



International Conference on
Road Weather and Winter Maintenance

MAY 9–10, 2023
Washington, D.C.

Convened by
Transportation Research Board

With support from
Federal Highway Administration

NATIONAL Sciences
ACADEMIES Engineering
Medicine

 **TRANSPORTATION RESEARCH BOARD**

2023 PLANNING COMMITTEE

This conference would not have been possible without the combined efforts of many individuals and organizations.

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Ilona Kastenhofer, Senior Program Officer
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INTRODUCTION

ANNA ARDVISSON AND PAUL PISANO

CHAIRS, WINTER MAINTENANCE AND ROAD WEATHER COMMITTEES

WELCOME TO WASHINGTON, D.C.!



Anna Ardvisson

After nearly three years of delays, it is our privilege to welcome you back, in person, to our International Conference on Road Weather and Winter Maintenance. Originally scheduled for April, 2020, this flagship conference brings together experts from the transportation and weather communities across academia, public agencies and the private sector to share their latest findings and experiences. Such interactions enable participants to learn about best practices and take them home to their agencies and institutions so that we all benefit from a safer and more efficient transportation system, regardless of the challenges that weather throws at us.

This conference is the final stop on the journey we have called the “Tri-event.” It started with a TRB Webinar “Managing Severe Storms and Environmental Impacts” November 29, 2022, and was followed with a Workshop entitled “Resilient and Sustainable Approaches for Road Weather and Winter Maintenance” on January 8, 2023, as part of the TRB Annual Meeting. Both events were well attended and successful thanks to all the speakers and attendees that contributed. What we learned at those two events has served as the basis for this conference, and we will continue these conversations.



Paul Pisano

Our last time together was in Fort Collins, Colorado in 2016. It was there that we initiated a new approach to this conference, modeling the agenda on the “flipped classroom” concept. This meant that speakers recorded their presentations prior to the event, and participants watched the presentations before convening. This enabled everyone to spend the majority of the time at the conference discussing what they had already heard, maximizing the time spent discussing the results and answering questions such as, “what are the latest success stories that I can implement, and how do I do it?” This conference follows that same model, adding live “Lightning Round” presentations to recap what has been pre-recorded, and leading into multiple break-out sessions. This ensures that the bulk of the

conference is spent discussing topics among peers, identifying both implementable solutions and research needs for future study.

We continue to see significant changes in the weather, technology, and the expectations of our customers, which force us to change the way we operate and maintain the transportation system. Whether it's new equipment or new regulations about winter maintenance materials, new ways to monitor road conditions or increases in extreme weather events, our world is very dynamic, and complacency is unacceptable. But we don't have to solve all the problems ourselves. By coming together at this conference, we can work together to figure out how best to provide a safe, efficient and environmentally sound transportation system.

If we've learned nothing over the past three years about the value of in-person, interpersonal communication, then we have missed an opportunity. That point has not been lost on us, and we are glad that you will join us to renew friendships and develop new relationships. We look forward to meeting each one of you, learning from all of you, and working with you to implement the knowledge that will be shared. We would also like to thank everybody who has contributed to making the conference a success, with special thanks to the committee members, abstract reviewers, TRB staff, and FHWA for being a sponsor.



The Transportation Research Board is one of seven major programs of the National Academies of Sciences, Engineering, and Medicine. The mission of the Transportation Research Board is to increase the benefits that transportation contributes to society by providing leadership in transportation innovation and progress through research and information exchange, conducted within a setting that is objective, interdisciplinary, and multimodal. The Board's varied committees, task forces, and panels annually engage about 7,000 engineers, scientists, and other transportation researchers and practitioners from the public and private sectors and academia, all of whom contribute their expertise in the public interest. The program is supported by state transportation departments, federal agencies including the component administrations of the U.S. Department of Transportation, and other organizations and individuals interested in the development of transportation.

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SCHEDULE AT-A-GLANCE

Tuesday, May 9		
7:15 AM–2:00 PM	Registration	<i>Keck 1st Floor Pre-Function Area</i>
7:30 AM–8:00 AM	Breakfast	<i>Keck 1st Floor Pre-Function Area</i>
8:00 AM–9:30 AM	Plenary Session	<i>Keck 100</i>
9:30 AM–10:00 AM	Break	<i>Keck 1st Floor Pre-Function Area</i>
10:00 AM–Noon	Lightning Round Session of Presentations for Topics A, B, & C	<i>Keck 100</i>
Noon–1:00 PM	Lunch	<i>Keck 1st Floor Pre-Function Area</i>
1:00 PM–2:30 PM	Breakout Room 1 - Topic A: Advancements in Winter Maintenance – Equipment and Materials	<i>Keck 103</i>
Concurrent Workshop Breakout Sessions	Breakout Room 2 - Topic B: Performance Improvement in Winter Maintenance and Road Weather Management	<i>Keck 106</i>
2:30 PM–3:00 PM	Break	<i>Keck 1st Floor Pre-Function Area</i>
3:00 PM–4:30 PM	Breakout Room 1 - Topic C: Resiliency and Weather-Responsive Transportation Management	<i>Keck 103</i>
Concurrent Workshop Breakout Sessions	Breakout Room 2 - Topic C: Resiliency and Weather-Responsive Transportation Management	<i>Keck 106</i>

SCHEDULE AT-A-GLANCE

Wednesday, May 10		
7:15 AM–Noon	Registration	<i>Keck 1st Floor Pre-Function Area</i>
7:30 AM–8:00 AM	Breakfast	<i>Keck 1st Floor Pre-Function Area</i>
8:00 AM–8:20 AM	Plenary Session	<i>Keck 100</i>
8:20 AM–10:00 AM	Lightning Round Session of Presentations for Topic D	<i>Keck 100</i>
10:00 AM–10:30 AM	Break	<i>Keck 1st Floor Pre-Function Area</i>
10:30 AM–Noon	Breakout Room 1 – Topic D: Advancements in Winter Maintenance – Information Management & Decision Support	<i>Keck 103</i>
Concurrent Workshop Breakout Sessions	Breakout Room 2 – Topic D: Advancements in Winter Maintenance – Information Management & Decision Support	<i>Keck 106</i>
Noon–1:00 PM	Lunch	<i>Keck 1st Floor Pre-Function Area</i>
1:00 PM – 2:30 PM	Reporting Out and Open Discussion	<i>Keck 100</i>
2:30 PM – 3:00 PM	Break	<i>Keck 1st Floor Pre-Function Area</i>
3:00 PM – 4:30 PM	Closing Remarks	<i>Keck 100</i>

CONFERENCE PROGRAM

TUESDAY, MAY 9, 2023

7:15 AM–2:00 PM

Keck 100 Pre-Function Area

Registration

7:30 AM–8:00 AM

Keck 100 Pre-Function Area

Breakfast

8:00 AM–9:30 AM

Keck 100

Plenary Session

Moderator: Paul Pisano, Chair, TRB Committee on Road Weather (AKR50)

Presentations:

- **Welcome and Introductions from Conference Co-Chair**
Paul Pisano, Chair, TRB Committee on Road Weather (AKR50)
- **Welcome and TRB Introduction**
Ilona Kastenhofer, TRB Senior Program Officer
- **How to Institutionalize Coordination with Our Partner Agencies for Responding to Emergency Events, with a Focus on Weather and Winter Related Events**
John Scrivani, Virginia Department of Transportation
- **Recap Webinar and Workshop**
Paul Pisano, Chair, TRB Committee on Road Weather (AKR50)
Anna Arvidsson, Swedish National Road and Transport Research Institute (VTI); Chair, TRB Committee on Winter Maintenance (AKR40)

9:30 AM–10:00 AM

Keck 100 Pre-Function Area

Break

10:00 AM–Noon

Keck 100

SESSION: Lightning Round Session of Presentations for Topics A, B, & C

Moderator: Kathy Ahlenius, Wyoming Department of Transportation (WYDOT)

Scan the QR Code
for the online program.



TOPIC A: Advancements in Winter Maintenance – Equipment and Materials

Effective snow and ice control is a critical aspect of highway winter maintenance. Snow removal equipment, especially, is a key element that is affected by harsh conditions. This topic will focus on new advancements in equipment and materials, salt savings and winter maintenance best practices.

The topic includes:

- *Advancements in maintenance equipment*
- *Best practices in materials management*
- *Salt savings to reduce environmental impacts*
- *Case studies and applications*
- *Drifting snow & avalanche control*

Presentations:

- **Artificial Intelligence for Winter Road Maintenance - Automatic Spreading/ Plowing Operation**
Enzo Giletta, Giletta SPA - Bucher Municipal
- **Winter Plowing and Deicing: Saving Money, Salt and Labor by Distinguishing Best Practices From Urban Legends**
Stephen Druschel, Minnesota State University, Mankato
- **Use of Speed Data to Assess Winter Maintenance Performance**
Dave Huft, South Dakota Department of Transportation (SDDOT)

TOPIC B: Performance Improvement in Winter Maintenance and Road Weather Management

Monitoring and measuring roadway conditions remains a critical component of effective and efficient winter maintenance. This topic will focus on how to attract winter maintenance personnel and how to plan and optimize for the best performance to achieve and maintain the targeted level of service.

The topic includes:

- *Crowdsourcing for Performance Improvement*
- *Human Resource Training*
- *Motivating Personnel*
- *Organizational Resiliency*
- *Levels of Service*
- *Performance Measures and Operations Management*

Presentations:

- **A Study on Relationship Between Precipitation Intensity of XRAIN and Snow-depth on the Ground**
Kotaro Yamashiro, Sho Takahashi, and Toru Hagiwara, Hokkaido University

- **Artificial Intelligence and Roadway Friction Modeling**
Thomas Brummel, Gerry Wiener and Seth Linden, National Center for Atmospheric Research (NCAR); and Laura Fay, Western Transportation Institute – Montana State University
- **Integrated Modeling For Road Condition Prediction (IMRCP): Phase 4 Research and Deployment**
John Garrett, Synesis Partners, LLC
- **Development of a Snowplow Driver Assist System**
Brian Davis, Max Donath, and Nichole Morris, University of Minnesota

TOPIC C: Resiliency and Weather-Responsive Transportation Management

The climate is changing, and how it changes can affect the way transportation agencies maintain and operate the roads all year round. What are some of issues your agency is dealing with in regard to a changing climate, extreme weather events and resiliency to future events? This topic will focus on the ways in which agencies are managing the transportation system under all types of weather events, especially as they face the challenges associated with an increase in extreme events. What does it take to operate and maintain a resilient transportation system under these circumstances?

The topic includes:

- *Repurposing Resources*
- *Detecting and Forecasting Extreme Events under Winter and Summer Conditions*
- *Environmental Sustainability and Impacts*
- *Best practices and case studies in traffic and emergency management (e.g., variable speed limits and traveler information systems, including Cost-benefit analyses)*
- *Data management and information systems to support weather-responsive transportation management*
- *Weather and the commercial vehicle community*
- *Refining/redefining/reshaping/exploring public and private sectors roles in road weather management*
- *Advancements in flood management for maintenance and operations*
- *Cross-coordination with infrastructure managers*
- *Cross-coordination with the meteorological and flood management communities*

Presentations:

- **Hot Shots for Cold Climes – Evaluating Treatment of The Hardest Icy Spots**
Stephen Druschel, Minnesota State University, Mankato
- **Investigation of Evaluation Indexes for Severe Snowstorm Events in the Snowy Cold Region of Japan**
Yusuke Harada, Satoshi Omiya, Hirotaka Takechi, and Atsush Nishimura, Civil Engineering Research Institute for Cold Region, Public Works Research Institute

- **Utilizing Weather Data to Create Network and Agency Resiliency**
Laura Fay, Karalyn Clouser, and Natalie Villwock-Witte, Western Transportation Institute - Montana State University
- **Winter Maintenance Forecast Improvement Using Mobile Observations**
James McCaa, Vaisala
- **Improvements in Pavement Model to Support Winter Maintenance Decision Making**
Benjamin W. Hershey, DTN LLC
- **Lessons Learned: An Investigation into Responses to the Pre-Christmas 2022 Severe Winter Storm**
Wilfrid Nixon, Professional Snowfighters Association; R. Mark DeVries, Vaisala Inc.; and Benjamin W. Hershey, DTN LLC.

Noon–1:00 PM

Keck 100 Pre-Function Area

Lunch

1:00 PM–2:30 PM

SESSION: Concurrent Workshop Breakout Sessions for Topics A and B

Breakout Room 1 - Keck 103

TOPIC A: Advancements in Winter Maintenance – Equipment and Materials

Moderator: Wilfrid Nixon, Professional Snowfighters Association

Breakout Room 2 - Keck 106

TOPIC B: Performance Improvement in Winter Maintenance and Road Weather Management

Moderator: Tae J. Kwon, University of Alberta

2:30 PM–3:00 PM

Keck 100 Pre-Function Area

Break

3:00 PM–4:30 PM

SESSION: Concurrent Workshop Breakout Sessions for Topic C

Breakout Room 1 - Keck 103

TOPIC C: Resiliency and Weather-Responsive Transportation Management

Moderator: Shawn Truelson, DTN, LLC

Breakout Room 2 - Keck 106

TOPIC C: Resiliency and Weather-Responsive Transportation Management

Moderator: Richard Nelson, American Association of State Highway and Transportation Officials (AASHTO)

4:30 PM–5:30 PM

Keck 100

Recap First Day

Moderator: Anna Arvidsson, Swedish National Road and Transport Research Institute (VTI); Chair, TRB Committee on Winter Maintenance (AKR40)



WEDNESDAY, MAY 10, 2023

7:15 AM–Noon

Keck 100 Pre-Function Area

Registration

7:30 AM–8:00 AM

Keck 100 Pre-Function Area

Breakfast

8:00 AM–8:20 AM

Keck 100

Plenary Session

Moderator: Anna Arvidsson, Swedish National Road and Transport Research Institute (VTI); Chair, TRB Committee on Winter Maintenance (AKR40)

Presentations:

- **Welcome and Introductions from Conference Co-Chair**
Anna Arvidsson, Swedish National Road and Transport Research Institute (VTI); Chair, TRB Committee on Winter Maintenance (AKR40)
- **Research to Support Road Weather & Winter Maintenance Operations - Current and Future Needs**
Laura Fay, Western Transportation Institute – Montana State University

8:20 AM–10:00 AM

Keck 100

SESSION: Lightning Round Session of Presentation for Topic D

Moderator: Anna Arvidsson, Swedish National Road and Transport Research Institute (VTI); Chair, TRB Committee on Winter Maintenance (AKR40)

TOPIC D: Advancements in Winter Maintenance – Information Management & Decision Support

Administrative and management policies for winter maintenance vary across agencies as well as the types and providers of services. The fields of automated and connected vehicle technologies will change winter maintenance operations in the coming years. The emergence of remote sensing and mobile data collection technologies will also impact the amount of data that is collected to support winter maintenance operations. This topic is focusing on tools and techniques to turn data into useful information for decision making.

The topic includes:

- *Autonomous and connected vehicle applications and impacts*
- *Automated Vehicle Location (AVL)/GPS applications including Route Optimization*
- *Detecting and monitoring road and weather conditions*

Presentations:

- **Correlation between floating car data and road weather information implemented for winter road maintenance follow-up by monitoring the road friction**
Sofia Sollén, and Johan Casselgren, Luleå University of Technology
- **Floating Car Data In Winter Maintenance – Making Roads Safer Using Real-Time Data From New Sources**
Björn Zachrisson, NIRA Dynamics; and Johan Petersson, NIRA Dynamics AB
- **An Edge-computing System for Observing Road Surface Condition and Visibility in Winter Road**
Sho Takahashi, Masahiro Yagi, and Toru Hagiwara, Hokkaido University
- **New Approaches to Collecting Road Weather Information**
Taisto Haavasoja and Pauli Nylander, Teconer Oy
- **Study on Driving Behavior of Drivers and Countermeasures against Flooded Road Surface**
Kazunori Munehiro, Kazuyuki Kurata, and Yasuyuki Ito, Civil Engineering Research Institute for Cold Region (PWRI) - Public Works Research Institute (PWRI), Japan
- **Using Snowplow Telematics to Assess Systemwide Fleet Response During Winter Weather Operations**
Jairaj Desai, Justin Mahlberg, Jijo Mathew, Howell Li, and Darcy M. Bullock, Purdue University
- **Evaluation of Traffic Congestion due to Heavy Snowfall in Sapporo Metropolitan Area Using Macroscopic Fundamental Diagrams (MFD)**
Toru Hagiwara and Sho Takahashi, Hokkaido University; and Masanori Matsuda, Department of Transportation, Docon Co.,Ltd
- **Impact of Climate and Environmental Factors on Salt Application Performance**
Samaneh Khani, Laval University, Canada
- **Performance Metrics For Winter Operational Planning: Experiences, Challenges, and Lessons Among Eight State Agencies**
Greg Jones, James Colyar, and Ralph Volpe, Federal Highway Administration (FHWA); and Vaishali Shah, AEM Corporation
- **Utilization of Magnetic Markers as Autonomous Driving Auxiliary Facilities in Snowy Areas**
Kazunori Munehiro, Kazuyuki Kurata, and Yasuyuki Ito, Civil Engineering Research Institute for Cold Region (PWRI) - Public Works Research Institute (PWRI), Japan

- **Lessons learned from the exchange of 800 RWiS in Sweden**
Dan Eriksson, Need Organization's information
- **Using Optimization to Improve Winter Maintenance Operations**
Benjamin Zietlow, Weiwen Xie , and Mark Berndt, Quetica Consulting & Engineering; and David L. Huft, South Dakota Department of Transportation (SDDOT)
- **Performance Analysis of a Winter Maintenance Decision Support System**
Shawn Truelson, DTN, LLC
- **Rapid Induction Heating of Asphalt Repair Material for Winter Road Maintenance**
John Rushing, Ben C. Cox, and Sadie E. Casillas, U.S. Army Engineer Research and Development Center
- **The Visual Distance of Industrial Cameras Varies with Exposure Time During Blowing Snow**
Toshimitsu Sakurai, Hiroataka Takechi, Tetsuya Kokubu, and Atsushi Nishimura, Civil Engineering Research Institute for Cold Region, Public Works Research Institute
- **Using AVL to Measure Sustainability in Winter Operations**
Bill Hoffman and Paul Brown, Innovating Maintenance Solutions, Inc.
- **Automated Winter Road Condition Recognition - A Deep Learning-based Framework**
Mingjian Wu and Tae J. Kwon, University of Alberta, Edmonton, AB, Canada

10:00 AM–10:30 AM

Keck 100 Pre-Function Area

Break

10:30 AM -Noon

Keck 100

SESSION: Concurrent Workshop Breakout Sessions for Topic D

Breakout Room 1 - Keck 103

TOPIC D: Advancements in Winter Maintenance – Information Management & Decision Support

Moderator: Tina Greenfield, Iowa Department of Transportation (IOWADOT)

Breakout Room 2 - Keck 106

TOPIC D: Advancements in Winter Maintenance – Information Management & Decision Support

Moderator: Mike Burton, Campbell Scientific

Noon–1:00 PM

Keck 100 Pre-Function Area

Lunch

1:00 PM -2:30 PM

Keck 100

SESSION: Reporting Out and Open Discussion

TOPIC A: Advancements in Winter Maintenance – Equipment and Materials

Wilfrid Nixon, Professional Snowfighters Association

TOPIC B: Performance Improvement in Winter Maintenance and Road Weather

Tae J. Kwon, University of Alberta

TOPIC C: Resiliency and Weather-Responsive Transportation Management (Breakout Room 1)

Shawn Truelson, DTN, LLC

TOPIC C: Resiliency and Weather-Responsive Transportation Management (Breakout Room 2)

Richard Nelson, American Association of State Highway and Transportation Officials (AASHTO)

TOPIC D: Advancements in Winter Maintenance – Information Management & Decision Support (Breakout Room 1)

Tina Greenfield, Iowa Department of Transportation (IOWADOT)

TOPIC D: Advancements in Winter Maintenance – Information Management & Decision Support (Breakout Room 2)

Mike Burton, Campbell Scientific

2:30 PM–3:00 PM

Keck 100 Pre-Function Area

Break

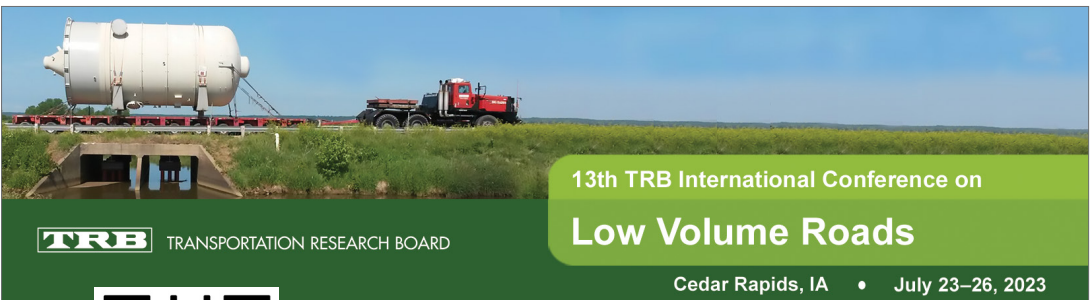
3:00 PM–4:00 PM

Keck 100

Closing Remarks

Moderators: Paul Pisano, Chair, TRB Committee on Road Weather (AKR50) and Anna Arvidsson, Swedish National Road and Transport Research Institute (VTI); Chair, TRB Committee on Winter Maintenance (AKR40)

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