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ENSO-related Impacts on Antarctic Sea Ice: Synthesis of Phenomenon and Mechanisms

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Many remote and local climate variabilities influence Antarctic sea ice at different time scales. The strongest sea ice teleconnection at the interannual time scale was found between El Nino-Southern Oscillation (ENSO) events and a high latitude climate mode named the Antarctic Dipole. The Antarctic Dipole is characterized by an out-of-phase relationship between sea ice and surface temperature anomalies in the South Pacific and South Atlantic, manifesting itself and persisting 3-4 seasons after being triggered by the ENSO forcing. This study examines the life cycles of ENSO warm and cold events in the tropics and associated evolution of the ADP in high latitudes of the Southern Hemisphere. In evaluating the mechanisms that form the ADP, the study suggests a synthesized scheme that links these high latitude processes with ENSO teleconnection in both the Pacific and Atlantic Basins. The synthesized scheme suggests that the two main mechanisms responsible for the formation/maintenance of the Antarctic Dipole are the heat flux due to the mean meridional circulation of regional Ferrel Cell and regional anomalous circulation generated by stationary eddies. The changes in the Hadley Cell, the jet stream in the subtropics, and the Rossby Wave train associated with ENSO link the tropical forcing to these high latitude processes. Moreover, these two mechanisms operate in phase and are comparable in magnitude. The positive feedback between the jet stream and stationary eddies in the atmosphere, the positive feedback within the air-sea-ice system, and the seasonality all reinforce the anomalies, resulting in persistent Antarctic Dipole anomalies.