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Weather and Society Watch

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How Important Is Knowledge Management for Meteorology?

by Jacques Descurieux*

> *For also knowledge itself is power.*
> —Francis Bacon
>
> "De Hæresibus,"
> *Meditationes Sacræ* (1597)[1]

Over the past 15 years, the increasing number of scholarly papers and books dedicated to the subject have shown that more and more scholars and scientists are recognizing the need to manage knowledge. Although weather and meteorological services organizations are generally effective *information* managers, managing *knowledge* is the next and inescapable step toward any substantive improvements in meteorological and weather forecast services.

Knowledge management is too often confused with information management. To differentiate between the two, we must understand the differences among data, information, and knowledge. *Data* are facts such as measurements or statistical results: A temperature reading of –25°F is data. Data becomes *information* when placed into context. When the wind chill makes the outside temperature feel like –45°F, that's information. Understanding that –25°F with a wind chill of –45°F will cause any exposed flesh to freeze in two minutes is *knowledge*. Knowledge is data and information that acquires meaning through refinement, synthesis, and presentation in ways that can guide action. Information is documentation—the basis of knowledge—which includes meaning and is understandable, usable, and actionable.

Information management is about collecting, controlling, disseminating, and using the information. *Knowledge management* is about capturing, selecting, developing, refining, analyzing, transferring, and sharing information to make it usable and actionable in a decision-making or social context.

Decision makers and private individuals can protect or safeguard against the weather only if they know and understand its potential—or probable—consequences on people, their environment, their economic activities, or all three.

Knowledge is generally described as a continuum. At one end, *tacit* knowledge encompasses skills and know-how. As the cognitive dimension of knowledge, it includes beliefs, values, insights, intuitions, and hunches, and is difficult to express. At the other end of the spectrum, *explicit* knowledge is expressed in words or numbers, and is easily transmitted, communicated, or codified. Weather forecasters and meteorological services use both dimensions of knowledge daily.

Meteorologists make forecast-related decisions several times a day. Several recent papers (Doswell 2004; Hutton 2007; Stuart et al. 2007) describe the process of forecast development and the cognitive dimension of weather forecasting.

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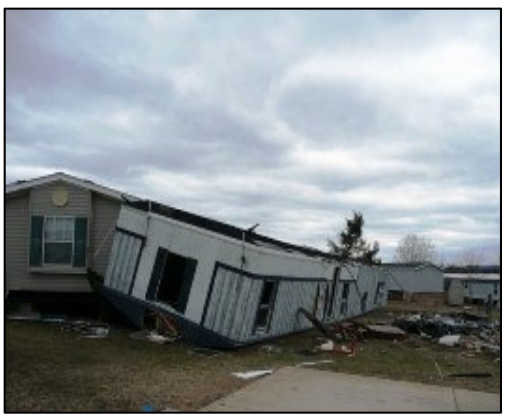


An overturned mobile home rests in a mobile home park in Gassville, Ark., near where one woman died when an EF 2 tornado hit the area. (Photo by Julie Demuth)

In This Issue

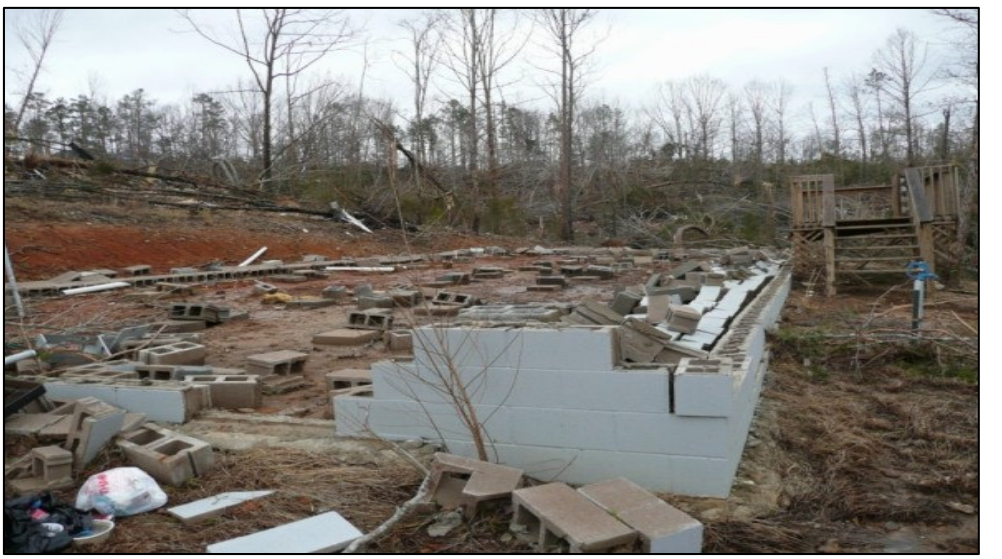
Societal Impacts Analysis Featured in Super Tuesday Tornado Outbreak Service Assessment

by Kevin Barjenbruch*

It's Valentine's Day as we work our way through the Union University campus in Jackson, Tenn., heading to a meeting with David Dockery, the university's president, and Marty Clements, the emergency management director for Jackson County. Behind a clock tower we see the wreckage of a dormitory struck just nine days earlier by a tornado rated as a 4 on the Enhanced Fujita Tornado Scale (EF Scale). The hands of the clock remain fixed at 7:02 p.m., the precise time the tornado struck the campus.

A few minutes later Julie Demuth, an NCAR scientist and my partner for this effort, and I sit down to conduct the first of nearly two dozen interviews with members of the public and emergency response and safety officials. We are part of the National Weather Service (NWS) Super Tuesday Tornado Outbreak Service Assessment Team, assembled in response to the tornado outbreak of February 5–6, 2008. The outbreak consisted of 82 tornadoes in nine states and claimed 56 lives, making it the largest in terms of death toll since the May 31, 1985 tornado outbreak.

The NWS conducts service assessments to evaluate its performance for events that caused, for example, (1) major economic impacts, (2) multiple fatalities or numerous serious injuries, (3) unusually high public or media interest. Assessment teams, usually convened just one or twice a year, are composed of experts from both inside and outside the NWS who study the event itself as well as NWS actions before, during, and immediately after the event. After conducting these studies, the teams work with designated officials at NWS headquarters to write assessment reports that recommend changes in NWS procedures, products, and services to improve future performance.



The foundation and deck are all that remain of this mobile home in Izard County, Ark., where one man lost his life when an EF 4 tornado struck.
(Photo by Julie Demuth)

Traditionally, these assessments have been inward-looking, focusing on NWS procedures, actions, and equipment, as well as the physical science relevant to a weather event. In this case, however, because so many people died despite extensive efforts to warn the public about the impending event, the assessment took on an additional component—a societal impacts analysis to help better understand why the loss of life was so great.

Although we heard many stories about how people were able to stay out of harm's way, we also listened to a multitude of tragedies.

This component also afforded an opportunity to gather information about the warning information people actually received, along with their response behaviors. The societal impacts analysis focused on assessing the public's knowledge, perceptions, and decision making, with an emphasis on (1) what information people had about the severe weather situation and how they interpreted that information, (2) how people perceived the situation, and (3) what decisions they made.

From our Valentine's Day arrival through the following Monday— a total of five straight days—we spoke with family, friends, and neighbors of the victims, as well as plant officials and emergency managers, to find out why, how, and where lives were lost. We did hear some success stories.

For example, Union University officials successfully implemented the university's emergency plan, sounding an alarm through the intercom system in every building on campus. In this broadcast, individuals from the university's Office of Safety and Security instructed everyone to take shelter on the lowest floor of their buildings in interior hallways and bathrooms. The combination of ample warning lead time, threat awareness, and a detailed, practiced plan likely saved lives.

Another success story took place at the Caterpillar plant in Oxford, Miss. Here, plant officials received a warning about the tornado via a phone subscription service provided by WeatherData, a subsidiary of

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WAS*IS in Practice: Forecast Impacts During the Blizzard of March 1, 2007

by Amanda Graning*

The blizzard of March 1, 2007, which affected communities surrounding the western edge of Lake Superior, including Duluth, Minn., and Superior, Wis., created challenges in communicating complex weather information. As a general forecaster for the National Weather Service (NWS) office in Duluth, my involvement in WAS*IS helped me navigate the standard practices of NWS winter weather forecasting to make critical decisions that allowed our office to successfully convey the dangers of this storm.

In late February and early March 2007, a series of winter storms struck the area, including a paralyzing blizzard that dropped more than 20 inches of snow. Heavy snow, falling at rates up to 3 inches per hour at times, combined with persistent 60-mph winds to create whiteout conditions and snow drifts as high as 25 feet. The blizzard—the first in ten years—was preceded by a more "typical" snow event, which dropped 6 inches of snow. Although locals are well accustomed to severe cold and snow, the regional topography and dense forestation often reduce the threat of high winds and whiteouts.

About 18 hours before the initial snow event of 6 inches—and nearly 36 hours before the anticipated significant blizzard—weather forecast models were in excellent agreement, and forecaster confidence was very high. At that time, a *winter storm warning* was in effect to cover both the first snowfall and the impending blizzard. This presented a complex scenario for our office because NWS warning criteria would define each storm as two distinct events: a "low-end" winter storm and a rare and intense blizzard, separated by a several-hour midday lull.

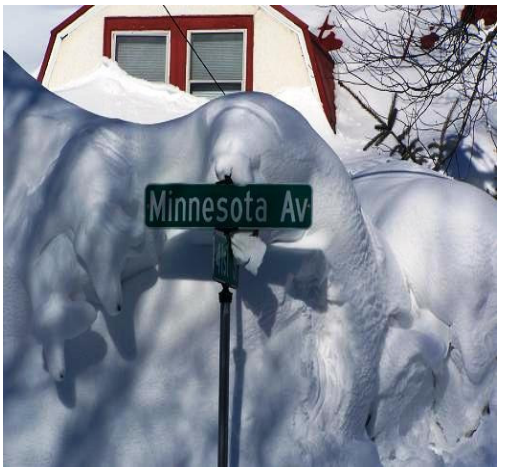
We had to make a critical decision—whether to keep the winter storm warning for both the initial snow and the blizzard or to put out two separate warnings, a winter storm warning for the first 6 inches and a *blizzard warning* for the much more dangerous high-impact event to follow.

Another option was to issue a single blizzard warning that encompassed both events. In making the decision, we had to consider which solution would best serve the community while minimizing confusion.

This is where my WAS*IS experience became invaluable. During significant and dangerous weather events like the 2007 blizzard, understanding how to communicate the severity and threat of the storm effectively is arguably just as or perhaps even more important than the physical science of the event.

Because of my WAS*IS training, I was able to thoroughly consider the impacts and consequences of my decision. I was also very fortunate to be working this shift with Declan Cannon, who previously spent several years at The Weather Channel and has considerable knowledge and experience in social sciences, weather impacts, and effective communication. We spent time weighing the positive and negative impacts of our options and how to best convey the severity of the expected blizzard.

The final decision was to replace the winter storm warning with a single blizzard warning that treated both events as one storm. This decision was based both on our high confidence that blizzard conditions would occur, and in our belief that such a warning would result in the appropriate preparation and response by our customers.



Snow was piled nearly as high as many rooftops after the March 1, 2007 blizzard. (Photo by Carol Christenson)

Many factors figured into this decision, including concern about creating confusion within an already complex event by having two different warnings in the forecast. In addition, because the initial snowfall of 6 inches does not typically have a large impact for this region, we felt that a separate warning would take attention away from the main threat. And we feared that putting a blizzard warning in effect a day and a half before it developed might be a bit premature, adding confusion about the start time. The importance of getting the message out early to allow for preparation, however, outweighed the prospect of timing confusion.

The final factor was considering conflicting information in the warning product itself. Recall that a winter storm warning was already in effect and confidence was extremely high that a blizzard warning would be needed eventually. When that time came, because of the way the software

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From the Director

Integrating Social Science Theory into Hydrometeorology

by Jeff Lazo*

"What does it mean to integrate social sciences into hydrometeorological research, applications, and operations?"

If you're reading *Weather and Society Watch,* you're probably already interested in this topic. The mission and vision statements for NCAR's SIP and the broader Weather and Society*Integrated Studies (WAS*IS) effort explicitly aim to achieve this integration (see sidebar) and have come a long way in achieving these goals. Interest in the societal aspects of weather and weather forecasts is undeniably significant and growing, and examples of the application of social science methods to weather-related issues are numerous. But social science research does not simply mean applying research methods to societal issues. I would argue that, to successfully infuse or integrate social sciences into meteorological activities, we need to do a better job of building on the full range of theoretical foundations and the accumulated body of knowledge of the social sciences.

Especially because disciplines have evolved, diverged, and merged over the years, it's useful to first ask ourselves: What exactly are the social sciences? Without delving into the complex philosophical question—What is a "science"?—and perhaps drawing on my "old world" education in a university that had departments in each of these fields, I'm inclined to identify eight primary social sciences: anthropology, communication, economics, geography, history, political science, psychology, and sociology. Some believe that the social sciences also include—but are not limited to—linguistics, demography, education, and law. I have no doubt that each of these disciplines brings valuable and beneficial approaches to many societal issues related to hydrometeorology.

In my four years with SIP, I've witnessed a quantum increase in studies on the societal aspects of hydrometeorological events—perhaps in large part because of the work of the 145 individuals who have participated in the five WAS*IS workshops to date. I can't begin to list the diversity of societal issues studied, the social science research methods used, or the hydrometeorological phenomena and events examined. I firmly believe that these efforts have already had a fundamental and lasting impact on the weather enterprise.

Missions and Visions

The stated mission of NCAR's SIP is to ". . . to improve the societal gains from weather forecasting by infusing social science and economic research, methods, and capabilities into the planning, execution, and analysis of weather information, applications, and research directions."

In a similar vein, the vision of the WAS*IS effort is ". . . to change the weather enterprise by comprehensively and sustainably integrating social science into meteorological research and practice" (Demuth et al. 2007).

I would argue that, to successfully infuse or integrate social sciences into meteorological activities, we need to do a better job of building on the full range of theoretical foundations and the accumulated body of knowledge of the social sciences.

I worry, though, that even as we use the *methods* from the social sciences, we aren't paying enough attention to the *theories* of the social sciences. Nor do I feel that the institutional knowledge—that broad body of information based on the theory, the methods of inquiry, and the years upon years of research in all the social sciences—has been adequately tapped.

Furthermore, I think that there is a fundamental danger in the perception that social science means applying methods without an understanding of underlying theory and knowledge. This will lead to a significant undervaluation of the true benefits of integrating the social sciences into meteorological research and practice.

So, what DOES it mean to infuse or integrate social sciences into meteorological activities?

Quoting from Wikipedia—itself a source of useful information when based on critical reading: "The social sciences . . . emphasize the use of the scientific method in the study of humanity, including quantitative and qualitative methods." The scientific method in part suggests a primary relation between science and theoretical foundations.

Wikipedia again: "Theories that encompass wider domains of inquiry may bind many hypotheses together in a coherent structure. This in turn may help form new hypotheses or place groups of hypotheses into context." I would argue, then, that the successful integration of social sciences into meteorological activities requires—in part—that we build on the range of theoretical foundations and accumulated knowledge of the various social sciences.

As a small but illuminating example, I've reviewed a number of studies of the economic impact of weather events where the authors count diminished tax revenues caused by decreased economic activity as a loss to society. Even though this seems reasonable at

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Minding the Gap: Social Science Research on a Pacific Atoll and Weather Risk Communication in the United States

by Heather Lazrus*

If you have traveled on the London underground—or seen it in movies — you know that survival in the face of an oncoming train depends on "minding the gap." In the scientific community, the oncoming train is a changing climate with potentially devastating impacts. As scientists, our imperative is to mind and eliminate the gaps between social and technical science and between theory and application. Each "traveler" needs to understand this and make his or her own small contribution. A map of the London subway is available. But there is no detailed map of the future of our planet and our climate. We do know, however, that the oncoming train is fast approaching.

With this in mind, I joined a couple dozen people from the weather industry for a workshop on a sizzling July day in Boulder, Colo. Meteorologists and a few social scientists had come together for the fourth Weather and Society Integrated Studies (WAS*IS) Workshop. We were there to explore a mutual interest—how to transform the ways in which weather research is conducted and weather data and information are collected and communicated. The workshop represented an opportunity to be initiated into the growing "society" of practitioners in public, private, and academic sectors who share—and want to actively participate in—the goal of changing what *was* to what *is* (and will be!) in the industry.

I was one of three anthropologists who have attended WAS*IS so far, and one of two at the July 2007 workshop. Anthropologists have been a minority in the WAS*IS effort, in part because it has focused on promoting social science objectives and methods to nonsocial scientists. What would inspire us to come to a venue where we—often being painfully aware of the gap between production and application of technical knowledge and society, as well as the need for social science to bridge the gap—were, so to speak, the "choir"?[1]

My personal incentive to attend was twofold, one somewhat selfish and the other more altruistic. I hoped that my expertise as an anthropologist could contribute to conversations about the usability of social science and the benefits of bringing it to the table.[2] The more selfish motivation was to learn, through better understanding of the intricacies of the weather industry, how I, as an anthropologist, could do meaningful work that would be relevant to decision makers in the fields of weather and disaster policy.[3]

I am currently working toward completing a Ph.D. in environmental anthropology at the University of Washington. My dissertation, entitled *Weathering the Waves: Global Climate Change, Livelihoods, and Politics in Tuvalu* is about how people perceive and respond to changes in the weather and atmospheric hazards in a Polynesian society on a low-lying atoll. Although I conducted my research in a place very geographically, culturally, and politically different from the United States, I hope to make what I learned relevant and applicable to various communities, including weather communicators, closer to home.

This aspiration is not new among anthropologists. Roy Rappaport, one of the greats in the field, advises us to pay attention to how "information concerning the troubles of a system [is] to be introduced into that system in ways that will help avoid, ameliorate, or correct those troubles rather than exacerbate them." [4] WAS*IS practitioners, I learned, are also keen on finding ways to do this.

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Lazrus conducting focus groups in Nanumea, the northernmost atoll of Tuvalu, in 2006. (Photo courtesy of Heather Lazrus)

Review of *Weather, Climate, Culture*

by Carlie Lawson*

In *Weather, Climate, Culture,* editors Sarah Strauss and Ben Orlove weave together 15 papers representing a cross-section of disciplines to examine two issues key to weather and climate: time scale and language. This volume examines different time scales of weather and climate experience, represented as the book sections "Days," "Years," and "Generations." As the editors explain in the introductory chapter, "Up in the Air: The Anthropology of Weather and Climate," they also consider communication—specifically language and communication methods—including oral history, religious ceremony, everyday conversation, and scientific discourse.

The five chapters relating to the short-term temporal scale, "Days," broadly focus on communication (language) aspects of weather in Jan Golinski's "Time, Talk, and the Weather in Eighteenth Century Britain," Strauss' "Weather Wise: Speaking Folklore to Science in Leukerbad," and Trevor A. Harley's "Nice Weather for the Time of Year: The British Obsession with the Weather." This section of the book also peeks at more specific topics of language and communication, such as gender in weather and religion's effect on weather-related public policy through Todd Sanders' "(En)Gendering the Weather: Rainmaking and Reproduction in Tanzania," and Michael Paolisso's "Chesapeake Bay Waterman, Weather, and Blue Crabs: Cultural Models and Fishery Policies," respectively.

Moving to the mid- to long-range temporal scale, the Years section consists of four chapters that examine such diverse anthropological topics as "How People Name Seasons" (Orlove's chapter) to an ethnography of the effects of the 1997 drought in Papua New Guinea on the people of its Pio-Tura region in David M. Ellis' "Changing Earth and Sky: Movement, Environmental Variability, and Responses to El Nino in the Pio-Tura Region of Papua New Guinea." Ellis' chapter also includes an examination of local perceptions of development and national and international humanitarian aid response.

The featured authors, cognizant of the challenges inherent in integrated studies, collectively present sound methodology and clear writing to communicate their results to a cross-disciplinary audience.

In contrast, the section also features a chapter on art's communication of weather and climate events via "Monet's 'London Series' and the Cultural Climate of London at the Turn of the Twentieth Century" by John E. Thornes and Gemma Metherell. Finally, the Years section features a chapter on risk communication from the research team of Carla Roncoli, Keith Ingram, Christine Jost, and Paul Kirshen. Their chapter, "Meteorological Meanings: Farmers' Interpretations of Seasonal Rainfall Forecasts in Burkina Faso," assesses how personal climate experience shapes our understanding of climate information. The authors also explore the necessity of choosing a communication approach and a message that allow end users to understand forecasts, especially those of a probabilistic nature.

The book draws to a close with "Generations," which delves further into how personal climate experience shapes our understanding of climate information with Colin Thor West's and Marcela Vasquez-Leon's chapter, "Testing Farmers' Perceptions of Climate Variability: A Case Study from the Sulphur Springs Valley, Arizona." The section also explores the interconnections of climate and traditional communication forms of mythology and oral history in Anne Henshaw's chapter "Climate and Culture in the North: The Interface of Archaeology, Paleoenvironmental Science, and Oral History," and Astrid E. Ogilvie's and Gisli Palsson's "Mood, Magic, and Metaphor: Allusions to Weather and Climate in the Sagas of Icelanders."
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The book returns to public policy, again in relation to drought, with Timothy J. Finan's "Climate, Science, and the Policy of Drought Mitigation in Ceara, Northeast Brazil." Generations ties it all together with the final chapter, "Domesticating Nature: Commentary of the Anthropological Study of Weather and Climate Discourse," in which Steve Rayner looks at the development of the anthropology and climate change literature from Margaret Mead to the present, including the place each chapter holds in the ethnoclimatology and ethnometeorology literature.

In *Weather, Climate, Culture,* the featured authors, cognizant of the challenges inherent in integrated studies, collectively present sound methodology and clear writing to communicate their results to a cross-disciplinary audience. Strauss and Orlove have created an unusual property—a volume both accessible and valuable to student and professor, alike. This book provides an admirable illustration of the possibilities of integrated studies and would prove useful in both a classroom and a research setting.

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Review of *Weather, Climate, Culture*

by Ashley Coles*

Weather and climate are ubiquitous—no individual or group can escape the atmospheric phenomena endemic to their region of the world. Precisely how weather and climate influence cultural beliefs and practices may vary by location and social group, but the impacts affect many aspects of social life, from farming practices to the strengthening of social bonds and the reproduction of social roles. In *Weather, Climate, Culture,* Sarah Strauss and Benjamin Orlove offer examples of how ideas about typical and anomalous atmospheric conditions become intertwined and perpetuated within a cultural group's attitudes, beliefs, and practices.

These studies contribute new perspectives to the ongoing discussion of climate variability and human adaptability, particularly the social perspectives that are often neglected in climate discourse.

The book is divided into three sections according to the duration of the weather or climatological phenomena in question. The "Days" segment includes topics ranging from discussion of the weather to make casual conversation or to formulate livelihood strategies (such as farming or crabbing) to the ways in which ideas about gender and reproduction are woven into rainmaking practices in Tanzania.

The "Years" portion includes studies of how people interpret and classify seasons, seasonal forecasts, seasonal anomalies such as El Niño, and the persistent London fog as depicted and deeply appreciated by Monet and others. The final section, titled "Generations," contains studies of climate variability as understood by various cultures, and discusses how perceptions and understanding of climate influence not only decision making in livelihood sustainability, but also a group's sense of place and existence in the world.

This book gives us a fairly jargon-free and easily understood introduction to the field of climate anthropology. Several of the chapters are centered on Great Britain, but the rest are diverse and include locations from around the world. These studies contribute new perspectives to the ongoing discussion of climate variability and human adaptability, particularly the social perspectives that are often neglected in climate discourse.

*Ashley (coles@email.arizona.edu) is a graduate student in the Department of Geography and Regional Development at the University of Arizona.

Job Announcement

Emergency Management Analyst

System Planning Corporation in Washington, D.C., seeks an individual with 2-4 years in emergency management and continuity of operations experience to join a team supporting preparedness for multiple locations throughout the country. This is a customer service-oriented position and includes professional briefings, development and delivery of training programs, and one-on-one support to offices as they develop their emergency plans.

Requirements include 3-5 years of experience; a bachelor's degree in emergency management, political science or related field; and experience with public speaking For more information, please visit http://www.sip.ucar.edu/news/opportunities.jsp.

Outbreak *(continued from page 9)*

distributing it, and the members of the public whose lives depend on receiving and understanding the information and taking protective action.

In the end, through the conversations, the tears, the nervous giggles, and the delirium, we may have raised more questions than we've answered. It does feel, though, like we're on the right path. We hope that our work during this assignment will help to define the structure for future assessments.

The Super Tuesday Tornado Outbreak Service Assessment should be available by early summer on the NWS Service Assessments page at http://www.weather.gov/os/assessments.

*Kevin (Kevin.Barjenbruch@noaa.gov) is the warning coordination meteorologist at NOAA's National Weather Service in Salt Lake City, Utah.

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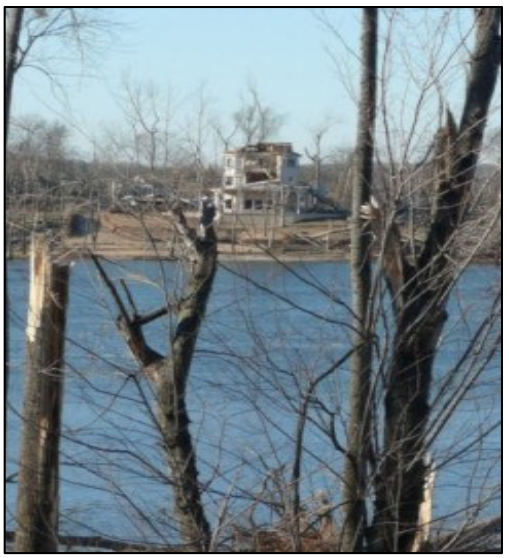

The Super Tuesday tornado outbreak caused extensive damage in Hardin County, Tenn., where 3 people died.
(Photo by Julie Demuth)

Knowledge *(continued from page 1)*

The evidence presented in these works is clear and incontrovertible: Forecasters use tacit knowledge and heuristics when making decisions under uncertainty. *Heuristics* are subjective expertise, insights, intuitions, personal beliefs, abilities, and skills that are internally anchored and based on personal learning and experiences. In other words, heuristics are tacit knowledge under another name. To improve the forecast process, weather services need to capture that tacit element, translate it into explicit knowledge, and share it.

To capitalize on knowledge that already exists, an organization must manage it as it would any other resource.

Explicit knowledge is extremely important for any meteorological organization that aims to disseminate the information or knowledge required to make weather-related decisions. Decision makers and private individuals can protect or safeguard against the weather only if they know and understand its potential—or probable—consequences on people, their environment, their economic activities, or all three.

A forecast that tells only what the weather will be is only information. But a forecast that includes the potential consequences of the weather transforms the information into usable and actionable knowledge. Indeed, the potential consequences of the weather are seldom included in forecasts, watches, and warnings. The correlation between the weather and its consequences is the difference between plain information and usable and actionable knowledge.

Knowledge management is about facilitating the transfer and exchange of information combined with expertise. It links people, processes, and technology to broaden situational awareness. It facilitates decision making and increases organizational effectiveness. To capitalize on knowledge that already exists, an organization must manage it as it would any other resource. Given that knowledge management relates to decision making and that meteorological processes include both the tacit and explicit dimensions of knowledge, knowledge management becomes elemental for weather forecasters and meteorological services.

*Jacques (jacques.descurieux@ec.gc.ca) is the national communications advisor for the Service Improvement and Development Division of the Meteorological Service of Canada.

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Footnote

[1] "Of Heresies," *Sacred Meditations.*

Blizzard *(continued from page 3)*

forced to produce a new warning with a headline of: "…Winter Storm Warning Cancelled….Blizzard Warning In Effect…" We expected this conflict of critical information to cause further confusion. I felt it was extremely important to get this headline conflict resolved as soon as possible.

The social science training and exposure I gained through WAS*IS taught me to think beyond NWS protocols on warnings and lead times and to more fully consider the public's reaction to our products and services. This helped me to be more decisive and to send a clear warning of the potential life-threatening blizzard nearly 2 days in advance.

All customers of the NWS, including partners in the media, emergency management, local government services, and the public were able to appropriately prepare and respond, not only for the onslaught to come, but also for the post-storm recovery. The local newspaper even praised the "precisely predicted" storm, with zero storm-related deaths.

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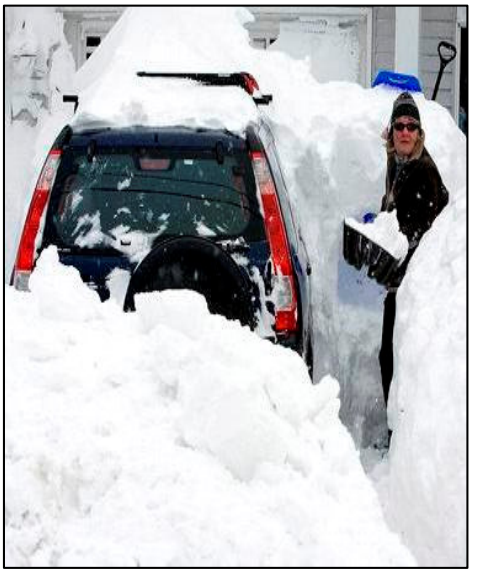


The heavy snowfall made even the most routine tasks difficult during the Mach 2007 blizzard. (Photo by Pam Bonkoski)

AccuWeather. They immediately sounded the plant's sirens and implemented their response plan, with approximately 100 people sheltering in reinforced safe rooms. Despite extensive damage to the building from the EF 3 tornado, not a single life was lost.

Although we heard many stories about how people were able to stay out of harm's way, we also listened to a multitude of tragedies. One man recounted that his father had called to ask if he and his wife should leave their mobile home and come up the hill to his son's house to take shelter, to which the son replied, "Dad, we've never had a tornado . . . but you're more than welcome to come up here."

His father and mother stayed in their mobile home and, moments later, he watched as his father's house was lifted into the air and annihilated. His parents were killed. Seconds later, he was knocked unconscious as his own home was struck by the tornado, and when he regained consciousness, he found a 2 × 4 embedded in his thigh.

We also listened to a plant supervisor at the DSC Logistics distribution facility in Memphis recall the details of the EF 2 tornado that hit the plant, claiming the lives of three people who sheltered in a break room. Another tragedy took place at the Rivertrail Boat Company in Clinton, Ark., where despite efforts to take shelter, a young man lost his life to an EF 4 tornado.

Consider the story of an 83-year-old woman in Atkins, Ark., who first heard about the tornado threat from local television news broadcasts, then later on a local radio station. According to the woman, the siren sounded approximately an hour before the tornado arrived, but she opted not to shelter at that point. Fifteen minutes later the siren sounded again and, at that point, her son-in-law called, and they decided to shelter in his home next door. Her son-in-law spotted the tornado as it approached, and they then decided to move to her private storm cellar a couple hundred feet away, where they safely waited out the event. This woman lived next door to a family of three who did die in that EF 3 tornado.

In another case, a man in Gassville, Ark., acknowledged a year-round tornado threat, quipping, "Hell's bells, this is Arkansas, that's normal, that's normal." Yet he still did not go to the designated shelter for the mobile home park in which he lived, despite being aware of tornado warnings issued for the area. He was lucky to survive, but a woman in that same mobile home park was killed by that EF 2 tornado.

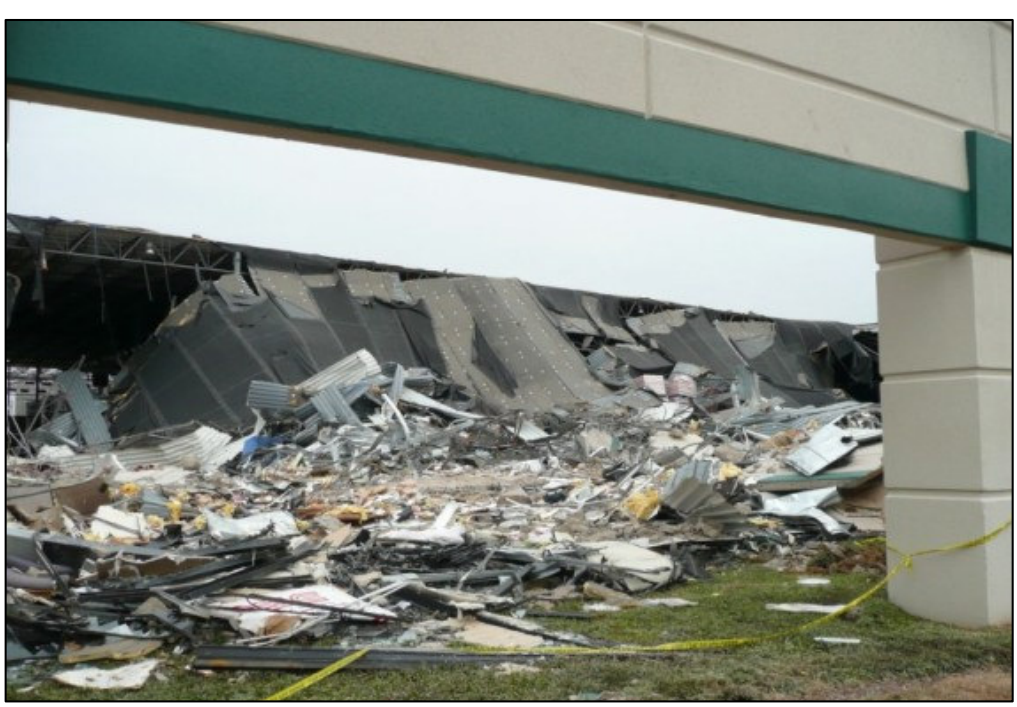
In the end, through the conversations, the tears, the nervous giggles, and the delirium, we may have raised more questions than we've answered.

Aggregated, these stories illustrate the complexities and diversities of how the public receives warnings about and responds to tornadic events. The entire weather community, not just the NWS, must address these myriad ways in which people gather and interpret warning information, perceive it, and ultimately make their decisions. The magnitude of the differences is staggering and somewhat sobering with respect to the challenges ahead.

In my nearly 20-year career with the NWS, I've seen the technology advance by leaps and bounds. Where we once sat in a dark room looking at attenuated Weather Surveillance Radar-74C data—yes, that was 1974 technology—we now have the ability to analyze high-resolution, four-dimensional, storm-cell information on multiple systems. Yet despite the advances in technology and scientific understanding, the decline in tornado fatality rates has stalled (Ashley 2007). This further underscores the need for and importance of societal impacts analysis.

Even though internal NWS assessments will always be necessary, a holistic, outward-looking approach has become critical. Such an approach must encompass the private-sector providers of weather information, the emergency response and safety officials charged with

(continued on page 7)



Three people were killed when an EF 2 tornado struck the DSC Logistics plant in Memphis, Tenn., during the Super Tuesday tornado outbreak.
(Photo by Julie Demuth)

Conferences and Opportunities

Call for Abstracts: Hazards and Disasters Researchers Meeting

Meeting Date: July 16, 2008
Location: Boulder, Colo.
Abstract Deadline: May 30, 2008

The 2008 Hazards and Disasters Researchers Meeting (HDRM) will take place on July 16, 2008, immediately following the 33rd Annual Hazards Research and Applications Workshop to be held at the Omni Interlocken Resort near Boulder, Colo., July 12-15. Submissions of scholarly research on all aspects of hazards/disaster research from all disciplinary perspectives are being accepted. Please submit extended abstracts for papers electronically to HDRMeeting@gmail.com with "HDRM Abstract" in the subject line. The submission should include:

- Author's/co-authors' name, address, telephone number, and email address (Please also indicate presenter.)
- Title of the paper
- Three or more keywords that signal the topic area of the paper
- An extended abstract of two pages, single-spaced, and not more than 1,000 words describing the research
- Indicate whether you are willing to serve as a chairperson and/or discussant

Accepted presenters will be notified by June 1, 2008. If an earlier decision is required to arrange travel, please indicate so with the submission.

Call for Manuscripts: Community Disaster Recovery and Resiliency: Exploring Global Opportunities and Challenges

Community Disaster Recovery and Resiliency: Exploring Global Opportunities and Challenges, an edited and peer-reviewed volume, provides a forum for policy makers, students, scholars, community organizations, and citizens to discuss community trauma during the pre- and post- (immediate and long-term) disaster response and recovery periods as it is experienced around the globe. This volume engages practitioners, academics, researchers, policy makers, and grassroots organizations in search of sustainable ways to rebuild communities after disasters (both natural and human-induced). The editors of this volume are calling for diverse community examples as a framework to facilitate a candid, in-depth comparison of the best practices illustrating how communities experience disaster, recover from it, and affect social policies in such a way that the community's vulnerability to disaster is reduced. Chapter proposals in reference to opportunities and challenges to international community recovery are being accepted in the following areas:

- Building and Public Infrastructure
- Social and Cultural Revitalization (including formal and informal social support networks)
- Economic Revitalization
- Public Health and Safety
- Housing and Housing Policy
- Private-Public Partnerships for Building Sustainable Communities

Send a title, an abstract, and a 3- to 5-page double-spaced chapter proposal, in English, by June 1, 2008, to DeMond Miller at millerd@rowan.edu.

74th Annual Association of Public-Safety Communications Officials (APCO) Annual Conference and Exposition

Conference Date: August 3-7, 2008
Location: Kansas City, Mo.
To Register: Visit http://www.apco2008.org/register_now.cfm

This conference enables public safety communications professionals to update their knowledge, mingle with peers, and get the latest technology and information for public safety personnel. More than 90 sessions will address topics that enhance career effectiveness and advancement in the field of public safety. For more information, visit http://www.apco2008.org/.

From the Director *(continued from page 4)*

first glance—reduced tax revenues do have an impact on the government agencies collecting these taxes—from the perspective of economic theory, this is not a loss to society. For the most part, taxes represent a *transfer* between parties and not a *gain or loss* to society. Even with this nominal appreciation of economic theory, we can easily see that reduced taxes should not be added to other economic losses as an indicator of the impact of weather events.

I'm not criticizing anyone in particular. I've certainly undertaken research without adequately developing research questions based on existing knowledge or theoretical considerations. Even though such studies are often of interest to the hydrometeorological community, their overall impact may be limited in that they don't augment or leverage the broader knowledge of any particular discipline.

Returning to the broad mission and vision of integrating social sciences into hydrometeorological research, applications, and operations, I'll consider MY mission partially accomplished if you and your colleagues read this article, mull over my points, and then decide to contribute to *WSW*. I encourage you to respond—positively or negatively—to the thoughts I've put forth here.

I invite and challenge you to send in descriptions of research that's based on the theoretical foundations of social science and incorporates appropriate methods and analysis. Although we need not be slaves to theory, I'd like to see more contributions demonstrating how your research is based on, adds to, or tests some theoretical aspect of your particular discipline. For an excellent example of researchers exploring the integration of social science theory (economics) with hydrometeorological issues (observing systems), see Morss et al. (2005).

At the end of the day, I envision furthering the mission of SIP and the vision of WAS*IS by presenting essential examples of good social science research in this newsletter. I hope you'll join me in realizing that vision!

Jeff (lazo@ucar.edu) is the director of NCAR's SIP.

References

Demuth, J.L., E. Gruntfest, R.E. Morss, S. Drobot, and J.K. Lazo. 2007: Weather and Society * Integrated Studies (WAS*IS): Building a Community for Integrating Meteorology and Social Science. *Bulletin of the American Meteorological Society*. 88, 1729–1737.

Morss, R., K. Miller, and M. Vasil, 2005: A Systematic Economic Approach to Evaluating Public Investment in Observations for Weather Forecasting. *Monthly Weather Review*, 133: 374–388.

Minding the Gap *(continued from page 5)*

Questions we ask run along these lines: How can we understand the social, economic, and political constraints and conduits across which weather and hazard information must travel to make it effective? How can we understand what makes weather meaningful to people, allowing us to craft better forecasts? How can we actively incorporate the world views of users as we construct and disseminate information? How can we be explicit about particular political and ideological positions held by information producers that may influence the information they produce?

My research demonstrates that different people understand weather and climate differently. In Tuvalu, for example, weather patterns and extreme events such as tropical storms and droughts are traditionally thought to be related to the social behavior of powerful community leaders. My research has led me to find inspiration in the WAS*IS program. WAS*IS participants insist that the different realities of different people must be accepted and woven together with scientifically produced information to bridge gaps between knowledge and practice in efforts to reduce harm and disaster. In communicating weather information, not only must we use appropriate technologies—a challenging task in places like the island archipelago, as well as many communities in the United States—we must also make forecasts and warnings accessible and meaningful within particular cultural contexts.

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Footnotes

[1] For example, for anthropological attention to the impact of hurricanes on U.S. coastal communities in 2005, see the December 2006 issue of *American Anthropologist* 108(4): **637-954.**

[2] Michael Glantz discusses how the usability of science necessitates social science in an enlightening contribution to the July 2007 issue of *Weather and Society Watch*, 1(4). See http://www.sip.ucar.edu/news/pdf/Weather_and_Society_Watch_July_2007.pdf.

[3] It is helpful to think of policy in the broadest sense, as encapsulating the rules, norms, behavior, and infrastructure of differing management options. See Lance H. Gunderson, 2003. "Adaptive Dancing: Interactions between Social Resilience and Ecological Crisis." Pages 33–52 in *Navigating Social-Ecological Systems: Building Resilience for Complexity and Change,* edited by F. Berkes, J. Colding, and C. Folke. Cambridge: Cambridge University Press.

[4] Rappaport, 1993. "Distinguished Lecture in General Anthropology: The Anthropology of Trouble," *American Anthropologist* 95(2): 295–303, p. 301.

About *Weather and Society Watch*

Weather and Society Watch is published quarterly by the Societal Impacts Program (SIP) at the National Center for Atmospheric Research (NCAR). The University Corporation for Atmospheric Research (UCAR) operates NCAR with support from the National Science Foundation and other sponsors.

The purpose of *Weather and Society Watch* is to provide a forum for those interested in the societal impacts of weather and weather forecasting to discuss and debate relevant issues, ask questions, and stimulate perspective. The newsletter is intended to serve as a vehicle for building a stronger, more informed societal impacts community.

Any opinions, findings, and conclusions or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the views of NSF or other sponsors. Contributions to *Weather and Society Watch* are subject to technical editing at the discretion of SIP staff.

Weather and Society Watch is available on the World Wide Web at: http://www.sip.ucar.edu/news/. Archives of *WeatherZine*, a previous weather impacts newsletter upon which *Weather and Society Watch* was modeled, are available on the Web at http://sciencepolicy.colorado.edu/zine/archives/.

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About SIP

All aspects of the U.S. public sector, along with the nation's economy, are directly and indirectly affected by weather. Although the economic impacts of weather and weather information on U.S. economic agents have been loosely documented over the years, no definitive assessments have been performed, and information generated from the previous studies is difficult to locate and synthesize.

SIP, initiated in 2004 and funded by NOAA's U.S. Weather Research Program (USWRP) and NCAR, aims to improve the societal gains from weather forecasting. SIP researchers work to infuse social science and economic research, methods and capabilities into the planning, execution and analysis of weather information, applications, and research directions. SIP serves as a focal point for developing and supporting a closer relationship between researchers, operational forecasters, relevant end users, and social scientists concerned with the impacts of weather and weather information on society. Program activities include primary research, outreach and education, and development and support for the weather impacts community.

For more general information on SIP, contact Jeff Lazo at lazo@ucar.edu or http://www.sip.ucar.edu.