology. The net community production was largely controlled by the mixed layer depth and by light, the dissolved inorganic carbon flux did not show any correlation with any of the physical drivers. During the latter half of the season, the days where the carbon dynamics appear not to be controlled by the biology coincide with the deepening of the mixed layer, which could add additional inorganic carbon to the surface waters.

The comparison of the seasonal development of net community production and daily dissolved inorganic carbon fluxes and their physical drivers shows the analogy of both time series during summer. This means that the dissolved inorganic carbon data could be used to derive information about biological community production and carbon uptake.

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