

Mean Flow and Turbulence in the Hurricane Boundary Layer

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Abstract: Hurricanes are the costliest natural hazard in the United States and account for a disproportionate share of damage, injuries, and loss of life. Despite decades of research, the quantitative understanding of hurricane near-surface winds remains insufficient for many wind-engineering applications, largely due to limitations in field observations and numerical simulations. To address this gap, we have recently developed a turbulence-resolving computational fluid dynamics framework that simulates a small but dynamically representative portion of the hurricane boundary layer (HBL) while accounting for the influence of larger-scale atmospheric motions. This approach resolves both mean flow and turbulent variability across scales ranging from kilometers to meters, providing new insight into the structure and dynamics of the HBL. In this presentation, I will provide an overview of the numerical framework and discuss scaling properties of HBL mean flow and turbulence relevant to wind-engineering applications, as well as a recently derived analytical solution for the HBL mean velocity profile.

Bio: Marco Giometto is an Assistant Professor in the Department of Civil Engineering and Engineering Mechanics at Columbia University and an Amazon Scholar in the Prime Air program (Amazon's drone delivery initiative). His research focuses on atmospheric boundary-layer processes, which he studies using a combination of numerical simulations and analytical methods to advance understanding of atmospheric turbulence and improve weather forecasting, dispersion modeling, and wind-hazard prediction. He received his Ph.D. in Mechanical Engineering from the École Polytechnique Fédérale de Lausanne and subsequently held postdoctoral positions at the University of British Columbia and at Stanford University's Center for Turbulence Research.

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March 12, 2026
12pm - 1pm EST

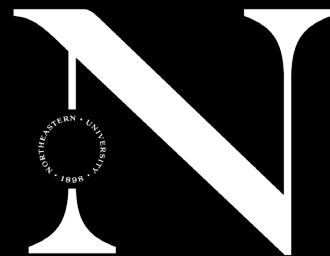


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