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Impacts of Horizontal Resolution and Air–Sea Flux Parameterizations on the Intensity and Structure of Tropical Cyclone

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This study investigates the impacts of horizontal resolution and surface flux formulas on typhoon intensity and structure simulations through the case study of the Super Typhoon Haiyan (2013). Three different surface flux formulas in the Weather Research and Forecasting Model are tested for grid spacing from 6 to 1 km. Both increased resolution and more reasonable flux formulas can improve the typhoon intensity simulation, but their impacts on wind structures are different. Sufficiently high resolution is more conducive to the positive effect of flux formulas. Reduce the grid spacing to 1 km yields deeper and stronger, more upright and contracted eyewall. As resolution increases, the size of updraft cores in the eyewall shrinks and the region of downdraft increases, and both updraft and downdraft become more intense. In the finer resolution of simulations, the convective cores are driven by more intense updrafts within a rather small fraction of spatial area. This resolution dependence of the spatial scale of updrafts is attributed to the model effective resolution, which is determined by grid spacing, not the flux formulas. While the use of more reasonable flux formulas can increase the simulated storm intensity to some extent, the positive effect of surface flux formulas cannot be effectively enhanced unless the grid spacing is properly reduced to efficiently yield intense and contracted eyewall structure.

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