

**Joint Meeting of the
Western Snow Conference
and the
Weather Modification Association**



April 17-20, 2017

The Grove Hotel

Boise, Idaho

Monday, April 17

- 8:00-11:30 **WSC Executive Committee Meeting** *Cattails Room*
- 11:00-11:30 **Short Course set-up, Registration** *River Fork Room*
- 11:30-5:00 **Short Course: Tracing the Effects of Cloud Seeding through the Hydrologic Cycle**
Aspen Room
- 3:00-7:00 **Poster and Vendor Set up** *The Landing*
- 5:30-7:00 **Registration and Hospitality** *The Terrace*

Tuesday, April 18

- 7:00-8:00 **Breakfast Buffet (All registered conference participants)** *River Fork Room*
- 7:00-8:00 **Conference Registration, Vendor set up, Poster set up (continued)**
- 8:00-8:10 **Opening Remarks, Ron Abramovich, Conference Chair, North Continental Region** *Ballroom*
- 8:10-8:20 **Weather Modification Association Welcome, Tom Ryan, WMA President**
- 8:20-8:30 **Western Snow Conference Welcome, Scott Pattee, WSC General Chair**

- 8:30-8:50 **Welcome to Idaho**
The Honorable Butch Otter, Idaho Governor
Darrel Anderson, CEO, Idaho Power Company
- 8:50-9:10 **Keynote Address** Jimmy Bramblett, USDA, NRCS Deputy Chief, Science and Technology
- 9:10-9:30 **Importance of Snow and Water to Western Economies** Dr. Garth Taylor, University of Idaho
- 9:30-9:50 **Western Water Issues** Tony Willardson, Western States Water Council
- 9:50-10:00 **Vendor Introductions:** Lucas Zukiewicz and Jordy Hendrikx, WSC, North Continental Region
- 10:00-10:30 **Break: Poster Sessions (listed on pages 7 and 8) and Vendor Exhibits** *The Landing*
- 10:30-10:50 **Novel Approaches to Water Management and Aquifer Sustainability in Idaho** Mathew Weaver, Deputy Director, Idaho Department of Water Resources
- 10:50-11:10 **Introduction to Cloud-Seeding** Bruce Boe, Vice-President of Meteorology, Weather Modification International
- 11:10-11:30 **Overview of SNOWIE: Seeded and Natural Orographic Wintertime Clouds: the Idaho Experiment** Jeff French, University of Wyoming
- 11:30-11:55 **Panel Questions and Answers**
- 11:55-12:00 **Closing Comments and Announcements**
- 12:00-1:30 **Lunch** (on your own)

Presentations Session I

1:30-3:10 **Concurrent Technical Sessions** *Aspen/Cedar and Evergreen Rooms*

<p>WSC Presentations <u>Snow and Precipitation Sciences</u> Session Chair Mel Kunkel</p> <p>1:30-1:35 Opening Announcements</p> <p>1:35-1:55 Precipitation Production in a Wintertime Atmospheric River Event North of Boise, Idaho. Sarah Tessorf, National Center for Atmospheric Research.</p> <p>1:55-2:15 Characteristics of Moisture Pathways Associated with Large Precipitation Events in the Upper Colorado River Basin. Johnathan Kirk, Department of Geography, Kent State University.</p>	<p>WMA Presentations <u>Winter Season Operations and Analysis</u> Session Chair Mark Solak</p> <p>1:30-1:50 The Use of Ice Detectors in Assessing the Presence of Supercooled Liquid Water for Winter Seeding. David Yorty, North American Weather Consultants, Inc.</p> <p>1:50-2:10 Sierra Nevada Winter Storm 700 hPa Temperature Trends and Implications for the Future of High Elevation Ground-Based Cloud Seeding with Silver Iodide. Kacie Shourd, Desert Research Institute and University of Nevada.</p>
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2:15-2:35 Toward a Greater Understanding of Utah Snowmelt Hydrology. Randall Julander, NRCS Utah Snow Survey.	2:10-2:30 Supercooled Liquid Water Observations within Storms over the Sierra Nevada Mountains. Frank McDonough, Desert Research Institute.
2:35-2:45 Q&A	2:30-2:50 Winter Cloud Seeding over the Cachapoal River Basin in Chile. Roberto Hilliard, Cachapoal River Oversight Board, Chile.
	2:50-3:10 Investigating the Feasibility of Cloud Seeding in the Bighorn Mountains. Sarah Tessendorf, National Center for Atmospheric Research.

2:45-3:30 **WSC Break: Poster Sessions (listed on pages 7 and 8) and Vendor Exhibits** *The Landing*

3:10-3:35 **WMA Break: Poster Sessions (listed on pages 7 and 8) and Vendor Exhibits** *The Landing*

3:30-5:00 **Concurrent Technical Sessions, continued** *Aspen/Cedar and Evergreen Rooms*

<p>WSC Presentations</p> <p>3:30-3:35 Introduction</p> <p>3:35-3:55 Declining Streamflows Reveal Decreasing Orographic Precipitation Enhancement Driven by Reduced Westerly Flows. Charles Luce, Rocky Mountain Research Station, U.S. Forest Service.</p> <p><u>Observed Trends in Snowpack Conditions</u></p> <p>3:55-4:15 Solar Forcing of Drought Detected in Snowfall Records of the Central Sierra Nevada, Western United States. John Kleppe, University of Nevada, Reno.</p> <p>4:15-4:35 Increasing Aeolian Dust Deposition to Snowpacks in the Rocky Mountains Inferred from Snowpack, Wet Deposition, and Aerosol Chemistry. David Clow, USGS.</p> <p>4:35-4:55 Has the Annual Point Snowfall on the Canadian Prairie Increased or Decreased? Harold Steppuhn, Retired from Swift Current Research and Development Centre, Agriculture and Agri-Food Canada.</p> <p>4:55-5:00 Q&A</p>	<p>WMA Presentations</p> <p>3:35-3:40 Organization Updates: Stephanie Beall, President Elect WMA.</p> <p>3:40-4:00 Redesign of the Weather Modification Association Website: Erin Fisher.</p> <p>4:00-4:10 ASCE/EWRI Atmospheric Management Standard Committee Update and WMA MOU. Tom DeFelice, ASCE/EWRI AWM SC.</p> <p><u>Aerosols Introduction; Session Chair: Archie Ruiz</u></p> <p>4:10-4:30 Aerosols 102. Tom DeFelice, ASCE/EWRI AWM SC.</p> <p>4:30-4:50 Setup of the Pi Cloud Chamber for Cloud Seeding Flare Testing. David Delene, University of North Dakota.</p> <p>4:50-5:00 Q&A</p>
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5:30-7:30 **"Know your Snow" Public Forum at Jack's Urban Meeting Place (JUMP)**
Please join us for beer, wine, and appetizers at an open public meeting one block west of the Grove Hotel. This forum will include a panel of presenters discussing cloud seeding, snow science, and winter recreation.

5:30-7:30 **WMA Executive Board Meeting** - *River Fork Room*

Wednesday April 19

7:00-8:00 **Breakfast Buffet (All registered conference participants)** *River Fork Room*

8:00-1:00 **Guest Breakfast and Tour**

Guests of registered conference participants invited to a complimentary breakfast at Emilio's Restaurant and a tour of the World Center for Birds of Prey, 45 minutes south of Boise. Transportation provided.

Presentations Session II

8:00-9:30 **Concurrent Technical Sessions** *Aspen/Cedar and Evergreen Rooms*

<p>WSC Presentations <u>Snow Modeling</u> Session Chair Vince Matthews</p> <p>8:00-8:10 Opening Comments and Announcements</p> <p>8:10-8:30 High Resolution Climate Modeling of the Water Cycle over the Western United States Including Potential Climate Change Impacts. Roy Rasmussen, National Center for Atmospheric Research.</p> <p>8:30-8:50 Are Model Transferability and Complexity Antithetical? Insights from Validation of a Variable-complexity Snow Model on New Conditions in Space and Time. Abigail Lute, Rocky Mountain Research Station, U.S. Forest Service.</p> <p>8:50-9:10 Cold Content and Snowmelt Dynamics in the Alpine and Subalpine, Niwot Ridge, Colorado. Keith Jennings, Institute of Arctic and Alpine Research, University of Colorado–Boulder.</p> <p>9:10-9:30 Disentangling the Importance of Snowmelt Rate, Timing, and Amount on Runoff Production. Theodore Barnhart, Institute of Arctic and Alpine Research, Center for Water, Earth Science, and Technology, University of Colorado–Boulder.</p>	<p>WMA Presentations <u>Technology and Weather Modification Equipment</u> Session Chair Bruce Boe</p> <p>8:00-8:10 Opening Comments and Announcements</p> <p>8:10-8:30 Tech and Innovations Wxmod XVII. Tom DeFelice, ASCE/EWRI AWM SC.</p> <p>8:30-8:50 Prototype Methodology for Obtaining Cloud Seeding Guidance from HRRR Model Data. Nicholas Dawson, University of Arizona and Idaho Power Company.</p> <p>8:50-9:10 Calibration Uncertainties in the Droplet Measurement Technologies Cloud Condensation Nuclei Counter. Kurt Hibert, University of North Dakota.</p> <p>9:10-9:30 An Airborne Narrow-Beam Side Scanning G-Band Radiometer. Rick Stone, RHS Consulting, Ltd.</p>
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9:30-10:00 **WSC and WMA Break: Poster Sessions (listed on pages 7 and 8) and Vendor Exhibits** *The Landing*

10:00-11:30 **Concurrent Technical Sessions, continued** *Aspen/Cedar and Evergreen Rooms*

<p>WSC Presentations</p> <p>10:00-10:05 Introduction</p> <p>10:05-10:25 Assessment of Gridded Precipitation Estimates in the Interior Western United States using a Regional Climate Simulation. Bart Geerts, University of Wyoming.</p>	<p>WMA Presentations <u>Modeling</u> Session Chair Dan Gilbert</p> <p>10:00-10:20 WMI Modeling Update: Utilization of 3 km WRF and HYSPLIT for Wintertime Project Forecasting. Adam Brainard, Weather Modification International.</p>
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<p>10:25-10:45 How Snow Modeling Decisions Affect Simulated Snow Surface Temperature. Karl Lapo, University of Washington.</p> <p>10:45-11:05 Sensitivity of Snow and Hydrological Dynamics to Climate in a Catchment Characterized by Wind-driven Redistribution of Snow. Adrienne Marshall, University of Idaho.</p> <p>11:05-11:25 First Operational Application of an Energy Balance Snow Model for Water Management. Scott Havens, U.S. Bureau of Reclamation.</p> <p>11:25-11:30 Q&A</p>	<p>10:20-10:40 Summary of the Performance of the NCAR Wintertime AgI Seeding Case-calling Algorithm: 2012 to 2017. Lulin Xue, National Center for Atmospheric Research.</p> <p>10:40-11:00 WRF Model Case Studies of Cloud Seeding over the Bighorn Mountains in Wyoming. Roy Rasmussen, National Center for Atmospheric Research.</p> <p>11:00-11:20 Evaluating the Dispersion of AgI in WRF Cloud Seeding Simulations Using Silver-in-snow Samples Collected Downwind of the Payette Basin. Lulin Xue, National Center for Atmospheric Research.</p> <p>11:20-11:30 Q&A</p>
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11:30-1:00 **WMA: Hans Ahlness Memorial Luncheon (RSVP required)** *River Fork Room*

11:30-1:00 **Lunch** (on your own)

Presentations Session III

1:00-2:30 **Concurrent Technical Sessions** *Aspen/Cedar and Evergreen Rooms*

<p>WSC Presentations Session Chair Abigail Lute</p> <p>1:00-1:05 Introduction</p> <p>1:05-1:25 A Topographically Resolved Snow, Drought and Wildfire Danger Monitoring System for the Conterminous United States. Zachary Holden, U.S. Forest Service.</p> <p><u>Direct Measurement and Remote Sensing of Snow Cover</u></p> <p>1:25-1:45 Evaluating the Impact of Blowing Snow and Avalanche Redistribution on Modeling Alpine Snowpack and Snow Covered Area over the Canadian Rockies. Nicholas Wayand, Centre for Hydrology, University of Saskatchewan.</p> <p>1:45-2:05 Effect of the Tree Canopies in Microwave Radiometric Remote Sensing of Snowpack. Seyedmohammad Mousavi, University of Michigan.</p> <p>2:05-2:25 Mega-Snowstorms Follow Epic Drought in the Sierra Nevada. Noah Molotch, University of Colorado-Boulder.</p> <p>2:25-2:30 Q&A</p>	<p>WMA Presentations <u>Summer Season Operations and Analysis</u> Session Chair Mark Schneider</p> <p>1:00-1:20 Hygroscopic Seeding in Texas: Building a Conceptual Model and Evaluation of Seeding. Jonathan Jennings, West Texas Weather Modification Association.</p> <p>1:20-1:40 An Overview of 2016 Rainfall Enhancement Activities in Texas: A More Intensive Use of Hygroscopic Material. Kendell LaRoche, South Texas Weather Modification Association.</p> <p>1:40-2:00 Rocketry and Hail. Archie Ruiz, Active Influence and Scientific Management.</p> <p>2:00-2:20 Targeting the Critical Window of Opportunity during Hygroscopic Seeding. Roelof Burger, North-West University.</p> <p>2:20-2:30 Q&A</p>
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- 2:30-3:00 **WMA Break: Poster Sessions (listed on pages 7 and 8) and Vendor Exhibits** *The Landing*
- 2:30-3:10 **WSC Break: Poster Sessions (listed on pages 7 and 8) and Vendor Exhibits** *The Landing*
- 3:00-5:00 **Concurrent Technical Sessions, continued** *Aspen/Cedar and Evergreen Rooms*

<p>WSC Presentations</p> <p>3:10-3:30 Using Structure from Motion to Map Snow Cover Variations in the Little Cottonwood Canyon, Utah. Jeremy Andreini, Department of Earth Science, Utah Valley University.</p> <p>3:30-3:50 Using Ground Penetrating Radar to Assess the Variability of Snow Water Equivalent and Melt in a Mixed Canopy Forest, Northern Colorado. Ryan Webb, University of Colorado–Boulder.</p> <p>3:50-4:10 Constraining Physical Controls on Snow Hydrology along the Wasatch Front, Utah. S. McKenzie Skiles, Department of Earth Science, Utah Valley University.</p> <p>4:10-4:30 The Influence of Cloudiness, Temperature and Precipitation Variabilities on Snowmelt and Streamflow Variations in the Western U.S. Edwin Sumargo, Scripps Institution of Oceanography.</p> <p>4:30 Close Technical Session</p>	<p>WMA Presentations</p> <p><u>Methods and Evaluations of Weather Modification Operations</u></p> <p>Session Chair Jonathan Jennings</p> <p>3:00-3:20 West Texas Numbers Revisited: Looking for Long Term Modification Patterns. Archie Ruiz, Texas Tech University.</p> <p>3:20-3:40 Cloud Seeding Increased Runoff/Cost Analysis in Utah. Candice Hasenyager, Utah Department of Water Resources.</p> <p>3:40-4:00 Does the 2016 Gap in San Joaquin River Runoff Show Cloud Seeding Works? Maurice Roos, California Department of Water Resources.</p> <p>4:00-4:20 Statistical Analysis of the Polarimetric Cloud Analysis and Seeding Test (POLCAST) Field Projects. Jamie Ekness, University of North Dakota.</p> <p>4:20-4:40 An Assessment of HAILCAST Performance in Western North Dakota. Shawn Wagner, University of North Dakota.</p> <p>4:40-5:00 Q&A</p> <p>5:00 Close Technical Session</p>
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- 4:30-5:00 **WSC General Membership Business Meeting**
- 6:00-7:00 **No Host Hospitality Hour** *The Terrace*
- NAWMC Silent Auction** *The Terrace*
- 7:00-9:30 **Conference Banquet and Awards, Vendor Door Prize Drawing** *Ballroom*
Speaker: Brad Wilson, General Manager, Bogus Basin Recreation Area
 "Ski Area Management Challenges in a Changing Climate"

Visit Posters and Vendor Exhibits during Breaks *The Landing*

Poster Listing

1. **Remotely Automated Snow Sampling Device – RASSD.** Brandal Glenn, Idaho Power Company.
2. **Selecting Representative Snow Measurement Locations in Forested Watersheds: Evaluating the Potential Benefit of Lower Cost Sensors.** Rosangela Carreon, University of Nevada, Reno.
3. **Tracking Snow Accumulation Based on Storm Trajectory and Mountain Topography.** Jeremy Saldivar, Department of Earth Science, Utah Valley University.
4. **A Spatial and Temporal Analysis of Snow Albedo, Impurities, and Radiative Forcing across a Regional Scale in the Western United States.** Janelle Gherasim, Department of Earth Science, Utah Valley University.
5. **Ice Cover Duration and Timing of Ice Break Up on Utah Lake and the Implications for Ecohydrology and Phenology.** Hannah Peterson, Department of Earth Science, Utah Valley University.
6. **Evaluation of Remotely-Sensed Snow Water Equivalent and Snow Cover for the Continental United States.** Nicholas Dawson, University of Arizona and Idaho Power Company.
7. **Multi-channel Ice Penetrating Radar Traverse for Estimates of Firn Density in the Percolation Zone, Western Greenland Ice Sheet.** Tate Meehan, Department of Geosciences, Boise State University.
8. **Trends in Snow Line Elevation along the Wasatch Front, Utah from MODIS Fractional Snow Covered Area.** Dustin Joe, Department of Earth Science, Utah Valley University.
9. **Snow, Cold, and Winter: What Does that Mean for Canada in the 20 th and 21 st Centuries?** Jerry Toupin, Canadian Federal Government.
10. **Recent Changes in Southern Sierra Snowpack.** Maurice Roos, California Department of Water Resources.
11. **Optimizing Snowpack Conditions in the Valles Caldera National Preserve, New Mexico: An Investigation of Canopy Density and Stand Type Influence on Snow Hydrology in the Southwestern U.S.** Angela Gregory, University of New Mexico.
12. **Assessing the Impact of Atmospheric Forcing Data on Snowmelt Processes by Performing a Global Sensitivity Analysis on a Physically Based Snow Model.** Miguel Aguayo, Boise State University.
13. **Now You See It, Now You Don't: The Influence of Climate and Topography on Snow Seasonality.** Rose Petersky, University of Nevada, Reno.
14. **Physical Evaluation of Agl Targeting in Central Idaho.** James Fisher, Boise State University.
15. **SnowSchool Program and Weather Station Pilot Project.** Kerry McClay, Winter Wildlands Alliance.
16. **Towards a New High-resolution Global Snow Re-analysis over the Landsat Record.** Gonzalo Cortes, Civil and Environmental Engineering Department, UCLA.
17. **The Influence of Forest Canopy Structure on Snow Interception: Design and Implementation of a New Model.**
David Moeser, USGS.
18. **High-Elevation Evapotranspiration Estimates during Drought: Using Streamflow and NASA Airborne Snow Observatory SWE Observations to Close the Upper Tuolumne River Basin Water Balance.** Brian Henn, Scripps Institute of Oceanography, UCSD.

19. **Snow Water Equivalent Measurement Using Cosmic Ray Neutrons.** Randall Osterhuber, UCB Central Sierra Snow Laboratory.
20. **Orographic Influences on Ridge-Top Ice Detector Data.** David Yorty, North American Weather Consultants, Inc.
21. **World-Class Airborne Platform for Weather Modification and Atmospheric Research.** Kurt Hibert, University of North Dakota.

Thursday April 20

7:30-9:00 **WMA Business Meeting** *Cattails Room*

9:00-5:00 **Technical Tour: Join us for a look at snow and water resource management in the Boise River Basin. The tour includes a visit to the Dry Creek Experimental Watershed research sites, an NRCS SNOTEL site, and a collaborative weather station for youth education. Sites may require walking 5-15 minutes. Lunch is provided.**

Thanks to Our Sponsors

The Western Snow Conference and the Weather Modification Association would like to thank the following sponsors. Without their support, a successful conference would not have been possible.

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USDA Natural Resources Conservation Service
Weather Modification International
Winter Wildland Alliance