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Application of sediment core modelling to interpreting the glacial-interglacial record of Southern Ocean silica cycling

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Abstract. Sediments from the Southern Ocean reveal a meridional divide in biogeochemical cycling response to the glacial-interglacial cycles of the late Neogene. South of the present-day position of the Antarctic Polar Front in the Atlantic sector of the Southern Ocean, biogenic opal is generally much more abundant in sediments during interglacials compared to glacials. To the north, an anti-phased relationship is observed, with maximum opal abundance instead occurring during glacials. This antagonistic response of sedimentary properties provides an important model validation target for testing hypotheses of glacial-interglacial change against, particularly for understanding the causes of the concurrent variability in atmospheric CO_2. Here, I illustrate a time-dependent modelling approach to helping understand climates of the past by means of the mechanistic simulation of marine sediment core records. I find that a close match between model-predicted and observed down-core changes in sedimentary opal content can be achieved when changes in seasonal sea-ice extent are imposed, whereas the predicted sedimentary response to iron fertilization on its own is not consistent with sedimentary observations. The results of this sediment record model-data comparison supports previous inferences that the changing cryosphere is the primary driver of the striking features exhibited by the paleoceanographic record of this region.

Final Revised Paper (PDF, 427 KB) Discussion Paper (CPD)

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