



On the role of the Southern Annular mode in freshwater changes in the Southern Ocean

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Observational studies show that there has been a strong increase in freshwater content in the Southern Ocean over the last decades. Several mechanisms could contribute to the freshening trend in the Southern Ocean; movement of water masses, changes in precipitation and evaporation, changes in sea ice concentration and changes in glacial melt are obvious candidates, but no consensus has been brought out yet regarding the relative importance of these likely causes. On the atmospheric side, most of the change in atmospheric surface properties over the Southern Ocean during the last decades is arguably associated with the positive trend of the Southern Annular Mode. The impact of SAM related changes in surface winds on ocean properties and sea ice concentration has been well studied but little is known about the impact of SAM-related changes in ocean freshwater forcing.

In this study, we assess the role of the Southern Annular Mode on Southern Ocean freshwater forcing and quantify the relative contribution of SAM-related changes in precipitation, evaporation and sea-ice cycle to freshwater content in the Southern Ocean. To this purpose, we use a combination of atmospheric reanalyses, satellite observations and regional ocean-sea ice model simulations. Results from a series of sensitivity experiments with perturbed atmospheric forcing will be presented and discussed. Our results show that the Southern Annular Mode has a large impact on precipitation and evaporation and quantify the change in freshwater forcing due to SAM-induced changes in sea ice concentration. The relative impact of these changes on Southern Ocean freshwater content will be discussed.