RAL SEMINAR SERIES

Successes & Challenges in Storm Prediction Integrating Physics-Based Models with AI/ML

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HYBRID MEETING FL2-1022 | Watch Live

Severe weather events cause structural and environmental damage, disrupt wind energy generation and lead to widespread power outages - underscoring the critical need for accurate storm forecasts to mitigate risks to infrastructure, transportation, and public safety. In the Northeast United States, wind gusts—an indicator of severe windstorms—and snowfall accumulation and density during winter storms are among the most consequential weather variables. However, predicting wind gusts remains challenging due to the influence of small-scale processes such as turbulence from friction, wind shear, surface roughness, topography, and solar heating, all of which complicate even the most advanced convection-permitting numerical weather prediction models. Similarly, forecasting snowfall accumulation during extreme events, such as rapidly intensifying storms, is difficult due to the complex nature of snowfall formation and evolution.

To address these challenges, we have developed hybrid WRF-AI/ML models for gust and snowfall prediction, leveraging a synergy between physics-based model outputs, observational data, and machine learning algorithms—including decision tree methods (random forest, extreme gradient boosting) and evidential neural networks. This seminar will present lessons learned from applying these hybrid modeling approaches, highlight improvements in prediction accuracy, discuss methodological caveats, emphasize the role of explainable AI techniques, and outline the challenges that persist in severe weather forecasting. Event website.