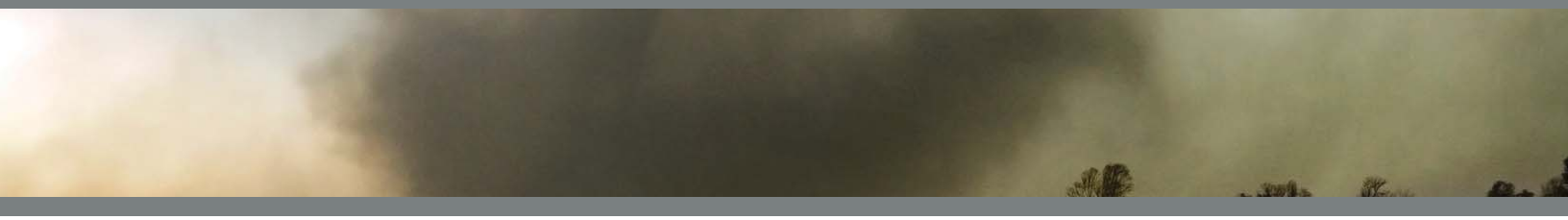
# Incorporating Weather Impacts in Traffic Estimation and Prediction Systems



The Federal Highway Administration (FHWA) Road Weather Management Program (RWMP) recently developed weather sensitive traffic analysis and prediction models, and incorporated them into an existing Traffic Estimation and Prediction System (TrEPS).

The project is a follow up to research conducted in 2006 on the impact of weather on traffic in three cities – Baltimore, Maryland; Minneapolis-St. Paul, Minnesota; and Seattle, Washington. The purpose was to develop, on a national scale, universally applicable tools to understand and mitigate the effects of weather on transportation systems.

***About 25 percent of all highway crashes and 18 percent of all fatalities are weather related. In addition to a tremendous impact on safety, adverse weather reduces service capacity, diminishes travel reliability, and impacts both supply and demand sides of transportation.***

Weather causes a variety of impacts on roadway transportation during and after weather events, which can be short- or long-term, and direct or indirect. The purpose of the analysis and prediction models is to help traffic operations managers respond to all adverse weather conditions by establishing linkages between inclement weather conditions and traffic flow.

*A snow storm can cause a major traffic jam as shown in the photo above. Photo courtesy of the Road Weather Management Program.*

## What is TrEPS?

TrEPS, Traffic Estimation and Prediction System, is a proactive decision support system tool that allows traffic managers and operators to evaluate and implement transportation advisory and control strategies based on prevailing traffic surveillance data.

TrEPS, which predicts where and when drivers are expected to travel, enables dynamic control and traffic management systems to anticipate problems before they occur, rather than simply reacting to them.

TrEPS relies on sophisticated models of traffic flow and driver behavior, coupled with powerful statistical techniques that combine actual sensor data with traffic simulation results.

## The Reasons to Incorporate Weather

Weather causes a variety of impacts on the transportation system. While severe winter storms, hurricanes, or floods can result in major stoppages or evacuations of transportation systems and cost millions of dollars, day-to-day weather events such as rain, fog, snow, and freezing rain can have a serious impact on the mobility and safety of the transportation system users.

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Effective traffic management requires an understanding of adverse weather which can be addressed by incorporating weather into transportation operations.

Prior to the RWMP project, existing TrEPS prototypes had only been calibrated and tested under "normal" weather conditions. No provision had been made to explicitly capture the behavioral phenomena that determine traffic patterns during adverse weather, predict how traffic might be impacted by such weather, and determine the effect of various advisory and regulatory interventions.

Even though there was a need for online estimation and prediction for unanticipated weather events, the current tools did not have the ability to represent traffic behavior under such conditions, or the possible interventions that would mitigate the impact.

## The DYNASMART System

Dynamic Network Assignment-Simulation Model for Advanced Road Telematics (DYNASMART), is a traffic assignment analysis tool that engineers and planners use to address complex transportation operations and planning issues, particularly in the ITS context.

DYNASMART can provide reliable estimates of network traffic conditions, predict network flow patterns and travel times under various traffic control measures and information dissemination strategies, and provide routing information to guide travelers.

*Photo courtesy of the Road Weather Management Program.*

DYNASMART fully integrates transportation management systems and advanced traveler information systems (ATIS), and provides guidance information and control actions under various operational conditions and deployment levels.

## New Weather Features

As a result of this project, The DYNASMART TrEPS can now capture the effects of adverse weather on traffic patterns through both supply and demand side modifications. New weather-related features in DYNASMART include the following:

***Weather Scenario Specification*** – DYNASMART allows users to specify various weather scenarios which can be represented as either a network-wide weather condition or a link to a – specific weather condition.

***Weather Adjustment Factor*** – Users can define the effect of weather on supply side traffic parameters such as free flow speed and capacity based on three weather parameters: visibility (mile), rain precipitation intensity (inch/hour), and snow precipitation intensity (inch/hour). DYNASMART applies user specified Weather Adjustment Factors (WAF), which can be based on the relationship between weather and traffic flow, to 18 supply side traffic properties for links within the impacted region. The result then simulates traffic under the specific weather conditions.

***Modeling Traffic Advisory and Control via Variable Message Signs (VMS)*** – DYNASMART provides three weather-related variable message signs (VMS), including a *Speed Reduction Warning* which indicates low visibility (e.g., fog) or slippery road (e.g., rain and snow); *Optional Detour* which suggests travelers re-evaluate their current route based on the delays caused by adverse weather; and *Variable Speed Limit (VSL),* where speed limits are posted for the prevailing weather conditions.

To view a copy of the full report, *Incorporating Weather Impacts in Traffic Estimation and Prediction Systems,* go to http://ntl.bts.gov/lib/31000/31400/31419/14497.htm.

*All photos courtesy of Road Weather Management Program*

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U.S. Department of Transportation
Federal Highway Administration

Publication #: FHWA-JPO-10-020
EDL #14525

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