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Comparison and Evaluation of Two Types of PBL Schemes in Tropical Cyclone Boundary Layer Simulations

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This presentation highlights major results from a series of numerical experiments with the popularly used Advanced Research WRF (ARW) model that were carried out for the purpose of comparing and evaluating two planetary boundary layer (PBL) mixing schemes: the GFS K-profile closure scheme and the Mellor-Yamada-Janjić 1.5-order TKE closure scheme. The two schemes are driven by the same surface layer scheme in the sensitivity experiments so that only the sensitivity of the ARW model to different formulations of the PBL mixing above the surface layer is examined. We will first compare the sensitivity of the asymptotic behavior of the ARW-simulated intensification of an idealized tropical cyclone to the two PBL mixing schemes. We will then compare the vertical eddy diffusivities from the two PBL mixing schemes with those estimated from observations. Finally, we will compare the assumptions embedded in the formulations of the two schemes. Using the results from the sensitivity experiments and the comparisons of the PBL mixing scheme formulations, we will point out and, more importantly, provide an explanation for an unintended consequence of using the GFS scheme in the simulation of tropical cyclones: overestimation of vertical eddy diffusivity in the eyewall region. Based on our findings, we will propose a possible route that the research community could take for improving the boundary layer physics in tropical cyclone prediction models.