FINAL REPORT

The National Weather Service's Hazard Simplification Project: Findings from the Case Studies

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Eastern Research Group, Inc.
Arlington, Virginia

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www.weather.gov

Eastern Research Group, Inc.

ERG provides environmental, social science, and engineering solutions to climate, weather, and coastal management issues. Learn more at *www.erg.com*.

NOAA's Office for Coastal Management "Coastal management" is the term used by communities and organizations striving to keep the nation's coasts safe from storms, rich in natural resources, and economically strong. The national lead for these efforts is NOAA's Office for Coastal Management, an organization devoted to partnerships, science, and good policy. This agency, housed within the National Ocean Service, oversees major initiatives that include the National Coastal Zone Management Program, Coral Reef Conservation Program, Digital Coast, and National Estuarine Research Reserve System.

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I. Executive Summary

NOAA's National Weather Service (NWS) forecasts hazardous weather situations and issues watches, warnings, advisories (WWA), and other information products to convey the threats posed by these events. These products are intended to help communities prepare for and respond to hazardous weather to protect people's lives and property. To better understand how the NWS and its stakeholders perceive and use the current system, Eastern Research Group, Inc. (ERG) worked with the NWS to distribute a survey (see Appendices A and B) to NWS staff and partners that resulted in a collected set of case studies.

The survey was designed to address the following questions:

- What are the strengths and weaknesses of the current WWA system from a hazard messaging standpoint?
- How do perceived weaknesses relate to potential solutions?
- Do stakeholders want to change the current WWA language? How much change is desired?

The case studies should help to build a foundational analysis for moving the Hazard Simplification project forward. The findings can provide insights into challenges to be addressed, as well as potential solutions for improving NWS warning communication.

Methodology

ERG worked with the NWS to develop a Web-based, case study survey instrument (using Qualtrics software) that asked participants to respond to a series of open-ended questions about a particular hazardous weather event where the messaging did (or did not) work well from their viewpoint or from the viewpoint of their community or audience. As an example, the survey asked respondents to consider a snowstorm or convective event where the WWA system enabled them to translate the messaging well; or conversely, a flash flood event where the system did not effectively empower them to communicate the expected impacts. The survey also gave respondents the option to consider their general experience with specific types of hazardous weather, rather than a particular event. This qualitative, open-ended, case study approach was chosen to encourage respondents to share and describe their perceptions of the NWS WWA system.

Sample and Analysis

In all, 706 case studies were deemed viable for analysis, with 88 of these cases submitted by internal NWS forecasters and staff; 566 cases submitted by emergency managers (EMs) and other external partners, such as representatives from disaster relief organizations, hospitals, transportation departments, and park services; and 52 cases submitted by broadcast meteorologists, other media, and the private weather sector.

ERG used a mix of inductive and deductive approaches to analyze these data. For the first phase of the work, ERG conducted an inductive, bottom-up analysis using a qualitative software called Nvivo. This approach detected theoretical patterns (called codes) in a subset of the data with no preconceived notions of particular findings. In the next phase of the analysis, the theoretical patterns were analyzed to develop emerging themes and associated keywords. These keywords were then used to employ a deductive, top-down approach to identify and summarize the recurring themes in all of the remaining case studies. Figure I-1 (on the next page) provides an overview of the methodology used.

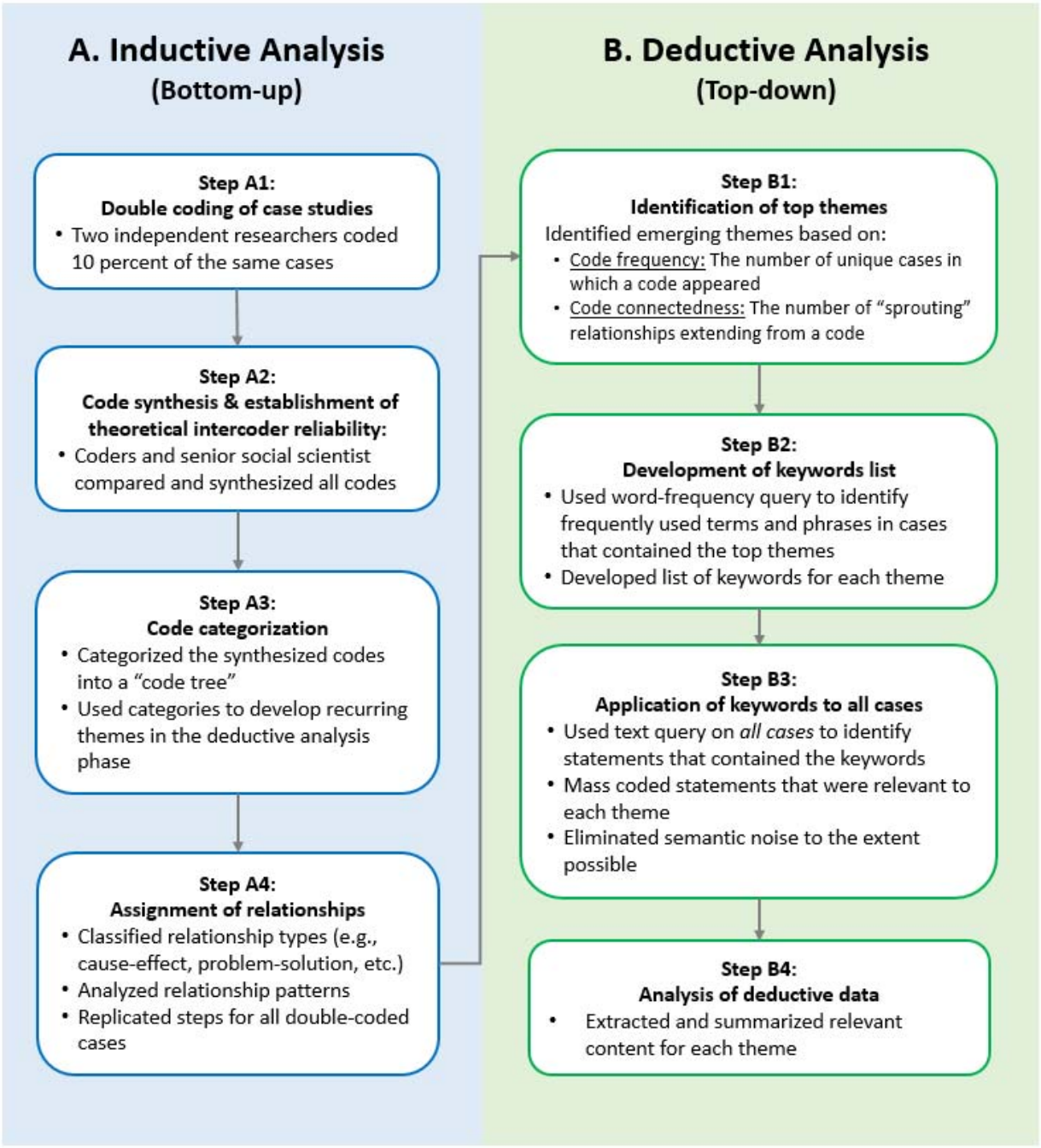

Figure I-1. Overview of Methodology

Summary of Case Study Themes

Table I.1 below summarizes all of the key recurring themes with their corresponding definitions in alphabetical order by group (NWS internal, EMs, and media).

Table I.1 Summary of Themes from the Case Studies by Sample Category

Theme/Case Count	Definition of Theme
Internal NWS	
1. **Adding Impacts to WWA** (8 out of 88 cases)	This theme focuses on incorporating impacts into WWA.
2. **Addressing Confusing Terminology** (27 out of 88 cases)	This theme includes forecasters' perceptions that some (or all) of the terms "watch," "warning," and "advisory" are confusing or ineffective.
3. **Collaborating with Other Entities** (22 out of 88 cases)	This theme focuses on forecasters' experiences in collaborating with other entities (e.g., Weather Forecast Offices [WFOs], national centers, regions, and external partners).
4. **Focusing on Graphics** (12 out of 88 cases)	This theme addresses the role of graphics, multimedia, and other visual information in communicating hazardous weather situations, both now and in the future.
5. **Handling Levels of Forecast Confidence** (22 out of 88 cases)	This theme focuses on forecasters' ability to convey confidence in a hazardous weather event within the current WWA system.
6. **Maintaining WWA Features** (67 out of 88 cases)	This theme reflects forecasters' opinions on the features of the WWA system that should be maintained. It also includes suggestions for changes to the system.
7. **Providing Education, Outreach, and Training** (8 out of 88 cases)	This theme includes both ongoing and past experiences with education, outreach, and training, as well as suggestions for future improvements.
8. **Referencing Above or Below Criteria** (26 out of 88 cases)	This theme addresses situations where WWA products do or do not meet specific NWS criteria and/or thresholds.
9. **Referencing Impact-Based Decision Support (IDSS) Services** (19 out of 88 cases)	This theme includes any reference to an array of IDSS, such as sending emails to partners, conducting webinars, hosting conference calls, or otherwise working with customers.
10. **Using the WWA Map** (12 out of 88 cases)	This theme includes references from forecasters regarding the display of WWAs on the map shown on local or national NWS websites.

Emergency Managers	
1. **Approving of Present System** (412 out of 566 cases)	This theme indicates respondents' general approval or liking of the current WWA system.
2. **Considering Outside Factors** (467 out of 566 cases)	This theme addresses factors outside of WWA products that can influence decision making and response to a hazardous weather event.
3. **Disseminating and Sharing NWS Information** (490 out of 566 cases)	This theme encompasses various types of information shared, as well as modes of transmission and with whom the information is shared, such as supervisors, partners, the public, and others.
4. **Experiencing Nighttime Hazards** (38 out of 566 cases)	This theme captures examples of experiencing hazardous weather at night and/or statements related to receiving WWA alerts from the NWS at night.
5. **Having Timely Information** (185 out of 566 cases)	This theme includes positive, negative, and general statements related to having, not having, appreciating, or wanting timely information or advanced notice of a hazardous weather event.
6. **Managing Staffing Decisions** (49 out of 566 cases)	This theme pertains to planning and managing staffing and operations in preparation for hazardous weather.
7. **Maintaining WWA Features** (459 out of 566 cases)	This theme reflects EMs' opinions on the features of the WWA system that should be maintained. It also includes suggestions for changes to the system.
8. **Preparing for Hazardous Weather** (135 out of 566 cases)	This theme includes examples of how the WWA system helped respondents prepare for potentially hazardous weather.
9. **Receiving NWS Information** (566 out of 566 cases)	This theme captures the variety of sources through which EMs receive WWA information, not just from the NWS but also from other government agencies, partners, and private entities.
10. **Referencing Above or Below Criteria** (48 out of 566 cases)	This theme addresses situations where WWA products do/do not meet specific NWS criteria and/or thresholds.
11. **Using NWS Products and Services** (489 out of 566 cases)	This theme captures how respondents use WWA products and information (such as to gauge situational awareness, to plan and prepare, to decide when and what to warn citizens; and to alert first responders).

Media	
1. **Addressing Overlapping Boundaries** (13 out of 52 cases)	This theme focuses on situations that arise when a media market is situated at a border of a county warning area (CWA) or has an audience base that spans multiple CWAs.
2. **Considering Outside Factors** (32 out of 52 cases)	This theme focuses on the many factors outside of the WWA system that can influence the media's coverage of a hazardous weather event.
3. **Finding WWA Effective or Ineffective/Limiting** (42 out of 52 cases)	This theme summarizes the media's assessments of the effectiveness of the WWA system from a messaging perspective.
4. **Maintaining WWA Features** (37 out of 52 cases)	This theme reflects the media's opinions on the features of the WWA system that should be maintained. It also includes suggestions for changes to the system.
5. **Referencing Above or Below Criteria** (8 out of 52 cases)	This theme includes statements that reference events that do/do not meet specific NWS criteria and/or thresholds.
6. **Referencing Time or Timeliness** (26 out of 52 cases)	This theme references situations where respondents have or have not received timely warnings and advance notice.
7. **Sharing WWA Information and Products** (44 out of 52 cases)	This theme captures how respondents share WWA products and information for a hazardous weather event.

Key Findings

A number of key findings emerged from the analysis. Some of these findings relate to one particular category of respondent (i.e., NWS forecasters, EMs, or the media), while others represent cross-cutting themes:

Findings Specific to a Particular Respondent Category

- **Nearly three-fourths of the EM respondents praised the current system.** Out of 566 EM respondents, 412 commended the current system using phrases such as, "I am happy with the current structure," "It works for me," and "The system you have in place is excellent." One EM stated, "If people don't understand the current system then they will likely not understand any future or different system."
- **In general, NWS forecasters and media respondents desire more change than the EM respondents.** The NWS and media cases support changing at least some part of the current WWA system. Few media respondents supported maintaining the WWA system in its entirety, though there was some support for maintaining the warning products. While the EM cases overwhelmingly supported maintaining the current system, they also did present a number of suggestions for changes (see Appendix C).
- **Some NWS forecasters and media respondents perceive that the current WWA system is confusing to the public and even some partners.** There is a perception (primarily from the NWS case studies) that members of the public (and even some NWS partners) do not understand the WWA terms. Some of the media respondents echoed these sentiments with one broadcaster stating, "Explaining what each WWA actually means is half the battle. The terminology is not obvious on its own." *Perceptions* of public and partner misunderstanding, however, are not complete evidence that these groups do not understand the terminology.
- **NWS forecasters and the media support the idea of adding impacts to the WWA system.** Some NWS respondents supported changing WWA to an impacts-based system or incorporating impacts into WWA criteria. Several media respondents also endorsed the inclusion of impacts. While not a key theme among EMs, some touched upon the topic. For example, several EMs suggested that the NWS keep its messages as area-specific as possible and indicate where potential impacts are most likely to occur.

Findings that Cross-Cut Respondent Types

- **There was general support for simplifying and reducing the number of WWA products, improving formatting, and using concise, easy-to-understand language.** All groups of respondents supported streamlining or consolidating the number of hazard products and by doing so decrease the number of products issued. There was also general support for organizing the information in a more user-friendly format, using bullets, and making the messages more readable. Many respondents suggested that the NWS simplify the language used in its warnings and focus more on conveying timing, confidence, and impacts.
- **There was a general acknowledgment that the WWA system resides within a larger communication, operational, and IDSS framework.** All respondent groups acknowledged that the WWA products are typically the *last* piece of information in a continuous flow of weather information. Many NWS respondents felt that their IDSS was the critical factor in their effective communication and cited their many mechanisms for providing IDSS, such as emails, phone calls, social media, briefings, and webinars. EMs echoed this sentiment and called out text messaging and smartphone alerts, in particular, as being "essential" to their daily operations. Media were less dependent on IDSS, but viewed their own role in translating WWA terminology as a critical part of a larger communication framework.

- **There was no consensus that any of the individual WWA terms should be eliminated or replaced.** Although some respondents did comment that the WWA terminology is confusing, they did not overwhelmingly identify specific problems with the particular words "watch, warning, or advisory." The NWS respondents were the most critical of the terms. Both the NWS forecasters and the media respondents were somewhat supportive of maintaining the "warning" term.
- **The rigid criteria for issuing WWA products can present challenges in collaboration and coordination among WFOs, which can delay issuing products, reduce preparation time, and contribute to inconsistent messaging.** All three sample groups criticized the rigidity of the criteria or thresholds for issuing certain WWA products, particularly in the flooding and winter weather categories. While many NWS and media respondents noted that the WFOs need to have some guidance and rules in their forecasts, NWS forecasters described the difficulties they often have in fitting a particular event into strict criteria and in applying differing criteria (among different WFOs) to an impending event.
- **There is a need for flexible consistency.** In addition to making the criteria less rigid, respondents across all three sets of cases discussed the balancing act between consistency and flexibility. Though all groups praised NWS IDSS, NWS forecasters specifically applauded its rule-free, flexible environment. EMs suggested giving the NWS "some latitude to customize the criteria to a region," but noted that latitude "shouldn't [have] huge deviations."
- **The attributes underlying the WWA products are more important than the actual words**. An underlying issue and a major question throughout all the case studies is what attributes should drive any changes in the current WWA products. EMs often use the product definitions to justify their binary decisions, while media use them to determine whether or not they go on air. Definitions can change, but how the words change in terms of underlying meteorological attributes must have transparency.
- **There is a need for education and outreach.** All three sets of respondents called for expanded public outreach and education. Some NWS respondents felt that the present system is simply unintuitive and no degree of education would solve this issue; others felt that the system should continue given the investments made in education and training. Several EMs cautioned against making major changes to the current WWA system as their partners and customers have become accustomed to the terms and products. Any changes would require proactive training and outreach to avoid misinterpretation and public confusion. Some respondents also suggested enhanced training, both internally within the NWS and externally with partners.

Conclusion and Next Steps

The case studies exemplify the complexity of communicating hazardous weather information. The findings describe a balancing act between maintaining the current system from the emergency management perspective with changing the system from the media and NWS standpoints.

Desired changes among all respondents included:

- Simplifying and consolidating products, including improving formatting and using easy-to-understand language
- Increasing NWS interoffice coordination and collaboration
- Revisiting WWA product definitions and criteria
- Expanding education and outreach efforts

Some of the NWS and media respondents also perceive that the current system is confusing to the public and even some partners—not only the WWA terminology, but also the way that WWA products are

issued. Respondents did not, however, overwhelmingly identify specific problems with the words “watch,” “warning,” or “advisory.” All of the respondent types also acknowledged that the attributes underlying the WWA terms are more important than the words themselves.

Within the NWS sample as a whole, less than one-third of the cases mentioned confusing terminology. Within these cases, a few respondents stated that they believe that the public mixes up watch and warning, and a few more felt that advisories create public confusion. However, taken as a whole, the cases did not coalesce on a particular problem with any specific WWA word or product.

Among the media respondents, confusing terminology did not even emerge as a key theme; instead respondents commented more generally that the present WWA system is limiting or ineffective, with terminology being only one facet of a broader issue. For example, media respondents also expressed concerns that the system too often raises an alarm for events that do not happen, that messaging is not always detailed or timely enough, that criteria can be too rigid, and that there are sometimes coordination issues between NWS offices.

The findings from these case studies should be considered in tandem with other ongoing research to help the NWS consider potential enhancements to the current WWA system. It is also important to note that the NWS and media samples were both small, at 88 and 52 respondents, respectively, so care must be taken in interpreting these findings. While the EM findings (with a sample size of 566 respondents) carry more weight than the NWS and media samples, the wider EM community is also larger than that of the media and the NWS. The NWS could further validate the findings from this report through targeted research on public and partner understanding of the WWA terms, as well as through reviews of the findings by the wider EM, media, and forecaster communities.

II. Introduction

Background

The NWS forecasts hazardous weather situations and issues WWA products and other informational products to convey the threats posed by these events. These products are intended to help communities prepare for and respond to hazardous weather in order to protect lives and property. The products are communicated to users through websites, smart phones, television programs, radio broadcasts, and NOAA Weather Radio. Users of NWS products include, but are not limited to, weather professionals, transportation and aviation officials, emergency management personnel, public works departments, broadcast meteorologists and other media, and the public.

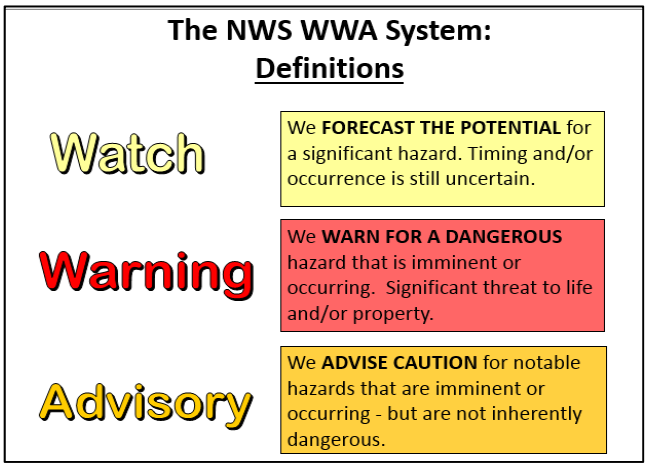

Figure II-1. WWA System Definitions

The NWS has embarked on an effort to evaluate its WWA products. However, any change to the current WWA system must happen deliberately, gradually, and with transparency since the terms are recognized and widely used by NWS partners, and may be institutionalized into some societal decision making, as well as in policies or laws.

Study Purpose

To better understand how the NWS and its stakeholders perceive and use the current system, ERG worked with the NWS to distribute a survey (see Appendices A and B) to NWS staff and partners that resulted in a collected set of case studies.

The survey was designed to address the following questions:

- What are the strengths and weaknesses of the current WWA system from a hazard messaging standpoint?
- How do perceived weaknesses relate to potential solutions?
- Do stakeholders want to change the current WWA language? How much change is desired?

These case studies provide a foundational analysis for moving the Hazard Simplification project forward. The current WWA system resides within a larger structure of NWS operations and IDSS. When partners consider the strengths and weaknesses of the WWA system, they also reflect on their perceptions of the warning system as a whole. As the NWS moves forward with the Hazard Simplification project, the findings from this analysis can help illuminate both the weaknesses that must be addressed in any new warning system, as well the strengths of the current system that must be retained. In addition, this analysis collects the many suggestions that stakeholders have for improving the warning system in its entirety—not only what warning language would be most effective, but also what education, training, internal coordination, technology, and operational challenges must be addressed for any new or enhanced system to succeed.

III. Overview of Methodology and Sample

To carry out the goals of the research, ERG worked with the NWS to develop a Web-based, case study survey instrument (using Qualtrics software) that asked participants to respond to a series of open-ended questions about a particular hazardous weather event where the messaging did (or did not) work well from their viewpoint; or from the viewpoint of their community or audience. As an example, the survey asked respondents to consider a snowstorm or convective event where the WWA system enabled them to translate the messaging well; or conversely, a flash flood event where the system did not effectively empower them to communicate the expected impacts. The survey also gave respondents the option to consider their general experience with specific types of hazardous weather, rather than a particular event.

This qualitative, open-ended case study approach was chosen to encourage respondents to share and describe their perceptions of the NWS WWA system. Analyzing over 700 case studies from the NWS, EMs, and other external partners, as well as from the media, the findings represent a rigorous bottom-up, inductive approach, as well as a thorough top-down, deductive analysis. Although the data were somewhat more complicated to analyze than a closed-ended, quantitative study, the open-ended survey approach allowed for a more comprehensive and unbiased assessment of the perceived strengths, weaknesses, and ideas for potential improvements to the current system. While a close-ended, quantitative survey instrument could have measured *if* stakeholders wanted change, it would not have adequately discerned *why* stakeholders did or did not desire change, and *what* kind of change they want.

Survey Distribution

ERG received approval to distribute the survey from the Office of Management and Budget (OMB) on May 25, 2015 (Information Collection Request reference number 201504-0648-015). Before the surveys were distributed, they were pre-tested with an EM and a broadcast meteorologist to ensure the questions were understandable, relatable, and able to capture the strengths and weaknesses of the WWA system.

The survey was then distributed in two phases during the summer of 2015:

- **Phase I – NWS internal staff.** NWS leadership announced the survey to the entire agency in the context of an all-hands briefing. Staff were briefed about the Hazard Simplification project and encouraged to submit case studies. After the briefing, an email with the survey link was distributed to all staff. The survey was open for about five weeks.

- **Phase II – External partners.** The Warning Coordination Meteorologist (WCM) in each of the 122 WFOs sent an invitation to complete the survey through its decision support email list, which includes a wide variety of respondents—not only EMs, but also transportation officials, aviation officials, school and school board representatives, first responders, hospital officials, members of the military, and others. The number and type of contacts vary from one WFO to another, but typically contain a few hundred names of individuals who work in local, state, regional, and federal government agencies, as well as those involved in preparedness and response efforts for entities in the private sector. The International Association of Emergency Managers (IAEM) also sent the survey invitation to its members and published the survey link in its weekly email newsletter, *IAEM Dispatch*. The American Meteorological Society (AMS) also distributed the survey invitation to its list of approximately 558 certified broadcast meteorologists.

The survey invitation encouraged participants to share the survey link with others. Although one survey link was sent to all potential respondents, there were two distinct tracks within the survey instrument: 1), an emergency management track and 2) a media track. These separate tracks were designed so that a respondent would complete a survey tailored to his or her job. The survey was voluntary and

anonymous, unless the respondent provided his or her contact information for follow-up. (The media and emergency management survey instruments are provided in Appendix A. The introductory survey questions for all respondents are provided in Appendix B.)

Sample

The sample includes three groups, broadly defined as:

1. *NWS internal staff.* Forecasters and/or staff from local WFOs, national centers, and NWS headquarters. Table III-1 displays the geographic distribution of these respondents.

2. *External partners.* Primarily EMs and first responders, but also representatives from disaster relief organizations, hospitals, transportation departments, schools, park services, and other organizations (see Table III-2). (For the remainder of the report, this group will be referred to as "EMs.") In response to question 2.1 (see *Emergency Managers' Survey* in Appendix A), respondents described their job responsibilities as follows:
    - Coordinating emergency planning, response, and recovery.
    - Monitoring weather for situational awareness.
    - Managing staffing decisions.
    - Alerting management and decisions makers of hazardous weather so they make action appropriate preparedness action.

3. *Media partners.* Primarily broadcast meteorologists, but also media representatives from radio, print, and blogs. Table III-3 describes the types of media respondents and their respective market size.

Table III-1. Geographic Distribution of NWS Case Studies

Region	Number of Respondents
Alaska Region	2
Central Region	27
Eastern Region	17
National Centers (including HQ)	9
Pacific Region	1
Southern Region	8
Western Region	21
Regional Information Not Provided	3

Table III-2. Job Categories of External Partners

Job Category	Number of Respondents
Emergency Manager or First Responder	383
Department of Transportation or Public Works	33
School or University Official	22
Hospital or Medical Facility Worker	17
Insurance or Reinsurance Industry	1
Other	110

Table III-3. Market Type and Size of Media Case Studies

Media Market	Number of Respondents
Local/Large-Sized Market	6
Local/Medium-Sized Market	20
Local/Medium-Sized Market	12
National Media Market	2
Newspaper (Online and/or Print)	2
Other Online	1 (national audience)
Radio	3
No Response	6

In all, 805 case studies were received (see Table III-4 on the next page) with a total of 706 deemed viable for analysis. Of these, 88 viable case studies were from the NWS, and 618 viable case studies were from external partners. A survey was considered not viable (and deleted from the analysis) if it came back empty, perhaps due to someone starting the survey and not finishing it, or if only a few questions were answered. If only one or two questions were unanswered, a survey remained in the analysis.

Table III-4. Breakdown of Case Studies Received and Case Studies Deemed Viable		
Sample Category	**Number of Raw Case Studies Received**	**Number of Viable Case Studies**
Internal NWS	88	88
External	717	618
EMs and Other External Partners	-	566
Media	-	52
Totals	805	706

A total of 717 entries were received from the external partners' survey. Of these, 618 (566 EMs and 52 media) were deemed viable for further analysis. For the external case study media track, 121 cases were initially received, but after review, 69 out of the 121 respondents described their job responsibilities as those of EMs or first responders, not that of media. Responses from these individuals were excluded from analysis as they do not accurately reflect the perspectives of broadcast meteorologists or other media, who were the intended target audience for this survey track. Once the viable cases were identified, ERG cleaned the responses by removing personal information, such as email addresses, names, and location identifiers, to ensure confidentiality.

Inductive and Deductive Data Analysis

ERG used a mix of inductive and deductive approaches to analyze the data. For the first phase, ERG conducted an inductive, bottom-up analysis using qualitative software called NVivo. This approach detected theoretical patterns (called "codes") in a subset of the data with no preconceived notions of particular findings. For example, the pattern "Experiencing Nighttime Hazards" emerged from the EM cases when discussing some of the weaknesses of WWA. For the next phase, the theoretical patterns were analyzed to develop emerging themes and associated keywords. These keywords were then used to employ a deductive, top-down approach to identify and summarize the recurring themes in all of the remaining case studies. Figure III-1 on the next page provides an overview of the methodology used to analyze the case studies; a more detailed description of the methodology is provided in the pages following the table.

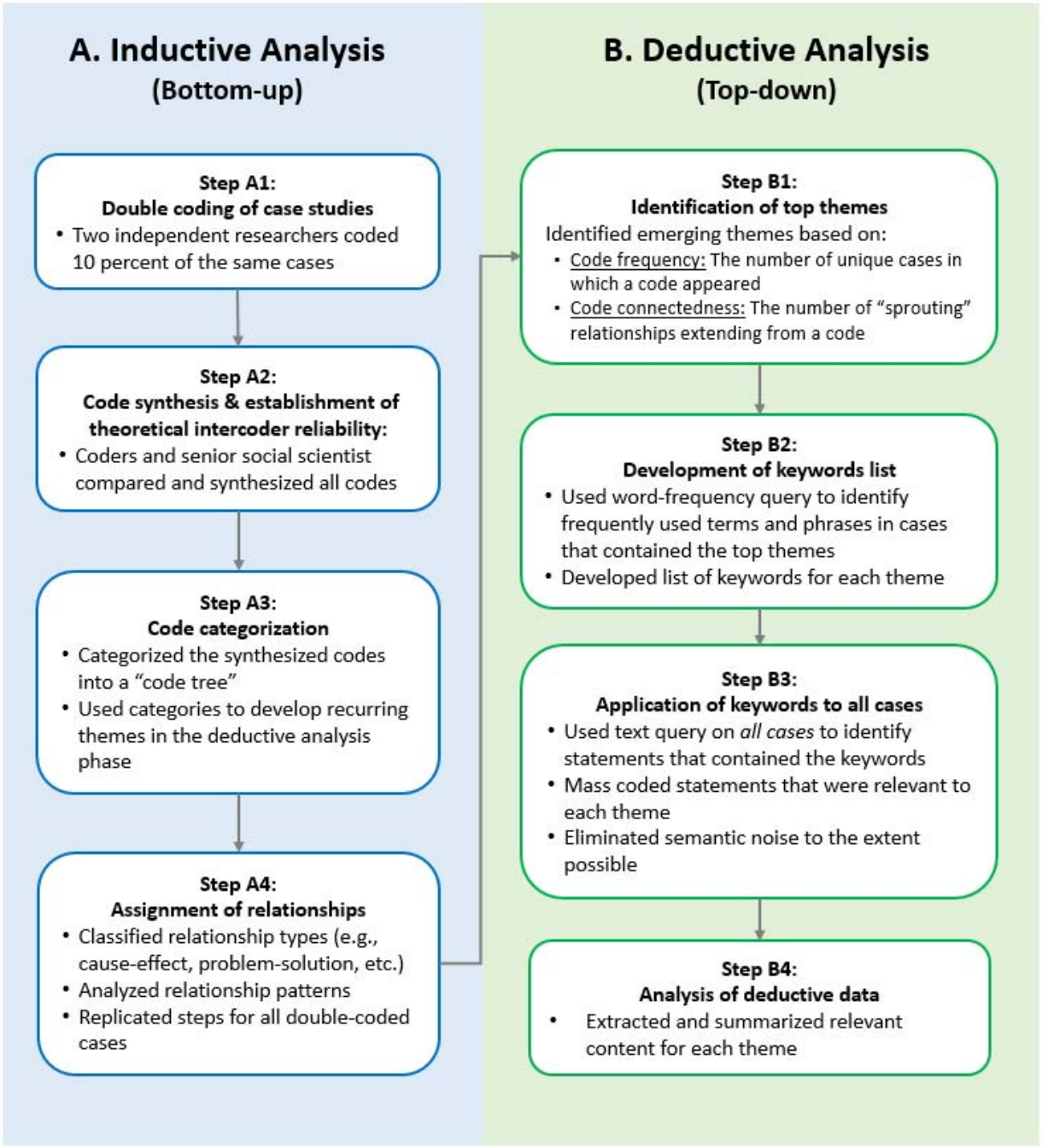

Figure III-1. Overview of Methodology

Inductive Analysis

As a first step in the analysis, ERG used the NVivo software to help condense the raw textual data into a brief phrases (codes) summarizing the experiences relayed through the case studies. These codes then provided a structural framework for identifying the top recurring themes being relayed through the data. The process involved:

1. **Double-coding of case studies:** Two independent researchers read through the same set of case studies (8 to 10 case studies). Using the software, each researcher assigned a code summarizing the meaning of each relevant portion of data (e.g., a phrase, a complete sentence, or perhaps even a few sentences) within each case study (see Figure IIII-2c on page 25). To remain as objective as possible, the researchers used action words already present in the data. For example, the code "Experiencing Nighttime Hazards" was assigned to the sentence "… our area had a severe thunderstorm during the night (when most residents were sleeping)." Table III-5 below summarizes the number of case studies per sample group that the researchers double-coded.

Table III-5. Summary of Inductive Double-Coding Phase

Sample Category	Viable Case Study Count	Double-Coded Cases
Internal NWS	88	30 (28%)
EMs and other External Partners	566	57 (10%)
Media	52	8 (15%)

2. **Code synthesis and establishment of theoretical intercoder reliability:** After a set of case studies was double-coded, a senior social scientist met with the two independent researchers to discuss, synthesize, and combine codes on each case study in the set. These team meetings ensured theoretical intercoder reliability, a qualitative measurement to see how much agreement there was between the two independent coders.

3. **Code categorization.** After a few sets of cases were synthesized, a code tree was created to categorize all of the ideas presented in the case studies (see Figure III-2a). As more cases were double-coded, this synthesized code tree began to reveal the top recurring categories.

4. **Assignment of relationships:** During the team meetings, the researchers also assigned relationships among the codes (see Figure III-3). Relationships were assigned classifications, such as cause and effect, problem and solution, or simply correlated in that they often happened at the same time. This process allowed us to see which codes were not only recurring, but also which ones were most interconnected with others. This process was replicated for a portion of all the viable case studies in each sample category (i.e., internal NWS, EMs, media). (See Figure III-3 on the next page.)

a) Code Tree

b) Case Study (each reference number and corresponding text relates to a question in the survey)

c) Codes Attached to Case

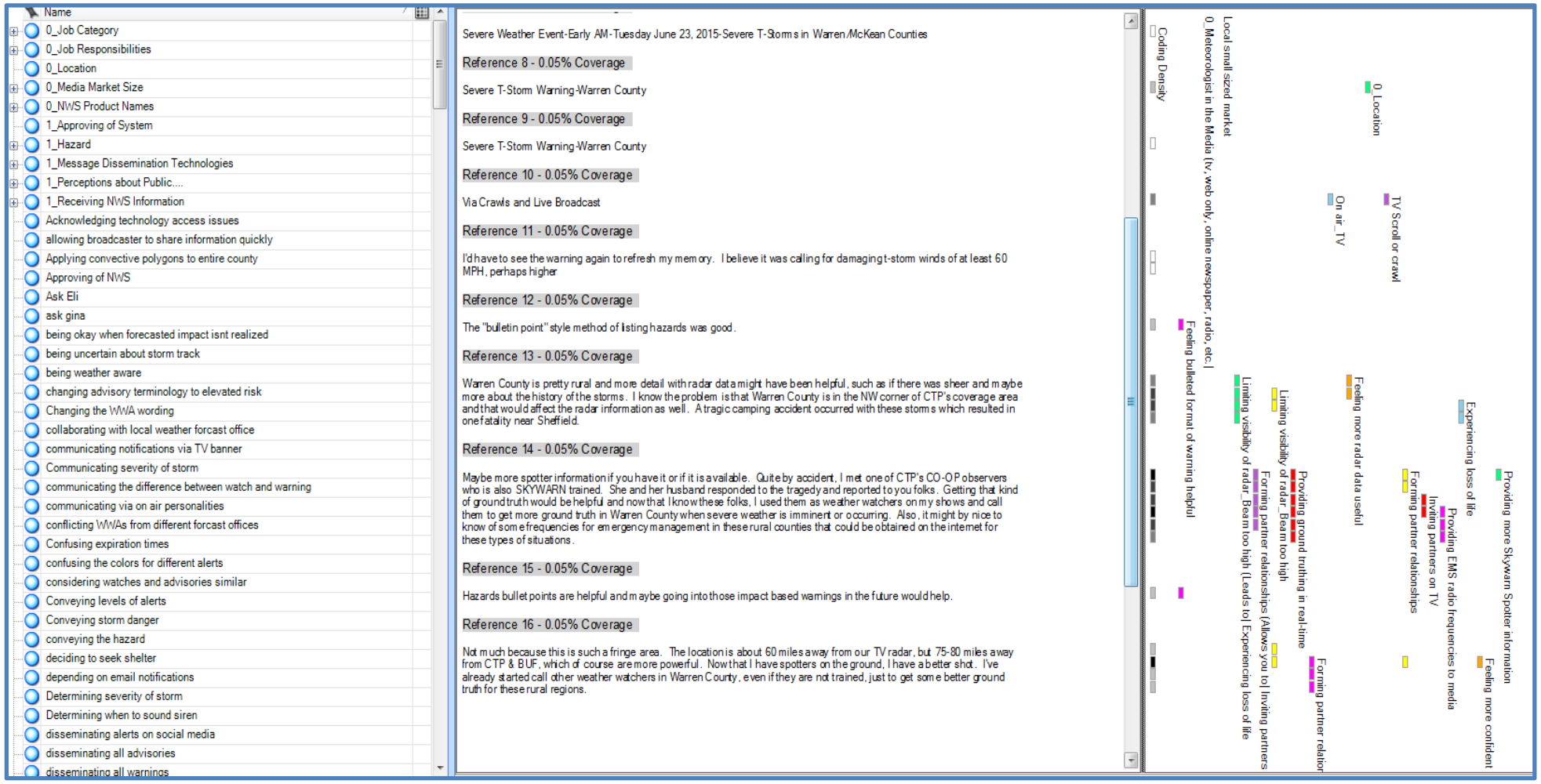

Figure III-2. Example from NVivo of Codes Attached to a Case Study

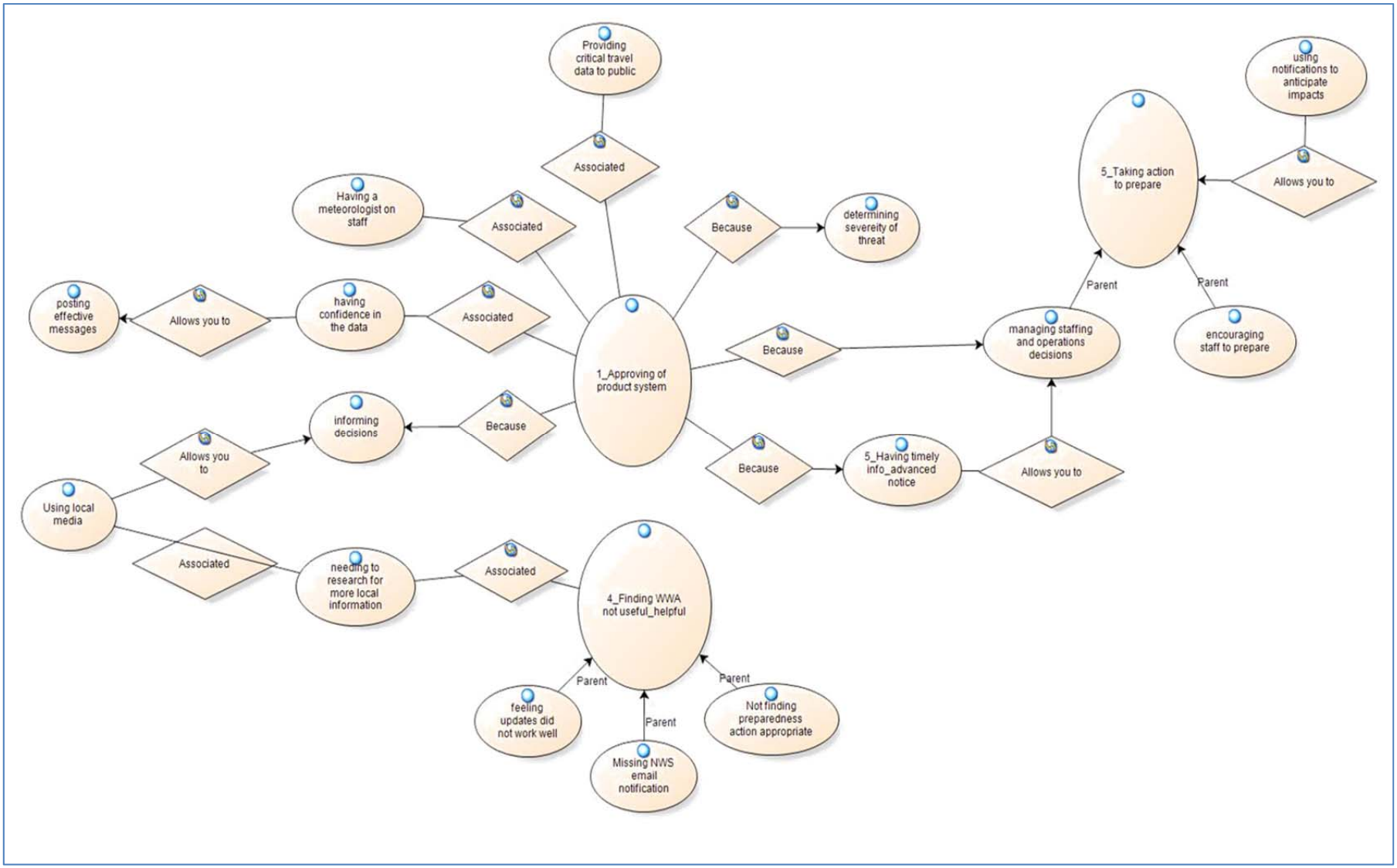

Figure IIII-3. Example of external partner code relationships. The more relationships sprouting out of a code, the more interconnected it is.

Deductive Analysis

The next phase of the research was designed to use the information gleaned from the inductive theoretical coding to determine the emergent themes and subsequently identify their respective keywords. These keywords were then used to identify and summarize the recurring themes in the case studies. The deductive analysis involved the following steps:

1. **Identification of top themes:** ERG identified the top themes in the case studies from each sample group based on the inductive analysis discussed previously. To do this, we considered two specific factors in the inductive coding patterns.

    - **Code frequency.** We counted the number of unique cases in each of our codes and identified the codes that had the highest number of cases. For example, a code that only had one case was not considered a top code. Given how the codes were merged and categorized during team meanings, many of the codes in the organized code tree were the codes that represented multiple unique cases. However, every individual code was checked for repetitiveness in the cases.

    - **Code connectedness.** After the number of cases were counted for each code, ERG analyzed the code relationships by using the "network model" function in NVivo. The goal was to identify codes that were highly interconnected defined by the number of "sprouting" relationships extending from the code (see Figure III-3 on page 22).

2. **Consensus of emergent themes.** ERG used the combination of code frequency and interconnectedness to build consensus of the emergent themes. Almost all of the codes with the highest case count were also interconnected, but some codes were further identified as emergent themes through the network analysis.

3. **Development of keyword list.** ERG developed a list of keywords for each theme, and these keywords were used to deductively code the remaining cases. To develop the keyword list, we ran a word frequency query on all of the unique phrases or sentences that were identified in all the cases attached to each individual theme. The words that appeared the most and were *semantically* related to the theme were chosen as keywords. For example, for the theme, "Having Timely Information," keywords such as "time," "early," "ahead," "advance," "ample," and "duration" were used. The word "issued" also came up as a frequently used term, but was not semantically related to time, and thus, using the word "issue" or "issued" in a query would not have found similar content.

    Additionally, to refine a query search, it was sometimes necessary to provide more specific information regarding keyword proximity. For example, for the "Managing Staffing Decisions" theme, the list of keywords included a combination of "plans" or "operations" appearing within a certain word count of the words "staffing" or "employees." For a few themes, such as "Considering Outside Factors," the keyword list showed no semantic pattern (e.g., no pattern was discernible in the top three keywords for this theme, which were "storm," "condition," and "fuel"). For these themes, we relied on the responses provided to relevant questions in the case study survey. For instance, EMs gave statements related to the "Receiving NWS Information" theme as answers to Question 2.2: "How do you normally hear about a weather watch, warning, or advisory?" In these cases, we simply extracted all responses to the relevant question(s) and summarized them. Each theme in the report includes a definition followed by a list of keyword combinations or related survey question(s).

4. **Application of keywords to all case studies.** Next, ERG used the text query function in NVivo

to conduct a keyword search on relevant statements in all of the remaining case studies. The keyword search included all the stems of each keyword (for example, “prepare,” “prepared,” “preparing,” and “preparedness”). We then mass coded these relevant statements and repeated this step for each theme. During the mass-coding process, we were mindful of identifying and eliminating semantic noise. For instance, a keyword search for the hazard “flood” produced a statement where the respondent said he/she was “flooded” with a large number of phone calls.

5. **Analyzed deductive data.** Finally, a senior researcher analyzed and summarized this extracted content for each theme. To ease readability, we corrected egregious spelling errors in the quotes chosen to exemplify the themes, but did not correct grammatical issues.

Potential Influences and Limitations

With any research study, it is important to reflect on the potential influences and limitations that might have impacted the outcomes. These limitations do not discount the findings of this study, but rather offer explanations for some of the challenges faced in the analysis, as well as the potential bounds of the generalizability of the results:

- **Survey fatigue.** For reasons previously described, an open-ended case study format was implemented since a close-ended survey would have limited the possible descriptions of WWA strengths and weaknesses. However, the open-ended research design may have impacted the overall response rate. First, given the time commitment required to complete the open-ended survey, survey fatigue potentially reduced the thoughtfulness or thoroughness of a participant’s response. This was partially evident by the fact that not all participants answered every question, or alternatively provided a lengthy response in one box, and then wrote, “see previous answer” in the next box. This format made it more difficult to analyze the data because answers to the open-ended questions were found scattered throughout the case study responses.
- **Typos and acronyms.** The open-ended responses contained many spelling errors and incomplete sentences, which made it challenging to identify the relevant keywords in the deductive analysis. In the inductive coding stage, if spelling errors or incomplete sentences made it too difficult to understand the participant’s case study, it was excluded from analysis as it would have required too much subjective judgment on behalf of the coder. Additionally, many acronyms were used, especially in the internal NWS case studies. Some represented shortcuts and abbreviations used to describe WWAs; others were deciphered through Internet research or clarified by the NWS team early on in the analysis.
- **Misunderstanding of external survey track.** Another limitation was the survey track in the external partner survey. A preliminary question in the external survey asked respondents to identify their job category (see Figure III-4). If participants chose “other,” the follow-up question asked if the respondent identified more with being a meteorologist or a non-meteorologist. If a respondent chose meteorologist, he or she was directed to the media track, while choosing non-meteorologist directed a respondent to the EM track. Out of the 121 media surveys, only 52

Figure IIIII-4. Job Category Question from External Survey

were from actual media. The other 69 were storm spotters, EMs, and other unique users. Questions in the media track were worded for this particular type of respondent; therefore, the submissions from non-media respondents were excluded from the analysis. It should be noted that many EMs mangers and other unique users did take the appropriate survey track.

- **Limited amount of inductive coding.** With qualitative data, it has become a disciplinary standard to double-code 20 percent of the items[1] (i.e., cases) to ensure a reliable coding scheme is developed. Such measures work well when there is a set codebook (i.e., a list of predetermined terms used to categorize and analyze responses). With this research project, however, the codebook of keywords and themes was derived inductively from the data.

  The team double-coded more than 20 percent of the double-coded cases for the NWS internal and media respondents. However, because of the large number of external surveys received and the labor intensity of double-coding 20 percent of the cases, the research team, in consultation with the NWS, made a methodological decision to double-code 10 percent of the external case studies. At this stage, recurring theoretical themes were emerging. However, an inductive-coded analysis of *all* the cases could have provided more insights into theoretical patterns of WWA strengths and weaknesses, as well as the relationships among them.

- **Keyword search limitations.** While the cases identified through the keywords do reflect their respective themes, there are likely additional cases that fit the theme that were not detected by those specific keywords. To counter this shortcoming, the text query searches were programmed to use the power of NVivo's dictionary. Not only did the search look up all the stems of each word (For example, "issue," "issuing," "issued"), but it also looked up synonyms. Semantic noise was also eliminated to the extent possible, as described earlier.

[1] With content analysis, Cohen's (1960) kappa, a quantitative measurement of intercoder reliability of qualitative data, is often used to show the reliability of a codebook. Two independent coders code 20 percent of the sample. Using such measures works well when there is a set deductive codebook. With this research project, however, the deductive codebook of keywords and themes was developed using theoretical coding, more akin to grounded theory (Charmaz, 2006). [Cohen, J. (1960). A coefficient of agreement for nominal scales. Educational and Psychological Measurement, 20(1), 37Y46.; Charmaz, K. (2006). Constructing grounded theory: A practical guide through qualitative analysis (Introducing Qualitative Methods Series).]

IV. Summary of All Case Studies

Table IV.1 below summarizes all of the emerging themes with their corresponding definitions in alphabetical order by group (NWS internal, EMs, and media).

Table IV.1 Summary of Themes from the Case Studies by Sample Category

Theme/Case Count	Definition of Theme
Internal NWS	
1. Adding Impacts to WWA (8 out of 88 cases)	This theme focuses on incorporating impacts into WWA. There is a general desire to include impacts in criteria or change the WWA system to an impact-based system, but there is no consistent definition of an impact. The word "impact" is used to convey a hazard, time, spatial area, damage to property, or an effect on people, such as an accident or death.
2. Addressing Confusing Terminology (27 out of 88 cases)	This theme includes forecasters' perceptions that some (or all) of the terms "watch," "warning," and "advisory" are confusing or ineffective. The theme encompasses viewpoints not only of the terms themselves, but also of instances when a WWA product is reissued, downgraded, or canceled; when one WWA product replaces another; or when multiple products are issued.
3. Collaborating with Other Entities (22 out of 88 cases)	This theme focuses on forecasters' experiences in collaborating with other entities (e.g., Weather Forecast Offices [WFOs], national centers, regions, and external partners). Collaboration is viewed as positive when it helps to coordinate product issuance with other offices or ensure consistent messaging among partners. Collaboration is viewed as negative when it is difficult to accomplish and restricts or delays the products that forecasters issue.
4. Focusing on Graphics (12 out of 88 cases)	This theme addresses the role of graphics, multimedia, and other visual information in communicating hazardous weather situations, both now and in the future. Graphics are viewed as important in enhancing the text-heavy WWA system and supplementing traditional dissemination mechanisms, such as NOAA radio and emails to partners.
5. Handling Levels of Forecast Confidence (22 out of 88 cases)	This theme focuses on forecasters' ability to convey confidence in a hazardous weather event within the current WWA system. The system is viewed as working well for situations when the confidence is high, but not when the confidence is low. Confidence levels are also viewed as highly subjective and variable among forecasters, which can result in different WFOs issuing different WWA products.
6. Maintaining WWA Features (67 out of 88 cases)	This theme reflects forecasters' opinions on the features of the WWA system that should be maintained. It also includes suggestions for changes to the system.
7. Providing Education, Outreach, and Training (8 out of 88 cases)	This theme includes both ongoing and past experiences with education, outreach, and training, as well as suggestions for future improvements. The theme encompasses both internal and external efforts.
8. Referencing Above or Below Criteria (26 out of 88 cases)	This theme addresses situations where WWA products do/do not meet specific NWS criteria and/or thresholds. It references events where severe weather occurred, but the NWS did not issue a WWA product (or did so too late) because criteria were not met, as well as situations where respondents perceive the criteria as being too broad and therefore WWA products were issued for marginal events.
9. Referencing Impact-Based Decision Support Services (IDSS) (19 out of 88 cases)	This theme includes any reference to an array of IDSS, such as sending emails to partners, conducting briefings or webinars, making or receiving phone calls, hosting conference calls, or otherwise working with customers. IDSS is perceived as being more useful than the WWA system in many instances. In some cases, the WWA system (as opposed to IDSS) is actually viewed as detrimental to forecasters and their work.
10. Using the WWA Map (12 out of 88 cases)	This theme includes references from forecasters regarding the display of WWAs on the map shown on local or national NWS websites. References include perceptions of the map helping or hindering communication of weather hazards.

Emergency Managers	
1. Approving of Present System (412 out of 566 cases)	This theme indicates respondents' general approval or liking of the current WWA system.
2. Considering Outside Factors (467 out of 566 cases)	This theme addresses factors outside of WWA products that can influence decision making and response to a hazardous weather event. These include *physical* factors such as instrumentation, on-the-ground verification, standard operating procedures, staff, and equipment; *social* factors, such as local knowledge, history, trust in a source, politics, people's anxieties, and conversations (both online and offline); and *conditional* factors, such as timing, events, crowds, and traffic. In some cases, contributing factors complement the NWS system; in others, they fulfill a process or product that respondents feel is lacking from the current system.
3. Disseminating and Sharing NWS Information (490 out of 566 cases)	This theme encompasses various types of information shared (e.g., actual WWA products, maps, emails, briefings), as well as modes of transmission (e.g., social media, phone calls) and with whom the information is shared, such as supervisors, partners, the public, and others.
4. Experiencing Nighttime Hazards (38 out of 566 cases)	This theme captures examples of experiencing hazardous weather at night and/or statements related to receiving WWA alerts from the NWS at night.
5. Having Timely Information (185 out of 566 cases)	This theme includes positive, negative, and general statements from respondents related to having, not having, appreciating, or wanting timely information or advanced notice of a hazardous weather event. References to information about time (such as time lines and path cast, in WWA products) are also included.
6. Managing Staffing Decisions (49 out of 566 cases)	This theme encompasses responses related to planning and managing staffing and operations in preparation for hazardous weather. (Cases referencing other kinds of preparation decisions are included in #8. Preparing for Hazardous Weather.)
7. Maintaining WWA Features (459 out of 566 cases)	This theme reflects EMs' opinions on the features of the WWA system that should be maintained. It also includes suggestions for changes to the system.
8. Preparing for Hazardous Weather (135 out of 566 cases)	This theme includes examples of how the WWA system helped respondents prepare for potentially hazardous weather. The theme also includes instances of how the WWA system discouraged or did not help respondents prepare. Preparatory actions include mobilizing operations, assisting special populations, communicating to stakeholders, or taking other steps to get ready before an event occurs. (Cases referencing managing staff are included in #6. Managing Staff Decisions.)
9. Receiving NWS Information (566 out of 566 cases)	This theme captures the variety of sources and media through which EMs receive WWA information, not just from the NWS but also from sources such as other government agencies (e.g., FEMA), partners (e.g., neighboring EMs and first responders), and private entities (e.g., media).
10. Referencing Above or Below Criteria (48 out of 566 cases)	This theme addresses situations where WWA products do/do not meet specific NWS criteria and/or thresholds. It references events where severe weather occurred, but the NWS did not issue a WWA product (or did so too late) because criteria were not met, as well as situations where respondents perceive the criteria as being too broad and therefore WWA products were issued for marginal events.
11. Using NWS Products and Services (489 out of 566 cases)	This theme captures how respondents use WWA products and information for a hazardous weather event, such as to gauge situational awareness; to plan, prepare, and implement inclement weather processes (see also #8. Preparing for Hazardous Weather); to assist in making informed decisions about when and what to warn citizens; and to alert first responders. The products also help to plan staffing (see also #6. Managing Staff Decisions), determine equipment needs, and develop response and recovery strategies.

Media	
1. Addressing Overlapping Boundaries (13 out of 52 cases)	This theme focuses on situations that arise when a media market is situated at a border of a county warning area (CWA) or has an audience base that spans multiple CWAs under the jurisdictions of different WFOs. Overlapping boundaries can pose problems when different types of WWA products are issued for different counties, when a product is issued for one CWA but not another, or when different products expire at different times.
2. Considering Outside Factors (32 out of 52 cases)	This theme focuses on the many factors outside of the WWA system that can influence the media's coverage of a hazardous weather event. These contributing factors encompass instrumentation and models, storm spotter reports, viewer feedback, briefings from NWS and decision makers, and local knowledge and experience. In some cases, contributing factors complement the NWS system; in others, they fulfill a process or product that respondents feel is lacking from the current system.
3. Finding WWA Effective or Ineffective/Limiting (42 out of 52 cases)	This theme summarizes the media's thoughts on whether they find the WWA system effective or ineffective/limiting from a messaging perspective.
4. Maintaining WWA Features (37 out of 52 cases)	This theme reflects the media's opinions on the features of the WWA system that should be maintained. It also includes suggestions for changes to the system.
5. Referencing Above or Below Criteria (8 out of 52 cases)	This theme includes statements that reference events that do/do not meet specific NWS criteria and/or thresholds. They reference specific events where severe weather occurred, but the NWS did not issue a WWA product (or did so too late) because criteria were not met, as well as situations where respondents perceive the criteria as being too broad and therefore WWA products were issued for marginal events.
6. Referencing Time or Timeliness (26 out of 52 cases)	This theme references situations where respondents have or have not received timely warnings and advance notice.
7. Sharing WWA Information and Products (44 out of 52 cases)	This theme captures how respondents share WWA products and information for a hazardous weather event. It also includes mechanisms used to share this information.

Key Findings

A number of key findings emerged from the analysis. Some of these findings related to one particular category of respondent (i.e., NWS forecasters, EMs, or the media), while others represent cross-cutting themes:

Findings Specific to a Particular Respondent Category

- **EMs approve of the current system.** Out of 566 EM respondents, 412 praised the current system using phrases such as, "I am happy with the current structure," "It works for me," and "The system you have in place is excellent." There was a general understanding from these respondents that weather is not always predictable, and as such, the system may not always work as well as intended. But, the respondents overwhelmingly believed that the current system meets their needs. One EM stated, "If people don't understand the current system then they will likely not understand any future or different system." This particular sentiment was echoed by a few NWS staff as well. One forecaster said, "Changing would cost lots of dollars and just move us to a different level of misunderstanding."

- **NWS forecasters and media respondents desire more change than the EM respondents.** The NWS and media cases support changing at least some part of the current WWA system. Many forecasters stated that the current system does not work well and that the entire system should be evaluated for change. One forecaster commented, "I think every hazard product should be on the table for changes." Few media respondents supported maintaining the WWA system in its entirety, though there was some support for maintaining the warning products. While the EM cases overwhelmingly supported maintaining the current system, they also did present suggestions for changes, such as simplified product formats, more specificity in messaging, enhanced websites and use of social media, and more coordination and collaboration—both among NWS offices and between the NWS and other entities.

- **NWS forecasters and media respondents perceive that the current WWA system is confusing to the public and even some partners.** There is a perception (primarily from the NWS and media case studies) that members of the public (and even some NWS partners) do not understand the WWA terms. An NWS forecaster noted, "I watched the weekend television meteorologist try to explain our warnings. He (an educated, high end user) was confused... One can only imagine what the public perception was." The media respondents echoed these sentiments with one broadcaster stating, "Explaining what each WWA actually means is half the battle. The terminology is not obvious on its own." *Perceptions* of public and partner misunderstanding, however, are not complete evidence that these groups do not understand the terminology. Targeted research on public and partner understanding of the WWA terms would be necessary to truly gauge the validity of these perceptions.

- **NWS forecasters and the media support the idea of adding impacts to the WWA system.** Some NWS respondents supported changing WWA to an impacts-based system or incorporating impacts into WWA criteria. One forecaster suggested, "Break the threats/impacts into levels (low, moderate, high, catastrophic) and enable the field to communicate what the impact/threat level is." Several media respondents also endorsed the inclusion of impacts. One media respondent said, "Keep impacts and suggested actions. People under stress can forget their plan." While not a key theme among EMs, some respondents did touch upon the inclusion of impacts. For example, several EMs suggested that the NWS keep its messages as area-specific as possible and indicate where potential impacts are most likely to occur.

Findings that Cross-Cut Respondent Types

- **There was general support for simplifying and reducing the number of WWA products, improving formatting, and using concise, easy-to-understand language.** All groups of respondents supported streamlining or consolidating the number of hazard products and by doing so decrease the number of products issued. One forecaster said, "We must reduce the number of headline products and try and focus the titles and messaging on what we can actually do well." An EM said, "The different weather warnings for flooding need to be simplified and renamed. I know that flash flood warning, flood warning and areal flood advisory all have different meanings and uses. But, the public does not understand the difference between them and neither do many emergency managers." There was also general support for organizing the information in a more user-friendly format, using bullets, and making the messages more readable. Many respondents suggested that the NWS simplify the language used in its warnings and focus more on conveying timing, confidence, and impacts. One media respondent said that "concentrating on what is going to happen--snow amounts over time, wind effects, etc., and directly translating that to impacts seems far more effective than trying to communicate a wide array of various warnings, watches and advisories." This sentiment was echoed by both forecasters and EMs.

- **There was a general acknowledgment that the WWA system resides within a larger communication, operational, and IDSS framework.** All respondent groups acknowledged that the WWA products are typically the *last* piece of information in a continuous flow of weather information. Many NWS respondents felt that their IDSS was the critical factor in their effective communication and cited their many mechanisms for providing IDSS to their users, such as emails, phone calls, social media, briefings, and webinars. EMs echoed this sentiment and praised the NWS for providing ongoing timing information, early notification of a potential hazardous situation, and useful ancillary timing information such as graphics. EMs called out text messaging and smartphone alerts, in particular, as being "essential" to their daily operations, enabling them to have situational awareness, manage staffing decisions, take preparedness actions, and carry out other job responsibilities. Media were less dependent on IDSS, though one broadcast meteorologist said that the "information that flows through the [NWS] Chat helps us verify what we are seeing on radar or getting from viewers." They also viewed their own role in translating WWA products into understandable, public-oriented language as a critical part of a larger communication framework.

- **There was no consensus that any of the individual WWA terms should be eliminated or replaced.** Although some respondents did comment that the WWA terminology is confusing, they did not overwhelmingly identify specific problems with the particular words "watch, warning, or advisory." The NWS respondents were the most critical of the terms. One NWS respondent stated, "Certainly people STILL do not understand the differences between a watch and a warning, which is the very basis of our system. We've tried for decades to educate people on the difference, but to no avail." Both the NWS forecasters and the media respondents were somewhat supportive of maintaining the "warning" term. One media respondent observed that, "Warnings do come off as highly effective, especially tornadoes. Viewers understand the urgency." One forecaster stated, "Warnings must be kept. The word 'warning' is effective." An EM said, "I would shed no tears if advisories and watches went away, but I'd recommend keeping warning, as that has a stronger meaning outside the NWS usage, and a clearer context within NWS and EM."

- **The rigid criteria for issuing WWA products can present challenges in collaboration and coordination among WFOs, which can delay issuing products, reduce preparation time, and contribute to inconsistent messaging.** All three sample groups criticized the rigidity of the criteria or thresholds for issuing certain WWA products, particularly in the flooding and winter weather categories. While many NWS and media respondents noted that the WFOs need to have some guidance and rules in their forecasts, NWS forecasters described the difficulties they often have in fitting a particular event into strict criteria and in applying differing

criteria (among different WFOs) to an impending event. One NWS respondent relayed a situation with a storm producing two hazards: wind and snow. The respondent said, "[it] turned out to be a huge challenge to manage mainly because of complex headline issues and the challenges in forecasting, collaborating, and communicating them. This is not an unusual case." A broadcaster admonished the NWS to "Be consistent and think outside of criteria. It is robotic to focus on a criteria based #weather warning system, human interpretation/impact must take precedence." EMs described events (particularly severe thunderstorms) that were below criteria leading to no public notice of the event.

- **There is a need for flexible consistency.** In addition to making the criteria less rigid, respondents across all three sets of cases discussed the balancing act between consistency and flexibility. One NWS forecaster observed, "I'd like to see us [the NWS] 'evolve' to a point of a continued discussion of the event and probable impacts." Though all groups praised NWS IDSS, NWS forecasters specifically applauded its rule-free, flexible environment: "In this messaging, we simply talk about the expected event and its likely impacts." Complementing this sentiment, EMs suggested giving the NWS "some latitude to customize the criteria to a region," but noted that latitude "shouldn't [have] huge deviations."

- **The attributes underlying the WWA products are more important than the actual words**. An underlying issue and a major question throughout all the case studies is what attributes should drive any changes in the current WWA products. When words have strict meanings (e.g., in the present system, meanings are derived from rigid criteria and thresholds), language cannot adapt to the weather situation, which can cause frustration. All three groups commented that there are times when the "severity" of an event is high due to timing or impacts, but it doesn't meet the criteria. As a result, the watch, warning, and advisory words feel limiting. Yet, respondents also want clear definitions and standards. EMs often use the term definitions to justify their binary decisions, while media use the products to determine when they go on air or not. Definitions can change, but how the words change in terms of underlying meteorological attributes must have transparency.

- **There is a need for education and outreach.** All three sets of respondents called for expanded public outreach and education. Although some NWS forecasters felt that the system is simply unintuitive and no degree of education will help solve this issue, others felt that the system should continue given the investments made in education, outreach, and training. Several EMs cautioned against making major changes to the current WWA system as their partners and customers have become accustomed to the terms and products over the years. Any changes would require proactive training and outreach to avoid misinterpretation and public confusion, a sentiment echoed by that of the media as well. Beyond public education and outreach, some cases pointed to a need for enhanced training, both internally within the NWS and externally with partners. Forecasters also noted the variation in skill, experience, and training among media users and suggested more active training.

The next sections of the report present an in-depth discussion of the recurring themes for each sample group.

V. Summary of Internal NWS Case Studies

A number of recurring themes emerged among the NWS internal responses. These themes (presented in alphabetical order) are:

1. Adding impacts to WWA
2. Collaborating with other entities
3. Addressing confusing terminology
4. Focusing on graphics
5. Handling levels of forecast confidence
6. Maintaining WWA features
7. Providing education, outreach, and training
8. Referencing above or below criteria
9. Referencing IDSS services
10. Using the WWA map

NWS forecasters also provided a number of suggestions for improving the current system. These suggestions are captured both in the discussions of the various themes, where relevant, as well as in a listing in Appendix C.

1. Adding Impacts to WWA

Definition: This theme focuses on incorporating impacts into WWA. There is a general desire to include impacts in criteria or change the WWA system to an impact-based system, but there is no consistent definition of an impact. The word "impact" is used to convey a hazard, time, spatial area, damage to property, or an effect on people, such as an accident or death.

Relevant statements were most often found in response to the following survey questions:

1.3 Please briefly describe the weather situation and thought process for your case study. Include date(s) of the event (if applicable). Please use lay terms to the extent possible.
1.4 If you can recall, please list the WWAs, and other statements and products issued.
1.5 Did the WWAs and other statements and products issued appropriately convey the weather for your case study? Why or why not? Please include factors related to the predicted hazard location and timing, as well as articulation of forecast confidence, potential impacts, and recommended actions.
1.6 From a hazard messaging standpoint, how was the WWA system effective in your case study? Please explain.
1.7 From a hazard messaging standpoint, how was the WWA system ineffective or limiting in your case study? Please explain.
1.8 Do you have any ideas as to how to resolve the current WWA system challenges or limitations you described in your case study? Please explain.

Keywords Searched:

- Relevant statements that contained words stemming from "impact"
- Relevant statements that contained words stemming from "damage"

Case Count: 8 out 88 cases included keywords relevant to the theme.

Examples that Support Including Impacts in WWA Criteria

Respondents stated that WWA products need the inclusion of impacts. Some respondents suggested developing an impacts scale, changing WWA to an impacts-based system, or incorporating impacts into WWA criteria. Sample comments include the following:

- *The weather service needs to add in some scale of impacts to the criteria for WWAs, as the older strict criteria does not always apply to the different situations. We notice this several times a year when it comes to winter and non-precipitation events. There are times we don't hit warning criteria snow, but it falls early in the year when the leaves are on the trees and causes many power outages due to broken tree limbs.*

- *Green = all clear/good weather, Yellow = Nuisance-type inconveniences, Orange = Significant impacts to travel/commerce with delays/closures likely, Red = Severe or historic impacts to travel, commerce, and property, Purple or Black = Unimaginable destruction and chaos that permanently alters our landscape. I've just described 5 tiers of impacts, using colors.*

- *Break the threats/impacts into levels (low, moderate, high, catastrophic) an enable the field to communicate what the impact/threat level is.*

Examples That Illustrate There Was No Uniform Definition of "Impact"

Although forecasters stated a desire to include impacts, there was no consistent definition of an impact. Respondents used the word "impact" to describe a hazard, spatial area, time or as people/property impacts, such as accidents or damage.

Impact as Hazard

- *First off, what we put in the "Impacts" bullets are rarely impacts (usually they are hazards), and only apply to the people who are exposed to the hazard. Example - we might say the impact is slick roads or dangerous travel conditions. These are not impacts, they are hazards. An impact would be the car accident or drowning resulting from the flooded roads.*
- *Once the rain began, offices issued a wide variety of flood products. As it turned out, Flash Flooding was not the primary impact during Odile. Yes, Flash Flooding did occur, but this became a prolonged heavy rain and areal flood event.*

Impact as Spatial Area

- *The impacts from lake-effect snow generally only affects a 10-20 mile wide area downwind from the Great Lakes yet we have to highlight whole counties where certain sections of a county may not see any impacts at all. I think this is a messaging issue that should be corrected with polygon shaped warning boxes.*
- *…the spatial extent was small but focused on more highly populated areas. In some counties, the western half of the county would be fine while the eastern half would have significant impacts.*

Impact as Time

- *A fast moving storm system on a busy pre-holiday travel day and also with the greatest impacts at morning rush hour for those working/travelling.*

Impact as Accidents/Damage

- *We desperately need some sort of convective snow warning that we can issue for these events [Blizzard-like showers, with near-zero visibility and 30-40 mph], possibly even polygon based, that are IMPACT driven. All it takes is a quick dusting of snow to cause slick roadways and major accidents, thus putting a snowfall number to them would be silly.*

Examples that Support Basing WWA Products on Severity or Impacts

Forecasters expressed a balancing act between communicating the severity of a weather event with its potential impacts. Forecasters expressed concern about the public misunderstanding severity of an event, as one WWA term cannot convey both different levels of severity and impacts:

- *Having to issue a tornado warning for any type of tornado, even though the known impact of the tornado is going to be minimal, degrades the public's perception of the severity of a tornado warning. When the big event strikes, people may not seek shelter or be slower to seek shelter as a result. We've tried to reduce this problem by instituting Impact-Based Warnings, but in the end, we are still issuing a tornado warning.*
- *Some warnings are highly accurate and valuable, while others are not, both as a function of weather event severity and the geographic areas highlighted. While the "Go/No-Go" warning decisions seem to be improving, the ability to discriminate between a "warning" level event and a high-impact/emergency event in real time is not a widely held skill.*

Definition: This theme includes forecasters' perceptions that some (or all) of the terms "watch," "warning," and "advisory" are confusing or ineffective. The theme encompasses viewpoints not only of the terms themselves, but also of instances when a WWA product is reissued, downgraded, or canceled, or when one WWA product replaces another, or when multiple products are issued.

Relevant statements were most often found in response to the following survey questions:

1.2 Consider a hazardous weather event or a general experience with hazardous weather where the messaging did (or did not) work well from your viewpoint or those of your stakeholders. Why are you selecting this event or general experience for a case study? (We will refer to this as "your case study" in subsequent questions.)

1.3 Please briefly describe the weather situation and thought process for your case study. Include date(s) of the event (if applicable). Please use lay terms to the extent possible.

1.5 Did the WWAs and other statements and products issued appropriately convey the weather for your case study? Why or why not? Please include factors related to the predicted hazard location and timing, as well as articulation of forecast confidence, potential impacts, and recommended actions.

1.6 From a hazard messaging standpoint, how was the WWA system effective in your case study? Please explain.

1.7 From a hazard messaging standpoint, how was the WWA system ineffective or limiting in your case study? Please explain.

1.8 Do you have any ideas as to how to resolve the current WWA system challenges or limitations you described in your case study? Please explain.

1.9 Are there any features of the WWA system that you feel we must maintain due to its strength? Please explain.

1.10 What factors *outside* of the WWA system influenced the success or failure of your case study?

Keywords Searched:

- Relevant statements that contained words stemming from "term" or "terminology."
- Relevant statements that contained words stemming from "confuse" or "misunderstand."
- Relevant statements that contained phrase "difference between."

Case count: 27 out 88 cases included keywords relevant to the theme.

2. Addressing Confusing Terminology

Examples of Perceived Public and Partner Confusion with the WWA Terms

A number of respondents stated that they believed there to be issues with the WWA terminology. The most-often cited criticism was a perception that users (including EMs, the media, and the public) don't always understand the WWA terms. Additional criticisms centered on beliefs that the terminology does not convey impacts, provide actionable information, or effectively communicate the confidence of a hazardous weather event occurring. Several stated they believed that users mix up the watch and warning terms or use them interchangeably. A number of respondents also stated they believed that people can interpret an advisory as a downgrade to a watch. Sample statements reflecting these perceptions include the following:

- *We don't have that much winter weather here and in virtually all events our local media, even*

the ones with degrees in Meteorology, have a heck of a time differentiating between, Watch, Warning and Advisory.

- *The terms often get accidentally used interchangeably. In addition, in the current fast paced world where data are flying around in multiple venues, people tend to just watch for headlines.*
- *There still seem to be limitations to understanding the difference between 'watch' and 'warning'. Advisories often seem to get little notice and the various types of advisories seem to generate confusion about what means what.*
- *The term Watch also gets confused with the short term Severe Watches when conditions are favorable for severe storms or tornadoes.*
- *Certainly people STILL do not understand the differences between a watch and a warning, which is the very basis of our system. We've tried for decades to educate people on the difference, but to no avail.*
- *I watched the weekend television meteorologist try to explain our warnings. He (an educated, high end user) was confused. They are our partners, but we shouldn't need them to explain what we're doing. One can only imagine what the public perception was.*
- *The EMs do not know the difference between all of our hydrology warnings and statements nor do they care. All they know is they have feet of water covering roads and parking lots.*

Examples of Perceived Public and Partner Confusion when Different or Multiple WWA Products Are Issued

In addition to the terms themselves, respondents thought it was confusing to their users when the NWS switches the WWAs issued, such as when a WFO downgrades or cancels one product and issues another. They also pointed to difficulties when multiple products are issued, or a particular product is issued that doesn't adequately convey the threat:

- *The public gets confused when they see winter storm warnings cancelled, then immediately see ice storm warning (or freezing rain advisory) issued. In reality, we have one significant hazardous event we want to warn (alert) people to, so they can mitigate their actions.*
- *Sometimes we get strong thunderstorms that will result in not only large hail but also flash flooding. Our current products only allow us to warn for large hail and flash flooding separately. We should be able to combine the two when appropriate or warn for the major hazard while mentioning the other lessor problem in the text below the headline. Putting out two warnings for the same storm does not help in our messaging and can lead to confusion with the public and media.*
- *I believe it was confusing for people to see these headlines in the same product: ...WINTER WEATHER ADVISORY IS CANCELED... ...FREEZING RAIN ADVISORY IN EFFECT...*
- *... it became potentially confusing to our users to switch types of advisories even when basically the same impacts were to be observed.*
- *Confusion about our products - Flash flood warning that expired and subsequent Areal Flood Warning was issued. An EM called us to ask why we cancelled the FFW. EMs were confused and upset because they are the front lines and are now having to explain our peculiarities to others.*
- *The main threat from this system was wind, and our message should have hit on this wind threat rather than confuse the public with multiple warnings, one for a threat that had a near-zero chance of impacting any structures.*

Examples of Perceived Limitations of the Terminology in Conveying Important Warning Information

Some forecasters found fault with the system not only in its confusing terminology but also in its failure to adequately convey impacts, actionable information, or confidence through its language:

- *The current system also is very confusing because it focuses on the terms "watch", "warning" or "advisory" when it needs to be focused more on conveying impacts. This goes for both visual and text formats.*
- *Users were confused as to the level of confidence expressed in watches and warnings. Such confusion means that planning and actions were delayed resulting in a greater negative impact from the weather event.*
- *We have to get offices into a more impact-flexible frame of mind. We try to lean as far forward as we can in this area, but my impression is we've just about maxed out the comfort level of all five of our neighboring WFOs.*
- *I think if we also get rid or change terms like "advisory, we can make things simpler to understand and convey impacts and any uncertainty.*

Examples that Support Maintaining Current Terminology

For all the critical comments, however, there also was some support among the forecasters for maintaining the current terminology or at least portion of it. These reflections are included in the discussion under

3. Collaborating with Other Entities

Definition: This theme focuses on forecasters' experiences in collaborating with other entities (e.g., WFOs, national centers, regions, and external partners). Collaboration is viewed as positive when it helps to coordinate product issuance with other offices or ensure consistent messaging among partners. Collaboration is viewed as negative when it is difficult to accomplish and restricts or delays the products that forecasters issue.

Relevant statements were most often found in response to the following survey questions:

1.2 Consider a hazardous weather event or a general experience with hazardous weather where the messaging did (or did not) work well from your viewpoint or those of your stakeholders. Why are you selecting this event or general experience for a case study? (We will refer to this as "your case study" in subsequent questions.)

1.3 Please briefly describe the weather situation and thought process for your case study. Include date(s) of the event (if applicable). Please use lay terms to the extent possible.

1.4 If you can recall, please list the WWAs, and other statements and products issued.

1.5 Did the WWAs and other statements and products issued appropriately convey the weather for your case study? Why or why not? Please include factors related to the predicted hazard location and timing, as well as articulation of forecast confidence, potential impacts, and recommended actions.

1.6 From a hazard messaging standpoint, how was the WWA system effective in your case study? Please explain.

1.7 From a hazard messaging standpoint, how was the WWA system ineffective or limiting in your case study? Please explain.

1.8 Do you have any ideas as to how to resolve the current WWA system challenges or limitations you described in your case study? Please explain.

1.9 Are there any features of the WWA system that you feel we must maintain due to its strength? Please explain.

1.10 What factors *outside* of the WWA system influenced the success or failure of your case study?

Keywords Searched:

- Relevant statements that contained words stemming from "term" or "terminology."
- Relevant statements that contained words stemming from "confuse" or "misunderstand."
- Relevant statements that contained phrase "difference between."

Case Count: 22 out of 88 cases included keywords relevant to the theme.

Examples of Positive Collaboration Experiences

Forecasters described positive examples of collaboration with national centers and other WFOs as well as with partners, such as EMs and the media:

- *Thanks to years of collaboration with state EMs and WFOs, many critical people knew what tsunami alert levels meant.*
- *The ability of our state partners (and WFOs) to properly understand and explain to their county officials the expected impact.*
- *On the success side: a closer relationship with partners, including the media, has greatly aided in the success of our newer messaging vehicles.*

- *Early communications with our partners resulted in DOTs and emergency managers getting the upper hand on the heavy snowfall and they were well prepared to deal with it when it arrived.*

Examples of Negative Collaboration Experiences

Forecasters also described some instances where collaboration was difficult and caused frustration and lost time. In some cases, the need for collaboration delayed the issuance of a product; such delays can translate into a loss of valuable preparatory time for partners. In other cases, forecasters regretted the particular decision made for the sake of collaboration, but didn't feel as if they could change the product issued as this could engender further disagreements and potential confusion among users. A number of case studies that described difficulties in collaboration among forecasters pertained to flood or snow products:

- *Collaboration! Criteria is different for southern IN (covered by WFO-LMK, WFO-PAH and the southern portions of WFO-ILN) where 4" of snow in 12 hours constitutes a warning.*
- *One storm producing two hazards, wind and snow, turned out to be a huge challenge to manage mainly because of complex headline issues and the challenges in forecasting, collaborating, and communicating them. This is not an unusual case.*
- *Actually the meteorology was pretty well and somewhat easily collaborated. The breakdowns occurred when the discussion about which highlights to issue began.*
- *Again, once you are committed and collaborated for the sake of lead time, it doesn't look good to flip-flop between warning, advisory, or worse yet, nothing!*
- *During collaboration the question that arose was whether existing Flood Watches should be changed to Flash Flood Watches. I realize this is only a limited example covering a couple of WWA products, but it does illustrate the issues that WFOs face when trying to collaborate appropriate WWA products that provide consistent messaging.*

Examples of Positive and Negative Collaboration Between WFOs and National Centers

A few cases mentioned collaboration between WFOs and national centers. One case described both positive and negative aspects of this collaboration:

- *NHC trumped WFO in the hurricane warning decision… We didn't feel a hurricane warning was needed.*
- *On a more positive note, NHC has become a master of collaboration with the WFOs, especially on surge. New probabilistic forecasts of wind and surge will better communicate the threat to our emergency managers so they can make the best decision possible.*

Another respondent renounced the need for "collaboration" between centers and WFOs in the first place, stating that:

- *SPC outlooks, watches and MCDs serve a broad audience of expert meteorologists…who then can focus the message to the local audience… It's when WFOs 'go rogue'--whether by changing the risk lines or using different colors than SPC, that the message gets inconsistent and confusing. I am not convinced that more 'collaboration' is the answer because …specialized, focused, deepest scientific expertise in severe storms resides at the SPC. Every minute spent 'collaborating' is a minute taken away from weather analysis and awareness. This can hurt forecast quality.*

4. Focusing on Graphics

Definition: This theme addresses the role of graphics, multimedia, and other visual information in communicating hazardous weather situations, both now and in the future. Graphics are viewed as important in enhancing the text-heavy WWA system and supplementing traditional dissemination mechanisms, such as NOAA radio and emails to partners.

Relevant statements were most often found in response to the following survey questions:

1.2 Consider a hazardous weather event or a general experience with hazardous weather where the messaging did (or did not) work well from your viewpoint or those of your stakeholders. Why are you selecting this event or general experience for a case study? (We will refer to this as "your case study" in subsequent questions.)

1.3 Please briefly describe the weather situation and thought process for your case study. Include date(s) of the event (if applicable). Please use lay terms to the extent possible.

1.4 If you can recall, please list the WWAs, and other statements and products issued.

1.5 Did the WWAs and other statements and products issued appropriately convey the weather for your case study? Why or why not? Please include factors related to the predicted hazard location and timing, as well as articulation of forecast confidence, potential impacts, and recommended actions.

1.7 From a hazard messaging standpoint, how was the WWA system ineffective or limiting in your case study? Please explain.

1.8 Do you have any ideas as to how to resolve the current WWA system challenges or limitations you described in your case study? Please explain.

1.9 Are there any features of the WWA system that you feel we must maintain due to its strength? Please explain.

1.10 What factors *outside* of the WWA system influenced the success or failure of your case study?

Keywords Searched:

- Statements containing stems of “graphic,” “visual,” “picture,” or “image.”

Case Count: 12 out 88 cases included keywords relevant to the theme.

Examples that Support a Need for More Graphical Modes of Conveying Warning Information

A number of respondents described the difficulty of communicating weather information through text alone. They observed that multiple kinds of messaging (in addition to WWA text) are helpful in describing a situation. These can include telephone conversations, multimedia briefings, and graphical weather stories. Some forecasters expressed a desire to move away from a focus on text-based driven WWA to a more graphically driven environment. Sample statements included:

- *In general, all of our WWA messages contain too much general information and not enough specific information. WWA type products should be multimedia, with graphics, images, pictures to convey the threat, impacts and actions.*

- *A picture is worth a thousand words. Let's include some images in our advisories and warnings.*
- *We need to sell our products better, and streamline the process of getting warnings out. Also, we have virtually no way of effectively getting a picture of where the warning is, other than initially just typing up a warning.*
- *I think we need focus on visual versus written text. If people want to see the actual text, provide a way to do that. However, our society wants everything in an easy-to-read visual aid and in a simple format. This includes on the WWA map and also with statements themselves, either on our webpages or anything sent out through venues like iNWS, social media, etc.*
- *A recent Nurture Nature study indicated that a combination of graphics and text is most desired by our partners—NWS as a whole does not link these two types of output streams and should pursue this to maximize the benefit of messaging.*

Examples that Support a Need to Maintain Traditional Text/Audio Dissemination Mechanisms

However, there also was concern about too much of a focus on graphics/text for handheld devices and computers, and not on the verbal communication of the message. One respondent stated that there is a need for concise verbiage to be broadcast via audio dissemination systems (NWR, Emergency Alert System, VHF radio, etc.). He stated:

- *This audio dissemination might be the primary means for NWS alerting in remote or rural parts of our country. Audio communication is also considered an important redundant/secondary means of NWS alerting everywhere else in our country. Ideally we will have very concise verbiage that is consistently applied (across geography, cultures and hazards) that helps the target audience know their risk and take protective action.*

Another echoed the same sentiment with this statement:

- *In these days of graphics products - some sort of text component is needed, if nothing else to serve as a legend for the graphic. This is especially true for populations that may not be able to interpret the graphic content due to vision issues & cultural issues in which symbology is not clear.*

Still another forecaster pointed out a need to satisfy both traditional dissemination mechanisms, like NOAA radio and emails to partners, while also evolving the system to include more graphics:

- *It must satisfy both the classic dissemination streams and the social media streams which have shown increasing capacity to reach the masses in a quick and effective way.*

5. Handling Levels of Forecast Confidence

Definition: This theme focuses on forecasters' ability to convey confidence in a hazardous weather event within the current WWA system. The system is viewed as working well for situations where the confidence is high, but not when confidence is low. Confidence levels are also viewed as highly subjective and variable among forecasters, which can result in different WFOs issuing different WWA products.

Relevant statements were most often found in response to the following survey questions:

1.3 Please briefly describe the weather situation and thought process for your case study. Include date(s) of the event (if applicable). Please use lay terms to the extent possible.
1.5 Did the WWAs and other statements and products issued appropriately convey the weather for your case study? Why or why not? Please include factors related to the predicted hazard location and timing, as well as articulation of forecast confidence, potential impacts, and recommended actions.
1.6 From a hazard messaging standpoint, how was the WWA system effective in your case study? Please explain.
1.7 From a hazard messaging standpoint, how was the WWA system ineffective or limiting in your case study? Please explain.
1.8 Do you have any ideas as to how to resolve the current WWA system challenges or limitations you described in your case study? Please explain.
1.9 Are there any features of the WWA system that you feel we must maintain due to its strength? Please explain.
1.10 What factors *outside* of the WWA system influenced the success or failure of your case study?

Key Words Searched:

- Relevant statements containing the words "confidence" or "probability."

Case count: 22 out 88 cases included keywords relevant to the theme.

Examples of Positive Experiences in Conveying Confidence

A number of forecasters stated that the system worked well when they had *high confidence* in an event:

- *Models handled the situation well and indicated it was going to be a major event will in advance. Forecast confidence was thus high and expressed in products by making direct statements--there was little or no use of terms like 'possible' or 'likely'*
- *Forecaster confidence was high in this event and it lived up to the stern warnings.*
- *The WWA system was effective in the sense that the "big kahuna" (Blizzard Warning) was being used with high confidence; this event was well advertised for a few days and there ended up being scarcely few accidents since people largely stayed off the roads.*

Examples of Negative Situations in Conveying Confidence

The respondents had more criticisms of the present system when their confidence in a forecast was *low.* They described situations where different WFOs had different opinions about what product to issue, and this caused different products to be issued for the same event, which respondents believed was confusing to users. They also stated that deciding what WWA to issue (either within one WFO or among

neighboring WFOs) can hold up issuing *any* product, potentially reducing the usefulness of the messaging and delaying planning and preparatory actions.

- *We had low confidence on where to place the snow/freezing rain/rain transition zones and WPC as well as neighboring offices differed with our forecast solutions. These differences were pointed out by an external blogger.*
- *The forecast confidence nearly leading up to the event was on the low side, however this started to increase rapidly once some signs on the radar data appeared. There was some 12Planet discussions with some neighboring offices about issuing an advisory. This held up the final decision to issue an advisory. The product selection combined with the lower confidence delayed the final decision to some extent.*
- *The confidence level or threshold chance for issuing an advisory can be viewed differently among the forecasters. In this case, the advisory was not issued because of the low confidence factor plus other issues such as timing and temperature trends. Freezing rain however was in the forecast. This delay in issuing an advisory significantly limited the effectiveness of the messaging.*
- *The WWA system does not routinely include statements of confidence. The WWA statements were constrained by the CWA boundaries, thereby splitting the messaging and impact statements right through the middle of the impact area.*

Another issue that one forecaster mentioned is that end users have a tendency to consider NWS products deterministic, regardless of how the agency defines them:

- *Our Flash Flood Watch to an end user, for example, means that Flash Flooding is going to happen. They don't read the definition or understand that we issue a Flash Flood Watch when confidence exceeds 50% (or whatever the value is at each office). Even if they did understand that issue, there is no objective method to arrive at a 50% confidence within the local WFO's. That confidence level is highly subjective and variable between forecasters and offices. So it really loses its meaning.*

Suggestions for Enhancing the System

A couple of forecasters offered a similar suggestion for handling high-confidence, major events:

- *Allowing us to use emergency wording in products where we have better than average confidence on a major tornado or flooding impacting the area.*
- *Suggest that WWA system be revised to use "Warning" to mean ~50% confidence that a weather event with serious impact will occur; and the term "Emergency" to mean >80% confidence that the weather event *is* occurring and requires immediate action to mitigate risk and enhance safety.*

6. Maintaining WWA Features

Definition: This theme reflects forecasters' opinions on the features of the WWA system that should be maintained. It also includes suggestions for changes to the system.

Relevant statements were most often found in responses to the following questions:

1.5 Did the WWAs and other statements and products issued appropriately convey the weather for your case study? Why or why not? Please include factors related to the predicted hazard location and timing, as well as articulation of forecast confidence, potential impacts, and recommended actions.

1.6 From a hazard messaging standpoint, how was the WWA system effective in your case study? Please explain.

1.10 Are there any features of the WWA system that you feel must be maintained due its strength? Please explain.

Key Words Searched:

- Words stemming from "maintain."
- Relevant statements containing the word "bullets" (because of their recurrence in the inductive coding).
- Appearance of the words "keep" and "system" within a certain word count.
- There were no results for statements where "keep" and "current" appeared together.

Case Count: 67 out 88 cases included keywords relevant to the theme or responses to the questions.

Examples that Support Maintaining All or Most Features of the Current WWA System

Some forecasters felt the current WWA system is good, and thus all or most of its features should be maintained. One respondent commented that "The current WWA system does not appear to have any significant deficiencies from our WFO's vantage point. So, if it's not broken, don't fix it!" These respondents observed that the NWS has invested a lot of time and money in educating the public about the system and that changing it would be both costly and confusing. Sample statements reflecting these viewpoints include the following:

- *Continuing with watch and warning terminology is important. We've spent years educating people about watches and warnings.*
- *The WWA system definitely carries an "official" authority and this was evident in this case. So if the system is changed the NWS still needs to be the authority and the "official" source of watches and warnings.*
- *Yes... a great investment has been made in outreach materials and education to explain the Tsunami levels of alert. Changing would cost lots of dollars and just move us to a different level of misunderstanding.*
- *The watch vs. warning concept basically works, but the difference needs to be better conveyed to users not very familiar with the weather concepts, such as radio broadcasters.*
- *I think the idea of a watch/warning/advisory can be and is effective, it's just the number of watches/warnings/advisories that creates the confusion.*
- *SPC outlooks, watches and MCDs serve a broad audience of expert meteorologists (from WFO to private-sector), EMs, and media, who then can focus the message to the local audience. This guidance is absolutely necessary, and if followed correctly from WFO to WFO, will be consistent across CWA borders.*

Warnings

A number of forecasters supported maintaining the term “warning” as they believed this term is familiar to members of the public and that they generally respect and pay attention to these products since they “reflect higher impact events.” As such, they also felt that the term should be used sparingly for very dangerous events. Comments included the following:

- *Warning. Most everything else, especially the watch and outlook, can be eliminated.*
- *Warnings must be kept. The word "warning" is effective. I have learned that people generally respect and pay attention to Tornado Warnings, Hurricane Warnings, Winter Storm Warning, Gale Warning etc.*
- *I think "warning" (even if it's just the term) needs to be maintained to reflect the higher impacts events.*
- *The word "warning," it is well known and action oriented.*
- *Obviously, keep the Warning. The general public identifies with the Winter Storm Warning, or Flash Flood Warning, or Flood Warning, or Ice Warning (rather than Freezing rain or Sleet Warning).*
- *Warning/Advisory should be maintained because it provides a final confirmation of event and means of tracking this specific NWS service.*
- *It would be good to somehow maintain the most severe and readily recognizable warnings that we issue - Blizzard, Tornado, Hurricane. Everything else is too open to interpretation.*

Watch and Advisory

Some forecasters had mixed thoughts on maintaining the terms “watches” and “advisories”:

- *The advisory portion of the WWA system might be beneficial for landspout type events.*
- *…watches and warnings are good. Advisories are not. Read the definition of advisory and we have enough/better info to report on the weather.*
- *All that needs to change is a) drop "watch", b) change "warning" to mean 50% probability, and c) add "emergency" to mean >80% probability and that action is required immediately.*
- *Watches are absolutely critical, and I argue the most important of the WWA paradigm.*
- *The watches and warnings have more meaning overall, however the wealth of advisory products out there tend to either get ignored or are viewed as a minor thing. Focus should be more on the watch and warning portion of the WWA system which triggers more of a response.*

Examples that Support Maintaining Specific Features of the Current System

Some forecasters stated that they thought it was important to maintain the bulleted format of the text and the ability to highlight important information using headlines. They also expressed a desire for an improved mapping solution:

- *Headlines/highlights are handy to raise awareness of the more extreme events and separate them out from the "routine" events. We need to ensure they are tied to impacts.*
- *Some sort of improved mapping solution*
- *The bulleted format should remain.*
- *The bulleted text is good, however NWRwaves has problems putting it on the NWR*

Additional features that forecasters suggested maintaining or even enhancing include the basic color gradation; level of details in products; use of polygons; and application of deterministic system:

- *We need to maintain the basic color gradation from low to extreme (e.g., green, yellow, orange, red).*
- *The format of the WWA statements require detailed statements as to timing, location and elevation of forecast weather conditions.*
- *The resolution of SVR and TOR polygons. This paints the picture much clearer than expanding the coloring to the entire county.*
- *The deterministic "yes/no" aspect of the system. That aspect is quite simple, you are either under a warning, or you aren't. The traditional and emergency dissemination methods. The core fundamental principles of the system. We know it works, we just know it doesn't work as well as we want it to.*

Examples that Support Changing the Current System

Some forecasters also provided suggested changes to the current system. These individuals did not believe that the current system is effective. Some felt that the entire system should be evaluated for change:

- *We obviously still need a method to heighten awareness for major weather events and we need to maintain the trust that we have gained. Those are the two key components of WWA I would maintain. Otherwise, I don't see any reason to maintain any aspect of longer term WWA products. They simply do not have a place in the impacts paradigm.*
- *I think every hazard product should be on the table for changes. Central region has made sizeable changes to convective warnings and it has been a great success.*
- *No. I could see a complete overhaul being beneficial if it is well thought out, then beta tested, then modified, then beta tested again, then modified...until customers and users really like it.*
- *I think the public does not understand the differences between advisory, watch, and warning in my experience no matter how many times it is communicated. They just want to know if it is going to snow and affect their day-to-day activities. Perhaps we should use different verbiage.*
- *Quite honestly, I'd like to see it all changed. Certainly people STILL do not understand the differences between a watch and a warning, which is the very basis of our system. We've tried for decades to educate people on the difference, but to no avail.*

Several forecasters expressed a desire to change the current WWA system to a tiered system:

- *No start completely over. Use a simple 3 or 4 color system.*
- *Need to simplify the message. I think a 2 tier system would work best. Basically, a warning is an alert and hopefully people will take action. Putting on more layers (outlook, watch) really can complicate the message.*
- *Some sort of tiered system is needed, but the vernacular doesn't appear to gel with public understanding.*
- *If I'm assuming the WWA system currently has an adequate tiered approach, which I don't think it really does, that would be a benefit to keep.*
- *Is do think the tiers are important.*

7. Providing Education, Outreach, and Training

Definition: This theme includes both ongoing or past experiences with education, outreach, and training, as well as suggestions for future improvements. The theme encompasses both internal and external efforts.

Relevant statements were most often found in response to the following survey questions:

1.2 Consider a hazardous weather event or a general experience with hazardous weather where the messaging did (or did not) work well from your viewpoint or those of your stakeholders. Why are you selecting this event or general experience for a case study? (We will refer to this as "your case study" in subsequent questions.)

1.3 Please briefly describe the weather situation and thought process for your case study. Include date(s) of the event (if applicable). Please use lay terms to the extent possible.

1.5 Did the WWAs and other statements and products issued appropriately convey the weather for your case study? Why or why not? Please include factors related to the predicted hazard location and timing, as well as articulation of forecast confidence, potential impacts, and recommended actions.

1.7 From a hazard messaging standpoint, how was the WWA system ineffective or limiting in your case study? Please explain.

1.8 Do you have any ideas as to how to resolve the current WWA system challenges or limitations you described in your case study? Please explain.

1.9 Are there any features of the WWA system that you feel we must maintain due to its strength? Please explain.

1.10 What factors *outside* of the WWA system influenced the success or failure of your case study?

Keywords Searched:

- Statements containing stems of the words “educate,” “outreach,” or “training.”

Case Count: 8 out 88 cases included keywords relevant to the theme.

Examples that Reflect Upon the Investments Made in Providing Education on the Current WWA System

Some respondents reflected on the investments already made in education, outreach, and training on the WWA system, which contributed to their sentiments toward maintaining the current system (see *5. Maintaining WWA Features)*. Sample statements supporting this stance include:

- *We've spent years educating people about watches and warnings. While surveys may show there is confusion about these terms among a segment of the population, it is certain there will always be confusion by a segment of the population with any type of threat alerting system.*
- *Yes... a great investment has been made in outreach materials and education to explain the Tsunami levels of alert. Changing would cost lots of dollars and just move us to a different level of misunderstanding.*

Examples that Demonstrate the Limitations of Providing Education on Current WWA System

Other forecasters felt that the present system is simply unintuitive and that no degree of education will help solve this issue. Sample statements critical of the current system include:

- *Quite honestly, I'd like to see it all changed. Certainly people STILL do not understand the differences between a watch and a warning, which is the very basis of our system. We've tried for decades to educate people on the difference, but to no avail. Therefore, we need a much simpler, more intuitive system.*
- *This is a general observation from over 26 years of trying to teach the public the different between watches, warnings, statements, advisories, etc. They don't get it. We do a poor job of educating the public and media and emergency management cooperators. We need to sell our products better, and streamline the process of getting warnings out.*

One respondent also pointed to a specific deficiency within the present system that hinders training and education:

- *There is a glaring hole in the NWS WWA structure for short-fused sub-advisory (amount) snowfall events (typically snow squalls). Forecasters have become very adept at predicting squalls and anticipating their impacts, yet the efficiency and urgency of the information dissemination and even basic education of the hazard is handicapped by lack of appropriate NWS short-fused winter warning product for severe winter convection (squalls).*

Suggestions for Enhancing Training Internally and Externally

Beyond public education and outreach, some cases pointed to a need for enhanced training, both internally within the NWS and externally with partners.

External Operations

Forecasters noted the variation in skill, experience, and training among media users and suggested more active training of strong social media followers (in a manner similar to SKYWARN) “to increase the rate at which the appropriate protective action is taken.”

Internal Operations

Suggestions for improving internal operations included:

- *Work with WAS*IS[2]-involved social scientists to improve delivery and education of messages on the public end, and in order to do so, identify all the sectors within the public who are not receiving info timely or consistently. This includes those with power outages, those without Internet, urban and rural poor, and many travelers.*
- *If we're going to keep NOAA weather radio, work with makers to put location-finding technology in each to give customers the option of only receiving warnings valid for their location (not the whole county).*
- *There needs to be a focus on having consistent optimized verbiage in our WWAs.*
- *Warning decisions remain inconsistent. While the "Go/No-Go" warning decisions seem to be improving, the ability to discriminate between a "warning" level event and a high-impact/emergency event in real time is not a widely held skill. Consistently including valuable details and advice in our warnings, with scientifically drawn conclusions and information will result in the text of these products being more widely distributed.*

[2] This statement is referencing Weather and Society*Integrated Studies (WAS*IS), which is a grassroots movement interested in integrating social science into meteorological research and practice in comprehensive and sustained ways. See http://www.sip.ucar.edu/wasis/ for more information.

8. Referencing Above or Below Criteria

Definition: This theme addresses situations where WWA products do/do not meet specific NWS criteria and/or thresholds. It references events where severe weather occurred, but the NWS did not issue a WWA product (or did so too late) because criteria were not met, as well as situations where respondents perceive the criteria as being too broad and therefore WWA products were issued for marginal events.

Relevant statements were most often found in response to the following survey questions:

1.2 Consider a hazardous weather event or a general experience with hazardous weather where the messaging did (or did not) work well from your viewpoint or those of your stakeholders. Why are you selecting this event or general experience for a case study? (We will refer to this as "your case study" in subsequent questions.)
1.3 Please briefly describe the weather situation and thought process for your case study. Include date(s) of the event (if applicable). Please use lay terms to the extent possible.
1.4 If you can recall, please list the WWAs, and other statements and products issued.
1.5 Did the WWAs and other statements and products issued appropriately convey the weather for your case study? Why or why not? Please include factors related to the predicted hazard location and timing, as well as articulation of forecast confidence, potential impacts, and recommended actions.
1.7 From a hazard messaging standpoint, how was the WWA system ineffective or limiting in your case study? Please explain.
1.8 Do you have any ideas as to how to resolve the current WWA system challenges or limitations you described in your case study? Please explain.
1.9 Are there any features of the WWA system that you feel we must maintain due to its strength? Please explain.
1.10 What factors *outside* of the WWA system influenced the success or failure of your case study?

Keywords Searched:

- Appearance of the word “criteria” or “threshold.”
- Stemmed occurrences of the word “trigger.”

Case Count: 26 out 88 cases included keywords relevant to the theme.

Examples that Demonstrate a Perceived Rigidity in the Current System

A few forecasters noted that the WFOs need to have some guidance and rules in their forecasts, and one respondent captured this sentiment by stating, “Varying thresholds based on the hazard threat and expected impacts are something that work well.” This same respondent also went on to say that “WWA terminology does not necessarily have to be in place to communicate this.” In fact, many more forecasters commented on the rigidity of the present criteria-based WWA system. They noted the difficulties they often have in fitting a particular event into strict criteria and in applying differing criteria (among different WFOs) to an impending event. Sample statements reflecting these situations are as follows:

- *It exemplifies the hesitation forecasters experience when it comes to fitting a particular event into the definition of a highlight (advisory or warning). As agency we are still having trouble breaking away from rigid criteria for highlights.*
- *On the failure side: Rigidity of many within the NWS, meaning a strict adherence to concrete*

criteria no matter the given situation. That sounds like a nonsensical approach right, yet it remains the norm for this organization.

In particular, forecasters noted that difficulties arose for potentially high-impact weather situations that did not meet the criteria:

- *It did not clearly communicate the main threat/impact. Headlines only repeated the name of the product and criteria for which it was being issued for. In this case, the criteria did not match the impacts (greater impacts than criteria suggested).*
- *A fast moving storm system on a busy pre-holiday travel day and also with the greatest impacts at morning rush hour for those working/travelling. Using the criteria for our winter WWA (snow less than 6" and near-zero visibility for less than 3 hours), this would suggest that a winter weather advisory would be needed. However, common sense suggested that a more strongly worded message was needed for this type of event as advisories typically do not draw the attention that something may become a life threatening situation.*
- *It was a case in which the impacts were high for low end winter accumulations due to other factors. However, our normal WWA criteria would not have allowed for us to properly address those impacts if followed strictly. Also, it was an event of small areal coverage.*

Respondents also noted other deficiencies in the present criteria-based system, particularly for the winter weather and flooding product suites. They noted instances where the current suite of WWA do not fit the situation, leaving them unsure what product to issue:

- *There is a glaring hole in the NWS WWA structure for short-fused sub-advisory (amount) snowfall events (typically snow squalls). These so-called High Impact Sub-Advisory (HISA - DeVoir 2004) kill a disproportionate amount of highway travelers every year, WITHOUT NWS WARNINGS ever being issued. In the absence of an appropriate short-fused winter warning product/vehicle, local NWS field offices are made to fend for themselves in educating and notifying decision makers and the public of these dangerous and truly life threatening events.*
- *…we were stuck between several different products to handle the situation with none of them really fitting it entirely. It has blizzard impacts on travel, but didn't last long enough to be verified with blizzard criteria. The SPS can handle it, but doesn't have the attention-getting factor that a blizzard warning has. People tend to go about their business when one is in effect. A Winter Weather Advisory could have worked, but again many people ignore these products and continue to go about their day.*
- *Given we are so focused on criteria, a Winter Weather Advisory does not apply to these blizzard-like showers, with near-zero visibility and 30-40 mph winds. As mentioned before, they frequently kill people in the Ohio Valley. We desperately need some sort of convective snow warning that we can issue for these events.*
- *We have advised our partners of brief blizzard conditions but issued a winter weather advisory for 1-2 hours of blizzard conditions. I feel the current hazards/products need to be amended (and possibly a widespread criteria change is needed).*
- *This is not a specific case but a general problem with Hydrologic Warnings… The software only allows a flood warning to be issued when the forecast or observation at the gauge is above flood stage. However, there are times where a warning is needed even though the river level at the gauge does not meet that criteria. An example is when flooding has occurred and the river is receding, the reach of the river downstream from the river still has flood problems.*

Suggestions for Enhancing the Current System

Impact-Based System

Many forecasters repeatedly suggested that the NWS shift to a more impacts-based system.

- *It is an example of how providing watches/warnings or advisories (WWA) simply based on criteria is not as effective as issuing WWAs based on impacts. Events with similar criteria often create much different impacts based on the associated conditions. We are still in a verification intensive mentality with regard to advisory versus warning products.*
- *Perhaps the argument here is not whether an advisory or warning product should have been issued, but how could we have better conveyed our uncertainty and expected impacts of the hazard?*
- *Warning, Watches and Advisories should be issued based on impact and not just numerical criteria. Numerical criteria don't always relate to the impact people experience. For example, 4 inches of snow could have a significant impact on travel if temperatures are cold or if temperatures are near freezing, the impacts to roads will be minimal for a 4-inch snowfall.*
- *If impacts to roads will be significant even though the criteria is not expected to reach warning criteria, a Winter storm Warning should be issued. This is not allowed under current policy. Again, warn based on impacts not just hard numbers.*
- *Change to impact based criteria or eliminate heavy snow as a warning criteria.*
- *We (NWS) get so hung up on thresholds and numbers. Perhaps instead of warnings, we should just issue "impact statements.*
- *The weather service needs to add in some scale of impacts to the criteria for WWAs, as the older strict criteria does not always apply to the different situations. We notice this several times a year when it comes to winter and non-precipitation events.*

Additional Suggestions

- *Additional suggestions focused on reducing the number of products, re-evaluating and updating criteria, reducing the range for some criteria, moving to a polygon-based system, and enabling users to set their own thresholds for warning.*

- *However, the criteria for a warning must be evaluated and updated routinely to match current social and physical environment. For example, the criteria for Severe Thunderstorm Warning was developed during WWII and it has not changed much since. It's current wind and hail criteria are too low and as a result, too many SVRs are issue and in general, people do not respect the SVR.*

- *I believe there are too many NWS warning events categories. The amount of categories needs to be reduced. For example, there are numerous flooding related WWAs, flood, flash flood, coastal flood, ice jam flood, storm surge, river flood etc.*

- *One problem with this situation is that the Winter Weather Advisory (at least locally) has too large of a range of criteria for which it can be issued. It can be issued for minor or no impact events such as trace of freezing rain or for snowfall events up to 4.9 inches in 24 hours which can cause significant travel impacts.*

- *In situations like this, having tools available to customers allowing them to set their own thresholds would be ideal. If I'm Customer Bob, and I'm always concerned about temps below*

30F, then having a tool to alert me of when that is forecast, and only then, would be helpful. Unfortunately, the local NWS offices have to take a one-size-fits-all approach.

- *Also, the spatial extent was small but focused on more highly populated areas. In some counties, the western half of the county would be fine while the eastern half would have significant impacts. Our current WWA software only allows issuance by zone, as opposed to polygons.*

- *A simple fix that we've actually successfully tested in this office...polygon display of long-fused warnings (WSWs) on the WWA map This would be a great help, at least to the mountainous West. We need to move away from the zone concept wherever we can.*

9. Referencing Impact-Based Decision Support Services (IDSS)

Definition: This theme includes any reference to an array of IDSS, such as sending emails to partners, conducting briefings or webinars, making or receiving phone calls, hosting conference calls, or otherwise working with customers. IDSS is perceived as being more useful than the WWA system in many instances. In some cases, the WWA system (as opposed to IDSS) is actually viewed as detrimental to forecasters and their work.

Relevant statements were most often found in response to the following survey questions:

1.2 Consider a hazardous weather event or a general experience with hazardous weather where the messaging did (or did not) work well from your viewpoint or those of your stakeholders. Why are you selecting this event or general experience for a case study? (We will refer to this as "your case study" in subsequent questions.)
1.3 Please briefly describe the weather situation and thought process for your case study. Include date(s) of the event (if applicable). Please use lay terms to the extent possible.
1.4 If you can recall, please list the WWAs, and other statements and products issued.
1.5 Did the WWAs and other statements and products issued appropriately convey the weather for your case study? Why or why not? Please include factors related to the predicted hazard location and timing, as well as articulation of forecast confidence, potential impacts, and recommended actions.
1.6 From a hazard messaging standpoint, how was the WWA system effective in your case study? Please explain.
1.7 From a hazard messaging standpoint, how was the WWA system ineffective or limiting in your case study? Please explain.
1.8 Do you have any ideas as to how to resolve the current WWA system challenges or limitations you described in your case study? Please explain.
1.9 Are there any features of the WWA system that you feel we must maintain due to its strength? Please explain.
1.10 What factors *outside* of the WWA system influenced the success or failure of your case study?

Keywords Searched:

- Responses containing the words “DSS,” “IDSS,” “email,” “briefing,” “webinar,” “phone,” “call,” conference,” or “customer.”

Case Count: 19 out 88 cases included keywords relevant to the theme.

Examples of the Importance of IDSS Versus the Issuance of WWA Products

Forecasters mentioned an extensive list of mechanisms for providing IDSS to their users. These included emails, phone calls, social media, briefings, webinars, and many more. A common theme among a number of forecasters is that the actual WWA product issued can be just one or even the last message distributed by a WFO. Many felt that their IDSS was the critical factor in their communication being received successfully:

- *Our ability to message through social media, email, briefings (e.g. DSS) made our message far more useful than the WWA.*
- *Considerable IDSS, which ended with winter weather advisory. The prior Advisory IDSS was: Weather Story, Facebook Posts, Email to customers.*

- *The winter weather advisory was one of the last messages distributed by WFO, in a chain of other IDSS methods. As such, it did little to notify key partners that conducted mitigation efforts (i.e. treating roads, plowing).*
- *NWS puts too much weight into WWA. Whereas, the most effective means of communicating an impact is often done through other means and well before the traditional issuance of WWA (through social media, email, phone calls, YouTube briefings, etc.)*
- *There are other more efficient means of communicating impacts to customers, such as emails, phone calls, etc. Customers did not react because WWA, but instead because we tracked a vulnerability they helped us identify and then we let them know, rather than they needing to search for weather answer.*
- *Our Webinar was critical in properly messaging our partners about the danger of the approaching storm. Although we heavily relied on WWA in the briefing, it would look very different today. We probably would not even mention the WWA products in effect, which would muddy the waters as we would have to go about explaining the different headlines and what they entailed. We are finding that using colors simplifies our message here and frees up time in creating these slide decks used in Webinars and other briefings.*

Examples of Detrimental Impacts of WWA System on Forecasters and Offices

Forecasters also expressed that with all the IDSS they do—and all the positive impacts of these messages—the "old" way of having to issue a product can now seem inflexible, difficult, and stress-producing, particularly when offices have to collaborate on deciding what WWA to issue. Sample statements reflecting this viewpoint included:

- *The newer "IDSS" messaging is easy for forecasters as we have kept them flexible and rule-free for the most part. In this messaging, we simply talk about the expected event and its likely impacts. Then within a day or two of onset, the forecaster has to fit it into an often rigidly defined, and accountable product. I hope a day comes when we can make the staffs feel completely empowered and comfortable in simply discussing what they know (and what they don't know) with the stakeholders.*
- *A Freeze Warning was issued, but it was only the final step in Decision Support. But this step seemed more difficult than it should have been. New types … of DSS were employed early and liberally in this event. For the final step we decided to issue a Freeze Warning, but since this product isn't "typically" issued that early, suddenly it became a somewhat difficult (and even contentious with neighboring WFOs) decision to do what we felt was simply continue telling stakeholders/public a damaging freeze was very likely.*
- *The warning did seem to add some noticeable increase in visibility for this event, but I'm not sure it was enough to offset the angst over the decision, and the subsequent fence mending done with a couple neighboring WFOs.*

10. Using the WWA Map

Definition: This theme includes references from forecasters regarding the display of WWAs on the map shown on local or national NWS websites. References include perceptions of the map helping or hindering communication of weather hazards.

Relevant statements were most often found in response to the following survey questions:

1.2 Consider a hazardous weather event or a general experience with hazardous weather where the messaging did (or did not) work well from your viewpoint or those of your stakeholders. Why are you selecting this event or general experience for a case study? (We will refer to this as "your case study" in subsequent questions.)

1.3 Please briefly describe the weather situation and thought process for your case study. Include date(s) of the event (if applicable). Please use lay terms to the extent possible.

1.6 From a hazard messaging standpoint, how was the WWA system effective in your case study? Please explain.

1.7 From a hazard messaging standpoint, how was the WWA system ineffective or limiting in your case study? Please explain.

1.8 Do you have any ideas as to how to resolve the current WWA system challenges or limitations you described in your case study? Please explain.

1.9 Are there any features of the WWA system that you feel we must maintain due to its strength? Please explain.

1.10 What factors *outside* of the WWA system influenced the success or failure of your case study?

Keywords Searched:

- Relevant responses containing stems of the words “map,” “website,” “trump,” or” overlap”

Case Count: 12 out 88 cases included keywords relevant to the theme.

Examples of Hazards Being Masked on the Map

Forecasters described a number of cases where a particular hazard was not displayed on the map. In some cases, the masked hazard was the one that posed the greatest threat and most severe impacts:

- *Too many colors on the WWA map. Hurricane warning trumped the other hazards (e.g. coastal flood) that was expected to be more of an impact.*
- *… the Riverton (RIW) NWS office had a Red Flag Warning (today) and a Blizzard Watch (tonight/Wednesday) for Johnson County. Only the Red Flag Warning was displayed on the WWA map.*

Examples of Products Displayed on the Map in a Confusing or Misleading Way

They also described situations where a particular product was displayed on the map but in a way that was confusing or misleading if a user just looked at the map and not any additional or ancillary information explaining the situation:

- *Overnight temps had reached the freezing point on several mornings, but a hard or damaging freeze had not occurred. On the WWA map, in this case, the displayed title of Freeze Warning was thus somewhat confusing. The WWA map is often where the public stops. It was more efficient to immediately explain what we expected via social media and weather stories.*

- *The event was a prescribed burn in Wind Cave National Park on April 13th. It grew into a wildfire, called the Cold Brook Fire. There was a Fire Weather Watch for the 14th, but the WWA map on our website made it look as if the Watch was for the 13th, which confused customers.*
- *In several instances, we have had systems that have multi-threats that will impact southern New England. Customers looking at the WAA map can quickly glance and believe that one of the multi-hazards will impact them, leading them to be unprepared.*
- *February Blizzard of 2013 for Southern New England. This coastal storm brought heavy snow, near hurricane force winds and coastal flooding. This multi-hazardous storm cannot be displayed properly on the WAA map. In fact, many individuals and even TV mets were not prepared for the coastal flooding impact that was properly forecasted, as the snow and winds were the main focus.*

Suggestions for Improving the Map

Forecasters offered up a number of solutions for improving the map, including polygon displays and multiple maps:

- *A simple fix that we've actually successfully tested in this office...polygon display of long-fused warnings (WSWs) on the WWA map. This is apparently not allowed, and I don't get it. This would be a great help, at least to the mountainous West. We need to move away from the zone concept wherever we can.*
- *The map on our web pages is flawed in the fact it still shows whole counties/zones when in fact we can make these smaller in scale within AWIPS using GFE.*
- *One way to avoid this confusion would be to display multiple WWA maps on our web page, such as a map for each day in the short term. This would be similar to Storm Prediction Center Outlooks.*

VI. Summary of Emergency Manager Case Studies

A number of recurring themes emerged among the EM responses. These themes (presented in alphabetical order) are:

1. Approving of present system
2. Considering outside factors
3. Disseminating and sharing NWS information
4. Experiencing nighttime hazards
5. Having timely information
6. Managing staff decisions
7. Maintaining WWA features
8. Preparing for hazardous weather
9. Receiving NWS information
10. Referencing above or below criteria
11. Using NWS products and services

EMs also provided a number of suggestions for improving the current system. These suggestions are captured both in the discussions of the various themes, where relevant, as well as in a listing in Appendix C at the end of this report.

1. Approving of Present System

Definition: This theme indicates respondents' general approval or liking of the current WWA system.

Relevant statements were most often found in the responses to the following questions:

2.3 Consider a particular hazardous weather event or a general experience with specific types of hazardous weather where the NWS messaging did (or did not) work well from your viewpoint or from the viewpoint of your community or audience.

2.5 If you can recall, please list the watch, warning, and advisories (and other NWS statements and products) issued, or share the products you generally receive for the type of event you have in mind.

2.6 Please describe the utility of NWS weather messaging for that event. First, what worked well for you?

2.10 Do you have any suggestions to resolve the current watch, warning, advisory system challenges or limitations you described in this survey? Please explain.

2.11 Are there any features of the watch, warning, advisory system that you feel must be maintained? Please explain.

Key Words Searched:

- Phrases similar to "system works well."
- Phrases similar to "system is good."
- Statements that contain the words stemming from "maintain," such as "maintain," "maintaining," etc.
- Statements that contain the word "keep."
- Stemmed occurrences of the words "current" and "maintain" within a certain word count.

Case count: 412 out of 566 cases included keywords relevant to the theme.

Examples of Positive Statements About the Current System

Many respondents praised the current system for its simplicity, accuracy, timeliness, and utility. Sample statements include the following:

- *System worked very well from our perspective. Watch, warnings and advisories were both timely and accurate.*
- *I like the stability of the Watch, Warning and Advisory system. It is not complicated and is easy to understand what you are saying.*
- *The products are always very informative and timely. The warnings are very succinct.*
- *Critical to public safety. Extremely useful, accurate, timely. Advisories got me alerted, Watches enabled me to begin spooling up, Warnings were the trigger point.*

Examples of Perceived Detrimental Effects to Changing the System

Not only did some respondents approve of the present system, but they also felt that any change to the system would be unwarranted. Some respondents suggested that more education of the current system would be preferable to changing the system:

- *I prefer the KISS system Keep it simple and direct educate and train people on the difference of*

watches and warnings then spend the resources to make them more accurate.

- *Educating the public and NWS partners on weather outlooks (convective, winter, tropical) and operationalizing them within the CWA, as opposed to creating an adjunct methodology, is the solution.*

Examples that Support Maintaining the Current WWA System in Its Entirety

Respondents who favored maintaining the current system mostly did so in its entirety:

-
- *I feel all of the features are useful.*
- *I like it just the way it is.*
- *I would not like to see anything discontinued.*
- *The current format is working well, all aspects.*
- *I like the features of the current system and would encourage that it be continued and maintained.*
- *Do not change - all is good for us.*
- *All aspects should be maintained. This is our county's only information that we use to look at upcoming weather situations.*

2. Considering Outside Factors

Definition: This theme addresses factors outside of WWA products that can influence decision making and response to a hazardous weather event. These include *physical* factors such as instrumentation, on-the-ground verification, standard operating procedures, staff, and equipment; *social* factors, such as local knowledge, history, trust in a source, politics, people's anxieties, and conversations (both online and offline); and *conditional* factors, such as timing, events, crowds, and traffic. In some cases, contributing factors complement the NWS system; in others, they fulfill a process or product that respondents feel is lacking from the current system.

Relevant statements were found in response to the following survey question:

2.9 Were there other factors outside of the watch, warning, advisory system that shaped your ability to respond?

Keywords: All relevant responses to the question were directly extracted from the survey data. We did not search keywords for this theme because a word-frequency query from a previous step resulted in a pattern of words and phrases that was not semantically related/significant.

Case count: 467 of 566 cases included responses to this question.

Examples of Physical Factors Influencing Decision Making

Respondents routinely rely on instrumentation (such as radar and satellite imagery, tide and stream gauges, and rain gauges) to help in their understanding of hazardous weather conditions. Some also have begun to monitor live video from area storm spotters, which can provide additional visual input to aid in decision making. Respondents also stated that they rely on the on-the-ground information provided by sources such as citizen reports, field and maintenance crews, road crews, utilities, highway patrols, and law enforcement officers.

Examples of Social Factors Influencing Decision Making

Many respondents noted that their own observations, local and historical knowledge, and years of training play an important factor in their decision making:

- *As a native to this area, I know which streets and neighborhoods are prone to flooding."*
- *… locally we use history as reference as we know how cold it can get and [that] high winds and lots of ice bring down power lines."*

Others stated that they seek out other forecasts and forecasters' opinions in increasing their confidence in an NWS forecast and in shaping their decision making:

- *I don't always have the luxury of having the additional forecasts/forecasters, but when they do provide the information, I compare [it] to what NWS is advising and try to make the best decision I can.*
- *Weather is not an exact science, but if multiple outlets are forecasting similar effects, my confidence in the forecasts increase.*
- *We use as much information to make decisions. Other weather sites, radar, and TV.*

Most respondents cited local or national news stations as their most frequently used sources of information (after the NWS). A few respondents also mentioned their reliance on customized services,

such as customized notifications for the immediate area or private weather services that provides area-specific weather.

The importance of conversation and the "human element" also plays a large role in influencing and shaping decision making. These conversations happen at many levels and in various formats. For example, they can take the form of formal briefings at a local or state level, or informal discussions with road crews, sky spotters, or even online on social media platforms or in chat rooms. One respondent captured the importance of these connections, saying, "The information I get from my partners is sometimes more in-depth and gives me the ability to increase my knowledge and make better decisions out in the field."

Social media can also play a role, with some respondents noting they use social media to gain situational awareness through reports, photos, and text descriptions. Some also follow the social media platforms of local broadcasters.

Examples of Conditional Factors Influencing Decision Making

Some EMs said that conditional factors such as timing (e.g., time of the day or night, and even time of the week), special events, large congregations of people, and rush hour traffic, can all influence decisions:

- *Timing - the start of the week is when most hospitals get supplies. Knowing the storm would strike early in the week promoted all of us to move up our deliveries to early Monday.*
- *Most of the public we serve was also at home trying to sleep.*

3. Disseminating and Sharing NWS Information

Definition: This theme encompasses various types of information shared (e.g., actual WWA products, maps, emails, briefings), as well as modes of transmission (e.g., social media, phone calls) and with whom the information is shared, such as supervisors, partners, the public, and others.

Relevant statements were found in responses to the following survey question:

2.4 If you can recall, please list the watch, warning, and advisories (and other NWS statements and products) issued, or share the products you generally receive for the type of event you have in mind.

Key Words Searched: All relevant responses to the question were directly extracted from the survey data. We did not search keywords for this theme because a word-frequency query from a previous step resulted in a pattern of words and phrases that was not semantically related/significant.

Case Count: 490 out of 566 cases included responses to this question.

Examples of the Types of Information Shared

Respondents stated that they share text forecasts from the www.weather.gov site, tailored forecasts from local WFOs, PowerPoint presentations, and maps. They use their public information offices, email lists, social media, sirens, radio, websites, phone calls, and app notifications to disseminate the information. The breadth of types of information shared are reflected by these comments from respondents:

- *Maps are great for sharing, and I use the forecaster's discussion for detail to add to the map's hyperlinks (watches, warnings, etc.) on the NWS website advisory map.*
- *The weather map graphics were helpful to share with other emergency personnel.*
- *I forward PowerPoints out to [my] email list of emergency responders and school systems, county management, municipalities, and local hospitals.*
- *I send out emails to my eight counties in my district to advise them of the forecast and pending weather statements to give them a heads up for any preparation they need to do with their crews and equipment.*
- *I post to our Facebook page.*

Types of WWA Products Shared

Some respondents noted that they only pass along the watch and warning information; others noted that they share just warnings.

- *I will forward the first watch and will forward all warnings because it is stating that `we have imminent flooding.*
- *Watches and warnings were forwarded to residents of the county utilizing available media.*
- *Advisories gave us a heads up, as watches came out we were more proactive, warnings, we pushed out to the public and responders.*
- *The warning is the signal for our staff (and the listeners) to take an appropriate action. This system works very well.*

Some respondents stated that they share all significant weather information (watches, warnings and advisories) with citizens. Some noted they generally "interpret" NWS information into basic plain English for citizens or “soften the language” for end user understanding. They noted they use multiple methods to share information as quickly as possible, including social media and across local radio frequencies.

Examples of with Whom Information Is Shared

EM respondents also stated that they routinely share NWS information with the community and other partners, including first responders, field crews, transportation departments, technicians, local hospitals, assisted living facilities, schools, and municipal departments (e.g., police, fire, public works), as well as water works and sewage disposal plant operators.

Respondents also noted that they interpret and forward NWS information to their superiors or senior leadership so they are aware of the situation and have information to inform decision making.

4. Experiencing Nighttime Hazards

Definition: This theme captures examples of experiencing hazardous weather at night and/or statements related to receiving WWA alerts from the NWS at night.

Relevant statements were most often found in response to the following survey questions:

2.3 Consider a particular hazardous weather event or a general experience with specific types of hazardous weather where the NWS messaging did (or did not) work well from your viewpoint or from the viewpoint of your community or audience. Please briefly describe the weather situation for your case study. Include date(s) of the event (if applicable). Please use lay terms to the extent possible.

2.4 If you can recall, please list the watch, warning, and advisories (and other NWS statements and products) issued, or share the products you generally receive for the type of event you have in mind.

2.5 How did you use, if at all, these watch, warning and advisory products for this event?

2.6 Please describe the utility of NWS weather messaging for that event. First, what worked well for you?

2.7 Second, what could have worked better for you?

2.8 Did the watch, warning, and advisory system adequately enable you to make an appropriate decision? Why or why not? Please include factors related to the predicted hazard location and timing, as well as articulation of forecast confidence, potential impacts, and recommended actions.

2.9 Were there other factors outside of the watch, warning, advisory system that shaped your ability to respond?

2.10 Do you have any suggestions to resolve the current watch, warning, advisory system challenges or limitations you described in this survey? Please explain.

2.11 Are there any features of the watch, warning, advisory system that you feel must be maintained? Please explain.

Key Words Searched:

- Stems of the words “sleep” and “asleep.”
- Statements that contain the word “wake,” “awake,” and “night.”
- No results were found for a search of words stemming from or similar to “nocturnal.”
- No results were found for occurrences of the words “early” and “hour” next to each other.

Case Count: 38 out of 566 cases included keywords relevant to the theme.

Examples of Positive Experiences in Receiving Nighttime Alerts

Many respondents cited the utility of receiving nighttime alerts, both in helping them prepare and in alerting members of the public to an emergency situation:

- *I felt that the use of the flash flood emergency was effective. There were flash flood warnings all over town, but use of the emergency really captured the severity of the event, and help[ed] communicate it to the public.*
- *In general, advance weather knowledge is a good thing, and that is certainly the case here. Once the citizens are awake we can use the lead time to educate them and get them better prepared.*

Examples of Negative Experiences in Receiving Nighttime Alerts

In spite of many positive experiences, however, the case studies revealed some negative experiences as well, focused on the following: 1) not receiving notice because a situation did not meet the criteria for an alert, 2) receiving nonemergency alerts, and 3) receiving multiple alerts, and 4) receiving vague alerts.

Not Receiving Notice Because Criteria Are Not Met

Respondents called out severe thunderstorms as a hazard where dangerous storms do not always meet the criteria for a warning to be issued. Therefore, no notice is provided to the public. This problem can cause particular problems at night when most residents are sleeping. One respondent described a storm that was severe enough "to take down trees, peel back siding/roofing, cause power outages, and downed trees took out phone/cable lines," yet no storm warning was issued. The respondent said that:

- *It is very difficult to explain to the public why they didn't receive a warning alert during the night for a storm that caused a significant amount (in the citizen's eyes) of damage. Please revise your criteria for severe thunderstorms so that a warning is issued the next time a storm like this comes through (especially during the middle of the night). The public deserves notices/alerts for these types of storms.*

Receiving Nonemergency Alerts

Another respondent noted that the reverse can also happen, in that people can receive alerts for nonemergency severe thunderstorms:

- *"SPS is a broad category that includes many different hazard types, ranging from strong thunderstorms to dense fog advisories. Some are of more interest to us than others. It would be better if there could be sub-types of SPS that we can select to receive and not others. Being awaken by a text message at 3 a.m. for a fog advisory gets real old, real fast."*

The most frequently cited problem around nighttime warnings was receiving nonemergency alerts in the middle of the night. Respondents noted that sometimes these alerts are received well in advance of a forecast event:

- *I am going to pick a topic I see as a problem which I do not feel is getting enough attention within the NWS: issuing non-emergency weather products in the middle of the night. The most recent example occurred on July 6, 2015, when a flash flood watch was issued at 03:30 a.m. that would not take effect until 19:00 that same day. Another example I will reference occurred approximately 18 months ago (exact dates unknown) when a blizzard warning was issued for a wide area of the state at 4:00AM on a Sunday or Monday, which was around 2 1/2 DAYS in advance of when the storm would affect the area.*

Receiving Multiple Alerts

A related problem is receiving nonemergency alerts over and over again, particularly when they occur in the middle of the night. Respondents noted that these multiple alerts often arise from the NWS reissuing a long-standing watch/warning. Respondents were particularly frustrated when these multiple alerts were not even for their warning area.

- *… the same warning kept getting re-issued, causing the WEA alert to go off over and over again, waking me up several times (I wasn't in the warned area, and I live up high, so this was not helpful).*
- *… the reports come through several times a day and one every day between 2 and 4 AM. These messages wake me up (which is good if there is something to wake up for) but when there is*

nothing to really report it just wastes my time.

- *The only complaint I have is re-issuing a long standing flood watch/warning at 4 AM causes every weather radio in the house and both of my phones to go crazy. That is hard on me after working the EOC for a week straight - especially when it is for a flood WATCH that has been in place for 2 days already.*

Respondents worried that receiving nonemergency or irrelevant alerts (particularly if they happen multiple times) can desensitize the public and cause people to opt-out of future alerts:

- *"I know there are people within the NWS who understand warning fatigue; they know if you issue too many warnings and nothing happens, people get tired of the hype and start to tune you out. Then when the threat is real, they're no longer listening.*
- *... in this context we need to use the term emergency to refer to something that poses an IMMEDIATE threat to life or property, and when we're issuing the alerts 15 1/2 hours, or TWO AND A HALF DAYS before the event, then it is very hard to make the case that this meets the "immediate threat" criteria."*

Receiving Vague Alerts

Some respondents found certain emergency notification messages to be very vague. They suggested that the messaging provide a better description of an event and the timing of an event. One respondent suggested that the transmitters.

- *...send out the digital code to make the Weather Alert Receivers wake up with an Advisory, Watch, or Warning—give a short voice explanation of what the particular transmission code means, i.e. Warning: This means it's fixing to happen or is happening folks... then go on with telling the folks listening of what is fixing to happen or actually happening.*

5. Having Timely Information

Definition: This theme includes positive, negative, and general statements from respondents that are related to having, not having, appreciating, or wanting timely information or advanced notice of a hazardous weather event. References to information about time, such as time lines and path cast, etc., in WWA products are also included.

Relevant statements were most often found in response to the following survey questions:

2.3 Consider a particular hazardous weather event or a general experience with specific types of hazardous weather where the NWS messaging did (or did not) work well from your viewpoint or from the viewpoint of your community or audience.
2.5 How did you use, if at all, these watch, warning and advisory products for this event?
2.6 Please describe the utility of NWS weather messaging for that event. First, what worked well for you?
2.8 Did the watch, warning, and advisory system adequately enable you to make an appropriate decision? Why or why not? Please include factors related to the predicted hazard location and timing, as well as articulation of forecast confidence, potential impacts, and recommended actions.
2.9 Were there other factors outside of the watch, warning, advisory system that shaped your ability to respond?
2.10 Do you have any suggestions to resolve the current watch, warning, advisory system challenges or limitations you described in this survey? Please explain.
2.11 Are there any features of the watch, warning, advisory system that you feel must be maintained? Please explain.

Key Words Searched:

- Statements where words similar to or stemming from “enough” and “time” appear within a certain word count.
- Stemmed occurrences of the words "timely," "duration," and "advanced."

Case Count: 185 out of 566 cases included keywords relevant to the theme.

Examples of the Importance of Timing Information

Respondents repeatedly stressed the importance of timing information, stating that this information is critical for planning and decision making:

- *Knowing the timing and location of the event is key.*
- *The fact that emergency managers can know the threat, date and time of arrival, and execute plans is critical in saving lives.*

Timely information is not only necessary for planning and preparedness, but also to enable dissemination of that information to partners and the public.

Examples of Positive Experiences in Receiving Timely Information from the NWS

A total of 141 respondents praised NWS products as being well-timed and detailed—and these statements were made across a wide variety of hazards, including high winds, convective storms, flooding, and snow. In particular, respondents praised the NWS for 1) providing a continual flow of timing

information, 2) providing early notification of a potential hazardous situation, 3) enabling direct communication with NWS staff, 4) adding local information; and 5) issuing useful ancillary timing information such as graphics.

Continual Flow of Information

Respondents praised the NWS for providing ongoing updates and a continual flow of information regarding weather events, as captured by this commenter:

- *This county relies on the info from the NWS and knows that this office constantly monitors weather events and relays the NWS "official" info in a timely manner so that our community constantly remains aware and prepared.*

Early Notification

They appreciated early notification of impending or potential events, as reflected by these respondents' statements:

- *During a tornado incident on 2-5-2008, the National Weather Service issued the first tornado warning around 30 minutes before the tornado touched down. This helped in saving the lives of a lot of people. There were still fatalities, but due to the long warning time, more people had a chance to make it to a shelter.*
- *… NWS products had been talking all day that an incident would occur. It was not known … at what time or location the incident would occur. Due to the information obtained from the NWS, we kept monitoring the weather and kept additional personnel on staff if the incident occurred. This provided the needed personnel for the incident.*

Direct Communication with NWS Staff

In addition to receiving the WWA products, however, may respondents also commented on the importance of communication with NWS staff directly, such as through NWSchat, as well as through the briefings they receive from the WFO:

- *The weather statements work well in general, and the briefings are, for me personally, even better. They allow me to more specifically hone in on the areas of greatest potential hazard and the timing of the event for my geographical area.*
- *The advanced briefing slides were helpful and allowed our staff to be on higher alert.*
- *Having the ability to monitor and participate in NWSchats allow us real-time access to forecasters.*
- *Our Warning Coordination Meteorologist and his team do an excellent job of putting out timely updates and responding to questions via NWSchat.*

Adding Local Information

They also appreciated when the local WFO tailored the timing information from national centers, such as the Storm Prediction Center (SPC) and Weather Prediction Center (WPC), by adding their local knowledge:

- *…it was the additional information from the NWS team that helped us determine what actions we should take and when.*
- *Our local NWS team did an excellent job translating the technical forecast information coming from the SPC and WPC into lay terms, and added their risk assessment, especially related to*

timing of the onset of storms, the timing of peak rainfall, and their estimate of when precipitation would end.

Providing Additional Information

In addition to the timing information provided in the WWA products, respondents noted that the NWS often provided additional information to help them understand the timing of potential threat. Several found that graphics were particularly helpful:

- *For those of us who are very visual, the graphics are great (expected threat areas & extent of potential threat in each respective area).*
- *The weather map graphics were helpful to share with other emergency personnel.*

Examples of Negative Experiences in Receiving Timely Information from the NWS

While respondents cited numerous situations where they received timely information through the WWA products and other NWS information, they also pointed to limitations in the products in regards to timing or where improvements could be made.

Products Issued Too Late

The most frequently cited limitation was receiving WWA products too late; this was mostly an issue with convective storms:

- *... by the time we get a warning, it has already gone by, [and] we mostly just have to watch the radar and sky and guess on how bad it is going to be.*
- *... by the time warning was issued, it had passed our city.*
- *The problem came when the tornado was not detected. in time for a warning.*
- *Tornado warnings ... have not been communicated in a timely or consistent manner through the weather alert systems.*
- *Too many times the severe weather has passed over Chickasaw County when the warnings are issued.*
- *Not sure if it can be done, but if we could get the warnings earlier? there have been times when we notify the field and they inform us the storm is already on top of them.*
- *When I do receive something significant from NWS, it is often received AS the weather is happening, with little to no notice. I know that's how weather works, but it is difficult to send out timely alerts to residents if I'm warning them on something they're already aware of (i.e. Thunderstorm Warning that goes out after its already clearly thundering and lightning).*

In addition to WWA *products* being issued too late, some found the information from the NWS came too late to be useful:

- *Briefings that are held after 2:00 pm on any school day are not generally useful because schools must make their plans for early dismissal, cancellation of after school activities and the like early in the afternoon. While I appreciate the holding of briefings in the 3:00 pm window, they are virtually useless to me when it comes to planning for afternoon and evening activities of schools because they are generally too late.*

Lack of Actionable Information

One of the key limitations that respondents cited was the lack of actionable information in the products:

- *All of the products are good. They help, but right now, we are making educated guesses as to actions to take. We just need to use the advancements in computer technology to develop protective action decision aids that can help us make protective action decisions with appropriate lead times.*
- *… as a preparedness and response decision-maker I benefit from more actionable information regarding likelihood (in terms of forecast confidence), timeframes (between certain hours), and a sense of whether the risk/confidence is growing or decreasing.*
- *It would also be helpful to the public if additional, or more detailed preparedness actions were listed.*

No Set Schedule for Updates

Another criticism was the lack of a precise schedule for receiving updates. Several respondents suggested the NWS establish a set schedule for issuing updates during active weather periods:

- *Having a set schedule for updates during active weather periods (with the understanding that significant developments will be briefed acutely) would help us plan our internal preparedness and response efforts.*
- *One recommendation I have is for the periodic updates of weather pattern developments to go out at more specific pre-determined time schedules rather than at random times.*

Lack of Specificity

Respondents also cited a lack of specificity in some timing information:

- *The current watch/warning/advisory system is much improved in terms of the specificity of the threat (e.g. winds over xx mph, or hail larger than xx inches) but are often vague in terms of timelines (e.g. "this afternoon and evening").*
- *The local TV broadcasters are able to show their viewing audience a timeline projection of movement which forecasts onset times for locations in the path of a severe weather threat. Warnings (in particular) should be enhanced to include these timeline and path location projections, as well as ongoing aftermath damage reports, so that people can determine in real time their level of risk and how quickly they need to take protective action.*

6. Managing Staff Decisions

Definition: This theme encompasses responses related to planning and managing staffing and operations in preparation for hazardous weather. (Cases referencing other kinds of preparation decisions are included in #8. Preparing for Hazardous Weather.)

Relevant statements were most often found in response to the following survey questions:

2.1 Please describe your job responsibilities in relation to using or conveying weather information.

2.3 Consider a particular hazardous weather event or a general experience with specific types of hazardous weather where the NWS messaging did (or did not) work well from your viewpoint or from the viewpoint of your community or audience. Please briefly describe the weather situation for your case study, Include date(s) of the event (if applicable). Please use lay terms to the extent possible.

2.4 If you can recall, please list the watch, warning, and advisories (and other NWS statements and products) issued, or share the products you generally receive for the type of event you have in mind.

2.5 How did you use, if at all, these watch, warning and advisory products for this event?

2.6 Please describe the utility of NWS weather messaging for that event. First, what worked well for you?

2.8 Did the watch, warning, and advisory system adequately enable you to make an appropriate decision? Why or why not? Please include factors related to the predicted hazard location and timing, as well as articulation of forecast confidence, potential impacts, and recommended actions.

2.9 Were there other factors outside of the watch, warning, advisory system that shaped your ability to respond?

2.11 Are there any features of the watch, warning, advisory system that you feel must be maintained? Please explain.

Key Words Searched:

- Statements where the word “staff” appears near words synonymous with “event,” “plan,” or “operation.” Results containing “NWS” were omitted.
- Occurrences of the words similar to “plan” and “staff” near each other.

Case Count: 49 out of 566 cases included key words relevant to the theme.

Examples of Staffing Decisions that Are Based on NWS Information

Respondents stated that many types of staff decisions are made based on information they receive from the NWS, such as:

- *Staffing for emergency operations’ centers (EOCs).*
- *Scheduling/deploying crews (e.g., road preparation, cleanup, law enforcement, airline flights, fire).*
- *Calling for on-the-ground surveillance teams or storm spotters.*
- *Gauging the need to call in extra staff, such as contractors, volunteers, and off-duty personnel.*

For example, one respondent stated that NWS messaging:

- *… allowed for pre-planning of staff needs for response and sustainment of operations. It also provided justification to leaders on the pre-event expense necessary to mitigate event consequences.*

Ensuring Workplace Staffing

Many respondents stated that a key concern is getting staff to the workplace and then accommodating these staff to ensure they can remain on site as needed, sometimes for several days:

- *The main events we see are related to snow, blizzards, and severe rain. Our main concern is staffing (in terms of how staff will be able to get to work).*
- *Since we are a 24/7 operation, we use all of these products to gauge the number of support personnel and outside contractors to remain on site to mitigate snow and ice accumulation. Depending on the severity and precipitation expected, our support staff can plan to remain on site for upwards of 72 hours.*
- *[We] … encouraged all staff to … fill in all the available hotels/motels that are closest to [the] hospital. Some staff had to stay at the hospital for 4 days!*

Planning EOC Staffing

A number of respondents stated they used advance warning information to plan staffing for their EOCs:

- *With the warnings that were being issued ahead of time, we were able to plan seating ahead of time for our Emergency Management 911 center and ensure we had strong fire related individuals on the fire radio for flooding/rescue situations.*
- *From a first responder standpoint, we were also able to ensure staffing around the firehouse for the duration of the event to include an officer on duty and staff our internal emergency management operations center to prioritize our events.*

7. Maintaining WWA Features

Definition: This theme reflects EMs' opinions on the features of the WWA system that should be maintained. It also includes suggestions for changes to the system.

Relevant statements were most often found in responses to the following questions:

2.10 Are there any features of the watch, warning, advisory system that you feel must be maintained? Please explain.

2.11 Do you have any suggestions to resolve the current watch, warning, advisory system challenges or limitations you described in this survey? Please explain.

Key Words Searched:

- Statements that contain the words stemming from "maintain."
- Statements that contain the word "keep."
- Stemmed occurrences of the words "current" and "maintain" within a certain word count.

Case Count: 459 out of 566 cases included either keywords relevant to the theme or responses to the questions.

In terms of WWA products, there was no clear support for maintaining any of the specific "watch," "warning," or "advisory" terms, and no discernible support for maintaining warnings and watches over advisories. However, many respondents seemed most passionate about maintaining tornado/thunderstorm products and most indifferent about flood/fog products.

Examples that Caution Against Making Major Changes to the Current WWA System

Several respondents cautioned against making major changes to the current WWA system as their partners and customers have become accustomed to the terms and products over the years. Any major changes would require proactive training and outreach to avoid misinterpretation and public confusion. Sample statements reflecting these sentiments include the following:

- *I would caution major changes. We have generations of people who are used to a system, even if they do not always respond well to it. I would urge better graphics to convey the higher levels of danger.*
- *…we feel the public has become accustomed over many years to the current advisory systems and therefore its core should be maintained to prevent misinterpretations of watches/warnings. Our opinion is- It ain't broke- no need to fix it!*
- *I would hate to get rid of watches, warnings, and advisories. Most of the residents of our area are familiar with these terms. I don't think that changing to something like the Homeland Security Threat Levels would be helpful.*

Examples that Support Maintaining Most or All of the Features of the Current WWA System

A total of 134 of 459 cases in this theme reflected respondents' satisfaction with the current system and the desire to maintain all or most of its features. They felt the current system works efficiently and effectively, as evidenced by the following statements:

- *I feel all the current features and practices that are in place be maintained. Explanation? If it ain't broke, don't fix it.*
- *All of them, in fact they should continue to grow and improve so that we can keep citizens safer.*
- *I believe all features should be maintained. It's important to anticipate severe weather that will*

affect the community and gives us opportunity to prepare ahead of time when we know we have potential for severe weather.

- *I like the existing system. As long as a new system builds off this existing system, without degradation, I think it will be great.*
- *All of it; it is a useful tool for emergency management and it provides us an opportunity to share information about threats with 1st responders and the community.*

Additional Suggestions for Enhancing the Current System

In addition to maintaining all or most or all of the current features, many respondents provided additional recommendations for enhancing the current WWA system.

Improving Understanding, Readability, and Formatting

Some EMs recommended providing the public with clear definitions and standards of WWA products; improving the format and presentation of the products; and including more information about geographic location, time, and forecast confidence.

- *Explanations must be maintained for citizens and others to understand the levels being used in the forecast standards. Most people don't use the information often enough to be aware of the standards.*
- *To the extent that the general population understands the distinction of the three elements, it would seem to be valuable to maintain use of those--with a possible expansion or improvement to the most serious Warning category with enhanced specifics to the evolving event(s).*
- *Yes, absolutely. Keep it all. It's more of a matter of making it more accessible and "presentation".*
- *I feel the watch, warning and advisory systems are well known and understood communication methods. While they could improve in readability or formatting, the information is valid and useful.*
- *Keep the system - work to make the definitions and geo locations better. A watch/warning that encompasses the entire county is not helpful unless the entire county will be impacted. For example - winter weather usually impacts a larger region and so a county wide watch/warning may be helpful. In contrast - a fast moving summer thunderstorm/tornado needs a more geo precise notification.*
- *Again, a better pairing to watch, warning and advisories with confidence data -- including an enhanced understanding of what that means -- would be important.*

Support for Maintaining Other NWS Mechanisms

The responses also encompassed non-WWA items, such as NOAA weather radio.

- *NOAA radio, E-Mail, and TXT messaging. All of these are good ways to get information out. None of them are always in the same place at the same time. If you only put out watches/warnings on NOAA radio and you aren't around NOAA radio, you won't get the watch/warning. You need all 3 of these.*
- *NOAA weather radio must be preserved for when internet and phone systems are down.*
- *Keep the SAME Weather Radio system and expand on it…*

Mobile Apps

Some EMs expressed a desire for the NWS to develop its own mobile app:

- *NWS needs an app for iNWS.*
- *I feel that the watches, warnings, and advisories are all useful tools for preparation and planning around weather. I am not sure if the issues I encounter are due to the third-party apps that are used to send the alerts out. I think if the NWS had their own stand alone app it might function better.*
- *Maybe the NOAA can develop an app that pushes out these warnings in a text format instead of using other apps that share the information you send out.*

8. Preparing for Hazardous Weather

Definition: This theme includes examples of how the WWA system helped respondents prepare for potentially hazardous weather. The theme also includes instances of how the WWA system discouraged or did not help respondents prepare. Preparatory actions include mobilizing operations, assisting special populations, communicating to stakeholders, or taking other steps to get ready before an event occurs. (Cases referencing managing staff are included in #6. Managing Staff Decisions.)

Relevant statements were most often found in response to the following survey questions:

2.1 Please describe your job responsibilities in relation to using or conveying weather information.
2.2 How do you normally hear about a weather watch, warning, or advisory? Please explain.
2.3 Consider a particular hazardous weather event or a general experience with specific types of hazardous weather where the NWS messaging did (or did not) work well from your viewpoint or from the viewpoint of your community or audience. Please briefly describe the weather situation for your case study, Include date(s) of the event (if applicable). Please use lay terms to the extent possible.
2.4 If you can recall, please list the watch, warning, and advisories (and other NWS statements and products) issued, or share the products you generally receive for the type of event you have in mind.
2.5 How did you use, if at all, these watch, warning and advisory products for this event?
2.6 Please describe the utility of NWS weather messaging for that event. First, what worked well for you?
2.7 Second, what could have worked better for you?
2.8 Did the watch, warning, and advisory system adequately enable you to make an appropriate decision? Why or why not? Please include factors related to the predicted hazard location and timing, as well as articulation of forecast confidence, potential impacts, and recommended actions.
2.9 Were there other factors outside of the watch, warning, advisory system that shaped your ability to respond?
2.10 Do you have any suggestions to resolve the current watch, warning, advisory system challenges or limitations you described in this survey? Please explain.
2.11 Are there any features of the watch, warning, advisory system that you feel must be maintained? Please explain.

Key Words Searched:

- Positive statements that include stems of the words “prepare” and “operation.”
- Examples where stems of the words “response” and “prepare” occur within a certain word count of each other.
- No relevant results obtained from for a search of the word “trigger” near “prepare.”
- Stems of the words “provide, “make,” “determine,” “plan,” and “action” yielded too many results.
- Negative statements that include stems of the words “prepare” and “operation.” No relevant results obtained from automated search of the word “not” near “prepare.”
- Appearance of the word “no” with stems of “attention,” “heed,” and “encourage.”
- Statements including the stems of the word “ignore.”
- No relevant results obtained from a query of the words stemming from and similar to “unprepared.”

Case Count: 135 out of 566 cases included keywords relevant to the theme.

Examples of Positive Experiences in Using NWS Information to Prepare for Hazardous Weather Events

Respondents stated that NWS weather information enables them to better prepare for emergency response efforts, pre-stage materials and equipment, coordinate activities across state or regional areas, mobilize staff (such as in fire departments, law enforcement, public works, and utilities), activate plans, warn and move vulnerable populations, set up shelters, advise community members of potential impacts and recommended actions, and more. Many praised the WWA system for providing timely and accurate information to make appropriate preparedness decisions. Others commented that other NWS information, such as forecast confidence levels, are helpful for EMs in determining the level of preparedness that they need to initiate. Sample comments include the following:

- *System has been very effective and provides information for emergency management to prepare and respond for public safety, first responders, and general public.*
- *The information helps us prepare. We would rather be ready for flooding, sandbags, pumping potential flooded areas, and be prepared than be caught without any expectations.*
- *Based on the forecast Sunday night I brought people in around 7 a.m. Monday to start plowing. Literally thousands of dollars were spent on decisions made based solely on the NWS forecasts.*
- *The early warning of the tornado gave us plenty of time to move patients. The flood advisories gave us time to work on alternative routes for patients and employees.*
- *Recognizing that the hazard existed through the advisories allowed time for notification of essential staff, reminders to the public (particularly parents) to stay weather aware and watch their news and social media channels for updated information and a chance to distribute safety messages related to ice, staying warm, etc.*
- *I believe the appropriate notification (several days in advance) was very useful and help our response agencies prepare with up-to-date information/real time information to maintain a high level of situational awareness.*

Examples of Negative Experiences in Using NWS Information to Prepare for Hazardous Weather Events

Criticisms of the WWA system for helping EMs prepare focus on timing and issuance of multiple warnings. As far as criticisms of specific products, a few respondents stated they pay little attention to watches. Several also criticized the utility of advisories.

Not Receiving Timely Information

Some respondents commented that they received a WWA product (most often, these comments pertained to warnings) too late:

- *…it was slow so that by the time it got to us there was not much time to take action.*
- *"Watch, warning, advisory system?" If you wait for that system to initiate response actions, you have blown the opportunity to prepare.*
- *I received a tornado warning through push alerts on my cell phone a few minutes before the tornado touched down. In speaking to the residents affected, the alert came just seconds before their house was destroyed, and before they could even make it to the basement. It worked well for those ahead of the system, not extremely well for those at the present location of the most severe portion of the cell.*

One respondent suggested that a solution to the timing problem may be to add an "action stage" between watches and warnings. He noted: "There is a large jump from the … conditions are ripe for development to conditions actually exist. The addition of an action stage would indicate that we are moving toward a warning and conditions are worsening."

Receiving Multiple Warnings

Some respondents stated that WWA products are issued multiple times as an event moves across their area. Some EMs said that this can seem "excessive" and that they can cease to pay attention to multiple warnings. Others were more concerned that the issuance of multiple products desensitizes the public and causes them to tune out rather than prepare. Relevant sample comments include:

- *…having multiple watches issued over a short period of time covering several wide spread areas became saturating to some… causing a let up in their attention.*
- *There are WAY TOO MANY ALERTS!!! People need to heed them and they are ignoring them.*
- *During the last flood event there were multiple flash flood advisories followed by a real flood advisory. Stop, send only one. The public is getting desensitized to the tones. Less is more!!*
- *Many, many flood advisories were initiated during the few days that we had flooding potential. There wasn't much (if any) change from the first message to the last message. They were all the same, so it became very easy not to pay any attention to the following messages, once two or three of them had been transmitted.*

Lack of Public Concern/Apathy

In addition to their concerns about members of the public tuning out multiple warnings, some respondents more generally pondered whether citizens pay attention to *any* NWS watch, warning, and advisory products:

- *The NWS office can give warnings, but people who ignore watches and warnings will continue to exist.*
- *The pre-storm information helped local officials understand the confidence and impacts. The general public didn't heed the information as much.*
- *It was obvious that we were going to get flooding from the amount of rain we were receiving. People still didn't pay attention to the warnings and drove off into high water.*
- *The high wind warning was not well heeded by residents. I believe this is because of the number of high wind events the northwest coast sees each winter. Residents become immune to the messages.*

One suggestion to help combat the apathy issue was to make messages as area-specific as possible and to indicate where potential impacts were most likely to occur.

9. Receiving NWS Information

Definition: This theme captures the variety of sources and media through which EMs receive WWA information, not just from the NWS but also from sources such as other government agencies (e.g., FEMA), partners (e.g., neighboring EMs and first responders), and private entities (e.g., media).

Relevant statements were found in response to the following survey question:

2.2 How do you normally hear about a weather watch, warning, or advisory? Please explain.

Key Words Searched: All relevant responses to the question were directly extracted from the survey data. We did not search keywords for this theme because a word-frequency query from a previous step resulted in a pattern of words and phrases that was not semantically related/significant.

Case Count: All 566 cases included a response to this question.

EMs use multiple technologies to receive WWA information. Figure VII-1 shows the most frequently used terms in the EM case studies pertaining to *how* they receive NWS information. About 57 percent of respondents mentioned the terms "phone," "apps," "cell," "smartphone," and "alert," indicating that they rely heavily on text notifications and smartphone apps alerts to receive weather information. In fact, many EMs stated that email and text alerts are "essential" to their daily operations and should be continued and even enhanced. Respondents stated that these technologies, in particular, enable EMs to have situational awareness, manage staffing decisions, take preparedness action, and carry out other job responsibilities.

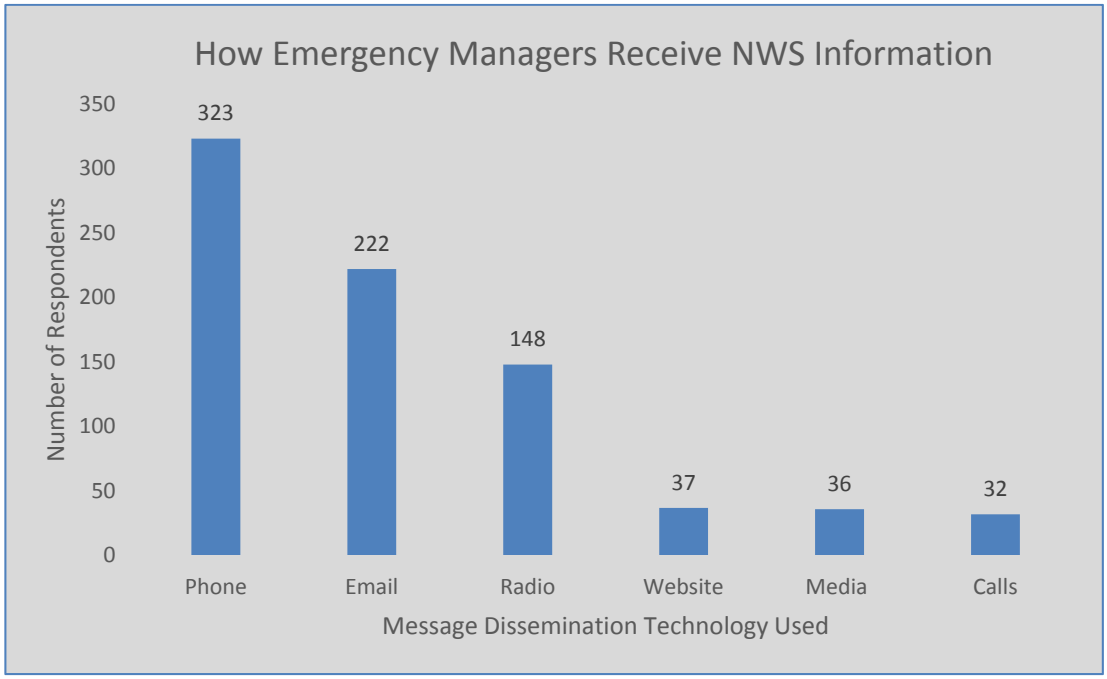

Figure VII-1. Top Technologies Used by EMs to Receive WWA Information

In terms of the *sources* from which they receive WWA information, 42.5 percent of respondents mentioned the terms "NWS," "NOAA," or the name of the local WFO in their answers, indicating that the NWS was their primary source. Other top sources included the local emergency management community, county and state offices, and law enforcement dispatch and traffic data. Table VI-1 summarizes the top message dissemination mechanisms and the sources used by EMs to receive WWA information.

Table VII-1. Top Information Dissemination Mechanisms and Sources

Mechanism	Source
Text Messages or Smartphone Alerts	Text notifications from: • NWS (iNWS) • State or county mass notification system • Airport Weather Warning system • FEMA (IPAWS) • Local/community text notification system Alerts from the following smartphone apps: • Radar app (Radarscope) • The Weather Channel • Weather Bug • StreamerRT • Accuweather • Red Cross • Wx Alert USA • Pro Weather Alert • Flash Alerts • Max Tracker
Email	• Local NWS office • Other EM listservs and subscriptions (e.g. Emergency Email Network) • Airport Weather Warning • Law Enforcement Information network (LEIN)
Radio	• NOAA weather radio • Emergency Weather Radio • 911 and law enforcement dispatch announcements • Amateur and ham radio communications • Local radio stations
Media	• Local media • Social media
Websites	• Local NWS page • Storm Prediction Center (SPC) • Various weather-related websites
Phone Calls	• NWS conference calls • County mass alerting/notification system • State agencies • Airport Weather Warning texts

10. Referencing Above or Below Criteria

Definition: This theme addresses situations where WWA products do/do not meet specific NWS criteria and/or thresholds. It references events where severe weather occurred, but the NWS did not issue a WWA product (or did so too late) because criteria were not met, as well as situations where respondents perceive the criteria as being too broad and therefore WWA products were issued for marginal events.

Relevant statements were most often found in response to the following survey questions:

2.1 Please describe your job responsibilities in relation to using or conveying weather information.
2.2 How do you normally hear about a weather watch, warning, or advisory? Please explain.
2.3 Consider a particular hazardous weather event or a general experience with specific types of hazardous weather where the NWS messaging did (or did not) work well from your viewpoint or from the viewpoint of your community or audience. Please briefly describe the weather situation for your case study. Include date(s) of the event (if applicable). Please use lay terms to the extent possible.
2.4 If you can recall, please list the watch, warning, and advisories (and other NWS statements and products) issued, or share the products you generally receive for the type of event you have in mind.
2.5 How did you use, if at all, these watch, warning and advisory products for this event?
2.6 Please describe the utility of NWS weather messaging for that event. First, what worked well for you?
2.8 Did the watch, warning, and advisory system adequately enable you to make an appropriate decision? Why or why not? Please include factors related to the predicted hazard location and timing, as well as articulation of forecast confidence, potential impacts, and recommended actions.
2.10 Do you have any suggestions to resolve the current watch, warning, advisory system challenges or limitations you described in this survey? Please explain.
2.11 Are there any features of the watch, warning, advisory system that you feel must be maintained?

Key Words Searched:

- Statements that contain the word “criteria.”
- No relevant results obtained from a search of the word “not” appearing near stems of “issue.”

Case Count: 48 out of 566 cases included keywords relevant to the theme.

Examples of Specific Types of Hazards That Pose Issues Relating to Criteria

Respondents mentioned a number of hazards as posing the most challenges when it comes to criteria, including severe thunderstorms, tornadoes, rainfall flooding, wildfires, and heat:

- *…I received a call from one of the local business owners in my town asking me if I knew that our town was flooding. I did not. The flood event was caused by heavy rainfall in a short period of time; however, the rainfall totals did not meet either NWS thresholds or our internal thresholds that would normally trigger a watch or a warning.*
- *I would recommend an earlier "pull the trigger" on certain events that are very likely to affect an area such as tornado warnings and severe weather warnings. Other than the possibility of reviewing the current tornado watch criteria, already mentioned, I don't believe we can do anything to improve the current system.*

- *Let's review the criteria for fire weather watches and red flag warnings.*
- *Need to work with NWS staff, fire managers, information staff to better understand criteria, predictive tools, making sure common understanding and accurate messaging gets to folks that need it in time to modify behaviors for prevention of wildfire events.*

Severe thunderstorms engendered the most discussion and debate. Most of the respondents that mentioned this particular hazard called for lowering the warning criteria:

- *An example would be during spring/summer thunderstorms. We see severe storms moving toward or area with warnings being issued. Why can't watches go up in the area 30 to 60 minutes ahead of these known severe weather systems.*
- *Please revise your criteria for severe thunderstorms so that a warning is issued the next time a storm like this comes through (especially during the middle of the night). The public deserves notices/alerts for these types of storms.*
- *Often we see severe weather on radar that impacts operations on the scene of an emergency and although the storm may not meet criteria it still poses a risk to the responders. Sometimes we see storms that result in storm warnings being issued. We know these storms are going to go through our county but a warning or watch is not issued until after they reach the county.*
- *In this case, the storms did not reach the "Severe Thunderstorm" criteria - so we knew there was a chance of heavier rain in a thunderstorm, but thought it was just rain, until it dumped 4" on us in short order.*

A few felt the existing criteria for severe thunderstorm watches and warnings were already too low:

- *The criteria for Severe Thunderstorm Watches and Warnings are too broad. Too many warnings are issued each year. I would estimate we receive about 15 Severe Thunderstorm Warnings per year, and only 1 or 2 seem to have widespread impacts.*

Timing Concerns

Still others felt the matter was more of a timing problem than a criteria problem:

- *…the Watches and Warnings value are limited because of the associated criteria to insure validity, which shortens, if not eliminates the window to prepare of educate the public of a looming event.*

Suggestions for Enhancing the System

The solution for some respondents was regional customization:

- *… there should be some latitude to customize the criteria to a region. Marginal events have a tendency to falsely communicate a risk that leads to over warning of the public and in the long term desensitizes them to the hazard. Watches and advisories are weak tools. My only suggestion for improvement is to focus these products geographically and communicate them more within the forecast framework verse a special product.*

- *…warnings are an effective tool, but some modification to specific regions the criteria for warning would be helpful. Note that this shouldn't be huge deviations*.

Finally, one respondent, looking to the future, made this observation:

- *Given climate change, drought and tree mortality, I think we need to talk about other warning criteria thresholds.*

11. Using NWS Products and Services

Definition: This theme captures how respondents use WWA products and information for a hazardous weather event, such as to gauge situational awareness; to plan, prepare, and implement inclement weather processes (see also #8. Preparing for Hazardous Weather); to assist in making informed decisions about when and what to warn citizens; and to alert first responders. The products also help to plan staffing (see also #6. Managing Staff Decisions), determine equipment needs, and develop response and recovery strategies.

Relevant statements were found in response to the following survey question:

2.6 How did you use, if at all, these watch, warning and advisory products for this event?

Key Words Searched: There was no need to search keywords for this theme because all relevant responses to the question were directly extracted from the survey data.

Case Count: 489 out of 566 cases included responses to this question.

Examples of Ways in Which WWA Products Are Used in Operational Situations

NWS information can activate or elevate procedures and plans, be shared with others, or trigger additional information-seeking.

Activating or Elevating Procedures and Plans

In some situations, WWA products trigger delays, closings, or operating procedures. One respondent noted that a NWS "tornado warning is what activates our plan to pull patients out of their rooms to interior hallways." Another stated: "I made decisions to close and/or delay university operations." Still another noted that excessive heat warnings will prompt the respondent's agency to establish hydration stations and protocols. In some situations, particular products prompt EOC activation or increase EOC activation levels. They also can trigger warning sirens. NWS warnings may also trigger emergency alerting to specific communities with action items (such as evacuate or shelter in place).

Sharing Information

Many respondents share the products they receive with citizens, schools, hospitals, emergency responders, fire and law enforcement agencies, field crews, and others:

- *Any weather advisory, watch, or warning issued by our local NWS office is disseminated to the public. Depending on the threat potential, it may be pushed via social media or using a mass notification system to notify by text, email, and/or voice.*
- *I share this information with school administrators to assist them in making plans for field trips, athletic practices, event planning, etc.*
- *I shared information with our field crews for street sand crews in our parks--so that they can be better prepared with their equipment in the trucks*
- *Forwarded watch information to Special Event coordinators and first responders.*

They noted they also interpret the information they receive from the NWS and forward it to their superiors and partners:

- *We use the slides and weather briefings we get for our department heads and stakeholders to*

help them make a good decision on their day to day operations.

Triggering Information-Seeking

Finally, respondents said the NWS products can prompt them to initiate other information searches and also alert them to pay attention to instrumentation, such as tide and river gauges.

VII. Summary of Media Case Studies

A number of recurring themes emerged among the media responses. These themes (presented in alphabetical order) are:

1. Addressing overlapping boundaries
2. Considering outside factors
3. Finding WWA effective or ineffective/limiting
4. Maintaining WWA features
5. Referencing above or below criteria
6. Referencing time or timeliness
7. Sharing WW information and products

Media respondents also provided a number of suggestions for improving the current system. These suggestions are captured both in the discussions of the various themes, where relevant, as well as Appendix C at the end of this report.

1. Addressing Overlapping Boundaries

Definition: This theme focuses on situations that arise when a media market is situated at a border of a county warning area (CWA) or has an audience base that spans multiple CWAs under the jurisdictions of different WFOs. Overlapping boundaries can pose problems when different types of WWA products are issued for different counties, when a product is issued for one CWA but not another, or when different products expire at different times.

Relevant statements were most often found in the responses to the following questions:

3.1 Consider a particular hazardous weather event or a general experience with specific types of hazardous weather where the NWS messaging did (or did not) work well from your viewpoint or those of your audience or clients. Please briefly describe the weather situation for your case study. Include date(s) of the event (if applicable). Please use lay terms to the extent possible.

3.5 Did the watch, warning, and advisory system adequately enable you to convey the hazard information? Why or why not? Please include factors related to the predicted hazard location and timing, as well as articulation of forecast confidence, potential impacts, and recommended actions.

3.6 From a hazard messaging standpoint, how was the watch, warning, and advisory system effective? Please explain.

3.7 From a hazard messaging standpoint, how was the WWA system ineffective or limiting? Please explain.

3.8 Do you have any suggestions to resolve the current watch, warning, advisory system challenges or limitations you described in this survey? Please explain.

3.10 Were there other factors outside of the watch, warning, advisory system that shaped your ability to convey the hazard message?

Key Words Searched:

- Relevant statements containing the words “border,” “boundary,” “county,” “CWA,” “multiple,” or “WFO.”
- Stems of the words “expire” and “overlap.
- Occurrence of the word “different” near “office.”
- Relevant statements where the word “explain” appear near “different” and “criteria.”

Case count: 13 out of 52 cases included keywords relevant to the theme.

Examples of Overlapping Boundary Situations for Media Markets

Some media respondents reported that their markets span or overlap more than one WFO. They noted numerous instances where different WFOs issue different WWA products for their different CWAs (or portions of their CWAs). Respondents said that these situations can make it difficult for them to explain the differences in the products issued, and that they often need to take extra time out of their coverage to attempt to explain the situation, which detracts from their ability to provide the actual forecast. The following statements illustrate the kinds of situations reported by respondents:

- *This television market covers counties located in 3 different CWAs. [One office] had a Winter Storm Warning in effect for their part of the area. Meanwhile, the rest of the area, which was expecting essentially identical conditions, was under an Ice Storm Warning and another portion of our region was under a Freezing Rain [3] Warning. The division between warning types was divided precisely along NWS office boundaries, which was hard to explain to viewers.*
- *The only problem, in my market, [is] we overlap with [two WFOs]. It was hard to describe to viewers why one county had a Heat Advisory, yet the other's wasn't issued yet.*
- *My area … lies at the border between multiple NWS offices. On numerous occasions, the WWA do not sync up in an easy way for the public to understand. The most glaring example is during the winter when Winter Storm Warnings will butt up against Winter Weather Advisories. This is sometimes the case even when similar weather is expected in both counties.*
- *[Our] television market is divided between 4 NWS offices. Quite often, each office will issue a different winter weather product for the same storm and that can lead to 3 or 4 different products for the same viewing area, often with different valid times. Since the CWA's have irregular shapes that resemble voting districts, that often means that one county can have a different product than all of the other counties surrounding it.*

Challenges in Rural Locations

A different situation exists for media markets that are in rural areas or in between WFOs. These "fringe" areas do not always receive the radar or alerts that they need:

- *… we do not receive the Alerts that we would like to relay. A recommended action would be to install a NWS station closer to our area to "fill in" the gap.*
- *… this is such a fringe area. The location is about 60 miles away from our TV radar, but 75-80 miles away from CTP & BUF, which of course are more powerful. Now that I have spotters on the ground, I have a better shot. I've already started call other weather watchers, even if they are not trained, just to get some better ground truth for these rural regions.*

[3] It should be noted that there is no NWS Freezing Rain Warning, and that the respondent likely is referring to an Ice Storm Warning.

Too Broad an Area of Coverage

Another concern that arose was that sometimes the WWA products cover too broad of an area, lacking the specificity that broadcasters need for their particular viewing areas:

- *Sometimes a watch/warning is issued for multiple areas and I find that in San Diego it's not as bad as say San Bernardino, but that isn't conveyed in the watch/warning. For example, there was a chance for isolated gusts of 60mph, but I think that was more so for areas out of San Diego. I wish it was more specific, like gusts to 50 mph in San Diego and up to 60 in San Bernardino. This goes for all watches/warnings.*
- *Sometimes warnings are issued for too many counties at once. Other times different parts of the same county can be under two or more warnings when not needed. If a line is moving through then the polygon should be adjusted to fill in entire counties. The new tags in warnings are helpful when trying to determine the most severe storm.*
- *…it was frustrating to convey that my whole viewing area was going to see strong winds. It is my belief that the counties under an "advisory" compared to the ones in the "warning" take it less seriously.*

More Coordination Among WFOs

Many respondents suggested a solution to the boundary issues is more coordination among different WFOs.

- *Encourage neighboring NWS offices to coordinate. Redistribute the CWA's so that there is a clearer dividing line and a few random counties aren't left standing out. Redistribute the CWA's to better cover or surround major cities.*
- *I think if the WFOs discuss between themselves … what kind of warning, advisory or watch they want to issue, it would convey a centralized idea.*

Definition: This theme addresses the many factors outside of the WWA system that can influence the media's coverage of a hazardous weather event. These contributing factors encompass instrumentation and models, storm spotter reports, viewer feedback, briefings from NWS and decision makers, and local knowledge and experience. In some cases, contributing factors complement the NWS system; in others, they fulfill a process or product that respondents feel is lacking from the current system.

Relevant statements were found in response to the following survey question:

3.10 Were there other factors outside of the watch, warning, advisory system that shaped your ability to respond?

Key Words Searched: All relevant responses to the question were directly extracted from the survey data. We did not search keywords for this theme because a word-frequency query from a previous step resulted in a pattern of words and phrases that was not semantically related/significant.

Case count: 32 out of 52 cases included responses to this question.

2. Considering Outside Factors

Examples of Factors Influencing Media Coverage of Hazardous Weather Events

Media respondents noted a number of outside factors that contribute to their weather coverage. A few cited the utility of instrumentation and models, while many pointed to the importance of on-the-ground knowledge and reports, whether that information comes from storm spotters, residents, police, social media, or ham radio:

- *Reports from spotters and live video of storms helped us convey the danger the most.*
- *Often, residents will share with you what the weather is like in their neighborhoods, and that's different from what you've observed. Sometimes, something as simple as a photo texted or emailed to me can give me a little extra insight into something I may not be aware of.*
- *Two-way social media interaction is usually the best way for us to shape the message. When we know what real people are experiencing, we can better communicate the sense of urgency.*
- *Social media is conditionally helpful, if the source is trusted.*
- *Police scanners can help.*

Good Working Relationships with WFOs

A number of respondents pointed to the usefulness of good working relationships with the NWS and participation in NWS chats.

- *... the Chat Room with each NWS office we work with ... has had a major positive impact on our weather coverage.*
- *There is wonderful information that flows through the Chat, helps us verify what we are seeing on radar or getting from viewers.*
- *Yes, occasional (to sometimes numerous) messages on NWS chat advising us to pay particular attention to specific storms where NWS mets are seeing very strong damage potential indicators.*

Lack of Communication with WFOs

Others cited a lack of communication with NWS local offices as being a contributing factor in their ability to cover hazardous weather situations:

- *It would be good to have more insight from the NWS office when we have brief warnings like the one I've mentioned. I fully understand staffing issues in "surprise" situations. We go wall-to-wall for all Tornado Warnings, and it would be good to get more thoughts from the person issuing the warning so we can better communicate the reasons a person should be seeking cover, etc.*
- *IN-Ability to speak directly with the met[eorologist] by phone or NWSChat during weather events.*

Importance of Their Own Specialized Knowledge and Communication Abilities

Many media respondents cited their own knowledge and experience as a key factor:

- *I will use my knowledge as a meteorologist to convey risks to my viewers, independent of the NWS.*
- *Just [my own] forecast knowledge.*

Similarly, they mentioned their own abilities to translate WWA products and information into language the public can understand as being an important contributing factor to their weather coverage:

- *… my ability to rewrite in terms the public could understand. I think many TV meteorologists and many other knowledgeable bloggers do the same thing.*
- *Without using the specific terminology I feel is reserved for these specific hazard products, I will always rely on my education, experience and feedback to shape the message that I convey.*
- *… concentrating on what is going to happen--snow amounts over time, wind effects, etc., and directly translating that to impacts seems far more effective than trying to communicate a wide array of various warnings, watches and advisories.*
- *When I have a rainbow of winter weather headlines with various start and end times over my viewing area, it could take over a minute just to explain what they are, why they are in effect, and how that could affect viewers.*

3. Finding WWA Effective or Ineffective/Limiting

Definition: This theme summarizes the media's thoughts on whether they find the WWA system effective or ineffective/limiting from a messaging perspective.

Relevant statements were found in response to the following survey questions:

3.6 From a hazard messaging standpoint, how was the watch, warning, and advisory system effective? Please explain.

3.7 From a hazard messaging standpoint, how was the WWA system ineffective or limiting? Please explain.

Keywords Searched: All relevant responses to the question were directly extracted from the survey data. We did not search keywords for this theme because a word-frequency query from a previous step resulted in a pattern of words and phrases that was not semantically related/significant.

Case count: 42 out of 52 cases included keywords relevant to the theme.

Examples that Support the Perceived Effectiveness of the Current WWA System

For those respondents who found the WWA system effective, many stated that the products help alert people of the potential for a hazardous event:

- *It puts a highlight on the weather event that was going to ensue.*
- *The warnings enabled local authorities to sound warning sirens and for warnings to be issued over radio and social media.*
- *I think when the "warning" is issued, the word gets out a little more and people start taking notice.*
- *It informed the public that (potentially dangerous) cold weather would be occurring.*
- *It was effective in making people think the winds were about to get very strong.*

In particular, many stated they found the products effective in conveying the specific hazards of concern. A number of respondents also praised the timeliness of the products and some also felt they were easy to understand:

- *"I think the current watch, warning and advisory system is effective, timely, and for the most part easy to understand when major weather events are happening.*
- *Most of the time your warnings and watches are valid and are timely.*
- *If is effective in communicating the timing and areal coverage of said events.*
- *Specific, timely information and easily understandable.*
- *Warnings do come off as highly effective, especially tornadoes. Viewers understand the urgency.*
- *It warned people WELL ahead of time.*

Examples that Support Perceived Ineffectiveness of the System

Those respondents who found the WWA system to be ineffective cited many different issues of concerns. Individual commenters each had their own complaints (e.g., not enough detail in messaging, not timely

enough, lack of continuity between offices, issues with criteria), but a number of commenters did coalesce around three issues:

- *Public understanding of the WWA terms*
- *Too many false alarms or the "cry wolf" syndrome*

Perceived Lack of Public Understanding of the Terminology

A number of respondents voiced the opinion that people don't understand the WWA terms or get confused by the terminology:

- *People still get Watch and Warning mixed up and don't know what Advisory means.*
- *Explaining what each WWA actually means is half the battle. The terminology is not obvious on its own. I don't like having to explain to some folks why they are in an advisory and folks right next door are in a warning.*
- *It seems as if viewers are still having a hard time distinguishing between a WATCH and WARNING.*
- *I feel like most people understand the difference between watch and warning, although I fear there are many who do not as well. Maybe we could use a different word for watch or warning to make the difference more obvious.*
- *Multiple terms for pretty much the same weather phenom[enon] is confusing to the general public.*

Perceived Issues with the Term "Advisory"

In particular, several comments focused on the term advisory with questions about whether the public understands the meaning of the term:

- *There is a gray area between warning and advisory though. Does everyone understand that a Winter Storm Warning is worse than a Winter Weather Advisory? Is a Winter Storm Watch worse than a Winter Weather Advisory?*
- *I don't have a problem with the three terms, although there are places in which advisories have a higher level of risk than do watches or warnings.*
- *Can be limiting when people downgrade the significance of an advisory. Maybe different word for it. Pre-warning…?*

"Cry Wolf" Syndrome

A number of commenters also felt that the system too often raised an alarm for weather hazards that did not happen.

- *Ineffective because the hazards rarely happen. Cry wolf syndrome.*
- *Often times the hazards forecast do not happen, so it leaves me as a media representative feeling like I cannot rely on the information to share with my readers.*
- *The winds didn't get very strong! If someone took steps to prepare for 60 mph winds and ended up "wasting" their time because winds were only 35 mph, they are less-likely to pay attention to the message in the future.*

4. Maintaining WWA Features

Definition: This theme reflects the media's opinions on the features of the WWA system that should be maintained. It also includes suggestions for changes to the system.

Relevant statements were most found in response to the following survey questions:

3.8 Do you have any suggestions to resolve the current watch, warning, advisory system challenges or limitations you described in this survey? Please explain.

3.9 Are there any features of the watch, warning, advisory system that you feel must be maintained? Please explain.

3.10 Were there other factors *outside* of the watch, warning, advisory system that shaped your ability to convey the hazard message?

Key Words Searched:

- Statements that contain the words stemming from "maintain."
- Statements that contain the word "keep."
- Stemmed occurrences of the words "current" and "maintain" within a certain word count.

Case Count: 37 out of 52 cases included either keywords relevant to the theme or responses to the questions.

Examples Reflecting Satisfaction with Portions or All of the Current WWA System

Only 8 of the 37 individuals who responded to this question stated that they are satisfied with the current WWA system and want to keep all or most of it, and even enhance it:

- *"I like everything that it includes now."*
- *"I think the system is good and should be maintained, maybe even enhanced."*

However, similar to EMs, some media respondents cautioned against changing WWA terms as the public is familiar with them, and as such, introducing new terms will require public awareness:

- *"Don't change the terms. Even with some confusion, the public has some idea what they mean. Introducing new terms will require starting public awareness anew."*

Maintaining Warnings

Among the respondents, there was some support for maintaining warning products; some reservations were expressed regarding "watch" and "advisory" products.

- *"Use of the word "warning" seems effective but should ONLY be used when there is a call to action. And frankly if there is no call to action, we as a weather community should not really be messaging.*
- *"I would maintain Warning and Emergency. Other than that I think the terms can be changed."*
- *"I would maintain Emergency and Warning in the tropical system."*
- *"Tornado warnings and severe thunderstorm warnings need to stay pretty much as is."*
- *"I think warnings work well. I think watches don't work as well, and advisories don't work at all."*
- *"...Advisories are still misleading to many."*

Viewpoints on Specific WWA Products

In terms of specific hazards, media respondents mostly referred to tornado/thunderstorm, tropical, and winter products in their responses. Some expressed that the current system is well-suited for convective WWA products, while others suggested some enhancements to the present system for these products:

- *The over-all system works well for severe weather; there are minor tweaks that should be made to make it better.*
- *Tornado warnings and severe thunderstorm warnings need to stay pretty much as is. I do think adding a frequency of lightning threshold to severe thunderstorms could benefit the public, especially outdoor venues, etc.*
- *I think we MUST differentiate between tornado and t-storm warnings. Advisories are still misleading to many.*
- *Local storm reports have been a little sparse during a couple of events this year. Perhaps this is due to the fact that there were no spotter reports coming into the NWS offices, not sure. But when there is a radar indicated tornado warning, it is helpful to get local storm reports of wind or other weather.*
- *I'm all for giving people a heads-up that conditions are favorable for tornadoes or severe thunderstorms. We need to make sure the risk that lies ahead justifies a watch, though. For the past 10-15 years, there's been a tendency to issue more watches and warnings than needed. We need a watch/warning process, but it needs to be implemented with the utmost respect and caution. The Significant Weather Advisory is a GREAT product to get across the risk of strong thunderstorms, without issuing a warning. I would like to see more NWS offices use that product more-often.*

Support for Impact-Based Information

Several media respondents expressed a liking for impact-based information:

- *All the basic information. I really like the impact based information and feel it should be maintained.*
- *It is robotic to focus on a criteria based #weather warning system, human interpretation/impact must take precedence.*
- *…maybe going into those impact based warnings in the future would help.*
- *Keep impacts and suggested actions. People under stress can forget their plan.*

5. Referencing Above or Below Criteria

Definition: This theme addresses situations where WWA products do/do not meet specific NWS criteria and/or thresholds. It references events where severe weather occurred, but the NWS did not issue a WWA product (or did so too late) because criteria were not met, as well as situations where respondents perceive the criteria as being too broad and therefore WWA products were issued for marginal events.

Relevant statements were most often found in response to the following survey questions:

3.1 Consider a particular hazardous weather event or a general experience with specific types of hazardous weather where the NWS messaging did (or did not) work well from your viewpoint or those of your audience or clients. Please briefly describe the weather situation for your case study. Include date(s) of the event (if applicable). Please use lay terms to the extent possible.

3.5 Did the watch, warning, and advisory system adequately enable you to convey the hazard information? Why or why not? Please include factors related to the predicted hazard location and timing, as well as articulation of forecast confidence, potential impacts, and recommended actions.

3.6 From a hazard messaging standpoint, how was the watch, warning, and advisory system effective? Please explain.

3.7 From a hazard messaging standpoint, how was the WWA system ineffective or limiting? Please explain.

3.8 Do you have any suggestions to resolve the current watch, warning, advisory system challenges or limitations you described in this survey? Please explain.

3.9 Are there any features of the watch, warning, advisory system that you feel must be maintained? Please explain.

Key Words Searched: Statements that contain the word “criteria,” “threshold,” or “triggers.”

Case Count: 8 out of 52 cases included keywords relevant to the theme.

Examples of Not Understanding the Criteria or Finding Them Limiting or Confusing

A number of respondents stated that they did not understand the NWS criteria for issuing specific WWA, or they found the criteria confusing. Several suggested that it confusing for both themselves and the public when the NWS does not issue a particular WWA product for a hazardous weather situation or discontinues a WWA because the criteria are not met. A few also noted that their crawl systems were not activated because of the particular warning issued. In some cases, this resulted in people not being warned about potentially hazardous weather. Sample statements reflecting these viewpoints include the following:

- *Several months ago we had an Areal Flood Warning issued for our region. This warning did not activate our weather crawl since it was deemed (areal). The flooding was bad enough that it probably should have been a Flash Flood Warning. The criteria are not well understood, nor clearly indicated.*
- *The criteria for the warning was not understood, and the warning was missed.*
- *The criteria were not well understood. Also, we did not have our equipment set up to automatically launch for that type of warning.*
- *Be consistent and think outside of criteria. If you are carrying hard freeze warnings one night and it is going to be colder the next night, whether or not time criteria are met, imagine the confusion created for the public if the warning is not continued the next night. It is robotic to focus on a criteria based on #weather warning system; human interpretation/impact must take precedence.*

Differing Thresholds Among Different WFOs

Respondents also noted that differences in criteria thresholds from one CWA can result in different types of WWA products being issued from one area to another, which can also create confusion:

- *"I believe that more consistent thresholds for issuance of products between offices as well as a consistent protocol for the products under which products are distributed would help. Also, pardon me for saying, but it seems as though certain products are not issued and they are withheld even when models and forecasts have suggested WWA criteria would be met. Numerous occasions from our local WFO at FGF when surrounding offices issued Winter Weather Watches/Warnings (for example) and nothing is issued locally."*
- *"We had a freeze episode during the winter of 2015 that raised some questions as to the effectiveness of the watch/warning/advisory criteria. I as a meteorologist found this confusing, so can't imagine what a viewer had thought. On a night where very cold temperatures had been expected, freeze watches were posted. The confusion came when the afternoon crew issued freeze and hard freeze warnings. Not only is it difficult to communicate to the general viewer the difference between the two, but in this case, the more hazardous of the two (hard freeze) was for southern locations which were going to be warmer! cold to "take seriously" and what cold not to."*
- *"… criteria for these warnings vary around the local CWA. Therefore, there are variations of one warning being issued for the same hazard. I think we were able to communicate that it was going to be dangerously cold but impacts could not be clearly differentiated for the lay person."*

Suggestion to Add Lightning to Criteria for Severe Thunderstorm Products

A couple of respondents specifically suggested that lightning be added to the criteria for a severe thunderstorm product.

- *Another complaint I hear from the public is "it's lightning like crazy!! I'm not sure what to do here, but with lightning being a big weather killer, maybe a threshold needs to be established for adding lightning as a criterion for a severe thunderstorm? I don't know…58 mph wind, quarter size hail and XXX strikes per 25 square miles per minute?*
- *Tornado warnings and severe thunderstorm warnings need to stay pretty much as is. I do think adding a frequency of lightning threshold to severe thunderstorms could benefit the public, especially outdoor venues, etc.*

Definition: This theme references situations where respondents have or have not received timely warnings or advance notice.

Relevant statements were most often found in response to the following survey question:

3.1 Consider a particular hazardous weather event or a general experience with specific types of hazardous weather where the NWS messaging did (or did not) work well from your viewpoint or those of your audience or clients. Please briefly describe the weather situation for your case study. Include date(s) of the event (if applicable). Please use lay terms to the extent possible.

3.2 If you can recall, please list the watch, warning, and advisories (and other NWS statements and products) issued, or share the products you generally receive for the type of event you have in mind.

3.4 How did you convey the information provided by watch, warning, and advisory products/statements?

3.6 From a hazard messaging standpoint, how was the watch, warning, and advisory system effective? Please explain.

3.7 From a hazard messaging standpoint, how was the WWA system ineffective or limiting? Please explain.

3.8 Do you have any suggestions to resolve the current watch, warning, advisory system challenges or limitations you described in this survey? Please explain.

3.9 Are there any features of the watch, warning, advisory system that you feel must be maintained? Please explain.

3.10 Were there other factors *outside* of the watch, warning, advisory system that shaped your ability to convey the hazard message?

Key Words Searched:

- Statements where words similar to or stemming from “enough” and “time” appear within a certain word count.
- Stemmed occurrences of the words "timely," "duration," and "advanced."

Case Counts: 26 out of 52 included keywords relevant to the theme.

6. Referencing Time or Timeliness

Examples that Reflect Positive Experiences with the Timing or Timeliness of WWA Products

Respondents related a number of positive experiences in receiving timely information through the WWA products:

- The timeliness of the advisories was great.
- WWA's were issued in an extremely timely manner.
- It warned people WELL ahead of time.

Examples that Reflect Negative Experiences with the Timing or Timeliness of WWA Products

Media respondents also provided criticisms of the timing or timeliness of WWA products. These comments focused on a perceived lack of clarity in some products, which obscure important timing information; the existence and/or issuance of too many products, which can be confusing to both the media and their viewers; and issuance of products right before or during a broadcast, which limits the media’s ability to convey the information received.

Lack of Clarity

On the critical side, one recurring theme was about the lack of clarity and wordiness of some warnings and the need for the media to help interpret the timing information for their viewers:

- *I also think some of the advisory information is a bit wordy. We want a simplistic warning that tells us the time frame, the area under the warning and the hazards that can be encountered. That's it! Sometimes they become long and wordy.*
- *I had to explain that this is for the storm that is coming several days out. There is still uncertainty as to the exact track of the system and who will get hit the worst from the storm. Also, I let people know the difference between a winter weather advisory and winter storm warning is the advisory is less serious but can still cause travel issues.*
- *When I have a rainbow of winter weather headlines with various start and end times over my viewing area, it could take over a minute just to explain what they are, why they are in effect, and how that could affect viewers.*
- *… when lengthy messages are created, whether for public, TV, and/or EM use, the time to create initially and then read/decode while being disseminated overwhelm (or can overwhelm) the intended "call to action.*

Too Many Products

Compounding the clarity issue, is the number of WWA products that exist and can be issued for a given event, with different time frames and expirations:

- *There are also so many various alerts, such as winter weather advisories, snow advisories, blowing snow advisories, etc.*
- *The only time it gets a little confusing for the public is when a watch AND a warning are in effect. It also gets confusing when different parts of the viewing area are under a watch until 3 different times.*

Poor Timing

Another recurring issue related to timing, was the issuance of products right before or during broadcasts:

- *I like that I can get notifications to my phone via text message. Often times when I'm busy in the morning during the newscast, I'll miss a watch/warning that happens, and most of the time I see it on my phone first. I wish they could come in before we go on-air at 4:30 but understand that may not be possible in certain situations.*
- *Most hazardous weather events are well documented and reported by the local NWS office, but at times I feel the timing of those issued warnings and watches are issued without consideration of the media that has specific deadlines. Example, we go on the evening news at 5:00 PM why issue a warning at 5:10 PM when we are on the air and will miss that warning? Why not if you feel the weather will require that warning be issued that you make best efforts to issue it say at 4:55 so that all media outlets can get it on the air and to the public which need to be aware of it?*
- *Timing is everything, keeping in mind that the media is our connection to the general public, try and issue the warnings at a time frame that allows us to get them on the air in a timely fashion.*

7. Sharing WWA Information and Products

Definition: This theme captures how respondents shared WWA products and information for a hazardous weather event. It also includes the mechanisms used to share this information

Relevant statements were found in response to the following survey question:

3.3 Among the watch, warning or advisory products or other NWS statements issued, which products did you share via any media (on air, radio, print, web, phone, etc.) with your audience or clients?

3.4 How did you convey the information provided by watch, warning, and advisory products/statements?

Key Words Searched: All relevant responses to the question were directly extracted from the survey data. We did not search keywords for this theme because a word-frequency query from a previous step resulted in a pattern of words and phrases that was not semantically related/significant.

Case count: 44 out of 52 cases included responses to this question.

Examples of Sharing Most or All NWS WWA Products

Many of the media respondents noted that they shared all or most of the WWA products issued by the NWS:

- *We shared all the alerts, but really pushed it when the warnings started to come out. The winter storm watch can be days out from an event and it seems like people get a bit annoyed if we have the crawl up all the time 48 hours in advance of the storm.*
- *Most advisories, watches, and warnings. There may be some minor exceptions for river flood warnings after a certain point, along with frost advisories/freeze warnings that should expire during the morning hours toward the end of the headline.*

Selectivity

Some were more selective about the WWA products shared, with a number stating they share all warnings but may not share all watches or advisories:

- *I share watches and warnings and occasionally advisories.*
- *All warnings, plus tornado watches.*
- *All Warnings!*
- *Sometimes I use NWS highlights. Other times I write my own specific to this industry.*

Customization

Many also noted that in sharing the WWA information, they add their own information to help message the situation:

- *Depending upon the event, I will either share and/or repackage in easy-to-understand terminology.*
- *All of them, trying to add a narrative that relates to the situation.*
- *… we do not directly reference NWS winter weather products. We instead concentrate on forecasting the conditions and communicating that in a simple way.*

Examples of Communication Channels

The communication channels for sharing WWA products include radio broadcasts, television broadcasts, social media, and websites. Many noted they share WWA products across all of the platforms they use:

- *I share all on-air when they happen and also on social media.*
- *We place all watch and warnings on television, and on the web via social media and our websites.*
- *Almost all products are shared via our many platforms. On air via crawl or by cutting over programming for life threatening situations. We also post watch/warn/advisory products graphically to our web page and to numerous social media pages and outlets including Twitter and Facebook.*

One individual pointed out that weather vendors provide software that allows broadcast meteorologists to show many NWS/NHC products, but that the vendors do not provide software to allow show experimental products, which hinder their ability to use them.

VIII. Conclusion and Next Steps

The case studies exemplify the complexity of communicating hazardous weather information. The findings describe a balancing act between maintaining the system from the emergency management perspective with changing the system from the media and NWS standpoint. For EMs, the WWA system embodies messaging that overwhelmingly meets their needs. The terms "watch," "warning," and "advisory" represent the last step in a productive IDSS process that helps them assess risk and take life-saving measures for their communities. EMs do not feel that large change is required, but remain open to the possibility, as long as the necessary investment is made in public outreach and education.

Desired changes among all respondents included:

- Simplifying and consolidating products, including improving formatting and using easy-to-understand language
- Increasing NWS interoffice coordination and collaboration
- Revisiting WWA product definitions and criteria
- Expanding education and outreach efforts

Some of the NWS and media respondents also perceive that the current system is confusing to the public and even some partners—not only the WWA terminology, but also the way that WWA products are issued. Respondents did not, however, overwhelmingly identify specific problems with the words "watch," "warning," or "advisory." All of the respondent types also acknowledged that the attributes underlying the WWA terms are more important than the words themselves.

Within the NWS sample as a whole, less than one-third of the cases mentioned confusing terminology. Within these cases, a few respondents stated that they believe that the public mixes up watch and warning, and a few more felt that advisories create public confusion. However, taken as a whole, the cases did not coalesce on a particular problem with any specific WWA word or product.

Among the media respondents, confusing terminology did not even emerge as a key theme; instead respondents commented more generally that the present WWA system is limiting or ineffective, with terminology being only one facet of a broader issue. For example, media respondents also expressed concerns that the system too often raises an alarm for events that do not happen, that messaging is not always detailed or timely enough, that criteria can be too rigid, and that there are sometimes coordination issues between NWS offices.

It is important to also note that the NWS and media samples were both small, at 88 and 52 respondents, respectively, so care must be taken in interpreting these findings. Those who participated in the case study effort may represent a strong, but minority opinion. Another issue is not knowing the perceptions of those who did *not* participate in the case study effort. To what extent does the wider community agree or disagree with the sentiments found in this report? While the EM findings (with a sample size of 566 respondents) carry more weight than the NWS and media samples, the wider EM community is also larger than that of the media and the NWS.

Next Steps

The findings from these case studies should be considered in tandem with other ongoing research to help the NWS consider potential enhancements to the current WWA system. Additionally, future NWS research efforts to further validate the findings from this report could include 1) targeted research on public and partner understanding of the WWA terms to truly gauge the legitimacy of perceived misunderstanding of

these terms; and 2) reviews of the EM, media, and forecaster case study findings by their respective member groups to see if the conclusions represent the opinions of the wider communities.

Appendix A: Survey Questions

Internal NWS

Hazard Simplification Project

Case Study Survey

The purpose of collecting this case study data is to gather information on the strengths and weaknesses of the current Watch, Warning, Advisory (WWA) system from a hazard messaging standpoint. Participating in this case study analysis is entirely voluntary, and your identity will remain anonymous, unless you offer your contact information. This case study survey is intended for an NWS audience *only*. Our NWS partners will receive a survey customized to their needs in the coming weeks. By continuing with this survey, you are agreeing that you will not share it with outside audiences.

For any questions or comments regarding this process, please email them to hazsimp@noaa.gov

Instructions:

Consider a hazardous weather event or a general experience with hazardous weather where the messaging did (or did not) work well from your viewpoint or those of your stakeholders. For example, you may select a snowstorm where WWA messaging enabled partners to take the appropriate actions; or conversely, you may have been through a flash flood event where the WWA messages did not effectively convey the expected impacts.

If you have two cases or experiences that you would like to share (perhaps one highlighting strengths and another weaknesses), please focus on one at a time. You may submit a second case study, if you choose. For the case you are submitting, please focus on the messaging and resulting actions not on whether a forecast was accurate or verified. If you have any graphics or supporting documentation that you want to submit with your case study, please email them separately to hazsimp@noaa.gov. Please title or label your supporting material so that it corresponds with your case study.

Submissions due by May 31, 2015.

For any questions, please email them to hazsimp@noaa.gov. Please choose the option that best characterizes where you work within the National Weather Service.

I agree to participate.

I do not agree to participate (This will exit the survey).

1.1 If you feel comfortable sharing, which Center, Region, or office are you with? For example, you may list, WFO Binghamton, Storm Prediction Center, or Western Region.

1.2 Consider a hazardous weather event or a general experience with hazardous weather where the messaging did (or did not) work well from your viewpoint or those of your stakeholders. Why are you selecting this event or general experience for a case study? (We will refer to this as "your case study" in subsequent questions.)

1.3 Please briefly describe the weather situation and thought process for your case study. Include date(s) of the event (if applicable). Please use lay terms to the extent possible.

1.4 If you can recall, please list the WWAs, and other statements and products issued.

Local Forecast Office

Regional Office

National Center

Other

1.5 Did the WWAs and other statements and products issued appropriately convey the weather for your case study? Why or why not? Please include factors related to the predicted hazard location and timing, as well as articulation of forecast confidence, potential impacts, and recommended actions.

1.6 From a hazard messaging standpoint, how was the WWA system effective in your case study? Please explain.

1.7 From a hazard messaging standpoint, how was the WWA system ineffective or limiting in your case study? Please explain.

1.8 Do you have any ideas as to how to resolve the current WWA system challenges or limitations you described in your case study? Please explain.

1.9 Are there any features of the WWA system that you feel we must maintain due to its strength? Please explain.

1.10 What factors *outside* of the WWA system influenced the success or failure of your case study?

This concludes this survey. We appreciate the time and effort you took in answering the questions. Our team will thoroughly review your responses, consider your ideas, and aggregate the findings. As part of our analysis efforts, we may need to clarify ideas or suggestions. If you are willing to share your identity, and have the Hazard Simplification team followup with you, please provide your email address in the form below. This is strictly voluntary. If you have any questions for the Hazard Simplification Team, please email them to: HazSimp@noaa.gov

Name:

Email:

Emergency Managers Survey

Hazard Simplification Project: Case Study Survey Questions for Emergency Managers**

Due by August 15th

Questions or Comments? Please send to hazsimp@noaa.gov

**Please note that this document provides you the case study questions in advance to allow for thoughtful consideration and adequate time to respond. This is *not,* however, the actual survey. Your responses must be submitted through the following web link:

http://erg.qualtrics.com/SE/?SID=SV_0f8wuXuJOHfkaSF

Hazard Simplification Project: Case Study Survey

Please consider taking this open-ended survey to help NOAA's National Weather Service (NWS) better understand the strengths and weaknesses of its current watch, warning, advisory system.

This survey is aimed at those who use or communicate the watch, warning, advisory system, such as media partners and emergency managers. Please feel free to send the survey web link to your colleagues.

Completing this case study survey is voluntary and your responses to the questions are anonymous. Please note that the "save and continue" feature allows you to exit the survey and return to it at another time. Your responses will be saved for one week. Be aware that your saved responses may be viewed by others when using a public computer. By selecting "I agree to participate" below, you are indicating that you have read this and agree to participate in this survey. Otherwise, please select "Exit."

For any questions or comments regarding this process, please email them to hazsimp@noaa.gov

Paperwork Reduction Act Statement: Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other suggestions for reducing this burden to Sarah Brabson, NOAA National Weather Service, SSMC 2, Room 17205, 1325 East West Highway, Silver Spring, MD. Notwithstanding any other provisions of the law, no person is required to respond to, nor shall any person be subjected to a penalty for failure to comply with, a collection of information subject to the requirements of the Paperwork Reduction Act, unless that collection of information displays a currently valid OMB Control Number.

Confidentiality Statement: All data will remain confidential, unless you provide us with your contact information to follow-up. If you choose not to do this, the data will remain confidential including no collection of devise IP addresses.

___ I agree to participate

___ I do not agree to participate (This will exit the survey).

Instructions: This survey asks you to respond to a series of questions about a particular hazardous weather event where the NWS messaging did (or did not) work well from your viewpoint or from the viewpoint of your community or audience. For example, you might consider a snowstorm or high wind event where the watch, warning, and advisory system enabled you to translate the messaging well; or

conversely, a flooding event where the system did not effectively empower you to communicate the expected impacts. You may also consider your general experience with specific types of hazardous weather, rather than a particular event.

If you have more than one experience that you would like to use as the basis for completing this survey (perhaps one highlighting strengths and another weaknesses of the watch, warning and advisory system), please focus on one experience at a time. You may submit a second survey if you choose. Please focus on the messaging and resulting actions—not on whether a forecast was accurate or verified.

If you have any graphics or supporting documentation that you want to submit related to your experience, please email them separately to hazsimp@noaa.gov. Please title or label your supporting material so that it corresponds with your submission.

For any questions, please email them to hazsimp@noaa.gov.

For emergency management and related fields:

2.1 Please describe your job responsibilities in relation to using or conveying weather information.

2.2 How do you normally hear about a weather watch, warning, or advisory? Please explain.

2.3 Consider a particular hazardous weather event or a general experience with specific types of hazardous weather where the NWS messaging did (or did not) work well from your viewpoint or from the viewpoint of your community or audience.

Please briefly describe the weather situation for your case study. Include date(s) of the event (if applicable). Please use lay terms to the extent possible.

2.4 If you can recall, please list the watch, warning, and advisories (and other NWS statements and products) issued, or share the products you generally receive for the type of event you have in mind.

2.5 How did you use, if at all, these watch, warning and advisory products for this event?

2.6 Please describe the utility of NWS weather messaging for that event. First, what worked well for you?

2.7 Second, what could have worked better for you?

2.8 Did the watch, warning, and advisory system adequately enable you to make an appropriate decision? Why or why not? Please include factors related to the predicted hazard location and timing, as well as articulation of forecast confidence, potential impacts, and recommended actions.

2.9 Were there other factors *outside* of the watch, warning, advisory system that shaped your ability to respond?

2.10 Do you have any suggestions to resolve the current watch, warning, advisory system challenges or limitations you described in this survey? Please explain.

2.11 Are there any features of the watch, warning, advisory system that you feel must be maintained? Please explain.

Media Survey

Hazard Simplification Project: Case Study Survey

Questions for Broadcast Meteorologists, Other Media and

Private Sector Meteorologists who forecast for specific client needs**

Due by August 15th

Questions or Comments? Please send to hazsimp@noaa.gov

**Please note that this document provides you the case study questions in advance to allow for thoughtful consideration and adequate time to respond. This is *not,* however, the actual survey. Your responses must be submitted through the following web link:

http://erg.qualtrics.com/SE/?SID=SV_0f8wuXuJOHfkaSF

Hazard Simplification Project: Case Study Survey

Please consider taking this open-ended survey to help NOAA's National Weather Service (NWS) better understand the strengths and weaknesses of its current watch, warning, advisory system.

This survey is aimed at those who use or communicate the watch, warning, advisory system, such as media partners and emergency managers. Please feel free to send the survey web link to your colleagues.

Completing this case study survey is voluntary and your responses to the questions are anonymous. Please note that the "save and continue" feature allows you to exit the survey and return to it at another time. Your responses will be saved for one week. Be aware that your saved responses may be viewed by others when using a public computer. By selecting "I agree to participate" below, you are indicating that you have read this and agree to participate in this survey. Otherwise, please select "Exit."

For any questions or comments regarding this process, please email them to hazsimp@noaa.gov

Paperwork Reduction Act Statement: Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other suggestions for reducing this burden to Sarah Brabson, NOAA National Weather Service, SSMC 2, Room 17205, 1325 East West Highway, Silver Spring, MD. Notwithstanding any other provisions of the law, no person is required to respond to, nor shall any person be subjected to a penalty for failure to comply with, a collection of information subject to the requirements of the Paperwork Reduction Act, unless that collection of information displays a currently valid OMB Control Number.

Confidentiality Statement: All data will remain confidential, unless you provide us with your contact information to follow-up. If you choose not to do this, the data will remain confidential including no collection of devise IP addresses.

___ I agree to participate

___ I do not agree to participate (This will exit the survey).

Instructions: This survey asks you to respond to a series of questions about a particular hazardous weather event where the NWS messaging did (or did not) work well from your viewpoint or from the viewpoint of your community or audience. For example, you might consider a snowstorm or high wind event where the watch, warning, and advisory system enabled you to translate the messaging well; or conversely, a flooding event where the system did not effectively empower you to communicate the

For any questions, please email them to hazsimp@noaa.gov.

For broadcast meteorologists, Private Sector Meteorologists, and other media:

3.1 Consider a particular hazardous weather event or a general experience with specific types of hazardous weather where the NWS messaging did (or did not) work well from your viewpoint or those of your audience or clients.
Please briefly describe the weather situation for your case study. Include date(s) of the event (if applicable). Please use lay terms to the extent possible.

3.2 If you can recall, please list the watch, warning, and advisories (and other NWS statements and products) issued, or share the products you generally receive for the type of event you have in mind.

3.3 Among the watch, warning or advisory products or other NWS statements issued, which products did you share via any media (on air, radio, print, web, phone, etc.) with your audience or clients?

3.4 How did you convey the information provided by watch, warning, and advisory products/statements?

3.5 Did the watch, warning, and advisory system adequately enable you to convey the hazard information? Why or why not? Please include factors related to the predicted hazard location and timing, as well as articulation of forecast confidence, potential impacts, and recommended actions.

3.6 From a hazard messaging standpoint, how was the watch, warning, and advisory system effective? Please explain.

3.7 From a hazard messaging standpoint, how was the WWA system ineffective or limiting? Please explain.

3.8 Do you have any suggestions to resolve the current watch, warning, advisory system challenges or limitations you described in this survey? Please explain.

3.9 Are there any features of the watch, warning, advisory system that you feel must be maintained? Please explain.

3.10 Were there other factors *outside* of the watch, warning, advisory system that shaped your ability to convey the hazard message?

Appendix B: Qualtrics Survey

Hazard Simplification Project: Case Study Survey

Please consider taking this open-ended survey to help NOAA's National Weather Service (NWS) better understand the strengths and weaknesses of its current watch, warning, advisory system. This survey is aimed at those who use or communicate the watch, warning, advisory system, such as media partners and emergency managers. Please feel free to send the survey web link to your colleagues. Completing this case study survey is voluntary and your responses to the questions are anonymous. Please note that the "save and continue" feature allows you to exit the survey and return to it at another time. Your responses will be saved for one week. Be aware that your saved responses may be viewed by others when using a public computer. By selecting "I agree to participate" below, you are indicating that you have read this and agree to participate in this survey. Otherwise, please select "Exit."

For any questions or comments regarding this process, please email them to hazsimp@noaa.gov

> ***Paperwork Reduction Act Statement:*** *Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other suggestions for reducing this burden to Sarah Brabson, NOAA National Weather Service, SSMC 2, Room 17205, 1325 East West Highway, Silver Spring, MD. Notwithstanding any other provisions of the law, no person is required to respond to, nor shall any person be subjected to a penalty for failure to comply with, a collection of information subject to the requirements of the Paperwork Reduction Act, unless that collection of information displays a currently valid OMB Control Number.*
>
> ***Confidentiality Statement:*** *All data will remain confidential, unless you provide us with your contact information to follow-up. If you choose not to do this, the data will remain confidential including no collection of devise IP addresses.*

I agree to participate.
I do not agree to participate (This will exit the survey).

Instructions: This survey asks you to respond to a series of questions about a particular hazardous weather event where the NWS messaging did (or did not) work well from your viewpoint - or from the viewpoint of your community or audience. For example, you might consider a snowstorm or high wind event where the watch, warning, and advisory system enabled you to translate the messaging well; or conversely, a flooding event where the system did not effectively empower you to communicate the expected impacts. You may also consider your general experience with specific types of hazardous weather, rather than a particular event.

If you have more than one experience that you would like to use as the basis for completing this survey (perhaps one highlighting strengths and another weaknesses of the watch, warning and advisory system), please focus on one experience at a time. You may submit a second survey if you choose. Please focus on the messaging and resulting actions—not on whether a forecast was accurate or verified.

If you have any graphics or supporting documentation that you want to submit related to your experience, please email them separately to hazsimp@noaa.gov. Please title or label your supporting material so that it corresponds with your submission.

Submissions are due by August 15, 2015.

For any questions, please email them to hazsimp@noaa.gov.

Which category best describes your job? Please choose only one.

Emergency Manager or First Responder

Meteorologist in the Media (TV, web only, online newspaper, radio, etc.) Private Sector

Meteorologist who forecasts for specific client needs

Department of Transportation or Public Works

School or University Official

Hospital or other Medical Facility Worker Insurance or Reinsurance Industry

Other (Please describe)

Who do you identify more with?

Meteorologists

Non-Meteorologists

WCM Partner Questions

Please describe your job responsibilities in relation to using or conveying weather information.

How do you normally hear about a weather watch, warning, or advisory? Please explain.

Consider a particular hazardous weather event or a general experience with specific types of hazardous weather where the NWS messaging did (or did not) work well from your viewpoint or from the viewpoint of your community or audience.

Please briefly describe the weather situation for your case study. Include date(s) of the event (if applicable). Please use lay terms to the extent possible.

If you can recall, please list the watch, warning, and advisories (and other NWS statements and products) issued, or share the products you generally receive for the type of event you have in mind.

How did you use, if at all, these watch, warning and advisory products for this event?

Please describe the utility of NWS weather messaging for that event. First, what worked well for you?

Second, what could have worked better for you?

Did the watch, warning, and advisory system adequately enable you to make an appropriate decision? Why or why not? Please include factors related to the predicted hazard location and timing, as well as articulation of forecast confidence, potential impacts, and recommended actions.

Were there other factors outside of the watch, warning, advisory system that shaped your ability to respond?

Do you have any suggestions to resolve the current watch, warning, advisory system challenges or limitations you described in this survey? Please explain.

Are there any features of the watch, warning, advisory system that you feel must be maintained? Please explain.

This concludes this survey. We appreciate the time and effort you took in answering the questions. Our team will thoroughly review your responses, consider your ideas, and aggregate the findings.

As part of our analysis efforts, we may need to clarify ideas or suggestions. If you are willing to share your identity, and have the Hazard Simplification team follow up with you, please provide your email address in the form below. This is strictly voluntary.

If you have any questions for the Hazard Simplification Team, please email them to: HazSimp@noaa.gov
Name:

Email:

Non-NWS Meteorologists

What type of media market best describes your job?

National Media Local/Small-sized market Local/Medium-sized market Local/Large-sized market Print
Radio
Newspaper Online and/or in Print Other online
Other

Please indicate the geographic area or media market of your audience. (e.g., national audience or "Chicago, IL.")

Please generally describe your client base. For example, do you work with specific sectors or a diverse set of clients? Do you work with a national client base, or work more local/regional?

How do you use or convey weather information as part of your job responsibilities?

Consider a hazardous weather event or a general experience with specific types of hazardous weather where the NWS messaging did (or did not) work well from your viewpoint or those of your audience or clients.

Please briefly describe the weather situation for your case study. Include date(s) of the event (if applicable). Please use lay terms to the extent possible.

If you recall, please list the watch, warning, and advisories (and other statements and products) issued, or share the products you generally receive for the type of event you have in mind.

Among the watch, warning or advisory products or other NWS statements issued, which products did you share via any media (on air, radio, print, web, phone, etc) with your audience or clients?

How did you convey the information provided by watch, warning, and advisory products/statements?

Did the watch, warning, and advisory system adequately enable you to convey the hazard information? Why or why not? Please include factors related to the predicted hazard location and timing, as well as articulation of forecast confidence, potential impacts, and recommended actions.

From a hazard messaging standpoint, how was the watch, warning, and advisory system effective? Please explain.

From a hazard messaging standpoint, how was the WWA system ineffective or limiting? Please explain.

Do you have any suggestions to resolve the current watch, warning, and advisory system challenges or limitations you described in the survey? Please explain.

Are there any features of the watch, warning, and advisory system that you feel must be maintained? Please explain.

Were there other factors outside of the watch, warning, and advisory system that shaped your ability to convey the hazard message?

This concludes this survey. We appreciate the time and effort you took in answering the questions. Our team will thoroughly review your responses, consider your ideas, and aggregate the findings.

As part of our analysis efforts, we may need to clarify ideas or suggestions. If you are willing to share your identity, and have the Hazard Simplification team followup with you, please provide your email address in the form below. This is strictly voluntary.

If you have any questions for the Hazard Simplification Team, please email them to: HazSimp@noaa.gov

Name:

Email:

Appendix C: Summary of Suggestions

Suggestions from Forecasters

This section captures suggestions from respondents who specifically answered the following questions from the survey:

1.8 Do you have any ideas as to how to resolve the current WWA system challenges or limitations you described in this survey? Please explain.

Case count: 67 out of 88 cases included responses to this question.

Consolidate Products

One of the most common suggestions from the forecasters is to simplify the current WWA system by consolidating the product categories. The winter weather products and flood/hydrological products were mentioned most often.

Reduce Winter Products

- *Winter weather hazards may need to be simplified to a further extent than what was done around 5 years ago.*
- *I believe we should combine freezing rain advisories and winter weather advisories into one product. For instance, we had a winter weather advisory out, while surrounding office had freezing rain advisory out.*
- *I don't think there should be different types of winter advisories. A generic winter weather advisory and winter storm warning would be sufficient.*
- *Handle it all with just a Winter Storm Warning, then use good messaging in the WSW to convey the threat, transition from snow to fz rain, time frames, and when the event is likely to end.*
- *Many issues always arise with collaboration surrounding frost/freeze headlines, and wind chill/heat advisory/warnings due to so many differences between offices and how offices are situated. … simplify all of those or [find] ways to deal more with times of actual impact …*
- *We simply need to reduce the number of products. It's so complicated even our own staff occasionally mess up on what product works best.*
- *Almost all advisory level events mostly tend to only impact people if they are driving (dense fog, winter weather, sometimes wind, freezing rain, etc), it would be nice to combine all of these events into something like a traveler's advisory.*
- *Winter weather is bad too; freezing drizzle and rain advisories. Dense fog and freezing fog advisories, winter weather advisories. All of those advisories have a direct impact on transportation. Call it a travelers' advisory. And, get rid of many of the advisories and communicate the hazard.*

Reduce Flood/Hydrological Products

- *There are too many products going into the FLS that are too diverse. River Flood products should be separate from areal flood products*

- *Combine point and areal flood warnings into one flood warning. Period.*
- *The obvious choice is to limit the WWA flood watch/flash flood watch option to flood watch only, with specifics about the flood threat explained in the product itself. I am not sure this is the best route to follow though, as I do not know if customers and partners make decisions and prepare differently depending on whether a flood watch or flash flood watch is in effect.*
- *We need to 1. simply our products/hazards. The flooding program is a disaster. We issue flood products for: flash floods, river floods, areal floods, ice jam flooding, dam breaks, etc. All floods produce the same results so why can't we simplify those headlines?*
- *I would place all river flood products into its own category. River flood advisories, watches, warnings, and statements would be all in the same product. Perhaps River Flood Update (RFU). Each point on a river could be included with the proper headers for that segment. This way, one product could inform the customer the status of every point on a river, instead of looking at several different products.*
- *There are a plethora of redundant and often confusing products (especially hydrologic products) - such as River Flood Warning, Areal Flood Warning, Flash Flood Warning, Flood Advisory, Urban & Small Stream Flood Advisory). The number and type of ALL WWA products (and support statments) that we issue needs to be streamlined and made less confusing (i.e., made to be more intuitive) so that the meaning is not lost.*
- *All of the hydrologic products has some form of call-to-action, yet because of their number, most (excluding perhaps only the most experienced of users) could make any sense of them - often requiring calls to the office to provide clarification during a time when workload is the highest.*
- *I think the hydro product suite could be simplified into one of three products:*
    - *Flood Watch for flash flooding, river flooding, dam break, etc.*
    - *Flood Warning for flash flooding, river flooding, etc.*
    - *Flood Advisory for an area or river gauge*

Transition to an Impact-Based Warning System

Many forecasters supported a transition from a criteria-based warning system to an impact-based one.

- *Warning, Watches and Advisories should be issued based on impact and not just numerical criteria. Numerical criteria don't always relate to the impact people experience.*
- *We need to take a bottom up approach and understand that weather is not always the most important factor that influences impacts. In order to assess the potential for impacts, we have to understand the vulnerability and exposure of the end user.*
- *A recommended action might be to allow watches/warnings based on impacts rather than strict adherence p-types… Of course, this will likely lead to inconsistencies in the types of warnings issued. Once you warn on impacts, then anything is possible.*
- *Break the threats/impacts into levels (low, moderate, high, catastrophic) an enable the field to communicate what the impact/threat level is.*
- *In addition, all GPRA goals need to be realigned to conform to the WRN concept - specifically more toward impact and less toward static statistics that often have little (or no) direct relevancy to our core users.*
- *…redo the software to allow the forecasters to issue or continue flood warnings even when gauge observed and forecast values are below flood state. Warnings need to be based on impacts not strictly on gauge values.*

Issue Polygon-Based Warnings

Many forecasters prefer polygon-based warning over county based warning that would address issues related to overlapping NWS and county boundaries.

- *We (NWS) get so hung up on thresholds and numbers. public basically needed to know that weekend was 1.) it was going to be cold and 2.) snow and blowing snow would be an issue for travelers. Perhaps instead of warnings, we should just issue "impact statements*
- *Instead of county-based warnings we should be issuing polygon warnings for lake-effect snow events.*
- *Evolution of the NWS web presence to allow refined polygons to be used for WSW's rather than the legacy zone-based approach.*
- *We desperately need some sort of convective snow warning that we can issue for these events, possibly even polygon based, that are IMPACT driven. All it takes is a quick dusting of snow to cause slick roadways and major accidents, thus putting a snowfall number to them would be silly.*
- *I'd like to see polygon-based convective snow shower warnings that are issued for these extreme cases. We would need the media to get on board with this and to play these up as potentially deadly situations when we issue them, because they truly are in this part of the country.*
- *A simple fix that we've actually successfully tested in this office...polygon display of long-fused warnings (WSWs) on the WWA map. This is apparently not allowed, and I don't get it. This would be a great help, at least to the mountainous West. We need to move away from the zone concept wherever we can.*
- *We need to maintain some type of VTEC code for automation/dissemination sake, but we need to get away from any county based warning to a more polygon threat area.*
- *Quit using county lines and CWA borders as bounds for polygon warnings (the atmosphere does not care about these lines).*
- *Yes, we need the ability to issue winter warnings/advisories with polygons, like we can with convective warnings.*

Improve the Concision and Focus of Language Used

Forecasters suggested that more concise language and more targeted messaging could help to effectively convey a hazardous weather situation.

Keep Information Concise, Precise, and Focused

- *Bullets need to be concise, not sentences. People need a means to get the information fast and most of the time, extra words are included in bullets.*
- *We use bulleted products already, which is great. Keeping the information as concise as possible should be a major goal. We may need to add bullets (like Confidence Factor and/or Risk factor) ... but at the same time, we probably need to limit the wordiness that occurs within the bullets themselves.*
- *In general, all of our WWA messages contain too much general information and not enough specific information. This includes many lines of headers, codes, location descriptions that are not familiar, [and] long "call to action statements." Wording in warnings often contains boiler plate statements that are generated by our computer systems and are of little value to customers. We need more detailed, and specific information in our products, and if we don't know it then the WWA messaging should be very short.*
- *Possibly it is as simple as working on our message to the agriculture community, working with*

Cooperative Extension to come up with specific call to actions for agriculture.

Eliminate "Catch-All" Headlines or Create More Focused, Impactful Headlines

- *Just have Statements and let the content of those products describe expectation instead of relying on specific headlines in which criteria are constantly changing due to expected or occurring impacts (mostly to motorists).*
- *I would like the NWS to remove the WSW, NPW catch all headers. We can create a specific hazard header and stick to it. Use the Hazard that is the primary concern and include additional hazards in the text. For example, instead of a Blowing Dust Advisory, use a Wind Advisory and include blowing dust possible in the text. Instead of a Winter Weather advisory, in spring we get big snows in the Sierra and a Winter product doesn't make sense in Spring. Just say Snow Advisory.*
- *Headlines should be attention grabbing and clearly highlight the main threat/impact.*
- *Headlines/highlights are handy to raise awareness of the more extreme events and separate them out from the "routine" events. We need to ensure they are tied to impacts.*
- *The messages of our warnings are always lost, it's the top line of the warning people see. For instance, a Severe Thunderstorm Warning is issued. I'd argue the majority of people see that and shrug it off. However, in the text of the warning we are calling for baseball-sized hail and 80mph winds! Do people know that just by seeing the warning on a map or seeing the warning on their phones? No! We need a way to show the impact in the warning itself (a category 5 severe t'storm warning) rather than hiding the impacts in the text of the warning that nobody reads or can find. I think that is really important and something I hope to see changed.*

Integrate More Graphics and Maps

- *One way to avoid this confusion would be to display multiple WWA maps on our web page, such as a map for each day in the short term. This would be similar to Storm Prediction Center Outlooks.*
- *A picture is worth a thousand words. Let's include some images in our advisories and warnings.*
- *We need to move away from a focus on text-based driven WWA to a more graphically-driven environment (where a picture conveys a thousand words) - similar to what we are doing now via graphical postings using social media.*
- *A recent Nurture Nature study indicated that a combination of graphics and text is most desired by our partners—NWS as a whole does not link these two types of output streams and should pursue this to maximize the benefit of messaging.*
- *I think we need focus on visual versus written text. If people want to see the actual text, provide a way to do that. However, our society wants everything in a easy-to-read visual aid and in a simple format. This includes on the WWA map and also with statements themselves, either on our webpages or anything sent out through venues like iNWS, social media, etc.*
- *WWA type products should be multi media, with graphics, images, pictures to convey the threat, impacts and actions.*

Improve Messaging with the Help of Social Scientists

Several respondents suggest working with social scientists to improve NWS messaging:

- *I think we meteorologists need to meet with the social science experts and have a discussion about how best to convey a multi-hazard event in a major winter storm. This seems to work easier for severe weather compared to winter weather. So there must be a solution out there.*

- *Lots of social science that will get us to the optimized WWA verbiage for the audio alerting. Ideally this verbiage will be consistently applied - from the pacific islands to NYC.*
- *Work with WAS*IS-involved social scientists to improve delivery and education of messages on the public end, and in order to do so, identify all the sectors within the public who are not receiving info timely or consistently. This includes those with power outages, those without Internet, urban and rural poor, and many travelers.*

Discontinue advisories, replace with forecast statements:

A few forecasters suggest eliminating or changing advisories as do not intuitively convey impacts or uncertainty. Additionally, they believe WWA should only be reserved for unusual events that will have significant impacts. They recommend replacing advisories with forecast statements:

- *I think if we also get rid or change terms like "advisory", we can make things simpler to understand and convey impacts and any uncertainty.*
- *Advisories should not be issued for minor impact events. That information can be delivered with forecasts statements etc. WWAs should only be issued for unusual events that will have significant impacts and require planning outside people's normal routines. The greatest weather impacts to people occur when they are caught off guard and unprepared.*
- *We should also discontinue the issuance of advisories. It is either hazardous to life and property or it isn't. We hedge our bets by issuing advisories which do not cause decision makers to move resources in most situations.*

Change to a Tiered System

Several forecasters want to see the current system to change to a tiered system that is more intuitive and based a color scheme that most people are familiar with:

- *Have a one-tier system of weather alerts with some sort of scale for the expected impact. E.g. a yellow weather alert for snow, a RED weather alert for snow. etc.*
- *I would prefer to go to a tiered, color-based system...which most people likely are familiar with at least in principle, or could be educated rather quickly on how to interpret. We've done much work on this system at our WFO. Green = all clear/good weather, Yellow = Nuisance-type inconveniences, Orange = Significant impacts to travel/commerce with delays/closures likely, Red = Severe or historic impacts to travel, commerce, and property, Purple or Black = Unimaginable destruction and chaos that permanently alters our landscape. I've just described 5 tiers of impacts, using colors, that are more understandable than a multitude of watch/warning/advisory lingo that we're currently strapped down with. They can be adaptable to whatever phenomenon we are dealing with, with probably events like catastrophic blizzards, violent tornadoes/hurricanes, etc. garnering most of the reds and purples.*
- *Need to simplify the message. I think a 2 tier system would work best. Basically, a warning is an alert and hopefully*
- *... we need a much simpler, more intuitive system. Perhaps something along the lines of a traffic light using colors? Or even categories - people seem to understand a Cat 5 hurricane is bad or a Cat 5 (F-5) tornado is bad, so why not incorporate this into our levels of warning?*

Think Beyond WWA

Ideas to resolve challenges and limitations of the WWA system also included a number of non-WWA items.

Update technology

Forecasters were interested in improvements in forecasting and dissemination technology:

- *Also, the software that is used to create these hazards in GFE is clunky at best. There MUST be a simpler way to create, and especially to update, these products. It seems that so many of our products and tools are driven by how it will sound and operate and function within NOAA weather radio. IT IS TIME FOR US TO CREATE TASK FRIENDLY AND USER FRIENDLY TOOLS TO ACCOMPLISH OUR GOALS, AND *THEN* MAKE THEM WORK FOR NOAA WEATHER RADIO NEEDS.*
- *I heard a few years ago about an idea to have an EAS alert option that would trigger the smart phone alerts on a subjective basis from the forecaster. Seems like a good thing if we can keep it only to truly extreme cases and only for those in the warning area.*
- *The Integrated Warning System goes beyond NWS to include delivery and safety. Here is where the Integrated Warning System did fail in some instances. Post-storm reports (including the NWS Service Assessment), noted that people failed to get the watch and warning notices due either to apathy (not paying attention) or power/COMMS outages. This is a classic case of the most excellent services from the forecast side falling short on the receiving end.*
- *… having tools available to customers allowing them to set their own thresholds would be ideal. If I'm Customer Bob, and I'm always concerned about temps below 30F, then having a tool to alert me of when that is forecast, and only then, would be helpful. Unfortunately the local NWS offices have to take a one-size-fits-all approach. For Ag, there is way more variability than just temps below freezing. Some citrus really benefit from temps in the 30-32 range while others take significant damage, some are able to tolerate temps down to 28F. And this is just the Ag industry.*

Focus on Message Dissemination

Forecasters feel that the most effective means of communicating impact is not just through the WWA products, but through dissemination of messages through traditional and digital media:

- *NWS puts too much weight into WWA. Whereas, the most effective means of communicating an impact is often done through other means and well before the traditional issuance of WWA (through social media, email, phone calls, YouTube briefings, etc)*
- *We were using legacy mechanisms & products to alert stakeholders. Is this a WWA issue - not really, but the WWA suite did not spur action.*
- *Continue to press social media distribution (although the numbers will never approach EAS override/Wireless Emergency alert levels) the users of social media are frequently more knowledgeable and engaged and can spur their followers/friends into the appropriate protective action at higher rates than a warning by itself. Actively train strong social media followers (in a manner similar to SKYWARN) to increase the rate at which the appropriate protective action is taken.*
- *Further relaying of message…with additional comments by our partners. Once we issue any WWA product it sets in to action a change of actions that are not completely with in our control. This can be a really good thing to have in our tool box since we want people to widely distribute the information …*

- *…It must satisfy both the classic dissemination streams and the social media streams which have shown increasing capacity to reach the masses in a quick and effective way.*

Provide Education and Training

Respondents called for more public outreach as well as internal staff training:

- *This is a general observation from over 26 years of trying to teach the public the different between watches, warnings, statements, advisories, etc. They don't get it. We do a poor job of educating the public and media and emergency management cooperators.*
- *More training classes and public outreach to inform as many people about our products.*
- *Continue to work towards executing it with higher skill. Warning decisions remain inconsistent. Some warnings are highly accurate and valuable, while others*

Get More Partner and Public Feedback

Forecasters suggested getting more feedback about the WWA system directly from the key stakeholders and the general public before making any changes.

If anything, our key constituents and the general public should be consulted FIRST to define a standard to start from. Securing input from within the agency is like putting the cart in front of the horse, trying to see the forest through the trees, and/or asking the fox to guard the hen-house. We lack the ability to look from the eyes of our constituents - we (NWS) lack contrast and are myopic in our perspectives.

This section captures statements from respondents who specifically answered this question from the survey:

2.12 Do you have any suggestions to resolve the current watch, warning, advisory system challenges or limitations you described in this survey? Please explain.

Case count: 308 out of 566 cases included responses to this question.

Suggestions from Emergency Managers

Many respondents indicated that the current system works well for them. They explicitly stated that they see no challenges or limitations to the system and would like to maintain all or most of the features as they are. Sample statements include:

- *Leave it alone.*
- *I am sorry I don't believe there are any Challenges or problems... the advisories, watches, and warnings have been pretty much Johnny on the spot.*
- *I do not see anything wrong with the current system. It is simple and concise, anything more would detract from its user friendliness and anything less would make it inadequate.*
- *I must say that I am a firm believer that the current system cannot be made any simpler or better than it already is. If people don't understand the current system then they will likely not understand any future or different system. In conclusion, if it is not broke then don't fix it.*
- *NONE - System has been very effective and provides information for Emergency Management to prepare and respond for public safety, first responders, and general public.*
- *I think they do a very good job of keeping us informed with the potential weather coming in. We fully realize that sometimes the area changes and that cannot be always predicted.*
- *PLEASE keep up the good work! You may just think you're giving a weather report, when you are actually helping families to prepare and get to safety before it's too late!!*

Other respondents, however, did offer suggestions for enhancing the present system.

Simplify Product Format

Many respondents wanted simpler products with succinct text, consistent headlines, and, highlighted call-to-action items. They stated they want products that easy to read and that include graphics:

- *Keep it simple, factual, graphically appealing.*
- *Change to sentences instead of all caps.*
- *A more condensed version of the products issued so that recommended actions stand out more and are more likely to be seen.*
- *Products should be easy to read visually, and include graphical depictions of affected areas. I know this information is available online, and I know where to find it, but I believe I represent an exception. The vast majority of colleagues in public safety and higher education are not as versed in the array of NWS products, and how to find needed information.*

- *More consistent subject lines. I use email rules to automatically forward emails based on the subject title. Lack of consistency is subject line results in automatic formatting not working.*
- *Improve the format of forecast messages and graphics:- Use upper and lower case font, and use color, bold and italic font options to highlight critical information - Use subheads that are short and relevant (e.g., Counties Most At Risk) - Improve maps by clearly highlighting danger pathways (e.g., big, red arrow, vs. many small skinny arrows).*

Collaborate Internally and Externally

EMs also called for more collaboration between NWS offices, with external partners, and with the general public:

- *Building relationships with Mexican forecasters and local community leaders, state, federal partners, too.*
- *Coordinating local weather station information w/ ongoing weather reporting from NES*
- *Emergency Management will be working with emergency services and NOAA to educate the citizens to be more informed as to receive the information we are giving out and what they should do before the incident occurrences.*
- *I work over three different WFOs, each of which has created different zones in different ways. More uniform zones would help.*
- *maybe closer cooperation between NWS and USGS and Army Corps of Engineers could have alerted the residents and industrial partners in the County.*
- *More face time between end users and NWS.*
- *Don't be afraid to work more with the commercial internet and TV sites in more public/private partnerships to get out a good consistent and correct message.*

Use Color-Coding

Several respondents desired a color-coded system. They noted that such a system, paired with call-to-action language, would be more intuitive than the present system:

- *Change to [a] color-coded system.*
- *Mentioned before, have a color system. Color codings? Advisory - Green, Watch - Yellow, Warnings - Red, as examples.*
- *Not sure if a number or color system works better. Clear text like "take cover now" make it clear what to do.*
- *Use more intuitive language or a color coded scale regarding watch/warnings. also, sending more frequent forecast models.*
- *In Alabama we have been working on this since April 2011. We need the messaging to be more direct. We probably need to look at changes in color system for maps. Green=flood. other areas Green=good all in the green, ok. We know we need multiple approaches to informing the public.*

Improve Terminology

In general EMs feel that that WWA terminology is confusing to the general public. Even with years of experience, several EMs stated that they find themselves looking up definitions and thresholds for WWA products:

EMs want WWA terms and product criteria to be defined clearly and consistently for all hazards:

- *The messages should briefly explain the difference between a watch, warning, and advisory. Most people can't keep track of which is worse.*
- *The terms watch and warning are confusing to some people I work with frequently. Especially when a watch is cancelled before a warning is issued. People think when a watch is cancelled that the weather has improved*
- *Link to a page that explains what the different watches, warnings, advisories, etc. mean and the related criteria.*
- *I don't know that differentiating between "possible" and "a little more possible" is clear to messaging recipients.*
- *I have been trained for over 30 years, and still have to stop and think about which is more severe, the Watch or the Warning. I would like the an updated alert/warning system to not be so confusing. Young and Old alike are confused by the current system.*
- *Make sure it is standardized for all hazards.*

There are many suggestions to replace specific WWA terms and descriptions with a system that is more intuitive, has actionable information, and is easier to understand and respond to:

- *Again, use more commonly understood terms.*
- *I think terms like "expected" or "likely" would be more clear to the public, at large.*
- *Pick better words... Watch and Warning don't explain the danger... Flooding is possible versus flooding is imminent... A tornado is possible versus a tornado is imminent in your area...*||*Maybe the Weather Radios could display a text message and maybe the user could select their language...*
- *Instead of "watch" and "warning," how about "possible" and "now"*
- *Yes, I think that watch should be changed. The average person gets very confused watch verses warning or they forget the differences in the terms. "monitoring" would be a good substitute for watch, or something similar.*|*Warning is usually taken as it sounds, so it seems to pose less of an issue.*
- *Again, i still get watch and warning mixed up. I have to look it up every time, and i understand that different entities have the ability to send different messages. The action items in the broadcast message helped me understand the severity of the situation. "Do this now" as opposed to "Hey, this is happening" is a clearer message*
- *...the words watch and warning look too similar. Perhaps the use of another word for watch such as surveillance or monitoring or placed in parenthesis after the word watch would clarify*
- *Weather Alerts for Severe Thunderstorm or Tornado Warnings should include either "reported by trained observers" or "Radar Indicated"*
- *The different weather warnings for flooding need to be simplified and renamed. I know that flash flood warning, flood warning and areal flood advisory all have different meanings and uses. But, the public does not understand the difference between them and neither do many emergency managers. I think the warnings need to be simplified and the names need to be changed to be more descriptive. For example, a flood warning should be named to River/Stream Flood Warning since these warnings are issued for waterways. Instead, many people interpret the Flood Warning as just a less severe version of a Flash Flood Warning. For areal flood advisory, I have found that no one understands what that means.*

Improve Message Dissemination

EMs heavily rely on their phones (cell phones) to receive notification about hazardous weather and want to NWS to continue improving text and email alerts systems by making them succinct and timely:

- *Keep the text messages short, but with information as to who, what, when, where, why, how. Expected times of the flooding to reach the creeks in Abilene, would be great. Things such as Cedar Creek is expected to rise to flood levels by 1:00 p.m. Residents along cedar creek should prepare NOW for evacuation. It's hard to describe the "overhead" that comes with the messages, but there is a lot of nonimportant "headers" that the text messages contain.*
- *Most cell phones (where text messages are received) cut off a bunch of the "meat" of the message and we only get the headers telling us that something is coming toward us. We have to use other means to find out exactly what is going on.*
- *Ability to update zone fire wx forecasts as conditions change throughout the day - maybe include an option for individuals to sign up for text updates.*
- *Maybe if a text alert notification could also be implemented.*
- *A more robust email or text alert system for emergency managers*
- *I like SPW and Ops email. I like adv, watch warning. Sometimes message come in one after another as conditions change. So messaging internally and externally can be a real challenge. Play the game over messaging but want public to ready! Like how you include the definitions for various incidents.*

Enhance Website and Use of Social Media

Respondents also had specific suggestions regarding improvements to the NWS website:

- *...a link to NWS site - radar - link to safety tips - some people may not know what to do so when they get the text--having the ability to click right on safety tips may help save lives*
- *eliminate the searching, actual pop up mapping showing weather events as they are being released.*

There was also a desire for more social media updates:

- *We just need to make sure we are targeting the social media and portable generation as much as possible along with traditional methods as most today are getting their news and messages directly to portable devices.*
- *... some how integrating social media into the determination of weather events. Videos and Pictures will be available almost as soon as climate information.*

EMs would also like NWS to consider the following IDSS ideas:

- *Provide best practices to organizations with their own alert systems to help them get accurate information out quickly.*
- *Area forecasts should be supplemented with THIRA decision tools to aid in making pre-event decisions. If they could also be updated in real-time, and include threshold alarms that can be user-defined, we could set up signal markers on the area products that cue us when it's time to make a protective action recommendation or decision. The largest challenge is in how to translate an area % forecast into a risk level that requires action.*

Provide More Timely Warnings

EMs want warning to be issued in advanced as much as possible so they have sufficient time to inform their stakeholders and take necessary action. They also appreciate products to include information about time for better situational awareness:

- *The earlier we get the storm surge information the better when it comes to the evacuation process and response planning.*
- *Timelines are essential. The current watch/warning/advisory system is much improved in terms of the specificity of the threat (e.g. winds over xx mph, or hail larger than xx inches) but are often vague in terms of timelines (e.g. "this afternoon and evening"). While this may be appropriate for the general public, as a preparedness and response decision-maker I benefit from more actionable information regarding likelihood (in terms of forecast confidence), timeframes (between certain hours), and a sense of whether the risk/confidence is growing or decreasing.*
- *Since we have implemented a mass notification system warnings are quicker to reach people. I think using advanced notification to managers is very important and using that information along with normal EBS warnings is good.*
- *The only suggestion is to try to see if we can get warnings issued quicker. We understand the limitations based on storm development and radar, but sometimes (not often) by the time the warning is issued, the storm has already moved through the area and had a moderate impact.*
- *Again if you could post them earlier that would help. Sometime the description of the location of the storm is all over the board? Not sure if this could be clarified, but that would help as well.*
- *Also would like more duration and totals info. Heavy rains will last 30 min, followed by 2 hrs of moderate or whatever. Terms of rainfall per hour would be nice.*
- *Prediction of when warnings and watches will end could be helpful.*

EMs working in the hospitals and health need more lead time of a potential threat so they can take appropriate action to alert their patients and take necessary action:

- *...as mentioned before, a notification to hospital/health to ensure we are informed when the potential threat is building and not just when a warning occurs.*

Reduce the Number of Alerts Issued

- *If there is a way to cut down on the delay between the multiple systems that utilize NWS alerts, that would be the best*
- *There are WAY TOO MANY ALERTS!!! people need to head them and they are ignoring them. Because in my opinion they hear them way too often. The amber alert system goes off with same tone as a major weather alert, the general public is immune to hearing the sound… Secondly the alert tones are going off on radio stations without a message …Why?? All of this has led to a sense of general apathy to the alert tones (Which may be the one thing that saves a life!!!) It needs to change.*

Think Beyond WWA

Expand and Improve Dissemination Technology

Many recommendations encompassed notification and message dissemination mechanisms that are beyond, but connected to the WWA system. Majority of these comments reflect a desire for mobile app(s) or text notification with coordination from the EM community and the private sector.

- *Look at the way commercial programmers develop AV wx app's and try to follow those. The*

same for TV station Met Sections, they have the means to quickly present storm movement, speed and direction while doing their daily briefs.

- *If there is a way to cut down on the delay between the multiple systems that utilize NWS alerts, that would be the best*
- *TV MET's need to work more closely with WFO's and EM's to get the message out!!*
- *The WEA alert system is great...but the notification area for TOR and especially FFW is too large. Public perception of tropical vs. wind products has been shown to be an issue as are blizzard criteria and winter weather impacts.*
- *Devise a joint military and civilian advisory system that includes HURCON levels with watches and warnings. Make sure government municipalities are aware of the military HURCON levels and how these levels may impact the military installation and surrounding communities.*
- *Coordination of community notification systems with NWS and other emergency services is essential. A lot of the notification systems are private sector generated and while someone is always trying to build a better mousetrap, the lack of consistency of messaging is taking a toll on the loss of lives and property. When a threat is imminent, such as flooding, the get out warning must be prompt and strong.*
- *iNWS should no longer be experimental; and can be further enhanced/developed.*
- *Figure you can do this: when your transmitter(s) send out the digital code to make the Weather Alert Receivers wake up with an Advisory, Watch, or Warning - give a short voice explanation of what the particular transmission code means.*
- *I would like to see a good Android app that ties in to current GPS location.*

Provide More Radar Coverage and Data

EMs rely heavily on radar data to monitor hazardous weather and evaluate the impacts. As such, their responses reflect the desire for better radar coverage and access to radar information:

- *Better radar coverage for central Idaho would be very helpful. This would allow the NWS staffs to have more information for weather predictions.*
- *No. I do realize our particular area is in a radar shadow and topography makes it difficult to forecast for. Perhaps raising the lowest threshold for issuing a Special Weather Statement so there aren't so many that result in false alarms.*
- *Perhaps the message could have a link to local radar...*
- *...improve ability to modify radar displays*
- *While a watch/warning gets your attention, it is important to be able to evaluate the data, so more detail or quick links to additional detail: hourly predictions, forecast discussion, satellite and radar...maybe even a graphical projection into the future of predictive radar/satellite info if possible.*
- *Just what I stated earlier of adding more River Gauges. I watch what is happening in other bordering counties as well to see if they need assistance.*
- *I think the nws does a good job but if anything is lacking in our county it is the number of trained observers we have to monitor the skies. Radar is very high when it goes over our county and what is happening on the ground really needs to be watched by trained observers on the ground.*
- *I would like the NWS to provide at a price, if necessary, the means to subscribe to real time radar. This would be for ham operation and SkyWarn volunteers.*

Suggestions from Media

This section captures statements from media respondents who specifically answered this question from the survey:

3.8 Do you have any suggestions to resolve the current watch, warning, advisory system challenges or limitations you described in this survey? Please explain.

Case count: 40 out of 52 cases included responses to this question.

Given the public-facing nature of their job, media respondents are sensitive to certain issues in the current WWA system that may lead to public confusion, and thus make it hard to communicate hazardous weather in a timely and accurate manner. The most common suggestions offered by media to resolve these challenges are related to changing product names or terminology; improving inter-office collaboration and consolidating products for a more streamlined forecast; expanding graphics, dissemination technology; expanding public education, etc. Respondents seem most passionate about resolving issues related to convective products, followed by flooding and winter products, while a few mentions of hurricane and fire products.

Reword Product Names and Descriptions

Respondents have specific suggestions about rewording certain terminology in the WWA system which they believe will help reduce public confusion and false alarm:

- *"People may not understand what advisory or watch mean. Most are well educated, but in non-life threatening situations like winter weather advisory or wind advisory, the message can be lost or confusing. So a different kind of system may be helpful for non thunderstorm events."*
- *"Stop issuing on "potential" and warn more on the "is occurring or imminent" verbiage. A warning needs to have some bite. Over-warning ends up doing more harm than good."*
- *Change Warning to Red Warning and Advisory to Orange Warning on hazards that need gradated warnings. Watch could also be changed to Elevated Risk to eliminate the WA-WA problem."*
- *"Referring to forecasting in general, I believe greater care and detail is needed with the forecast discussion wording/grammar as well as to the temperature forecasting."*

Respondents feel that warnings are easily understood by the public and most effective for extreme events. Therefore, they suggest reserving warning terminology, such as "emergency" and "elevated risk," for significant events:

- *"The WWA system is most effective for extreme events. Warnings are understood most well. It is least effective when it is a weaker system, then you get into the advisory / watch terminology that can easily be misconstrued."*
- *"I would add Hurricane Emergency, keep Hurricane Warning (even with its shortcomings), change Hurricane Watch to something like Elevated Risk, and add a Risk Area that can be issued up to 96 hours in advance."*
- *Let's reserve warnings for situations where life and property are really at risk.*

A few respondents had suggestions specific to headlines:

- *"Avoid changing headlines mid-late in a storm just because of one or two reports."*
- *"Drop the word areal from use in flood headlines."*

Consolidate Products

Media respondents are concerned that there are too many WWA products that confuses their viewers and makes it harder them to communicate the hazard. As such, there seems to be a general desire to consolidate and reduce the number of products to avoid over warning and false alarms. Respondents particularly want to see flooding, convective, and winter weather products streamlined:

- *Many of these different types of warnings need to be consolidated. Especially for flooding and Winter weather.*
- *Just the re-issues and changing one little thing and giving me so many warnings over a long period of time - flood watches, winter storm watches are the worst.*
- *...flood warnings, watches and advisories are so confusing that even I, a trained meteorologist, have to remind myself of the differences when issued. I think Areal Flood Warnings, Flash Flood Warnings, River Flood Warnings, Urban Stream Advisories, etc. need to be thrown out and culled down to a shorter list of flood related statements that are easier to understand.*
- *I am concerned about the false alarms on tornado warnings. I would suggest breaking it down to two types of warnings ... perhaps using "alert". For example, if radar indications a possible tornado forming use a phase such as "This is a Tornado Alert" that a tornado could form at any moment. Versus an actual well defined tornado use a phase such as "This is a Tornado Warning" ... a tornado is indicated by radar and moving ...*
- *Reduce the number of winter weather products to avoid confusion. For example, combine freezing rain advisory and winter weather advisory into one product. Also consider renaming the products. I'm not sure that most people understand the difference between a warning and an advisory or that one is more serious than the other. I know that most people still confuse a watch and a warning.*

A few respondents recommend reducing or even eliminating the number of advisory statements as it confuses the public and respondents who have to explain the difference between the different products:

- *I think the fewer amount of advisory statements or products issued by the NWS, the better ... sometimes it seems there are too many categories or products, confusing viewers and those of us who have to explain the differences.*
- *Streamlining of advisory terms, especially the flood products, would really help the general public understand what you are trying to convey.*
- *I would eliminate the advisory terminology altogether.*

One respondent indicated wanting more updated warnings and advisories:

- *"What would be wrong with issuing more frequent updated warnings and advisories? Since weather changes from what it was five or 10 minutes ago, why shouldn't advisories reflect that - including instances where the weather has improved. People often want to know if a storm is in a lull or if it has passed."*

To overcome the challenges of receiving too many products, media respondents suggest that NWS offices collaborate more and strive for more consistent thresholds and dissemination mechanisms for issuing products:

- *I think the consolidation of winter products has helped in the sense that we do not have to explain the difference between a Snow & Blowing Snow Advisory in county A vs a Winter Weather Advisory in county B vs a Snow Advisory in county C. I believe that more consistent thresholds for issuance of products between offices as well as a consistent protocol for the products under which products are distributed would help.*

Collaborate with Neighboring WFOs

Majority of the respondents feel that more collaboration between WFOs with overlapping boundaries would help alleviate public confusion caused by multiple WFOs issuing several products for the same events in the same area:

- *For the ice storm example I named, collaboration between overlapping offices could cut down on the number of warning types that are issued for the same in event in the geographically the same area/DMA.*
- *I think if the WFOs discuss between themselves about the boarding counties on what kind of warning, advisory or watch they want to issue would convey a centralized idea i.e. if a storm is rolling through County A to County B and WFO A issues a tornado warning for the storm moving towards County B, WFO B should also issue a tornado warning for County B.*
- *The only time it gets a little confusing for the public is when a watch AND a warning are in effect. It also gets confusing when different parts of the viewing area are under a watch until 3 different times. I like to think people are smart enough to figure out which time is for their area, but I have always the research shows most people can't pick out their county on a map.*

One respondent suggests redistributing CWAs so that there the boundaries are clearer and smaller counties are not left out.

- *Encourage neighboring NWS offices to coordinate. Redistribute the CWA's so that there is a more clear dividing line and a few random counties aren't left standing out. Redistribute the CWA's to better cover or surround major cities.*

Define Terms and Thresholds (Convective Products)

Majority of the responses to this theme are focused on making changes to products in the convective system. Suggestions encompass clarifying terminology; establishing and defining thresholds; tightening polygons and shortening warning times; and communicating confirmation sources:

- *The use of the Significant Weather Advisory comes into question quite a bit from viewers... again, they are unsure what it means.*
- *Smaller hail and slightly less wind may be much more than significant to some viewers ... the storm has hail and high wind is severe in many people's minds. Personally I base cut-ins on whether an Advisory or a Warning is issued ... interrupting programming for warnings, letting our weather crawl handle the Sig.*
- *"I think we could include wording for a brief EF-0 or EF-1 tornado in the definition of a severe thunderstorm for verification purposes. Catching a brief spin-up tornado on radar with the same Tornado Warning that covers violent tornadoes is extremely limiting. Public perception and reality are at odds in this case. To John Q. Public: Tornado = Tornado. There is no differentiating."*
- *Another complaint I hear from the public is "it's lightning like crazy!! I'm not sure what to do*

here, but with lightning being a big weather killer, maybe a threshold needs to be established for adding lightning as a criteria for a severe thunderstorm? I don't know...58 mph wind, quarter size hail and XXX strikes per 25 square miles per minute?

- *Tighten the warning polygons and shorten the warning time. Summertime storms are pulse storms. They are not going to produce 60+ mph winds for the next 45-60 minutes! Let's give people some credit to know if the sky turns dark and the rain and winds pick up, they know to take shelter.*
- *When Dual Pole radar confirms a tornado I'm not sure radar confirmed is the most persuasive language. Public may confuse it with radar indicated. Since one cannot honestly say spotter confirmed either, perhaps use confirmed with no modifier.*

Change Flash Flood Warning or Tornado Warning Colors

Respondents think the colors of flash flood warning and tornado warning is too close and can look the same on screen. They recommend one of the products to a shade of green:

- *I think the color of the flash flood warning and tornado warning can look too similar on some people's TVs. One is bright red and the other is dark red. I've often heard it can be confusing trying to determine which one is which. It may not be a bad idea to change the flash flood warning color to a brighter green color to differentiate the two.*
- *Also - change the flash flood warning color. It's red - almost same color as tornado warning - most stations have had to change the color system to dark green.*

Enhance product format and visual

There are several recommendations for improving the format of the product, with special focus on high-quality graphics that can be used on air:

- *Graphically, we are limited pretty much to what the weather vendors (WSI and Weather Central) provide. I always had a dream that the NWS would provide TV ready graphics that could be used on-air. I would gladly use the NWS graphics during a tropical cyclone event if they were high enough quality to use on-air. This is not the case. Social scientists tell us that if we don't hear a consistent message during a weather disaster, we either don't respond properly or don't respond as quickly as we should. If all the media provided the same high quality graphics from the NWS, we would have a consistent message. I would hope that the public and private sectors could do a better job of working together on this.*
- *Have to make written hurricane information products shorter (somehow) without losing the "meat."*
- *There should be serious consideration given to a system similar to the UK Met Office's color coded system. Start with the desired behaviour or action and then back up to what meteorological conditions would make that action necessary. Eliminate the entire system of warnings based on weather parameters.*

Issue Products in a Timely Manner

Given the public connection to the public, there is a desire among the media respondents to receive WWA products in a timely manner:

- *...timing is everything, keeping in mind that the media is our connection to the general public, try and issue the warnings at a time frame that allows us to get them on the air in a timely fas[h]ion.*

Improve NWS Training

A few respondents called for more staffing training and changes at specific NWS offices:

- *Here in [NWS Office] the system is 75% broken and in need of desperate replacing of employees operating the NWS Charleston office.*
- *Replace and/or retrain staff. REMOVE [NWS Office] and MANAGEMENT. And bring in people well trained in\how to do their jobs and not let us and public hang.*

Think Beyond WWA

Improve dissemination technology

Similar to EMs, statements from the media encompass suggestions beyond the WWA system. Most of these suggestions are geared towards improving dissemination technology and IDSS:

- *Maybe if there was a way if a watch/warning gets issued that when it pops up in the NWSChat the bookmark tab on the top of the screen will highlight to draw your attention to something happening? This would be great if you could do it whenever anything is posted in NWSCHat so you know of any new storm reports as well.*
- *Text message or email to those who want advance notice of likely warnings and watches. Some TV stations jump the gun, and the public feels that there are too many warnings and that many that are needed are to late.*
- *Send the watches and warnings out in the winter months via weather radio.*

Partner with outside entities

Respondents also call for strengthening partnerships with external entities such as storm spotters and the private sector:

- *Is it possible to do geo-based partnerships with Facebook similar to what occurred with the Nepal earthquake? I'm thinking particularly of the flooding along the Blanco and seeking notification that might have saved lives. Also it is extremely helpful with tornado warnings offer the exact location of a tornadic activity on radar or actual spotted funnel with direction its heading including communities. First responders can hopefully pick up on the messages and help get the word out.*
- *Maybe more spotter information if you have it or if it is available. Quite by accident, I met one of CTP's CO-OP observers who is also SKYWARN trained. She and her husband responded to the tragedy and reported to you folks. Getting that kind of ground truth would be helpful and now that I know these folks, I used them as weather watchers on my shows and call them to get more ground truth in Warren County when severe weather is imminent or occurring. Also, it might by nice to know of some frequencies for emergency management in these rural counties that could be obtained on the internet for these types of situations.*

Although, outside the jurisdiction of NWA, one of the respondents wants advance notification before sirens are blown to get a better idea of the severity of an event and to be able communicate to the public more effectively:

- *BEFORE any sirens are blown, the communication about why they are being blown MUST be sent to the media!!! Only in the most unique of circumstances would they ever need to blow the sirens without warning or communicating the media and the NWS about why. And in that case, I would assume the severeness of the situation would readily apparent for those us monitoring the event, and we could communicate that to the audience.*