Abstract View

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A Numerical Case Study of the Development of Large-Scale Thermal Anomalies in the Central North Pacific Ocean

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ABSTRACT

A 10-level primitive equation ocean circulation model is used to investigate the formation and evolution of large-scale thermal anomalies in the central North Pacific Ocean during the fall and winter of 1976–77. A simplified parameterization of the effects of turbulent vertical mixing produced by wind stirring and surface cooling is included in the model. The numerical experiments consist of prescribed change experiments in which monthly mean ocean temperature anomalies, observed down to 400 m by the North Pacific Experiment (NORPAX), are used to define the prescribed changes (anomalies) in the initial conditions and observed monthly mean anomalies of surface winds, and surface heat fluxes are used to define the prescribed changes in the atmospheric forcing.

Oceanic processes are investigated by comparing several prescribed change experiments with observations. With anomalous wind forcing, horizontal advection by anomalous wind-driven surface (Ekman) currents and anomalous wind mixing contribute to the development of a large-scale cold anomaly in the upper 100 m of the central North Pacific in qualitative agreement with the observed anomaly development. The effects of anomalous horizontal advection are primarily confined to the upper 50 m while anomalous wind mixing produces strong cooling down to 125 m and warming below that. The inclusion of anomalous surface heat fluxes improves the simulation and is especially important for the development of a shallow warm anomaly to the east of the large-scale cold anomaly. In all the experiments the pattern correlation between simulated and observed temperature anomalies is greatest near the surface ($r \approx 0.88$) and decreases with depth ($r \approx 0.25$ at 262 m).

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