Critical conditions

The weather plays a vital role in road safety and traffic management applications

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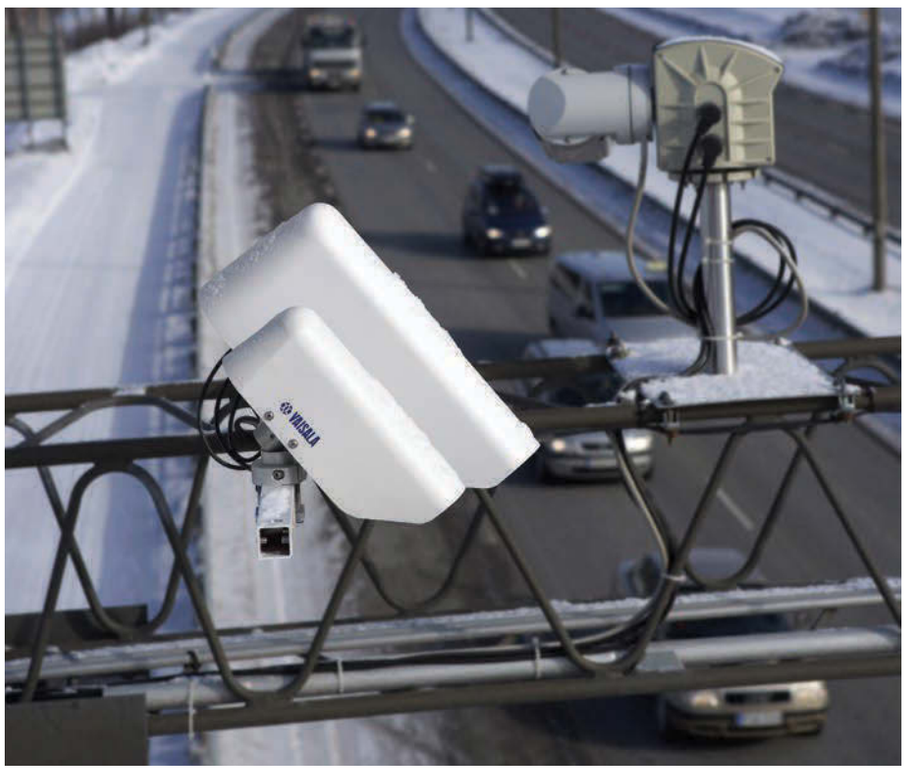
Despite weather being one of the biggest influences on road conditions, when most agencies and communities consider ways to improve traffic flow, it is almost never part of that discussion. Why? Does the problem seem too large? Does it seem like nothing can be done about it anyway? With the continuous improvement of short- and long-term weather forecasts, and the increasing coverage and accuracy of real-time weather information, we have tools to solve these challenges.

In addition, information is beginning to flow more freely from agencies to the traveling public. Just 10-15 years ago, agencies that had a network of road weather information systems (RWIS) shared the information only within their own organization, and certainly not very often with the general public. That mindset is changing, as more information, such as camera images, snowplow locations and traffic data, is made freely available – not to mention all the data streaming in the form of social media traveler applications.

Information is good, but information with no understanding is not. Sharing the amount of chemical on the road surface with motorists is probably not a good idea, as the general public would likely struggle to understand what that value even means. The key for road weather experts and agencies is how and what to tell drivers so that they can actually use the information to change their behavior. A key factor is making sure the information is accurate and frequently updated. It takes just one outdated or inaccurate piece of information for a user to lose faith in the information being provided.

Making information useful

Over the past 10 years, a new technology has emerged in the road weather industry, dramatically changing the provision of road weather information. The advent of non-intrusive, or remote, road weather sensors has created several possibilities. These sensors measure surface temperature and surface condition from the side of the road, similar to a non-intrusive traffic monitoring device.



The innovation is not just in the location of the sensor, but in what the sensor reports. Because the non-intrusive sensor uses laser technology to detect water, ice and snow on the surface, it can actually measure true road conditions. With this information, the surface-condition sensor is then able to calculate the coefficient of friction of the road surface with the water, ice or snow on it. This single value of grip provides a clear decision point on road condition, which has many applications. The coefficient of friction is a value that ranges from 0 to 1.0. A typical dry road surface reported by the Vaisala Road Surface Condition Sensor DSC111 reports the friction as 0.82. A wet road would be around 0.7, and a snow or ice-covered road could range from 0.4 to 0.6. The value is reported in real time and changes frequently depending on what the sensor sees on the surface of the road.

It is not recommended that agencies start providing this grip value to the traveling public because, as pointed out earlier, the level of understanding would not be high. However, translating the value into simple text or visuals would make sense and would be of real value to drivers. For example, providing color-coded roadway segments with road conditions, or activating local 'slippery road ahead' signs could prove very effective.

The friction value can also integrate with roadside ITS equipment, so local alerts and information can be provided direct to the motorist. In one example, the Colorado Department of Transportation had a particular area where snowmelt during the day was running across the highway in and out of the town of Aspen. Later in the day, as the highway was shadowed by a mountain, the runoff would refreeze. The site was prone to crashes from vehicles traveling at a typical dry-condition speed and entering the curve too fast for icy conditions. In fact, nearly all the crashes were when the weather was nice, because road conditions ahead of the

site were in good shape. When the entire highway was experiencing winter conditions, the site was no more prone to crashes than anywhere else.

Colorado installed Vaisala's DSC111 non-intrusive sensors along with variable message signs to warn motorists about the road conditions ahead. When certain thresholds of friction were reached, the signs would activate locally. The results from this system were positive and immediate. Crash rates before the system was implemented stood at approximately 15 per year. Afterward there were almost none.

Expanded possibilities

The grip value is also effective for water. At the 2014 US Federal Highway Administration Road Weather Management meeting, Oregon Department of Transportation (DOT) reported that it had a particular exit curve off the interstate highway that had a high rate of crashes. When it analyzed the weather present for each case, 81% of the crashes occurred when it was raining and only 1% occurred during snow and ice conditions. The DOT explained that Oregon was in the process of deploying a curve warning system to alert motorists about the slippery conditions before they enter the curve. Using friction values to activate slippery condition signs in real time, only when the condition is present, will have more impact than a static sign that motorists see every day. The value can also be used for a wide variety of ITS applications, such as automating the adjustments of traffic-signal timings during bad weather.

RWIS has been around for 40 years, but before non-intrusive sensors, solutions involved embedded sensors, which had to calculate or infer the road condition. This is not as accurate as non-intrusive sensors that can measure the road condition directly. Inaccurate messages to the public, or poorly functioning warning signs based on RWIS, create doubt, and thus are less effective. As has been shown, non-intrusive sensors are changing the way that roadway agencies communicate with motorists, and the possibilities will increase as the technology becomes more popular. ■

(Opposite) **Non-intrusive sensors in-situ in Colorado**
(Below) **Speed has a huge impact on braking distance in icy conditions**