M.S. Defense Announcement
Eleanor Delap
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A SIMPLIFIED APPROACH TO UNDERSTANDING BOUNDARY LAYER STRUCTURE IMPACTS ON TROPICAL CYCLONE INTENSITY

The relationship between tropical cyclone boundary layer (TCBL) structure and tropical cyclone (TC) intensity change is difficult to understand due to limited observations of the complex, non-linear interactions at both the top and bottom boundaries of the TCBL. Consequently, there are debates on how the TCBL interacts with surface friction and how these interactions affect TC intensity change.

To begin to address these questions, a conceptual framework of how axisymmetric dynamics within the TCBL can impact TC intensity change is developed from first principles in the form of a new, simple logistic growth equation (LGE). Although this LGE bears some similarities to the operational LGE Model (LGEM; DeMaria 2009), the difference is that our growth-limiting term incorporates TCBL structure and surface drag. The carrying capacity of the LGE—termed the instantaneous logistic potential intensity (ILPI) in this study—is used to explore the relationship between TCBL structure and TC intensity. The LGE is also further solved for the drag coefficient (C_D) to explore the relationships between it and both TCBL structure and TC intensity.

The validity of this new LGE framework is then explored in idealized numerical modeling using the axisymmetric version of Cloud Model 1 (CM1; Bryan and Fritsch 2002). Results show that CM1 exhibits changes to TCBL structure and TC intensity that are consistent with the LGE framework. Sensitivity of these results to the turbulent mixing lengths, L_h and L_v, are also explored, and general LGE relationships still hold as C_D is increased. Finally, the LGE framework is applied to observations, and initial C_D retrievals indicate that while this new method is low compared to Bell et al. (2012), they are still plausible estimates.