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Iron supply to the Southern Ocean mixed layer from below; the ocean model effect

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In the iron limited Southern Ocean, the biogeochemical results of commonly used ocean general circulation biogeochemical models differ greatly dependent on the ocean model used. This is largely due to the difficulties in reproducing a realistic mixed layer depth (MLD), which leads to different degrees of light limitation and nutrient supply from below.
Regarding the iron sources to the Southern Ocean, research has traditionally focused on the input from dust and the sediment, but recent studies have highlighted the importance of the vertical supply to the mixed layer from the nutrient rich deeper water. This latter supply mechanism may also be affected by the large inter-model differences in the MLD and thereby influence the total net primary production and export production in the models.
We have performed a model study in which the biogeochemical model REcoM2 was coupled to two different ocean models, the Finite Element Sea-ice Ocean Model (FESOM) and the MIT general circulation model (MITgcm). The effect of the ocean mixed layer on the magnitude of the iron sources from below in the two models was analyzed, as was the effect on the export and net primary production.
Our results revealed a remarkable difference in terms of mode and magnitude of transport dependent on the mixed layer depth in the two models; the mean iron supply from below in the Southern Ocean was on average four times higher in MITgcm than in FESOM. The dominant pathway was entrainment in MITgcm, whereas diffusion dominated in FESOM. We discuss how the difference in the depth and seasonal amplitude of the mixed layer between the models has a major effect on the vertical iron profile and thereby also on the iron fluxes. A further effect of the difference in supply is that the fraction of exported net primary production is higher in MITgcm than in FESOM, showing that the choice of ocean model has a significant impact on the modeled carbon cycle in the Southern Ocean, with possible implications for model runs predicting the future carbon uptake in the region.