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Atmospheric forcing of sea ice anomalies in the Ross Sea Polynya region

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Despite warming trends in global temperatures, sea ice extent in the southern hemisphere has shown an increasing trend over recent decades. Wind-driven sea ice export from coastal polynyas is an important source of sea ice production. Areas of major polynyas in the Ross Sea, the region with largest increase in sea ice extent, have been suggested to produce the vast amount of the sea ice in the region. We investigate the impacts of strong wind events on polynyas and the subsequent sea ice production.

We utilize Bootstrap sea ice concentration (SIC) measurements derived from satellite based, Special Sensor Microwave Imager (SSM/I) brightness temperature images. These are compared with surface wind measurements made by automatic weather stations of the University of Wisconsin-Madison Antarctic Meteorology Program. Our analysis focusses on the winter period defined as 1st April to 1st November in this study. Wind data was used to classify each day into characteristic regimes based on the change of wind speed. For each regime, a composite of SIC anomaly was formed for the Ross Sea region. We found that persistent weak winds near the edge of the Ross Ice Shelf are generally associated with positive SIC anomalies in the Ross Sea polynya area (RSP). Conversely we found negative SIC anomalies in this area during persistent strong winds. By analyzing sea ice motion vectors derived from SSM/I brightness temperatures, we find significant sea ice motion anomalies throughout the Ross Sea during strong wind events. These anomalies persist for several days after the strong wing event.

Strong, negative correlations are found between SIC within the RSP and wind speed indicating that strong winds cause significant advection of sea ice in the RSP. This rapid decrease in SIC is followed by a more gradual recovery in SIC. This increase occurs on a time scale greater than the average persistence of strong wind events and the resulting Sea ice motion anomalies, highlighting the production of new sea ice through thermodynamic processes.