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Session ZC26: Geophysical Fluid Dynamics: Atmospheric III
12:50 PM–3:26 PM, Tuesday, November 26, 2024
Room: 251 D

Chair: Eric Pardyjak, University of Utah

Abstract: ZC26.00008 : Mean and Turbulence Dynamics in Hurricane Boundary Layers*
2:21 PM–2:34 PM

← *Abstract* →

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While hurricanes have been the most expensive natural disaster in US history, our understanding of the turbulence dynamics of these geophysical flows is limited due to the lack of sufficient measurements and high-resolution simulations. To bridge this knowledge gap, we will employ high-resolution large-eddy simulations (LESs) to characterize the impacts of the radius, gradient wind, and surface roughness and waves on hurricane's mean and turbulence dynamics. Our results show that increasing the Rossby number (rotation) increases the hurricane's maximum jet velocity, decreases the boundary layer height, and reduces the size of coherent turbulent structures at the same elevation. It was also found that as the Rossby number increases, the shear production of turbulence is enhanced near the wall and decreased away from the wall, indicating turbulence suppression by rotation. Moreover, the implications of such changes on real hurricane forecasts of weather models will be briefly shown by adjusting the diffusion magnitude in the atmospheric boundary layer. Using these insights, we were able to significantly improve the intensity forecasts of real major hurricanes by an average of ~30% in five considered cases. The findings of this research provide new insights into the turbulence dynamics of hurricanes, and can guide the development of more accurate forecasting models for hurricane flows.

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