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Wave turbulence interaction induced vertical mixing and its effects in ocean and climate models

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Heated from above, the oceans are stably stratified. Therefore, the performance of the general ocean circulation and climate studies through coupled atmosphere-ocean models depend critically on vertical mixing of energy and momentum in the water column. Many of the traditional general circulation models are based on Total Kinetic Energy (TKE), in which the roles of waves are averaged out. Although theoretical calculations suggest that waves could greatly enhance coexisting turbulence, no field measurements on turbulence have ever validated this mechanism directly. To address this problem, a specially designed field experiment has been conducted. The experimental results indicate that the wave-turbulence interaction induced enhancement of the background turbulence is indeed the predominant mechanism for turbulence generation and enhancement. Based on this understanding, we propose a new parameterization for vertical mixing as an additive part to the traditional TKE approach. This new result re-confirmed the past theoretical model that had been tested and validated in numerical model experiments and field observations. It firmly establishes the critical role of wave-turbulence interaction effects in both the general ocean circulation models and atmosphere-ocean coupled models, which could greatly improve an understanding of the sea surface temperature and water column properties distributions, and hence the model-based climate forecasting capability.