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The impact of changes in the Antarctic wind field on the Southern Ocean sea ice

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Satellite observations show an enlargement of the sea ice extent of the Southern Ocean in the last decades. A possible trigger for the increase is a change in the atmospheric circulation, which leads to a southward shift and intensification of the westerlies around Antarctica. We performed a sensitivity study with an eddy-permitting sea ice-ocean model forced by ERA-Interim data. We compare a set of numerical simulations with simple manipulations of the wind velocities in the forcing data and investigate the response of sea ice and on-shelf water properties.

In our results, increases of the zonal wind component lead to the onset of deep convection in the Weddell Sea within 10 years (with one exception) and a reduction of sea ice. Manipulations of the meridional wind component can lead to an increase of ice extent and volume, but only if regions of strengthened northward wind alternate with regions of increased southward wind. The convergent drift against the shoreline is necessary to thicken the sea ice. Without it, enhanced northward drift leads to an exhanced ice extent during winter but combined with a loss of sea ice thickness which entails a strongly reduced ice extent during summer.

For increases of the westward/eastward wind component at the Antarctic coastline, the on-shelf water temperatures increase/decrease due to Ekman pumping. Except for regions with more southerly winds, the manipulated forcing in all cases increases the sea ice production at the coastline and therefore the on-shelf waters are more saline. After a period of 10 years in all the experiments the increased wind results in a higher density of the on-shelf water column.