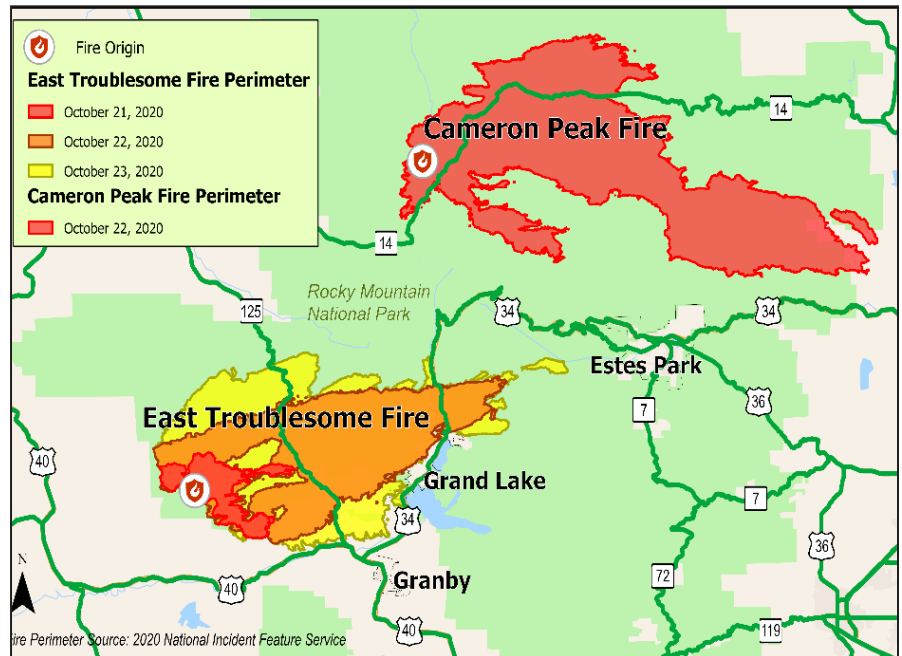


# MOUNTAIN-PLAINS CONSORTIUM

RESEARCH BRIEF | MPC 23-509 (project 685) | December 2023

## Regional Emergency Evacuation Analysis in Traffic with Connected and Autonomous Vehicles



### the ISSUE

Wildfires are an increasing threat to communities located near forests and other areas characterized by natural vegetation. As evacuation of these areas becomes a more common occurrence, it is important to understand how connected and autonomous vehicles (CAVs) may impact disaster response and evacuation strategies.

### the RESEARCH

Researchers focused on three research issues: 1) predicting and making recommendations for future evacuations under wildfire conditions using connected vehicle data, 2) driving behaviors in wildfire evacuations, and 3) autonomous vehicle perceptions in winter conditions.

This research addresses the urgent need for enhanced emergency evacuation strategies in the MPC region during natural disasters, particularly wildfires, by capitalizing on data from CAVs. Leveraging a dataset from connected vehicles, the study evaluates driving behavior and traffic conditions during wildfire evacuations, providing crucial insights for disaster response. Furthermore, it investigates the role of CAVs in disaster management and assesses public attitudes toward their integration in a medium-sized metropolitan area with cold weather. This research offers a data-driven foundation for optimizing emergency evacuation plans and underscores the potential of CAVs in improving disaster response, highlighting the importance of public perception in realizing this potential.



A University Transportation Center sponsored by the U.S. Department of Transportation serving the Mountain-Plains Region. Consortium members:

Colorado State University  
North Dakota State University  
South Dakota State University

University of Colorado Denver  
University of Denver  
University of Utah

Utah State University  
University of Wyoming



### Lead Investigator(s)

Dr. Pan Lu  
pan.lu@ndsu.edu  
North Dakota State University

### Co-Investigator(s)

Dr. Ying Huang  
ying.huang@ndsu.edu  
North Dakota State University

### Research Assistant(s)

Asad Ali GRA, PhD  
Salman Ahmad, GRA, MS  
Xinyi Yang, GRA, PhD  
Yihao Ren, GRA, PhD  
Hafiz Usman Ahmed GRA, MS

### Project Title

MPC Regional Emergency  
Evacuation Analysis in  
Traffic with Connected and  
Autonomous Vehicles

### Sponsors | Partners

North Dakota State University  
Upper Great Plains  
Transportation Institute

USDOT, Research and  
Innovative Technology  
Administration

## the FINDINGS

The researchers found that:

1. CV dataset is suitable for estimating traffic delays during wildfire evacuations
2. Traffic intersections are critical congestion points during evacuation with clusters of hard braking events
3. Evacuation warning time plays an important role in shaping aggressive driving behavior
4. Rural and urban areas show significantly different evacuation patterns
5. Demographic and socioeconomic parameters play a pivotal role in shaping attitudes toward AVs
6. Gender patterns align with previous studies in larger metropolitan areas, but variables such as travel time to work and household income level yield distinct results, particularly when analyzed within specific age groups or student and non-student categories

## the IMPACT

The utilization of real-time data for microsimulation will advance transportation planning and safety management. If widely implemented, use of these data can lead to quantifiable enhancements in evacuation times and traffic flow during wildfires. Use of these data and traffic simulations will significantly improve evacuation planning, potentially reducing accidents and congestion, leading to safer and smoother evacuations.

For more information on this project, download the Main report at <https://www.ugpti.org/resources/reports/details.php?id=1150>

For more information or additional copies, visit the Web site at [www.mountain-plains.org](http://www.mountain-plains.org), call (701) 231-7767 or write to Mountain-Plains Consortium, Upper Great Plains Transportation Institute, North Dakota State University, Dept. 2880, PO Box 6050, Fargo, ND 58108-6050.



This publication was produced by the Mountain-Plains Consortium at North Dakota State University. The contents of this brief reflect the views of the authors, who are responsible for facts and the accuracy of the information presented herein. This document is disseminated under the program management of the USDOT, Office of Research and Innovative Technology Administration in the interest of information exchange. The U.S. Government assumes no liability for the contents or use thereof.



NDSU does not discriminate in its programs and activities on the basis of age, color, gender expression/identity, genetic information, marital status, national origin, participation in lawful off-campus activity, physical or mental disability, pregnancy, public assistance status, race, religion, sex, sexual orientation, spousal relationship to current employee, or veteran status, as applicable. Direct inquiries to Vice Provost, Title IX/ADA Coordinator, Old Main 201, 701-231-7708, [ndsu.eoaa@ndsu.edu](mailto:ndsu.eoaa@ndsu.edu).