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Future trends in oxygen minimum zone volume are sensitive to model representation of iron

Wanxuan Yao[1,2], Karin Kvale[1], Angela Landolfi[1], Wolfgang Koeve[1], Eric Achterberg[1], and Andreas Oschlies[1]
[1]GEOMAR Helmholtz Centre for Ocean Research
[2]HOSST Research School - GEOMAR Helmholtz Centre for Ocean Research

Increasing the complexity of the representation of iron in an earth system model can lead to significant differences in surface ocean nutrient pathways in a pre-industrial climate. These differences persist even after automated calibration forces the models to achieve similar fit to the same observational data. We explore the impact of these nutrient pathway differences in the context of climate change by forcing the models (one without iron, one with a seasonally-cyclic iron mask, and one with a fully dynamic iron module) with the RCP8.5 business-as-usual atmospheric CO_2 concentration scenario from years 1800 until 2100. We find that while the global oxygen inventory drops across all models over this period, different trends in the oxygen minimum zone (OMZ) volume arise. Models with iron represented simulate decreases between 60 and 80 percent in OMZ volume, while the model without iron simulates an OMZ volume increase of 10 percent. The difference is attributed to the role of iron limitation in regulating the low latitude primary production response to warming and stratification. We further quantify the corresponding denitrification trends and impact on ocean nitrate inventory. This study illustrates that model structural uncertainty further challenges predictions under a changing climate, and highlights the strong role of iron in regulating nutrient cycling and ocean deoxygenation.