EGU22-3041
https://doi.org/10.5194/egusphere-egu22-3041
EGU General Assembly 2022

Sensitivity of the relationship between Antarctic ice shelves and iron supply to projected changes in the atmospheric forcing

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Previous studies showed that correlations of satellite-derived estimates of chlorophyll *a* in coastal polynyas over the Antarctic continental shelf with the basal melt rate of adjacent ice shelves are a result of upward advection or mixing of iron-rich deep waters due to circulation changes driven by ice shelf melt, rather than a direct influence of iron released from melting ice shelves. In this study, the effects of projected changes in winds, precipitation, and atmospheric temperatures on this relationship were examined with a 5-km resolution ocean/sea ice/ice shelf model of the Southern Ocean. The atmospheric changes are added as idealized increments to the forcing. Inclusion of a poleward shift and strengthening of the winds, increased precipitation, and warmer atmospheric temperatures resulted in an 83% increase in the total Antarctic ice shelf basal melt, with changes being heterogeneously distributed around the continent. The total dissolved iron supply to the surface waters over the continental shelf increased by 62%, while the surface iron supply due just to basal melt driven overturning increased by 48%. However, even though the total increase in iron supply is greater than the increase due to changes in the ice shelf melt, the ice shelf driven supply becomes relatively even more important in some locations, such as the Amundsen and Bellingshausen Seas. The modified atmospheric conditions also produced a reduction in summer sea ice extent and a shoaling of the summer mixed layers. These simulated responses to projected changes suggest relief of light and nutrient limitation for phytoplankton blooms over the Antarctic continental shelf and perhaps an increase in annual production in years to come.