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Modeling the Present-day CO_2 Drawndown in the HNLC Southern Ocean

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The Southern Ocean is the largest HNLC region of the World Ocean and the only one characterized by a seasonal ice cover. Typically in this area the biological pump of CO_2 is not working at its maximum capacity. Current knowledge on the structure and functioning of the Antarctic pelagic ecosystem indicates that the HNLC conditions of the Southern Ocean are resulting from the successful growth of micrograzer-controlled nanophytoplankton communities in an iron-limited environment. Episodic diatom blooms with related carbon export production are well occurring in iron-enriched areas provided optimal light conditions are reached and maintained. Hence the large uncertainty wrapping the role of the Southern Ocean in global carbon cycle notably are due to the highly heterogeneous pattern of hydrodynamical, meteorological, sea-ice and iron conditions. The present-day CO_2 drawndown in the Southern Ocean has been investigated regionally and seasonally, making use of the one-dimensional biogeochemical model $SWAMCO_2$ (Hannon et al., submitted). This complex model results of the coupling between an ecological model (SWAMCO, Lancelot et al., 2000) describing the cycling of carbon, the three major nutrients and dissolved iron through functional units of planktonic system to a one-dimensional physical model integrating the sea-ice dynamics and to a chemical model of the carbonate system and air-sea exchange of CO_2. Model runs were performed at key latitudes with contrasting wind velocity field and dissolved iron in the different biogeochemical provinces of the Southern Ocean. On this basis regions with net sink of atmospheric CO_2 and carbon export are identified and the relative contribution of physical and biological drivers is discussed.

Lancelot, C, Hannon, E, Becquevort, S, Veth, C, de Baar, H, *Deep-Sea Research I*, **47**, 1621-1662, (2000).