Identification of Antarctic sea ice regimes using objective data mining

Jinfei Wang

Sun Yat-sen University

A suitable classification of sea ice provides a valuable framework for understanding sea ice variability and its drivers. In this study, Antarctic sea ice regimes are objectively identified using a novel data mining approach, the Native Emergent Manifold Interrogation (NEMI). The three main classes of processes governing the sea ice mass balance evolution, namely vertical thermodynamics, horizontal thermodynamics, and dynamics, are analyzed in the NEMO-SI³ ocean–sea ice coupled model during the growth season from 1979 to 2023. These three terms are scaled, embedded, clustered into regimes and the clustering is validated. Six stable regimes are identified, each characterized by distinct dynamic and thermodynamic behaviors. We term these regimes 'Pack' (pack ice, accounting for 52.6% of the total grid cells), 'Coast' (coastal ice, 24.7%), 'OEdge' (outer ice edge, 13.6%), 'IEdge' (inner ice edge, 8.2%), 'WPO' (Western Pacific Ocean, 0.5%), and 'Res' (residual, 0.3%). Interannual analysis reveals a significant decreasing trend in the "Coast" regime area since 1979. The findings demonstrate NEMI's utility in identifying sea ice regimes that correspond to our physical intuition, and enhance our understanding of Antarctic sea ice dynamics and variability in the context of a possible change in mean Antarctic sea ice state as suggested by recent studies.