

Abstract Submitted
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A coupled horizontal and vertical subgrid-scale dissipation scheme for atmosphere and ocean models¹ SINA KHANI, University of Washington, MICHAEL L. WAITE, University of Waterloo — In atmosphere and ocean simulations with anisotropic horizontal-vertical grids where $\Delta x \gg \Delta z$, subgrid-scale dissipation schemes are usually decoupled in the horizontal and vertical directions. In this framework, it is assumed that the energy exchange in the horizontal direction between unresolved horizontal scales and resolved scales, is totally decoupled from the energy exchange in the vertical direction between unresolved vertical scales and resolved scales. Using a careful and systematic horizontal-filtering and examination of sub-filter terms in idealized stratified turbulence simulations, we show that the energy exchanges between resolved scales and unresolved horizontal and vertical scales are highly coupled. Indeed, having unresolved horizontal scales in the system implies a subgrid dissipation term in the vertical momentum equation. Our results show that with a coupled horizontal-vertical subgrid dissipation scheme, the accuracy of results in the atmosphere and ocean models will be significantly enhanced at coarse-resolution simulations. We will also discuss that how our new coupled subgrid dissipation scheme can be integrated into large-scale climate models.

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