Supplement of Biogeosciences, 23, 3735–3754, 2026
https://doi.org/10.5194/bg-23-3735-2026-supplement

Biogeosciences Open Access EGU

Supplement of

The impact of large-scale macroalgae cultivation and harvesting strategies on the marine carbon dioxide removal efficacy and marine biogeochemistry

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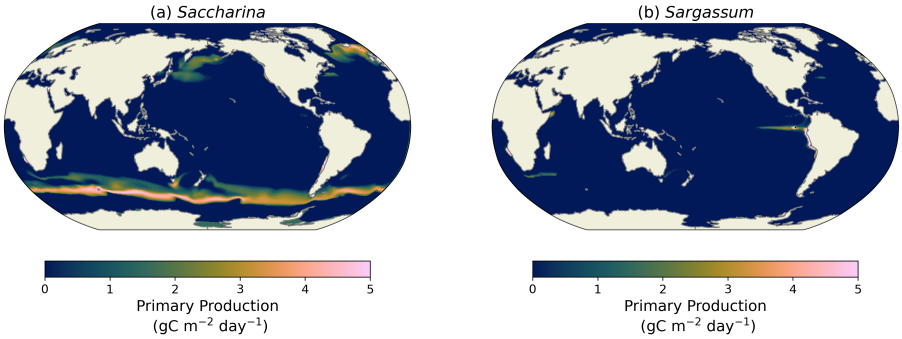

Figure S1: Macroalgae Net Primary Production (NPP) of (a) Saccharina and (b) Sargassum from the default experiment averaged between 2015-2024. Other species concentrations are not shown since these are in very small concentrations

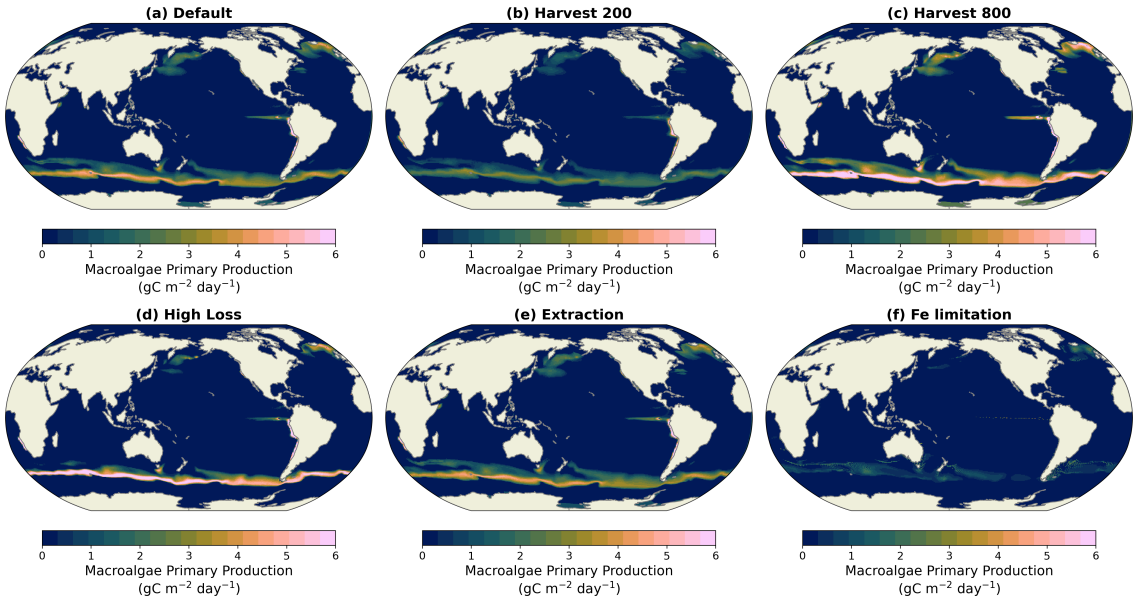

Figure S2: Macroalgale NPP of (a) default, (b) Harvest 200, (c) Harvest 800, (d) High Loss, (e) Extraction, and (f) Fe Limitation. These results are averaged between 2015-2024. Please refer to Table 2 in the main text for experiment name.

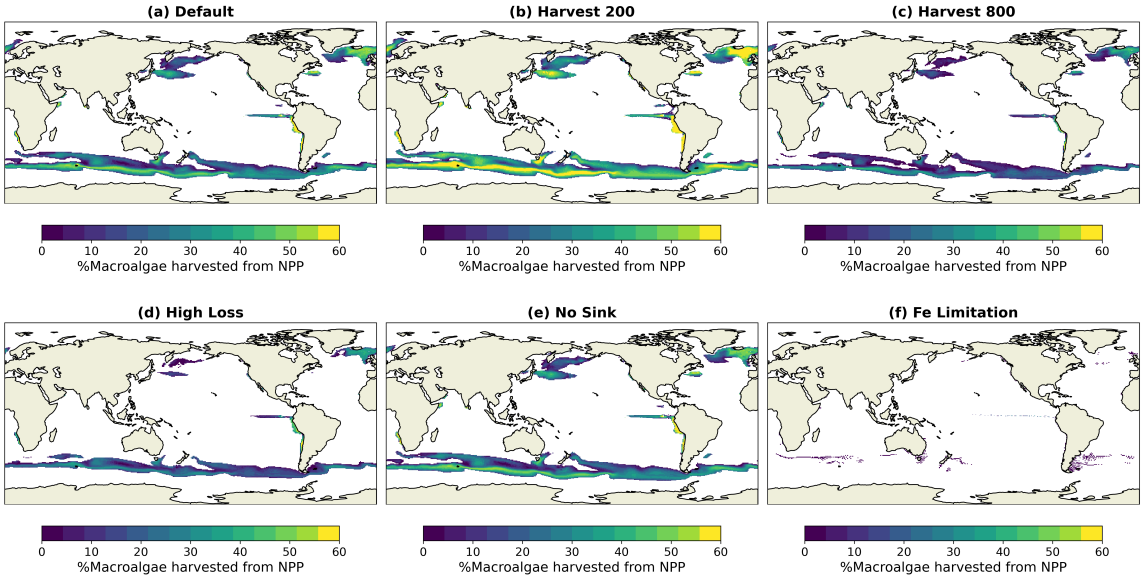

Figure S3: Proportion of harvest compared to macroalgae NPP from different experiments; (a) default, (b) Harvest 200, (c) Harvest 800, (d) High Loss, (e) Extraction, and (f) Fe Limitation.

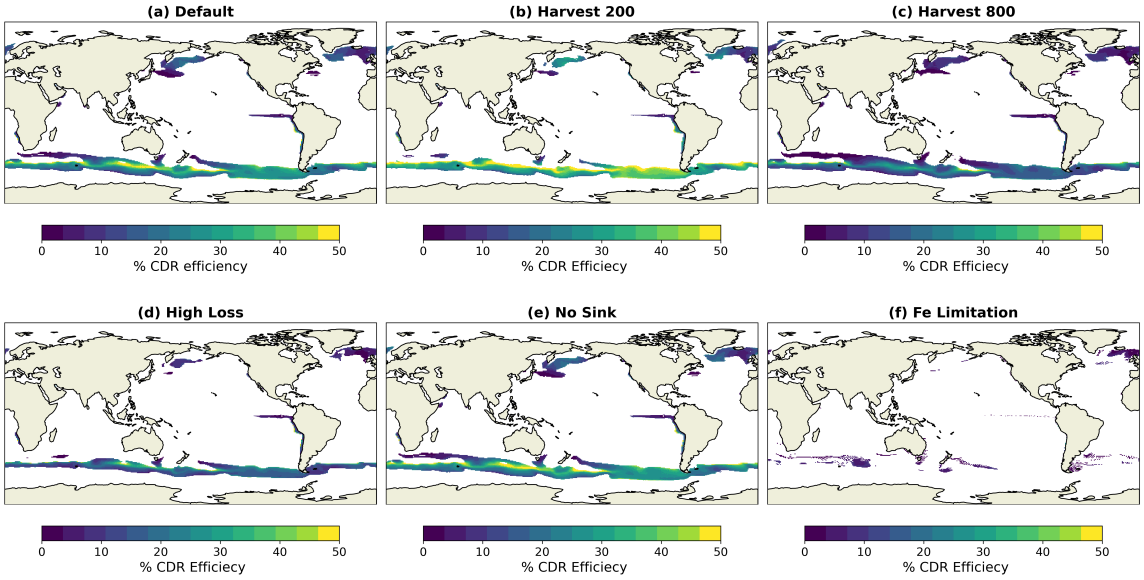

Figure S4: $CDR_{eff\ NPP}$ from different experiments; (a) default, (b) Harvest 200, (c) Harvest 800, (d) High Loss, (e) Extraction, and (f) Fe Limitation. These are calculated from the fraction of additional CO_2 flux from macroalagae NPP

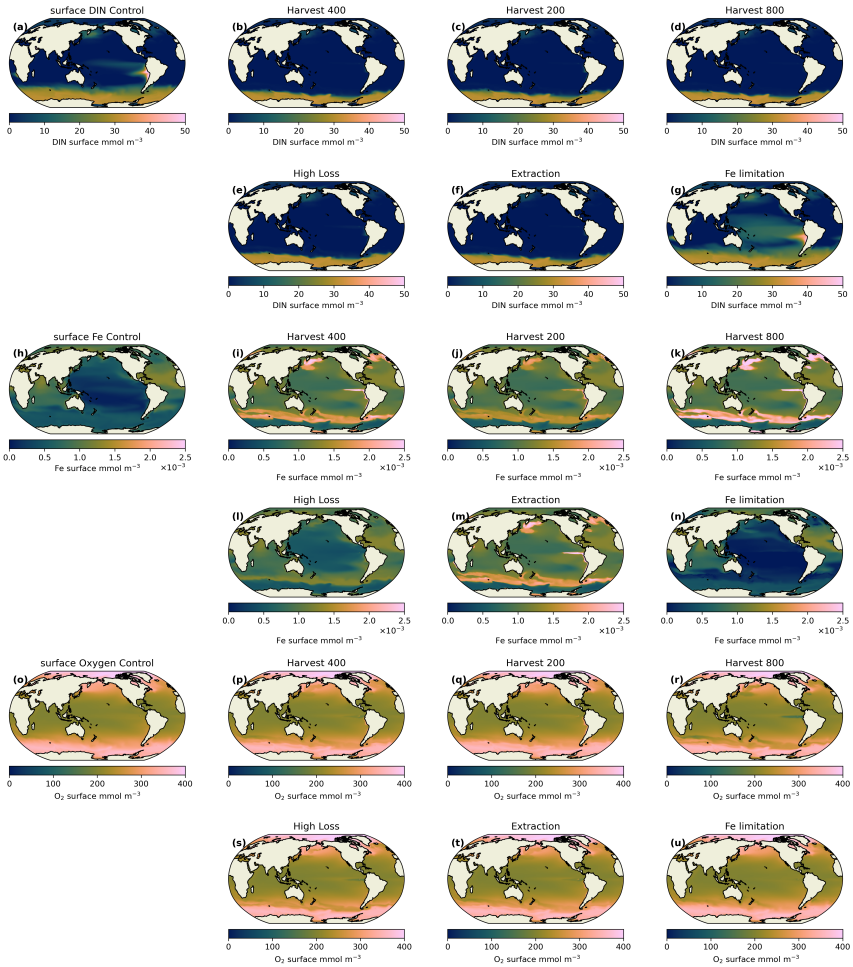

Figure S5: Surface nutrients and oxygen. Dissolved inorganic nitrogen (DIN) 2015-2024 averages from the control and other experiments are shown in a-g, iron (Fe) in h-n, and Oxygen in o-u. The first column (a,h,o) shows the control simulation. The odd number rows show the harvest experiment, while the even rows show high loss, extraction, and Fe limitation experiments.

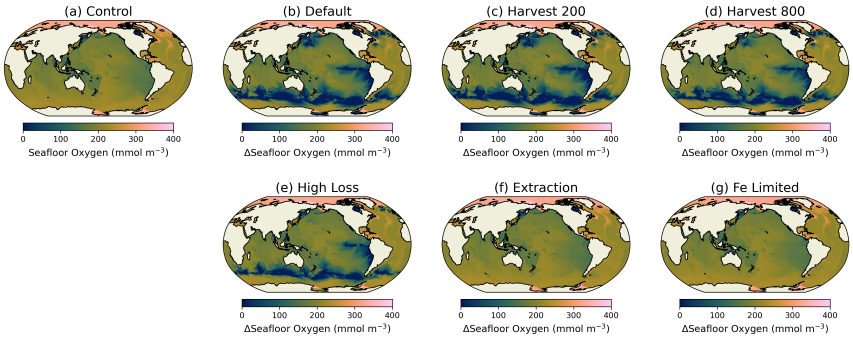

Figure S6: Seafloor oxygen concentration from the control simulation (a) and other macroalgae experiments. c and d show harvesting experiments and e,f,g show high non-harvesting loss, not sinking harvested macroalgae, and not supplementing iron, respectively.

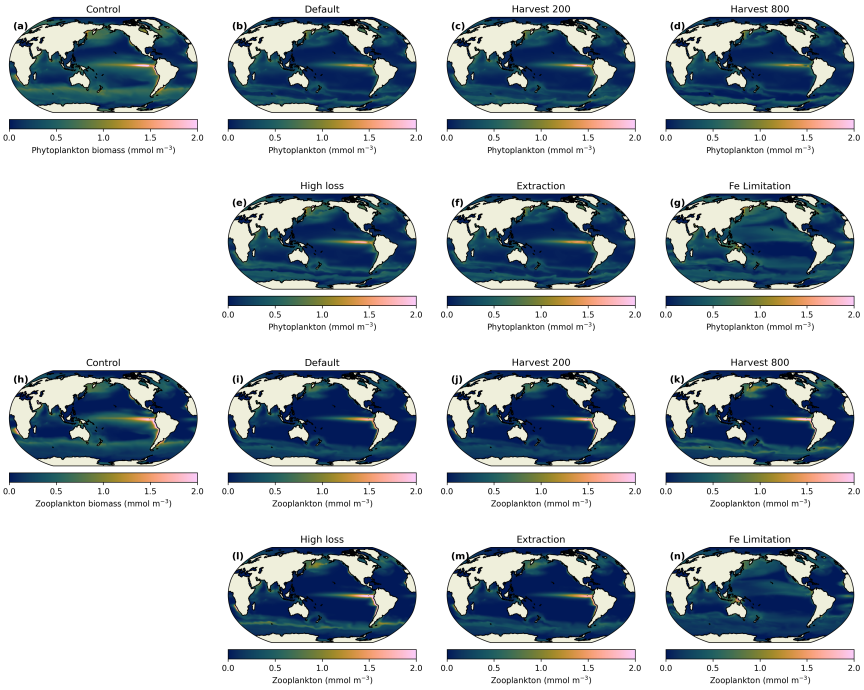

Figure S7: Phytoplankton (a-g) and zooplankton biomass (h-n) from control simulation and other macroalgae experiments. These are arranged similarly to Figures S5 and S6

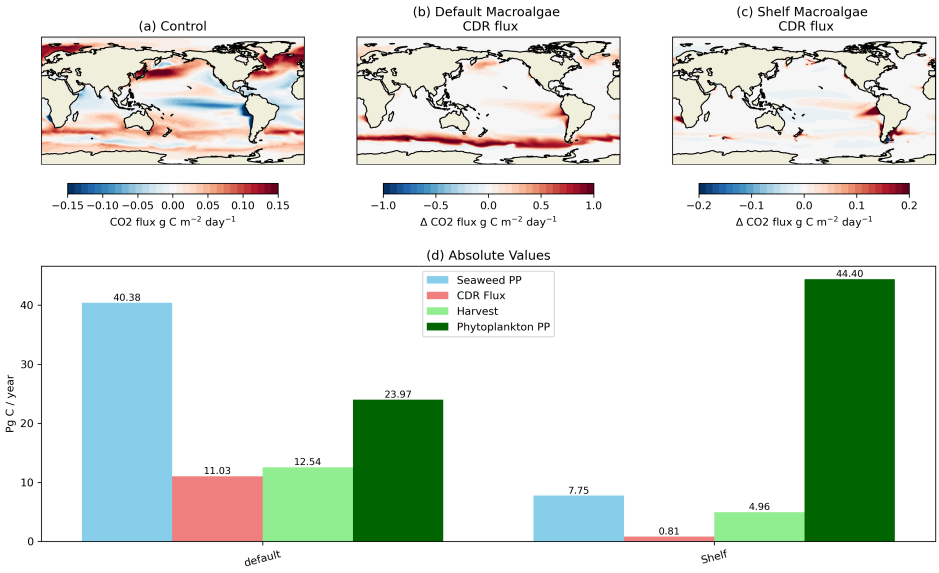

Figure S8: Global macroalgal cultivation and its influence on air-sea CO_2 flux between the default experiment and when macroalgae is grown only on the shelf sea area (depth < 200m). Top panel shows CO_2 flux for the control (a), and the difference between control and default macroalgae run (b), and shelf sea macroalgae simulation (c). Bottom panel shows the absolute values of macroalgae primary production, phytoplankton primary production, CDR flux, and harvest between the two macroalgae simulations (d).