Abstract View

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Numerical Simulation Studies for Oceanic Anomalies in the North Pacific Basin: II. Seasonally Varying Motions and Structures

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ABSTRACT

Seasonally varying currents and structures in the North Pacific Ocean are simulated by a baroclinic ocean model. The model has satisfactorily reproduced the gross nature of current systems and density fields as well as their seasonal variations in the North Pacific Ocean. The simulated fluctuations of oceanic transport have been found to be closely related to the imposed meridional movement of the atmospheric system. The vertically integrated transport is strong in late winter and early spring, with a maximum in the Kuroshio region of 63×10^6 m^3 s^{-1}, and weak in summer, with a minimum of about 33×10^6 m^3 s^{-1}. All three major circulation gyres, namely, the subtropic anticyclonic gyre, the subarctic and the tropic cyclonic gyres are intense in winter and broad and weak in summer. The subarctic gyre almost disappears from the North Pacific basin in July. The simulated equatorial undercurrent and countercurrent demonstrate significant seasonal changes. Both currents are strong but shallow in fall and winter, and weak but deep in spring and summer. The simulated surface temperature agrees with observations in midlatitudes, especially in summer, but it is higher than that observed in high latitudes during winter. In the tropics, westward propagating baroclinic long waves having wavelengths of about 11 000 km are also shown in the simulation.

Most of the poleward flow of heat energy is transported in the upper layers, especially the surface layer. The maximum heat transport occurs near 17°N in winter and near 25°N in summer.

The seasonal cycle of energetics shows that variations of the total barotropic energy follow the variations of the imposed winds with a lag of about one month and that the maximum baroclinic energy follows closely the maximum of the overall horizontal thermal gradient in the cooling cycle. This also confirms that the large-scale baroclinic current is generally in geostrophic balance.

Simulated results are compared with observational data whenever appropriate. General agreement is satisfactory.

Discrepancies in comparisons are pointed out and improvements needed for the model are discussed.

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