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Potential influences on the Southern Hemisphere atmospheric circulation of negative and positive sea ice extension anomalies in the Ross Sea

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This study have used the CPTEC/INPE AGCM to explore the role of sea ice extent in the Ross Sea as a forcing of the asymmetric atmospheric circulation in the southern hemisphere during the austral winter (July-September), on a seasonal scale. The impacts have been assessed from the standpoint of positive and negative observed anomalies in ice extent in the Ross Sea. A differential of this study was to use sets with a large number of members (60) in order to increase the potential for signal detection in atmospheric circulation, due to anomalies in sea ice. In a first step, the climatological characteristics of the asymmetric flow in the southern hemisphere high latitudes have been assessed. In general, the model reproduces the main features of the geographic distribution and annual cycles of asymmetric oscillatory patterns, which are the waves of wave number 1 to 4. The model is able to reproduce an important mode of oscillation in the southern hemisphere: the Pacific-South America. Responses due to the anomalous experiments were evaluated in two steps: local and hemispherical responses. The local response is consistent with previous studies. A negative (positive) anomaly in ice cap warms (cools) the lower levels of the atmosphere, increases (decreases) the near surface temperature and decreases (increases) the surface pressure. Large-scale responses indicate that sea ice anomalies are associated with modifications of the jet streams and patterns of planetary waves. In association with less ice, there is a strengthening of the subtropical jet over Australia, and a barotropic wave 2 belt in mid and high latitudes, while the predominant configuration associated to ice in excess is a wave train in subtropical latitudes and the weakening of the jet stream over Australia. Significant anomalies in high frequency activity forming a wave train pattern over southern South America suggest an association between transient activity in this region and anomalies of sea ice in Ross Sea. In the Ross Sea region, the association of enhanced transient activity and anomalous anticyclonic circulation suggest a weakening of the polar vortex. The analysis of standardized temperature anomalies highlighted the existence of Antarctic Dipole in association with sea ice anomalies in the Ross Sea. When the sea ice edge retreats (advances) temperatures become abnormally high (low) in the Ross Sea and low (high) in the seas of Amundsen-Bellingshausen and Weddell. The results of analysis of standardized geopotencial anomalies suggest that anomalies of sea ice might feedback the Pacific- South American pattern. The resulting configurations display a large-scale wave train pattern being originated from the region of anomalies in sea ice. This wave train emanates from the Ross Sea towards East and curves toward low latitudes on the Atlantic Ocean. The anomalous centers invert their polarity in response to the sign reversion in the sea ice anomaly.