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温暖化時の海洋の鉄循環変化の予測計算
The iron budget in ocean surface waters in the 20th and 21st centuries: projections by the Community Earth System Model

三角 和弘 [1*] ; Lindsay Keith[2] ; Moore Keith[3] ; Doney Scott[4] ; Bryan Frank[2] ; 津旨 大輔 [1] ; 吉田 義勝 [1]
MISUMI, Kazuhiro[1*] ; LINDSAY, Keith[2] ; MOORE, Keith[3] ; DONEY, Scott[4] ; BRYAN, Frank[2] ; TSUMUNE, Daisuke[1] ; YOSHIDA, Yoshikatsu[1]

[1] 電力中央研究所, [2] 米国大気研究センター, [3] カリフォルニア大学アーバイン校, [4] ウッズホール海洋研究所
[1]Central Research Institute of Electric Power Industry, [2]National Center for Atmospheric Research, [3]University of California at Irvine, [4]Woods Hole Oceanographic Institution

We investigated the simulated iron budget in ocean surface waters in the 1990s and 2090s using the Community Earth System Model version 1 and the Representative Concentration Pathway 8.5 future CO_2 emission scenario. We assumed that exogenous iron inputs did not change during the whole simulation period; thus, iron budget changes were attributed solely to changes in ocean circulation and mixing in response to projected global warming, and the resulting impacts on marine biogeochemistry. The model simulated the major features of ocean circulation and dissolved iron distribution for the present climate. Detailed iron budget analysis revealed that roughly 70 % of the iron supplied to surface waters in high-nutrient, low-chlorophyll (HNLC) regions is contributed by ocean circulation and mixing processes, but the dominant supply mechanism differed by region: upwelling in the eastern equatorial Pacific and vertical mixing in the Southern Ocean. For the 2090s, our model projected an increased iron supply to HNLC waters, even though enhanced stratification was predicted to reduce iron entrainment from deeper waters. This unexpected result is attributed largely to changes in gyre-scale circulations that intensified the advective supply of iron to HNLC waters. The simulated primary and export production in the 2090s decreased globally by 6 and 13 %, respectively, whereas in the HNLC regions, they increased by 11 and 6 %, respectively. Roughly half of the elevated production could be attributed to the intensified iron supply. The projected ocean circulation and mixing changes are consistent with recent observations of responses to the warming climate and with other Coupled Model Intercomparison Project model projections. We conclude that future ocean circulation has the potential to increase iron supply to HNLC waters and will potentially buffer future reductions in ocean productivity.