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The Establishment of the Wave-circulation Coupled Model and Its Application

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An accurate representation of the upper ocean mixing processes and thus the oceanic surface mixed layer is important for ocean circulation models, whether they are aimed at small-scale coastal simulations or for large-scale global climate simulations. The widely used Mellor-Yamada (M-Y) turbulence closure scheme often underestimates the vertical mixing in the upper ocean with strong stratification, and thus the sea surface temperatures is overestimated, mixed layer is too shallow and the seasonal thermocline is underestimated, especially during the summer.

Base on the theory of wave-induced mixing put forward by Yuan Yeli and Qiao Fangli this work established the MASNUM wave-circulation coupled model, which incorporated the MASNUM wave model and the Princeton Ocean Model (POM). The coupling method is that first calculate the wave-number spectrum then compute the wave-induced mixing Bv and put it into the circulation model.

In the summer upper ocean in the middle and high latitude the wave-induced mixing Bv is larger than the vertical mixing derived from the M-Y turbulence closure model while in the low latitude Bv is smaller than Kh. Comparing the simulated summer upper ocean temperature structure by the wave-circulation coupled model and the original POM with the Levitus data, it suggests there is obvious difference between the result of the original POM and the the Levitus data and the result of the coupled model agrees the Levitus data well. The mixed layer depth in the coupled model result is much deeper than the result of the original POM and it fit the Levitus data well. This suggests that the wave-induced mixing play the key role in forming the summer surface mixed layer in the middle latitude, it is also significant to the surface mixed layer in the tropical area.