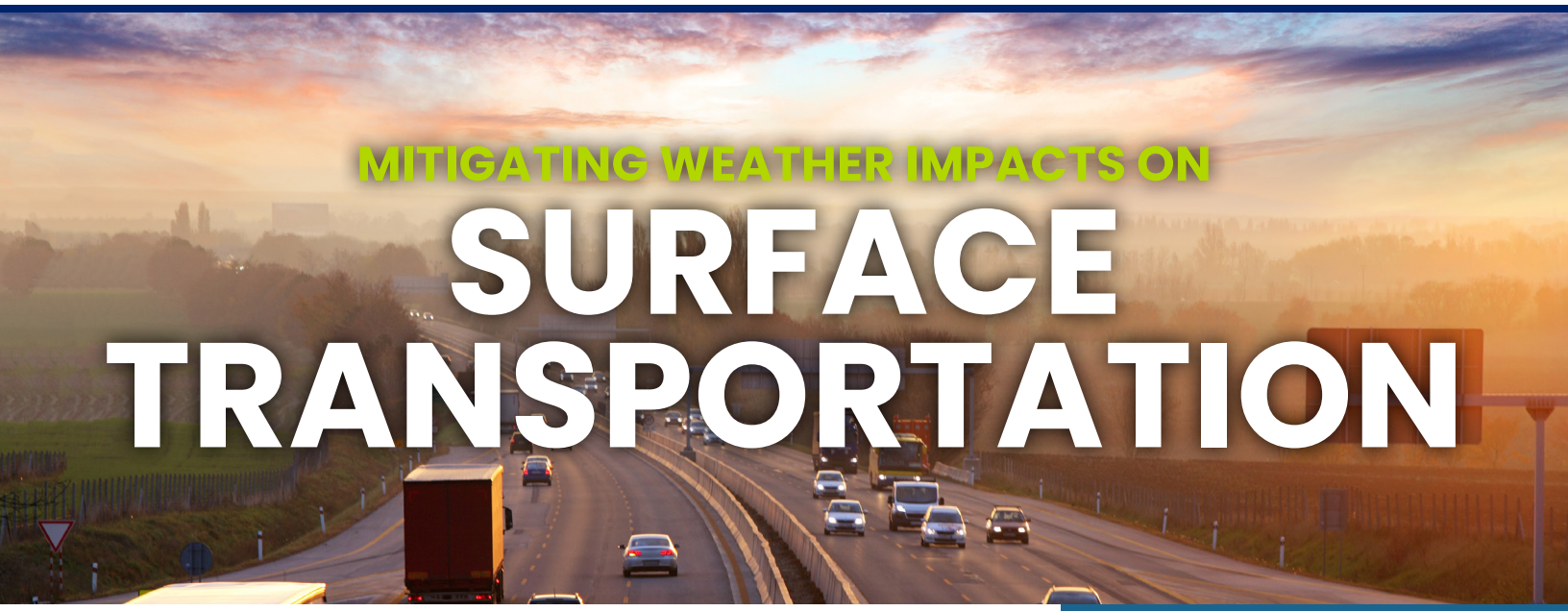

MITIGATING WEATHER IMPACTS ON

# SURFACE TRANSPORTATION

## Weather-Resilient Transportation

Over 1.2 million weather-related vehicular crashes in the U.S. each year account for about 5,000 fatalities and 400,000 injuries and, alongside congestion, result in billions of dollars lost. These challenges are not new, but the frequency and magnitude of events are ever shifting. Changes in adverse weather are accompanied by changes in technology, including the rapid development and deployment of connected and automated vehicles and artificial intelligence models. By facilitating public, private, and academic partnerships and leveraging new technologies for transportation weather decision support, NCAR/RAL is paving a road towards a more resilient transportation network.

### BEYOND WINTER WEATHER

Traditionally, the surface community has focused its resources on addressing challenges and hazards present in transportation by winter weather. Emergent technologies both require and promote a broader consideration of the spectrum of events in the hazard landscape. Strong crosswinds present a rollover risk for large commercial and lightweight, high profile vehicles. Wildfires necessitate strategic evacuation route identification for vulnerable communities. Visibility obstructions induced by fog, heavy precipitation, blowing dust, snow, or smoke are a unique, localized component of the hazard landscape that can induce deadly

## Benefits & Impacts

- Advancing road condition observations
- Supporting connected, automated, & electric vehicle operations in adverse weather
- Fostering partnerships for multi-modal weather decision support

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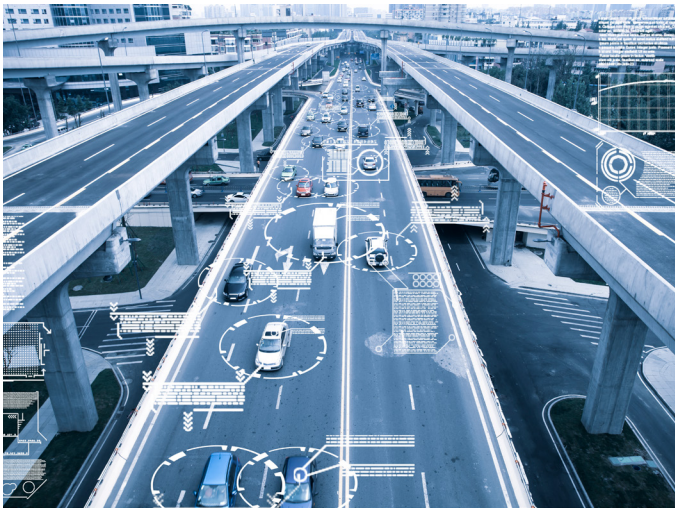
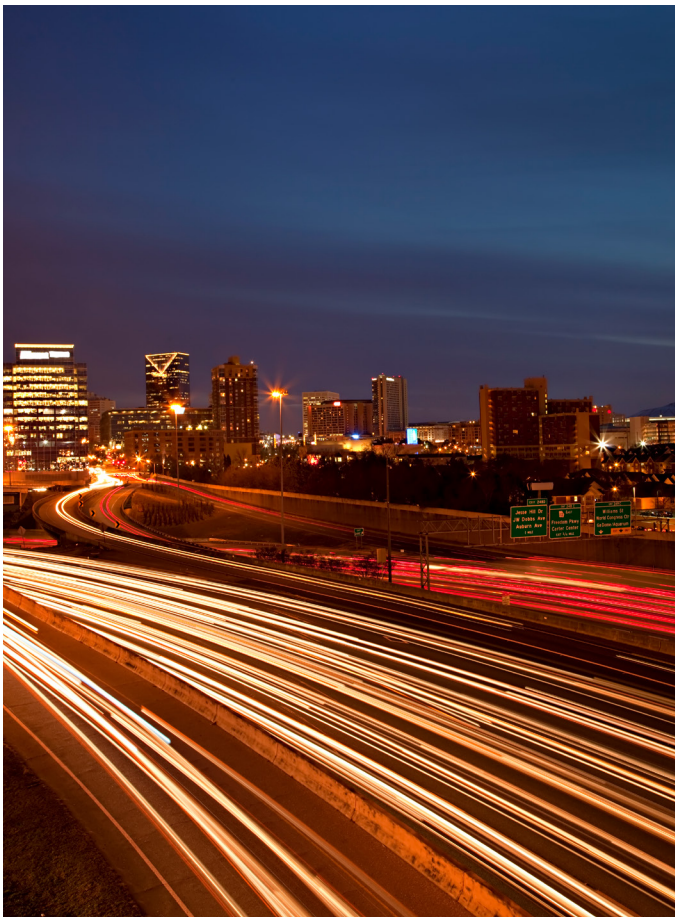
multi-vehicle pileups. Flooding ranges from relatively minor nuisance flooding to catastrophic riverine, flash flooding, or tropical cyclone coastal inundation events. Flooding events can disrupt large, multi-modal segments of the surface transportation network for long durations.

## ENABLING ALL-WEATHER CONNECTED, AUTOMATED, AND ELECTRIC VEHICLES

The future of mobility is connectivity and automation, and many of these new vehicles are fully electric. Automated vehicles require a complex sensor fusion of technologies to perceive and adapt to their surrounding environment. Simulation environments with realistic weather conditions are pivotal in understanding how weather affects automated vehicles and to develop solutions to overcome these challenges. Automated vehicles also require greater connectivity to navigate their environment. Detailed understanding of weather impacts is necessary, not only on vehicle operation, but also on attenuation of transmitted information and fidelity of sensor data. Advancements in artificial intelligence modeling allow leveraging of the infrastructure to further support the deployment of new vehicle technologies, such as image recognition from roadside cameras leading towards a higher density of observations available for transmission to the vehicle. And with increased computational load, these vehicles will require pinpoint guidance on battery performance in a variety of weather conditions to relieve range anxiety.



**Enabling observations of road conditions through image recognition**



**Fostering public, private, and academic sector partnerships for multi-modal weather decision support**

## BUILDING PARTNERSHIPS

Strategic partnerships are crucial to facilitate the future needs of surface transportation meteorology. Academic, public, and private partnerships must ensure cross-disciplinary research teams provide the necessary breadth and depth of scope to support a broad, multi-modal weather research, development, and technology implementation program. NSF NCAR RAL works with public agencies, private companies, and universities across the weather, water, and climate enterprise alongside the transportation sector to build capability and facilitate continuous stakeholder engagement to refine and develop priorities and ensure alignment with end-user needs.

**SURFACE TRANSPORTATION**

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