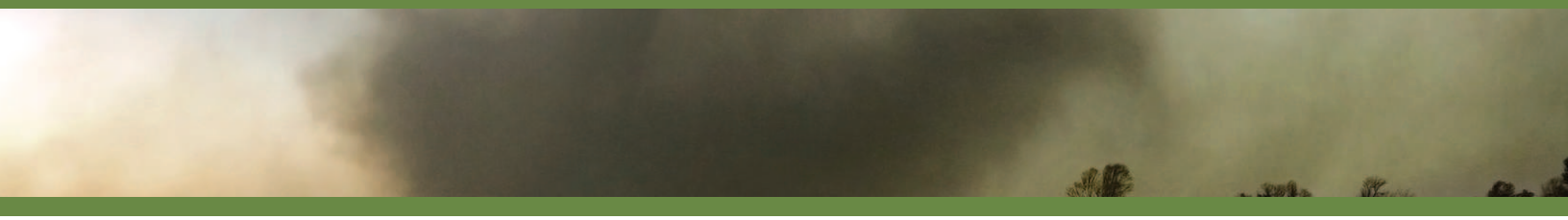
Enhanced Road Weather Forecasting

Clarus Regional Demonstrations



The quality of road weather forecasts has major impacts on users of surface transportation systems and managers of those systems. Improving the quality involves the ability to provide accurate, route-specific road weather information (e.g., timing and type of precipitation, pavement temperature, likelihood of blowing snow).

Enhancing road weather forecasting is part of the *Clarus* Initiative's regional demonstration projects where state and provincial departments of transportation provided ideas for five new potential uses for *Clarus* data. The *Clarus* Initiative, a joint effort of the U.S. Department of Transportation Intelligent Transportation Systems (ITS) Joint Program Office and FHWA's Road Weather Management Program (RWMP), is a six-year effort to develop and demonstrate an integrated weather observation data management system that can reduce the impact of adverse weather conditions on surface transportation.

In this use case, two teams explored the impact of *Clarus* observations on road weather forecasting. There was also an independent evaluation with results published in a separate document.

An example of enhancing road weather forecasting is captured by one of the teams in a three-step process, as shown in Figure 1. The process includes the following steps:

- Acquiring and validating *Clarus* System data using quality checks;
- Assimilating *Clarus* System ESS data with other available surface- and upper-level atmospheric data to provide a comprehensive, fine-scale analysis of road weather conditions; and
- Initializing and executing mesoscale and road weather prediction models.

Figure 1. Enhancing Road Weather Forecasting

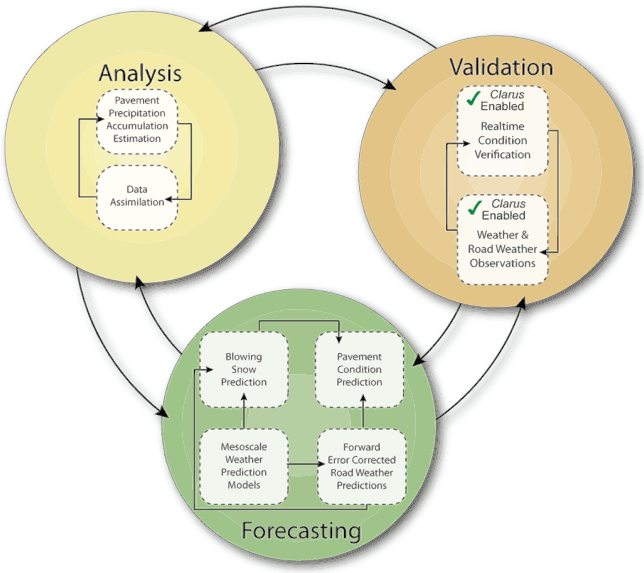


Figure courtesy of Meridian Environmental Technology

Highway transportation agencies are concerned about safety and mobility and a problem central to this mission is precipitation detection on road surfaces.

One potential solution is the aggregation of observed weather data in the Pavement Precipitation Accumulation Estimation System (PPAES). This is a unique blending of surface observations with remotely sensed data that fills the important gaps between pavement observations and permits a more realistic distribution of highway pavement conditions.

Further use of the analyses from the data assimilation can provide initialization of high-resolution weather prediction models and improvement in model initialization using a process of repeated cycling between the data assimilation and weather prediction processes.

During the regional demonstration, Environmental Sensor Stations-(ESS) enabled data assimilation produced high-resolution (i.e., 3 km grid spacing) model output from the Weather Research and Forecasting (WRF) mesoscale model. The enhanced road weather forecasts was then fed into user applications associated with seasonal weight restrictions, transportation department's decision support systems, and in enhanced road weather content for traveler advisories.

Figure 2 shows how using *Clarus*-enabled forecasts results in a multistate road condition prediction system and road weather forecasting decision support tools that permit quick visualization of the current and future road weather conditions through a visual display of *Clarus* data and *Clarus*-enabled products.

Forecasts generated by numerical weather prediction models rely heavily on the accurate and reliable observations of the current state of the atmosphere. If the initial conditions provided to these prediction models are unreliable and not quality controlled the result is likely a flawed forecast.

For meteorological observations on the ground today's operational weather models are largely dependent on Automated Surface Observation Stations (ASOS), which are chiefly located around airports.

While the use of ASOS observations is vital to these weather models, there is a need to add enhanced observations from other networks to better sample the conditions away from airports. This provides timely forecasts that are more accurate over broader regions.

The *Clarus* system (http://www.its.dot.gov/*clarus*/index.htm) is a broad network of automated weather and road surface observations that provide greater regional resolution of current weather conditions as well as better information on the weather affecting roadways. The observations from the automated stations in the *Clarus* network are comprehensively quality checked for a wide variety of situations. The inclusion of these data into operational weather models increases the accuracy and con-sistency of weather forecasts in general as well as weather that relates specifically to highways and roads.

Figure 2. *Clarus* Enhancements

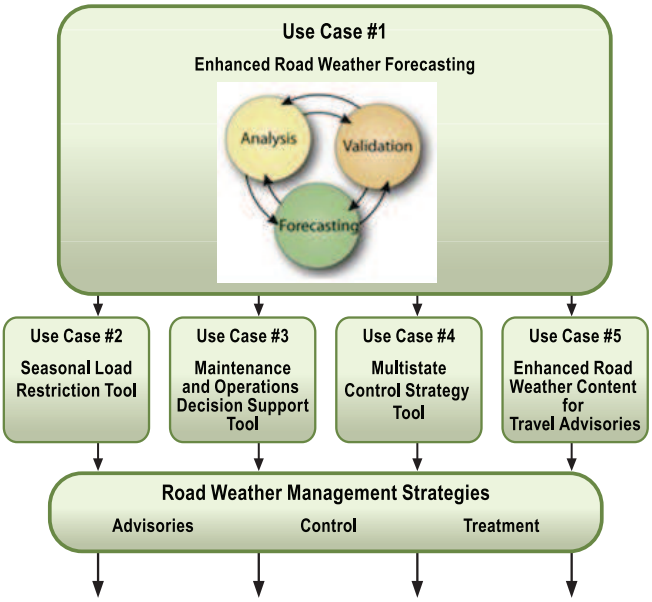


Figure courtesy of the FHWA Road Weather Management Program

The second team examined the impact of *Clarus* observations on five test cases:

Liquid precipitation – Test Case 1 examined whether *Clarus* data will help to better define the surface wind patterns along with locations of major storm components (fronts, surface low, etc.) which ideally will help to improve the precipitation forecast.

High winds – Test Case 2 determined whether *Clarus* data will help define the surface wind patterns and track the timing of a hurricane's passage.

Squall lines – Test Case 3 looked at whether *Clarus* data will help define the surface wind patterns, the availability of heat and moisture necessary for convection, and better track the timing of a cold front.

Cold case – Test Case 4 looked at the impact of *Clarus* data on improving the forecasting of the timing and intensity of a cold air mass.

Warm case – Test Case 5 determined whether *Clarus* data will increase the accuracy of both temperature and dew point temperature forecasts.

The study analyzed the results for forecasts of air temperature, dew point temperature, wind speed, and pavement temperature. The study found *Clarus* observations did not degrade the forecasts for all five cases for the four major weather variables and it significantly decreased the error in the first few hours. There were also decreases in errors for wind speed and a significant decrease in error for pavement temperature in the cold weather case. *Clarus* data also provided a practical improvement in forecast quality. This use case provided invaluable insights into the advantages and limitations of using *Clarus* observations in various weather and road weather models. The results will be invaluable for future research and development efforts.

All photos courtesy of the FHWA Road Weather Management Program.

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Federal Highway Administration
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"Anytime, Anywhere Road Weather Information"

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