EGU21-9437
https://doi.org/10.5194/egusphere-egu21-9437
EGU General Assembly 2021

Investigating the impact of the Southern Annular Mode on ice-shelf basal melt in Antarctica using a regional ocean model forced by reanalysis data

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The climate of polar regions is characterized by large fluctuations and has experienced dramatic changes over the past decades. In the high latitudes of the Southern Hemisphere, the patterns of changes in sea ice and ice sheet mass, in particular, are more complex than for the Northern Hemisphere. Some regions have warmed less than the global average with some sea-ice advance, in particular in the Ross Sea, while other regions such as the Bellingshausen Sea have warmed significantly and displayed sea-ice loss. The Antarctic Ice Sheet has also lost mass in the past decades, with a spectacular thinning and weakening of ice shelves, i.e., the floating extensions of the grounded ice sheet. Despite recent advances in observing and modelling the Antarctic climate, the mechanisms at the origin of those trends are very uncertain because of the limited amount of observations and the large biases of climate models in polar regions, in concert with the large internal variability prevailing in the Antarctic. One of the most important atmospheric modes of climate variability in the Southern Ocean is the Southern Annular Mode (SAM), which represents the position and the strength of the westerly winds. During years with a positive SAM index, lower sea level pressure at high latitudes and higher sea level pressure at low latitudes occur, resulting in a stronger pressure gradient and intensified Westerlies. However, the current knowledge of the impact of these fluctuations of the Westerlies on the Southern Ocean and Antarctic cryosphere is still limited. Some efforts have been devoted over the past few years to the impact of the SAM on the Antarctic sea ice and the surface mass balance of the ice sheet from an atmospheric-specific perspective. Recently, a few studies have focused on the local impact on ice-shelf basal melt in specific regions of Antarctica. However, to our knowledge, there is no such study of the impact of the SAM on ice-shelf basal melt at the pan-Antarctic scale. In this communication, we will address this issue by using simulations performed with the regional ocean and sea-ice model NEMO-LIM3.6 at a spatial resolution of 0.25° forced by the ERA5 reanalysis over the period 1979-2018 CE. The impact of both the annular and the non-annular components of the SAM on ice-shelf basal melt will be assessed through regressions and correlations between the seasonal or annual averages of the SAM index and the ice-shelf basal melt.