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Western Antarctic variability attributed to SAM during the 20thC

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The Southern Annular Mode (SAM) has been exhibiting a positive trend since the mid-1960s. This positive trend is related to the strengthening of the atmospheric pressure gradient between the subtropics and high latitudes associated with the intensification of the Westerlies. In this work we examine the simulation results of the NCAR/CCSM4 model for the 20^{th} century to evaluate the SAM-related changes in the ocean-atmosphere surface variables for the Amundsen-Bellingshausen seas and Antarctic Peninsula. Our results show that CCSM4 model results represent well the SAM index behavior in the last century, accounting for 25% of the total variance. The MSLP anomalies show a negative trend over the Antarctic continent, which is connected with the migration of the whole surface pressure system to the south. This is consistent with the SAM positive trend in the end of the 20^{th}C, since there is a high correlation between the MSLP and SAM index (-0.9 significant at the 95% level). Moreover, we observed the low pressure center known as the Amundsen Sea Low (ASL) moving eastward throughout the century. This eastward displacement does not show in the seasonal cycle, even though there are seasonal differences in magnitude ($\sim$3hPa) mainly during spring. The barotropic transport intensified $\sim$15Sv from the early to the late 20^{th}C in the between 180-120W and 50-70S. The barotropic transport intensification is related with changes observed in the zonal wind stress. Both seasonal cycle and long-term trends are considered important modulators of changes in the wind stress. Between 60-50S, we observed a intensity change 5 times greater during winter and spring than in the other seasons from the early to the late 20^{th}C, besides a significant positive long term trend of 0.04N.m^2.year^{-1} (at 95% confidence level). These changes are guided by SAM variability, since wind stress and SAM index show 0.96 correlation coefficient. Results for the surface salinity show that the differences from early to the late 20^{th}C observed are very small, but corresponds to a salinity decrease up to 80%, mostly south of 66S. Observed salinity changes do not seem related to the SAM, considering that the correlation coefficient between them, although significant at the 95% level, is small ($\sim$0.2). Results also show that along the 20^{th}C, there is a decrease in precipitation of 6mm.yr^{-1}. Its variance changed about 9% from the early to the late century. The associated variance has decreased over the Antarctic Peninsula, in contrast with the Amundsen-Bellingshausen seas, where its variance had increased. This means that it has been raining more over the Amundsen-Bellingshausen seas than in the Peninsula region in the late 20^{th}C. Which suggests that precipitation contributes, together with ice melting, in the observed changes of surface salinity. Finally, we show that in a regional context only some of the ocean-atmosphere variables are connected with SAM variability: less precipitation over the Antarctic Peninsula is related with decreased surface salinity in the Amundsen-Bellingshausen seas, which could not be correlated with the SAM. On the other hand, SAM, MSLP, zonal wind stress and barotropic transport are highly correlated.