

# Best Practices for Road Weather Management

## Appendix C

### Publication Listing

TITLE	ABSTRACT	SOURCE
A BENEFIT/COST ANALYSIS OF INTELLIGENT TRANSPORTATION SYSTEM APPLICATIONS FOR WINTER MAINTENANCE	Washington State DOT assessed the benefits and costs of deploying an automated anti-icing system on a high-accident corridor.	Transportation Research Board 80th Annual Meeting, Search TRIS <a href="http://199.79.179.82/sundev/search.cfm">http://199.79.179.82/sundev/search.cfm</a>
A DECISION SUPPORT SYSTEM FOR SNOW EMERGENCY VEHICLE ROUTING: ALGORITHMS AND APPLICATION	Summarizes results of research to develop a decision support system to assist the Maryland State Highway Administration Office of Maintenance staff design snow emergency routes for Calvert County, MD and achieve improvements in service and savings in operational costs.	Transportation Research Board 80th Annual Meeting, Search TRIS <a href="http://199.79.179.82/sundev/search.cfm">http://199.79.179.82/sundev/search.cfm</a>
A GUIDE FOR SELECTING ANTI-ICING CHEMICALS, V1.0	The purpose of the guide is to specify the key performance measures that are required from an anti-icing chemical, and suggest ways of grading chemicals according to those performance measures. It also provides a method whereby an agency can weight these measures according to the specific needs of that agency.	<a href="http://www.anti-ice-guide.com">www.anti-ice-guide.com</a>
A LIFE CYCLE COST-BENEFIT MODEL FOR ROAD WEATHER INFORMATION SYSTEMS	Describes a decision tool supporting implementation of RWIS and quantification of costs and benefits.	Transportation Research Board 77th Annual Meeting, Search TRIS <a href="http://199.79.179.82/sundev/search.cfm">http://199.79.179.82/sundev/search.cfm</a>
A PORTABLE METHOD TO DETERMINE CHLORIDE CONCENTRATION ON ROADWAY PAVEMENTS	Studies have shown that the ability to measure the salt concentration on roadway surface would bring dramatic advances in the effective use of deicers. Concentration measurement devices currently in use are only for point measurement and are dangerous for field personnel because they require manual on-site measurement. A new portable concentration system developed in this project is mounted on a truck and enables safer and continuous measurement of salt concentration.	Transportation Research Board 81st Annual Meeting, Search TRIS <a href="http://199.79.179.82/sundev/search.cfm">http://199.79.179.82/sundev/search.cfm</a>
ADVANCED COLLISION WARNING SYSTEM FOR THE ROADVIEW SNOWPLOW DRIVER ASSISTANCE SYSTEM	Research program conducted in California and Arizona on Advanced Snowplow with a multi-lane, radar-based Advanced Collision Warning system and a magnetic Lateral Sensing System for use in low visibility conditions. A visual display provides two-dimensional driver assistance information.	7th World Congress on ITS, University of California - Davis.

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ADVANCED TRAVELER INFORMATION SERVICE (ATIS): WHAT DO ATIS CUSTOMERS WANT?	This is the second of two white papers written for the “ATIS Data Gap” workshop with the objective of providing insights from MMDI Customer Satisfaction ATIS evaluations and other USDOT-sponsored ATIS research. The paper synthesizes findings from research and evaluations dating back to 1996, including several field operational tests.	<a href="http://www.itsdocs.fhwa.dot.gov/\JPO DOCS\REPTS_TE/9H801!.PDF">www.itsdocs.fhwa.dot.gov/\JPO DOCS\REPTS_TE/9H801!.PDF</a>
ADVANCED VEHICLE CONTROL SYSTEMS (AVCS) FOR MAINTENANCE VEHICLE APPLICATIONS	Highway maintenance operations most suitable for the application of AVCS are snow removal and work zone following by a shadow vehicle. This study explores opportunities for AVCS-based snow removal and work zone following vehicles. A description of these operations, and their suitability for the application of AVCS is presented. Previous and on-going work related to vehicle automation for these operations is introduced, along with recommendations for the future, based on an assessment of technical feasibility of AVCS and the attitudes of the highway and airport maintenance communities towards this technology.	<a href="http://ahs.volpe.dot.gov/avcsdoc/p1report.pdf">http://ahs.volpe.dot.gov/avcsdoc/p1report.pdf</a>
ADVERSE WEATHER TRAFFIC SIGNAL TIMING	Study conducted for Minnesota DOT to determine the impact of bad weather on a coordinated signal system (three-mile section of Trunk Highway 36 with five signals) and to determine if it would be beneficial to develop timing plans to accommodate adverse weather conditions.	<a href="http://www.trafficware.com/documents/1999/00005.pdf">www.trafficware.com/documents/1999/00005.pdf</a>
AN ASSESSMENT OF SELECT METROPOLITAN WASHINGTON PUBLIC SAFETY AND TRANSPORTATION AGENCIES USER NEEDS	Study of integrated information projects within the transportation community nationwide.	<a href="http://www.capwinproject.com/extras/reports/user_needs_assessment.pdf">www.capwinproject.com/extras/reports/user_needs_assessment.pdf</a>
AN INDEPENDENT EVALUATION OF THE OK-FIRST DECISION-SUPPORT SYSTEM	The Oklahoma Climatological Survey (OCS) implemented a DSS known as Oklahoma's First-response Information Resource System using Telecommunications to provide public safety officials with customized, county-level environmental information within minutes of observation.	<a href="http://okfirst.ocs.ou.edu/press/prints/2envapps/1_11.pdf">http://okfirst.ocs.ou.edu/press/prints/2envapps/1_11.pdf</a>

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<p>AN INVESTIGATION OF INCIDENT FREQUENCY, DURATION AND LANES BLOCKAGE FOR DETERMINING TRAFFIC DELAY</p>	<p>Traffic delay caused by incidents is closely related to three variables: incident frequency, incident duration, and the number of lanes blocked by an incident. Relatively, incident duration has been more extensively studied than incident frequency and the number of blocked lanes. In this study, we provided an investigation of the influencing factors for all of these three variables based on an incident data set that was collected in New York City. The information about the incidents derived from the identification can be used by incident management agencies in New York City for strategic policy decision making and daily incident management and traffic operations. Rain is the only factor that significantly influenced incident frequency.</p>	<p>Transportation Research Board 81st Annual Meeting, Search TRIS <a href="http://199.79.179.82/sundev/search.cfm">http://199.79.179.82/sundev/search.cfm</a></p>
<p>ANALYZING THE EFFECTS OF WEB-BASED TRAFFIC INFORMATION AND WEATHER EVENTS IN THE SEATTLE PUGET SOUND REGION: DRAFT REPORT</p>	<p>Analysis of web-based ATIS usage logs against observed weather conditions, and generation of a new profile of ATIS market penetration. Simulation results were analyzed and compared to results from Mitretek's earlier MMDI study. Analysis showed that non-uniform ATIS utilization rate related to severe weather has a small positive impact on road system efficiency.</p>	<p>Mitretek Systems, ITS Division</p>
<p>ANOTHER STEP TOWARD A NATIONALLY INTEGRATED TRAVELER INFORMATION SYSTEM</p>	<p>Overview of traveler information including definition, explanation of growth, USDOT role and vision, and next steps.</p>	<p><a href="http://www.itsdocs.fhwa.dot.gov/jpodocs/periodic/8ph01!.htm">www.itsdocs.fhwa.dot.gov/jpodocs/periodic/8ph01!.htm</a></p>
<p>ANTI ICING SUCCESS FUELS EXPANSION OF THE PROGRAM IN IDAHO</p>	<p>Idaho Transportation Department anti-icing success story on section of US Highway 12.</p>	<p><a href="http://www.sicop.net/US-12%20Anti%20Icing%20Success.pdf">www.sicop.net/US-12%20Anti%20Icing%20Success.pdf</a></p>
<p>APPLICATION OF ADVANCED ITS INTERFACING THAT IMPROVES MAINTENANCE OPERATIONAL EFFECTIVENESS AND WINTER SAFETY IN RURAL AREAS</p>	<p>In 1995, the state DOT's of Iowa, Michigan, and Minnesota formed a consortium to define and develop the next-generation highway maintenance vehicle that would utilize the latest maintenance operational technologies and interface with Intelligent Transportation Systems. This advanced technology highway maintenance vehicle functions as both an operational truck and a mobile data-gathering platform. Sensors mounted on the vehicle record air and roadway surface temperature, roadway surface condition, and roadway surface friction characteristics.</p>	<p><a href="http://www.ctre.iastate.edu/pubs/midcon/front.pdf">http://www.ctre.iastate.edu/pubs/midcon/front.pdf</a></p>

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APPLICATION OF JETTING TECHNOLOGY TO PAVEMENT DEICING	Over 20 years ago, the Connecticut DOT investigated the use of pressurized salt brine jets to enhance the deicing performance. Despite promising results from several field trails, technical difficulties led to abandonment of this technology in the early 80's. Recent advances in high pressure jetting technology suggest that the use of high pressure jets in conjunction with improved chemical agents for pavement deicing may now be practical. In this study, the application of modern high pressure jetting technology as a means of pavement deicing is explored. The proposed system removes ice and snow through the combined action of mechanical jetting forces and controlled use of deicing chemicals.	Transportation Research Board 81st Annual Meeting, Search TRIS <a href="http://199.79.179.82/sundev/search.cfm">http://199.79.179.82/sundev/search.cfm</a>
APPLICATION OF ROAD WEATHER INFORMATION SYSTEMS IN THE WESTERN UNITED STATES	MesoWest software links weather observations from roughly 350 stations in the NWS surface aviation network and 2,100 additional stations, including RWIS stations. MesoWest collects and processes data from over 40 organizations. MesoWest data is available in Montana, Nevada, Utah and Wyoming through cooperative agreements between local NWS offices and state DOT agencies.	<a href="http://www.met.utah.edu/jhorel/html/mesonet/rwis.pdf">www.met.utah.edu/jhorel/html/mesonet/rwis.pdf</a>
APPLICATION OF THE ADVANCED TRAVELER INFORMATION SYSTEMS (ATIS) MESSAGE STANDARD	Mitretek demonstrated an information system that provides route-specific travel forecasts that contain weather, traffic, and road closure information using eXtensible Markup Language (XML). The demonstration used XML data sets from a DOT's web site containing manual weather observations and RWIS data, as well as data from a web-based Pavement Condition Reporting System (PCRS).	8th World Congress on ITS, Mitretek Systems ITS Division
APPLICATIONS OF INTELLIGENT TRANSPORTATION SYSTEMS FOR WINTER MAINTENANCE	This paper describes potential applications of ITS for winter maintenance and provides examples of case studies. Moreover, the paper identifies and discusses the institutional, technical and operational barriers to the implementation of advanced technologies for ice and snow removal.	Transportation Research Board 80th Annual Meeting, Search TRIS <a href="http://199.79.179.82/sundev/search.cfm">http://199.79.179.82/sundev/search.cfm</a>
ARE SIMPLISTIC WEATHER-RELATED MOTORIST WARNING SYSTEMS "ALL WET"?	On a two-lane exit ramp in Ft. Lauderdale, Florida; an automated motorist warning system (including a wet pavement sensor and vehicle detector) that activates flashing beacons atop static speed limit signs. Speed reductions and reduced crash frequency resulted.	7th World Congress on ITS, University of South Florida.
AVALANCHE HAZARD REDUCTION FOR TRANSPORTATION CORRIDORS USING REAL-TIME DETECTION AND ALARMS	Presents configurations of systems that detect and provide warning to motorists and highway maintainers of the onset of avalanching onto the roadway. Warnings include on-site traffic control signing and in-vehicle audio alarms for winter maintenance vehicles.	<a href="http://www.sicop.net/annals-paper%20total.pdf">www.sicop.net/annals-paper%20total.pdf</a>

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BENEFIT/COST STUDY OF RWIS AND ANTI-ICING TECHNOLOGIES	Report describes anti-icing and RWIS research and implementation efforts, and summarizes anti-icing technologies. Benefits and costs as reported in the literature and supplemented with interviews of highway professionals.	<a href="http://www.sicop.net/NCHRP20-7(117).pdf">www.sicop.net/NCHRP20-7(117).pdf</a>
BEST PRACTICES FOR ROAD WEATHER MANAGEMENT	Weather threatens surface transportation nationwide and impacts roadway mobility, safety, and productivity. There is a perception that traffic managers can do little about weather. However, three types of mitigation measures—control, treatment, and advisory strategies—may be employed in response to environmental threats and impacts. Best management practices include road weather and traffic surveillance to assess threats to transportation system performance, arterial and freeway management to regulate roadway capacity, as well as dissemination of advisory information to influence traveler decisions and driver behavior. These management practices are employed in response to various weather threats including low visibility, high winds, snow, rain, ice, flooding, tornadoes, hurricanes, and avalanches.	Mitretek Systems ITS Division
BEST PRACTICES OF OUTSOURCING WINTER MAINTENANCE SERVICES	Contract language and provisions being used by various owner-agencies in the public sector. Best practices include clear contractual language placing responsibility on private sector to develop, train and equip personnel; confine language to measurable outcome-based performance measures; connect producer-contractor to user-customer; producers proactively responding to RWIS-based predictions and encouraged to utilized anti-icing; seek the sharing of knowledge; and maximize opportunities for the private sector to be responsive, efficient and effective. Appendix D contains sample contract provisions.	<a href="http://www.vmsom.com/images/pdf/Best%20Practices%20Outsourcing%20Winter%20Maintenance%20Services.pdf">www.vmsom.com/images/pdf/Best%20Practices%20Outsourcing%20Winter%20Maintenance%20Services.pdf</a>
CLOSING THE DATA GAP: GUIDELINES FOR QUALITY ADVANCED TRAVELER INFORMATION SYSTEM (ATIS) DATA	ITS America's ATIS Committee developed guidelines to assist public agencies and private firms in generating and using data to support the expansion of ATIS products and services. The focus of these guidelines is limited to real-time or dynamic traffic-related information necessary to offer traveler information services envisioned in the near-term.	<a href="http://www.itsdocs.fhwa.dot.gov/jpodocs/rept_mis/13580.html">www.itsdocs.fhwa.dot.gov/jpodocs/rept_mis/13580.html</a>
CURRENT PRACTICES IN TRANSPORTATION MANAGEMENT DURING INCLEMENT WEATHER	Best practices include road weather and traffic surveillance to assess threats to transportation system performance, arterial and freeway management to regulate roadway capacity, as well as dissemination of advisory information to influence traveler decisions and driver behavior. These management practices are employed in response to various weather threats including low visibility, high winds, precipitation, hurricanes, flooding, and avalanches. Weather-related transportation management practices (1) improve mobility by increasing roadway capacity and promoting uniform traffic flow, (2) increase public safety by minimizing crash risk and exposure to hazards, as well as (3) enhance the safety and productivity of road maintenance personnel.	Institute of Transportation Engineers 2002 Annual Meeting, Mitretek Systems ITS Division

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DECISION SUPPORT SYSTEM FOR WINTER MAINTENANCE: FEASIBILITY DEMONSTRATION	This project reports on existing work in developing decision support tools to select chemical applications appropriate to winter weather conditions, to describe in detail those which are at or near an operational state, and to assess the feasibility of implementation as part of a RWIS. A literature review identified four DSS: an expert system development project by the Swedish National Road Administration (SNRA), a table-based menu for anti-icing developed by FHWA, a computerized adaptation of the FHWA menu, and an expert system development by Swedish Road and Transport Research Institute.	<a href="http://www.aurora-program.org/pdf/decision1and2.pdf">www.aurora-program.org/pdf/decision1and2.pdf</a>
DEVELOPING THE FRAMEWORK OF A DYNAMIC TRAFFIC MANAGEMENT MODEL FOR HURRICANE EVACUATION: SUMMARY REPORT	Paper describes the development of a dynamic hurricane evacuation modeling framework, which can be used for planning and operational purposes. See also TRAFFIC MODELING FRAMEWORK FOR HURRICANE EVACUATION.	Transportation Research Board 79th Annual Meeting, Search TRIS <a href="http://199.79.179.82/sundev/search.cfm">http://199.79.179.82/sundev/search.cfm</a>
DEVELOPMENT OF ROAD SURFACE CONDITION SENSOR USING OPTICAL TEMPERATURE SENSOR AND WEATHER SENSOR	System is comprised of optical fiber embedded in the road and a temperature distribution measurement apparatus to measure longitudinal temperature distribution, ESS, and a judgment apparatus that classifies road conditions into five categories based on the various measurement data.	8th World Congress on ITS, Ministry of Land Infrastructure and Transport, Japan
DEVELOPMENT OF ROAD TEMPERATURE SENSING SYSTEM USING OPTICAL FIBER	Road surface temperature distribution sensing using optical fiber sensor embedded in roadway and ESS data. Tests on two kilometer section of National Route No. 18 in Nagano Prefecture, Japan.	7th World Congress on ITS, Ministry of Construction, Japan
DOCUMENTATION AND ASSESSMENT OF MN/DOT GATE OPERATIONS	Study conducted from March to August 1999 to assess new operational procedure prohibiting access to Interstates during unsafe driving conditions using mainline and ramp gates. Benefits and costs data.	<a href="http://www.dot.state.mn.us/guidestar/pdf/gatereport.pdf">www.dot.state.mn.us/guidestar/pdf/gatereport.pdf</a>
DYNAMIC MESSAGING	The Enterprise program is multi-state pooled-fund study group with a focus on providing effective solutions for rural transportation applications. Enterprise, in cooperation with the Arizona DOT, is researching solutions for problems motorists face in limited visibility situations. Identifies components of low-visibility warning systems and the techniques deployed by various states that best address improving safety by detecting low visibility events and disseminating advanced information to motorists as well further evaluating low-visibility detection technologies during these conditions.	<a href="http://enterprise.prog.org/">http://enterprise.prog.org/</a>

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ECONOMIC EVALUATION OF ADVANCED WINTER HIGHWAY MAINTENANCE STRATEGIES	Estimated potential savings in labor and equipment costs of using pavement temperature data to customize material type and application rates.	<a href="http://www.ctre.iastate.edu/pubs/midcon/front.pdf">http://www.ctre.iastate.edu/pubs/midcon/front.pdf</a>
EFFECT OF ENVIRONMENTAL FACTORS ON FREE-FLOW SPEED	Use of Idaho Storm Warning System project data to determine the effects of various weather factors on free-flow speed during 1997/1998 and 1998/1999 winter.	<a href="http://www.nas.edu/trb/publications/ec018/10_25.pdf">http://www.nas.edu/trb/publications/ec018/10_25.pdf</a>
EFFECTS OF VARIABLE SPEED LIMIT SIGNS ON DRIVER BEHAVIOR DURING INCLEMENT WEATHER	On a two-mile test roadway in Salt Lake Valley, Utah; speed limits are varied based on visibility and traffic conditions using a weighted average algorithm and display via DMS. Reduction in speed deviation, reduction in crash frequency, and increase in overall mean speed resulted.	Institute of Transportation Engineers 2000 Annual Meeting, University of Utah
EFFECTS OF VARIOUS DEICING CHEMICALS ON PAVEMENT CONCRETE DETERIORATION	Study investigating the effects of different deicers on concrete deterioration. Deicers produce characteristic effects on concrete samples by physically and chemically altering the aggregate, the aggregate-past interface, and the cement paste.	<a href="http://www.ctre.iastate.edu/pubs/midcon/front.pdf">http://www.ctre.iastate.edu/pubs/midcon/front.pdf</a>
EFFICACY AND ECONOMIC EFFICIENCY FOR THAWING AGENTS SPRAY SYSTEMS - FINAL REPORT	With a length of 6 km, the thawing agents spray system used on the A45 (Sauerland line) is the longest installed in Germany. After the installation of this system, the number of crashes on the equipped road section and due to winter road conditions was reduced by more than 50%.	<a href="http://www.ops.fhwa.dot.gov/website/Publications/GermanAnti-icingReport.pdf">http://www.ops.fhwa.dot.gov/website/Publications/GermanAnti-icingReport.pdf</a>
ENHANCEMENTS TO THE VIRTUAL WEATHER STATION METHODOLOGY	Representative climatic conditions at any location can be estimated using data from nearby weather stations. The reasonableness of such estimates depends on the quality of weather data as well as method used in developing such estimates. This study investigates the possibility of improving the accuracy of climatic estimates. Four different methods of estimating the climatic parameters were studied and it was found that simple average of climatic parameters from nearby weather stations provides the most reasonable estimate. It was found that the elevation difference between the desired location and nearby weather stations significantly affects estimate bias. A relationship was developed to remove the bias due to elevation difference.	Transportation Research Board 81st Annual Meeting, Search TRIS <a href="http://199.79.179.82/sundev/search.cfm">http://199.79.179.82/sundev/search.cfm</a>
EVALUATION OF A FIXED ANTI-ICING SPRAY TECHNOLOGY (FAST) SYSTEM	This paper describes the development of Fixed Anti-Icing Spray Technology (FAST) systems to apply less corrosive liquid chemical freezing-point depressants on portions of the Brooklyn Bridge. During the first phase of the project, several operational parameters were investigated, including spray pattern, spray angle and spray pressure. Phase II of this project describes the proposed extension of the FAST system and integration of a RWIS.	Transportation Research Board 81st Annual Meeting, Search TRIS <a href="http://199.79.179.82/sundev/search.cfm">http://199.79.179.82/sundev/search.cfm</a>

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EVALUATION OF CALTRANS DISTRICT 10 AUTOMATED WARNING SYSTEM: YEAR TWO PROGRESS REPORT	The Caltrans Automated Warning System (CAWS) entered service in November 1996. The system includes 36 speed monitoring sites, 9 weather stations, 9 DMS and TMC computer systems. Researchers at the University of California carried out the independent evaluation. The report bibliography includes summaries of all highway fog warning systems for which published information was available.	<a href="http://www.path.berkeley.edu/PATH/Publications/PDF/PRR/99/PRR-99-28.pdf">http://www.path.berkeley.edu/PATH/Publications/PDF/PRR/99/PRR-99-28.pdf</a>
EVALUATION OF MOTORISTS WARNING SYSTEMS FOR FOG-RELATED INCIDENTS IN THE TAMPA BAY AREA	Investigation to determine extent of fog patterns and fog-related incidents in the Tampa Bay area, and suitable countermeasures to detect and warn motorists of fog conditions. Fog warning systems in Alabama, Arkansas, Georgia, New Mexico, Tennessee, Idaho, New Jersey, South Carolina, Louisiana, Oregon, Utah and California are discussed. Types of fog, conditions conducive to formation, and visibility detection technologies are also covered.	<a href="http://www.cutr.eng.usf.edu/research/fog.pdf">www.cutr.eng.usf.edu/research/fog.pdf</a>
EVALUATION OF THE FORETELL CONSORTIUM OPERATIONAL TEST: WEATHER INFORMATION FOR SURFACE TRANSPORTATION	Defines strategy for conducting an independent evaluation of the FORETELL project, a regional road and weather forecasting/dissemination system in Iowa, Wisconsin, and Missouri.	<a href="http://www.itsdocs.fhwa.dot.gov/jpodocs/repts_te/7tr01!.pdf">http://www.itsdocs.fhwa.dot.gov/jpodocs/repts_te/7tr01!.pdf</a>
EVALUATION OF THE OPERATION AND DEMONSTRATION TEST OF SHORT-RANGE WEATHER FORECASTING DECISION SUPPORT WITHIN AN ADVANCED RURAL TRAVELER INFORMATION SYSTEM	The Advanced Rural Traveler Information System (ARTIS) aims to provide en-route, operational decision support information including real-time and forecast weather conditions in rural areas. A three-year operational test was designed to measure user acceptance, use of the system for decision making, and use of weather-related data for maintenance operations.	<a href="http://www.itsdocs.fhwa.dot.gov/jpodocs/repts_te/@9301!.pdf">www.itsdocs.fhwa.dot.gov/jpodocs/repts_te/@9301!.pdf</a>
EVALUATION OF THE SEATTLE SMART TREK MODEL DEPLOYMENT INITIATIVE	Evaluation focused on institutional benefits, ATIS customer satisfaction, and ITS integration modeling. The impact of weather events was evident in the December 1998 web site usage levels.	Science Applications International Corporation (SAIC)
EVALUATION REPORT FOR THE EVACUATION TRAVEL DEMAND FORECASTING MODEL: DRAFT	The TDFM is a web-based software tool designed to predict congestion levels on major evacuation routes and predict state-to-state traffic volumes to aid in effective hurricane evacuation planning. Evaluation of the model was based on performance during a tabletop exercise.	Science Applications International Corporation (SAIC)

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EXTRACTION OF THE SLIPPERINESS COMPONENT FROM WEATHER AND TRAFFIC DATA FOR WINTER MAINTENANCE OPERATIONS	While traffic and weather information systems provide the current status of air and road surface temperatures, what many drivers really want to know is not the temperature but the degree of slipperiness. Although the friction coefficient is the best index for snow and ice maintenance operations, it is not so easy to manipulate. Some weather condition data are closely correlated with this friction coefficient. In this study, the substitutability of weather and traffic data is examined quantitatively through analysis of field data observed at an intersection.	Transportation Research Board 81st Annual Meeting, Search TRIS <a href="http://199.79.179.82/sundev/search.cfm">http://199.79.179.82/sundev/search.cfm</a>
FLOOD WARNINGS ON-LINE	In Queensland, Australia; remote sensors are used to monitor creek and river water levels to warn motorists. The Queensland Department of Main Roads and the Royal Automobile Club of Queensland (RACQ) provide road condition information via web page ( <a href="http://www.racq.com.au/journey">www.racq.com.au/journey</a> ) and toll-free telephone system with interactive voice response (IVR) technology.	ITS International, March/April Issue
FRICTION AS A TOOL FOR WINTER MAINTENANCE	Considers how friction measuring devices might be used operationally. They will likely be used as a measure of quality, as a source of traveler information, and as a means of controlling chemical application.	<a href="http://www.ctre.iastate.edu/pubs/crossroads/86friction.pdf">http://www.ctre.iastate.edu/pubs/crossroads/86friction.pdf</a>
GETTING CLEAR ON FOG-RELATED CRASHES IN TAMPA BAY	Paper discusses a four-step process employed to evaluate advanced fog-detection technologies and suggest possible strategies to address fog-related incidents in the Tampa Bay Area. See also EVALUATION OF MOTORISTS WARNING SYSTEMS FOR FOG-RELATED INCIDENTS IN THE TAMPA BAY AREA.	<a href="http://www.path.berkeley.edu/~leap/it_sdecision_resources/articles/S_i_te_0200_fog_warning.pdf">www.path.berkeley.edu/~leap/it_sdecision_resources/articles/S_i_te_0200_fog_warning.pdf</a>
HAPPY MOTORING ON SAFER INTERSTATE HIGHWAY: HIGH-TECH FOG WARNING SYSTEM DEVELOPED AT GEORGIA TECH WILL ISSUE ADVISORIES TO MOTORISTS	An automated fog and smoke warning system will be deployed on 14 miles of Interstate 75 near Adel, Georgia. The system includes 19 fog sensors, ESS, speed detectors and CCTV. System software at GDOT's Atlanta TMC analyzes field data and decides which messages to display on four DMS and when to illuminate streetlights. A three-year evaluation is being planned.	<a href="http://gtresearchnews.gatech.edu/reshor/rh-ss01/fog.html">http://gtresearchnews.gatech.edu/reshor/rh-ss01/fog.html</a>
HIGHWAY DEICING: COMPARING SALT AND CALCIUM MAGNESIUM ACETATE (SPECIAL REPORT 235)	Deicing chemicals are important tools for highway snow and ice control. The National Research Council conducted a study to examine the full economic costs of using salt and CMA for highway deicing. The report defines the true cost of salt; estimates of monetary costs involved in mitigating environmental damage from road salt; summaries of the field performance, infrastructure and environmental impacts, production technologies and costs of CMA.	<a href="http://gulliver.trb.org/publications/sr/sr235.html">http://gulliver.trb.org/publications/sr/sr235.html</a>

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I-35W & MISSISSIPPI RIVER BRIDGE ANTI-ICING PROJECT: OPERATIONAL EVALUATION REPORT	A bridge that spans the Mississippi River on US Interstate 35W in Minneapolis, Minnesota has been fitted with a computerized system that sprays potassium acetate, an anti-icing chemical, on the bridge deck when data from environmental sensors indicate that hazardous winter driving conditions are imminent.	<a href="http://www.dot.state.mn.us/metro/maintenance/Anti-icing%20evaluation.pdf">http://www.dot.state.mn.us/metro/maintenance/Anti-icing%20evaluation.pdf</a>
IDAHO STORM WARNING SYSTEM OPERATIONAL TEST	Two phased test conducted on I-84 in southeastern Idaho between 1998 and 1993 to (1) determine accuracy of visibility sensors and (2) whether DMS reduce vehicle speed during low visibility conditions.	<a href="http://www.itsdocs.fhwa.dot.gov/jpodocs/repts_te/@cc01!.pdf">http://www.itsdocs.fhwa.dot.gov/jpodocs/repts_te/@cc01!.pdf</a>
IDENTIFICATION AND DOCUMENTATION OF WEATHER AND ROAD CONDITION DISSEMINATION DEVICES AND DATA FORMATS	This project identifies means for improving consistency and usability of road and weather information presentation through identification of current and planned road and weather information dissemination systems and synthesis of various means for presenting information to end users.	<a href="http://www.aurora-program.org/pdf/standardinfort.pdf">www.aurora-program.org/pdf/standardinfort.pdf</a>
IDENTIFICATION OF TRIGGER WIND VELOCITIES TO CAUSE VEHICLE INSTABILITY	Study to determine the critical wind velocity and angle that would overturn different vehicles. A variety of road surface conditions, vehicle types and profiles, vehicle speeds, and vehicle loads are considered to identify the most critical condition.	Nevada DOT District II
IMPROVING PUBLIC RESPONSE TO HURRICANE FLOODING	Operational procedures include forecasts of the storm-total area average rainfall and its location in south Florida by the Miami Weather Forecast Office (WFO). If guidance from the Southeast River Forecast Center (RFC) indicates potential for flooding, a flood watch is issued. If flooding is imminent a flood warning is issued.	American Meteorological Society Symposium on Precipitation Extremes Proceedings
INFORMATION ON THE PLANNING, CONSTRUCTION AND OPERATION OF CHEMICAL THAWING AGENT SPRAYING INSTALLATIONS	Chemical thawing agent spraying systems are fixed equipment of the winter service. Road surface and weather condition detectors detect the ice formation of a road and trigger a thawing agent spraying system into operation. A spraying system allows the timely prevention of icing on hazardous places and assists a conventional (usually mechanical) winter service, by preventing the packing down of the snow layer.	<a href="http://www.ops.fhwa.dot.gov/Weather/Publications/GermanAnti-icingGuidance.pdf">http://www.ops.fhwa.dot.gov/Weather/Publications/GermanAnti-icingGuidance.pdf</a>
INTERNET TECHNOLOGY-BASED ROAD INFORMATION SYSTEMS	A method of using eXtensible Markup Language (XML) technology, Road Web Markup Language (RWML) in the road information field is proposed.	<a href="http://152.99.129.29/cdrom/3013.pdf">http://152.99.129.29/cdrom/3013.pdf</a>

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TITLE	ABSTRACT	SOURCE
IOWA DOT WEATHER INFORMATION SYSTEM TO SUPPORT WINTER MAINTENANCE OPERATIONS	Understanding and interpreting weather information can be critical to the success of any winter snow and ice removal operation. Knowing when, where and what type of deicing material to use for a particular winter weather event can be a challenge. Knowing where to find the weather information needed to make decisions and what information to use can also be difficult. The Maintenance Division of the Iowa DOT has taken a number of steps to provide supervisors and operators with the weather information and training they need to make better operational decisions. A fifty-site RWIS coupled with a satellite delivered weather information system at nearly every maintenance garage have been sources for real-time weather information.	<a href="http://www.ctre.iastate.edu/pubs/midcon/front.pdf">http://www.ctre.iastate.edu/pubs/midcon/front.pdf</a>
ITS APPLICATIONS FOR SNOW AND ICE CONTROL	Paper describes potential applications of ITS for winter maintenance and provides case studies.	7th World Congress on ITS (1026.pdf), Michigan State University
ITS INSTITUTIONAL ISSUES: A MAINTENANCE/OPERATIONS PERSPECTIVE	Details challenges of using advance technology to optimize resources. Personnel, training, and cost issues are discussed. The Aurora-sponsored project found that, particularly with RWIS, the proprietary nature of new technologies tends to hold public agencies to using equipment from a single vendor.	<a href="http://www.ctre.iastate.edu/pubs/midcon/Smithso2.pdf">http://www.ctre.iastate.edu/pubs/midcon/Smithso2.pdf</a>
LOSS OF LIFE IN THE UNITED STATES ASSOCIATED WITH RECENT ATLANTIC TROPICAL CYCLONES	Freshwater floods caused more than half of US deaths directly associated with tropical cyclones or their remnants during the 30-year period from 1970 to1999. Most fatalities occurred in inland counties. Statistical summary of casualties, reasons for losses, and review of efforts to mitigate threats.	<a href="http://www.ametsoc.org/AMS/amsnews/aug282000.html">http://www.ametsoc.org/AMS/amsnews/aug282000.html</a>
MANAGEMENT OF ROADS IN WINTER USING CCTV CAMERA	A snowfall forecast system collecting and analyzing numerical data has been installed in Sapporo. A System for Managing Frozen Road Surface Using CCTV Camera enables real time monitoring of remote conditions. A system using CCTV images and ESS was developed to complement patrols and support efficient winter maintenance.	8th World Congress on ITS; Office Community Service Bureau, City of Sapporo, Japan

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MANUAL OF PRACTICE FOR AN EFFECTIVE ANTI-ICING PROGRAM: A GUIDE FOR HIGHWAY WINTER MAINTENANCE PERSONNEL	Highway anti-icing is the snow and ice control practice of preventing the formation or development of bonded snow and ice by timely applications of a chemical freezing-point depressant. This manual provides information for successful implementation of an effective highway anti-icing program. It is written to guide the maintenance manager in developing a systematic and efficient practice for maintaining roads in the best conditions possible during a winter storm. It describes the significant factors that should be understood and must be addressed in an anti-icing program, with the recognition that the development of the program must be based on the specific needs of the site or region within its reach. The manual includes recommendations for anti-icing practices and guidance for conducting anti-icing operations during specific precipitation and weather events.	<a href="http://www.fhwa.dot.gov/reports/mopeap/eapcov.htm">http://www.fhwa.dot.gov/reports/mopeap/eapcov.htm</a>
MEASUREMENT OF MOTORIST'S RELATIVE VISIBILITY INDEX (MRVI) THROUGH VIDEO IMAGES	This paper introduces a new road visibility index referred to as the motorists' relative visibility index (MRVI). This index represents the amount of visual information lost to the view of motorists due to atmospheric conditions in relation to the visual information available on an ideal clear day. MRVI is computed using readily available video images of roadways using relatively simple image processing techniques. MRVI is a road condition indicator and can be used for control of DMS, analysis of visibility effects on motorists, road closure decisions, and for fast identification of low visibility areas or time periods from a very large set of images collected from multiple video cameras.	Transportation Research Board 81st Annual Meeting, Search TRIS <a href="http://199.79.179.82/sundev/search.cfm">http://199.79.179.82/sundev/search.cfm</a>
MOBILITY AND SAFETY IMPACTS OF WINTER STORM EVENTS IN A FREEWAY ENVIRONMENT: FINAL REPORT	The main goal of the research project summarized in this report was the investigation of winter storm event impacts on the volume, safety and speed characteristics of interstate traffic flow. A literature review of weather related speed and trip choice factors, RWIS and traveler information dissemination was completed. The models that resulted from this research can be applied in conjunction with each other to produce expected winter storm event volume and speed reductions (i.e., event travel and delay impacts), and crash increases (i.e., event safety impacts).	<a href="http://www.ctre.iastate.edu/pubs/midcon/front.pdf">http://www.ctre.iastate.edu/pubs/midcon/front.pdf</a>
MODIFYING SIGNAL TIMING DURING INCLEMENT WEATHER	The largest decrease in vehicle performance occurs when snow and slush begins to accumulate on the road surface. Saturation flows (capacity) decrease by 20%, speeds decrease by 30%, and start-up lost times increase by 23%.	Transportation Research Board 80th Annual Meeting, University of Utah
MULTI-FUNCTIONAL DEPLOYMENT OF AHS KEY TECHNOLOGY	Overview of state of development of key technologies for Advanced Cruise-Assist Highway System (AHS). Users services of AHS include support for road surface condition information. The functions required from road surface condition sensors are dry, wet, water film, new snow, packed snow, slush, packed snow ice sheet, and ice film. Laser radar sensors and millimeter wave radio meters are non-contact sensors able to detect road condition states.	Ministry of Construction, Japan

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<p>NATIONAL REVIEW OF HURRICANE EVACUATION PLANS AND POLICIES: A COMPARISON AND CONTRAST OF STATE PRACTICES: DRAFT</p>	<p>National review of evacuation plans and practices including literature review, and survey of DOT and emergency management officials in coastal states. Focus on current state practices, use of reverse flow operations and ITS, management policies, information exchange methods and decision-making criteria.</p>	<p><a href="http://www.hurricane.lsu.edu/">http://www.hurricane.lsu.edu/</a></p>
<p>OPERATOR INTERFACE DESIGN OF A LANE AWARENESS SYSTEM FOR SNOW REMOVAL OPERATIONS</p>	<p>Research conducted on a two-lane, rural state highway in Minnesota in low visibility conditions. Vehicle-mounted, magnetic, lane-tracking system displaying lane position through a prototype user interface with continuous visual reference to centerline or shoulder line, as well as peripheral modalities (i.e., directional seat vibration, peripheral visual displays in windshield corners, and an optional auditory warning). Could result in improved safety of operator and public, improved service levels (mobility) and reduced cost for snow removal operation operations and reduced economic impact on region (productivity).</p>	<p>7th World Congress on ITS, University of Iowa</p>
<p>OPTIMAL CONTROL OF VARIABLE SPEED LIMITS AND ROAD LIGHTING BASED ON PREDICTED SHORT TERM SOCIO-ECONOMIC IMPACTS</p>	<p>In research conducted on a 6 km rural, two-lane road section in Finland during low visibility and winter weather conditions, information on traffic and weather conditions is input to a control system that executes the optimal decision (varying speed limits and roadway lighting intensity) on each road sections. The control system minimizes socio-economic costs (vehicle, time, environmental, lighting and crash costs), while maintaining an acceptable level of service.</p>	<p>7th World Congress on ITS; Helsinki Traffic Information Centre of FinnRA, Finland</p>
<p>PERCOSTATION FOR REAL TIME MONITORING MOISTURE VARIATIONS, FROST DEPTH AND SPRING THAW WEAKENING</p>	<p>This paper presents the findings of the research and product development project, in which percostation (the road structure moisture, frost depth and spring law weakening monitoring station) was installed on a road in Rovaniemi, Finland. Percostation can be used to assist road officials in tracking real-time moisture levels, depth of the frost and especially the risk for the permanent deformations in the road structure during the spring thaw season. Based on the percostation measurement results, road officials can make decisions about measures to preserve the state of the road during critical conditions, for example by imposing weight restrictions during the worst thaw softening period.</p>	<p>Transportation Research Board 81st Annual Meeting, Search TRIS <a href="http://199.79.179.82/sundev/search.cfm">http://199.79.179.82/sundev/search.cfm</a></p>

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PREDICTION OF DAILY TEMPERATURE PROFILE IN FLEXIBLE PAVEMENTS	The majority of previously published research on pavement temperature prediction has focused on predicting the annual maximum or minimum pavement temperature so as to recommend a suitable asphalt binder performance grade. However, modeling the pavement temperature on a daily or hourly basis has only been recently investigated. To determine the pavement temperature profile, the influence of ambient temperature and seasonal changes must be understood such that the effects of heating and cooling trends within the pavement structure can be quantified. In addition, the influence of different pavement structures on the temperature distribution within the pavement structure must be determined. This paper presents the temperature profile monitoring of flexible pavements on the Virginia Smart Road from March 2000 through May 2001. Developed models to predict the daily maximum and minimum temperature at depths to 0.188m within the pavement structure are presented.	Transportation Research Board 81st Annual Meeting, Search TRIS <a href="http://199.79.179.82/sundev/search.cfm">http://199.79.179.82/sundev/search.cfm</a>
PROCEEDINGS FOR THE WEATHER INFORMATION FOR SURFACE TRANSPORTATION: DELIVERING IMPROVED SAFETY AND EFFICIENCY FOR TOMORROW	Symposium attended by a cross-section of transportation and weather professionals to establish national needs and requirements for weather information associated with decision-making actions involving surface transportation. See also WEATHER INFORMATION FOR SURFACE TRANSPORTATION (WIST): ESTABLISHING THE NATIONAL NEEDS AND REQUIREMENTS.	<a href="http://www.ofcm.gov/wist_proceedings/pdf/toc.pdf">www.ofcm.gov/wist_proceedings/pdf/toc.pdf</a>
PROCEEDINGS OF THE WORKSHOP ON STRATEGY FOR PROVIDING ATMOSPHERIC INFORMATION	The purpose of the workshop was to address issues identified in studies conducted by OFCM and the National Research Council (NRC). The workshop examined how the ever-increasing inventory of atmospheric information could be accessed and used by those who need it. The issue was divided into two parts: getting the information to where it is needed, and insuring that users can read and understand that information.	<a href="http://www.ofcm.gov/sai/proceedings/pdf/00_opening.pdf">http://www.ofcm.gov/sai/proceedings/pdf/00_opening.pdf</a>
REAL TIME FORECASTING OF HURRICANE WINDS AND FLOODING	Forecasting system developed to support emergency preparedness, evacuation and sheltering decisions in Louisiana.	<a href="http://www.hurricane.lsu.edu/_unzipped/suhayda_paper1/suhayda_paper1.pdf">http://www.hurricane.lsu.edu/_unzipped/suhayda_paper1/suhayda_paper1.pdf</a>
REMOTE SENSING AND EMERGENCY MANAGEMENT FOR COASTAL ENVIRONMENTAL DISASTERS	Natural coastal hazard include inundation events, erosion events, circulation and depositional processes, and biological hazards.	<a href="http://www.hurricane.lsu.edu/_unzipped/huh_paper1/huh_paper1.pdf">http://www.hurricane.lsu.edu/_unzipped/huh_paper1/huh_paper1.pdf</a>

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REMOTE SENSING FOR TRANSPORTATION: REPORT OF A CONFERENCE	Proceedings summarize highlights from the conference held in December 2000. Sponsors include USDOT RSPA, NASA, AASHTO & National States Geographic Information Council. Themes of university consortia include Traffic Surveillance, Monitoring and Management; Environment Assessment, Integration and Streamlining; Transportation Infrastructure Management; and Disaster Assessment, Safety, and Hazards (DASH). The DASH theme includes flood, fog, snow, tornado and earthquake events.	<a href="http://gulliver.trb.org/publications/conf/reports/remote_sensing_1.pdf">http://gulliver.trb.org/publications/conf/reports/remote_sensing_1.pdf</a>
REUNION ISLAND'S MERLIN PROJECT: AN ITS IMPLEMENTATION SUCCESS STORY	In response to rock falls triggered by torrential rains and high winds over a coastal road on Reunion Island (a French territory) in the Indian Ocean, traffic managers use automatic lane closure barriers on lanes near cliff and movable barriers to delineate travel lanes on remainder of road. From the TCC, they collect traffic and weather data and disseminate information via DMS. This technique increases safety by separating opposing traffic flows, reducing speed limits, and reducing incident response times.	7th World Congress on ITS, Direction Departementale de l'Equipement, France
REVIEW OF THE INSTITUTIONAL ISSUES RELATING TO ROAD WEATHER INFORMATION SYSTEMS (RWIS): FINAL REPORT	Review of existing documentation of RWIS institutional issues including funding, staffing, partnering and the expandability, transferability, and compatibility of RWIS. Explore coordination and standardization issues of RWIS. Status of RWIS developments in various agencies. Experiences in implementing and deploying RWIS.	<a href="http://www.aurora-program.org/pdf/inst_issues.pdf">http://www.aurora-program.org/pdf/inst_issues.pdf</a>
ROAD WEATHER INFORMATION SYSTEM (RWIS): ENABLING PROACTIVE MAINTENANCE PRACTICES IN WASHINGTON STATE	Washington State DOT's "rWeather" program has integrated and expanded the capabilities of RWIS in the state, enabling proactive winter maintenance practices and better informed winter travel decisions. Report reviews potential benefits of a comprehensive, integrated RWIS; examines use and opinions of RWIS by maintenance personnel; identifies barriers to expanded use of RWIS technologies; and evaluates public response to the "rWeather" traveler information website.	<a href="http://www.wsdot.wa.gov/PPSC/Research/CompleteReports/WARD529_1RWISeval.pdf">http://www.wsdot.wa.gov/PPSC/Research/CompleteReports/WARD529_1RWISeval.pdf</a>
ROAD WEATHER INFORMATION SYSTEMS: SOME FINDINGS ON HOW RWIS INFORMATION SHOULD BE DISSEMINATED TO THE TRAVELING PUBLIC	Survey of four potential user groups of RWIS information: commuters, recreational travelers, long distance travelers, and truckers. Results show that DMS, commercial radio and HAR are the most popular delivery methods. Road condition information (e.g., accumulating snow, fog, ice, wind and road closures) is preferred over information on alternate routes, travel times, or travel speeds. Preferred delivery times are one hour before departure and while en-route.	Transportation Research Board 80th Annual Meeting, Search TRIS <a href="http://199.79.179.82/sundev/search.cfm">http://199.79.179.82/sundev/search.cfm</a>
ROAD WEATHER REQUIREMENTS: EXECUTIVE SUMMARY	The first phase of the Surface Transportation Weather Decision Support Requirements (STWDSR) project documented needs for decision support by operators and users who must contend with weather threats on the surface transportation system. The second phase defined the high level requirements for decision support to winter road maintenance, and is the basis for on-going development. This executive summary describes the main results of these two phases and their relation to on-going projects.	Contact <a href="mailto:itspubs@fhwa.dot.gov">itspubs@fhwa.dot.gov</a>

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RURAL FREEWAY MANAGEMENT DURING SNOW EVENTS - ITS APPLICATION	Based upon visibility, road surface conditions, and capacity of towns to accommodate motorists; the Minnesota DOT and law enforcement personnel activate warning sign, lower (or swing) gate arm, and activate gate lights to prohibit access to rural interstate freeways. Law enforcement personnel are positioned at gate location during closing and reopening. Systematic and well-coordinated plan for closing and reopening has reduced delay (mobility), accident frequency (safety), and lowered DOT costs to clear and reopen by 15% (productivity). Significant time savings result in less overtime pay. Future plans include the addition of fixed and portable DMS, CCTV cameras, and an electronic map.	7th World Congress on ITS, Minnesota DOT
RURAL ITS APPLICATIONS FOR SNOW MAINTENANCE AND WINTER HAZARD MITIGATION	Presents emerging ITS concepts and products for winter maintenance safety developed from the Ideas Deserving Exploratory Analysis (IDEA) program managed by Transportation Research Board. Includes fleet management, avalanche detection and gateway management system, fiber-optic-based visibility information system, and road condition sensor system concepts/products.	Transportation Research Board, Search TRIS <a href="http://199.79.179.82/sundev/search.cfm">http://199.79.179.82/sundev/search.cfm</a>
SIGNS OF RAIN	The New South Wales Roads and Traffic Authority has expanded DMS use to warn motorists during wet weather conditions.	8th World Congress on ITS
SNOW & ICE CONTROL OPERATIONS	Describes various aspects of Caltrans' methods of controlling snow/ice on mountainous highways, including chain controls, materials, environmental concerns, equipment, personnel management, communications, forecasting, enforcement, and avalanche control.	<a href="http://www.dot.ca.gov/hq/roadinfo/snwicecontrol.pdf">www.dot.ca.gov/hq/roadinfo/snwicecontrol.pdf</a>
SNOW EMERGENCY VEHICLE ROUTING WITH ROUTE CONTINUITY CONSTRAINTS	This paper summarizes new results from continuing research dealing with development of a decision support system for assisting the Maryland State Highway Administration Office of Maintenance staff in designing snow emergency routes for Calvert County. By taking into account some of the more realistic constraints, we try to solve two problems. One involves minimizing the total number of trucks and, the second one involves minimizing the total deadhead distance given the number of trucks. The two problems do not result in identical solutions in general. Some application results are also reported which indicate using such a system can achieve improvements in service and savings in operational costs.	Transportation Research Board 81st Annual Meeting, Search TRIS <a href="http://199.79.179.82/sundev/search.cfm">http://199.79.179.82/sundev/search.cfm</a>

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SOCIOECONOMIC IMPACTS OF HEAVY PRECIPITATION IN THE UNITED STATES	Flood losses rank just behind hurricane losses as the second greatest cause of economic losses from weather, and flood losses continue to grow. The number of lives lost due to flooding is decreasing but still ranks as the third highest cause of death ranking behind heat waves and lightning. Heavy rain in the Chicago metro area create rain-slick streets and highways causing three times the number of crashes than occur in light rain conditions. They also cause a 25% increase in the number of fatalities.	American Meteorological Society Conference Proceedings
SOUTHEAST UNITED STATES HURRICANE EVACUATION TRAFFIC STUDY	Study to address problems during the Hurricane Floyd evacuation. The study documents behavioral analysis, Evacuation Travel Demand Forecast Model, reverse lane standards, and ITS strategies.	<a href="http://www.fhwaetis.com/etis">www.fhwaetis.com/etis</a>
STATE OF THE PRACTICE AND REVIEW OF THE LITERATURE: SURVEY OF FOG COUNTERMEASURES PLANNED OR IN USE BY OTHER STATES	DOTs from 49 states (all but Virginia) were contacted in an effort to document the fog countermeasures that are currently in use or being planned by the other states. The results are presented in the report, along with the contact name and phone number or email address for each state.	Virginia Tech Research Council
SURFACE TRANSPORTATION WEATHER APPLICATIONS	Weather threatens surface transportation nationwide and impacts roadway mobility, safety, and productivity. There is a perception that traffic managers can do little about weather. However, three types of mitigation measures—control, treatment, and advisory strategies—may be employed in response to weather threats. Road weather data sharing, analysis, and integration are critical to the development of better road weather management strategies. Environmental information serves as decision support to traffic, maintenance, and emergency managers; and allows motorists to cope with weather effects through trip deferrals, route detours, or driving behavior.	Institute of Transportation Engineers 2002 Annual Meeting, Mitretek Systems ITS Division
SURFACE TRANSPORTATION WEATHER DECISION SUPPORT REQUIREMENTS	This series of documents presents the latest findings of the ongoing Surface Transportation Weather Decision Support Requirements (STWDSR) project. STWDSR Draft Version 1.0 documents the weather information requirements of all road users and operators. STWDSR Draft Version 2.0 focuses on the decision support requirements of a particular stakeholder group--winter road maintenance engineers. It also presents an operational concept for a Weather Information for Surface Transportation Decision Support System (WIST-DSS).	<a href="http://www.itsdocs.fhwa.dot.gov/jpodocs/repts_te/94f01!.pdf">http://www.itsdocs.fhwa.dot.gov/jpodocs/repts_te/94f01!.pdf</a> , <a href="http://www.itsdocs.fhwa.dot.gov/jpodocs/repts_te/9dc01!.pdf">http://www.itsdocs.fhwa.dot.gov/jpodocs/repts_te/9dc01!.pdf</a> , <a href="http://www.itsdocs.fhwa.dot.gov/jpodocs/repts_te/9db01!.pdf">http://www.itsdocs.fhwa.dot.gov/jpodocs/repts_te/9db01!.pdf</a> , <a href="http://www.itsdocs.fhwa.dot.gov/jpodocs/EDLBrow/401!.pdf">http://www.itsdocs.fhwa.dot.gov/jpodocs/EDLBrow/401!.pdf</a> , <a href="http://www.itsdocs.fhwa.dot.gov/jpodocs/repts_te/@701!.pdf">http://www.itsdocs.fhwa.dot.gov/jpodocs/repts_te/@701!.pdf</a>
SYNTHESIS OF ROAD WEATHER FORECASTING	Survey to document relationships between national surface transportation agencies and meteorological agencies. The countries of Canada, Denmark, Finland, Germany, Japan, New Zealand, Norway, Sweden and the United Kingdom were surveyed.	<a href="http://www.aurora-program.org/pdf/synthesis_weather.pdf">www.aurora-program.org/pdf/synthesis_weather.pdf</a>

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SYSTEM MONITORS FLOOD-PRONE CREEKS	The City of Palo Alto, California maintains a "Creek Level Monitor" website that displays water levels at five bridge locations. The system detects water levels with ultrasonic devices under bridges and transmits data to the communication system that controls storm pump stations. City residents receive advanced warning of flood conditions.	<a href="http://www.civic.com/civic/articles/2001/0122/web-flood-01-26-01.asp">www.civic.com/civic/articles/2001/0122/web-flood-01-26-01.asp</a>
TEMPERATURE AND HUMIDITY EFFECTS ON THE CO-EFFICIENT OF FRICTION VALUE AFTER APPLICATION OF LIQUID ANTI-ICING CHEMICALS	Experiment conducted in Canada to establish the reliance of various anti-icing chemicals based on temperature and humidity; specifically to determine what roll they play on road co-efficient of friction. Research showed that when most anti-icing chemicals transition from liquid to solid, and solid to liquid, a "slurry" phase is formed; producing relatively short-lived reductions in friction co-efficient.	<a href="http://www.wsdot.wa.gov/fossc/maint/pns/pdf/slicknessrpt.pdf">http://www.wsdot.wa.gov/fossc/maint/pns/pdf/slicknessrpt.pdf</a>
TESTING THE ADVERSE VISIBILITY INFORMATION SYSTEM EVALUATION (ADVISE) - SAFER DRIVING IN FOG	There are many advisory systems to warn drivers of fog. However, warning drivers that there is fog ahead does not instruct them on what to do. During the 1995-2000 winter seasons, a new technology known as the Adverse Visibility Information System Evaluation (ADVISE) was tested. ADVISE uses visibility sensors to determine current sight distance and corresponding safe speed for the prevailing conditions. DMS instruct drivers of safe speed. This research measures the effectiveness of the system in reducing the variability between speeds. ADVISE successfully reduced speed variability by an average 22%.	Transportation Research Board 81st Annual Meeting, Search TRIS <a href="http://199.79.179.82/sundev/search.cfm">http://199.79.179.82/sundev/search.cfm</a>
THE ADVANCED TRANSPORTATION WEATHER INFORMATION SYSTEM (ATWIS)	The Advanced Transportation Weather Information System (ATWIS) project was designed to provide a current road and forecasted weather report to the traveling public and commercial vehicles within North and South Dakota. This prototype project was to investigate how to merge information and current technologies from both state and private industry to provide in-vehicle decision support data for the traveler. The ATWIS was conceived and designed to provide information specifically for ground transportation, its users and maintainers. This paper examines the development and operational history of the multi-state ATIS.	<a href="http://www.ctre.iastate.edu/pubs/midcon/front.pdf">http://www.ctre.iastate.edu/pubs/midcon/front.pdf</a>
THE EFFECT OF VARIABLE MESSAGE SIGNS ON THE RELATIONSHIP BETWEEN MEAN SPEEDS AND SPEED DEVIATIONS	This research studies the effect of DMS on the relationship between hourly cross-sectional mean speeds and speed deviations. This section of I-90 in the vicinity of Snoqualmie pass, Washington is a rural freeway location subject to adverse weather conditions, and experiences over seventy-five reported vehicle crashes annually. DMS were installed to reduce crash potential by effective speed and traffic flow management. Aggregate results on vehicle speeds and vehicle speed deviations at the hourly level show that there is a significant decrease in mean speed when the DMS are on, along with a significant increase in speed deviation.	Transportation Research Board 81st Annual Meeting, Search TRIS <a href="http://199.79.179.82/sundev/search.cfm">http://199.79.179.82/sundev/search.cfm</a>

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THE EFFECT OF WEATHER ON FREE FLOW SPEED	Free flow speed is affected by pavement conditions, visibility and wind speeds. The effects of poor weather should be considered in such cases as part of capacity and level-of-service analyses.	Transportation Research Board 80th Annual Meeting, Search TRIS <a href="http://199.79.179.82/sundev/search.cfm">http://199.79.179.82/sundev/search.cfm</a>
THE MEASUREMENT AND THEORY OF TIRE FRICTION ON CONTAMINATED SURFACES	Summarizes results of various studies related to friction characteristics of wet, snowy and icy pavement. Preliminary project showed that modeling constants can be used to differentiate contaminants (water, snow, ice), and that friction levels can be monitored for salting control.	<a href="http://www.ctre.iastate.edu/pubs/crossroads/94measurement.pdf">http://www.ctre.iastate.edu/pubs/crossroads/94measurement.pdf</a>
THE USE OF ABRASIVES IN WINTER MAINTENANCE: FINAL REPORT OF PROJECT TR 434	Report reviews the state of the practice of abrasive usage in Iowa counties and classifies usage according to effectiveness.	<a href="http://www.sicop.net/Abrasives%20report.pdf">www.sicop.net/Abrasives%20report.pdf</a>
THE USE OF MOBILE VIDEO DATA COLLECTION EQUIPMENT TO INVESTIGATE WINTER WEATHER VEHICLE SPEEDS	Research involves traffic and weather data (i.e., visibility, roadway snow cover, volume, speed, and headway/gap data) collected by a trailer-mounted video data collection/monitoring system. Collected data used to predict vehicle speed and speed variability. Results indicate that average winter weather speed was 16% lower than that in speed under dry conditions. In winter weather, speed variation was 307% higher than variation during dry conditions. The resulting model predicted that off-peak winter weather speeds would decrease by 3.9 mph when visibility fell below one-quarter mile, and decrease by 7.3 mph when snow began to cover roadway lanes.	Transportation Research Board 79th Annual Meeting, Search TRIS <a href="http://199.79.179.82/sundev/search.cfm">http://199.79.179.82/sundev/search.cfm</a>
TRAFFIC MODELING FRAMEWORK FOR HURRICANE EVACUATION	Development of computer-based incident management decision aid system (IMDAS).	Transportation Research Board 80th Annual Meeting, Search TRIS <a href="http://199.79.179.82/sundev/search.cfm">http://199.79.179.82/sundev/search.cfm</a>
TRAVELAID	Report discusses effectiveness of DMS and in-vehicle traffic advisory systems (IVUs) on a mountainous pass for changing driver behavior. DMS and VSL signs were installed on I-90 to provide speed limit, weather, and roadway information to motorists in order to reduce the number and severity of crashes. Report includes analysis of mean speeds and speed deviation based upon a driving simulator study.	<a href="http://www.itsdocs.fhwa.dot.gov/jpodocs/repts_te/13610.html">www.itsdocs.fhwa.dot.gov/jpodocs/repts_te/13610.html</a>

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TITLE	ABSTRACT	SOURCE
USE OF EXPERT SYSTEMS FOR ROADWAY WEATHER MAINTENANCE DECISIONS	Automated systems for forecasting frost and fog on roads and bridges using expert systems were deployed in Iowa.	<a href="http://www.ctre.iastate.edu/pubs/semisesq/session5/takle/">http://www.ctre.iastate.edu/pubs/semisesq/session5/takle/</a>
USE OF PAVEMENT TEMPERATURE MEASUREMENTS FOR WINTER MAINTENANCE DECISIONS	Analyzed pavement temperature data from urban and rural sites on bridges and roads to evaluate nighttime trends and differences of temperature at different locations under different weather conditions. Using RWIS pavement temperature data and cloud cover data from Jan. 1997, temperature differences, cooling rates, and lag times between urban and rural sites were computed.	<a href="http://www.ctre.iastate.edu/pubs/crossroads/33use.pdf">http://www.ctre.iastate.edu/pubs/crossroads/33use.pdf</a>
VARIABLE SPEED CONTROL: TECHNOLOGIES AND PRACTICE	Static speed limit signs fail to provide accurate information on speed selection when traffic and environmental conditions are less than ideal. Paper documents findings from a state-of-the-practice review on VSL systems. Paper reviews and compares characteristics of VSL systems, and discusses potential benefits and limitations associated with their deployment.	ITS America 11th Annual Meeting Proceedings, Michigan State University
VIDEO CAMERAS FOCUS ON VISIBILITY	A researcher has developed a technique for automatically measuring visibility with video cameras. The camera is aligned to detect contrasting portions of targets in order to generate a signal indicative of contrast levels. A processor uses the signal to compute visibility. Prototype system was installed on northbound Highway 35 near Duluth, Minnesota.	<a href="http://www.its.umn.edu/news/visibility.html">www.its.umn.edu/news/visibility.html</a>
VISION AND CHALLENGES OF INTEGRATING TRAFFIC MANAGEMENT AND EMERGENCY RESPONSE SYSTEMS	There is a vision of a completely integrated public safety, emergency management system, and traffic management communications system that would save lives, reduce serious injuries, conserve public safety resources, and improve transportation efficiency. Various enablers and barriers to an Integrated Traffic Management and Emergency Response System (ITMERS) are discussed.	<a href="http://www.itsa.org/itsview.html">www.itsa.org/itsview.html</a>
WEATHER BASED TRAFFIC MANAGEMENT APPLICATIONS IN NEVADA	Maintenance operations dealing with inclement weather occur at almost all levels of government across the United States. Several operational strategies and technologies have been developed to assist in the forecasting and detection of roadway conditions associated with inclement weather. RWIS technologies have become a cornerstone to several traffic management applications in northern Nevada. Detection of road and weather conditions allow for the development of detection and warning systems to alert motorists of potential driving difficulties of intermittent hazards.	Institute of Transportation Engineers 2002, Nevada DOT

# Best Practices for Road Weather Management

## Appendix C

TITLE	ABSTRACT	SOURCE
WEATHER IN THE INFO-STRUCTURE	This paper addresses the Weather Response component of the National Highway System Info-Structure and estimates an aggregate cost for national deployment. It does this by first documenting a methodology for determining the number of RWIS sensors needed across the country and then a methodology for determining the cost.	Cambridge Systematics, Inc.
WEATHER INFORMATION FOR SURFACE TRANSPORTATION (WIST I): ESTABLISHING THE NATIONAL NEEDS AND REQUIREMENTS	OFCM and FHWA initiated a project, within the federal meteorological community, to identify the nation weather needs and requirements for all surface transportation modes. Establishing initiatives, the Joint Action Group for WIST, database records, and plans for 2000 WIST Symposium are discussed.	<a href="http://www.ofcm.gov/wist_proceedings/proceedings.htm">http://www.ofcm.gov/wist_proceedings/proceedings.htm</a>
WEATHER INFORMATION FOR SURFACE TRANSPORTATION (WIST II): ESTABLISHING THE NATIONAL NEEDS AND REQUIREMENTS	OFCM and FHWA initiated a project, within the federal meteorological community, to identify the national weather needs and requirements for all surface transportation modes. In this venue, surface transportation consists of roadways, rail, waterways, and pipelines. Noted shortcomings were the absence of definitive information on the spatial and temporal scales required for decision processes, and the lack of any specific threshold for identified weather elements.	<a href="http://www.ofcm.gov/wist2/proceedings2000/wist2startup.htm">http://www.ofcm.gov/wist2/proceedings2000/wist2startup.htm</a>
WEATHER: A RESEARCH AGENDA FOR SURFACE TRANSPORTATION OPERATIONS	Weather crosscuts almost every goal, use, and operation of highways, and yet, meteorology, from a transportation perspective, is focused mostly on the flight operations. To make weather issues an important part of highway programs, people who manage highway operations must seek new techniques and ITS that complement the amazing system of weather-information collection, analysis, and forecasting that exists in the US.	<a href="http://www.tfrc.gov/pubrds/02mar/05.htm">http://www.tfrc.gov/pubrds/02mar/05.htm</a>
WEATHER: MAKING IT A NATIONAL PRIORITY IN SURFACE TRANSPORTATION	Includes "A National Program for Surface Transportation Weather Applications" by Pisano & Nelson; "An Advanced Winter Road Decision Support System" by Mahoney; "Research Needs in Weather Information for Surface Transportation--The Perspective of the User Community" by Nixon; "Utilizing FAA-Developed Automated Weather Algorithms for Improving Surface Transportation Operations in Adverse Weather" by Hollowell; "Foretell--Some Findings and their Research Implications" by Davies, Choudhry & Canales; "Future Growth of Surface Transportation Weather: An Academic Question" by Osborne; and "Private Sector Meteorology and ITS" by Smith.	<a href="http://www.ops.fhwa.dot.gov/weather/publications/its_america.pdf">www.ops.fhwa.dot.gov/weather/publications/its_america.pdf</a>

# Best Practices for Road Weather Management

## Appendix C

TITLE	ABSTRACT	SOURCE
WHITE PAPER: AN INTEGRATED NETWORK OF TRANSPORTATION INFORMATION	The integrated network is the "infostructure" that facilitates monitoring, management, and operation of the entire transportation network. The integrated network will enable Road Weather Information and offer the opportunity (1) to detect and respond to regional crises, (2) for fewer and less severe crashes, (3) for better operator and user information, and (4) to reduce energy consumption and negative environmental impacts.	<a href="http://www.itsa.org/ITSNEWS.NSF/4e0650bef6193b3e852562350056a3a7/927cd5cae21c0ff085256b190049bd4e?OpenDocument">www.itsa.org/ITSNEWS.NSF/4e0650bef6193b3e852562350056a3a7/927cd5cae21c0ff085256b190049bd4e?OpenDocument</a>
WINTER MAINTENANCE IN THOMPSON FALLS (MEMORANDUM)	Comparison of treatment strategies for a winter storm event in Thompson Falls, Montana.	Montana DOT
WINTER OPERATIONS WEATHER FORECASTS: DO THEY WORK FOR THE MAINTENANCE SHED SUPERVISOR?	An evaluation of Utah DOT's RWIS included validation of NWS forecasts and Northwest Weathernet forecasts for specific interstate corridors, and satisfaction surveys completed by maintenance supervisors.	Transportation Research Board 80th Annual Meeting, Search TRIS <a href="http://199.79.179.82/sundev/search.cfm">http://199.79.179.82/sundev/search.cfm</a>
WINTER STORM EVENT VOLUME IMPACT ANALYSIS USING MULTIPLE SOURCE ARCHIVED MONITORING DATA	Paper discusses how data from several information management systems in Iowa were used to analyze the volume impacts of winter storms. Analysis indicated that winter storms decrease traffic volumes by 29% on average (range from 16% to 47%). Analysis revealed a relationship between percent volume reduction and total snowfall, minimum average wind speed and the square of maximum wind gust speed.	Transportation Research Board 79th Annual Meeting, Search TRIS <a href="http://199.79.179.82/sundev/search.cfm">http://199.79.179.82/sundev/search.cfm</a>