Session: C9 Poster: M164A

Coupled ocean-atmosphere interactions and local impact of mesoscale SST on atmospheric boundary layer along SST fronts

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We examine the air-sea interactions and impact of local mesoscale sea surface temperature (SST) features in SST frontal regions of the world's ocean, such as the Kuroshio-Oyashio Extension (KOE) system, using the Scripps Coupled Ocean-Atmosphere Regional (SCOAR) model. The oceanic component for this model uses Regional Ocean Modeling System (ROMS) and the atmospheric component uses the Regional Spectral Model (RSM). Recent studies based on satellite observations suggest that in the KOE region, there is a tight coupling between SST gradients and wind stress derivatives, and the SCOAR model has reproduced many aspects of the observed coupled processes. We further investigate the influence of mesoscale SST gradients on the overlying atmospheric boundary layer (ABL) by traditional contrasting of the fully-coupled SCOAR run with an uncoupled RSM run forced by smoothed SST fields from the SCOAR run. In addition, to identify the impact of the ocean mesoscale on the atmospheric circulation, we implemented a 2D spatial filter on the SST fields as they are passed to the atmosphere at each coupling step within SCOAR and compared it with the fully-coupled, unsmoothed SCOAR run. The results are important for understanding the effect of mesoscale oceanic feedback on atmospheric stability, overlying winds, and surface heat flux, which influences the resulting mean ocean-atmosphere circulation of this region. It also enables us to examine the feedback of downscaled winds that has seen mesoscale SST versus smoothed, large-scale SST, on upwelling intensity, structure and variability, as well as its impact upon mixed layer depth and mesoscale eddy statistics. This provides insights for understanding the processes that control the mean and eddy circulation in the KOE region, which contributes to the overall heat balance in the upper ocean.