2025 PAMIP Webinar Series – May 29th at 3:00 pm (GMT)

Understanding Recent SST Trends in the Southern Ocean: The Roles of Freshwater Forcing and Mixed Layer Depth Variability

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Time: 3:00 pm (GMT)

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Abstract

Recent surface climate trends in the Southern Ocean featured regional SST cooling and sea ice expansion from 1979-2015. These trends remain poorly captured in coupled climate models, which typically simulate Southern Ocean warming over the historical period. This talk discusses two important contributors to this model-observation discrepancy: underestimated freshwater forcing and biases in mixed layer depth (MLD) variability. First, I will present work that quantifies SST response functions for coordinated freshwater forcing experiments in CMIP6 models, which are used to estimate the historical SST cooling associated with observed Southern Ocean freshening. Missing Antarctic ice sheet melt and underestimated precipitation trends effects emerge as key drivers of the "missing" cooling. Second, I will discuss an under-appreciated link between intensifying circumpolar westerlies and deeper summertime mixed layers, which can suppress summertime warming in the Southern Ocean. A simple conceptual model and observational evidence demonstrate that this mixed-layer deepening is essential for understanding the Southern Ocean response to wind forcing, which has typically been described exclusively through Ekman dynamics. This work highlights the critical role of representing both freshwater inputs and MLD dynamics for accurately simulating Southern Ocean SST trends. Incorporating these factors is essential for interpreting the region's outsized influence on global climate sensitivity through remote teleconnections and the SST pattern effect.