Abstract View

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Short-Term Oceanic Response Predicted by a Mixed Layer Model Forced with a Sector Atmospheric Model

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ABSTRACT

A one-dimensional version of the Garwood bulk, oceanic mixed layer model is used to simulate the short- term response in a 60° sector. The atmospheric forcing is derived from a version of the UCLA general circulation model used by Sandgathe to study the role of air-sea fluxes in maritime cyclogenesis. A five-day integration of the ocean model is made using the complete 3 h momentum and heat flux histories as calculated by the sophisticated planetary boundary layer, latent heat and radiative parameterizations of the UCLA model.

The zonal mean sea-surface temperature changes during the five days include increases of 0.4°C per day in equatorial regions and decreases of 0.2°C per day along the Northern Hemisphere storm track. Ocean temperature changes and the associated atmospheric forcing are related using a storm-following coordinate system. In addition to the general rapid warming of the ocean surface layers in the tropical regions, there is a large horizontal variability. High surface temperatures are produced during the periods of maximum insulation in the regions of light winds and minimum cloudiness. Significant horizontal gradients in the sea-surface temperatures are predicted between the cloudy and cloud-free regions. When daily averaged heat fluxes are used to force the ocean model, the horizontal variations in mixed layer temperature and depth are more realistic.

These results have implications for coupling atmosphere and ocean models for short-term forecasting. Although the midlatitude ocean response appears realistic, the ocean model is very sensitive to large horizontal variations in solar flux that are predicted between tropical cloud cluster and adjacent cloud-free areas. Such high sea-surface temperature gradients might be expected to lead to very vigorous deep convection in a coupled atmospheric model. Both the atmospheric forcing provided to the ocean model and the sea-surface temperature provided the atmospheric model in a fully coupled system may have to be averaged in time and space.

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