The Upper Ocean Response to a Moving Typhoon

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Abstract

Upper ocean response to the translation speed of typhoon is studied using a three-dimensional primitive equation model. Previous similar model study applied stability criteria rather than diffusion term to simulate vertical mixing process. This study retains the diffusion term and use level-2 turbulence closure scheme to estimate vertical eddy viscosity. Model results show that in forced period mixed layer temperature decrease is larger for slow moving storm due to stronger upwelling from longer residence time. The fast moving storm can reach a similar cooling intensity in wake period if its residence time allows the wind to resonate with the ocean current. For these resonant events significant downward diffusion and advection of momentum in the first few inertial period leads to strong and persistent inertial pumping throughout the upper ocean in the wake period. Entrainment mixing supported by the vertical shear of inertial currents further cools the mixed layer. The upper thermocline, on the other hand, has compensating temperature increase instead. The vertical transfer magnitude and penetration scale are much smaller for slow moving case that its inertial motion decay quickly in 5 inertial periods. The model results also indicate that among the conventional parameters used to evaluate the storm-induced response, the storm residence time alone is sufficient to infer the dominant process. Its value, however, may be misleading for very rapid moving storms in which the current response is so far away from the storm that little wind work can be done to the ocean.