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Improvement of MOM4 by including non-breaking surface wave-induced vertical mixing

Q. Shu, F. Qiao, Z. Song, C. Xia, and Y. Yang
The First Institute of Oceanography, State Oceanic Administration, Qingdao, China (shuqi@fio.org.cn)

A parameterized non-breaking surface wave-induced vertical mixing (Bv) is incorporated into the Modular Ocean Model version 4 (MOM4p0). A comparison of the two numerical experiments with and without Bv shows that Bv can significantly improve the upper-ocean (20-100 m) simulation in summer. The simulated upper-ocean temperature errors are reduced in summer due to the surface wave-induced vertical diffusive heat flux. The non-breaking-wave-induced vertical mixing can increase the probability of the simulated SST biases between -1°C and 1°C from 64% to 76% in the Southern Hemisphere (60°S-10°S) in January, and from 66% to 75% in the Northern Hemisphere (10°N-60°N) in July. The averaged mixed layer depth (MLD) simulated by the MOM4 without Bv is 14.4 m shallower than the observations in 10°S-60°S in January, and 7.2 m shallower than the observations in 10°N-60°N in July. Bv can deepen the modeled MLD by 12.4 m in the Southern Hemisphere in January and by 6.3 m in the Northern Hemisphere in July. By including Bv, the corresponding MLD biases from the observations are only 2.0 and 0.9 m in the Southern and Northern hemispheres, respectively. These results clearly demonstrate that the incorporation of Bv can improve the performance of MOM4 significantly in summer.