

# Observing Road Weather Conditions Using Passenger Vehicles



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## Motivation



### Safety

Over 1,500,000 crashes occur each year during poor weather conditions, which result in more than 690,000 people injured and nearly 7,400 fatalities.\*

### Efficiency and Mobility

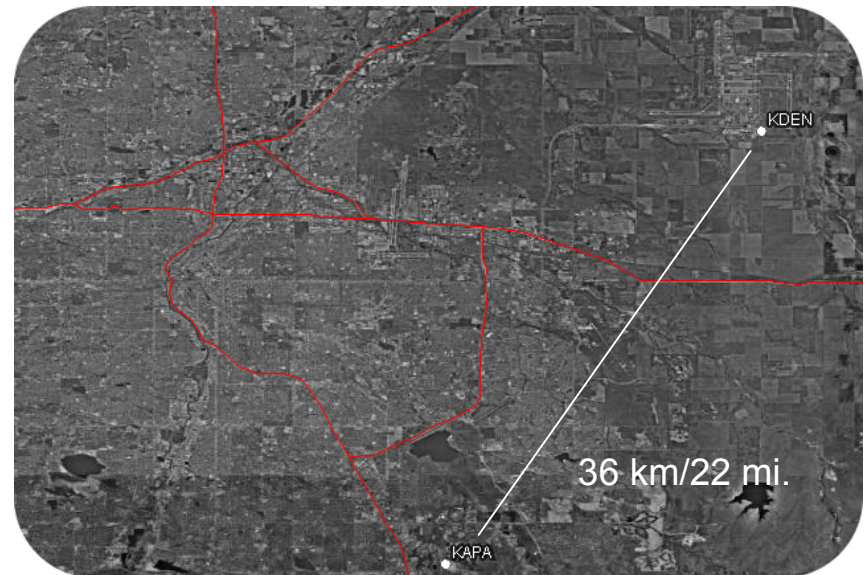
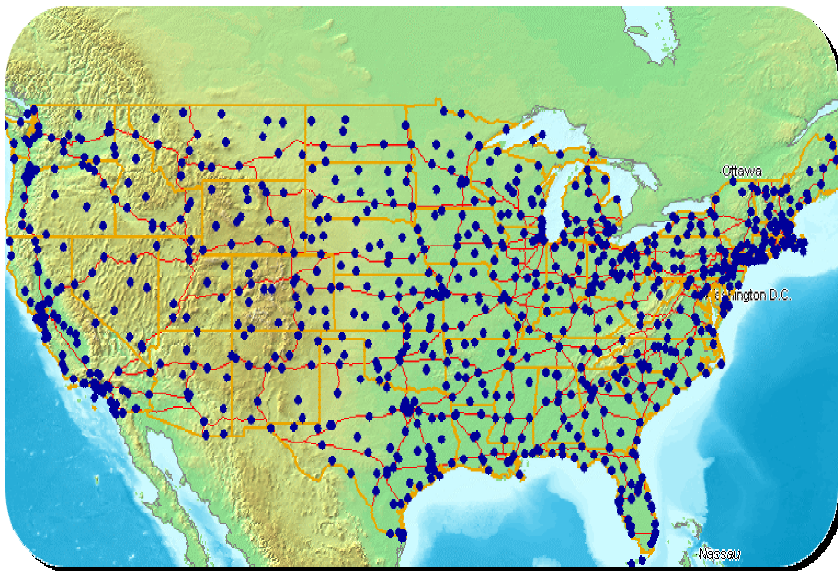
It is estimated that 554 million vehicle-hours of delay per year result from snow, ice, and fog.+



## Conventional Data

Need for increased spatial and temporal near-surface observations to support roadway operations

Automated Surface Observing Systems (ASOS) & Automated Weather Observing Systems (AWOS) have long served as the foundation for surface observations



Denver, Colorado



Roadway operations solution



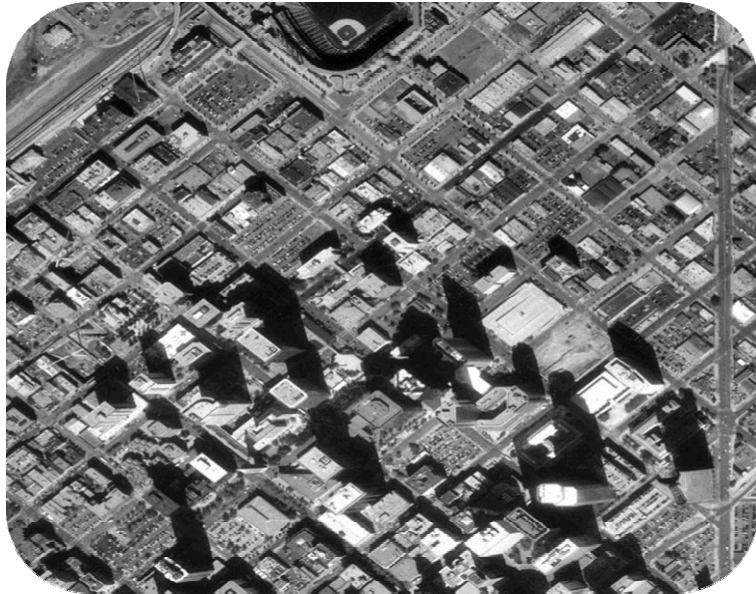
Deploy Road Weather Information System (RWIS)  
Environmental Sensor Stations (ESS)

- Atmospheric
- Road weather variables
- Localized conditions





## Needs and Requirements



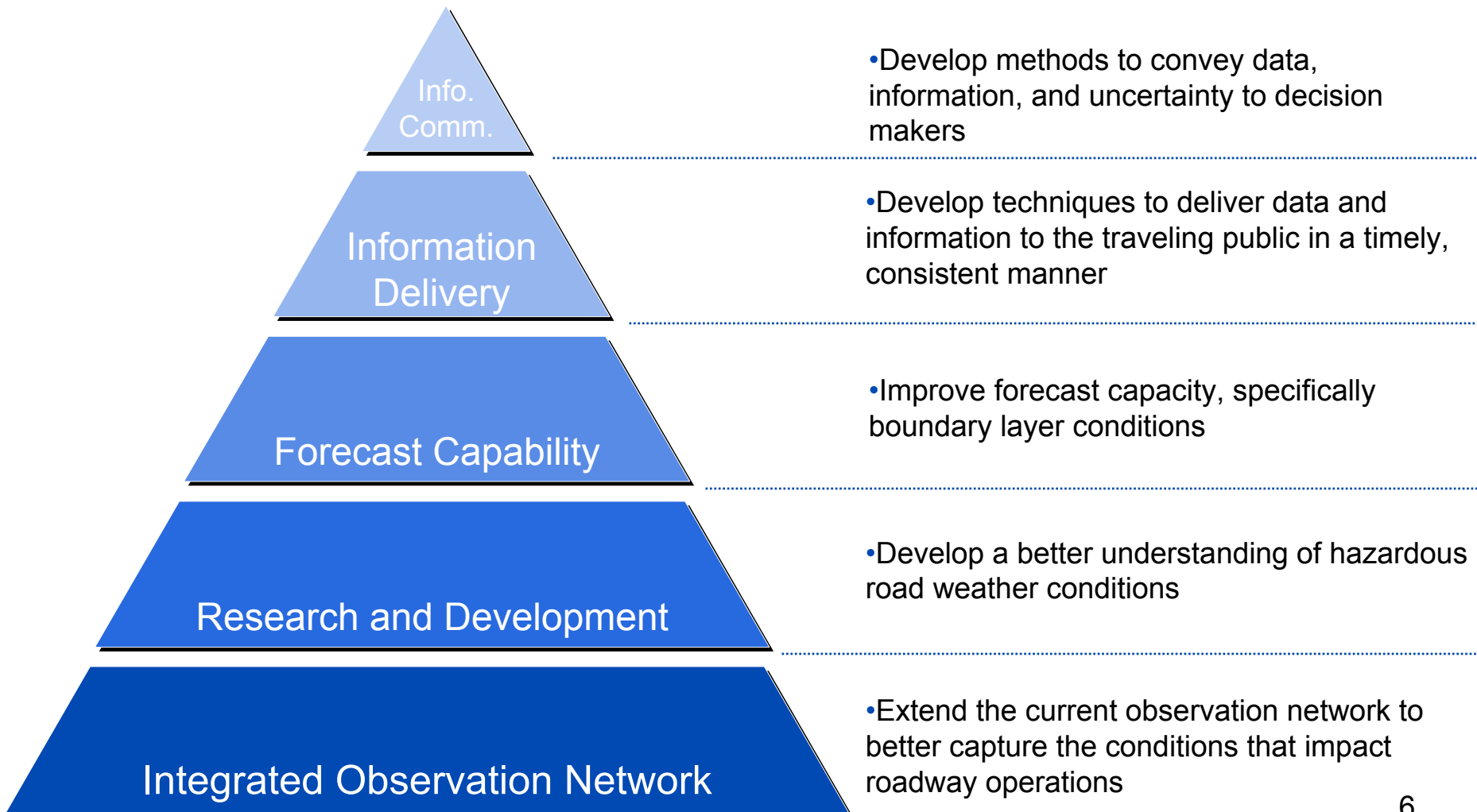
Denver, Colorado

### General road weather needs

- Need weather information on very small scales (city blocks/minutes)
- Measurements that address surface transportation needs & requirements

### Specific diagnostic and prognostic road weather needs

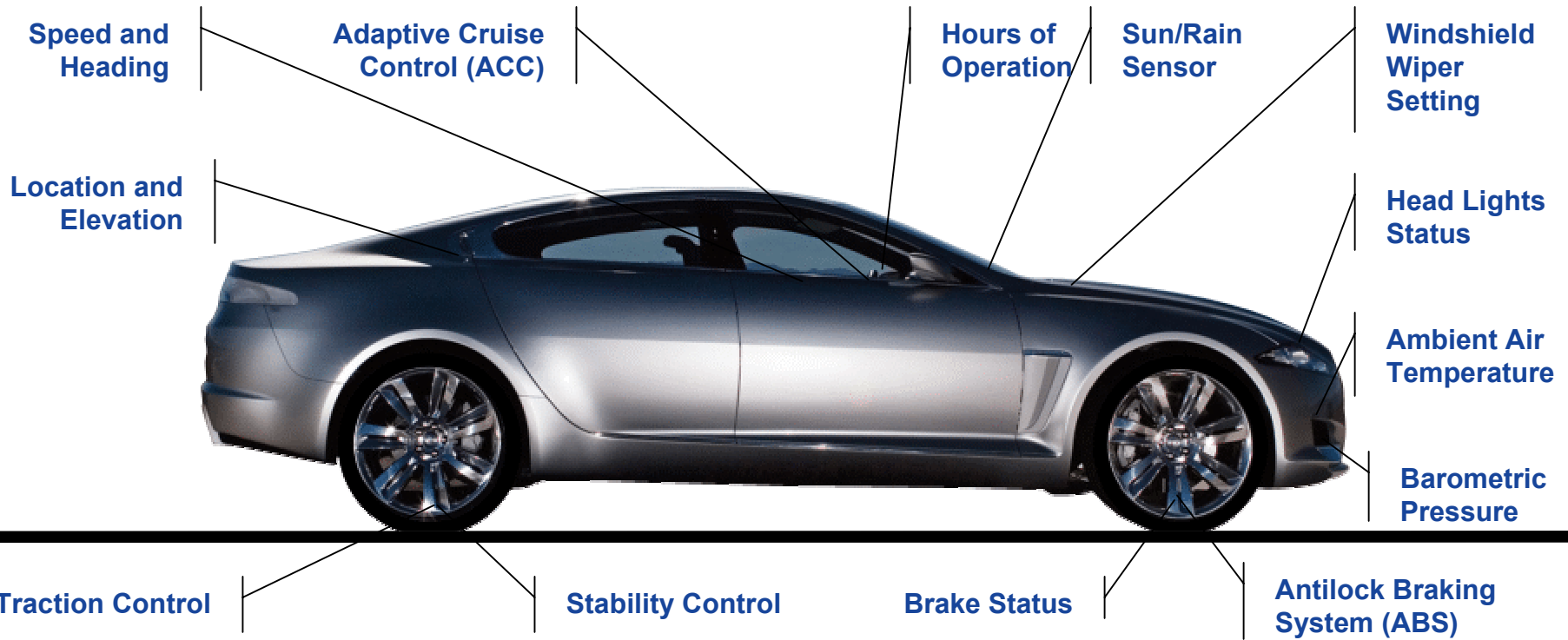
- Precipitation
  - Occurrence
  - Type
  - Amount
- Cloud cover/insolation
- Water vapor (fog, frost, etc.)
- Extreme events (heat, cold, wind, etc.)
- Pavement conditions (dry, wet, icy, etc.)





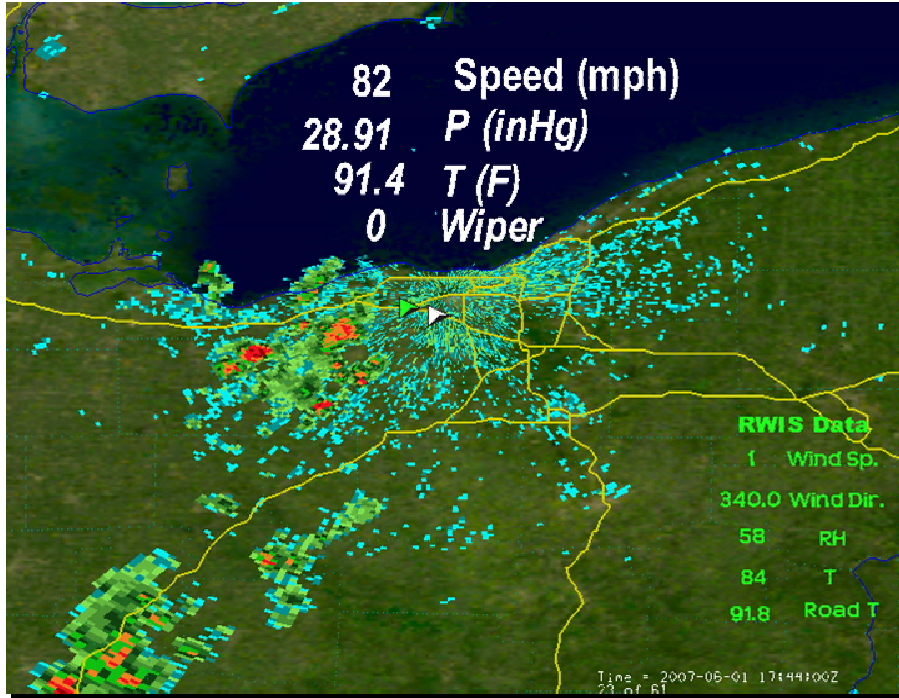
## Potential Solution

**USDOT DEFINITION:** Vehicle to Infrastructure (V-I) and Vehicle to Vehicle (V-V) communication (two-way) through Dedicated Short Range Communications (DSRC-wireless radio comm. 5.9 GHz)\*

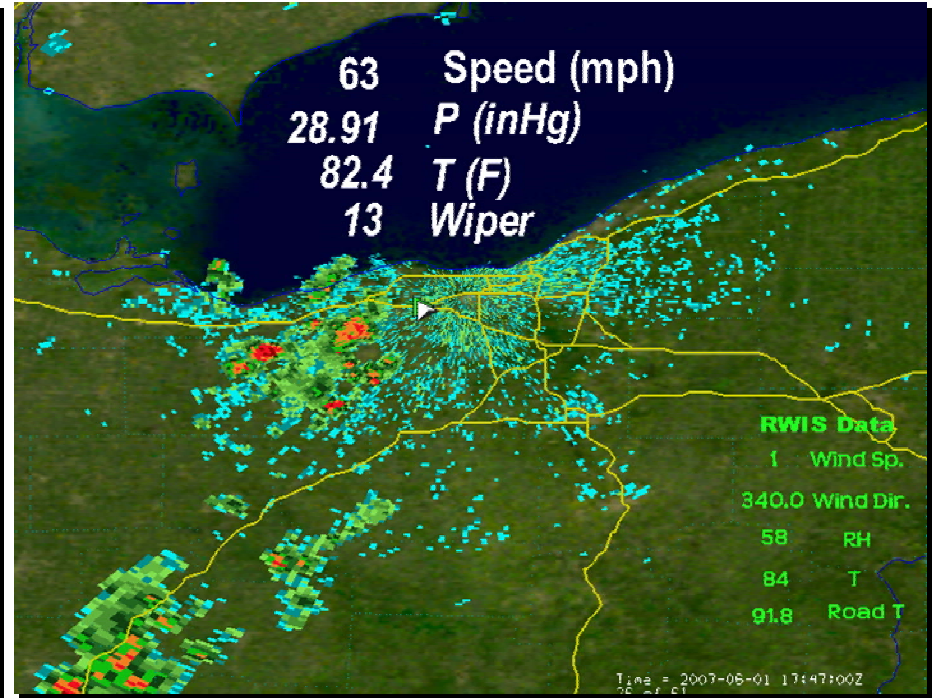




### Example Case



1 June 2007 17:44 UTC (1:00 PM)

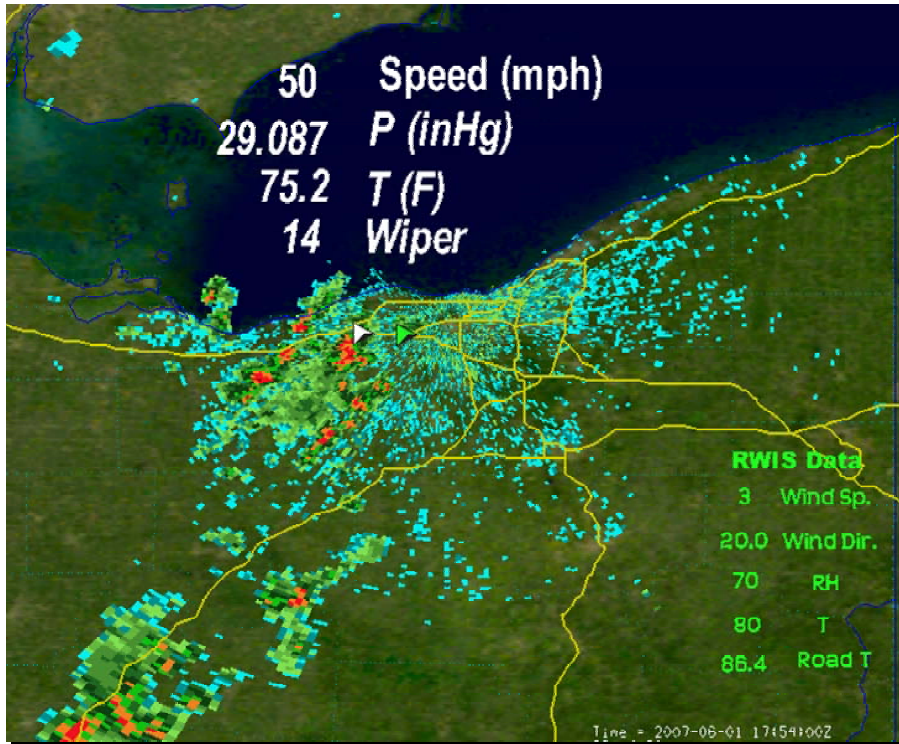


1 June 2007 17:47 (1:47 PM)

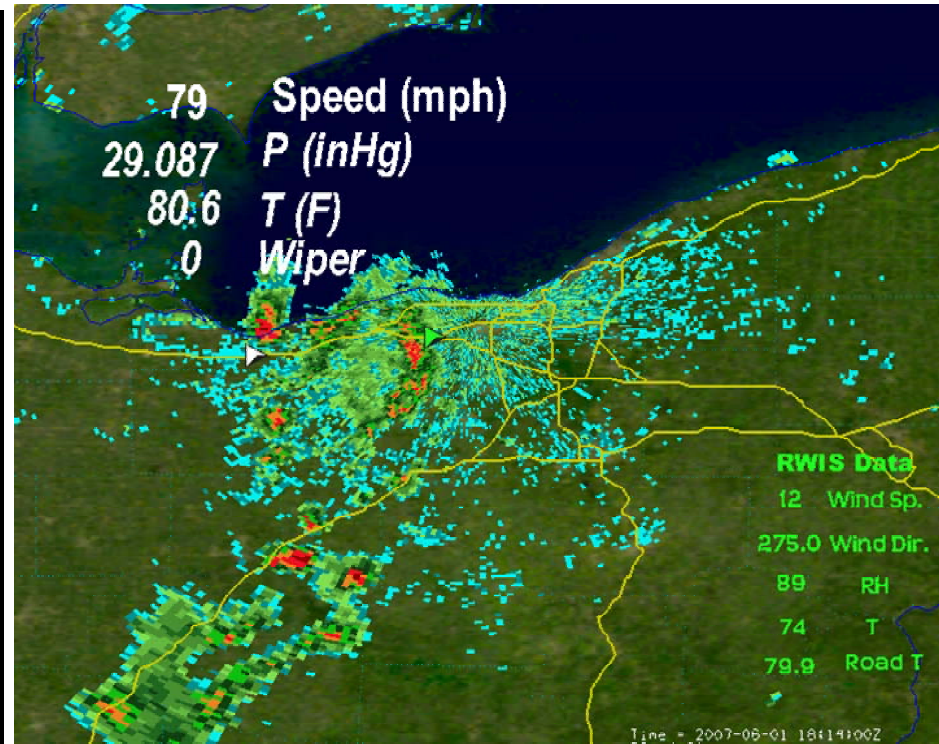




# Example Case



1 June 2007 17:54 UTC (1:54 PM)



1 June 2007 18:14 UTC (2:45 PM)



## VII-enabled Products and Apps.

### *Weather-Related Traffic Hazard Diagnosis*

- Precipitation (e.g., rain, snow, etc.)
- Dense Fog
- Smoke
- Pavement Conditions (e.g., wet, snow covered, etc.)
- Severe Thunderstorms
- Hail
- Flooding
- Blowing Snow/Ground blizzards

### *Numerical Model Initialization*

- Surface Pressure
- Air Temperature
- Relative Humidity
- Wind (speed and direction)
- Visibility
- Precipitation (occurrence, rate and type)

### *Miscellaneous Products and Applications*

- Input for Decision Support Systems
- Pavement Temperature Analysis
- Diagnosing Boundary Layer Water Vapor
- Improved Weather Characterization in Complex Terrain
- Identification of Radar Anomalous Propagation
- Identification of Virga
- Air Quality Monitoring

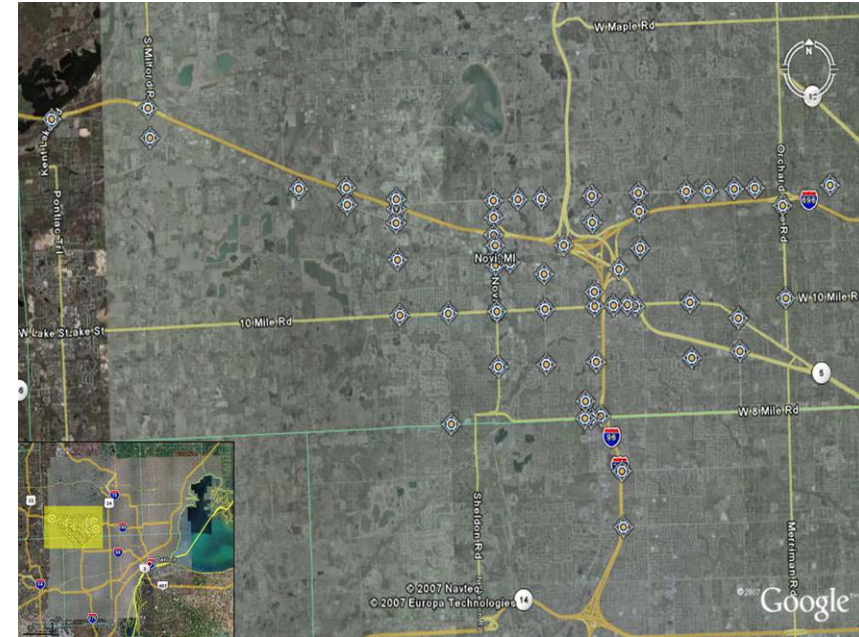


## Detroit, Michigan Proof of Concept (PoC)

- June 2008
- 57 Roadside Equipment (RSE) unit
- 25 well-equipped vehicles
- 6 week period

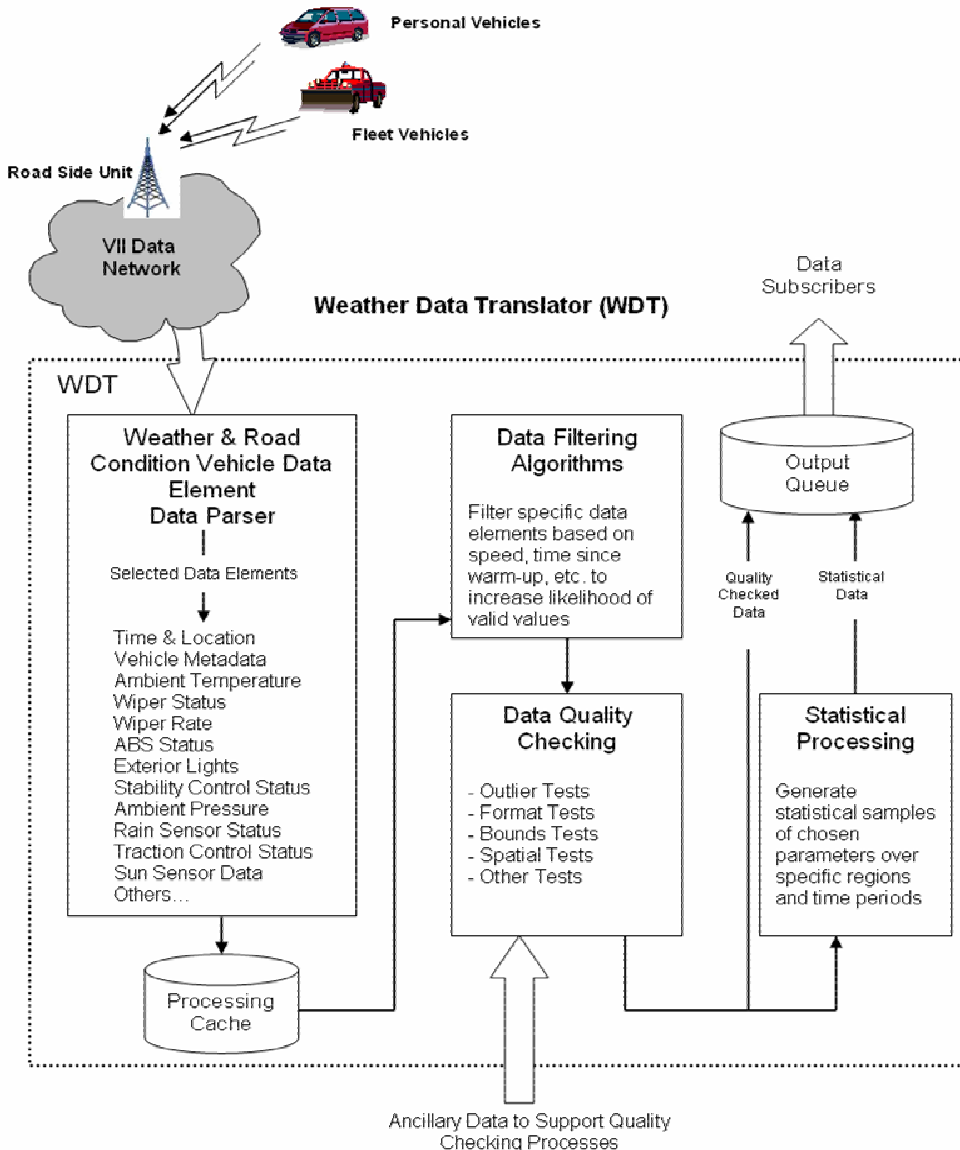
### Key PoC Data Elements

Barometric Pressure	Brake Status
External Air Temperature	Brake Boost
Date (Year, Month, Day)	Accelerometer (lateral, long.)
Time (Hour, Minute, Sec.)	Yaw Rate
Location (lat/lon)	Headlight Status
Elevation	Traction Control
Vehicle Heading	Stability Control
Vehicle Velocity	Wiper Status
Hours of Operation	ABS Status





## Weather Data Translator (WDT)



VII-enabled data are complex and pose a significant challenge, particularly when it comes to measuring or deriving weather and road condition data. Data issues include:

- Data volume
- Timeliness
- Quality
- Representativeness
- Format

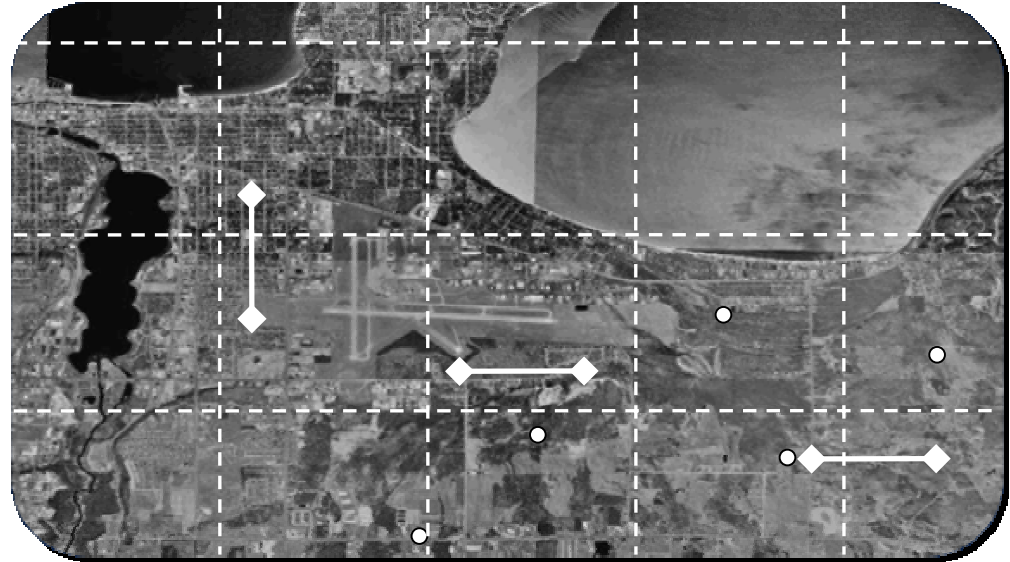


## Data processing for weather applications and products

- Points
- Road segments
- Grids or regions

## The use of ancillary data, as well as data fusion techniques, will be important

- ASOS/AWOS
- RWIS
- Radar
- Satellite
- Model analyses

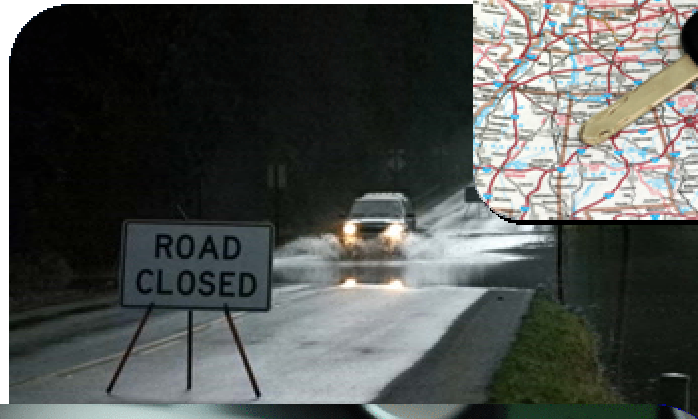


## VII-enabled Capabilities



VII enables tactical and strategic response to weather related surface transportation hazards.

New weather and road condition data (incl. VII and Clarus data) should be integrated into a seamless information database(s) to support:



- 511
- In-vehicle information
- Traveler information
- Highway operations
- Control systems
- Weather Prediction
- Road Condition Prediction
- Etc.





## Contact Information

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**Weather Applications and  
Products Enabled Through  
Vehicle Infrastructure Integration (VII)**

<http://ops.fhwa.dot.gov/publications/viirpt/index.htm#toc>

<http://www.ral.ucar.edu/projects/vii>

