

Measuring the Effect of Weather Events on Long-Haul Truck Traffic Using Anonymous Truck GPS Data

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Outline

1. Background and Motivations
2. Method
3. Application
4. Discussion
5. Future Research

Problem Statement

- Severe weather conditions can have major effects on truck traffic volumes
- Truck GPS data, a valuable source of freight movement
- Large data stream, how to deduce insights

Research Question

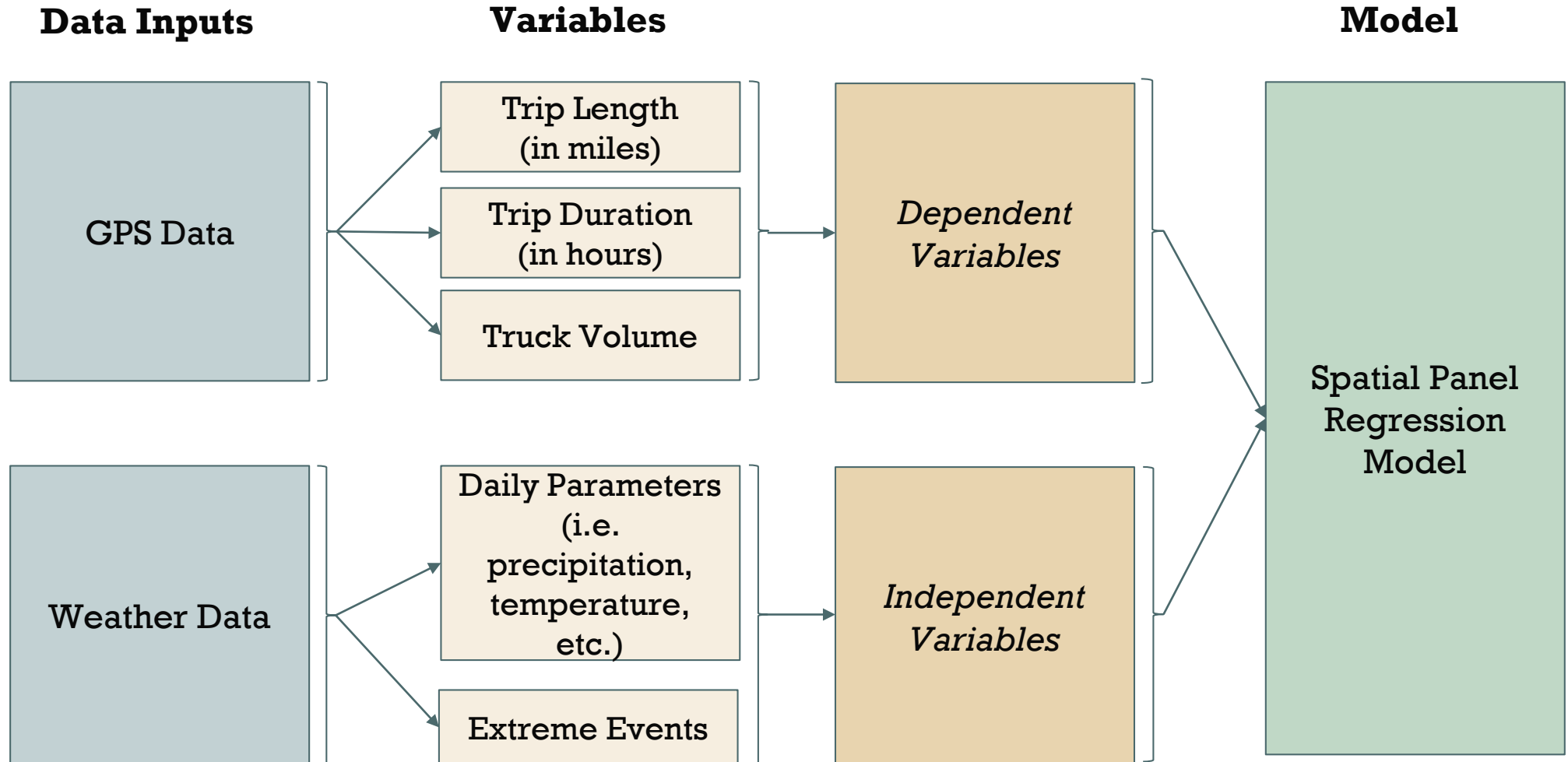
Can we develop a model that predicts Vehicle Miles Traveled (VMT) and Vehicle Hours Traveled (VHT) changes of trucks resulting from weather events ?

Applications

Assist state and regional transportation agencies in developing freight-oriented programs and policies.

Assist trucking industry to better plan accurate routes to estimate ETA and revenue miles.

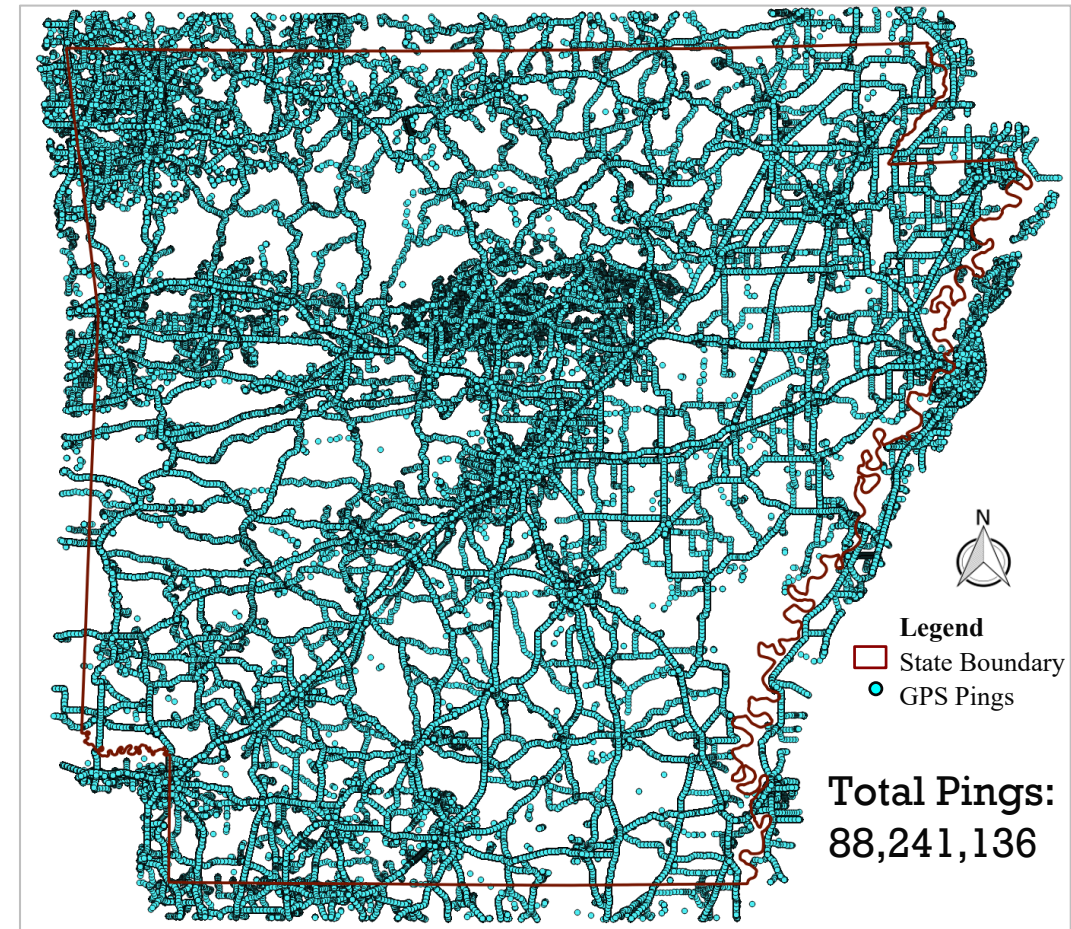
Method of the Study



Mobile Sensor Data: *GPS Data*

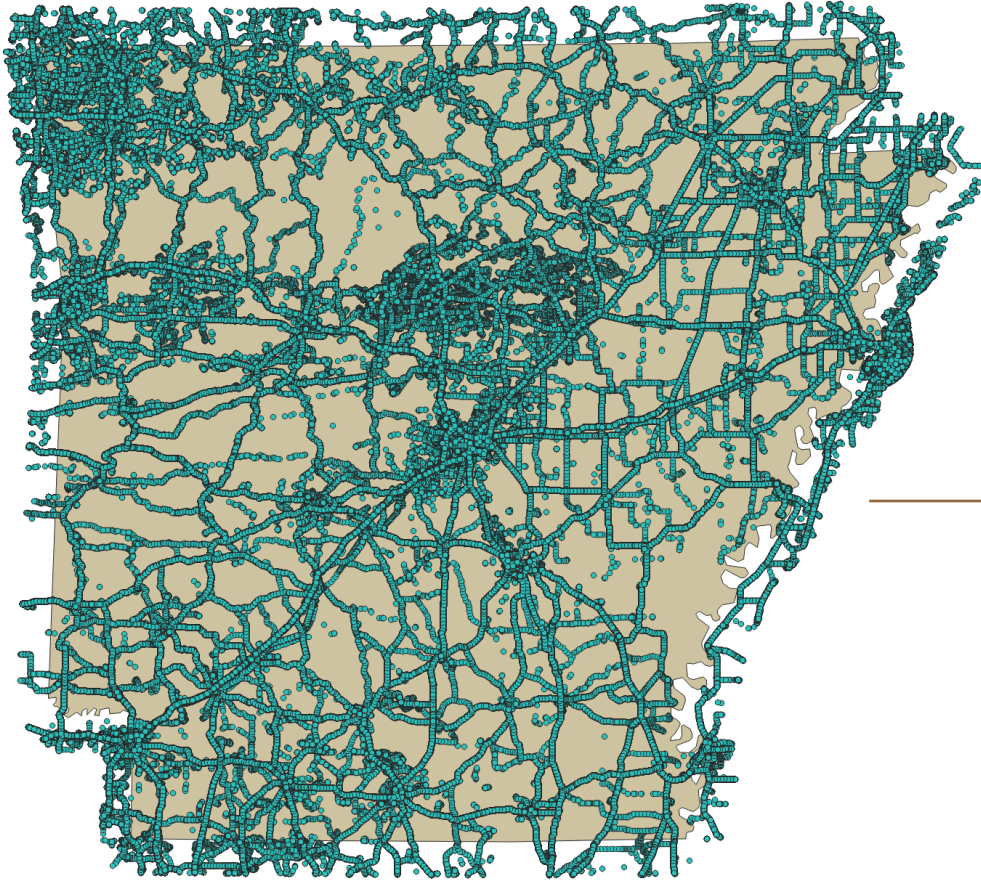
Sample

- Sample provided by the American Transportation Research Institute (ATRI)
- Over 35 million raw pings per week in Arkansas
- 10-15% coverage of truck traffic
- 2-week sample (in 2016)
 - February: 82,770 Trucks
 - May: 81,891 Trucks
 - August/September: 83,112 Trucks
 - November: 110,319 Trucks



Truck Volume from a Large GPS Data

Collected GPS Data



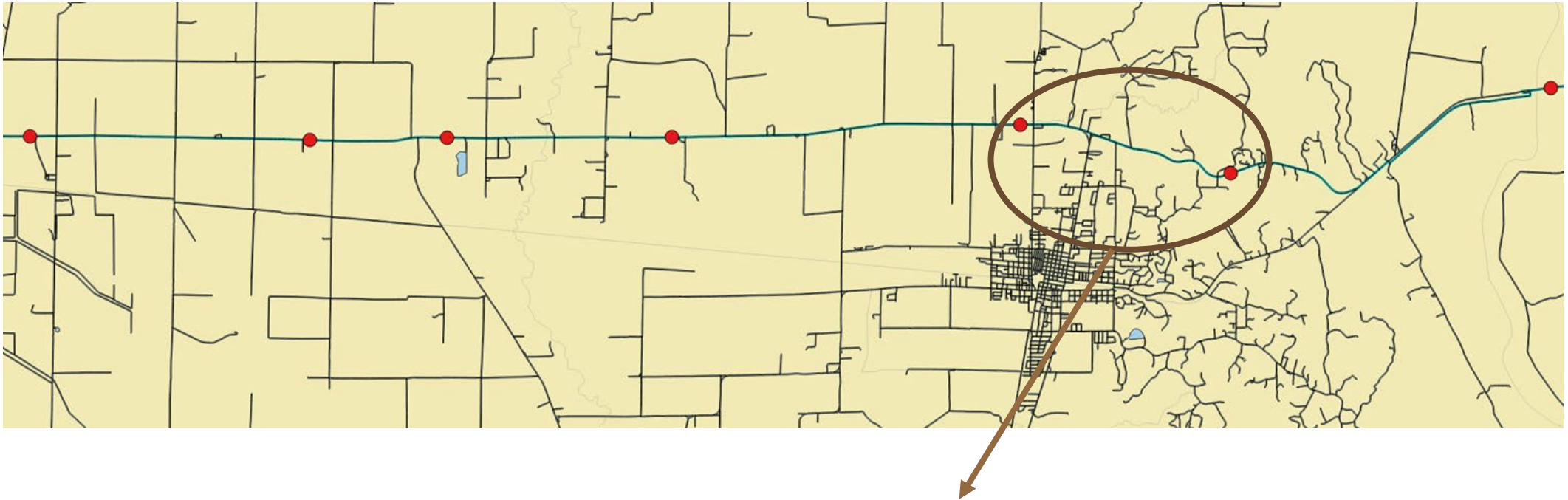
*National truck GPS sample
2 week period, 82,000 trucks*

Route Identification



*Complete, fully-connected links
comprising the truck path*

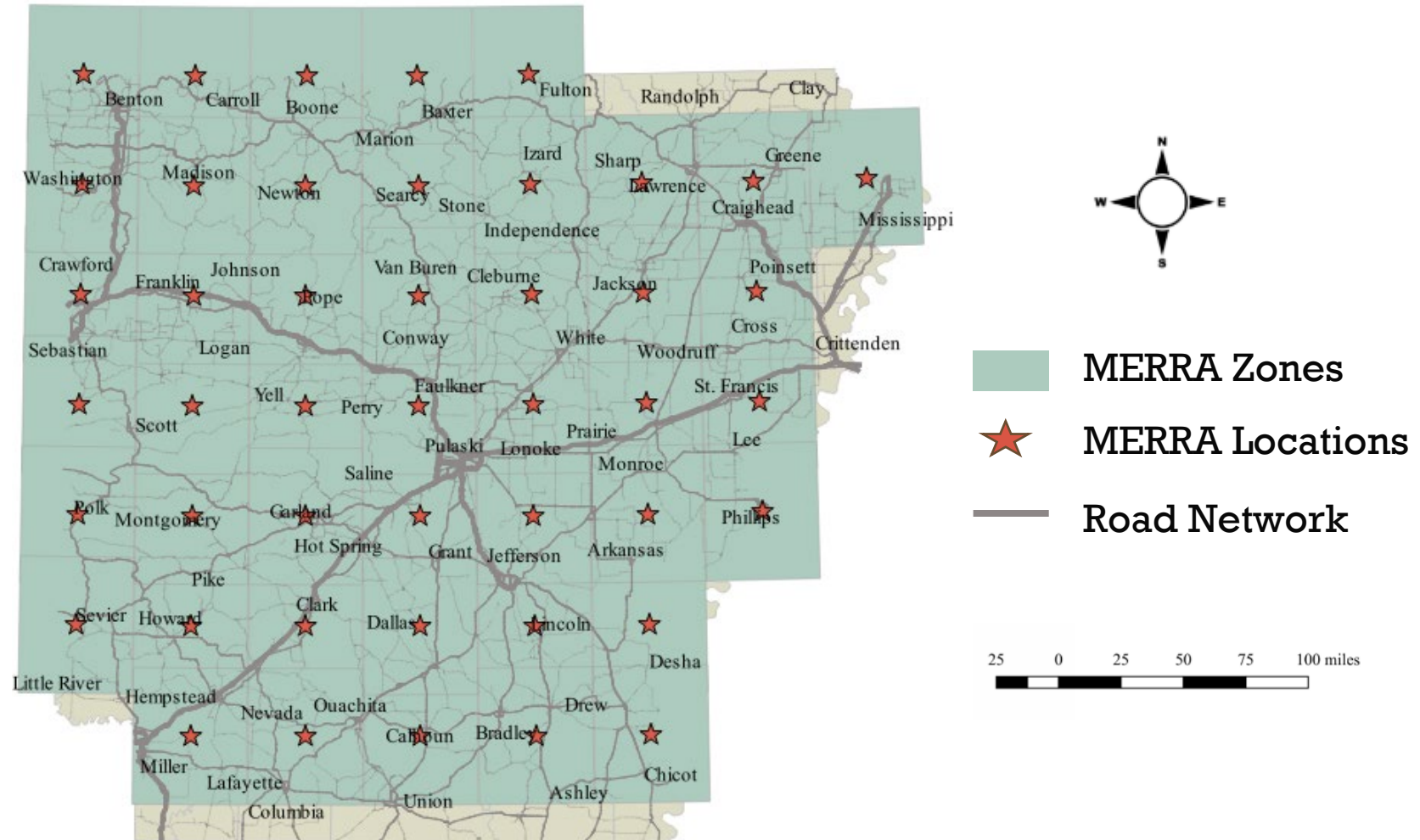
VMT and VHT on a Link



$\text{VMT} = \text{Daily Truck Volume} \times \text{Total Daily Trip Length (in miles)}$

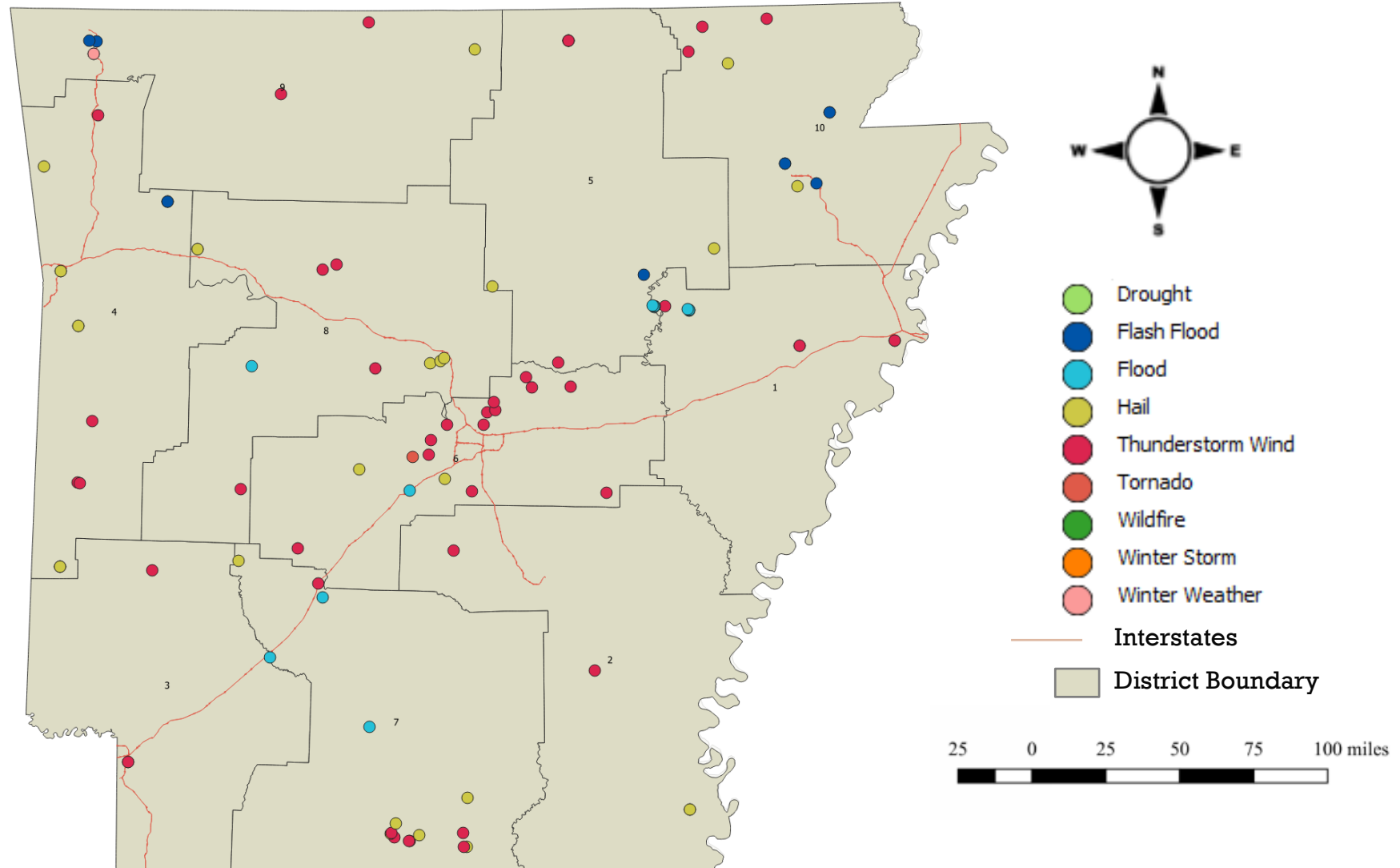
$\text{VHT} = \text{Daily Truck Volume} \times \text{Total Daily Trip Duration (in hours)}$

MERRA Locations in Arkansas



Source: Modern-Era Retrospective analysis for Research and Applications (MERRA), Long Term Pavement Performance (LTPP) InfoPave Climate Tool

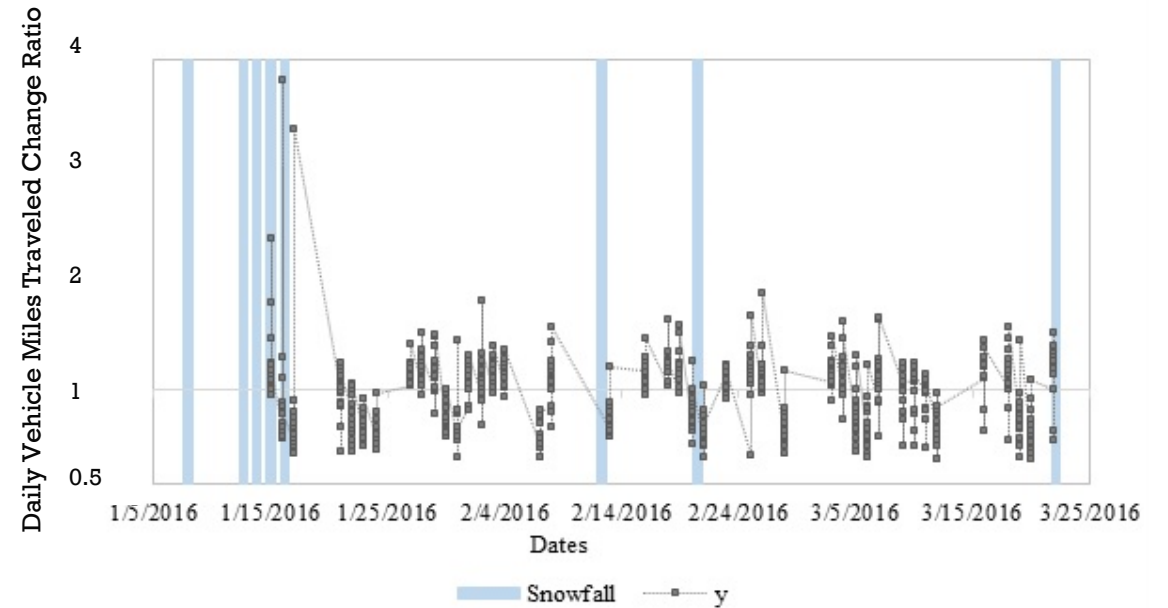
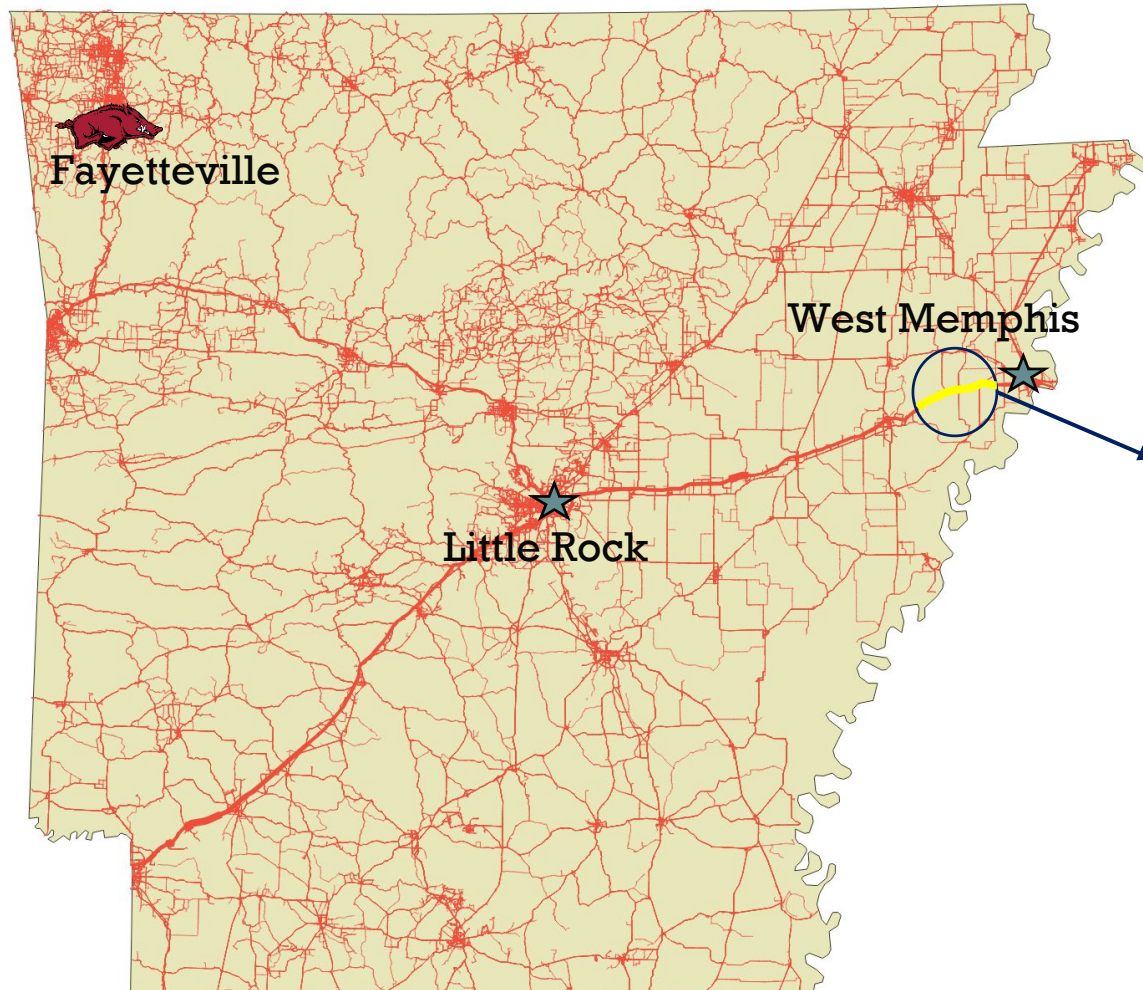
Extreme Weather Events in Arkansas



Results: Spatial Autoregressive Models- VMT

Independent Variables	Ordinary Least Square Regression (OLS)	Spatial Autoregressive Models (SAR)
Snowfall		-0.05***
Storm Events	-0.17***	-0.10***
Extreme Heat	-0.07***	-0.03***
Weekday	0.68***	0.29***
Spring	0.05***	0.02***
Summer	0.13***	0.04***
Fall	0.10***	0.03***
Constant	0.51***	0.14***
Spatial, rho (ρ)		0.72***
<i>R-squared:</i>	<i>0.54</i>	<i>0.54</i>
<i>AIC</i>	<i>829.5</i>	<i>214.6</i>

Applications of the Models



Discussion

These models can capture spatial effect of weather variables on truck volume.

Unlike static traffic data collection sites, like Weigh-In-Motion (WIM) or AADT, the use of GPS allows us to measure the changes in VMT/VHT at dispersed locations.

VMT/VHT better capture the effects of weather on rerouting or temporal delays to trips.

Future Work

Capture re-routing behaviors of trucks:

- Changes in VMT and VHT are not instantaneous, but delayed over time
- VMT and VHT are both spatially and temporally auto-correlated
- Develop Space-time lag model for trucks
- Using Delaunay triangle with origin-destination flows

Questions?

Thank You

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