Application of a new scale-aware three-dimensional subgrid mixing parameterization on the simulations of tropical cyclone

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A new scale-adaptive three-dimensional (3D) turbulent kinetic energy (TKE) subgrid mixing scheme is developed using the Advanced Research version of the Weather Research and Forecasting Model (WRF-ARW) to address the gray-zone problem in the parameterization of subgrid turbulent mixing. This scheme is based on the full 3D TKE prognostic equation and combines the horizontal and vertical subgrid turbulent mixing into a single energetically consistent framework.

A series of real tropical cyclone (TC) simulations with varying horizontal resolutions from 9km to 1km are carried out to compare the performance of the 3D mixing scheme and the conventional 1D planetary boundary layer (PBL) schemes to the observations, including conventional ones such as radiosonde and surface synoptic observations, as well as intensive ones obtained during the landfall of TC, such as mobile boundary layer wind profiler and Dual-pol Doppler Radar. This study aims to determine if the new scheme performs appropriate on TC simulation, and to evaluate the sensitivity of TC simulation to boundary layer schemes.