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Analysis of a decade of SST anomalies in the Southern Ocean: role of surface fluxes, lateral advection, and vertical processes

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The motivation of this work is to understand the processes responsible for the generation and evolution of non-seasonal SST anomalies in the Southern Ocean, as observed from a decade of satellite data.

We have developed a finite-element model for mixed-layer thermal anomalies, including forcing by air-sea and Ekman fluxes, processes of Ekman and geostrophic advection (prescribed from altimetry), diffusion. The influence of vertical mixed-layer processes (entrainment and non-seasonal mixed-layer depth anomalies) is also considered. The latter are determined using an hybrid approach based on hydrographic observations and a TKE model.

This model, which performs overall well in reproducing observations, is used to diagnose, regionally, the dominant processes responsible for the generation of SST anomalies, and their relationship to large scale atmospheric patterns of variability. Air-sea and Ekman fluxes anomalies are dominant processes over vast areas of the Southern Ocean. Geostrophic advection is important as well in specific regions. However, while data-model correlations are good, the level of simulated SST variance is smaller than observed values in several regions. It is shown that consideration of vertical processes (in particular non-seasonal mixed-layer depth anomalies) boosts SST variance and improves significantly the simulations in some key regions. Among these are the regions of formation of SAMW and AAIW for which the model is particularly skillful, and

where the heat budget is analyzed with greater detail.