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Southern Hemisphere sea ice trends: How well do model simulations explain the observed changes?

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Observations of the sea ice extent in the Southern Hemisphere during the last three decades show a weak but positive trend in almost all months of the year. These changes seem to be attributable to an enhancement of the meridional flow in the areas of the Ross and Weddell Seas and stronger Ekman transport due to a more positive phase of the Southern Annular Mode (SAM), favored by the depletion of Antarctic stratospheric ozone.

At the same time, climate model simulations with interactive ocean and sea ice modules which include observed Antarctic ozone changes do not show this evolution, but suggest the ozone hole to favor a reduction of the sea ice. The mechanism involves stronger westerlies, with stronger wind stress leading to an enhanced ocean upwelling of warmer near coastal Antarctic waters due to enhanced Ekman transport, resulting in stronger ice melting.

To verify this assumption, two simulations with the coupled atmosphere-ocean chemistry-climate model EMAC-O (ECHAM/MESSy Atmospheric Chemistry with MPIOM ocean) are compared, one representing transient climate and ozone change, and one including only ozone loss.

Though in our study the signal due to the Antarctic ozone depletion is underestimated compared to the climate signal, it nevertheless contributes to the sea ice increase, mainly due to a strengthening of the Amundsen Sea Low, causing locally stronger southerly flow and resulting in an enhanced export of sea ice in summer and autumn.