EXPLORATORY MINI-WORKSHOP SUMMARY REPORT

FRAMING THE QUESTIONS – ADDRESSING THE NEEDS

Moving to Incorporate Social Science Results into Meteorological Operations/Services

August 2010
FCM-R28-2010

Office of the Federal Coordinator for Meteorological Services and Supporting Research

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Cover images (left to right)
Top: Flooding related to Hurricane Katrina, September, 2005 - Credit: NOAA; Hurricane Bill, August 2009 - Credit: NOAA
Middle: Mudslide closed access across Lower Granite Dam, WA, January 2007 - Credit: USACE; Mt. St. Helens, March 1982 - Credit: USGS
Bottom: Tornado that struck Enterprise, AL, November 2007 – Credit: NOAA; Wildfire in Santa Barbara County, October 2007 – Credit: USFS

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FCM-R28-2010
Washington, DC
August 2010

FOREWORD

The origin for the Exploratory Mini-Workshop regarding the integration of social science research results into meteorological operations/services, which took place on May 3-4, 2010, was the 58th Interdepartmental Hurricane Conference (IHC). One of the actions from the 58th IHC recommended that a comprehensive strategy be developed to guide interagency tropical cyclone research and development (R&D) over the next decade. That recommendation was subsequently supported by both of my key coordinating committees: the Interdepartmental Committee for Meteorological Services and Supporting Research and the Federal Committee for Meteorological Services and Supporting Research (FCMSSR). A key recommendation in the R&D plan that was published in February 2007, entitled *Interagency Strategic Research Plan for Tropical Cyclones: The Way Ahead* (http://www.ofcm.gov/p36-isrtc/fcm-p36.htm), was: "Results of social science research need to be an integral part of the hurricane forecast and warning program." The Exploratory Mini-Workshop was ultimately driven in response to Action Item 2009-1.2 from the August 6, 2009, meeting of the Interdepartmental Committee for Meteorological Services and Supporting Research (ICMSSR). The action item stated, "The OFCM will organize an interagency exploratory meeting on the social science aspects of meteorological services and supporting research to facilitate the exchange of ideas and information." Finally, recommendations from the 64th IHC held in Savannah, Georgia, March 1-4, 2010, echoed support for a social science workshop. Both the ICMSSR and attendees at the 64th IHC encouraged the weather community to further integrate social sciences into its operations and services.

Appendix A to this Summary Report provides a 1-page Social Science Primer, *Towards the Further Integration of Social Sciences into Meteorological Operations*. Agencies have used results from social sciences for many years, but there is a growing acknowledgement on regarding the importance of social science to their mission. Knowledge gains in the social, economic, and decision sciences will lead to the implementation of better response strategies and can help set priorities as to where increased research would be most beneficial.

I want to express my deepest gratitude for the three social science facilitators and for all the participants that made the Exploratory Mini-Workshop very successful. Section III of this report provides a summary of results from the workshop, along with several actions that are categorized along the three main objectives of the Exploratory Mini-Workshop. I urge your support of the newly formed, OFCM-sponsored Working Group for Social Sciences, which will be working over the next several months to execute the actions/recommendations from this report and to develop an interagency Implementation Plan.

//SIGNED//
Samuel P. Williamson
Federal Coordinator for Meteorological Services
and Supporting Research

FRAMING THE QUESTIONS – ADDRESSING THE NEEDS
Moving To Incorporate Social Science Results into Meteorological Operations/Services

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SECTION I: OVERVIEW

A. Purpose, Theme and Objectives

The Exploratory Mini-Workshop, led by the Office of the Federal Coordinator for Meteorological Services and Supporting Research (OFCM), examined the incorporation of the social sciences into meteorological operations/services. This Mini-Workshop was convened in response to Action Item 2009-1.2 from the August 6, 2009, meeting of the Interdepartmental Committee for Meteorological Services and Supporting Research (ICMSSR). The action item stated, "The OFCM will organize an interagency exploratory meeting on the social science aspects of meteorological services and supporting research to facilitate the exchange of ideas and information." Additionally, recommendations from the 64th Interdepartmental Hurricane Conference (IHC) held in Savannah, Georgia, March 1-4, 2010, echoed support for a social science workshop. Both the ICMSSR and attendees at the 64th IHC encouraged the weather community to further integrate social sciences into its operations and services to: (1) improve the delivery of information and services; (2) communicate more clearly with the public; (3) enhance critical partnerships with emergency managers, media and the private sector; (4) reach out to diverse, at-risk populations; (5) improve societal responsiveness to severe weather; and (6) save lives.

The stated aim of this Exploratory Mini-Workshop was *Framing the Questions—Addressing the Needs*. Presenters and participants identified common questions/needs for the social sciences. Once these needs are established, specific projects will be advanced that can serve as a basis for expanded integration of social sciences into meteorological operations and services.

The Exploratory Mini-Workshop objectives were as follows:

Objective 1. Identify agency-specific and agency-overlapping social science–related actions and social science needs/priorities as related to meteorological operations/services.

Objective 2. Compile key recommendations for potential government action for *implementation* in meteorological forecasting and warning programs.

Objective 3. Develop an Action Agenda for the further inclusion of social science research results into meteorological operations/services.

A "Social Sciences Primer," given to all participants prior to the meeting, is at Appendix A. The agenda for the 2-day Exploratory Mini-Workshop is at Appendix B. Section II of this summary report is structured to coincide with the agenda.

B. Key Takeaways

Key takeaways are defined as the overarching impressions formed by those engaged in discussion, the impressions that will be remembered. The agency-specific and agency-overlapping social science–related key takeaways on the delivery of meteorological

operations/services are summarized below.

- Participants agreed that the work of social scientists is evidenced in the delivery of meteorological services since the vast majority of the public remains safe during natural and technological hazard events. The inclusion of the social sciences into the delivery of meteorological operations and services has a long and significant history within the National Weather service (NWS). During the early 1970s, social scientists were engaged by the NWS to fine tune and reword its warnings and messages. Their engagement served to ensure that the right message was delivered to NWS important partners/users—emergency managers, first responders (e.g., fire, police, and medics), the media, and the public. The need still exists to continue this 45-year partnership and to build upon its successes. It is anticipated that further inclusion of the work of social scientists can serve to reduce loss of life and reduce the dollars spent to address these events.

- Interwoven throughout the Mini-Workshop were expressions of the need to further use, disseminate, and communicate meteorological information in ways that the public understands. To be effective, this understanding must result in protective actions by the public, actions that mitigate risk to safety.

- The agencies recognize the benefit that social science research can provide for their operations. However, effective mechanisms have not been developed for learning about, accessing, and implementing the breadth of social science research and expertise that exist in academia, professional organizations, governmental agencies, and nongovernmental agencies. Therefore, effective methods to transfer knowledge are important considerations that should be addressed.

- Risk communication—the development and dissemination of effective messages for the different sectors of the public—was most consistently identified as the most important need for the agencies.

Highlights of Potential Government Actions

Several common social science needs emerged during the Mini-Workshop presentations and subsequent discussion. These needs fall into the broad thematic areas of (1) risk communication, (2) end-to-end analysis, (3) decision support systems, (4) knowledge transfer, (5) vulnerability assessment/economic valuation, and (6) partnerships. Below are highlights from each area.

Risk Communication

- Provide clear, concise, actionable information and diverse messages that define levels of risk and are understood by all sectors of the public.
- Seek communication experts who understand the language of meteorologists, the media, and the public to serve as ‘translators’ of multidisciplinary information.

End-to-End Analysis

- Perform a prototype field study, led by a team composed of individuals (e.g., social scientists, meteorologists, K-16 educators, emergency managers, first

responders, NGOs, the public) who will interface and partner directly with all communities and document the flow of information, identifying gaps in communication, understanding, and actions taken.

- Build bridges across agencies to raise awareness and to educate and address the needs of key communities, particularly State Departments of Transportation (State DOTs) and NWS. The dialogue between the decisionmaker (e.g., State DOTs) and the provider (e.g., Weather Forecast Offices) should incorporate and address the weather needs of surface transportation.

Decision Support Systems

- Develop visual and/or text-based products to convey probabilistic information regarding flood risk (based on post storm analyses) required for preparedness and response by audiences outside the National Oceanic and Atmospheric Administration (NOAA).
- Package weather information with the needs of responders, such as emergency and road managers, in mind as well as other end-users; ensure that weather-related products and messages are consistent.

Knowledge Transfer

- Provide an avenue for the Federal agencies to disseminate their social science efforts to a broader audience to reduce replication of Federal, State, and local work.
- Develop a repository of 'best practice' warning messages and graphics, categorized by type of weather event and tailored to all sectors of the public.

Vulnerability Assessment/Economic Valuation

- The demographics of communities influence the need for diverse warning messages and for a broad range of support services. Subsequently, there is a need to design messages, services, and partnerships that ensure the safety of all sectors of the public.
- There is a need to improve the preparedness of and support for socially vulnerable populations that have limited capabilities.
- There is a need to address not only the social impacts of meteorological data/information but also the economic and environmental impacts and the value of this information.

Partnerships

- Partnerships and collaboration are key—among Federal/State agencies and local entities (e.g., emergency management, law enforcement, fire services, public works, Red Cross, NWS, hospitals, local media, nongovernmental organizations [NGOs])—to strengthen the overall preparedness and response to emergencies.
- Nontraditional partners, such as faith-based organizations and nonprofits, are important partners to ensure that all communities and their residents are well informed and capable of avoiding harm's way.
- The Federal Highway Administration (FHWA) seeks enhanced partnerships to meet the need for tailored weather products/services for surface transportation.

SECTION II: MINI-WORKSHOP PRESENTATIONS

A. Introductory Comments and Presentations

Section II presents a synopsis of each invited presentation from the different agencies and stakeholders as indicated in the agenda (see Appendix B). Briefing slides for all of the presentations that were given at the Mini-Workshop can be found at http://www.ofcm.gov/wg-ssr/workshop05-2010/index.htm. After each synopsis, the key social science–related activities are summarized along with the identification of key social science needs that emerged in the presentation, in the discussion following the presentation, or from knowledge of existing research. Social science needs are assigned to broad thematic categories to highlight common requirements across the agencies. The intent is not to conceptualize the categories in an academic sense but rather to capture themes that resonated throughout the workshop in general areas. These categories are listed below with brief examples.

Risk Communication – All agencies saw the need to improve risk communication, its development, dissemination, and message, to elicit specific public responses. Two topics that recurred in the presentations were effective methods for communicating uncertainty (versus deterministic information) and reaching and communicating with socially vulnerable populations.

End-to-End Analysis – End-to-end analysis examines how information flows among the different decisionmakers based on receiver characteristics, organizational structures, the message and the method of dissemination. With an in-depth knowledge of the end-to-end process, agencies can determine how to best use the meteorological data to affect public response.

Decision Support Systems – Decision support systems, generally incorporating advanced information technology, extend traditional forms of organizational decisionmaking. A common theme was the need to better communicate scientific information to emergency managers to facilitate their decisionmaking, given their varying levels of training, access to technology, and diverse responsibilities during a hazard event.

Knowledge Transfer– There is an extensive body of knowledge and research on the nexus between disaster and the social sciences that can inform current agency operations. An important question is how to formulate effective mechanisms for implementing these findings into operations. New methods that go beyond journal articles and conference presentations need to be developed that can bridge the research-to-operations divide for this diverse group of government stakeholders. In addition, methods should be developed for agencies to share their own social science results.

Vulnerability Assessment/Economic Valuation – Agencies highlighted the need to identify socially vulnerable populations that have limited capabilities to prepare for and response to hazards. Once these populations are identified in terms of their characteristics and location, agencies may develop long-term planning, risk assessment strategies, and warning messages,

while also adjusting stakeholder roles. The development of measures of economic vulnerability to weather hazards also emerged as a need. Several participants stated that the Mini-Workshop should address not only the social impacts of meteorological data/information but also its economic and environmental impacts.

Partnerships – Effective methods of partnering with different types of stakeholders were addressed in the presentations and discussions.

PRESENTATION TITLE: *OVERVIEW OF EXPLORATORY MINI-WORKSHOP* - MR. SAMUEL P. WILLIAMSON, FEDERAL COORDINATOR FOR METEOROLOGY

SYNOPSIS: During the August 6, 2009, meeting of the Interdepartmental Committee on Meteorological Services and Supporting Research (ICMSSR), the Office of the Federal Coordinator for Meteorological Research and Related Services (OFCM) was tasked with developing recommendations and an action agenda to address the need for enhanced integration of social science results into meteorological operations and services. A similar recommendation resulted from the OFCM-sponsored 64th Interdepartmental Hurricane Conference held in Savannah, Georgia, during March 1-4, 2010. The ICMSSR action suggested that the OFCM enlist candid discussion, advice, and recommendations from affiliated meteorological agencies regarding existing communication gaps and scientific needs that, if addressed, would serve to better ensure public safety. Recent losses of life to weather hazards, such as the multiple deaths in Tennessee in April 2010 from tornadoes, underscore the ever-present need to continue improving warning systems. Concern for those most vulnerable is key. To illustrate, senior citizens and socioeconomically disadvantaged groups experience higher fatality rates than the general population. To be more effective, meteorological and flood warnings, forecasts, and services must be people-centric and reflect the complexities of peoples' lives as they receive, think through, and (where and when possible) take action.

The objectives of the Exploratory Mini-Workshop were as follows:

1. Identify agency-specific and agency-overlapping social science–related actions and social science needs/priorities as related to meteorological operations/services.
2. Compile key recommendations for potential government actions for *implementation* in meteorological forecasting and warning programs.
3. Develop an Action Agenda for the further inclusion of social science research results into meteorological operations/services.

PRESENTATION TITLE: *WELCOME* - DR. BRENDA PHILLIPS, PH.D., SENIOR RESEARCHER, CENTER FOR THE STUDY OF DISASTERS AND EXTREME EVENTS, FIRE AND EMERGENCY MANAGEMENT PROGRAM, OKLAHOMA STATE UNIVERSITY, STILLWATER, OK.

SYNOPSIS: As a prelude to the discussions to ensue throughout the Exploratory Mini-Workshop, Dr. Phillips offered examples of ways that more effective and efficient

partnerships and collaborations could better safeguard the lives of affected people. Goals for the workshop include further encouraging collaborative efforts between social scientists and meteorologists with the express goal of saving lives. Workshop sessions are intended to review what Federal agencies are doing to advance collaborations, with a focus on the critical areas of the warning process, decisionmaking, behavioral response, and social impacts and valuation. Interdisciplinary collaboration is critical to reaching these goals, particularly in areas related to the development and dissemination of weather-related messages that can reach those marginalized by economic, political, social, or cultural circumstances. Understanding behavioral response to warnings requires that those involved in collaborative efforts appreciate the complexity of human response. More-effective weather warning messages must reflect that complexity and involve user audiences in test messages; tap into social networks that people trust and believe; and use a process with redundant, diverse messaging that effectively reaches the full range of users from those issuing the warning (weather services, media, emergency managers) to the diverse communities and populations that need to respond. Innovative efforts such as Weather and Society*Integrated Studies (WAS*IS) (http://www.sip.ucar.edu/wasis/boulder) reflect current attempts to integrate meteorology with social science. Federal agencies such as the National Council on Disability encourage integrating those at risk in the process of planning messages, designing warning messages that provide population-specific instructions, and building strong relationships with social and organizational networks that link to those at risk. Such efforts, however, are only at the forefront of what must become a steady stream of collaborative efforts.

B. Partnership Collaborations: Preparedness and Response

This session addressed preparedness and response through effective and efficient partnerships and collaborations.

PRESENTATION TITLE: *EFFECTIVE DISASTER RELATIONSHIPS FOR PREPAREDNESS AND RESPONSE* - MR. WALTER DICKERSON, PRESIDENT, DIVERSIFIED EMERGENCY MANAGEMENT ASSOCIATES, INC., AND FORMER DIRECTOR, MOBILE COUNTY [ALABAMA] EMERGENCY MANAGEMENT AGENCY.

SYNOPSIS: Mr. Dickerson began his presentation with the statement that there are five, rather than four, areas within the emergency management cycle. Traditionally, the four areas have been mitigation, preparedness, response, and recovery. A fifth area, *re-entry*, was added to the cycle because of its critical role in the full cycle of recovery of individuals, families, communities, and their myriad stakeholders.

The effectiveness of the emergency management cycle is dependent on the thoroughness of planning for events through well-documented and well-communicated policies, procedures, and directives. Training and mock exercises are invaluable in the process of ensuring preparedness for meteorological events, and it is vital that both responders and citizens are actively involved in these efforts. Outreach programs that involve the media, elected officials, the NWS, citizens, and others are essential to the process.

A team approach to emergency management is deemed to be the more effective means of engaging partners in the business of protecting the public. This approach allows all involved to have a keener sense of ownership and accountability for the effectiveness of the entire operation, not just of their own part. By working as a team, those involved work collaboratively to understand that gaps in preparedness planning and limitations of educating all involved may result in avoidable loss of life. Consequently, the team becomes more vested in the end goal of preventing loss of life when each partner takes responsibility for the entire process.

It cannot be overemphasized that effective and efficient partnerships and collaborations are key—among Federal/State agencies and local entities (e.g., emergency management, elected officials, law enforcement, fire services, public works, Red Cross, NWS, hospitals, local media, NGOs)—to strengthen the overall preparedness and response to emergencies. Nontraditional partners, such as faith-based and nonprofit organizations, are important to ensure that all communities and their residents are well informed and capable of avoiding harm's way.

David Paulison, Former Director, FEMA, stated the following in a *Washington Post* article (27 August 2006), titled, "*Weathering the Next Storm.*"

> *"While emergency management should remain first and foremost a state and local responsibility, the federal government has to be prepared to engage more proactively during the initial states of a disaster. To do this, we need to enhance partnerships with state and local governments, nongovernmental organizations, and the private sector to identify where the weaknesses exist. The federal government should work with states and municipalities to close capability gaps and improve our combined, integrated response. Katrina has taught us the value of early and unified engagement."*

In summary, effective and efficient partnerships are vitally important in the comprehensive cycle of emergency management.

AGENCY-SPECIFIC SOCIAL SCIENCE–RELATED ACTION(S): Engagement of a team of stakeholders, including emergency managers, NWS forecasters, local media, faith-based organizations, and citizens, to ensure improved planning and response to natural hazards.

SOCIAL SCIENCE NEEDS/PRIORITIES AS RELATED TO METEOROLOGICAL OPERATIONS/SERVICES:

- **Knowledge Transfer**: Create mechanisms for effective transfer of social science research findings on best practices for multi-stakeholder, end-to-end preparedness and training for meteorological hazard response for application by practitioners; identify knowledge gaps in this area for further research.
- **End-to-End Analysis**: Perform a prototype field study, led by a team composed of individuals (social scientists, meteorologists, educators, emergency managers, NGOs, etc.) who will interface directly with all communities to document the flow of information to the public and the relationship of this flow to the need for added

technology access and training for emergency managers, media, National Weather Service, etc. to address gaps noted above.

- **Risk Communication**: Work through elected officials, first responders, emergency managers, and NGOs to deliver messages to citizens that are appropriate for eliciting a viable response to meteorological hazards.

PRESENTATION TITLE: *AN EXPLANATION OF THE COMPREHENSIVE EMERGENCY MANAGEMENT SYSTEM AND THE ROLE OF SOCIAL SCIENCE IN DEVELOPING PERFORMANCE MEASURES TO ACHIEVE THE HOMELAND SECURITY MISSION* – MR. DANIEL CATLETT, PROGRAM MANAGER, NATIONAL HURRICANE PROGRAM, DEPARTMENT OF HOMELAND SECURITY, FEDERAL EMERGENCY MANAGEMENT AGENCY (FEMA)

SYNOPSIS: The statutory mission of FEMA is to increase the Nation's resilience by leading and supporting the "comprehensive emergency management system." Responsiveness to this mission includes the need to reduce loss of life and property and protect the nation from all hazards, to include natural disasters. The *New* FEMA Mission is more deliberate in its identification of the stakeholders that it aims to support. Specifically, the New FEMA Mission is to: "*Support our citizens and first responders to build, sustain and improve our capability to prepare for, protect against, respond to, recover from and mitigate all hazards.*"

Hurricane Katrina and its associated emergency management cycle heralded the need to clearly articulate the definitions of emergency management, capability, capacity and responsibility as each pertains to safeguarding the public's welfare and security. The Post-Katrina Emergency Management Reform Act of 2008 (PKEMRA) [P.L. 109-295] provides the following definition of "emergency management": *the governmental function that coordinates and integrates all activities necessary to build, sustain, and improve the capability to prepare for, recover from, or mitigate against threatened or actual natural disasters, acts of terrorism, or other man-made disasters.*

While this definition is concise, it includes ambiguities, for example, what does 'capability' mean, not based on a definition in a dictionary, but rather based upon the need to save lives and property. Consequently, FEMA has defined capability as follows:

> *The term "capability" means the ability to provide the means to accomplish one or more tasks under specific conditions and to specific performance standards.*

The new FEMA mission, coupled with this definition of "capability," requires that all citizens, first responders, and stakeholders have a unity of effort, a unity of purpose, a common operating picture, a common planning picture, achievable goals, and a clear understanding of *who is responsible for what*. There must be standardized assessments of capacity, risk, and expectation to ensure that realistic and consistent planning assumptions are defined, communicated, and workable.

By engaging communities well before a severe weather event is predicted, we can better ensure reductions in hazards, vulnerabilities, and adverse consequences. This engagement

must include disseminating information, fielding questions, and ensuring that those least prepared for disaster have viable means of support. The first responders are individuals; families; and local, regional and state governments. This hierarchy of responsibilities clearly demonstrates the need for viable partnerships and collaborations designed to ensure the safety of the public.

AGENCY-SPECIFIC SOCIAL SCIENCE–RELATED ACTION(S): FEMA's post-Katrina strategy builds the requisite operational capacity to ensure a comprehensive emergency management system through a cycle of re-assessment, strategy development, process planning, mitigation, and preparedness after an event occurs. FEMA stresses the importance of engaging multiple stakeholders in this cyclic process.

SOCIAL SCIENCE NEEDS/PRIORITIES AS RELATED TO METEOROLOGICAL OPERATIONS/SERVICES

Partnering: Ensure that all understand that emergency management response to natural disasters is the responsibility of the local community first; clearly communicate to all the hierarchy of responsibility, namely, individuals, families, local, State and lastly, Federal, when confronted by adverse impacts of natural disasters.

C. Meteorological User/Provider and Supporting Research Perspectives – I

This session provided information regarding the nature of technological hazards in relationship to meteorological operations and the ways that the results of social science research are being used to reduce harm to life and the environment.

PRESENTATION TITLE: *FLOOD RISK MANAGEMENT: A VIEW TO THE FUTURE* – MS. JOAN POPE AND MR. ANDREW J. BRUZEWICZ, U.S. ARMY CORPS OF ENGINEERS

SYNOPSIS: The U.S. Army Corps of Engineers (USACE) is responsible for a spectrum of operations that includes water resources, environment, infrastructure, disasters, and war-fighting. Bruzewicz discussed USACE's plans for flood risk management, which includes oversight of the nation's dams, levees, river basins, watersheds, and coastal zones, as well as emergency response. Based on lessons learned from Hurricane Katrina, the USACE is transitioning to a systems-based approach to flood risk management. This more comprehensive approach represents a shift from focusing on short-term individual projects to focusing on interdependent projects, which take a long-term, risk-based approach including more social, cultural, ethical, environmental, political and legal considerations. This form of shared flood risk management involves multiple levels of responsibility from the definition of zoning ordinances to the formulation of building codes, evacuation plans, and insurance and to the placement and maintenance of levees. Risk should be defined and monitored at each level of responsibility. *All stakeholders contribute to reducing risk!* As part of the shift, USACE described the need to increase interaction among key government agencies and also to engage stakeholders on local, regional, and state levels. USACE has proposed the creation of an Intergovernmental Flood Risk Management project that would include FEMA, the Association of State Floodplain Managers, and the National Association of Flood and

Stormwater Management Agencies. This project would include outreach to local stakeholders.

AGENCY-SPECIFIC SOCIAL SCIENCE–RELATED ACTION(S): As part of its flood risk management responsibilities, USACE is seeking to engage a wider group of Federal, regional, and local stakeholders in a long term planning process. The USACE recognizes the importance of incorporating social science expertise in its risk assessment and its public education efforts.

SOCIAL SCIENCE NEEDS/PRIORITIES AS RELATED TO METEOROLOGICAL OPERATIONS/SERVICES.

- **Socio-technical consequence modeling**: Define socio-technical risk-based modeling of dam, levee failure, and inundation, integrated with zoning, population vulnerability, and economic considerations to 1*)* help determine the priority of infrastructure management projects within a region and across regions and 2*)* inform disaster response. This interdisciplinary effort would include the development/application of social and economic risk measures that can be mapped geospatially.
- **Risk communication**: Creation of effective communications strategies for the public about how structural approaches mitigate risk and of recommended protective actions in case of failure.
- **Partnering**: K-12 outreach should be explicitly addressed as part of the effort to communicate risk and preparedness.
- **Public response behavior**: A more comprehensive understanding of public response can be employed to inform the above activities. Issues that should be addressed include (1) the time between accurate warnings and the ability to respond and (2) whether people should evacuate or shelter in place, given the type of flooding event.

PRESENTATION TITLE: *USGS HAZARDS INFORMATION* – MR. BRIAN MCCALLUM, USGS GA WATER SCIENCE CENTER, U.S. DEPARTMENT OF THE INTERIOR.

SYNOPSIS: The United States Geological Survey (USGS), positioned within the U.S. Department of Interior, addresses four areas: water, geology, mapping, and biology**.** Brian McCallum reviewed the USGS Water Hazards Information program, an extensive and high quality source of real time and historical data from the 16,000 USGS surface water, lake and reservoir, raingauge/streamgage, ground water, wells, and water quality stations. These data are critical for flood warnings and forecasting; flood control, hurricane surge, drought monitoring, state water planning, design of bridges and roadways, waterways, water supplies for continued growth, and modeling. The USGS personnel provide the NWS with measurements of flood waters that are used to forecast expected flood crests. These forecasts, in turn, are communicated to emergency managers to save lives and protect property. Examples were shown of USGS crews measuring water levels during the September 2009 floods in Georgia. The USGS web site has many products that provide archived and instantaneous information on water. For long term planning, USGS historical measurements and modeling can determine the magnitude of flooding for a given area for future design of bridges, culverts, and roads. Inundation information can be mapped on GIS to determine

evacuation routes, potentially vulnerable populations for preparedness and mitigation, and regional planning. For short term response and water management, the USGS *Waterwatch* product provides a map of current flood and high water conditions, as well as drought conditions; *Streammail* sends user-requested information to a cell phone number or email, and the *WaterAlert* product sends a text message or email notification when user-selected water gauges pass a specified threshold. USGS is also venturing into social media with a presence on *Facebook* and *Twitter*. USGS needs help in communicating post-storm probabilistic risk and in developing and evaluating products that meet specific user needs beyond the scientific community.

AGENCY-SPECIFIC SOCIAL SCIENCE–RELATED ACTION(S): USGS provides critical data for water hazard forecasting and warnings to NWS forecasters (River Forecast Center, National Hurricane Center, and Weather Forecast Offices). These forecasts and warnings are disseminated to emergency and town managers for public safety. Historical data are available for planning. In addition, the USGS Water Hazard Information program maintains a web site with extensive real-time and archived data from its network of 16,000 water stations. The USGS is reaching out beyond the scientific forecasting community by providing user-customizable products and notifications sent through social media. USGS would benefit from an integration of social science expertise in determining how its products can best be used by decisionmakers outside NWS/NOAA.

SOCIAL SCIENCE NEEDS/PRIORITIES AS RELATED TO METEOROLOGICAL OPERATIONS/SERVICES.

- **Decision Support**: Evaluate existing USGS Water Hazard Information products to identify critical information that should be communicated to decisionmakers, who are not part of NWS, based on research on decisionmaking by forecasters and emergency managers and public response to water hazards; recommend appropriate modifications to decision support products; develop approaches in collaboration with social scientists to use social media effectively.
- **Risk communication**: Develop visual and/or text-based products to convey probabilistic information regarding water risk (based on post-storm analyses) required for preparedness and response for non-NOAA audiences.
- **Social Vulnerability Analysis**: Categorize population, infrastructure, and commerce risks for longer term water management and water hazard planning.

PRESENTATION TITLE: *PINK ZONES: METEOROLOGY, CHEMICAL WEAPONS, AND SOCIAL SCIENCE* – MR. PAUL HEWETT, CENTER FOR INTEGRATED EMERGENCY PREPAREDNESS, DECISION AND INFORMATION SCIENCES DIVISION, ARGONNE NATIONAL LABORATORY, U.S. DEPARTMENT OF ENERGY

SYNOPSIS: Paul Hewett discussed the challenges emergency managers face when interpreting complex meteorological information to plan for and react to technological hazards, specifically chemical agents. In a rapid onset event, such as the dispersion of a chemical agent, emergency managers and other decisionmakers may be challenged on how to use weather-related information most effectively. This is due to a wide variation in knowledge,

skills, and abilities associated with how chemical agents may travel as a result of meteorological and geographic conditions. Emergency managers need to incorporate meteorological data as part of efforts that identify at-risk populations. They need appropriate emergency operations plans and protective action strategies. Further, the public may not understand the risk and the complexity of ways that weather affects their potential exposure. Several critical questions, which require an in-depth understanding of weather, hazard, population location, and likely behavioral response include:

- Where is the plume going?
- When will it get there?
- What are the consequences?
- What should the public do?

SOCIAL SCIENCE NEEDS/PRIORITIES AS RELATED TO METEOROLOGICAL OPERATIONS/SERVICES

- **End-to-End Analysis**: This pilot could be broadened to a wider group of emergency managers with the goal of creating training and identifying the key decision criteria for emergency managers given their tasks and the nature of the threat.
- **Decision Support Product Development**: How well is the intended message communicated to emergency managers given an overload of weather information from sometimes disagreeing sources? Decisionmakers must understand uncertainty and integrate it into their plans and actions.
- **Risk communication**: During a technological hazard event, what weather information should be communicated to the public in order to motivate the desired protective actions?
- **Vulnerability Assessment**: Are warning messages and alerts currently informative only for the middle class, or are they truly applicable across a broad and diverse population? Language and literacy barriers may prevent dissemination of risk information and protective action recommendations.

PRESENTATION TITLE: *RECENT SOCIAL SCIENCE RESEARCH TO ENHANCE EMERGENCY PREPAREDNESS* – MS. SARA K. MROZ, OFFICE OF NUCLEAR SECURITY & INCIDENT RESPONSE, U.S. NUCLEAR REGULATORY COMMISSION

SYNOPSIS: Within the United States, there are over 100 nuclear plants regulated by the U.S. Nuclear Regulatory Commission (NRC.) It is part of the mission of the NRC to ensure adequate protection of public health and safety with regard to these plants. For each nuclear plant, emergency planning zones (EPZs) are defined. These zones correspond to designated geographical areas within a 10-mile radius of a nuclear plant. The level of threat varies for each zone, depending on prevailing meteorological conditions, topography, etc. Protective action recommendations (PARs) are defined for each zone and used to safeguard the well-being of life in case of an emergency.

Sara Mroz presented recent social science research conducted by NRC to explore public understanding of the PAR process and how alternative PAR schemes could be received/accepted by the public. The results showed that the public was relatively well informed about PAR and that given proper messaging, it seemed likely that the public would follow a staged evacuation and also shelter in place if asked. The NRC research also confirmed that emergency workers would respond (vs. only addressing their personal safety) in an emergency. The survey identified a gap in the PAR for special needs populations that do not reside in special facilities. Based on this study, protective action plans were revised to address this population segment. Results of this research are published in NUREG/CR-6953 (ML0831104060). The results of the survey and the protective action plans can be seen on the NRC web site. As a follow-on to the research, the NRC contracted with a communications specialist to craft messages and a communications template for the revised PAR. The results of this effort are not yet available for public review.

AGENCY-SPECIFIC SOCIAL SCIENCE–RELATED ACTION(S): The NRC uses social science expertise to evaluate and enhance protective action recommendations for nuclear emergencies through the use of public surveys. It has also engaged communications specialists to create templates and make recommendations on crafting effective messages to the public on staged sheltering and evacuation instructions.

SOCIAL SCIENCE NEEDS/PRIORITIES AS RELATED TO METEOROLOGICAL OPERATIONS/SERVICES.

- **Vulnerability assessment**: There is a need to improve the preparedness of and support for special needs populations that are not in emergency-ready facilities.

- **Knowledge transfer**: The NRC social science research uncovers important information on public access and interpretation of warning and sheltering messages, as well as methods of identifying population segments with unmet needs. When the communications research is complete, it will also provide useful information on risk communication that could be used by other agencies. Mechanisms to share research information across government agencies would be helpful.

PRESENTATION TITLE: *ROAD WEATHER HAZARDS* – MR. PAUL PISANO, TEAM LEADER, ROAD WEATHER MANAGEMENT, FEDERAL HIGHWAY ADMINISTRATION, U.S. DEPARTMENT OF TRANSPORTATION

SYNOPSIS: The number of fatalities attributable to the combined effects of road travel and weather far exceeds the number of fatalities due to all other severe weather events combined. As published in 2008, 24% of all crashes were weather-related, specifically, 1.6 million crashes, 673,000 injuries, and 7,400 fatalities. Further, the cost of congestion is $9.45 billion per year for 85 major urban areas. Weather-related delays add $3.4 billion to freight costs annually, which also affects overall productivity. Chemicals that are used to treat road conditions also affect watersheds and air quality and can damage infrastructure. Mr. Pisano

further indicated that the economic impact of road closures from storm-related events in the winter of 2008-09 exceeded $3.82 billion. These costs, borne by fifteen states, herald a need for surface weather models to support road weather managers and the traveling public. Such models should predict time and space changes at the surface and on geographical/regional scales tied to transportation needs. Clearly, incorporating the needs of transportation managers as well as the traveling public into collaborations between meteorologists and social scientists would be useful.

Decision support systems support the need to integrate large amounts of weather-related data and information into usable formats needed to facilitate and make timely decisions. Examples of these systems and related efforts include:

- Maintenance Decision Support Systems (MDSS).
- *Clarus System* & Regional Demonstration.
- Integration of Weather information into Traffic Management Centers.
- Developing "Weather Message Guidelines."

AGENCY-SPECIFIC SOCIAL SCIENCE–RELATED ACTION(S): The primary objective of US DOT initiatives is to identify ways to disseminate road weather information to transportation managers and users in a manner that is understandable, useful, effective, and actionable. High resolution weather forecasts relevant for transportation require a network of in situ measurements that characterize changing meteorological conditions. The FHWA has developed a mesonet to address this requirement, namely, the *Clarus System.* Additionally, in situ measurements may be available from mobile observing platforms, i.e., weather and road condition data from vehicles such as a system currently being piloted called IntelliDrive^{SM}. Additional information regarding IntelliDrive^{SM} is available at the following web sites: http://www.its.dot.gov/intellidrive and http://www.intellidriveusa.org.

SOCIAL SCIENCE NEEDS/PRIORITIES AS RELATED TO METEOROLOGICAL OPERATIONS/SERVICES

- **Partnering**: There is a need to build bridges across agencies to raise awareness and educate key communities, particularly, State DOTs and NWS. We should partner further to address user needs that mitigate societal impacts including traveler safety, economic well-being, the environment and infrastructure. Doing so involves increasing dialogue between the decisionmaker (e.g., State Departments of Transportation) and the provider (e.g., Weather Forecast Offices) in a way that incorporates and addresses transportation-related needs.
- **Risk communication**: We should not assume that the answer to enhanced safety is better 'packaging' of weather data and information and insure that weather-related messages are consistent. It is particularly important to package weather information with the needs of transportation managers in mind as well as other end-users.
- **Knowledge Transfer**: There is a need to develop on-line road management training courses that include weather information and messaging from both the meteorological community and the social sciences.

- **End-to-End Analysis**: Improved weather prediction models, namely, high resolution weather forecasts are needed for ground level operations with links to transportation-based observing systems.

D. Meteorological User/Provider and Supporting Research Perspectives - II

This session addressed the current and planned use of results of social science research for meteorological operations and services.

PRESENTATION TITLE: *A30-W: AIR FORCE WEATHER* – LT COL THOMAS C. MOORE, DIRECTORATE OF WEATHER, DEPARTMENT OF DEFENSE, U.S. AIR FORCE

SYNOPSIS: The USAF issues its weather watches/advisories/warnings based on the needs of the Warfighter. For example, base commanders must make decisions to move assets out of harm's way in advance of events; doing so requires considerable lead time in order to prepare, stage and deploy both personnel.

There are numerous challenges related to the weather watch/advisory/warning process. For instance, communication across the various offices and with personnel on an Air Force Base can be challenging. When assets are being evacuated, such as before an approaching severe thunderstorm event, people may not have time to acquire, evaluate and act on newly-arriving weather information. Other recent threats affecting the Air Force have included both storm surge and volcanic ash, both of which are outside the scope of experience and responsibility for most Air Force forecasters, and as such, involve coordination with other agencies. Both of these events are challenging to assess and explain to decisionmakers as they each carry uncertainties in predicting movement, strength and impact. Also, both military personnel and civilian workers and their families must be considered when acquiring and disseminating weather information. The delivery of weather information is further challenged by the myriad of user needs. For example, a decisionmaker may require wind speed and direction, the size of the predicted threat (e.g., hail), and other information. The time of day may also matter. For example, a tornado threat at the end of a work day threatens civilian populations and others traveling off-base. Coordination between base personnel and those in surrounding jurisdictions is necessary and requires appropriate weather information. Finally, constant staff turnover on bases also means that continual education is necessary at all levels, from base commanders to civilian populations.

AGENCY-SPECIFIC SOCIAL SCIENCE–RELATED ACTION(S): USAF indicated a desire to collaborate with social scientists to better understand the current tools and technology available to disseminate warnings to its customers, and how customers can/will use these tools. To a lesser extent, the USAF seeks to understand how non-military customers (e.g., dependents) perceive and act on Air Force weather warnings.

SOCIAL SCIENCE NEEDS/PRIORITIES AS RELATED TO METEOROLOGICAL OPERATIONS/SERVICES.

- **Vulnerability Assessment:** The USAF seeks to better understand the broad array of customers, including both military and non military, which may use USAF weather products.
- **Partnering.** The USAF identified a need to strengthen collaborations between USAF and other federal agencies in order to better secure weather information, particularly during regional/national natural disasters/events. For example, better coordination and collaboration between federal agencies such as DHS and the NWS and US military services during national events such as the Winter Olympics would alleviate conflicting forecasts and duplicated effort, while better communication between US military services and the NWS/NHC during signification tropical storm landfall would ensure affected populations were receiving the same information/direction.
- **Knowledge Transfer:** To provide better data to DoD leaders for future crisis planning purposes, a need exists to connect with social scientists for purpose of better understanding population migration specific to the USAF/DoD customer base, and how such movement influences impact of severe weather events, and delivery of weather information.

PRESENTATION TITLE: *DOD NAVY PRESENTATION* – MR. KIM CURRY, DEPUTY TECHNICAL DIRECTOR, DEPARTMENT OF DEFENSE, U.S. NAVY

SYNOPSIS: Deputy Technical Director Curry continued discussion of weather hazards for military users. Similar issues resonated in this presentation as with the USAF. For instance, to move a Navy ship out of harm's way requires at least 72 hours lead-time with a preference of 120 hours lead-time. Aircraft require 36-48 hours to deploy to safe locations. The rapid turnover of personnel, typically every 2-3 years, makes it challenging to retain an educated critical mass of decisionmakers. Also of concern is education of the civilian population, including K-12 students. Those subject to potential risk from technological hazards (nuclear, chemical, biological) are trained on base but civilians living on base or nearby may not have such training.

AGENCY-SPECIFIC SOCIAL SCIENCE–RELATED ACTION(S): Navy weather support is centralized at specific hubs but additional weather information sources may be used by those connected to the U.S. Navy including civilians and family members. To illustrate, tornado and flood warnings are provided by NOAA, the National Weather Service or local television at a number of sites. Social science support is characterized as currently lacking in the present weather information and decisionmaking structure.

SOCIAL SCIENCE NEEDS/PRIORITIES AS RELATED TO METEOROLOGICAL OPERATIONS/SERVICES

- **Risk Communication**: There is a significant need to enhance social science support in the existing weather information delivery structure. Consequently, the US Navy presenter reported a need for additional knowledge that enhances awareness of the full range of those affected.
- **Knowledge Transfer**: One recommendation is to develop a social science

briefing protocol that links to local emergency managers. Additional training, with a particular emphasis on training Kindergarten through 12th grade students, teachers and administrators, would be helpful as well.

PRESENTATION TITLE: *NWS SOCIAL SCIENCE ACTIVITIES* – MR. DAVID CALDWELL, DIRECTOR NWS OFFICE OF CLIMATE, WEATHER AND WATER AND MS. JENNIFER M. SPRAGUE, NWS SOCIAL SCIENCE FOCAL POINT.

SYNOPSIS: NWS has taken advantage of social sciences since the 1970s, but now recognizes the need for greater focus and has developed a plan for integration of the social sciences into NWS products and services. This Presentation summarizes these NWS plans.

EARLY NWS SOCIAL SCIENCE APPLICATIONS[1]: In the early 1970s, social scientists were engaged by NWS to help fine tune and reword warnings to ensure an effective message was delivered to emergency managers, first responders (fire, police and medics) and the media. A course was developed by Dr. Benjamin McLuckie, entitled "*Warning – A Call to Action*," designed to communicate the key factors that best motivate people to take proper action in response to NWS watches, warnings and advisories. This led NWS to change the structure of its warnings with the overall intent to blend very time efficient weather warnings text with response-motivating "call-to-action" (CTA) statements intended to prompt public response. NWS incorporated CTA descriptions into its internal technical directives and they became a standard feature of NWS products.

CURRENT NWS PLANS: While NWS recognizes work has been done to integrate social science into meteorological operations, NWS believes more could be done to (1) understand how customers/users perceive and use NOAA products and services, (2) understand customer/user risk perception and assessment, (3) improve communication of information for effective decisionmaking, and (4) understand the economic value of NWS products and services.

At the Workshop, NWS described agency efforts to incorporate social science results into meteorological operations, including the inclusion of social science into the Agency high-level strategic plans and Roadmaps:

- Drafting a NOAA Next Generation Strategic Plan that includes a social science component.
- Involving the NOAA Chief Economist as a NOAA Senior Advisor for Environmental Social Science.
- Drafting a NWS Strategic Plan that includes social science and decision support components.
- Working on an NWS Science and Technology Roadmap and NWS Services 2020 Roadmap that includes social science elements.

[1] Mr. William "Bill" Proenza, NWS Southern Region Director, was interviewed after the Exploratory Mini-Workshop and provided historical context especially helpful for this section. See Appendix C for a summary of Mr. Proenza's interview.

NWS also discussed plans to utilize social science to enhance the understanding of uncertainty and thus better communicate risk. A particularly desirable outcome is to improve call-to-action statements in ways that incorporate up to date social science methodologies (e.g., recognition of cultural differences and the effects of social networks on response). The potential to use more current technology was noted as important, including improved graphic design and exploration of the use of social media. Examples were provided of local weather forecast offices working with key stakeholders to improve the consistency and content of the message to the public in consultation with social scientists.

AGENCY-SPECIFIC SOCIAL SCIENCE–RELATED ACTION(S): NWS social science projects underway address tsunamis and storm surge; updating the NWS "Forecast-at-a-Glance" web pages to better convey risk and uncertainty; including a social scientist on NWS Service Assessments (e.g., the "Super Tuesday" and "Mother's Day" Assessments); utilizing social scientists on the NWS Customer Satisfaction Survey and undertaking research relating to the economic valuation of the Hurricane Forecast Improvement Project and the Climate Prediction Center Products. Other NWS social science projects in the planning phases include better communication of flood risk and communications about fire weather information tied to societal actions.

SOCIAL SCIENCE NEEDS/PRIORITIES AS RELATED TO METEOROLOGICAL OPERATIONS/SERVICES.

- **End-to-End Analysis**: There is a need to better understand societal response to NWS forecasts and warnings and apply this information towards the development of clear, actionable information, geared towards user needs.
- **Economic Valuation**: Develop ways of measuring the economic value of the different types of weather information for socio-economic impacts to help determine funding priorities for research, development and operations.
- **Partnership**: It is necessary to further engage social scientists in the development of a NOAA strategy to ensure the early integration of socio-economic issues in NOAA programs.
- **Risk Communication**: It is recommended that research be conducted to more effectively measure how NWS products and services convey risk and uncertainty.
- **Decision Science**: To identify key decision points from NWS/NOAA partners that can provide data and information, influence actions and enhance decisions made by the broader stakeholder communities.

PRESENTATION TITLE: *CASA'S APPROACH TO TEST BEDS AND END-TO-END SYSTEM DESIGN* – MS. BRENDA PHILIPS, END USER INTEGRATION RESEARCH LEADER, ENGINEERING RESEARCH CENTER FOR COLLABORATIVE ADAPTIVE SENSING OF THE ATMOSPHERE (CASA), UNIVERSITY OF MASSACHUSETTS, AMHERST

SYNOPSIS: CASA, a National Science Foundation funded engineering research center has

created a new paradigm for atmospheric sensing based on the creation of low-power, low-cost, X-band radar networks that provide high resolution, lower atmospheric observations. CASA's current focus is on severe thunderstorms (hail and high winds) and tornados. A key part of CASA's research involves a multidisciplinary team of social, physical and technical scientists who evaluate and design CASA technology in the context of the different stakeholders and the end-to-end warning system. This team seeks to understand how severe weather warning information flows among these different stakeholders and out to the public in light of technical, social, behavioral and demographic considerations. CASA operates a prototype end-to-end test bed in southwest Oklahoma with 4 node radar network that disseminates data in real time to NWS forecasters, and emergency managers with jurisdictional responsibility in the test bed. The End User integration team conducts its research during real time events and post event analyses through participant observation, archive case review, focus groups and surveys.

A review of a recent tornado that occurred in the test bed demonstrates how CASA interacts with different stakeholders. CASA participates the NOAA Hazardous Weather Test bed where off duty NWS forecasters evaluate CASA data in real time and review archived data for decisionmaking and technology evaluation; using a multi-method approach, CASA has begun to document how emergency managers' weather assessment, decisionmaking, and warning communications change as a severe weather event progress; a national survey is underway to provide a quantitative analysis of how the different sectors of the public receive, interpret and respond to severe weather warning information. Most recently, CASA researchers are beginning to evaluate *integrated* decisionmaking between NWS forecasters and Emergency managers by using social media chat rooms and twitter. The presentation concluded with lessons learned on effective interdisciplinary research. They are: working with users on a new paradigm requires finesse; Engineers/meteorologists need to know the users and their behavioral, technical and societal context; social scientists need strong understanding of technology; test beds are an effective way to foster collaboration among disciplines and between academics and practitioners. Bridging the very quantitative work of physical and technical science and the more qualitative work of social science is hard; Iterative design, deployment and evaluation is key.

> **AGENCY-SPECIFIC SOCIAL SCIENCE–RELATED ACTION(S):** CASA engages social scientists in its research to determine how social, demographic, and organizational factors could influence the use and effectiveness of a new technology. The program examines the technology in the context of the end-to-end warning system

E. Discussion

The final session of the Exploratory Mini-Workshop provided participants with an opportunity to discuss known and perceived gaps in the delivery of meteorological data, information and services to stakeholder communities. A broad definition of stakeholder communities was assumed throughout the discussion. Members of these communities include the public; local, state and federal agencies; businesses; and NGOs (NGOs.) Each participant was asked to offer their perspective, in general and specific to their agencies, regarding ways

to further integrate social science tenets and research findings into meteorological services.

Participants acknowledged that the work of social scientists is evidenced in the delivery of meteorological services by the fact that the vast majority of the public remains safe during severe weather and technological hazard events. It is anticipated that further inclusion of the work of social scientists can serve to reduce loss of life and the dollars spent to address the impact and aftermath of these events. While this action is commendable, it was also acknowledged through general consensus that more could be done to safeguard those least prepared to endure the impact and hardships of severe meteorological events. Subsequently, the need still exists to communicate risk and preparedness measures more effectively to all sectors of the population, particularly to those who may need additional assistance. To address this need, participants stated that meteorological messages must be tailored to reach diverse groups of people in ways that serve to better safeguard their lives and mitigate damage to property.

The discussion has been captured under six topic areas. These areas are: (1) risk communication, (2) end-to-end analysis, (3) decision support systems, (4) knowledge transfer, (5) vulnerability assessment/economic valuation, and (6) partnerships. Topic areas listed parallel areas of emphasis highlighted during presentations delivered during Sessions 2 and 3. For each topic area, a brief defining statement is provided followed by Concerns/Needs that were highlighted during Session 4. It should be noted that some key points are captured under more than one topic area. This is attributable to the varied emphases provided by Workshop participants. A summary of concerns/needs under each topic area follows.

Risk Communication

Risk communication is defined, in the context of this Workshop, as the proactive dissemination of information that defines the likelihood and consequences of and preparedness for severe weather events. The most effective level of risk communication is that which results in an absence of loss of life. When this level is not obtained, ways must be sought to better assist people in their individual and collective need to remain safe. The theme of risk communication covers a number of areas that involve development, transmission, receipt and interpretation of weather information. A number of areas were identified that require greater collaboration between the meteorological community, end-users/practitioners and social scientists in order to enhance risk messaging, particularly for highly vulnerable populations. Key points of discussion for this area and their associated needs are provided below.

Concern: In some instances, the meteorological community and media disseminate fragmented, disjointed "bits and pieces" of risk-related messages.
Need: A more robust nomenclature for weather-related risk communication must be devised and implemented to better safeguard the public.

Concern: The single most challenging aspect of risk communication appears to be defining for and communicating to the general public and emergency managers the

probability and uncertainty surrounding risk associated with meteorological events.
Need: Further translate the language of meteorologists into the language of the general public. To address this need, further engagement is needed by those who serve the public, to include social scientists, emergency managers, first responders, and NGOs.

Concern: The meteorological terms ‘watch’ and ‘warning’, and their implied meanings and implied ‘calls for action’ are confusing and not well understood by a large segment of the population.
Need: Define words or phrases that clearly and concisely communicate the specific need for action throughout the range of meteorological events.

Concern: Graphics that deliver information sometimes lack consistency as well as content and are not necessarily understandable. For example, it is confusing to use colors other than ‘red, yellow and green’ to communicate ‘danger, caution, and safety.’
Need: Examine ways to ensure that consistent, easily understood warning messages are communicated.

End-to-End Analyses

End-to-end analyses examine how information flows among the different decisionmakers based on receiver characteristics, organizational structures, the message, and the method of message dissemination, which forms the basis of the social and economic impact of a hazard.

Concern: There exists a further need to "complete the forecast", meaning that we need a more comprehensive understanding of how information travels from forecasts to end-users.
Need: Establish a testbed between meteorological forecasting and a variety of end users for purpose of following a weather warning message from "end-to-end", namely, from onset to recovery.

Concern: The meteorology community and/or the media need ready access to information delineating where to turn (e.g., research centers) and/or who to turn to (e.g., social scientists, communication specialists, journalists, etc.) to find information, consultation and other assistance, which can be understood by the public, before, during and after a meteorological event.
Need: Develop a list of individuals who understand the languages of both the meteorologists and the public, and are available to talk to the media and serve as ‘translators’ for meteorologists, hydrologists and stakeholders.

Concern: In some instances, silos exist that separate those who generate forecasts, namely, meteorologists, from those that have a need to prepare for, mitigate against and recover from meteorological events.
Need: Facilitate further cross-disciplinary interaction to communicate social science knowledge to key meteorology-related decisionmakers, on crafting and disseminating weather information, varied behavioral responses to warnings, and the value of social networks to deliver weather information.

Decision Support Systems

Decision support can be defined as assistance, from knowledgeable individuals or from the use of computer-based models, which can be used to aid an individual, group or organization in their need to determine which choice, of many, to select. Examples of choices for both emergency managers and the public include: evacuate or stay, in the event of a hurricane or tornado; slow or maintain posted speeds, when driving during light rain or fog; or adhere to posted signs of flooded roadways, or risk driving through an often driven road. These examples highlight a general need to continue to develop and revise decision support tools that enable end-users, particularly emergency managers and first responders, to make decisions that safeguard the public.

Concern: There is limited knowledge of the extent, depth, and breadth of available social science research findings that are relevant and adaptable for use by the meteorological community or by the media responsible for communicating weather predictions and warnings. Considerable research exists that could be of value; however it is not known, shared or used.
Need: Define ways to coalesce social science research findings as a resource available for access by those responsible for preparedness and mitigation efforts.

Concern: Some words or phrases used by those who communicate meteorological warnings and predictions do not spur appropriate public actions or reactions.
Need: Identify key words and phrases that both motivate and result in preparedness, mitigation and recovery actions needed to ensure public safety and resilience.

Concern: There is loss of life during a wide range of meteorological events, particularly, 'short-fused' events, such as flash floods, thunderstorms and tornados. It was noted that more people lose their lives in weather-related traffic accidents than during the combined types of severe weather, yet surface weather forecasts are not generated by the National Weather Service.
Need: Develop predictions of surface weather conditions and develop a catalog of diverse meteorological warning messages that can be understood by all sectors of the traveling public.

Knowledge Transfer

Knowledge transfer is the process of exchanging timely, useful, fact- and experience-based data and information with decisionmakers, which include the public, who must prepare and respond to severe weather events. Federal, state and local governmental agencies and NGOs are driven by missions, which in most instances, integrate the fundamental tenets of social sciences, to include protect and serve the public. Subsequently, agencies have the inherent responsibility to ensure that their work benefits the public-at-large. Participants commented on the further need to transfer social science findings to the meteorological community. Efforts ranged from the development of a compendium of social science research findings to training and education preparedness and response courses for both emergency managers and

first responders.

Concern: Meteorologists are not trained to understand the most effective ways to concisely communicate predictions, warnings and watches to the public-at-large.
Need: Encourage program managers within governmental and NGO agencies to obtain social science knowledge and related training.

Concern: Sometimes children are neglected from the audience receiving targeted weather messages.
Need: Provide additional outreach to K-12 children to better educate and prepare them for the dangers of severe weather and the actions that they should take during severe weather events.

Concern: At present, social science research findings that are relevant to weather are not readily available and exchanged across federal agencies. There is a tendency to share 'snapshots' of what is known rather than 'manuals' on how to incorporate research findings into operations.
Need: Develop a repository of social science findings that are centralized and organized to serve the needs of emergency managers and first responders, NGOs and the media.

Vulnerability Assessment/Economic Valuation

While it is clear that some populations remain differentially at risk, more is needed to ensure that all members of the public receive weather messages and are prepared to take action when warranted. These populations may vary by agency. Strategies to reduce the risks faced by those communities must be developed and/or transferred between the social science community and those tasked with weather dissemination, to include practitioners that use meteorological information.

Concern: Economic valuation of the costs, both direct and collateral, of weather-related events is needed to define the value-added benefits of mitigation strategies. As an illustration, the U.S. Navy has estimated the cost of deploying ships and aircraft during severe weather events; however, it has not included in its estimates the lost staff hours and the economic costs associated with these hours.
Need: Establish a protocol, if one does not already exist, for defining the economic valuation of a hierarchy of meteorological events, for different industries, ensuring that the guiding assumptions are clearly stated and the resultant statistics are all-inclusive.

Concern: Statistics defining weather related fatalities do not include those that occur on the roads and highways.
Need: Ensure that statistics detailing weather-related fatalities include roads and highway fatalities.

Partnerships

Preparedness and mitigation efforts allow the public an opportunity to develop and

implement plans of action to safeguard their lives and the lives of those that they serve to protect; and to prevent predictions of meteorological events from resulting in disastrous consequences. In this context, the 'public' refers to individuals and families, emergency managers, first responders, volunteers, elected officials and other support personnel. These efforts allow individuals, families, communities, and states to safeguard the lives of those whom they are responsible to protect before, during and after a meteorological event. Countless reasons exist to initiate and strengthen collaborations among federal agencies as well as with social scientists, emergency managers, first responders, NGOs and the broader community of people.

Concern: The National Weather Service (NWS) highlighted the need to address societal preparedness in the event of severe meteorological events, even though the Federal Highway Administration (FHWA) stated that there is more loss of life as a result of less severe events, e.g., rainfall and fog, than during and after flooding, tornadoes and hurricanes combined.
Need: Explore partnerships to address the weather needs of the traveling public.

Concern: Based upon statements made by Workshop participants, a 'clearinghouse' of best practices, as defined by the broader social science community, does not exist. This clearinghouse could serve to inform meteorological services and preparedness and mitigation efforts across agencies and reduce redundancy of efforts.
Need: Develop an inventory of best practices, categorized with respect to user groups, that is readily accessible to the range of stakeholder communities.

Concern: Military bases have transient personnel – enlisted, career and civilian. As people leave the military, their meteorological services' expertise also leaves.
Need: Engage social scientists for purpose of better understanding population migration specific to the USAF customer base and how such movement influences delivery of weather information.

SECTION III: OUTCOMES

A. Lessons Learned from Existing Agency Initiatives

Presentations delivered by federal agencies highlighted the existence of weather-related operational processes, research programs, tools, data and initiatives that serve the needs of the public and can be adapted and/or adopted for use by others. A broader dissemination of existing 'lessons learned' is both cost-effective and 'ready-now'; and removes unnecessary redundancy of effort from potentially oversubscribed budgets. Examples of agency-based 'lessons learned' that can be replicated by others include the following:

Argonne National Laboratory: Argonne National Laboratory has created multiple products that can be used during a technological hazard/event. For example, Argonne National Laboratory has developed free, downloadable software called the Special Population Planner (SPP) in cooperation with the Alabama Emergency Management Agency and six Alabama counties. SPP is GIS-based software specifically designed to aid in preparedness among special needs and populations in need of added support. The SPP was first used in 2001 and is being used currently for emergency preparedness planning for nearly 5000 special needs residents of Alabama. In March 2007, the open source SPP 4.0 was released on SourceForge.net (http://sourceforge.net/projects/spc-pop-planner/).

Federal Highway Administration: High resolution weather forecasts relevant for transportation require a network of in situ measurements that characterize changing weather conditions. The FHWA has developed a network of sensors to address this requirement, namely, the *Clarus System.*

National Weather Service: The NWS Forecast Office in Kansas City/Pleasant Hill, Missouri has created an Integrated Warning Team. This partnership has resulted in the local weather service and the media using consistent graphics and messages for severe weather watch and warning statements. NWS social science projects in the planning phases include hurricane forecast improvement and economic valuation, better communication of flood risk, improved communications about fire weather information tied to societal action, and is planning to convene a call-to-action team and service assessment teams.

Nuclear Regulatory Commission: The NRC uses social science expertise to evaluate and enhance its protective action recommendations for nuclear emergencies through the use of public surveys. It has also engaged communications specialists to create templates and make recommendations on crafting effective messages to the public on staged sheltering and evacuation instructions. These messages can be adapted for broader use.

United States Air Force: The USAF bases are communities that include both military and civilian populations and children. Weather-related preparedness and recovery operations overlap the needs of larger communities. In some instances, the policies, processes and procedures employed on bases may be adaptable for the non-military public.

United States Geological Survey: The USGS provides critical data for water hazard

forecasting and warnings to NWS forecasters (River Forecast Center, National Hurricane Center, and Weather Forecast Offices.) Additionally, these data are disseminated to emergency and town managers for use in ensuring public safety; and historical data are available for planning. The USGS Water Hazard Information program maintains a web site with extensive real-time and archived data from its network of 16,000 water stations. The USGS is reaching out beyond the scientific forecasting community through the provision of user-customizable products, and notifications through social media.

National Science Foundation-sponsored Engineering Research Center (ERC) for Collaborative Adaptive Sensing of the Atmosphere (CASA): CASA, a National Science Foundation funded Engineering Research Center, is creating a new paradigm for atmospheric sensing based on the creation of low-power, low-cost, X-band radar networks. These networks provide high resolution, lower atmospheric observations. CASA's current focus is on severe thunderstorms (hail and high winds) and tornados. A key part of CASA's research involves a multidisciplinary team of social, physical and technical scientists that designs and evaluates CASA technology in the context of different stakeholders and end-to-end warning systems. This team seeks to understand how severe weather warning information flows among these different stakeholders and out to the public, in light of technical, social, behavioral and demographic considerations. CASA operates an end-to-end test bed in southwest Oklahoma with 4 node prototype radar network that disseminates data in real time to NWS forecasters, and emergency managers with jurisdictional responsibility in the test bed.

B. Key Action Items

Presentations and discussions revealed a clear need for the further integration of the social sciences into meteorological services. While many concerns and needs were raised, the identified key actions encapsulate areas deemed to provide results that are adaptable and cross the federal agencies and organizations. These key action items, as aligned with the objectives of the Exploratory Mini-Workshop are as follows:

Objective 1: Identify agency-specific and agency-overlapping social science–related actions and social science needs/priorities as related to meteorological operations/services.

- **Action**: Develop a repository of 'best practice' warning messages and 'best practice' graphics, categorized by type of weather event, which is tailored to various sectors of the public.
- **Action**: Establish a website that allows the fifteen agencies that provide or use meteorological data and information to broadly disseminate their practical applications of social science efforts for purpose of enhancing public safety and reducing replication of efforts.

Objective 2: Compile key recommendations for potential government actions for *implementation* in meteorological forecasting and warning programs.

- **Action**: Explore partnerships to address the weather needs of the traveling public.
- **Action**: Create a central web site for social science/weather-related documents and organize a virtual working group that allows for topical and scenario-based discussions, works in progress, as well as a directory and interactions among social scientists, emergency managers, first responders, NGOs and the meteorological community. Outcomes should result in a set of tools that users take away for immediate application in their agencies, organizations and communities (e.g., effectively crafted messages for diverse end-users); acquisition of a body of social science knowledge particularly risk communication principles for future use.
- **Action**: Develop a COMET®-like [COMET®- Cooperative Program for Operational Meteorology, Education and Training] module that can serve to educate emergency managers, first responders, NGOs, media and others on ways to better communicate the message of weather to the public-at-large.

Objective 3: Develop an Action Agenda for the further inclusion of social science research results into meteorological operations/services.

- **Action**: Establish a protocol, if one does not exist, for defining the economic valuation of a hierarchy of meteorological events, for different industries, ensuring that guiding assumptions are clearly stated.
- **Action**: Create a Rapid Assessment team that would conduct rapid 'lessons learned' after an event, much like the NWS Storm Assessment Teams, and the emergency managers 'hot wash.'
- **Action**: Perform a prototype field study, led by a team comprised of individuals (social scientists, meteorologists, K-16 educators, emergency managers, first responders, NGOs, etc.) who will interface directly with all communities, and document the flow of weather information, identifying gaps in communication, understanding and actions taken.
- **Action**: Identify a realistic means to regularly engage federal agencies on issues related to ways to safeguard the public that does not over-task those already involved on multiple committees. The means must incorporate a wider range of social scientists, emergency managers and first responders.

C. The Way Ahead

According to data from NOAA Office of Climate, Water and Weather and the Federal Highway Administration, during the period from 1980-2009, weather-related fatalities exceeded 200,000, with the majority of fatalities resulting from weather-related highway accidents. For the same time period, the National Climatic Data Center estimates that over $700 billion were spent from the same period to address the impact and aftermath of weather-related events. These facts herald the need to continually seek ways to reduce loss of life and minimize economic losses. This can only be accomplished through the full

engagement of those tasked with protecting the public, namely, emergency managers, first responders, etc., teaming with social scientists that are skilled at communicating concise, effective messages to all sectors of the public, and meteorologist who understand the science of weather. Collaborative partnerships benefit from a reduction in overlapping initiatives and redundancies in effort, thereby resulting in mutually beneficial and cost-effective relationships and solutions. The requisite plan forward must learn from the past and continually improve upon current strategies that safeguard life. These improvements must be iterative by design and address the processes of evaluation, mitigation, preparedness, response, re-entry and recovery. Existing social science research and new event-based qualitative and quantitative social science research should be formally included in this iterative cycle.

The OFCM Exploratory Mini-workshop '*Framing the Questions – Addressing the Needs: Moving to Incorporate Social Science Results into Meteorological Operations/Services*, has identified key action items that will serve to enhance public safety and, over time, begin to mitigate damage to property through changes in policies and regulations governing the built environment. From end-to-end, the active engagements and partnerships among social scientists, emergency managers, first responders, governmental organizations, NGOs, and the public can result in significant reductions in weather-related fatalities and injuries, and dollars spent to address the impact and aftermath of weather-related events.

Specific proposed actions regarding the way ahead include:

- Brief results at the June 25, 2010, Interdepartmental Committee for Meteorological Services and Supporting Research (ICMSSR); obtain feedback from ICMSSR members **(COMPLETED)**

- OFCM reviews/edits this report, obtains feedback from participants, and releases report to ICMSSR members **(COMPLETED)**

- Recommend to ICMSSR members to form an OFCM-sponsored Working Group for Social Sciences **(COMPLETED; ICMSSR APPROVED)**
  - Begin executing actions/recommendations from this report (develop an Implementation Plan)
  - Reach out to a multitude of stakeholders/partners such as American Meteorological Society (AMS), National Weather Association (NWA), Intelligent Transportation Society of America (ITS-America), Friends and Partners for input and feedback

- Brief status at future Interdepartmental Hurricane Conferences, ICMSSR, and FCMSSR meetings

SECTION IV: APPENDICES

Appendix A - Social Science Primer: *Towards the Further Integration of Social Sciences into Meteorological Operations*

Weather predictions are used by people on a daily basis to make decisions that directly influence their safety, quality of life, economic vibrancy, and future plans. These predictions are produced using meteorological operations, which integrate knowledge of the physical and social sciences to ensure that people are best served. Simply stated, the physical sciences generate weather predictions and the social sciences ensure that the predictions are communicated and used by people in effective and efficient ways. Social sciences with histories of producing disaster research include sociology, psychology, political science, economics, and geography. Studies spanning decades of work exist that focus on warnings, decisionmaking, evacuation, sheltering, and societal impacts. This extensive body of work can inform our understanding of how weather information is used (or not) by the public. Sociologists study socio-behavioral response to disasters, particularly in group and organizational contexts. Research on households and organizations provides insights into the complexities of complying with severe weather warnings and associated recommendations. Psychologists examine individual responses to disaster such as the cognitive functioning that takes place when risk messages are received or the traumatic impacts of events. Political scientists understand the governmental and policy contexts in which disasters and associated planning occur. Economists supplement our understanding of the value of weather information and of how disasters influence labor, delivery of goods and services, and economic recovery. Geographers situate people's responses to disaster spatially. As is the case for the physical sciences, no single social science can provide full insight into the socio-behavioral response to disasters. Rather, an integrated, interdisciplinary response is required.

Decisionmaking for severe weather is complex. Why, for example, do people not evacuate when weather warnings are issued? Responding may be difficult because of personal circumstances or because governmental planners fail to fully account for local needs related to conditions affected by disability, aging, and transportation. Personal preparedness may be the right thing to do, but cognitively we may remain reluctant to face something unpleasant such as a disaster. Even when weather messages indicate danger, differences across languages (e.g., American Sign Language) can influence the interpretation of key words. People may also remain in a risky geographic location because of job location, cultural and central place attachments, or historic patterns of segregation. Even policies that require consideration of those historically excluded from disaster planning, such as people with disabilities, are relatively recent in origin.

A stronger relationship between the social sciences and meteorological operations can better inform the process by which weather information is disseminated, understood, and acted upon. With the ultimate goal being a reduction in loss of life and injuries, such a partnership must necessarily be strong, collaborative, and ongoing. As noted by leading social scientists, "there has been a growing recognition that social and behavioral research is essential to understanding the causes of high societal-impact weather-related disasters."[2] No matter how timely or accurately weather information is delivered, the complex challenges that people face in responding require working across disciplinary silos to safeguard lives at risk. To understand why people remain at risk and how to reduce injuries and loss of lives requires further collaboration and knowledge exchange between social scientists and meteorological researchers and practitioners. It is incumbent upon all of us to reach beyond our respective disciplines, exchange information, infuse social science findings into meteorological operations and practice, and enhance our mutual goal: to safeguard those at risk.

[2] Gladwin, Hugh, Jeffrey K. Lazo, Betty Hearn Morrow, Walter Gillis Peacock and Hugh E. Willoughby. 2009. "Social Science Research Needs for the Hurricane Forecast and Warning System." **Bulletin of the American Meteorological Society** 90: 25-29.

Appendix B: Workshop Agenda

Monday, May 3, 2010

1:30 PM	Administrative Information	Mr. Mark Welshinger OFCM
1:35 PM	Welcome	Mr. Samuel P. Williamson Federal Coordinator for Meteorology
Session 1 - Partnerships and Collaborations: Preparedness and Response The response to weather events by the public is driven by the availability and communication of information regarding the timing, severity and duration of these events. Both the availability and communication of information involve processes that begin before the event, continue during the event and culminate once an event ends. These processes are carried out through partnerships and collaborations among local, regional, state, and federal agencies, NGOs, and individuals; and guided, in large measure, by the use of results from social scientists and their research. *This session addresses preparedness and response through effective and efficient partnerships and collaborations.*		
1:45 PM	**Dr. Brenda Phillips, Ph.D.** *Framing the value-added benefits of the use of social science research in meteorological operations*	Professor, Center for the Study of Disasters and Extreme Events Fire and Emergency Management Program Department of Political Science Oklahoma State University
	Mr. X. William (Bill) Proenza (information obtained via interview after the mini-workshop—see Appendix C) Director, NWS Southern Region	Department of Commerce National Oceanic and Atm. Administration
2:00 PM	**Mr. Walter S. Dickerson** President, Diversified Emergency Management Associates, LLC	Former Director, Mobile County Emergency Management Agency
2:15 PM	**Mr. Daniel Catlett** Program Manager, Nat. Hurricane Program	Department of Homeland Security Federal Emergency Management Agency
2:30 PM	**Session 1 Discussion** **Facilitator**	
3:00 PM	**BREAK**	

Session 2a: Meteorological User/ Provider and Supporting Research Perspectives I

Technological Hazards

Data and information regarding meteorological events is used to mitigate the negative consequences of technological hazards. Additionally, these potential technological hazards impact the surrounding public and the environment, both upstream and downstream of the event. The results of social science research define strategies to effectively communicate uncertainty, potential risks and steps to preparedness that influence all sectors of the affected public in the event that a technological hazard occurs.

This session will provide information regarding the nature of technological hazards in relationship to meteorological operations, and the ways that the results of social science research are being used to reduce harm to life and the environment.

3:15 PM	**Ms. Joan Pope** Program Director for Civil Works Engineering Research & Development Center	Department of Defense U.S. Army Corps of Engineers
3:30 PM	**Mr. Brian McCallum** (via phone) Assistant Director, Georgia Water Science Ctr	Department of the Interior U.S. Geological Survey
3:45 PM	**Mr. Paul Hewett** Deputy Director, Center for Integrated Emergency Preparedness Argonne National Laboratory	Department of Energy
4:00 PM	**Ms. Jocelyn Mitchell** **Ms. Sara Mroz** Office of Nuclear Regulatory Research	U.S. Nuclear Regulatory Commission
4:15 PM	**Ms. Debra Payton** (unavailable) Office of Response and Restoration (OR&R) Emergency Response Division (ERD)	Department of Commerce National Oceanic and Atm. Administration

Session 2b: Meteorological User/ Provider and Supporting Research Perspectives I

Transportation Weather Hazards

Regardless of the meteorological, natural or technological hazard, transportation networks along with their users and stakeholders experience adverse effects from severe weather conditions. The majority of people and business enterprises wish to avoid harm's way in the event of severe weather, flooding, natural and technological events. Subsequently, transportation arteries are a primary means to achieve this end. Exodus results in roads and highways experiencing bottlenecks; air flights being cancelled or rerouted; and flooding resulting in closed roads and bridges. To adequately prepare for transportation-related events that are guided, in large measure, by the need for meteorological data and information, the results of social science research serve to provide strategies to communicate knowledge in ways best suited for transportation managers and their stakeholders, namely, the traveling public and end-user communities. Data and information regarding meteorological events is needed to support the work of the transportation enterprise.

This session will provide information regarding transportation's continuing need for meteorological data and information, and the ways that the results of social science research can be further used to save lives, mitigate harm to life and the environment, and safeguard infrastructure.

4:30 PM	**Mr. Paul Pisano** Road Weather Management Coordinator	Department of Transportation Federal Highway Administration
4:45 PM	**Session 2 Discussion** Facilitator	
5:00 PM	**ADJOURN**	

Tuesday, May 4, 2010

8:25 AM	Administrative Information	Mr. Mark Welshinger OFCM
Session 3 – Meteorological User/ Provider and Supporting Research Perspectives II Lessons learned from past severe weather and technological hazards support the need for further integration of social science research results into meteorological operations. How can we frame the questions and the need for social science research in ways that will produce results on time frames that are responsive to the need of the public for action now? *This session will address the current, planned and projected use of the results of social science research for meteorological operations.*		
8:30 AM	**Lt Col Thomas C. Moore** Air Force Directorate of Weather	Department of Defense U.S. Air Force
8:45 AM	**Mr. William "Kim" Curry** Deputy Technical Director (CNO N84)	Department of Defense U.S. Navy
9:00 AM	**Mr. David Caldwell** Director, Office of Climate, Water and Weather Services (NWS) **Ms. Jennifer M. Sprague** NWS Social Science Focal Point	Department of Commerce National Oceanic and Atm. Administration
9:20 AM	**Session 3 Discussion**	
9:50 AM	**BREAK**	
Session 4 – Social Science Needs and Priorities		
10:15 AM	**Facilitators** **Open Discussion** • Needs Defined • Information Flow • Communication Gaps • Knowledge Transfer • Effective Collaboration Models • Realm of responsibilities – Stakeholder Community	
11:30 AM	**LUNCH (on Own)**	

Tuesday, May 4, 2010 (continued)

Session 5 – Conclusion and Way Ahead		
1:00 PM		**Discussion** **Towards an Action Agenda for the further inclusion of social science research results into meteorological operations**
2:30 PM	**BREAK**	
2:45 PM	Wrap-up and Next Steps	Facilitators
3:00 PM	**ADJOURN**	

MINI-WORKSHOP FACILITATORS	
Dr. Brenda Phillips, Ph.D. Professor of Political Science	Center for the Study of Disasters and Extreme Events Fire and Emergency Management Program Department of Political Science Oklahoma State University
Ms. Brenda Philips Director, Industry, Government and End User Partnerships End User Integration Research Leader	University of Massachusetts Center for Collaborative Adaptive Sensing of the Atmosphere (CASA) College of Engineering Resource Economics
Dr. Denise Stephenson Hawk, Ph.D. Consultant and CEO, The Stephenson Group, LLC	Consultant and Former Director, Societal-Environmental Research and Education Laboratory, National Center for Atmospheric Research (NCAR)

Appendix C: Summary of Interview with Mr. William 'Bill' Proenza

INTERVIEW: *A 40-Year Career Perspective* - Mr. William 'Bill' Proenza, Southern Region Director, NWS, National Oceanic and Atmospheric Administration (NOAA), Fort Worth, Texas

Mr. Proenza was unable to attend the Exploratory Mini-Workshop. However, he was interviewed to capture his perspective regarding the incorporation of social sciences into meteorological operations and services delivered by NWS. A synopsis of the interview is below.

Synopsis: The Southern Region of the NWS includes 27% of the nation's NWS Field Offices and is the nation's busiest area of severe meteorological activity. This area includes the states of Mississippi, Texas, Florida, Georgia, Alabama, Louisiana, Oklahoma, Arkansas, Tennessee, New Mexico, and Puerto Rico. These states and territories experience hurricanes, tornados, severe thunderstorms, violent lightning, high winds, flash floods and hail. While the occurrence of these weather events is unavoidable, the NWS must ensure the safety of the public and, in ways possible, mitigate damage to property.

With over 40 years of service with the NWS, Mr. Proenza has seen tremendous advances in technology that have made the NWS a trusted agent for weather information. Two of these advances are the Next Generation Weather Radar system (NEXRAD) and numerical weather prediction (NWP).

- The NEXRAD comprises 159 Weather Surveillance Radar-1988 Doppler (WSR-88D) sites throughout the United States and select overseas locations. This system is a joint effort of the Departments of Commerce (DOC), Defense (DOD), and Transportation (DOT). From the NOAAEconomics Web Site (http://www.economics.noaa.gov/?goal=commerce&file=obs/radar/nexrad): "Research has shown that the percentage of tornadoes warned for nearly doubled, from 35% pre-NEXRAD to 60% post-NEXRAD, and the average warning lead time increased from 5.3 to 9.5 minutes.[3] The study also examined a dataset of nearly 15,000 tornadoes in the United States that occurred between 1986 and 1999, comparing the number of tornado fatalities and injuries per year from 1986-1996, against the years 1997-1999, in which NEXRAD technology was widely available. The study concluded that NEXRAD tornado detection capabilities prevented 79 fatalities and over 1,050 injuries per year. In summary, expected U.S. fatalities were 45% lower and expected injuries 40% lower with the NEXRAD Doppler radar network installed. The additional minutes of warning time also provide critical time for the public to take proper precautions to protect lives and property from possible tornadic events."

[3] Sutter, D., and Simmons, K., 2005: WSR-88D radar, tornado warnings, and tornado casualties. *Weather and Forecasting*, **20(3)**, 301-310.

- A vivid example of improvements made in the field of NWP is the improvement of tropical cyclone track forecasts. Over the past 15 years or so, 24-72 hour track forecast errors have been reduced by about 50%, which is largely attributed to improvement in NWP.[4]

Mr. Proenza recalls the introduction of social sciences into the delivery of meteorological services in the early 1970s during his tenure at the NWS Headquarters in Silver Spring, Maryland. All NWS missions are important; however, highest priority is given to the protection of life. There was and continues to be sensitivity at the NWS regarding the effects of words used to characterize weather predictions on actions taken by users of the predictions. While it is understood at the NWS that local, State and Federal emergency managers (EMs) are the officials in charge of safeguarding the lives of the public, NWS managers recognize that viable partnerships must exist between the NWS and EMs. Consequently, the words used to communicate weather predictions are important. During the early 1970s, social scientists were engaged by NWS to fine tune and reword warnings to ensure that the right message was delivered to emergency managers, first responders (fire, police, and medics), and the media. A course was developed, *Warning – A Call to Action*, which was designed to communicate the key factors that best motivate people to act.[5] Dr. Benjamin McLuckie, a social scientist from the University of Delaware, worked with the NWS to develop this course and its associated guidance papers.

Mr. Proenza emphasized that many social scientists have long been involved in the design of the text in NWS products and services. He stated that a lot of work has gone into having our products "social science sensitive." In this vein, at least since the early 70s, the NWS has been using an effective blend between very time-efficient weather warnings text and information and the use of response-motivating "call-to-action" (CTA) statements. Mr. Proenza cited NWS Southern Region Technical Memorandum #215 (SR-Tech Memo 215) which incorporated decades of NWS social science sensitivity. Included in this memorandum are the CTA statements used by mission-delivery NWS field offices to effectively get the proper "protection of life" responses from EM partners, media and the public to the official NWS warnings, public information statements, and other services. The importance of the CTA statement is often overlooked, but it serves a very important purpose in the warning message. CTAs are the part of warning messages which prompts the public to respond, in effect saying, -*we have told you where the storm is and where it is going; now here is what you need to think about as it approaches.*

One of the driving forces for the Exploratory Mini-Workshop was the 64th Interdepartmental Hurricane Conference (IHC). Mr. Proenza referred to his presentations at the last three IHCs, especially emphasizing the technological advances and strategic initiatives of the NWS that have or will advance NWS forecast and warning programs. Highlights from these presentations include:

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[4] http://www.nhc.noaa.gov/verification/pdfs/Verification_2009.pdf

[5] McLuckie, B.F., 1974: Warning-A Call to Action: Warning and Disaster Response- A Sociological Background. NWS Southern Region Headquarters. PDF version available at: http://www.ofcm.gov/wg-ssr/noaa-nws-sr-a-call-to-action.pdf

- NWS Forecast Offices (WFOs) - excellent sources for hazardous weather's expected *local* impacts
  - WFO gridded data, plus WFO smart tools provide *impact* graphics
- WFOs – outstanding GIS radar data
  - Current radar enhancements
    - Improved elevation scans
    - Faster scans (from 6 to 4 minutes)
    - Improved national and regional mosaics
  - Radar enhancements allowed warnings to move from county-based to storm-based
    - Typical example: County-based - eight counties under warning (almost 1 million people warned); with storm-based warning, 70% less area covered and ~600,000 fewer people warned
  - Radar graphics include latest watches and storm-based warning boxes
  - Future radar enhancement: dual-pol radar
    - Finer imaging
    - Improved rainfall estimation
    - Pinpoint tornado location
- NWS Decision-Support: A Strategic Initiative
  - Local/state/federal EMs indicate they vitally need decision-assisting focused, on-site weather information
  - Solution: Emergency Response Meteorologists (ER-Mets)
    - EMs can immediately request from their local WFO an on-site forecaster to provide decision-support during both natural and human derived high impact events:
    - ER-Mets
      - Who: An "all-hazard" event trained meteorologist
      - From: From nearby WFO
      - To: Local/state/federal Emergency Operations Center (EOC) or 1st responder site in the field

Even with advances in technology and the Decision-Support Strategic Initiative, the NWS will continue to work with the social science community as it has in the past. Currently, the more urgent needs for social science guidance are in defining ways to better communicate predictions, including their accuracy and the weather hazard risks, to the EM community (county, city, and State), and to the Federal Emergency Management Agency (FEMA.) The EM community must carry forth information that motivates people to take appropriate actions. The information delivered must be true, vital, and concise; it must cause people to pay attention and know how to take action. Rapid-onset weather events, namely, tornadoes, flash floods, thunderstorms, hail, and lightning require more pre-education than events with longer predictive lead times, as people may have only minutes to act after a warning is issued.

In summary, the inclusion of the social sciences into the delivery of meteorological operations and services has a long and significant history, and the work must continue as the NWS partners with others to ensure the safety of the public.

AGENCY-SPECIFIC SOCIAL SCIENCE–RELATED ACTION(S): The more urgent need for social science guidance is in defining ways to better communicate predictions, including their accuracy and the weather hazard risks, to the EM community (county, city and state), and to FEMA.