

Supporting Information for "On the Southern Ocean CO₂ uptake and the role of the biological carbon pump in the 21st century"

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Additional Supporting Information (Files uploaded separately)

1. Box model description with equations

Introduction This file contains the supplementary figures S1 to S8 that show the dissolved inorganic carbon (DIC) gradient between surface and 100 m depth for all individual models and three latitudinal bands (south of 58°S, 44-58°S and 30-44°S). Specifically, it shows the mean seasonal cycle of the DIC gradient averaged over the start (2012 to 2031) and end (2081-2100) periods.

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It also contains the supplementary Table 1 that compares the box model to REcoM2 in terms of magnitude and timing of CO₂ flux into the ocean, and DIC concentration.

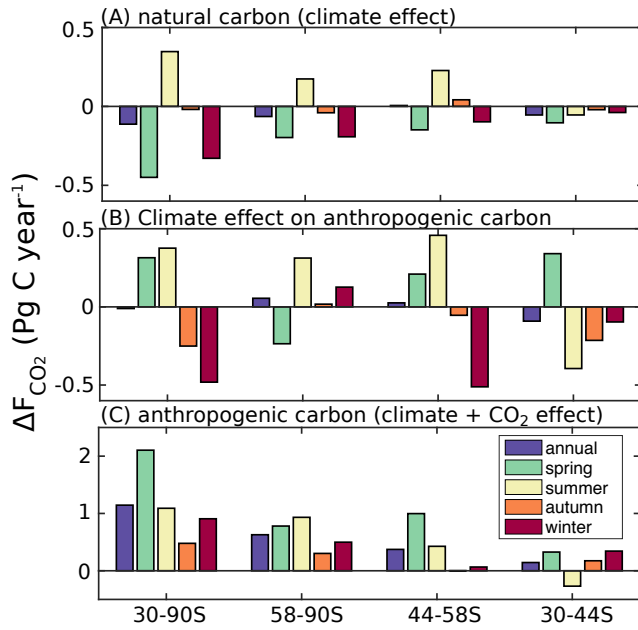


Figure S1. Mean change of (A) F_{CO_2} due to climate effects on natural carbon, (B) F_{CO_2} due to climate effects on anthropogenic carbon and (C) F_{CO_2} due to anthropogenic carbon changes, i.e. due to the sum of climate effects on anthropogenic carbon and the increase of atmospheric CO₂ between the periods 2012-2031 and 2081-2100 in REcoM2 in different seasons.

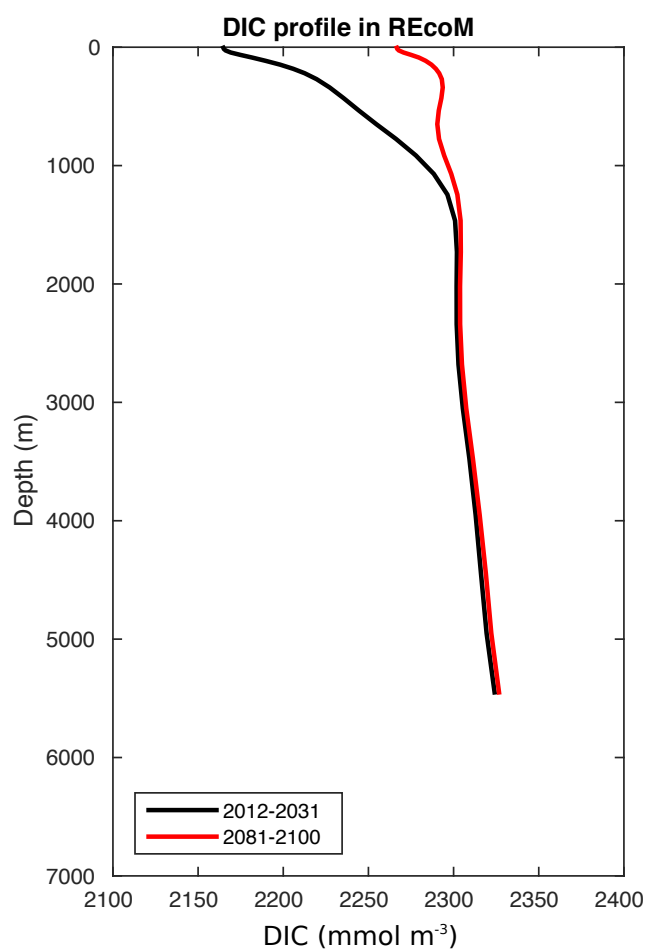


Figure S2. Mean Southern Ocean (south of 30°S) DIC profile in the MITgcm-REcoM2 model.

Black line: mean in start period (2012-2031), red line: mean in end period (2081-2100).

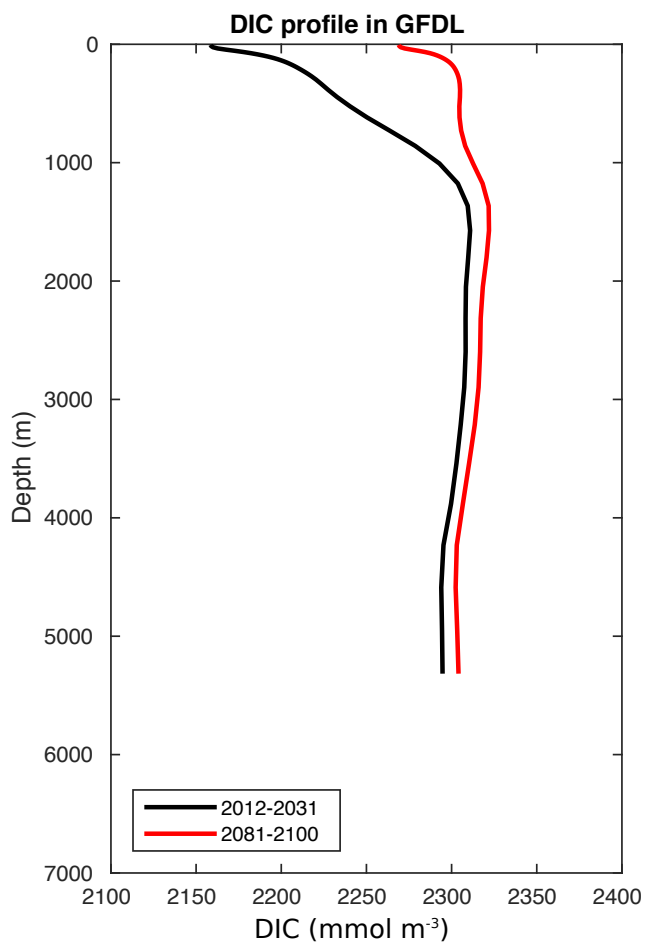


Figure S3. Same as Figure S2, but for the GFDL model.

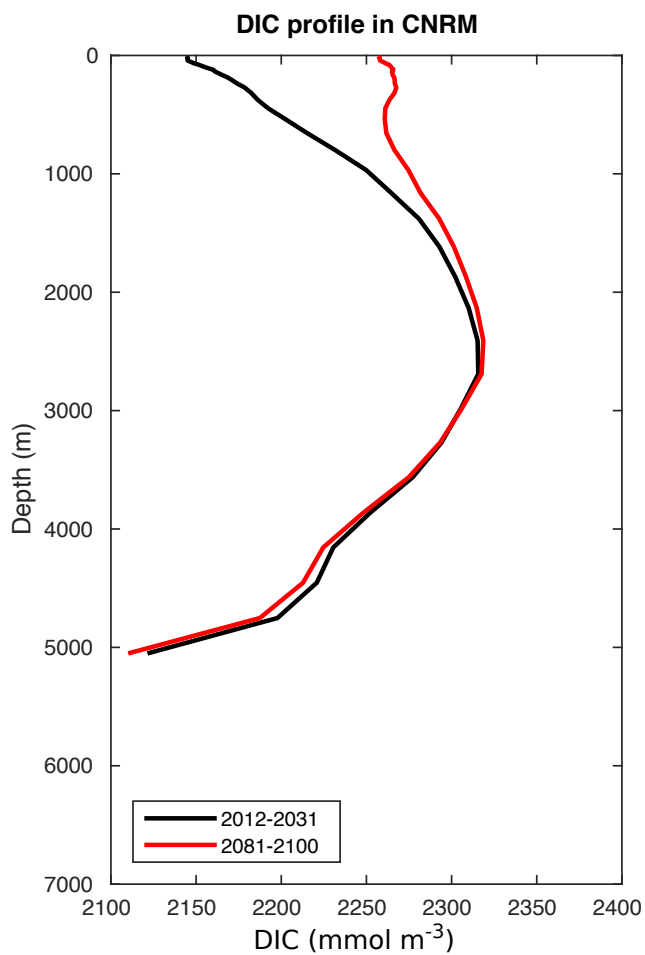


Figure S4. Same as Figure S1, but for the CNRM-CM5 model. Note that the Southern Ocean deep ventilation has been improved in the new version of the model (CNRM-ESM) that has, however, not yet been available for this study.

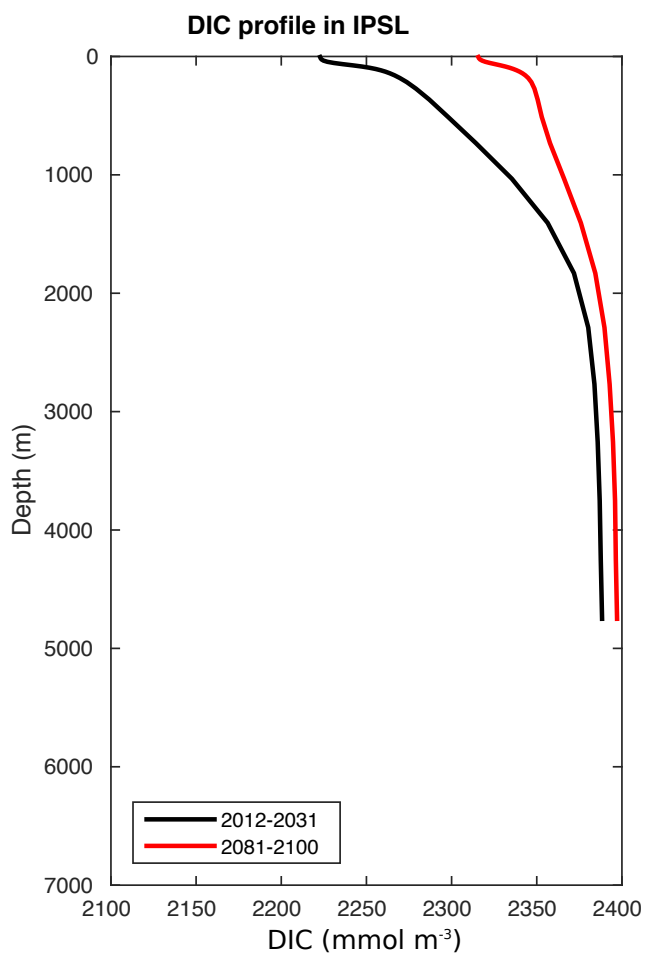


Figure S5. Same as Figure S1, but for the IPSL-CM5A-LR model.

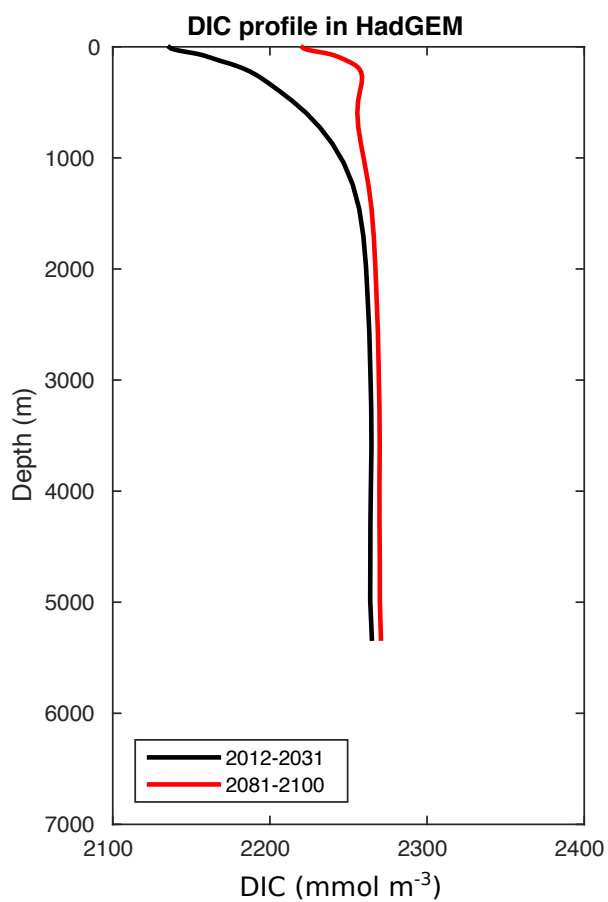


Figure S6. Same as Figure S1, but for the HadGEM model.

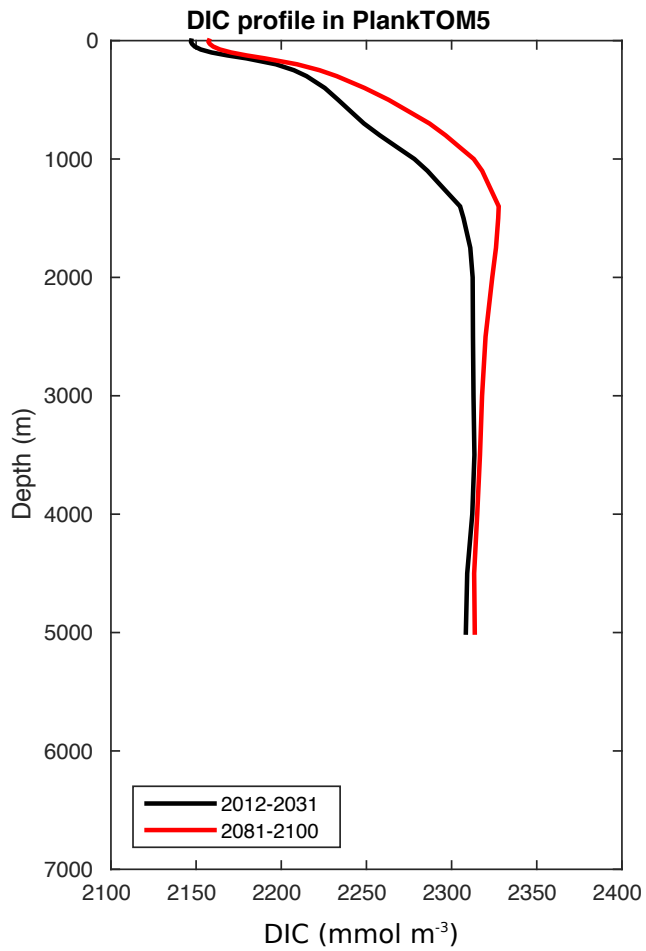


Figure S7. Same as Figure S1, but for the PlankTOM5.3 model.

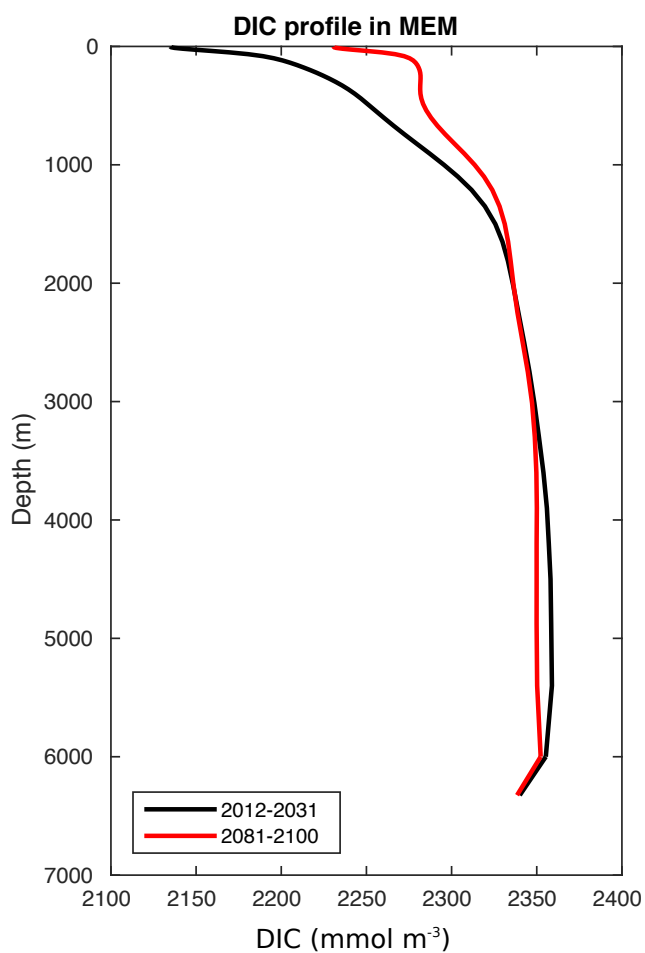


Figure S8. Same as Figure S1, but for the MEM model.

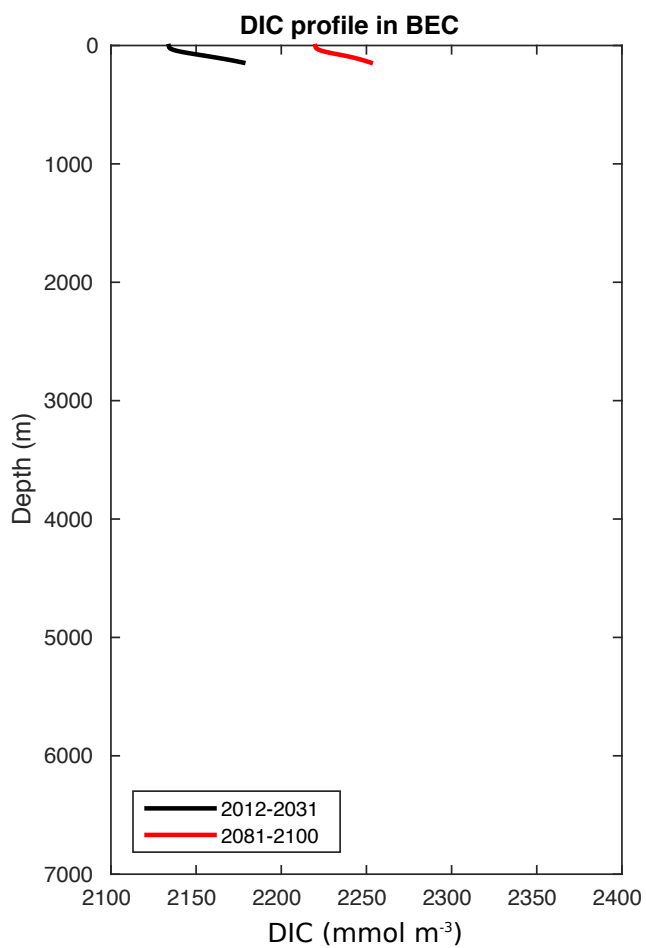


Figure S9. Same as Figure S1, but for the BEC model.

Table S1. Comparison of box model to REcoM2 in terms of magnitude and timing CO₂ flux into the ocean, and DIC concentration for the period 2012-2031.

Region	58-90°S	44-58°S	30-44°S
mean CO₂ flux into the ocean (PgC/yr)			
REcoM2	0.31	0.53	0.51
box model	0.32	0.68	0.48
month of max CO₂ flux into the ocean			
REcoM2	Dec	Nov	Oct
box model	Dec	Nov	Oct
month of min CO₂ flux into the ocean			
REcoM2	Oct	Feb	Feb
box model	Oct	Mar	Apr
min DIC concentration			
REcoM2	2193	2165	2122
box model	2229	2171	2111
max DIC concentration			
REcoM2	2249	2183	2137
box model	2246	2183	2118