

# AMS 2015 Summer Community Meeting Summary Report

August 3-6 • North Carolina State University • Raleigh, NC

## Executive Summary

The American Meteorological Society (AMS) Summer Community Meeting (SCM) provides a unique opportunity for leaders across government, academia, and private industry to come together to learn from each other, discuss challenges and issues needing attention, and identify opportunities for collaboration. In early August, 2015, on the campus of North Carolina State University, members of the Weather, Water, and Climate Enterprise [Enterprise] came together to discuss “[our moonshot moment](#)”, a modern day grand challenge to improve the end-to-end warning paradigm.

In the spirit of collaboration, the SCM [Meeting] began on the evening of Monday, August 3 with a Sponsor Recognition and Student Networking event made possible by Panasonic, the SCM’s Premier Sponsor. Principal Sponsors of the 2015 SCM included: AccuWeather and The Weather Company. CLS America, Earth Networks and Vaisala served as General Sponsors. We thank them all along with the AMS family for making the Meeting possible.

Formal sessions began on the morning of Tuesday, August 4, as 125 participants convened at the Hunt Library on the Centennial Campus of North Carolina State University to explore the 2015 SCM Theme:

*For the Greater Good: Strengthening Collaboration, Consistency & Trust  
To Support Informed Decision-Making*

In this context, the Meeting was designed to focus on three inter-related aspects of Enterprise activities:

- Improving how weather, water, and climate threats are predicted and communicated;
- Enhancing information for risk management decisions through better expression of urgency, confidence, and variability; and
- Supporting appropriate actions by the public.

Through presentations by several notable keynote speakers, panel discussions and wide-ranging dialogue among participants, the 2015 SCM provided an opportunity to explore the inter-dependent and interactive elements of successfully moving from forecasts to risk management including:

- Observations and modeling to support the development of skilled and effective forecasts;
- Successful communication of those forecasts;
- Associated development and dissemination of risk assessments and decision support information; and
- Supporting the public and decision-making communities as they take actions to appropriately manage those risks.

It was clear throughout the Meeting that this shared challenge and opportunity requires the Enterprise to think and act Enterprise-wide with contributions from public, private, and academic partners across multiple disciplines with the sustained engagement of the public.

The 2015 SCM agenda enabled participants to discuss a number of topics related to the Meeting's theme:

- Innovative Methods to Forecast Environmental Threats with an opportunity to explore the NOAA Forecasting a Continuum of Environmental Threats (FACETs) approach to probabilistic forecasting;
- Storm-scale Observations and Storm-scale Guidance in this context;
- The Future Role of the Forecaster through an interactive session that enabled participants to be forecasters utilizing concepts from this new approach;
- Forecast and Model Advancements in and for the energy sector and stretching the limits of modeling from mesoscale to microscale areas of study as well as a Pathfinder Applications effort for the transportation sector;
- Risk Communications for both short-term extreme events as well as significant events that take longer to evolve;
- Risk Perception and User Response; and
- Outcome-Based Verification.

After a closing presentation by co-chair Eileen Shea highlighting some of the insights that emerged during the week, participants discussed challenges that exist and potential follow-on activities for consideration by the Society. Participants believed that these potential activities would help the Enterprise continue the evolution of this new forecasting paradigm and a collaborative approach to communications, risk management and decision-making:

- Provide a forum for further discussion on the roles of both private and public sector forecasting communities in the new paradigm;
- Consider establishment of a "virtual homeroom" to document social science studies and best practices in the context of actionable information;
- Increase the use of visualizations and simulations in education and training;
- Focus on continuing/adult education and professional development as well as formal education of future generations;
- Build on successes in weather communications and the natural link with weather events when talking about changing climate;
- Facilitate access to data for and experiences with probabilistic forecasting and applications;
- Expand opportunities for shared learning associated with long-duration, slowly-evolving events (droughts, heatwaves, extended periods of flooding or storminess);
- Ensure broad engagement across the Enterprise and with core partners and users as the NOAA FACETs program evolves;
- Be intentional about including social scientists in day-to-day activities, research and discussion;
- Collect and integrate user needs early and continuously in the development of new forecasting systems and information products aimed to drive their costs down and support the nation's commerce;
- Be proactive in engaging with end users and learning about their work and decision-making frameworks;
- Expand efforts to develop and use disposable sensors in the context of observing systems;
- Work closely with the academic community to facilitate active learning and inquiry-based education, including considering possible modifications to undergraduate training to better

prepare the next generations of participants in a world of probabilistic and impacts-based forecasting and applications.

The 2015 SCM agenda, presentations and closing summary are posted on the [AMS BEC/SCM website](#) so that participants and the broader community can share, use, and build on the Meeting's discussions in their own work and to advance the work of the Enterprise as a whole.

Two additional activities followed the formal closing of the 2015 SCM on August 6. That afternoon, interested participants were invited to learn more about the [NOAA Big Data CRADA](#) announced earlier this year by Secretary of Commerce Penny Pritzker. Information was shared by a panel moderated by Matt Parker (Savannah River National Laboratory) that included: Brian Eiler (NOAA), Dr. Sandy MacDonald (current AMS President and NOAA scientist), Ariel Gold (Amazon Web Services), Dr. Mohan Ramamurthy (Open Cloud Consortium), Dr. Leanne Haselden (Global Business Services, IBM) and Paul Pisano (AMS Committee on Open Environmental Information Services).

Thursday evening, the North Carolina Museum of Natural Sciences hosted a public event entitled: "It's Tough to Make Predictions...Especially about the Future." Moderated by Nate Johnson (WRAL-TV), this event provided a public outreach forum in which five of the SCM participants were able to share their own experiences and many of the insights developed during the Summer Community Meeting. Additional information about this exciting outreach event can be found at the Museum's URL: <http://www.naturalsciences.org/>

A video recording of the event can be viewed at: <https://youtu.be/DN1Xc2zz-YA>

## Meeting Report

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*For the Greater Good: Strengthening Collaboration, Consistency & Trust  
To Support Informed Decision-Making*

In this context, the Meeting was designed to focus on three inter-related aspects of the Weather, Water, and Climate Enterprise [Enterprise] activities:

- Improving how weather, water and climate threats are predicted and communicated;
- Enhancing information for risk management decisions through better expression of urgency, confidence and variability; and
- Supporting appropriate actions by the public.

Through presentations by several notable keynote speakers, panel discussions and wide-ranging dialogue among Meeting participants, the 2015 SCM provided an opportunity to explore the inter-dependent and interactive elements of successfully moving from forecasts to risk management including:

- Observations and modeling to support the development of skilled and effective forecasts;
- Successful communication of those forecasts;
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- Supporting the public and decision-making communities as they take actions to appropriately manage those risks.

It was clear throughout the Meeting that this shared Enterprise challenge and opportunity requires us to think and act Enterprise-wide involving public, private and academic partners across multiple disciplines with the sustained engagement of the public.

The 2015 SCM agenda enabled participants to discuss a number of topics related to the Meeting's theme:

- Innovative Methods to Forecast Environmental Threats with an opportunity to explore the NOAA FACETs approach to probabilistic forecasting;
- Storm-scale Observations and Storm-scale Guidance in this context;
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- Risk Communications for both short-term extreme events as well as significant events that take longer to evolve;
- Risk Perception and User Response; and
- Outcome-Based Verification.

The Final Agenda and List of Participants for the 2015 Summer Community Meeting are included as Attachments A and B to this Summary Report.

The recording and pdf version of the Opening Keynote presentation by Dr. Gary Lackmann is available at:

<https://ams.confex.com/ams/2015AMSSCM/webprogram/Session39299.html>

The recording and pdf version of Keynote #2 presentation by Dr. Louis Uccellini is available at:

<https://ams.confex.com/ams/2015AMSSCM/webprogram/Session39300.html>

### **Insights from Individual Sessions**

Appendix C to this Report provides daily summary notes developed by student participant volunteers and reviewed by the Chair/Co-Chair for each Session. We hope that they will provide readers with some of the insights and questions that arose during each session.

### **Some Shared Ideas**

Following the final formal session on Day 3, participants joined the SCM Co-Chairs in reviewing some of the key insights and shared ideas that emerged during the week. Participants confirmed the importance of “Collaboration, Consistency and Trust” across the Enterprise as critical to successful efforts to support decision-making in the context of the SCM’s three themes.

In this context, participants encouraged broad and creative collaborations that recognize that one size doesn’t fit all in terms of decision-making in individual sectors and communities. Many actors share responsibility for action which requires an approach built on trust and respect for the intrinsic capabilities of individuals and institutions and the sustained engagement and empowerment of these actors in a shared endeavor. Participants highlighted the key role of trusted information brokers (e.g., broadcast meteorologists, local forecasting office personnel, university partners and key partners in sectors and communities.

Participants encouraged a probabilistic, impacts-based forecasting approach with emphasis on developing and conveying simple, consistent and actionable information to support decision-making including information on what, where, when, duration, history and confidence. In this context, participants found that the NOAA FACETs program (led by NOAA’s Office of Oceanic and Atmospheric Research) was an exciting opportunity to accelerate movement in this direction. Participants identified a number of suggestions with respect to successful communication including:

- Understanding the chain of communications and action;

- Investing time and energy in a program of sustained engagement with core partners and “first receivers” over time – invest in the process and the positions not just the individual in place today;
- Keeping the message simple and “don’t bury the lead;”
- Remembering the importance of conveying the three Cs: comfort, confidence, competence;
- Recognizing that most of our users are interested in confidence (not “uncertainty”);
- Addressing considerations of culture, language and behavior both within the Enterprise and with users.

Effective communication to support action involves insights from the Enterprise plus practitioners and expertise in communications, risk perception, risk management, decision support, social sciences, graphics, visualization, computer sciences and users. In this context, participants encouraged recognition of practices and tools that continue to work well while also embracing emerging tools like social media in effective ways. Partnerships are essential including:

- Within and among forecasting communities – public and private;
- Between and among forecasters, communicators and users;
- Between and among observational, research, modeling, forecasting and risk management communities; and
- Across multiple disciplines and constituencies.

Successful partnerships are built on problem- and process-focused approaches that recognize that we are all in this endeavor for the long-term. Participants highlighted the need for careful selection/development of metrics for verification including:

- Verification in a scientific sense – traditional and emerging measures/outputs;
- Documenting and verifying outcomes in the context of applications, benefits and uses;
- An understanding of users’ decision-making models, tolerance and thresholds; and
- A dynamic, evolutionary approach with feedback among partners and decision-makers.

Early in the 2015 SCM and again in the closing plenary, participants highlighted some requirements for forecasters of the future:

- An educational system that prepares them for the technology and tools that they will use as well as understanding of meteorology;
- Collaboration with social scientists – both in education and practice;
- Insights into risk perception, risk communication and risk management; and
- A broad and diverse family of core partners.

Ensuring that these requirements are met requires thinking and acting Enterprise- and Society-wide with a continuing and evolving dialogue.

### **Opportunities for Shared Action**

During the closing plenary, participants then helped to identify a set of potential follow-on actions for consideration by the Society. The focus of discussion was on both pursuing some “low-hanging fruit” as well as longer-term contributions to the pursuit of the Meeting theme. Participants believed that these potential activities could help the AMS and the Enterprise continue the evolution of this new forecasting paradigm and a collaborative approach to communications, risk management and decision-making. They are offered here as raised during the closing plenary, with minimal editing and without priorities, for consideration by participants, the Board on Enterprise Communication (BEC) and the Commission the Weather, Water, and Climate Enterprise (CWWCE), AMS boards and committees, and Society membership, leadership, and partners:

- Provide a forum for further discussion of the roles of both private and public sector forecasting communities in the new paradigm;
- Consider establishment of a “virtual homeroom” to document social science studies and best practices in the context of actionable information;
- Increase the use of visualizations and simulations in education and training;
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- Expand efforts to develop and use disposable sensors in the context of observing systems;
- Work closely with the academic community to facilitate active learning and inquiry-based education, including considering possible modifications to undergraduate training to better prepare the next generations of participants in a world of probabilistic and impacts-based forecasting and applications.

### **Affiliated Special Events**

Two additional activities followed the formal closing of the 2015 Summer Community Meeting on August 6. That afternoon, interested participants were invited to learn more about the NOAA Big Data CRADA announced earlier this year by Secretary of Commerce Penny Pritzker. Information was shared by a panel moderated by Matt Parker that included: Mr. Brian Eiler (NOAA), Dr. Sandy MacDonald (current AMS President and NOAA scientist), Ms. Ariel Gold (Amazon Web Services), Dr. Mohan Ramamurthy (Open Cloud Consortium), Dr. Leanne Haselden (Global Business Services, IBM) and Mr. Paul Pisano (AMS Committee on Open Environmental Information Services). For additional inquiries to this event, please email Douglas Hilderbrand ([douglas.hilderbrand@noaa.gov](mailto:douglas.hilderbrand@noaa.gov)).

Thursday evening, the North Carolina Museum of Natural Sciences hosted a public event entitled: “It’s Tough to Make Predictions...Especially about the Future.” Moderated by Nate Johnson (WRAL TV), this event provided a public outreach forum in which five of the SCM participants were able to share their own experience and many of the insights developed during the Summer Community Meeting. Additional information about this exciting outreach event can be found at the Museum’s URL: <http://www.naturalsciences.org/>

A video recording of the event can be viewed at: <https://youtu.be/DN1Xc2zz-YA>

### **Looking Ahead to 2016**

The closing plenary session on August 6, 2015 provided an opportunity for participants to hear about and discuss initial plans for the 2016 Summer Community Meeting focused on water. As currently envisioned, the 2016 SCM would explore issues related to water as a driver for both

- Societal action in areas like risk management for extremes, resource stewardship, community and infrastructure planning (including green infrastructure), and addressing the broad and central role that water plays for livelihoods and community resilience; and
- Society (AMS) action to envision and implement an Enterprise that embraces water equally with weather and climate.

AMS staff and BEC leadership are targeting Tuscaloosa, AL as the site for the 2016 meeting in order to capitalize on the emergence of the new NOAA National Water Center. Current thinking, in part informed by discussions at the 2015 Summer Community Meeting, suggest that the 2016 SCM will provide an opportunity to explore real-world insights from practitioners/end users, public and private information providers, observational communities, and scientific communities in diverse fields including physical, natural and social sciences as well as communications and risk management. Together, participants will help identify key water challenges and jointly develop some suggested solutions.

The 2015 SCM participants also provided some functional considerations for 2016 including:

- Provide more flexible time for networking;
- Ensure sufficient time to discuss next steps and opportunities to maintain the momentum initiated during panels and in plenary;
- Mix social sciences with physical and natural sciences throughout the meeting; and
- Develop actionable follow-up activities and identify a path for pursuing them.

The BEC membership and organizing committee for 2016 will bear these suggestions in mind as planning begins in earnest.

Since the 2015 SCM ended, the AMS Council has endorsed the idea of water as the theme for 2016. The BEC, CWWCE, and the AMS Policy Program will be co-sponsoring a Town Hall during the AMS Annual Conference in New Orleans (January 13, 2016) to elicit and explore community-wide insights and ideas about the theme and broader AMS activities in the water arena. PLEASE PLAN TO JOIN US!

# 2015 AMS Summer Community Meeting

August 3-6, 2015 Raleigh, NC

*For The Greater Good:*

*Strengthening Collaboration, Consistency, and Trust to Support Informed Decision Making*



Keynote Speakers:

- Dr. Gary Lackmann, NC State University
- Dr. Louis Uccellini, Director, National Weather Service

*The value of weather, water, and climate information is reflected in the decisions that are made, actions that are taken, and outcomes that result. The 2015 AMS Summer Community Meeting will bring government, academia, and industry together to identify opportunities to collaborate, increase consistency, and build greater trust within the Enterprise and outward to the public. Join us as we take a giant leap toward...*

- *Improving how weather, water, and climate threats are predicted and communicated.*
- *Enhancing information for risk management decisions through better expression of urgency, confidence, and variability.*
- *Supporting appropriate actions by the public.*

**This meeting is organized by the American Meteorological Society's Commission on Weather, Water, and Climate Enterprise Board on Enterprise Communication. Register at: [www.ametsoc.org](http://www.ametsoc.org)**



## **TIMES SUBJECT TO CHANGE**

### **Monday, August 3**

6:00-8:00 p.m. Registration      Holiday Inn Express & Suites Raleigh SW NC State  
3741 Thistledown Drive  
Raleigh, North Carolina 27606

Icebreaker:      Sponsor Recognition and Student Networking Event  
Location: Sammy's Bar & Grill  
2235 Avent Ferry Road, Raleigh 27606

### **Tuesday, August 4**

7:30 a.m.      REGISTRATION/COFFEE AND TEA

8:15 a.m.      Kickoff Remarks:      Eileen Shea and Douglas Hilderbrand (AMS BEC Co-Chairs)  
Welcome:      Walt Robinson (NC State University Marine, Earth, and Atm.  
Science Department Chair)  
Keynote #1:      Louis Uccellini (NWS Director)  
Keynote #2:      Gary Lackmann (NC State University, Professor and Director of  
Graduate Programs)

9:45 a.m.      AMS Summer Community Meeting 2014 Highlights: Betsy Weatherhead (Former BEC  
Chair)

10:00 a.m.      BREAK

**10:30 a.m.      Session #1: Innovative Methods to Forecast Environmental Threats**  
*'Grid-based, threat probability forecasting as a paradigm shift to how the enterprise forecasts  
environmental threats'*

Panelists:

- Session Lead: John Ferree (NWS/Office of Analyze, Forecast, Support)
- Jon Porter (AccuWeather)
- Christopher Strager (NWS Central Region Director)
- Lans Rothfus (OAR/National Severe Storms Laboratory)
- Jonathan Blaes (NWS WFO Raleigh)

12:00           **LUNCH**

Guest Speaker: Dr. Montse Fuentes (Head, Dept. of Statistics, NC State University) on “Human Health Impacts of Extreme Weather and Air Pollution: What Big Data Tell Us”

**1:15 p.m.       Session #2: Storm-scale Observations**

*“Exploration of a broad array of observational systems that is needed for improved storm-scale numerical guidance”*

Panelists:

- Session Lead: Neil Jacobs (Chief Scientist, Panasonic Avionics)
- Aaron Sims (Assistant State Climatologist of NC)
- Tye Parzybok (President, MetStat Inc.)
- Marty Bell (Dir. of Research, WeatherFlow)

2:45 p.m.       **BREAK**

**3:15 p.m.       Session #3: Storm-scale Guidance**

*“Output from numerical and statistical analyses applied to probabilistic hazard forecasting (e.g., Warn-on-Forecast)”*

Panelists:

- Session Lead: Lans Rothfusz (OAR/NSSL)
- Matt Parker (NC State University)
- Corey Potvin (University of Oklahoma/CIMMS)
- Kiel Ortega (University of Oklahoma/CIMMS)
- Neil Jacobs (Panasonic Avionics)

**4:30 p.m.       Session #4: Future Role of Forecaster (Interactive Exercise)**

*“Discussion of where the value of the forecaster will reside as weather, water, and climate services evolve”*

Panelists:

- Session Lead: Lans Rothfusz (OAR/NSSL)
- Don Berchoff (Metraweather)
- Gary Lackmann (NC State University)
- Nick Petro (NWS WFO Raleigh)
- Harold Brooks (OAR/NSSL)

6:00 p.m. ADJOURN FOR THE DAY

## Wednesday, August 5

8:15 a.m. AMS Joint Broadcasters/Communications Conferences Summary: Nate Johnson, WRAL-TV Raleigh, NC

8:30 a.m. **Session #5: Forecast and model advancements in support of the nation's economy**  
"Tools forecasters use to create useful climate/renewable energy forecasts"

Panelists:

- Session Lead: Joel Cline, Department of Energy
- Jeff Freedman (Research Associate, State University of New York at Albany)
- Jim Wilczak (OAR/PSD)
- Russ Bullock (Environmental Protection Agency)
- Tanya Spero (Environmental Protection Agency)

10:00 **BREAK**

10:30 a.m. **Session #6: Risk Communication I (language, format, consistency in short-term)**  
"Clearly articulated, risk-based hazard information (containing uncertainty and impact information) focusing on short-fused events, e.g., tornadoes"

Panelists:

- Session Lead: Erica Grow (WUSA-TV, Washington, D.C.)
- Tom Birkland (Professor of Public Policy, NC State University)
- Jeannette Sutton (Professor, University of Kentucky, Director of the Division of Risk Services)
- Matthew Merritt (Novant Health)
- Sam Hodge (Emergency Manager, Georgetown County, SC)

Noon **LUNCH**

Guest Speaker: Dr. Jennifer Martineau Vice President (Research, Innovation, and Product Development: Americas Center for Creative Leadership) on "How to Build A Better Work-Life Fit for You and Your Organization"

1:15 p.m. **Session #7: Risk Communication II (language, format, consistency in longer-fused events)**

"Clearly articulated, risk-based hazard information (containing uncertainty and impact information) focusing on long-fused events, e.g., drought"

Panelists:

- Session Leads: Burrell Montz (East Carolina University) and Susan Jasko (California University of Pennsylvania)
- Mike Daniska (Plans and Homeland Security Chief in the NC Office of Emergency Management)
- Jamie Rhome (National Hurricane Center)
- Mark Venters (GE-Hitachi Nuclear Energy)

2:45 p.m. BREAK

**3:15 p.m. Session #8(a): Transportation Pathfinder: Improving Collaboration between State Departments of Transportation and the Weather Enterprise**

Panelists:

- Session Lead: Brenda Boyce, Booz/Allen/Hamilton
- Kevin Cox (Wyoming Dept. of Transportation)
- Chad Hahn (NWS WFO Cheyenne)
- Julie Gondzar (DayWeather, Inc.)

**4:15 p.m. Session #8(b): Risk Perception and User Response**  
 “Gaining agreement as to what “effective and appropriate” end-user response might be”

Panelists:

- Session Lead: Derek Arndt (Chief Climate Monitoring Division, National Centers for Environmental Information)
- Linda Rimer (Environmental Protection Agency)
- Kim Klockow (UCAR)
- Amanda Johnson Bryant (FEMA)
- Wendy Marie Thomas (NWS Office of Analyze, Forecast, Support)

**6:30 p.m. AMS SUMMER COMMUNITY MEETING BANQUET**

- Keynote Dinner Speaker: Sandy MacDonald, AMS President *“Our Science: Protecting the Public in the 21st Century”*

**Thursday, August 6**

**8:30 a.m. Session #9: Outcome-based Verification**

“Improved verification methods would provide more useful insight into forecaster training needs and the overall threat forecasting process”

Panelists:

- Session Lead: Brian Etherton (OAR/ESRL Global Systems Division)
- Robert S. Lee (Vice President, AvMet Applications Inc.)
- Robyn Heffernan (Incident Meteorologist, National Weather Service)
- Barbara Brown (Joint Numerical Testbed, NCAR)

10:00 a.m. Group Discussion reflecting back on SCM Theme

11:00 a.m. Closing Remarks: Eileen Shea, Douglas Hilderbrand, and Mary Glackin

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1:00p.m. - 4 p.m

## **The NOAA Big Data CRADA and YOU!**

***Thursday August 6th, 2015, The Hunt Library, NC State University, Raleigh, NC***

NOAA’s big data collaboration project, established through Cooperative Research and Development Agreements (CRADAs) with Amazon Web Services, Google Cloud Platform, IBM, Microsoft, and Open Cloud Consortium, stands to impact the weather, water and climate enterprise dramatically. The AMS Commission on the Weather, Water and Climate Enterprise and NOAA are convening a panel discussion to cover the goals of the CRADAs and to encourage input from the audience to answer the following key questions:

- Do you know all of the datasets which are available from NOAA? Do you know where to find out what they are?
- How do we discern between what is available and what is possible?
- If you had access to all NOAA data servers, which data sets would you choose? And why?
- What expected benefit would these data sets provide the enterprise and your organization?
- How does the CRADA initiative help the government better serve the enterprise?
- What next steps should the enterprise now pursue after today’s panel?

The discussion will be targeted to extensive audience participation after brief opening comments. After the panel discussion concludes, CRADA representatives and attendees will have ample networking time to continue the dialog with each other. Your participation will impact the discussion!

## **PANELISTS**

**Moderator, Matthew J Parker, CCM**

Senior Fellow Meteorologist, Savannah River National Laboratory, Aiken, SC

Past Commissioner, AMS Commission on the Weather, Water and Climate Enterprise

**Dr. Sandy MacDonald**

Director, Earth System Research Laboratory, NOAA, Boulder, CO

President of the AMS – 2015-16

**Mr. Brian Eiler, JD**

Senior Advisor to the Under Secretary, NOAA  
Washington, DC

**Mr. Paul Pisano**

Team Leader, Road Weather and Work Zone Management  
Federal Highway Administration, Washington, DC  
Member AMS Committee on Open Environmental Information Services

**Ms. Ariel Gold**

Program Manager, World Wide Public Sector  
Amazon Web Services, Washington, DC

**Dr. Leanne Haselden**

Partner, Global Business Services, IBM  
Tampa, Florida

**Dr. Mohan Ramamurthy**

Director of Unidata at UCAR, Boulder, CO  
Open Cloud Consortium

For questions or comments, please contact the following panel organizers: Matt Parker, Moderator, matt.parker@srnl.doe.gov Doug Hilderbrand, douglas.hilderbrand@noaa.gov

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**Thursday Evening: Panel discussion on Weather Forecasting Accuracy coming to NC Museum of Natural Sciences**

***“It’s Tough to Make Predictions...Especially about the Future”***

What: Panel Discussion on Weather Forecasting Accuracy moderated by Nate Johnson (WRAL-TV) with Joel Cline (DOE), Gary Lackmann (NC State University), Jonathan Blaes (Raleigh Weather Forecast Office) and Matt Parker (CCM and Savannah River National Laboratory)

Where: North Carolina Museum of Natural Sciences 11 West Jones St. Raleigh, NC 27601

When: Thursday August 6<sup>th</sup> @ 7 p.m.

\*\*\*Summer Community Meeting participants welcome to attend

(RALEIGH) — By all accounts, Yogi Berra had it right. “It’s tough to make predictions,” he said, “especially about the future.” But through the use of lightning climatology, atmospheric modeling and more robust numerical data, meteorologists have been making great strides in improving the accuracy of their forecasts. To find out how a good forecast can keep you safe, and maybe even save you money, join us for a discussion about the latest breakthroughs in weather prediction, held at the NC Museum of Natural Sciences on Thursday, August 6, 7-8:30pm. Four weather experts will participate in this panel, which will be emceed by Nate Johnson, meteorologist and executive producer for WRAL-TV.

North Carolina is no stranger to the dangers of lightning; “Storm Data” ranks us sixth in the U.S. for the number of lightning fatalities between 1995 and 2010. Panelist Jonathan Blaes, Science Operations

Officer with the National Weather Service in Raleigh, will discuss how he is working with researchers to improve the understanding and forecasting of lightning, from anticipating days with extreme or prolific lightning, to predicting the transition of cumulus clouds from a typically harmless shower to a potentially deadly thunderstorm.

Panelist Matthew J. Parker, Senior Fellow Meteorologist with the Savannah River National Laboratory in South Carolina, will explain how he uses weather forecasts to help large businesses save money. "For example, if the customer requires 4 hours of wind speeds less than 10 mph sometime during a given week, I can handle that. If the customer needs to avoid freezing temperatures for several days when pouring a concrete foundation, I can handle that. In both cases, an erroneous forecast can result in a financial loss. The more specific the requirement, the easier the forecast is to make. This may be counter intuitive, but it's true."

What's the best weather forecast for efficient wind and solar energy use? Panelist Joel Cline, a meteorologist with the Department of Energy, will discuss how accurate weather predictions impact the economy of the U.S. as a whole as well as each of us individually as rate payers of utilities. He will also discuss a possible pathway forward to overcoming the gaps in forecasting.

Professor Gary Lackmann from NC State University's Department of Marine, Earth and Atmospheric Sciences will join the panel to demonstrate improvements in numerical weather prediction and atmospheric modeling, to discuss ensemble prediction and associated capabilities, and to explain limitations associated with data overload and the challenge of translating model output into useful end-user information.

The panel discussion will be followed by audience Q & A. Food and beverages are available for purchase in the Daily Planet Café prior to the event but are not allowed inside the theater.

**Appendix B**  
 2015 AMS Summer Community Meeting  
 List of Participants

Mr. Donald H. Berchhoff	MetraWeather US. INC
Mr. Larry E. Brazil	Riverside Technology, Inc.
Mr. Joel W. Cline	Dept. of Energy
Dr. Jeffrey M. Freedman	Atmospheric Sciences Research Center
Mr. Ronald K. Guy	Unisys Weather Information Svcs.
Ms. Mary M. Glackin	Commissioner
Mr. Paul O. G. Heppner , Jr.	Global Science & Technology, Inc.
Bradford T. Huffines	WeatherCall
Mr. Kevin Kloesel	University of Oklahoma
Dr. Gary M. Lackmann	North Carolina State University
Col. John A. Lasley	JAL Consultants, LLC
Dr. Geoff B. Love	
Mr. Jonathan T. Malay	Sea & Sky Science Company
Mr. H. Michael Mogil	National Council Industrial Meteorologists (NCIM)
Mr. Bryan S. Norcross	The Weather Channel
Mr. Randy A. Peppler	University of Oklahoma
Mr. Warren L. Qualley	Harris Corporation
Dr. Mohan K. Ramamurthy	Unidata
Mr. Lans P. Rothfusz	National Severe Storms Laboratory
Dr. Keith L. Seitter	American Meteorological Society
Mr. James R. Stalker	RESPR, Inc.
Mr. Christopher S. Strager	National Weather Service
Mr. John R. Toohey-Morales	WTVJ NBC6
Dr. Louis W. Uccellini	NOAA/National Weather Service
Mr. James M. Wilczak	NOAA/ESRL/PSD
Mr. Gregory P. Byrd	UCAR/COMET
Dr. Steven E. Koch	NOAA/NSSL
Dr. J. Marshall Shepherd	University of Georgia
Dr. Leonard J. Pietrafesa	Coastal Carolina University
Mr. Michael Thomas Moss	WRAL-TV
Dr. Alexander E. MacDonald	NOAA
Ms. Marjorie P. McGuirk	Asheville Area Chamber of Commerce
William P. Mahoney , III	NCAR/RAL
Mr. Gregory B. Fishel	WRAL-TV
Mr. Elliott Jacks	NOAA/NWS
Mr. Matthew James Parker	Savannah River Nuclear Solutions, LLC
Dr. Harold Edward Brooks	NSSL
Mr. Walter A. Robinson	North Carolina State University
Mr. Thomas C. Moore	USAF Director of Weather
Ms. Barbara G. Brown	UCAR/NCAR/RAL
Mr. Jonathan L. Blaes	National Weather Service Raleigh
Mr. John T. Ferree	NOAA National Weather Service

Mr. Matthew D. Parker	NC State University
Mr. Tye W. Parzybok	METSTAT, Inc.
Mr. Nicholas M. Petro	National Weather Service
Dr. Shawn W. Miller	Raytheon Company
Mr. Kevin R. Petty	Vaisala
Mr. Jonathan C. Porter	Accu Weather, Inc.
Mr. James K. Titlow	WeatherFlow, Inc.
Mr. Nathan S. Johnson	WRAL-TV
Mr. William F. Sjoberg	NOAA Joint Polar Satellite System
Ms. Wendy Marie Thomas	NOAA/National Weather Service
Robyn L. Heffernan	National Weather Service
Douglas C. Hilderbrand	NWS HQ Communications Office
Dr. Steven A. Ackerman	UW-Madison CIMSS/SSEC
Mr. Stephen M. Leyton	Duke Energy Corp.
Ms. Eileen L. Shea	ELS Consulting
Mr. Chad A. Hahn	NWS
Dr. Shalini Mohleji	NOAA
Ms. Kimberly E. Klockow	Kimberly E Klockow
Erica A. Grow	WUSA-TV
Mr. Robert S. Lee	AvMet Applications Inc
Mr. Derek S. Arndt	NOAA NCDC
Dr. Brian J. Etherton	NOAA
Mr. Paul A. Pisano	Federal Highway Admin.
Mr. Corey K. Potvin	CIMMS/NSSL
Dr. Paul A. Higgins	AMS Policy Program
Dr. John E. Ten Hoeve , III	John Ten Hoeve
Mr. Kiel L. Ortega	Univ. of Oklahoma / CIMMS
Dr. Neil A. Jacobs	Panasonic Avionics
Dr. Burrell E. Montz	East Carolina University
Dr. Philip E. Ardanuy	INNOVIM
Ms. Lindsay R. Blank	North Carolina State University
Ms. Brenda J. Philips	University of Massachusetts
Ms. Gina M. Eosco	Eastern Research Group
Mr. Allan W. Huffman	Panasonic Weather Solutions
Mr. Conrad C. Lautenbacher , Jr.	GeoOptics
Mr. Stephen C. Woll	WeatherFlow Inc.
Mr. Robert G. Goldhammer	WeatherCall Services LLC
Mr. Thomas E. Fahy	Capitol Meteorologics
Ms. Brenda C. Boyce	Booz Allen Hamilton
Mr. Don Pitts	Northrop Grumman Corporation
Mr. Michael Fowler	Vaisala Inc.
Ms. Valerie Ritterbusch	WeatherCall Services, LLC
Mr. Buck Lyons	WeatherFlow Inc
Dr. Marty Bell	WeatherFlow, Inc.
Mr. Castle A. Williams	Univ. of Georgia
Dr. Mark A. Casteel	Penn State York
Mr. Joseph Facundo	CyberData Technologies

Mrs. Jennifer M. Sprague	NWS HQ
Dr. Susan Jasko	California University of PA
Mr. Minh Phan	East Carolina University
Mr. William J. Callahan	Earth Networks
Mr. Michael Fox	Raytheon Company
Dr. Terri M. Adams	Howard Univ.
Mr. William F. Clark	
Mr. Joshua W. Young	Unidata
Mr. Eric McCormick	The University of Oklahoma
Mr. Aaron Sims	Panasonic
Ms. Elizabeth Wilson	
Ms. Nichole C. Riddle	North Carolina Sea Grant
Tanya Spero	HQ Air Force Weather Agency
Monserat Fuentes	NC State Univ.
Mr. Kevin C. Cooley	National Weather Service
Mr. Jamie Robert Rhome	NWS/NCEP
Joanne St-Coeur	Environment Canada
Everette Joseph	University of Albany
Jeannette Sutton	University of Kentucky
Mark Gildersleeve	The Weather Company
Peter Childs	Panasonic Avionics
Brian Eiler	NOAA HQ
Tom Birkland	NC State University
Julie Gondzar	DayWeather, Inc.
Kevin Cox	Wyoming Department of Transportation
Russ Bullock	EPA
Meredith Bell	Panasonic
Amanda Bryant	FEMA
Matthew Merritt	Novant Health
Mike Daniska	NCDPS
Linda Rimer	EPA
Edward Cokely	<a href="http://www.RiskLiteracy.org">www.RiskLiteracy.org</a>
Jennifer Martineau	Center for Creative Leadership
Brandi Orbin	NCSU
Sam Hodge	Georgetown County
Mark Venters	GE-Hitachi

## Appendix C

### Daily Session Summary Notes\* from the 2015 Summer Community Meeting

*\* Notes are made available here in their raw form. Please use these notes to help spur additional dialog vs. using for attribution purposes.*

**Day 1: August 4th, 2015**

**Notes by Lindsay Blank, Minh Phan, and Castle Williams**

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Keynotes (8:30 - 9:45AM)

1. Keynote Speaker #1: Gary Lackmann (North Carolina State University)

Title: Collaboration, Visualization & Communication Within and Beyond the Geosciences

Themes: Collaboration, Weather Visualization, and Communication

Collaboration:

- Current educational systems largely fail to recognize, develop, or reward collaboration.
- Diverse, effective collaboration offers clear benefits in a wide variety of contexts for society.
- Problem-solving needs diversity in ideas and collaboration allows for many different routes to achieve a solution.
- COLLABORATION with motion picture industry, gaming community, virtual reality, computer science visualization experts. The possibilities are endless!
- Collaboration: necessary in the classroom and within our field and across other disciplines
- Gary uses collaborative techniques, including team member evaluation forms (when completing group activities in his classroom).

Challenges in Collaboration:

- Academia rewards individualism:
  - University reward structure predominantly in “single investigator” mode: publications most recognized benchmark, plus grant money. Universities reward professors more so for single-authored publications and not as much value in collaborative research efforts and publications.
  - Academic arrogance and narcissism.
- NWS time commitment:
  - For NWS, research collaboration is “extra duty” and can be a challenge to carve out time to complete this extra work.

What makes for successful collaboration?

- Mutual respect/understanding of pressures and practices.
- Effective communication!

- “Skin in the game” all around: active, shared roles, responsibilities, rewards, broad participation.

Visualization:

- Underutilized NWP output:
  - Forecasters tend to overlook some NWP output variables, like physics tendencies, 3-D/4-D visualizations, radiation, cloud hydrometeor fields. They are rarely examined by forecasters.
- Could better utilize satellite imagery and “weather cams” in NWP model verification of cloud field. Generally make better use of model-produced information. Time Lapse photography.
- Use crowd-sourced verification of model forecasts using visualizations from other people and their images/video.

Example of Visualization with Maya software

- Dr. Andreas Muller <http://anmr.de/cloudwithmaya/>
- Uses Maya (film industry/animation software) to generate clouds and model forecasts using images and modeling.

2. Keynote Speaker #2: Dr. Louis Uccellini (Director, National Weather Service/NOAA Assistant Administrator for Weather Services)

Title: The National Weather Service of the Future: Building a Weather-Ready Nation

Outline:

1. Building a Weather-Ready Nation
2. Challenges Addressing Impact-Based Decision Support Services (IDSS)
3. New Warning Paradigm(s)
4. Addressing the “New Water” Challenges and Opportunities
5. Odds and Ends

Building a Weather-Ready Nation

- Ready, Responsive, Resilient
- Requires NWS to:
  - Fully integrate our Field structure
    - Better forecasts and warnings
    - Consistent products and services
    - Actionable environmental intelligence
- Provide Impact-based Decision Support Services
  - Deliver through multiple and reliable dissemination pathways
- Work with partners to gain needed response; includes embedding NWS in emergency
- Operations Centers and incorporating social sciences

Challenges Addressing Impact-Based Decision Support Services (IDSS)

- Important Role of Social Science!
- \*\*\*HUMANS ARE DESIGNED WITH *SHIFTING* RISK PREFERENCES\*\*\*

- The *shifting risk preference* poses enormous challenges to linking predictions to IDSS.
- The recognition of, and response to, risks are a function of the:
  - Spectrum of decision makers
  - Extent that they ‘have a plan’
  - Extent that plan suits their ‘risk management’ AND addresses ‘shifting risk preference’
- Intrinsic value of a forecast
- If nobody uses a good forecast, what value does it really have?
- Forecast example: January 25-28, 2015 Blizzard
  - Model forecasts 36 hour before the onset... they differed greatly for New York City.
  - In 2013, lives were lost and 3 days were needed to recover.
  - In 2015 with the call to shut down the city, no lives lost on roads.
  - How do we look at this event and make them realize the intrinsic value of the forecast...
  - Instead of focusing on “how bad” the forecast was, look at the positives.

#### New Warning Paradigms

- Nowcasting: focus on the first 12 hours
- Example: Massachusetts 2012

#### Addressing the “New Water” Challenges and Opportunities

- Water Extremes, Water Quality, Water Security
- Growing Importance of “Total Water Prediction”
- New National Water Center in Tuscaloosa at University of Alabama
- VISION: Scientific excellence and innovation driving water prediction to support decisions for a water resilient nation.
- Water Quality
  - NOS leading NOAA’s effort to predict/operationally water quality and produce forecasts
  - for HAB, Hypoxia, and Vibrio, involving NESDIS, OAR, NMFS, NWS
  - Example of Success:
    - Lake Erie Algal Bloom was correctly predicted by NOS-GLERL
      - This type of prediction and societal impacts implications are far-reaching
    - Total Water Prediction (TWP)
      - Policy/Outreach/Education-related Activities to Advance TWP
      - Provides a forum for stakeholder priorities
- Health vectors: the biggest concerns are false alarms

#### Odds and Ends

- Observations:
  - Vaisala Autosondes are in test mode. Tested at Sterling Field Support Center (SFSC) and will be tested in Kodiak, AK. Initial challenges were passed with more testing on the way.
  - Current Status of Supercomputer:

- Increased HPC capacity to 2.8 petaFLOPs (for primary and backup, respectively- for a total of 5.6 PF) by the end of the CY 2015
  - Model Upgrades
    - GFS upgraded to 13km with a lead time of up to 10 days
    - HRRR operational: 3km every hour
    - 2km HWRF (touted as best hurricane model in the world)
    - Upcoming Model Upgrades:
      - SREF, HRRRe, ENKF, and GEFS
- 

Session 1 (10:30AM - 12:00PM)

[Innovative Methods to Forecast Environmental Threats](#)

Moderator: John T. Ferree, NOAA/NWS

Panelists: Jonathan Porter (AccuWeather, Inc), Christopher Strager (NOAA/NWS), Jonathan Blaes (NOAA/NWS), and Lans Rothfusz (NSSL)

1. Lans Rothfusz (Deputy Director National Severe Storms Laboratory)

FACETs: A Next-Gen Forecasting Paradigm for High Impact Weather

- Forecasting a Continuum of Environmental Threats (FACETs)
  - <http://www.nssl.noaa.gov/projects/facets/>
  - FACETs is a modernization of NOAA's current teletype-era deterministic (binary), product-centric paradigm
  - Focused on entire forecast/warning process
  - Facet #1: Grid-Based Probabilistic Threats
    - Moving away from the binary polygons and shifting to a probabilistic approach
    - Legacy warnings "fall-out" of the grid
    - Information continuum downscale... starting days in advance. A continuous stream of calibrated, high-resolution, probabilistic hazard information (PHI)
    - Optimized for user-specific decision-making through comprehensive integration of social/behavioral/economic sciences.
  - Social science is here. 10 years ago, there wouldn't be any social scientists in the audience. But now, times are changing and collaboration is extremely important.

FACETs is:

- Multimedia, multi-point *enabling*.
- We can still use ALL CAPS TEXT, but the great thing about FACETs is you can use all sorts of media to get the information out. Many vendors in various media platforms can utilize and disseminate FACETs information.

- Vision of FACETs is to modernize NOAA's hazardous weather forecasting paradigm.
  - Starts with probabilistic hazard information.
- Part of WRN Action Plan
- Considerable benefits to society expected.
  - Reduction in warned areas (reduction in over-warning)

## 2. Jonathan Blaes (NWS WFO Raleigh)

- At WFO, chief challenges relate to effectively communicate what we know to those who need to know it.
- The amount of probabilistic information available to forecasters has *greatly* increased.
  - Convection Allowing Models (CAMs) from the Storm Prediction Center (SPC) has greatly increased the amount of probabilistic information.
  - Probabilistic information has not fully been integrated into operations:
    - Bandwidth issues
    - Storage issues
    - Display issues
- Some successful probabilistic forecasts...
- Minimum 10<sup>th</sup> percentile/maximum 90<sup>th</sup> percentile snowfall maps vs. most likely scenario
- WFO-Raleigh utilized social media and a text-heavy package to illustrate snowfall threat and show how confident forecasters were for snowfall and winter storm events.

## 3. Chris Strager (NWS Central Region Director)

### Operational Perspective on Forecasting Environmental Threats

#### Impact-Based Warnings (IBW)

- Goal: Give the customer a better sense of what is happening
- Initiative started in 2012 with 5 offices initially in KS/MO
- Now available to 67 offices nationwide
- IBW facilitates better impact communication
- IBW Verification
  - Fewer False Alarm Rates (FARS)
    - tornado warnings w/o IBW tag on text product have false alarm rates of 69%+
  - Need to communicate elevated risk
  - Majority of tornado warnings still do not have a tag of IBW on products
  - Very few EF2-5 tornadoes are unwarned (<10%)

#### Probabilistic Hazards from Analogs

- Probability of exceedance from analogs
  - e.g., Percent of Day 5 analogs with Heat Index >105F or LIFR ceilings and/or visibility (< 1 mile; <500 feet)
    - How great would it be to let emergency managers know that 5 days out, you will face extreme heat conditions...

#### Extracting Information from Ensembles

- Not just the value, but how unusual is a particular event for a certain area?
  - If we see precipitable water values of 1.75" in areas in TX that we rarely ever see...
  - Info about how rare an event is from ensemble info using model climatology.

#### Enhanced Hazardous Weather Outlook 2.0

- What is the biggest hazard?
- Integrated Impact-Based decision support services providing weather hazards, alert levels, and typical impacts
- Shows emergency managers what the biggest threats will be in the near future... and then turn to local WFO for additional information

#### 4. Jon Porter (AccuWeather)

##### A View from America's Weather Industry

- Global Severe Weather Alerts (over 40 countries)
  - Helping national weather services get the word out about severe weather
- The need for a defined and consistent deterministic warning system does not change.
- Engagement with America's Weather industry and Weather media is CRITICAL!
- What can we do today to cut FARs for tornado warnings?
- Future Opportunities with FACETs:
  - Unify around shared common goal within weather enterprise to save life and property.
  - Can we be confident that FACETs will improve public response?
  - Can't forget positive aspects of current system
- Challenges to consider:
  - Increasing complexity about "Am I in a warning?"... even in today's world with today's system
  - Warnings on a grid vs. polygon vs. zone/county/fire zone
  - Increased warning lead time does not always equate to better end-user decisions.
- Prioritizations needed on required core observational assets beneficial to the entire wx enterprise
  - Gap filling radar deployments, increased surface observations, MADIS, storm scale NWP
  - Role of the human forecaster in editing probabilistic grids
  - Broad use of FACETs framework for the large variety of hazards that we face in the U.S.
    - Winter, tropical, fire, convective, tsunami...

#### QUESTIONS

1. John Ferree: Research has shown that consistency matters, and forecaster expertise can vary. So how do we avoid inconsistent messages? We have to be consistent, so as we go into probabilities, how do we avoid that?

- a. (Blaes): Use mixed model ensemble members. WPC uses that for ice/snow accumulation grids. It's a good starting point for that
  - b. (Rothfusz) we have to calibrate our forecasters to begin with. Every MIC knows every forecaster has a different threshold... One of the underlying goals for gridded probability warnings... and you SHOULD NOT see any change from one county warning area to the other county warning area. And try to prevent that boundary issue.
  - c. (Strager): we're going to see a lot of training requirements that need to be adopted.
  - d. (Porter): This information is already being provided by some national centers, so now is the opportunity to leverage this current information now, so in the future when it is more widely used, we can use it more effectively.
2. Bryan Norcross (The Weather Channel): Concerned with a few aspects of communicating probabilistic information because it can convey that the forecaster is uncertain... If I were a decision-maker or business, would I tell my employees to come to work or not... if there snowfall forecast is 1-13" of snow... What do I draw from that? How do you get the probabilistic information to the public without confusing them?
    - a. (Blaes): In the Raleigh snow event in 2014, it was difficult... The initial reaction to the public with giving them huge ranges in snowfall, they think you don't know what you're talking about. I believe users are more sophisticated now than they used to be.
  2. Visualization is key. Some people just aren't going to take action no matter the message. I know the NWS is working with storm surge... and visualization of storm surge in coastal communities and neighborhoods. Is there a way to localize visualizations for people so that it really hits home? Maybe an e.g., would be to tell people that there will be an inundation of snow along this stretch of highway and hopefully they heed the warning.
    - a. (Strager): Forecast with probabilities... a lot of models ingest that uncertainty.. and hopefully can use those products for more visualization
    - b. (Porter): Once the datasets are available, the weather enterprise can really go and make those visualizations happen with innovative approaches.
    - c. (Rothfusz): I would advise against... the idea that meteorologists think they know what works best, what looks best... but we need to use the behavioral and social scientists.
  3. What training will be used to users, like to say emergency managers?
    - a. Training happens at all the WFOs (all 122) with the emergency managers every day. Consistency has to be there. We can't have EMs confused... and we have to be consistent. We need to keep things stable.
    - b. When people receive tornado warnings, do they immediately shelter? No. So if you're a rational person, you understand that there is uncertainty in the forecast... that's why you're not taking shelter. If you constrain the forecast to a small region or area or with limited information, you're depriving people of the possibility of letting them make their own decision. There are ways to display uncertainty that are really effective. We need to test them. We need to partner everyone on this panel with social scientists.
  4. How do we measure the reliability of the probability? How do we deal with problem of human nature with probability... so how do you track the probability of affecting a human?

- a. (Rothfusz): Forecaster can adjust the guidance probability. Verification... I wanted to look at my reliability curves for my probability of precipitation. Give feedback to forecaster so they can adjust future forecasts and tendencies. We have to look at end users and realize they're a diverse group of people. We're going to have to look at the probabilities. A lot of work to do.
  - b. (Porter) What have we learned about forecasters and how they perceive the new technology and the Hazard Weather Testbed? (Rothfusz): They need guidance and are awful at "making up" their own probabilities. So they need that nudge...
5. I have great concerns with the False Alarm Ratio. It angers me that we use "false alarm" when the tornado doesn't happen. I want to make sure that when we put out all of this data, we have companies unmanaged, unregulated with thousands of downloads... and they're horrible apps. And when you search "NOAA Weather Radio" you have companies making these awful apps... and then people download them and have no idea how to use them. How do we manage and regulate this industry?
- a. Strager: I don't disagree with you. But as the NWS, it's not our place to do this. The community has to work. The community gave the community a crappy rating. I don't know about regulatory issues... it makes me real itchy. There's an explosion of apps... and a lot of this data is getting out to people. And people don't know what they're doing with it. Don't underestimate the audience's ability to use and learn from the information, either.
  - b. Gina Eosco (Eastern Research Group): I want to echo that NWS can't do this alone. We have those WRN ambassadors. All of us together. With False Alarms, County vs. probabilistic warnings... Cell phone apps are still using county-based warnings for their text message warnings. There has to be a balance of effective communication and making money. The false alarm rate from the public perspective on county-based warnings is extremely high. For private sector folks, are you using county-based or polygon-based right now? Economics plays a role, but we don't want to favor that over effective risk communication
    - i. (Porter): We use storm-based warnings whenever possible. Probably some of the variances are tied more with "half in half out" of polygon world. Some products are and are not polygon-based. I can't speak for everyone, but a lot of the challenges, but from the notification standpoint, we want to let users know when something is impactful to them.
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## Session 2 (1:15-2:45PM)

### [Storm-scale Observations](#)

Moderator: Neil Jacobs (Panasonic Avionics Corporation)

Panelists: Aaron Sims (Assistant State Climatologist of NC), Tye W. Parzybok (MetStat Inc.), and Marty Bell (WeatherFlow)

Aaron Sims (Assistant State Climatologist of North Carolina)

A primary source for NC weather and climate information

State Climate Office- where university researchers, extension scientists, government agencies (state and federal) come together to work on weather and climate-related issues.

- Mission:
- Extension
  - Establish, operate, and maintain an extensive meteorological network
- Research
- Education

North Carolina Environment and Climate Observing Network (ECONet)

- 39 stations across North Carolina
- partnerships with South Carolina Climate and Coastal Carolina University
- collects temperature, solar radiation, PAR, soil temp/moisture, leaf wetness
- GOAL: at least one ECONet station in every county
- will install specific applications if other organizations request specific pieces of data
  - e.g., work with air quality organizations and install high elevation stations to collect
- soil core samples and use soil porosity/field capacity... and how it responds to precipitation
- in-house NWP and dispersion models

Partnerships with ECONet

- UNC Campuses, NWS, NC DOT, NC DAQ, NC NWR, NC Emergency Management
- Electric cooperatives
- Have installed weather stations for electric cooperatives to support them in what they need

ECONet has such a great capacity to take in and collect a variety of data...

- How can folks better utilize these observations in applications?
- How can we better support mesonet programs?

Marty Bell (Director of Research, Weatherflow)

Storm-scale Observations for Land-Falling Tropical Storms

Focus: land-based and near-shore observations for tropical systems

- they are relatively cheap and accessible
- provide reliable ground-truth information about land-falling impacts
- provide vital information to weather forecasters, emergency responders, the insurance and utility industries, and others...

Hurricane Network (~100 stations able to withstand Category 3)

- focus on clean fetch, 1-minute data
- financed by insurance industry partners

Professional Network (~300 stations in coastal zones)

- ~90 are on Coast Guard navigation aids
- financed by Weatherflow
- growing at about 15 stations annually

Partner Observations: Universities (Florida, Texas Tech....)

- use of deployable towers (3 x 10m and 2 x 15m)
- deploy Doppler on Wheels (DOWs)

Motivations:

- strong commercial interest (used as basis for StormPrint insurance products)
  - supports National Mesonet Program partnership with NWS
  - Data actively sought by WFOs
    - extensive outreach for awareness and site selection
    - real-time and post-storm support
- 

Tye Parzybok (President, MetStat Inc.)

Storm-Scale Observations near Real-Time Precipitation Measurements

220 networks and growing

- real-time rain gauge acquisition, aggregation and quality control
- 20,000 stations

How are they doing quality control?

- multi-sensor approach
  - High-res radar estimation (dual-pol)
  - satellite-estimated precipitation
  - results in a “quality-confidence” flag.
  - each one-hour precip value is given a value between 0-1.
  - a “0” means no confidence in accurate reading. “1” means very confident
- Benefits/Uses of Quality Precip Data
  - post-storm precipitation analyses
  - most for hydrologic modeling
- you can use it for radar rain-rate optimization. Make those algorithms even more accurate
- assimilation into NWP models
- improve QPF nowcasting

- 20,000 stations measurements but they could be exploited and used to a higher extent

Neil Jacobs (Panasonic Avionics)

UAV/UAS TAMDAR

Tropospheric Airborne Meteorological Data Reporting

Measures: air temperature, humidity, icing, turbulence reports, static/dynamic pressure

TAMDAR with Iridium Antennae

- made of nylon from 3-D printer
- more effective than airliners and their reporting due to thermal conflicts
- LED beam on ice detector can detect between clear and rime ice build-up. And also can detect the level of accretion of ice due to blockage of light using an algorithm

How tight of a circle can you fly and still get useful wind data?

- If you have good heading information, you still actually still get good data.

The UAV by itself is responsible for most of the improvement.

- You can perhaps use UAV for storms offshore or storms you typically would not analyze

#### QUESTIONS

1. How do you measure leaf wetness?
  - a. Sensors are really expensive. Painted leaf (painted white) and measures voltage when its wet and dry. Based on the voltage, you can determine how wet it is. Having people physically analyze some of the leaves is good for QC.
2. Is there some sort of effort to have a unified mesonet quality control system?
  - a. There is an immature effort nationally, but it's not something that is being done at the moment.
3. WeatherCall tells our uses to rely on different sources of weather for redundancy. How can we continue to support Mesonet programs (because the current funding for tower sites for weather radio signals is not sustainable due to rising leases). Are any of your clients actually helping to fund the ECONet sites? Is there some way to get them to fund it if they're not? Maybe apply that to the weather radio situation.
  - a. (Sims): we try to work with NC Highway patrol. Because we transmit very little data from each station, we're trying to use cell phone technology. Some of our partners give us additional money to fund new stations for their use. We are trying to reduce maintenance costs by partnering with schools and colleges who can have people on site to repair and maintain the sensors. Duke Power and electric cooperatives at one point helped fund some past research.
4. Does the panel have recommendations... What do we need to do in the boundary layer to improve storm scale observations? What about ground-based remote sensing devices? Do you have recommendations that you haven't spoken about yet?

- a. FAA is trying to figure out how to regulate UAVs. In the meteorological side, we have to make sure the FAA is comfortable so that we can get UAVs certified for commercial airplanes.
  5. Mahoney: Do the datasets you have now... can you articulate where all the mesonet data is sourced.
    - a. We don't have any goals to go beyond what data is already available in mesonets like MesoWest. We are looking into licensing agreements and automate the process. There's not much of an agenda.
  6. National Mesonet folks meet annually at the AMS Annual Meeting, so it's important to talk to one another. We have mesonets being set up all over the country. It starts with small partnerships that start off as fledgling projects that then blossom and grow into large-scale state-wide operations.
  7. Examples of funding: Florida helped pay for poles after they were decimated by hurricanes in 2004. Chesapeake Tunnel Bridge folks give them free rent for weather information that can help shut down the bridge when there are high winds for tractor trailers.
  8. Where do you think the U.S. stands on improving assimilation?
    - a. As we go to higher resolutions with 3DVAR, when you have synoptic observing systems, it's around the clock. Using all four dimensions is critical. The mathematics behind it can be debated, but you actually can get penalized for going to a higher resolution compared to just using 3DVAR over 4DVAR.
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### Session 3 (3:15-4:30PM)

#### [Storm-scale Guidance](#)

Moderator: Lans Rothfus (NSSL)

Panelists: Matthew D. Parker (North Carolina State University), Corey K. Potvin (CIMMS/NSSL), Neil A. Jacobs (Panasonic Avionics Corporation), and Kiel L. Ortega, (OU/CIMMS and NOAA/OAR/NSSL)

Output from numerical and statistical analyses applied to probabilistic hazard forecasting (e.g., Warn-on-Forecast)

Matt Parker (NC State)

“Introductory thoughts on storm-scale guidance”

Core values for end products:

- We want to start thinking more probabilistically. There are a lot of products like that from the SPC are a good example of these types of products.

Questions to think about:

- What are the proxies for tornadoes, severe hail, and severe winds in these models? How specific are these to the model, location, etc.
  - How do you take this probabilistic information and decide when to alert the public and when not to know? Is there a threshold?

- We are pretty darn good at issuing warnings right now. How will we change, and what will keep the same? There are some good things we can already utilize? Shouldn't we save those practices?
- Who all gets to utilize the data, or does NOAA get to keep it all. Can public entities use the info?

Corey Potvin (CIMMS/University of Oklahoma)

Warn-on-Forecast: Toward 0-2 hour, probabilistic, storm-scale guidance

Next-day vs. next-hour prediction

- outlooks days out vs. watches/warnings hours out

Warn-on-Forecasts and its connections to FACETs

- ensemble prediction systems produce probabilistic forecast of storm hazards
- output post-processed for forecaster
- forecaster combines packaged output with observations and other guidance
- continuous stream of threat info delivered to public, inc. traditional warnings
- threat products designed to illicit effective response

Warn-on-forecasts uses ensemble forecasts to try and issue warnings earlier than current NWS warnings for severe weather, like tornadoes.

Need to:

- maximize public response to longer warning lead times

Neil Jacobs (Panasonic Avionics)

Numerical Weather Prediction at Panasonic Avionics

\*\*\*The same technology used to stream internet on airplanes is being used for collecting weather data from airplanes\*\*\*

- Ku-band is preferred and much cheaper than iridium band from satellites.
- Panasonic runs anything from 4D NVAR GFS at 13km... to an 80-member ensemble EnKF.
- Polygon-based avoidance tool for dynamic flight route optimization for flights.
- Southwest Airlines is using data from Panasonic AVTECH CDA, and that gives them a 3-D wind field and allows for fuel savings and safety.
- Wake vortices...
  - Running high resolution models and showing the wake vortices so that pilots can land safely. Wake vortices form from other airplanes, so when you're landing a plane, if another plane is ahead of you, you as a pilot will fly into the wake vortices of the other plane. So if you can forecast this, you can coordinate with airplanes, figure out where and when they can land for safety and fuel savings.

Kyle Ortega (University of Oklahoma/CIMMS)

MYRORSS (Multi-Year Reanalysis of Remotely Sensed Storms)

Multi-radar, multi-sensor system:

- blend radar sites to get a 3-D lat/long height grid so that you can visualize cone-of-silence areas
- 5 minute 0.01x0.01 degree resolution... 35 vertical levels

- Quality Control is in process (5 years... started in 2012)

For MYRORSS, there are two sides: hydrometeor and severe weather components

MYRORSS:

Control for

- population density
- storm environment
- storm/report type
- geographic location
- warning volume
- watches
- local climatology
- other storm attributes

## QUESTIONS

1. With the warn-on forecast, what's the expectation... are you trying to forecast a tornado in a strong environment very conducive for tornadic development, an environment with some shear/CAPE...?
  - a. What makes supercells unique is they are longer-living and more predictable. But there are short predictability limits with model error and limited grid-spacing. Ideally, it would be good to predict probability of a tornado maybe 30 minutes in advance. In that time, it is likely that there is mesocyclone development already. It's probably in a high shear high CAPE environment, so in some storm environments, the predictability could be even higher... but that's speculation.
2. In hazardous weather testbeds, what GOES-R data can help in Warn-on forecasts? From what you guys know about what we can get stuff out of GOES-R, are we closer to be able to move to the Warn-On Forecast Paradigm. Will GOES -R help with Warn-On?
  - a. A lot of testing on GOES-R products ranging from pseudo GLM data (lightning)... what lightning you would expect to see.. Some testing with model forecasts with cloud-cover. If you look up presentations by Kristin Calhoun or Bill Kline (spell check names). There are some improvements with cloud data and GOES-R. Maybe more of an incremental improvement. But maybe these incremental improvements from other areas too like phased array radar will all come together to help the Warn-On Forecasts.
3. It's rare that people die when tornado warnings aren't issued. If you accept the fact that there are tornado warnings and there are false alarm rates, if the conclusion were that the system could never absolutely work (warn-on), could that help in deciding how much data to spend on this technology? How much money do we want to use on a routine basis operationally with this?
  - a. It's a practical question. There has to be a cost-benefit analysis. From mitigating economic loss vs. lives saved, in the west, we don't think of such things because they're not quantifiable, but if people feel safer, there's real value to that.
4. We have to start turning the question around. "How to maximize response to longer lead times?" Turn it around to: "Does the public need longer lead times?" Are we missing an

opportunity to think more outside to box? We have to think about ideas and flip it. We issue warnings, but we don't communicate the all-clear, but we normally talk about when the warning starts. We don't want you to sit in your tornado shelter or bathtub forever... just a few minutes. This is an old-school way of thinking. Where do you integrate the new social science techniques? We are placing value judgments on individuals when they already have their own value judgments. But we're forcing this on them. We're investing so much time and money into this and not hearing the social science in the dialogue.

a. Most of us in forecast science are aware of the social science and thoughts. We've been implementing social and behavioral science all along. We meteorologists have to listen to the end users. We're working on that.

b. Many others are aware of the possible problems of the longer warnings. We didn't delve too deeply in the social science areas because that's not my expertise (Potvin). Before we can think about giving people the all clear, we first need to determine if we have that kind of predictability. Or are we decades and billions of dollars away from that predictability?

c. For people responsible for other people's lives, a longer lead time would be of benefit. Stadiums, big venues, etc. The social science questions are a different way to look at the big idea.

d. Can we fundamentally predict tornadoes with some lead time is the big idea? Having "warn" in warn-on forecasts gives the idea a black eye. But the big idea is predicting tornadoes earlier, and that's a good thing.

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#### Session 4 (4:45-6:00PM)

##### [Future Role of Forecaster \(Interactive Exercise\)](#)

Panelists: Lans Rothfusz (NSSL), Don Berchhoff (Metraweather), Gary M. Lackmann, (North Carolina State Univ.), Nick Petro (NWS/WFO), and Harold Brooks (OAR/NSSL).

Discussion of where the value of the forecaster will reside as weather, water, and climate services evolve

##### Interactive Activity:

- EF-2 tornado from a "tornadic rainshower" for Buford, GA in November of 2010.
- Hazardous Weather Testbed (HWT) forecaster felt less pressure in communicating probabilistic information guidance instead of deterministic when the forecaster realized that there was a NON-ZERO possibility of a tornado with the storms in the HWT scenario.
- This was a great activity. Let's do more like this!

##### Don Berchhoff (Metraweather)

##### Forecaster Data Assimilation

- Key Assumptions:

- Forecasters will continue to add value to computer guidance
- Explosive growth in spatial and temporal resolutions of data continues
- Forecasters find “confidence” indicators critical; however decisions still will require deterministic inputs
- Forecasters still beat guidance in short-term forecasts
- Forecaster Data Assimilation hasn’t changed much over time
- Human Biases:
  - Human bias exacerbated by conflicting data
  - Humans have probability bias
  - How can we achieve consistency in human-“nudged” gridded probability forecasts
- Data Overload and Time Constraints
  - Unstructured data (social media, storm spotters) can be just as helpful as meteorological data.
  - It can be very critical. We need to use them.
- NWP: can’t assimilate EVERYTHING in real time.

Gary Lackmann

The Future of Humans in An Increasingly Automated Forecast Process

\*\*\*Refer to notes earlier this morning. Similar ideas conveyed.\*\*\*

Harold Brooks (OAR/NSSL)

- 18.5 minutes is the tornado lead time for tornadoes with an actual lead time and does not include
- tornadoes that did not receive a lead time (no warning).
- that number hasn’t really changed for a few decades...
- Lead times increase after 18.5 minutes and decrease UP TO 18.5 minutes.
- Providing the info for high resolution tornado warnings is easy.. it’s how people will understand and take the information and put it into action.
- People would rather be with their family in a dangerous place than in a safe place without their family.
- Are people even listening to us when we give them advice? How do people make decisions, and how can we insert information so that people will listen.

Nick Petro (NWS WFO Raleigh)

- Communication, Collaboration, and Human interaction to promote a weather-ready nation.

QUESTIONS

1. Aviation... So technology, psychological work... what has been done that can be applied in high pressure situations in forecasting?
  - a. Cognitive psychologists in Oklahoma are working on air traffic control graphics to help those people. They turned the brightness to one end and the contrast to the other

extreme... and became essentially a black and white screen... block out the weather information... because they had so much going on.

Nate Johnson (WRAL-TV)

AMS Joint Broadcasters/Communications Conference Summary 2015

- The numbers:
    - 244 attendance
    - 52 abstracts
    - 6 exhibitors
    - 6 countries represented
  - The FUTURE:
    - Possibility that the Communications Conference can pair with other conferences?
    - Severe Local Storms, Mesoscale, or even the National Weather Association Annual Meeting
    - Could we do the communications conference be done annually? Could we have a stand-alone Communications Meeting?
  - QUESTIONS/THOUGHTS:
    - It can be confusing that the communications conference is tacked along with other conferences, but it's only every OTHER year. As opposed to the broadcasters conference, which is held annually but only paired with the communications conference every two years.
    - It is good to pair the broadcaster conference and the communication one because the broadcasters need that exposure to the science and the communication. Because sometimes broadcasters are stuck in a bubble and need that weather check to make sure they are doing everything they can to effectively communicate.
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## Session 5

Forecast and Model Advancements in Support of the Nation's Economy

Session Lead: Joel Cline (Department of Energy)

Participants: Jeff Freedman (SUNY Albany), Jim Wilczak (OAR/PSD), Russ Bullock (EPA), and Tanya Spero (EPA).

### 1. Joel Cline (Department of Energy)

Forecast and Model Advancements in Support of the Nation's Economy

- Forecast and Model temporal and spatial scales are the biggest issues.
- The DOE and NOAA need to work together.
- Why do we need to invest in improving forecasts?

- Benefits to public safety, health, energy security, and planning = safety
- Need to improve understanding of heat, moisture, and momentum fluxes which drive stability and turbulence
- Need to improve topography in models and horizontal homogeneity (surface layer scheme needed as alternative to M-O similarity theory for regions of complex terrain)
- The Industry NEEDS:
  - MORE OBSERVATIONS for heat, moisture, momentum fluxes to better represent stability and turbulence.
  - We need more probabilistic information. Sometimes, it's good for others to know our level of uncertainty.

## 2. Jeff Freedman (Research Associate, SUNY Albany)

### Tools For Renewable Energy Forecast: The Wind Forecasting Improvement Project (WFIP1)

- Forecast systems for wind forecasting were started in the late 1970s
- As you build turbines, you will have to deal with lower boundary layer weather/low-level jet (LLJ):
  - What kind of profile do we have? What are my surface fluxes and roughness(es)?
    - With renewable energy, there are a lot of fluctuations and variability with the resource.
      - solar, wind fluctuations in a matter of seconds
- Texas, and especially a small town in NW Texas (Sweetwater) has by far the most wind energy, much concentrated in small area near Sweetwater. Highly susceptible to mesoscale phenomena, like LLJ.
- WFIP1 (2011-2014)
  - Goal: to improve short term (0-6 hour) wind power forecasts
  - Had three components:
    - Field Deployment and phenomena
    - Modeling
    - Economic Analysis
- The Forecast System for WFIP1
  - Ensemble forecasts for MASS, WRF, APS, and HRRR
- Extensive Mesonet (New York Mesonet):
  - First LIDAR network

## 3. Jim Wilczak (OAR/PSD)

### Improving Forecasts for Wind Energy: WFIP and WFIP2

- What will the future US energy system look like?
  - Look to Germany because they are really pursuing renewable energy.
  - Germany was unable to turn down its fossil fuel plans while developing renewable energy plans.
    - They actually had excess energy because they have too much energy from both fossil and renewable energy. Had to pay other countries to take their electricity.
    - At one point, they were generating 75% of electricity with renewables alone.

- Is there an economic benefit to improving wind forecasts?
  - YOU BET. General Electric did a study and found that \$200M in annual savings from a 20% improvement in forecast skill for “next day” forecasts.
- WFIP1:
  - 6 large errors
  - Implications:
    - Synoptic/mesoscale alpha errors suggest improvements in initial conditions are needed
    - Convection always biased (physical parameterization improvements are needed)
- WFIP2
  - Goals:
    - Improve NWP model forecast skill for turbine-height wind regions with complex terrain
    - Area to Study: Columbia Gorge (Eastern Washington/Oregon)
    - Partners: NOAA, Department of Energy Labs, Vaisala and private sector, NCAR...
    - Science Issues: mountain waves, mountain wakes, gap flow, mix out of stable cold pool
    - A collaboration between DOE, NOAA, and private sector will help speed up development carbon-free renewable energy.

#### 4. Russ Bullock (EPA)

##### Meteorological Modeling to Support Environmental Regulation of Air Quality

\*\*\*We expect to see 2 Trillion Dollars in benefits from EPA regulations from the Clean Air Act for 1990-2020. The COST is 65 Billion, so the benefit surely outweighs the cost.\*\*\*

- Air quality modeling provides critical role in development of regulatory policy.
- There was no air quality modeling in the beginning.
- Pollutant transportation is governed by weather.
- Pollutants can significantly affect the weather.
- Feedback mechanisms are the most important
- Observation-based model evaluation is necessary to develop trust that the model treats all important processes accurately.
  - Today, EPA uses modeling (in its third generation) from WRF-Chem, WRF-CMAQ, GEM-MACH. Integrated or coupled meteorology-chemistry. Includes aerosols with feedback to meteorology.
- Pollutant transport and transportation (physical and chemical) are governed by wind flow, temp, humidity, pressure, clouds, and radiation.
- Could better air-quality treatments improve weather forecasting?
- Growing trend for integrating chemistry and meteorology modeling
  - improve NWP-radiative feedbacks and satellite data assimilation
  - chemistry affects meteorology which affects air quality
- Looking at models from a Global Scale

- Earth system linkages (greenhouse gases, nitrogen, carbon cycling, ecology/hydrology links)
- Tighter air quality standards globally will need global modeling
- Improvements in modeling will:
  - Identify sources responsible for air pollution, and determine most cost-effective solution by simulating effects of proposed regulatory action.
- Currently testing different multi-scale models.
  - MPAS is doing very well.

## 5. Tanya Spero (EPA)

### Dynamically Downscaling Global Climate Change Scenarios to Examine Impacts on Air Quality and Human Health

- Why do we need REGIONAL Climate Modeling Research?
  - President's action plan and EPA Administrator McCarthy both state that addressing climate change and improving air quality on regional scales are priorities.
- Monthly Temperature and Precipitation Projections are Insufficient.
  - EPA has interests in national and local impacts of climate change
  - EPA has interests in extreme events and their frequency/intensity
  - EPA wants to know effects on human health, air quality, and ecosystems.
  - Dynamical Downscaling
    - EPA needs higher resolution needed to capture spatial variability for local assessments
    - details gained via regional climate modeling are essential for examining local effects of climate change on human health/environment
    - regional model is broadly consistent with global model with appropriate local differences
- Used BenMAP (Benefits Mapping software) to quantify range of increase in premature deaths, respiratory and emergency department and hospitalizations.
- Caveats about Dynamical Downscaling:
  - WRF options used for downscaling often differ from those used for retrospective AQ modeling and for forecasting

### QUESTIONS:

1: Do wind operators think that wind forecasts are improved and can work for them? Is it not more practical to have the private sector improve forecasts instead of wait for the money to come into the public sector?

- a. Some wind vendors who forecast wind may have issues... there are many of them. But from a panelist's POV, his past company had no problems with poor wind forecasts. The private sector is working in concert with the government, which is demonstrated by the WFIP projects. In the private sector, they do depend on improvements in operational NWP models, and there is a steady improvement in forecasting. Perhaps a forecast vendor that was called out at a previous meeting in Washington D.C. is using outdated technology.

- b. The governmental role is foundational modeling forecast. The independent vendors then use the initial base data for their own small-scale models for their wind plants in certain areas.
- c. Meetings and conferences with wind forecasters convene to talk about these issues to improve this sector.

2: Is the data getting into operations with the NWS? If not, what is preventing NOAA from benefitting from this information?

- a. With the data from the Wind Profiling Radars set in a picket fence-type line along the U.S. West Coast project discussed, it will all be public, it will all be assimilated into NWP models. With the smaller intermittent field programs, the data will be utilized to lay the groundwork for improvements for observational systems in the long term to determine what benefits there will be economically and in other facets. All data from the field campaigns are in the public domain and archived through DOE Pacific Northwest National Lab – Data Archive and Portal Project.
- b. The New York Mesonet is not fully operational but is coming online in the next months and years and will be public.

3: The wind farms are growing so quickly. The landscaping is changing. The concern is technical aspects... the issue of where they're located. With the NWS, if you live in Lubbock, Dodge City, Enid, you have ground clutter on your radar from your NEXRAD. It affects boundary layer measurements. When severe weather goes through wind farms, there's ground clutter from those wind farms when looking at radar, which poses observation and forecasting challenge for NWS forecasters. Is private sector working with NOAA to properly site wind farms to not impact negatively storms and radar.

- a. Department of Energy is working with Department of Defense, NOAA and FAA with mitigation issues with defense radar, weather radar, and try to mitigate some of that impact. As far as sites are concerned, that's private industry. There may be more work done there, but this all took off before regulations were really put in place.
- b. At Duke Energy, we actually own one of those wind farms by Dodge City. We are aware of the problem. We have a curtailment agreement with the NWS Dodge City. They have the ability to call us and curtail during tornado and severe weather events so that we can shut down operations so we don't affect forecasting.
- c. In recent years, there are exclusionary zones that were implemented for a variety of reasons. I don't know if every client is using that information that is available.

SESSION #6 RISK COMMUNICATION I (LANGUAGE, FORMAT, CONSISTENCY IN SHORT-TERMS)

SESSION LEAD: ERICA GROW (WUSA-TV)

Erica Grow (WUSA-9 TV)

- DC Market with 6 million people. Racially diverse (white, black, Hispanic, asian) and economically diverse.
- The many platforms: Broadcast, Facebook, Twitter, Instagram, Websites, Mobile Alerts

- Broadcasters have to:
  - keep it specific but also keep it as simple as possible
  - describe timing as it relates to large population centers and other communities w. high population
  - Instead of giving a time stamp, make it relatable (kids going home on bus, dinnertime, etc...)
  - CUT THE CLUTTER. Is a national weather map necessary? Not during severe weather...
  - The reach on mobile and through the internet is far greater than TV alone.
  - mobile alerts can drive traffic up to the mobile website by a lot (quadrupled in her example)
  
- Thoughts:
  - Do risk/impact graphics help people understand the threat, or are they just used as a gimmick at TV stations?
  - Would color-coded hazards based on impact instead of threat help people do better and make better decisions?
  - What about our rural areas and low-income areas in the TV market?

Tom Birkland (NC State University, Professor of Public Policy)

Ten Years after Katrina: Successes and Problems in Risk and Hazard Communication

Important Points:

- *\*Risk Communication and Hazard Communication* are different, in time and space.
- *\*Social media* are important, but should not be relied on to be the sole source of risk and hazard information
  - *\*What makes a message motivate action?*
    - a clear message-what the risk or hazard is and what to do
    - sent by credible senders to a receptive audience
    - with the means to act on the information
  
- Why is Katrina a good case study?
- largest natural disaster in US History
- failure of Homeland Security, including distorted risk messaging
  - natural disasters were not something well understood by Homeland Security
  - led to public policy reform
  - primarily a flood event for LA and a wind and surge event for MS and AL
  
- What is the weather community?
  - forecasters
  - communicators
  - enthusiasts (bloggers, public science, home weather stations)

- Katrina and the weather community: Warning in NWS text product for hurricane
  - “Shortages will make human suffering incredible by modern standards.”
    - was this hyping? To Birkland, no. Naming winter weather storms is hyping.

Jeannette Sutton (University of Kentucky, Professor & Director of the Division of Risk Services)

Social media and short-messaging situations

- HEROIC (Hazards, Emergency Response, and Online Informal Communication)
  - collected 6 billion tweets, 3 billion network connections, across 19 different hazards
  - what events? Wildfires, blizzard (NEMO), Sandy, Boston Terror Attacks, Colorado 2013 Floods)
  - STYLE MATTERS:
    - Directive Instructive Messaging
    - Telling people directly what to do. “stay inside.”
    - Hashtags, capitalization all matter.
- When looking across the different events, we look at characteristics of tweets and see if those characteristics will increase or decrease the likelihood of being retweeted on Twitter.
- Does using a URL increase the likelihood of people passing on a tweet? NO. It doesn’t.
- SIZE MATTERS:
  - (Tsunami Mobile Messaging as the example)
  - Focus group respondents didn’t understand the tsunami messages, what to do (from the Eureka, CA NWS office)
  - there is a 1380 character limit for smartphones.
  - the study changed the message on their own and retested with the focus group
    - they compared a 1380 character vs. a succinct 140 character emergency message
    - they then compared a series of 140 character messages back to back
- Personalization, Understanding, Believing, Deciding
  - The revised 1380 character message helped because it was more understandable
  - the short 140 character message went down to almost worse than the original long message
  - the sequence messaging (back to back to back) helped understanding.
  - more work to be done. What if there was something stuck between each consecutive message

Matthew Merritt (Novant Health)

- We need to consider how meteorologists can stratify the risk of severe weather so that healthcare organizations can act in time. Instead of just putting out the tornado warning polygon, for example, if a hospital is within the polygon, it would be extremely helpful to EMs if

NWS or other forecaster could quantify the threat to the hospital and its patients. This would aid the EM in decision making and would reduce false alarm fatigue

- for 14 hospitals and thousands of hospitals, there's only one emergency manager.
- for healthcare industry, binary YES/NO action is what is needed.
- In hospitals, the windows are the main risk from severe weather.
- the corridors are where they evacuate to. The shell of the hospital offers decent protection
- tornadoes are often at the top for vulnerabilities from weather and natural disasters. Ice storms also pose a threat
- looking at examples from Joplin, MO and Americus, GA and hospitals hit by tornadoes
- There are situations (neonatal ICU with equipment and a delicate situation where you cannot move the patient... ) What do you do? If folks tell the hospital that they need to move the most vulnerable of those in hospitals, then they know it's a big deal. Because ordinarily, they wouldn't go through all of the trouble.
- There is alarm fatigue with hospitals. False alarm rate... And there are times that hospitals don't want to act.

Sam Hodge (Emergency Manager, Georgetown County, SC)

- Emergency Managers look at WxUnderground and other weather sites, but the official folks with the NWS. In this case, NWS WFO Wilmington, NC
- Every street sign in the evacuation zone in Georgetown County, SC has a sign that shows them what evacuation zone they live in.
  - helps build a community that is prepared
  - these signs will hopefully build in their conscience of what actions to take before the storm hit
    - 861 hurricane evacuation zone bands on street signs

QUESTIONS/THOUGHTS:

1: What can we, the forecasters, do better to help stakeholders do their job more effectively?

- a. there is the conveyance of the perception to make it seem like "gee.. do these forecasters really know what the heck is going on?" You can't be too certain or uncertain. Which goes back to communicating confidence.

2: How do you better preach to the temporary visitors to big tourism centers to make sure those tourists are going to be safer? Everything was going well, until the realization that you have to communicate to your tourists that if you go up a mountain, and there's a convective storm with flooding, that trip could end up with you being dead. These tourism folks do not want to hear that, and it turns them off when we tell them about what could potentially happen. We need to really make sure the chambers of commerce folks understand they have the responsibility to their visitors to make sure they're safe.

- a. Talking to hotels can work. Hotels that received return business and stay sustained during catastrophic natural events will be more successful because they're more resilient.

- b. If you tell people that it's good business to take care of your guests, then that's when they would act. Guests appreciate that gesture.
- 3: Does heat get a pass in terms of "severe weather." How do coastal communities warn people of extreme heat?
- a. Anytime there's a heat advisory, it goes back to the local media market partners. Emergency management will issue the typical press releases and social media pushes to tell people to be safe. But more so, they rely on media partners.
- 4: You often don't see a significant downturn for tourism for areas that are affected by weather disasters (hurricanes). The data does not show that conclusion.
- 5: In the instance with hospitals, can extending tornado warning lead times for you help you?
- a. I believe that 20 minutes will be sufficient to move our critical care patients. I'd love to see some specificity with location with these storms. What can we really say about the storm itself.
- 6: Do you find it easy in healthcare services to find private sector organizations that can help you aside from public sector (NWS) because what is necessary for hospitals is far more than what the NWS can do.
- a. Private vendors are expensive. And sometimes too specific for what hospitals can afford or quite frankly really need. It comes down to the fact that it is the responsibility of the hospital for the safety for patients.
- 7: How do we talk about Facebook and severe weather. Because 66% of adults on the internet don't use Twitter.. And a lot of focus has been on Twitter for this type of research.
- a. Facebook has algorithms that may not equate to seeing time-sensitive information. And there's no way to get your news feed to prioritize those warnings.
  - b. You're not ignoring the FB population. Twitter is just one of those media that helps. There are multiple ways to get info out. FB is useless for getting crucial information out there. Does Twitter diffuse beyond the Twitter-using audience?
- 8: There is headway with Hawaii with tsunami resilience. One side does not fit all. In the Twitter sequential messaging, when did users stop looking at the messages? For a set of 10 messages for instance, did they stop looking after message 2? Message 5? Did they read ALL of them?
- a. More research to be done on that.
- 9: Have you thought about messaging and message content behind the wheel while driving? How do drivers get information?
- a. Radio alerts.
- 

SESSION #7 RISK COMMUNICATION II (LANGUAGE, FORMAT, CONSISTENCY IN LONGER-FUSED EVENTS)  
MODERATORS: BURRELL MONTZ (EAST CAROLINA UNIVERSITY) & SUSAN JASKO (CALIFORNIA UNIV. OF PENNSYLVANIA)

Mark Venturas (GE-Hitachi Nuclear Energy)  
GE Hitachi Forecast Needs

- There have been 27 actionable events since 2011. Over the past two years, we have had to shut the plant down for winter weather events the most often.
- When is the wind/rain going to arrive, intensify, and end are key considerations for planning.
- Winter storms are more difficult than tropical occurrences. The rain/snow line is the most difficult thing to get information on.
- Twitter and Social Media communication does not apply to us on site. We use more bulletins and an email system, but we do get weather information via twitter.

Mike Daniska (North Carolina Department of Public Safety)  
North Carolina Emergency Management

- When we push information out, it is important to think about before, during, and after an emergency activation.
- We use the information we get from the weather information providers to make a decision in a timely manner.
- What is the geography that will be impacted, what is the timing, and what are the anticipated impacts are all questions we ask of weather information providers.
- What resources to use, where to send them, and when are the major questions we ask ourselves during an emergency activation.

Jamie Rhome (National Hurricane Center)  
The Challenges of Risk Communication: An Operational Perspective

- We (NHC) do all of the risk modeling to support the creation of the nation's evacuation zones from Texas to Maine.
- Is this a real warning? Do I really need to evacuate?
- How many times do we put ourselves in the perspective of the customer?
- The nation would have unevacuated if we focused on single-track....
- At 48 hours, the 10% exceedance was still too low for Hurricane Arthur. We live in a society that the minute you say 5% they say, "I don't want this forecast again"
- How do we as a community learn to communicate low probability extreme events?
- How do we calibrate society to treat a 10% of precip differently from a 10% chance of an extreme event?

Burrell Montz (East Carolina University):

- It's all about relationships, and weather communicators need to know what those relationships are.
- We have to understand our stakeholders processes in order to communicate and give them the information they need.
- We all make decisions based on our mental models.

- Comfort, Confidence, and Competence: The three C's of forecasting and taking in weather communication and weather information.

QUESTIONS:

1. Why is it that rational people do not behave according to the risk formula? There are many other factors (15 factorial) that go into this. What makes us think that we can change "the publics" mind on this issue? Should we invest this money into this daunting problem?
  - a. How do I get 300 million Americans to see things the same way?
  - b. We spend too much time in the meteorological community for the first part of the question, and do not focus enough on the impacts. Lead with what you know! How much of the societal impacts is baked into our warning criteria? Is the societal impact of a storm surge warning the same as another warning? How much of that gets baked into the warning criteria? Many people tend to attenuate the risk of a more familiar hazard (i.e. hurricanes).
2. You implied that you get your information from multiple sources and that it could conflict. Do you see that as a liability?
  - a. Typically the NWS is providing us with information. We do have inhouse weather officers, but they do not do the same type of analysis as NWS. They look at NWS sources and other sources and then boil it down.
  - b. Is there a policy that requires you to use one source over another?
    - i. There's not a policy, but we usually go off of the NWS information. The in house officers provide their analysis and give that to us. By the time the info gets to me it has been consolidated. Overall, I would see it as a positive. There is the potential that they could make a recommendation that differs from the govt source.
    - ii. I think it can be an asset or a liability, it's an asset. We use the other information to ask NWS ("Hey, what about this?"). However, we normally default to the NWS.
3. Confidence of presentation has a lot to do with what you said it. Lead with what you know.
  - a. "Don't bury the lead" - Don't exhaust your customer before you tell them what they need to know.
4. If a Hurricane Hazel were to hit NC, you would not be expected to have transportation and communication, is there a plan?
  - a. Every year we do a state exercise. This year we did a Hurricane scenario. When we do our exercises, we have a lot of capability in the state. We have an 800 MHz communication statewide. Obviously if something big comes through it can impact the towers. We also have mobile towers that can be deployed. If it's a Hazel, I think everyone is going to have issues. In terms of first responders, I think the capability would be there. The biggest thing is actually getting away from a naturally caused communication outage, to a cyber-related outage.

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SESSION 8(A): TRANSPORTATION PATHFINDER: IMPROVING COLLABORATION BETWEEN STATE DEPARTMENTS OF TRANSPORTATION AND THE WEATHER ENTERPRISE

Moderator: BRENDA BOYCE (BOOZ ALLEN HAMILTON)

Pathfinder Project

Julie Gondzar (Wyoming DOT), Chad Hahn (NWS/WFO), Paul Pisano (FHWA)

- The goal of the Pathfinder Project is to promote coordination between State Departments of Transportation and the weather enterprise so that messages sent by these two entities to the traveling public are consistent.
- Before the Project, the message was always a condition and an action (Wet Road, drive slowly).
- By collaborating between the DOTs, the NWS and DOTs private-sector weather providers, the messages sent to the traveling public are consistent and the public will likely change their behavior on the roadway.
- When we are all on the same page and focusing on the impacts, increases the trust in us as a weather community.
- During snow events, 80% of the traffic on Wyoming highways are commercial vehicles.
- How do we get information to the users to help them in their travel arrangements and making alternate plans/decisions?
- NWS Chat was the best way for the Pathfinder partners to communicate with each other. It enabled the partners to develop a plan to determine weather impacts and then give that information to the public.
- The Dynamic Message Signs along the highways are the number one way of communicating with the traveling public.
- What storms get “Pathfinder” Treatment? The best way to decide to give weather messaging to the public depends on if the weather enterprise had high confidence of it being a high impact event.
- Do other states have the capability of providing these messages to the public via DMS/Email messaging?

QUESTIONS:

1. Has Utah generated statistics and have they seen any metrics on the impacts?
  - a. They do have some statistics, but nothing published.
2. During the Winter Storm events, which one of the communication channels is working best?
  - a. The Highway Advised Radios are used the least. WYDOT will put out a survey to get more information. We have heard a lot of positives about the signs, but no quantitative data.
3. Do you not have the ability to have alternating signs on the boards?

- a. Yes we can, but there is a limit to what we can put up there. We have to suggest an action, so that takes up part two of the sign. Therefore we can't address two storms on signs.
  4. Do you put anything up on the screens during normal weather conditions or blank?
    - a. Better to leave them blank, than to provide generic messaging.
  5. Create a gridded roadmap for accumulation.
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## SESSION 8(B): RISK PERCEPTION AND USER RESPONSE

Moderator: DEREK ARNDT (UNIVERSITY OF OKLAHOMA)

Amanda Bryant (FEMA)

- How do we take all the noise in this environment and turn the public to action?
- Three important key aspects: Relationships matter, identify your audience, and coordinate effectively.
- Call to Action: Let's Turn the Noise Around. Form a community enterprise, identify our target audience, come up with a message and deliver it consistently.

Wendy Thomas (NOAA/NWS)

Impacts Catalog

- Empowers the forecaster, but informs the emergency managers better than before.
- The Federal Agencies must be able to rely on each other.
- When it comes to an "event", our agencies are held up to these policies and guidelines.
- Provides a forecaster with a database to manage high impact thresholds for areas of interest to core partners.

Dr. Linda Rimer (EPA)

- Words matter.
- The Collective Behavior on mitigation is important.
- Climate change is perceived as not being very scary (Not me! Not now! Not Science!)
- It's happening, we're sure of it, we're doing it, it's bad for us,
- Improving the understanding of why individuals choose/don't choose to change their behavior.

Dr. Kim Klockow (NOAA)

- The weather enterprise is like a Sergeant to the public being the soldiers.
- We are operating under a command and control paradigm, we assume we know what's best.
- Cannot use deaths, or lack thereof, as the sole indicator of success.
- Social Equality is not always Social Justice.
- The way we define our goals will impact the way we serve society.

QUESTIONS:

1. Linking all the products together to have weather watches/warnings and impacts. Have FEMA and NWS products add up and work together on a singular system.
2. People don't understand the difference between weather and climate.
3. How can we be more sneaky to get the accurate information to the people who can spread it?
4. There is no reason to be fearful to talk about climate change on the air.
5. Using the strategy of "small nuggets" when broadcasting climate change.
6. How does hype affect how people perceive risk later and take action later?
  - a. Provide safety messages for the events, but do not say it's the worst event ever.
  - b. Encourage preparedness after extreme events
7. How is risk characterized in an individual's brain?

**DAY 3: August 6th, 2015**

**Notes by: Lindsay Blank, Minh Phan, and Castle Williams**

SESSION #9: OUTCOME-BASED VERIFICATION

Moderator: Brian Eberton

Brian Eberton (NOAA/OAR/ESRL)

Metrics

- The Union of weather and the built environment is what is of concern to the public.
- A good prediction of the weather could result in a bad prediction of impact.
- What if hail falls in a rural area where you don't get a storm report? What do you do?
- When does it start, when does it end, and how bad is it going to be? Are the questions people ask about severe weather.

Robert Lee (AvMet Applications Inc)

Outcome-based Verification with an Aviation Focus

- Each stakeholder has their own threshold for weather; therefore, verification is difficult.
- Improved verification methods would provide more useful insight into forecaster training needs and the overall threat forecasting process.

Robyn Heffernan (NOAA Fire and Public Weather Services Branch)

Fire Weather Impact Based Verification

- With metrics we are trying to gauge customer satisfaction
- Stakeholders know very little about needed accuracy of weather information, but understand the importance of that information.
- Customer collaboration is essential!
- We need to learn the tolerance and sensitivities are for weather information to raise the threat level higher.

Barbara Brown (NCAR)

User-relevant forecast verification: energy application

- The energy application is already at a level 3 of user focus, and moving into the level 4 for better understanding of forecast value.

QUESTIONS:

1. Do you have a field saying... How is that captured and influence future actions?
  - a. On-going fire activity and suppression actions. We get little feedback, except through the incident management meteorologist. Feedback forms can be submitted during the fire event, involving the weather forecast they experience during the event. There is one piece which you can transfer over to tactical operations -> the weather forecast provided. How is information interpreted and received by the end user?

2. Is your office on top of getting states more involved earlier in fire management?
  - a. Yes, we work with other federal organizations. Provide outlooks for significant fire events. They attempt to bring on the services early. There are some critical decisions made based on those outcomes, and the money is key. The money doesn't come until an emergency is declared.
3. How can we improve examples of over forecasting?
  - a. Giving examples from customer sampling can be beneficial to both forecasters and stakeholders. I think some education is needed for some thresholds for stakeholders and how those decisions are made within each stakeholder.
  - b. Going down to those major events and conducting case studies. Asking questions would you have changed anything?
4. Can you talk about sunshot more to discuss the economic benefit and how do you tell that story to the decision makers?
  - a. Jeff Lazo has spent a lot of time talking to the utilities companies and users of his forecasts to determine what they need and get out of the forecast. Getting them behind the analysis and involving them in the process for defining the metrics. We haven't gotten to the final stage to determine the benefits, but so far the utilities appear to be very involved with it, so we will have to see.
5. How do you account for fires with verification if the conditions are right, but there isn't a meteorological starter.
  - a. The null result is impossible to forecast . We should forecast a fire event will occur, We are truly forecasting potential, so we should verify potential. When we are looking at verification we have to look at the potential for extreme fire outbreaks.
6. How would all the sessions have worked backwards?

#### FINAL DISCUSSION:

1. *In Alaska, they can use simulations to put air traffic and weather and try to land a commercial aircraft in the middle of a thunderstorm. Can we use simulations to show the folks in the Weather Enterprise what it's like to experience what the end-users have to deal with so we can better relate to our partners?*
2. *Folks at Florida International University are trying to do studies on how survivors and how actual weather experiences impact people. This is an area needing more attention.*
3. *Sometimes, going out to damage assessments with a local NWS Weather Forecast Office (WFO) can be an eye-opening and humbling experience to let people understand. Documentaries or "point-of-view" video productions could better demonstrate the risks that exist to the public.*
4. *Education is extremely important (child and adult) to a better future of all points of weather and an area needing continued innovation.*
5. *Soon, we can say the word "climate" without it being like "the cat pooped in front of the dinner guests." Collaborations with climate service professionals can exist in these types of settings and meetings such as the AMS SCM.*

6. *We have to prepare for a revolution. The third revolution in forecasting is a combo of FACETs (temporal, spatial probabilistic techniques) and go on past Impact Based Decision and use NOAA Big Data Initiative... and put these information tools out on the web so maybe companies and organizations can use that information and make applications that can match the risk probability and risk consequence.*
7. *Format of meeting. Can we change the name to a “workshop” rather than a “meeting.”*
8. *Social scientists are facilitators when “physical scientists” get off track. We teamed people together so they could be cognizant of the other person’s POV. Team together the educator, the end user, and the forecaster. And come up with some goals and outcomes.*
9. *Foundational Data: renew focus on NWS and weather community. Get the info out to folks in enterprise as quickly as possible, especially on new and emerging areas. We need to make that data available to industry, even if it’s in the experimental mode.*
10. *Observations underpin all science we have. It’s so important.*
11. *What are the low-hanging fruit? Snow-squall problem... right now we don’t have a way to communicate to the public about actionable warning... special weather statements are too much... But add a snow squall warning.*
12. *Long-duration long-lead time events: California drought. Heat Wave. Hurricane that’s far out. We need to be able to communicate them.*
13. *Education has its challenges in today’s society. Kids are “spoon fed” what they need to know. They’re not taught to think on their own. I want to play up the word “learning” because they need to work harder to get the information.*
14. *Propose a session at next conference and force people to network. Good opportunity to mingle and understand different POV.*
15. *Vulnerable populations. Special needs, elderly, life-long learning people. Those are low-hanging fruit that we can really target those folks.*
16. *Invite folks from Facebook/Google and technology folks to come and see who else wasn’t in the room but would be good to have in here.*
17. *Engage with FACETs. Talk to Lans Rothfusz and see how we can help with social science/engagement aspects.*
18. *More publicity for community meeting and get more students to come out to this meeting. Travel grant to this meeting.*
19. *People draw from what they’ve already seen and experienced.*
20. *We need more broadcasters here. Broadcasters are still number one source for weather to end users. Make sure broadcast community is very interactive.*
21. *A lot of broadcasters feel helpless (TV Newscheck and national media and how they treat weather stories).*

[end]