AI-Driven Calibration of Precipitation and Wind Using NEXRAD Data for Highway Winter Maintenance
Recipient/Grant (Contract) Number: 69A3552348321
Center Name: Rural Safe Efficient Advanced Transportation (R-SEAT) Center
Research Priority: Resilience
Principal Investigator(s): Emmanuel Kidando, Josiah Owusu-Danquah, Lutful Khan, and Angela Kitali
Research Project Funding: $100,000 (Federal request) and $54,500 (Non-Federal cost share)
Project Start and End Date: 12/19/2025 to 12/18/2026
Project Description: Severe winter weather poses a major risk to road users due to slippery surfaces, disrupting highway traffic flow through speed reductions, capacity decreases, or complete highway closures. Departments of Transportation rely on Road Weather Information Systems (RWIS) for maintenance planning. However, RWIS has limitations, including downtime, equipment failures, and high installation and maintenance costs, resulting in limited station coverage. To supplement RWIS, some agencies use alternative weather data sources such as the Automated Surface Observing System (ASOS), Next Generation Weather Radar (NEXRAD), Meteorological Assimilation Data Ingest System (MADIS), and Multi-Radar/Multi-Sensor System (MRMS). While these sources offer valuable insights, most have geographic coverage constraints. In contrast, high-resolution Doppler weather radar systems like NEXRAD provide extensive precipitation estimates and atmospheric wind visualizations. Georeferenced NEXRAD data allows for detailed storm tracking and intensity monitoring. Nonetheless, factors such as beam blockage, radar calibration issues, and atmospheric conditions can impact the accuracy of precipitation estimates. This research aims to enhance NEXRAD's utility by developing and validating advanced calibration techniques using artificial intelligence (AI). Focusing on precipitation and wind attributes, algorithms such as deep learning and Gaussian process regression will be employed, leveraging Ohio's RWIS data as ground truth. The methodology incorporates spatial-temporal dynamics and external factors like radar proximity to improve model accuracy and transferability.
US DOT Priorities*:
Outputs: The primary objective of this study is to improve the accuracy and reliability of winter weather monitoring by calibrating NEXRAD radar data with advanced artificial intelligence methods. The project will develop and validate algorithms capable of correcting radar-based precipitation and wind estimates, using RWIS observations as ground truth. These algorithms will be integrated into a data processing framework that ingests near-real-time NEXRAD Level II data and delivers localized weather information through a web-based dashboard. The collaboration with Ohio DOT ensures access to critical RWIS data and operational insights necessary for evaluating model performance and practical utility. The outputs of this project will provide transportation agencies with a cost-effective supplement to RWIS, enabling more efficient winter maintenance planning, reducing resource waste, and enhancing roadway safety during severe winter storms.
Outcomes/Impacts: Findings will enhance winter maintenance operations by providing transportation agencies with more accurate, localized precipitation and wind data, enabling faster and better-informed responses to severe weather. The research will also guide policy and

investment decisions by demonstrating how AI-calibrated radar can serve as a cost-effective supplement to RWIS, improving roadway safety and reducing disruption to traffic flow during hazardous winter conditions.

Final Research Report: N/A

* *Section left blank until USDOT's new priorities and RD&T strategic goals are available in Spring 2026.*