Abstract View

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Numerical Simulation Studies of Oceanic Anomalies in the North Pacific Basin. I: The Ocean Model and the Long-Term Mean State

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ABSTRACT

A three-dimensional, prognostic numerical model of the North Pacific Ocean, possessing an actual coastal configuration and ten layers (but constant depth), has been developed in order to show the physical nature of large-scale normal and abnormal characteristics of this ocean in response to various normal and anomalous seasonal meteorological conditions. Based on the simulated energetics, emphasis is given to the identification of the major physical processes and essential dynamic mechanisms responsible for the generation, evolution and dissipation of large-scale anomalies in the North Pacific Ocean. The model is based on time integrations of the finite-difference forms of the primitive equations. The oceanic circulation is driven by atmospheric forcing, namely, the surface wind stresses and the differential heating over the ocean. The flux form of numerical scheme for energy conservation and the rigid-lid approximation for filtering out the external inertia-gravity wave are used in the formulation.

The model was spun-up for more than 60 years with the annual mean atmospheric data as the forcing boundary conditions. The long-term mean state in the model reveals the large-scale features of the circulation patterns and density distributions in the North Pacific Ocean. Three gyres, one large anticyclonic in the subtropical region and two smaller ones in the subarctic and in the tropic regions, are well developed. The total transport near the western boundary reached 56×10^6 m^3 s^{-1}, which agrees reasonably well with the observed mean transport in the Kuroshio Current south of Japan. The equatorial currents, the Oyashio Current, the North Pacific Current, the Alaska Current and the California Current are simulated roughly in the model. There is upwelling along both the equator and the western boundary. Temperature and salinity distributions, except in high latitudes, compare well with observational data.

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