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Sensitivity of ocean vertical mixing schemes in the coupled Korean Integrated Model (KIM)

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The Korea Institute of Atmospheric Prediction Systems (KIAPS) aims to develop an integrated numerical prediction system that can handle various spatial and temporal scales. As the first step, efforts were made to couple the ocean-sea ice-wave-river routing models to the Korea Integrated Model (KIM), to improve predictability over an extended-range of time scales. The Nucleus for European Modelling of the Ocean (NEMO), Sea Ice modelling Integrated Initiative (SI3), and Wave Watch (WW3) were successfully coupled for the first stage (2020–2022). Subsequently, the refinements have been focused on ensuring the consistency of surface radiative/turbulent fluxes between the model components and optimizing the surface layer parameterization of each model component. Preliminary results showed that the initial coupled KIM is stable for long-range simulation over 20 years and could provide reasonable performance in medium-range forecast and seasonal simulation.
The boundary condition for turbulent kinetic energy (TKE) can be expressed using the information of wave breaking calculated from the wave model to alleviate a systematic cold bias in summer regions. The reduction in TKE flux causes warming in regions with a shallow ocean mixed layer, which reduces the systematic cold bias but rather generates a warm bias in the summer hemisphere. Therefore, we attempt to address the bias by utilizing a parameterization of the Langmuir Circulation (LC) effects. LC effects can be carried out in a variety of ways, like including the contribution from the Stokes force in TKE or modifying a mixing length scale, as suggested in the previous studies. In this study, the effects of various LC parameterizations on ocean vertical mixing and sea surface temperature will be investigated and the optimal parameterization to the fully coupled model will be suggested.

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