

Fine-scale features in vertical velocity represented in a global cloud-resolving coupled model

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Deep convection frequently occurs in the tropical region owing to its high sea-surface temperature (SST). Although SST is relatively cold over the extra-tropical regions, intense updraft can be induced by tropical cyclones and atmospheric fronts. Also, recent studies argued that mesoscale ocean features, including Tropical Instability Wave, western boundary current and ocean eddies, can locally induce updraft that reaches the tropopause level. In the present study, we conducted global 10 ensemble simulations with an atmosphere and ocean coupled model to investigate the resolution dependence of fine-scale updraft features and its relation to SST. The horizontal resolution of the atmospheric model is either 14 km or 3.5 km, and that of the ocean model is 0.1 degrees. The sets of simulations were conducted over 40 days for midwinter in 2020 and midsummer in 2016.

Regardless of the horizontal resolution, the coupled model well resolves the intense ascent associated with cold atmospheric fronts in winter and typhoons in summer. Furthermore, updraft is intensified in the vicinity of steep SST fronts associated with the mesoscale ocean features, as consistent with the previous studies, in both resolutions. On the scale of $O(100\text{km})$, the horizontal feature of updraft is largely consistent between the resolutions. However, the higher-resolution model represents much finer updraft features with the horizontal scale of $O(10\text{km})$ and finer. Precipitation exhibits finer features as well. Thus, global atmosphere models with horizontal resolution of $O(1\text{km})$ can shed new light on the role of fine-scale updraft in the global climate and weather system.

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