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Influence of the Southern Annular Mode on the sea ice-ocean system

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The global sea ice-ocean model ORCA2-LIM, driven by the NCEP/NCAR (National Centers for Environmental Prediction-National Center for Atmospheric Research) reanalysis daily 2-m air temperatures and 10-m winds and by monthly climatologies for precipitation, cloud cover and relative humidity, is used to investigate the impact of the Southern Annular Mode (SAM) on the Antarctic sea ice-ocean system. Our results suggest that the response of the circumpolar Southern Ocean consists of an annular and a non-annular component. The annular component strongly affects the overall patterns of the upper ocean circulation. When the SAM is in its positive phase, a northward surface Ekman drift, a downwelling at about 45°S and an upwelling in the vicinity of the Antarctic continent are simulated. The non-annular component has a significant impact at the regional scale, especially in the Weddell, Ross, Amundsen and Bellingshausen Seas. In those regions, the pressure pattern associated with the SAM induces meridional winds that advect warmer air in the Weddell Sea and around the Antarctic Peninsula and colder air in the Amundsen and Ross Seas. This implies a dipole response of sea ice to the SAM, with on average a decrease in ice area in the Weddell Sea and around the Antarctic Peninsula and an increase in the Ross and Amundsen Seas during years with a high SAM index. In order to further understand the physical processes responsible for this response of the sea ice-ocean system to SAM, additional experiments have been performed using an idealised forcing that include the main characteristics of SAM. Those idealised experiments allow separating the role of the wind stress from the one of the changes in atmospheric temperature as well as of the role of the zonal and non-zonal components of the forcing associated to SAM.