UNIVERSITY of WISCONSIN
UWMILWAUKEE

Department of
Mathematical Sciences

Master's Thesis Defense

Dillon Blount

MS Graduate Student

Under the Supervision of Clark Evans

Thursday, August 5th
2021 @ 12:00pm

Hybrid: Online via. Microsoft Teams and In-Person at GLRF, Room 3093

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Environmental-Regime–Stratified GFS Short-Range Vertical Sounding Forecasts

In recent years, the United States' operational global numerical weather prediction model, the Global Forecast System (GFS) has been upgraded to include a new dynamical core and an updated turbulence parameterization. This updated turbulence parameterization uses a hybrid eddy-diffusivity, countergradient, and mass-flux formulation to approximate near-surface turbulent vertical mixing. The formulation used is based on the local stability, eddy-diffusivity (stable), countergradient (weakly unstable), mass flux (moderately/strongly unstable).

In this study, an objective classification of environmental regimes is used to verify the GFS short-range vertical soundings, primarily in the planetary boundary layer where the turbulence parameterization plays an important role. Observed temperature and dewpoint temperature from 15,488 soundings taken at 0000 UTC and 16,118 soundings taken at 1200 UTC between May – November 2019 are first interpolated into a height above-ground-level (AGL) coordinate and normalized to the psuedoadiabat defined by the surface-based parcel's wet-bulb temperature. This allows for soundings shapes to be classified together regardless of their temperature and dewpoint temperature differences due to climate. A multivariate empirical orthogonal function (EOF) analysis is then performed on the normalized sounding data, after which a k-means clustering analysis is conducted on the leading two principal components retained from the EOF analysis. The output of this analysis classifies soundings into three different environmental regimes, leading into a regime-specific model sounding verification. This study finds environments such as a deeply mixed-layer (strongly unstable), a shallow mixed-layer (weakly/moderately unstable), and radiation inversions (stable), and each profile has varying biases due in part to turbulent mixing issues within the boundary layer.

Committee Members:

Dr. Clark Evans

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