Improving Surface Transportation Safety and Effectiveness through Modern Weather Technologies and Information

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ABSTRACT

Roadway safety and cost data estimate that approximately 7,346 fatalities per year, 713,537 injuries, $42 billion in economic costs, and over 544 million hours in delays can be attributed to weather-related accidents and weather events. Since the National Oceanic and Atmospheric Administration and the Federal Highway Administration released Weather Information for Surface Transportation: A National Needs Assessment Report, a great deal of progress has been made in bringing new weather products and services to the surface transportation community. Examples include new technology and information capabilities such as 511 systems; new forecasts and visualizations of weather’s impact on roadways in national and local media outlets and on the internet; increased surface weather research and development activities by federal and state government, universities, and others; and an increased congressional interest in surface transportation research and development. Additionally, a consensus has formed among the federal meteorological community’s leadership that an integrated approach is needed, supported by the surface transportation and meteorological stakeholders, to continue to improve weather information for surface transportation and effectively meet all surface transportation user needs. This paper describes such an integrated approach designed to support the weather information needs of the surface transportation community. It also provides examples of work already underway, and activities that the federal meteorological community is doing to develop a vision to guide an integrated federal surface transportation weather research and development program.

Key words: accidents—surface transportation weather research—weather safety
ORGANIZATION OF THE FEDERAL METEOROLOGICAL COMMUNITY

Office of the Federal Coordinator for Meteorological Services and Supporting Research Mission

The mission of the Office of the Federal Coordinator for Meteorological Services and Supporting Research (OFCM) is “to ensure the effective use of federal meteorological resources by leading the systematic coordination of operational weather requirements and services, and supporting research, among the federal agencies.” The key point is the focus on systematic coordination among the federal agencies and their stakeholders.

Federal Meteorological Coordinating Infrastructure

OFCM carries out its mission through the Federal Meteorological Coordinating Infrastructure, as depicted in Figure 1. Overall policy guidance is provided by the Federal Committee for Meteorological Services and Supporting Research (FCMSSR). Fifteen federal departments and agencies are currently engaged in meteorological activities and participate in the OFCM’s coordination and cooperation infrastructure. The OFCM carries out its tasks through an interagency staff working with representatives from the federal agencies who lead and serve on program councils, committees, working groups, and joint action groups. This infrastructure supports all federal agencies engaged in meteorological activities or that need meteorological services. OFCM assesses the adequacy of the total federal meteorology program, as well as reviews current and proposed programs, to identify opportunities for improved efficiency, reliability, and cost avoidance through coordinated actions and integrated programs. OFCM also provides analyses, summaries, and evaluations that provide a factual basis for the executive and legislative branches to make appropriate decisions related to the allocation of funds. In this regard, the OFCM recently made significant contributions to the interagency meteorology community in the areas of natural disaster reduction (hurricanes and post-storm data acquisition) and weather information for surface transportation.

Figure 1. Federal meteorological coordination infrastructure
Based on the OFCM-published *Weather Information for Surface Transportation: A National Needs Assessment Report* (2002), it became apparent to the federal meteorological community’s leadership that it needed to conduct an in-depth coordination and synchronization of all weather information for surface transportation (WIST) requirements, research and development (R and D) needs, and services. A Working Group for Weather Information for Surface Transportation (WG/WIST) was chartered and aligned under the Committee for Environmental Services, Operations, and Research Needs, within the Federal Meteorological Coordinating Infrastructure, to accomplish the WIST coordination and synchronization.

**IMPACT OF WEATHER ON SURFACE TRANSPORTATION SYSTEMS**

It is common knowledge that weather has a significant impact on the nation’s surface transportation systems. Looking at the roadway piece alone indicates that safety and cost data estimates caused by weather-related accidents and weather events are approximately 7,346 fatalities per year, 713,537 injuries, $42 billion in economic costs, and over 544 million hours in delays. Note that the approximately 7,000 deaths per year is an astounding number that has escaped the general public’s attention. Recently, U.S. Transportation Secretary Norman Mineta called the problem of highway traffic deaths a “national epidemic.” He went on to indicate that if Americans saw the number of highway traffic deaths as a disease, then they would demand a cure. The much-publicized Baltimore water taxi accident in March 2004 and the October 2004 severe weather event of a fast-moving line of late-afternoon thunderstorms plowing into Interstate 95 traffic north of Baltimore, which caused 11 separate accidents, sent about 50 people to hospitals, and caused widespread traffic disruption in the heavily traveled corridor, further highlight the devastating impact that weather can have on the nation’s surface transportation systems.

**INTEGRATED APPROACH TO MEET SURFACE TRANSPORTATION WIST USER NEEDS**

**Major Themes for an Integrated WIST Program**

A consensus has formed that there are at least four key components that an integrated WIST program should contain to achieve success in reducing the numbers of weather-related surface transportation deaths, injuries, and delays. Broadly, they are (1) data collection and analysis, (2) research and development, (3) transition R and D to operations, (4) and education and outreach. These themes are already being reflected in both the National Oceanic and Atmospheric Administration’s (NOAA) Surface Weather Program and the Federal Highway Administration’s (FHWA) Clarus Initiative.

*Data Collection and Analysis*

In the area of data collection and analysis, federal agencies need to buy and operate sensors that incorporate the latest available and tested technologies to ensure the highest data quality possible is achieved. An example is the FHWA’s multi-year Clarus Initiative, which is an initiative to develop and demonstrate an integrated surface transportation weather observing, forecasting, and data management system, and to establish a partnership to create a Nationwide Surface Transportation Weather Observing and Forecasting System.

Additionally, there is a need to obtain and include private-sector sensor data into the federal data base for everyone to use. Such real-time data is needed to support the national deployment of 511 capabilities and support such R and D prototype activities as wireless connectivity that allows vehicles to collect and share data to avoid congestion and potential weather-related accidents.
Another facet of data collection and analysis is the establishment of federal standards. There is a need to standardize surface weather observation formats, accuracy requirements, and data security operations, wherever possible, or to develop some kind of data conversion applications to ensure surface transportation users have the quality of data when and where they need it. Common technologies and standards for access to and assimilation of sensor/measurement data are needed to maximize the data available to all users.

Research and Development

Ongoing R and D efforts must be leveraged wherever possible, such as applying boundary layer and other R and D findings from the aviation weather R and D programs. Some examples can include the Integrated Terminal Weather System, which ties in terminal Doppler weather radar data, the convective weather forecast product, and the low-level wind shear alert system; turbulence measuring and prediction systems; marine stratus forecast system; and weather support to a deicing decision making system.

Unique surface transportation problems must also be solved as a part of a coordinated surface weather R and D program. A few examples are black ice on roadways; turbulent vortices; sun glint and glare; spatial distribution of pavement conditions (temperature, frost, etc.); rainfall spatial variability; and crosswind, headwind, and turbulence.

Moreover, coordination among the WIST R and D programs and weather providers must be expanded. There are good starting points on which to build: the FHWA, American Meteorological Society (AMS), and the Intelligent Transportation Society of America partnering efforts; the ongoing FHWA outreach efforts as they implement their Corporate Master Plan for Research and Deployment of Technology and Innovation; and the National Research Council’s Board on Atmospheric Sciences and Climate report, Where the Weather Meets the Road: A Research Agenda for Improving Road Weather Services, released in January 2004. All of these provide many ideas for a coordinated approach.

Formation of strategic partnerships is needed, such as the recently formed NOAA-FHWA collaboration and the NASA development of decision support system enhancement arrangements with other agencies.

Since 2002, several universities and agencies have worked to expand WIST R and D efforts. Such efforts must be encouraged by providing a clear federal vision for efforts to improve WIST information for surface transportation users. Some places where this kind of R and D and coursework are being offered are the University of North Dakota’s Surface Transportation Weather Research Center, formed in 2004; Iowa State University’s Center for Transportation Research and Education; Montana State University’s Western Transportation Institute; Virginia Tech’s Transportation Institute; and the University Corporation for Atmospheric Research, to name a few.

Transition R and D to Operations

Several activities related to transitioning R and D to operations should be pursued vigorously. First, advanced development or demonstration projects should be supported to facilitate and evaluate the transition of successful research results into operations. Examples of such projects include roadway weather information systems testing and development, the winter maintenance decision support system (MDSS), the development of 511 technologies and operational concepts, and the use of the nationwide differential global positioning system data to collect precipitable water vapor measurements.
Second, R and D findings (e.g., the improved assimilation of sensor/measurement data) need to be integrated into next-generation weather research and forecasting (WRF) models to provide better guidance/advisory products and data sets, and into other programs such as the FHWA’s Clarus project.

Meanwhile, many unmet WIST needs could be satisfied within five years through applied R and D of technology applications. One such area is the development of the national 511 system. The system has already received over 30 million calls since inception; it now averages just over 1.25 million calls a month. Over 20 states are involved, with 28% of the United States having access. A telling statistic comes from a 2004 Virginia survey of 511 users: 49% of those surveyed indicated they changed their travel plans due to information obtained from the Virginia 511 system. It would appear that progress is being made in reaching the surface transportation user and influencing their travel plans.

**Education and Outreach**

To facilitate continued education activities, national WIST priorities must be determined that help academic institutions determine coursework and degrees to offer in WIST-related areas. One example of such outreach taking shape is the FHWA’s Turner-Fairbank Highway Research Center’s collaboration with the George Mason University in Fairfax, Virginia, to educate future transportation engineers.

There also needs to be outreach to all stakeholders (including the media) on improvements in WIST services such as 511 capabilities; improved weather forecasts and warnings and how to get them; and increased access to real-time observation data, such as RWIS. Many steps have already been taken to accomplish these tasks, and there are new services and products already available. Many TV and radio stations are now providing weather forecasts focused on surface travel weather impacts, as well as possible airport delays. Additional services, such as the web-based Intellicast’s “Drivecast” and The Weather Channel’s “Interstate Forecast” are helping travelers more effectively plan their highway trips. There is also the beginning of efforts (e.g., by Verizon, Clear Channel) to bring increased media content to cell phones, such as TV broadcast information, which should eventually provide another method to supply surface transportation users with improved weather information access.

NOAA weather radio (NWR) broadcasts are also available in the cars of several automobile manufacturers (BMW, Mercedes, Range Rover, and Saab), which equip their cars with radios capable of receiving NWR broadcasts. Finally, where possible, with help from such partners as the AMS, the federal meteorological community needs to ensure that public versus private sector responsibilities are clearly understood.

**CONCLUSION**

Based on projections of U.S. population growth and the limited expansion of our highway system, the need for improved surface weather data, forecasts, integration, dissemination, and education is real and growing. Much is already being done to meet the surface transportation user community’s needs for weather information, as was outlined in the 2002 WIST report. However, to continue to move forward effectively, an integrated approach is needed to improve our weather information for surface transportation products and services that incorporates the ideas and capabilities of all the stakeholders and service providers. Through the WG/WIST, work is underway to develop that vision and approach, and it will take the input and support of the surface transportation and meteorology communities to achieve success.
REFERENCE