

Weather and Traffic: Integrating the Right Information

by Paul Pisano*

Where do you think most deaths occur when the weather gets bad?

- A. At home
- B. At work or school
- C. Outside (e.g., golfing)
- D. In your car
- E. In an airplane

If you chose D, in your car, you were right. In fact, it's not even close. Approximately 7,400 lives are lost on the nation's roadways under adverse weather conditions each year. Compare this to the 167 weather-related aviation fatalities, and the 573 weather-related fatalities that occur elsewhere every year [1], and you can see that we've got a real problem on our hands.

The problem isn't just the 7,400 people who die each year in weather-related vehicle crashes. It's also that this statistic is some sort of best-kept secret. Why isn't it common knowledge that almost one-quarter of all roadway crashes—including fatalities, injuries, and property damage averaging more than 1.5 million per year from 1995 to 2005 [2]—occur during adverse weather and could be at least partially prevented with more targeted research efforts?

But while this fact may not be in the front of everyone's mind, there must be some implicit awareness. How else can we explain the deluge of weather and traffic information that Where do you think most deaths occurs every time you tune in to the news on your television set or

car radio? And those of you on the leading edge of technology can now become even more overwhelmed with weather and traffic information via your cell phone, navigation device or satellite radio. So upon further exploration, we find that the problem isn't a lack of information. Instead, it's the result of either too much information being presented in the wrong way, or a glaring lack of the "right" information.

What do I mean by the "right" information? Road users and transportation system managers don't need a weather forecast; they need transportation information, but not just any transportation information. They need dynamic, integrated information about the current and future state of the highway system.

Again, that's not a weather forecast, fancy radar loop or the current temperature at the nearest airport or school. It's not even dynamic routing on your in-vehicle navigation system—arguably such bits of information treat each vehicle as a discreet object and miss the fact that improving mobility and safety requires a system view that accounts for interactions between vehicles. It's road-related content from a system wide perspective based on very-high-resolution forecasts both above and at the road surface.

You can't get that when you separate the weather forecast from the traffic report. Instead, you get two pieces of critical information, and you

have to function as your own geographic information system (GIS) to overlay that weather forecast onto

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Approximately 7,400 roadway fatalities each year are weather related. (Photo courtesy of the Federal Highway Administration)

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Paws and Click: Disaster Preparedness Information on Animal Welfare Web Sites

by Kathleen Sherman-Morris*

Hurricane Katrina and its aftermath have forever changed this nation's thinking about the importance of taking animals into account during an emergency.

—Wayne Pacelle, Humane Society of the United States (HSUS) CEO and President (HSUS, 2006)

Before Hurricane Katrina, few studies focused on caring for pets in the time leading up to or during disasters. In one of the few pre-Katrina studies of pet evacuation during an emergency, Heath, Voeks, and Glickman (2001, p. 1904) recommended that pet care facilities promote pet evacuation as part of “responsible pet ownership” and that pet care providers become involved with the emergency management process. Highly publicized problems with the evacuation of people and their pets during Katrina drew attention to this need, and clearly demonstrated that the *Stafford Disaster Relief and Emergency Assistance Act* failed to adequately address it (Beaver et al., 2006).

Since Katrina, there has been much progress, including a National Animal Disaster Summit held in Washington, D.C. in May, 2006 to identify problems associated with the animal relief effort; additional research on the organizational relief effort (Irvine, 2006); and the passage of the *Pets Evacuation and Transportation Standards (PETS) Act* in October 2006. *PETS*



A Perspective on the Importance of Social Science to the Nation's Natural Disaster Warning System

by Larry Mooney*, with Eve Gruntfest**

This article summarizes comments from Larry Mooney, the meteorologist-in-charge (MIC) in the Boulder/Denver National Weather Service (NWS) office. During his four decades with the agency, Larry has taken on numerous assignments around the country. He speaks passionately about how collaborations between meteorologists and social scientists over the years have resulted in findings beneficial to the NWS (such as including warning coordination meteorologists in each forecast office). This article was inspired by Larry's remarks at the October 2007 meeting of the Central Region's Meteorologists in Charge in Kansas City, where he talked about how social science has informed and improved the NWS not only in the last 10 years but for the last 40 years or so. Eve Gruntfest first drafted the piece after a long chat with Larry, who then crafted this article in his own voice.

In looking at Web chat and Web pages, it's easy to get the impression that the collaborations between meteorologists and social scientists began with the Societal Impacts Program (SIP) at NCAR or with Weather and Society*Integrated Studies (WAS*IS) or with Roger Pielke's work in the 1990s. These efforts, though, are actually the continuation of the good practice of involving social science in meteorology, which has been around for at least 40 years.

When I started with the NWS as an intern in the early 1970s, the general philosophy of warning operations was that once a warning message was sent, your job was done. Most of the forecasters considered this to

be a logical approach because many had begun their meteorological careers as military forecasters in World War II or Korea. In their minds, the meteorological facts were all that the user needed. These were some of the best forecasters I ever worked with, but they did not understand the scope and the impact of their forecasts. They had little contact with their users and the dissemination of weather information was very limited compared to today's weather enterprise.

When I started with the NWS as an intern in the early 1970s, the general philosophy of warning operations was that once a warning message was sent, your job was done.

This began to change when the supervising meteorological technician at the Fort Worth office ventured outside of our weather world and took some journalism courses at a local university. He immediately began to teach the interns how to write in a different style, one that was clear and more focused on the users' needs. NWS Southern Region Headquarters soon recognized the importance of this broader approach. The result was a training course publication called "Clear Weather Writing," which became mandatory training for much of the NWS.

At the same time, leaders in the NWS Southern Region Headquarters, such as Jack Riley and Andy Anderson, recognized that we could make our warning products more effective by learning more about the warning process. From

the work of Benjamin McLuckie, they learned that the warning response decision was not an immediate stimulus response process and concluded that we needed to do more to get people to respond to our warnings. To address this problem, the NWS hired McLuckie from the University of Delaware to write "Warning, A Call to Action," a training guide stating that the NWS has further obligations beyond just conveying hazardous weather information. The publication asserted that the agency needs to influence people and to offer intermediate statements and updates on storm progress. The content of current warning products is still based on McLuckie's work.

Also in the early 1970s, a visionary at NWS Headquarters, Herb Lieb, recognized the importance of greater involvement of NWS staff in all phases of the warning process, including response. A community preparedness specialist (CPS) position was established at most of the forecast offices to train spotters and raise public awareness. The history of the duties and evolution of this position is contained in an excellent publication by Doswell, Moller, and Brooks. I was fortunate to be selected as a community preparedness meteorologist (CPM) in the Fort Worth office.

In the meantime, the Social Science Research Center at Mississippi State University had done an interesting study on public response to Hurricane Camille. In September 1975, Anderson quickly put together a team of CPSs (including me) to work with Peggy Ross from Mississippi State on a post-storm

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From the Director

On Philosophy and Meteorology by Jeff Lazo*

I'm an economist by training. At least that's what my Ph.D. is in. But my bachelor's degree is in economics *and* philosophy (I added the economics when I figured out I might never get a job as a philosopher). So because I remember just enough philosophy to be dangerous, I'll preface this article by saying that I simply want to raise some questions. My hope is that someone better qualified finds them interesting enough to step forward and clean up whatever mess I make in my philosophical musings.

My underlying focus in this exercise is this: Could many of the real questions about integrating social sciences knowledge and methods into the weather research and policy-making communities be better understood using approaches, tools, and methods from philosophy such as ethics, epistemology, logic, and metaphysics?

Ethical Questions: Societal Missions and Value-Free Research and Applications

Let's first consider the stated missions of two major meteorological research and application organizations in the United States—NCAR and NOAA. NCAR's mission, as seen by Walter Orr Roberts, the center's first director, is "Science in service to society." NOAA's stated mission is "To understand and predict changes in Earth's environment and conserve and manage coastal and marine resources to meet our nation's economic, social, and environmental needs" (NOAA 2005). The stated purpose of meteorological research and applications in the United States, then, is to benefit society.

That raises the question: Is it possible to do research in meteorology without making value judgments?

Hunt (1979, p. 127) states that

...values stand at the very foundation of the process of theorizing. They dictate not only what a theoretician will consider an important social issue but also what types of solutions to social problems would be acceptable.

I'll preface this article by saying that I simply want to raise some questions. My hope is that someone better qualified finds them interesting enough to step forward and clean up whatever mess I make in my philosophical musings.

Given that U.S. meteorological organizations focus ultimately on social problems related to the impact of hydrometeorological events, I would say that the answer to the value-judgment question is an emphatic no. When decision makers consider whether to invest in research on hurricane intensity, develop next-generation radar technologies, or improve the resolution on global climate models, each choice has different potential societal impacts.

Some examples will help illustrate this point. Hurricane research benefits coastal residents more than those in land-locked Oklahoma—tornado research does the reverse. Research to advance weather forecasting for air traffic benefits the

rich more than the poor. Research on improving urban heat wave warnings might benefit the poor relatively more than the rich. And benefiting one group more than another involves implicit, if not explicit, ethical decisions and value judgments of the relative worth of each.

Simply claiming that all forecast improvements are for the good of society is not value-free either, because different programs benefit different people in different ways. Even research driven by pure intellectual interest does not result in findings free from impacts on society or free from value judgments. Philosophy could bring much to this discussion through its rich history of analysis on the meaning of *value*—the purview of ethics.

I base my next shot at thinking philosophically on my reading of a chapter on the philosophy of the social sciences by Martin Hollis (2002), who did considerable work in this area. Hollis discusses different philosophical frameworks that can be applied to analyzing social action. He explores questions of knowledge using a dichotomy of *explanation* versus *understanding* and questions of analytical priority using a dichotomy of *holism* versus *individualism*. I focus here on my interpretation of Hollis's discussion on explanation versus understanding because it may relate to the study of society and the integration of social sciences with meteorology. Later, I'll touch on the holism versus individualism dichotomy when I discuss the approach of economics versus sociology.

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Connecting Weather and Society: My transition to Grad School

by Marcus Walter*

Most meteorologists fall in love with weather at an early age. Indeed, I became interested in weather around the age of 12. I would find myself watching The Weather Channel all day, sometimes for no reason, and other times to hear about the latest tornado in the Midwest or hurricane in the Atlantic. Today, as a recent graduate of Pennsylvania State University with a B.S. in meteorology, my interest in weather is keener than ever. And throughout the last two years of my educational experience, my interests have broadened from focusing only on weather to learning more about how weather affects society and business.

I developed this new interest after attending the 87th American Meteorological Society Annual Meeting in San Antonio, Texas, in January 2007. At the meeting, I discovered that the business world has a growing need for meteorologists who possess weather forecasting skills and an understanding of statistics to help companies manage their weather risk. Weather directly or indirectly affects more than one-third of the nation's economy, and understanding those effects can help businesses mitigate financial losses resulting from weather. I became even more interested in this area after participating in the SOARS (Significant Opportunities in Atmospheric Research and Sciences) program at the National Center for Atmospheric Research in Boulder, Colorado. There, I studied floods and heat waves. These extreme weather events can have major impacts on society that range from loss of life to millions of dollars in damaged property. From this research I learned that there is an urgent need to better understand

these events and to help society protect itself from them.

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As I entered my senior year in college, realizing that I wanted to learn more about the connections among meteorology, business, and society, I decided to pursue a graduate degree. But finding a graduate program with faculty members who have interests similar to mine wasn't exactly simple. Because this is a relative new area of meteorology, many graduate programs had no such research initiatives at their respective institutions. But through attending American Meteorological Society annual meetings, participating in the SOARS program, and researching several graduate programs around the country, I was able to find a program at Cornell University where I could study both weather and its impacts on society and business.

For those of you who want to research interdisciplinary interests or interests in new areas of research in graduate school but don't know where to begin your search for an appropriate program of study, here are some helpful suggestions:

- 1) ***Do a simple internet search for your interests.*** Search engines are very advanced these days and will be a

valuable tool in your search, not only for information on your interests, but possible graduate programs as well.

- 2) ***Talk to a professor or instructor about your interests.*** In most cases professors and instructors can be helpful in leading you to a graduate program that fits your interests.
- 3) ***Attend seminars and conferences related to your interests.*** Doing this will allow you to learn even more about your research interests and related topics. This will give you a chance to meet faculty and researchers from universities around world and find out if they have programs that fit your interests.

These suggestions were all helpful in finding an appropriate graduate program for my interests.

Looking to the future, I see numerous opportunities to learn more about and conduct research in this emerging field. I believe that this work will benefit society and business in the years to come, and I'm excited to be a part of it!

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Review of *The Weather Channel: The Improbable Rise of a Media Phenomenon*

by Daniel Sutter*

The early 1980s were an exciting time in the television cable industry, with new channels being established and delivered by satellite to serve expanding urban systems. The era of “narrowcasting,” with specialized channels like ESPN, Disney, HBO, and Showtime seeking to attract relatively small but dedicated audiences, was just beginning. The information age was also dawning—CNN had just begun offering news and information 24 hours a day, 7 days a week. This book by Frank Batten, chairman of Landmark Communications, tells the story of the founding of The Weather Channel (TWC) in 1982, arguably the ultimate experiment in information-based narrowcasting. The story focuses on the business side of the operation, so readers interested in profiles of on-camera meteorologists or details of weather events covered by the channel will be disappointed. Nonetheless the book is very well written and tells TWC’s story, particularly its near-death experience in 1983 and 1984, extremely well.

The concept of a 24/7 weather channel was the brainchild of John Coleman, then the weathercaster for *Good Morning America*. Coleman presented his idea to a number of venture capitalists and media companies without success before connecting with Frank Batten and Landmark Communications, a media company seeking to get into the programming business. In evaluating Coleman’s concept, Landmark determined that a viable weather channel required access to a transponder on one of the existing broadcast satellites; access to cable systems (many of which had capacities of only 12 or 24 channels at the time); an ability to

include local weather conditions and forecasts along with national coverage; and access to weather data and forecasts from the National Weather Service (NWS). Landmark was confident that the public was sufficiently interested in weather to sustain viewership if a quality service could be provided.

Delivering local conditions and forecasts became the key hurdle. Inclusion of local forecasts was an important consideration for many cable systems in agreeing to take TWC. Many early 12-channel systems included a “local weather” channel, often simply a camera fixed on a display showing the local temperature. Because this decidedly low-tech fare proved popular with viewers, Landmark could argue that it would deliver this same local information and much more. In many cases, this helped TWC avoid competing directly against networks like Disney or WGN for access to cable systems. Transmitting different local forecasts for different parts of the country using the same satellite transponder was a formidable technical challenge, which was surmounted by TWC’s WeatherSTAR (Satellite Transponder Addressable Receiver) system. Solving the problem allowed TWC to tailor ads for local dealers of national retailers, increasing its advertiser base. Landmark won the race against time and launched TWC on its target date of May 2, 1982.

But TWC almost died in childhood. The capital costs of the WeatherSTARs and programming costs for 24-hour weather coverage exceeded projections, and advertising revenue lagged because the cable medium was so new. And

although a visionary meteorologist, Coleman lacked management skills and had to be replaced after the first year of operation. First, Landmark looked to sell TWC. Then, the company planned to pull the plug on TWC because of mounting losses. At this point, cable system operators stepped in, volunteering to pay subscriber fees to keep TWC afloat. (In addition to revenue from selling ads, some cable networks receive payment from systems per subscriber to include a network on basic cable, or “subscriber fees.”) The rescue of TWC demonstrated the market value of weather coverage; cable companies recognized that TWC helped to drive subscriptions, and that they would be hard pressed to replace the local weather coverage and forecasts offered by TWC. Subscriber fees helped to stem the tide of red ink until the growing cable advertising market led to profitability. Today TWC stands as one of the most respected brands in television news and information.

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The Weather Channel: The Improbable Rise of a Media Phenomenon by Frank Batten with Jeffrey L. Cruikshank is available from Harvard Business School Press.

TWC gives us an important example of the successful marketing of weather information. Weather forecasts meet the classic economic definition of a public good, which implies that forecasts—especially general forecasts for a large public—will be difficult to supply commercially for a profit. TWC succeeded by drawing on the value of weather information to the audience. “Weather- engaged” viewers with a deep interest in weather make up the largest percentage of TWC’s audience. Recognizing that TWC would help attract cable subscribers accounted for, in large part, the willingness of cable companies to pay subscriber fees to keep TWC in business.

TWC gives us an important example of the successful marketing of weather information. Weather forecasts meet the classic economic definition of a public good, which implies that forecasts—especially general forecasts for a large public—will be difficult to supply commercially for a profit. TWC succeeded by drawing on the value of weather information to the audience.

The Impact of TWC’s Improbable Rise on Weather Research

The larger question this raises is the whether commodification of weather could help fund weather observation and research. The long term budget situation for the Federal government is bleak, with the war in Iraq, the war on terrorism, and the impending retirement of the Baby Boom generation. Federal funding for

basic science is unlikely to increase

considerably in the decades to come. Could the deep interest so many people have in weather augment funding?

In 1990s an astute insight from Ray Ban led TWC to realize their need to do more than repackage and relay NWS data and forecasts. Consequently TWC started running their own forecasting models, in essence contributing to atmospheric science research. TWC and many local television stations employ storm chasers, who conceivably assist in observing severe storms. Television thus already directs some of the weather engaged public’s interest in weather into funding. Could more be done in this regard? Two examples suggest yes.

In recent years, tornado chasing has emerged as a for-profit vacation activity. Hundreds (and by now maybe thousands) of people each year take a storm chasing vacation. One could easily imagine some of these people being willing to pay extra to help cover the cost of better observing tornadic thunderstorms, and these observations might help researchers better understand the formation of tornadoes. The fee paying storm chasers might consider that their tornado intercept is helping scientists understand tornadoes to be a neat extra aspect of their vacation. Elementary and secondary schools across the country attempt to try to interest and educate children in science. Conceivably schools could consider weather applications to accomplish this goal, and some of the dollars used for science education could help fund weather observation or research.

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Jobs & Opportunities

University of Utah Tenure-Track Faculty Position in Department of Meteorology

The Department of Meteorology at the University of Utah Department of Meteorology invites applications for a tenure-track assistant professor position. Applicants with a commitment to excellence in undergraduate and graduate education and a demonstrated capability to establish a strong externally funded research program in any area of the atmospheric and related sciences are encouraged to apply. All outstanding candidates will receive consideration including applicants with collaborative and interdisciplinary skills.

The successful applicant will join a growing and vibrant department with core research programs in cloud-climate interactions and remote sensing, tropical meteorology, mountain weather and climate, numerical modeling and data assimilation, climate dynamics, cloud physics, and boundary layer meteorology. Teaching and research activities extend into areas such as hydroclimate, snow hydrology, air quality, and wildfire prediction.

Review of applications will begin on September 19, 2008, and will continue until the position is filled. Please send a full statement of interests, CV, and contact information for at least three references to Faculty Search, Department of Meteorology, University of Utah, 135 South 1460 East, Room 819, Salt Lake City, UT 84112-0110. Complete applications in PDF format can also be emailed to: meteo-search-faculty@lists.utah.edu.



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generally easy to locate, with more than half within two clicks from the home page. Most of the information was for “pets” in general, although two Web sites specified horses, livestock, reptiles, and small pets. Three offered specific information for bird owners and half specifically mentioned cats and dogs.

The preparedness information could be divided into two areas: preparedness plans or actions that should be taken and lists of items to put in a preparedness kit. The only action mentioned by all Web sites was the need to arrange for a place to go with your pet—or alone as a last resort—before the disaster strikes. Other common actions included microchipping pets and identifying someone who could “pet-sit” in an emergency.

Recommendations for pet disaster kits included food and water, sanitation items, identification, medical supplies, a means to restrain and transport the animal, and other items that would help keep the animal on a normal routine.

The most common scenario reflected in the preparedness information was a hazard requiring evacuation. All of the Web sites’ plans would prepare you for evacuating with your pet. Six of the eight sites also included information for staying in your home throughout an event. Five sites posted information about what to do if you must leave your pet or are away from your pet when an emergency occurs. For example, it’s important to make an emergency plan for times when you’re at work as many people haven’t actually thought through such a scenario. And studies have shown that people who do not evacuate with pets

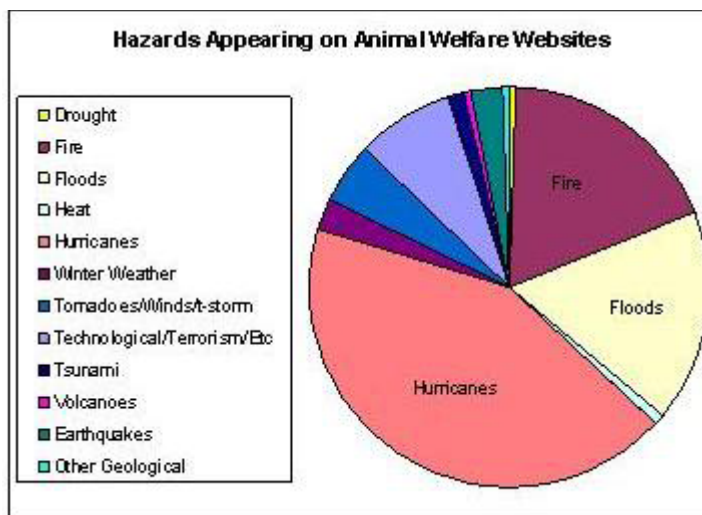


Figure 2. Hurricanes, fires and floods dominated the hazard-related content on animal welfare Web sites.

during a disaster often try to retrieve their pets during the evacuation period (Heath, Voeks, and Glickman, 2001; Heath et al., 2001).

Although most of the Web sites were written primarily for the public, two did provide information for pet care professionals in the form of manuals, specialized disaster preparedness information, or forms that shelters or other rescue groups can copy and use.

Recommendations for pet disaster kits included food and water, sanitation items, identification, medical supplies, a means to restrain and transport the animal, and other items that would help keep the animal on a normal routine. Of these general items, all eight sites listed identification, a collar, medical records and/or prescriptions, a crate, and a leash. Food, water, and a first-aid kit appeared on seven of eight lists. The number of items on the lists varied from seven to twenty-five. Instead of focusing on the quantity of items you might need, however, it’s more important to consider which of the items on the lists would be necessary to ensuring the safety of your pet. Figure 3 is an example of one of the checklists.

Hazard preparedness information represented a large portion of the total hazard content on several

of the Web sites, especially those that did not have a large amount of hazard-related content to begin with. Comparing all the Web sites, preparedness information was the third most frequent hazards-related topic (second if the 2005 hurricane season is grouped with all other responses.) Response during Hurricanes Katrina and Rita received the greatest amount of coverage.

Most of the sites highlighted that organization’s response to hazards, including Katrina and Rita, but also other hazards such as fires, floods, tornadoes, and other hurricanes. The map in Figure 1 shows the locations mentioned in the hazard-related information, which are largely those locations to which animal welfare organizations sent volunteers or workers to help rescue pets. All but seven states were mentioned at least once in the hazard content, but several areas stand out on the map. Because California experienced wildfires immediately before the analysis began, that state was featured in a high number of in articles. Fires also occurred in Montana in 2007. Hurricanes accounted for the high frequency of articles posted about the Gulf Coast states, with Katrina and Rita articles dominating. Several of the organizations maintained a presence in Louisiana or Mississippi for months after the hurricanes, and

many of the articles were updates on the progress of the relief effort. For all the organizations together, hurricanes were mentioned more than twice as often as fires or

floods (259 versus 111 and 105, respectively), and also about twice as often as all the other hazards (excluding fires and floods) combined (130). Figure 2 presents the entire list of hazards. For organizations disseminating information primarily about preparedness, the hazards were mentioned more evenly.

Other information included resources available to assist with animal evacuation and information about how the organizations generally respond to hazards. In addition, the sites described how to volunteer and donate and how to care for pets during emergencies. Information on legislation—most dealing with *PETS* and its pathway to passage—was also posted.

It's important to make an emergency plan for times when you're at work as many people haven't actually thought through such a scenario.

From the data collected, it isn't possible to determine whether the amount of information increased after Katrina, or how it may have changed, but the influence of this hurricane is still apparent. Because of the sheer number of articles focusing on the response to the 2005 hurricanes and those centering on passage of *PETS* (which may not have had the impetus to become law without Katrina), however, it is clear that Hurricane Katrina has greatly influenced the hazard-related content on animal organizations' Web sites. At least for those sites that included preparedness suggestions, animal welfare Web sites appear to be a fairly consistent and correct source

of information about how pet owners can prepare for hazards.

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UAN, November 2007: *Disaster Preparedness Checklist*. Available at http://www.uan.org/documents/Disaster_Tips.pdf (accessed January 9, 2008).

Disaster Kit Checklist

- ☒ **Food**
 - A one-week supply in airtight, waterproof containers
 - If using canned food, include a can opener and spoon
 - Rotate food every two months to avoid spoilage
- ☒ **Water**
 - A one-week supply in airtight, waterproof containers
 - Avoid storing in direct sunlight
 - Rotate water every two months to avoid spoilage
- ☒ **First aid/Medication**
 - Basic animal first aid kit and book
 - At least a one-week supply of any prescription medication
 - Heartworm and flea/tick preventative
- ☒ **Identification**
 - Photos of your pets that show any distinguishing features
 - Photos of you with your pets
 - Temporary "write-on" identification tag
 - Proof of vaccinations (in case you must board your pet)
- ☒ **Animal care supplies**
 - Collar and leash or harness
 - Crate or carrier
 - Collapsible food and water bowls
 - Blanket, toys and treats
- ☒ **Cleaning supplies**
 - Paper towels
 - Dish soap
 - Plastic bags or cat litter with litter tray

Visit www.uan.org to:

- Find more disaster preparedness resources
- Get disaster kit supply tips for various species
- Order supplies and planning materials



United Animal Nations

tel: (916) 429-2457

fax: (916) 429-2456

e-mail: info@uan.org

web: www.uan.org

Figure 3. This checklist from United Animal Nations (UAN) is also available in Spanish (UAN 2007).

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survey on public response to Hurricane Eloise. Ms. Ross trained us to do house-to-house interviews. It was certainly an interesting experience that gave the NWS staff new insights into the hurricane evacuation process from the point of view of those who actually used our forecasts.

Equally important from my perspective, that exercise created the first group of WAS*ISers. Many of us on the team went on to be warning coordination meteorologists (WCM) and meteorologists in charge (MIC). I soon moved to Corpus Christi as an MIC. My Eloise experience had increased my interest in and understanding of the evacuation process, which proved beneficial both while working hurricanes and later in my career.

After a tour as a warning preparedness meteorologist in the Oklahoma City office, I returned to Fort Worth as the regional warning preparedness meteorologist. That job description included the role of flash flood and hurricane program manager for the Southern Region. The social scientist in me surfaced again when we started looking at the continued rise in flash flood deaths. These fatalities were occurring despite our increased efforts to forecast heavy rain. I wanted to know more about why people were not responding the way we expected.

I reviewed every flash flood death listed in Storm Data and published a report that, for the first time, documented that more than half of flash flood deaths occurred in vehicles. As a result, we increased our office's attention to this aspect of the flood risk. In addition, we were able to influence national headquarters to increase the emphasis on including more detail about flash flood deaths in Storm Data, an emphasis that continues today. After the 1976 Big Thompson

Flood in Colorado, Eve Gruntfest worked with many agencies to move from simple detection to integrated detection and response for flash flood warning systems. It has been

a pleasure to work with Eve and her colleagues for the past three decades.

The Hurricane Program offered me additional opportunities to partner again with social scientists. In the early 1980s, the NWS decided to make public hurricane probability forecasts available to emergency managers and the public. Some people, in and out of the NWS, expressed concern about this decision as they feared the forecasts would be misunderstood and improperly used. Mike Carter, a sociologist the Office of Meteorology at NWS Headquarters, was a strong advocate of sharing all NWS information with the public. He argued for implementation along with a comprehensive training program for local government decision makers.

In response to this need to educate users of hurricane probability forecasts, two teams (including me) visited more than 30 cities in 29 days to brief news media and emergency managers on the probabilities. Our briefings included information from the social science community on anticipated public response to the probabilities. Following this training, probability forecasts were implemented and have remained a key part of the hurricane forecast product suite for over two decades. Social scientists played a vital role in taking a giant step toward communicating the uncertainty in coastal living.

Knowing how long it would take to evacuate a given area was critical to local governments if they were to use the probabilities effectively. Mike Carter joined our effort to develop hurricane evacuation studies, and his understanding of the warning process was critical to that work. I

did not complete this effort before moving to Norman, Oklahoma, as the deputy MIC. There was, however, at least a draft hurricane evacuation study for New Orleans.

It would probably be difficult to find a copy of it today, but I recall that it identified some of the problems we saw in Hurricane Katrina.

In Norman I was heavily involved in the testing and operational integration of the NEXRAD (Next-Generation Radar) Doppler radar. My past exposure to the social sciences once again proved valuable as we tried to address issues like how to best present these new and complex data to our partners and the public.

While at Southern Region Headquarters, I had my first opportunity to attend the Annual Natural Hazards Workshop in Boulder, Colorado. I've been an embedded meteorologist in the Colorado social scientist community ever since. By the time I became the MIC in Boulder, Chris Adams, a sociologist, had replaced Mike Carter at NWS headquarters. When the position was moved to Colorado State University, working with Chris became more convenient.

NOAA's Forecast Systems Laboratory (FSL) was nearing completion of the design of the NWS Advanced Weather Interactive Processing System (AWIPS) when Chris and I met with FSL scientist Dave Small to discuss how AWIPS would interface with external users and partners. To our amazement, we discovered that no such capability was planned. Working as a team, we visited NWS Headquarters and briefed NWS Director, Joe Friday, on the importance of creating and maintaining interfaces with the other elements of the warning system such as spotters, hydrologic data networks, emergency managers, and the Internet, among others.

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your mental road map to figure out if and how this will affect you and what you should do about it.

When you put the pieces together and see that the weather IS likely to affect you, you have to make some decisions: Do I drive 30, 40, or 50 mph through this fog? Do I take that route along the river or stay on higher ground? Or, if you're a transportation manager, you'll ponder, how much salt should I spread on the roads to keep the ice from bonding to the pavement, and when should I do it?

These are not easy decisions to make, and they are made all the more difficult when the information flowing into this mental GIS is inaccurate, incomplete or nonexistent. It's easy to imagine thinking, "The river route is shorter, but it might become flooded, in which case the higher route would be better. But all I know right now is that it's raining. I don't know if the road is going to be flooded by the time I get down there." Compound this uncertainty with the need to make some of these decisions while you're driving at highway speeds, and it's no surprise that bad decisions are made.

As dire as this article may sound, there is plenty of good work taking place today. The weather community continues to make advancements in numerical weather prediction, and the transportation community continues to advance intelligent transportation systems. However, while these are critical pieces to the puzzle, we will never get to where we need to be if each community does its work independently. Fitting these puzzle pieces together requires a significant amount of interdisciplinary cooperation. Likewise, extensive cooperation is necessary if we are going to develop the other pieces to the puzzle that don't yet exist (e.g., achieving better observations

of weather and road conditions, determining the best messages that produce the desired responses from

end users, and defining appropriate weather-responsive traffic management strategies).

Fortunately, there is a subset of the weather and transportation communities that is working very hard to bring these two worlds together. We're collaborating to explore the links between weather and roadways. We're working to understand how traffic flows under varying weather conditions and to develop high-resolution forecasts at the pavement surface. We're striving to integrate weather and transportation information into computer-based decision support systems and explore the decision-making process of road users and managers. We're doing all this necessary work with an ultimate goal of disseminating the right messages. It's quite a challenge when two communities depend on each other, but speak very different languages. In addition, the two communities are often driven by different priorities, policies, and politics.

One key way to address the challenge is to take advantage of "a new breed of experts," a phrase coined by William Hooke in his *Weather and Society Watch* editorial (Vol. 1, No. 2). We need translators and interpreters who can turn weather products into transportation information. We need information brokers who can articulate the needs of the road users. And we need meteorologists who can develop products that meet those needs. And the solutions must be cost-effective. Not only does that decision support system have to save lives and keep the transportation economy moving, but it must do so within a public agency's budget and/or in a profit-making manner for the private sector.

It's apparent that we have a significant problem on our nation's

roads. Recent advancements in the road weather world, however, show us that the problems are

surmountable if we recognize that weather doesn't stop when the forecast is disseminated. Instead, that's when weather starts to really matter—when society takes that forecast and tries to figure out what to do about it. Such efforts require the expertise of many disparate groups – not just meteorologists and highway engineers, but also social scientists, human factors psychologists, and technologists, to name a few who can act as a bridge and develop these cost-effective solutions. Again we're getting there, but it's clear that we ALL have more to do to lower the number of highway deaths and injuries caused by weather.

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Footnotes

[1] Aviation fatalities represent a 4-year average and all others represent a 10-year average, from the NOAA Natural Hazard Statistics website: <http://www.weather.gov/os/hazstats.shtml#>

[2] FHWA Road Weather Management website: <http://ops.fhwa.dot.gov/weather/index.asp>

Conferences & Opportunities

Next Generation Warning Services Workshop

Workshop Date: December 2-4, 2008

Location: Norman, Oklahoma

To Register: Please visit <http://apps.weather.gov/partners/index.php>

The National Weather Service (NWS) and the University of Oklahoma will jointly host a Next Generation Warning Services Workshop in Norman, Okla. December 2-4, 2008. This workshop will bring together technical and operations experts from the private weather enterprise, broadcast media, emergency management, academia, and other governmental agencies with a goal to determine potential requirements for future NWS warning services. Discussions will range from broad concepts of the types of information included in these services to the details of textual and graphical dissemination. The goal of the workshop is to enable NWS partners to:

- Fully take part in defining requirements for watch, warning, and advisory services,
- Share details regarding new technologies and capabilities that would impact these requirements, and
- Obtain a clear idea about how to maximize public and partner satisfaction with the quality, usability and flexibility of NWS future warning services.

A clear understanding of how people receive and interpret hazardous weather information is critical to meeting these goals. Consequently, the workshop also will address the current state of the social sciences with respect to the understanding of human response to warning services, and to identify social science needs.

Online registration is available at <http://apps.weather.gov/partners/index.php>. Additional information including a draft agenda, and logistical details will be e-mailed to registrants and linked on the web site in the near future. For more information, contact John.T.Ferree@noaa.gov or Kevin.Scharfenberg@noaa.gov with NWS Severe Storms Services.

European Meteorological Society (EMS) Annual Meeting

Meeting Date: September 29-October 3, 2008

Location: Amsterdam, The Netherlands

Deadline for Exhibitors and Pre-Registration: August 25, 2008

To Register: Please visit <http://meetings.copernicus.org/ems2008/registration.html>

The EMS annual meeting aims to strengthen and widen scientific exchange within the European context to explain the specific characteristics of the science of meteorology, to address the challenges of interpreting the results, and to communicate them to society at large. It includes the application of meteorology for the benefit of society, providing a platform for the meteorological community to discuss demands and aims for the present and the future. To address these issues the 2008 conference will have three streams: the atmosphere and the water cycle; meteorology and society; and forecasting the weather at all time scales – THORPEX studies, applications, and societal impacts. For more information, please visit: <http://meetings.copernicus.org/ems2008/>

The '88 Fires: Yellowstone and Beyond

Conference Date: September 22-27, 2008

Location: Jackson Hole, Wyoming

To Register: <http://www.iawfonline.org/yellowstone/>

The International Association of Wildland Fire, in association with the 9th Biennial Scientific Conference on the Greater Yellowstone Ecosystem, is sponsoring this conference to remember the events of the Yellowstone area fires of 1988. Discussions and presentations will focus on lessons learned, fire effects, large fire management, policy, research related to the fires, the use of fire as a management tool, and many other issues. For more information, please visit <http://www.iawfonline.org/yellowstone/>.

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As a result of Chris's arguments and Dave's technical knowledge, we were able to add a last-minute requirement for functionality that would become the Local Data Acquisition and Dissemination (LDAD) system.

Early Social Scientist Impacts Still Benefit NWS Today

I'm sure that social scientists made many contributions to the NWS that I've overlooked or am not even aware of. Nevertheless, their influence is pretty impressive when you consider the impacts I observed:

- The inclusion of action statements in NWS products
- A better understanding of the warning response process and the NWS role in this process
- Increased understanding of the hurricane evacuation process
- Use of hurricane probability forecasts
- Greater focus on the true nature of the flash flood risk and appropriate actions
- Hurricane evacuation studies
- The ability for AWIPS to communicate with the rest of the warning team.

In each of these, input from the social science community was critical to improving public warning services and ultimately to saving lives. All because meteorologists and social scientists listened to each other and worked to find solutions to problems that could not be solved within the scope of a single discipline. Links among researchers and practitioners in the weather world are more frequent and more fruitful as the end-to-end-to-end approach gains more acceptance (Morss 2005).

Incorporating social science is part of an evolutionary process. The increasing complexity of our society and the growing impact of weather phenomena make it essential that we build on these previous accomplishments. Increased

collaboration across disciplines must not only be accomplished in formal programs or projects; it needs to be a daily way of doing business down at the weather forecast office level. WAS*IS is a fantastic way to accomplish this goal.

I'm excited about the potential of the WAS*IS program to serve as the cornerstone of future improvements to the nation's disaster warning program. The program has been an outstanding success to date. It's breaking down barriers between operational and academic cultures, and providing a sustainable way to develop and implement improvements to the country's disaster warning and response system. Continued support at the federal level is a great investment. The talent, enthusiasm, and innovation of the WAS*ISers is exciting. The program has become a magnet that attracts the young scientists with the "right stuff," and I can't wait to see all the great things they will do!

*Larry (Larry.Mooney@noaa.gov) is the meteorologist-in-charge (MIC) for the Boulder/Denver National Weather Service office.

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Epistemological Questions: Explanation versus Understanding

In philosophy, analyzing the nature, scope, and meaning of knowledge is the purview of *epistemology*. That's a five-dollar word that encompasses some simple questions: Can actions in the "social world" be understood in the same way that we understand them in the "natural world"? Can we find fundamental laws of society the same way we expect to find them in meteorology? Are there equations and laws governing society and decision making, just as there are equations and laws of fluid dynamics that govern atmospheric flow?

Much of the early study of society, and perhaps much still today, proceeded from the idea that humans actions were subject to *explanation* in the same way that phenomena in the natural world could be explained by and described by the physical sciences—an approach often called *naturalism*. In other words, all phenomena—human and otherwise—can be explained in terms of natural causes and laws.

Explanation leads to questions of determinism in behavior and perhaps to the idea that we can eventually model human behavior using mathematical models with the same degree of predictive power as a weather forecast. To me, the explanation approach seems related to the idea of agent-based models that I've heard engineers and meteorologists mention as a tool for integrating decision making with weather-related decision support tools.

Understanding takes the approach that there is something fundamentally different about life compared to the natural world and that this has implications for analyzing social action. One way to see a difference here is what I'll call "one mind" versus "two minds." In

studying the physical motions of the atmosphere, there is one mind, the observer, trying to understand nature and the underlying physical laws. Once the observer assumes that there are laws of nature underlying the atmosphere, he is simply using his mind to dig into a set of fixed and immutable laws of nature. (See <http://plato.stanford.edu/entries/laws-of-nature/#BasQueWhatLaw> for an interesting discussion of what it means to be a law of nature.)

In understanding behavior, though, there are two minds involved—the observer and the subject. What can the observer infer about what is going on in the mind of the subject? This is a fertile—and perhaps dangerous—area of philosophical debate. Can we be sure that what appear to be laws of human behavior (as we create them in our mind) actually apply to other beings who have free will to act according to their preferences, rather than in some deterministic manner?

Can we find fundamental laws of society the same way we expect to find them in meteorology? Are there equations and laws governing society and decision making, just as there are equations and laws of fluid dynamics that govern atmospheric flow?

If a researcher takes an explanation philosophical approach, she will likely approach problems of integrating meteorology and social sciences from an entirely different perspective than a researcher taking an understanding philosophical approach. The *explanation* integrator may seek the equations of human action that can be modeled side by side with the equations of fluid and proceed to predict the linkages and subsequent human behavior. An *understanding* integrator may evaluate the meanings, roles, and rules of social action in order to understand how individuals

or human institutions depend on, respond to, or influence atmospheric phenomena. The different philosophical approaches are based on very different ideas about what should be studied, how it should be studied, and what can be done to disseminate meteorological information for the betterment of society. If these two researchers tried to discuss their research, they might end up talking past each other.

Appreciating the existence of these different approaches may also help us understand why different social sciences have been integrated into meteorology at different levels. Without adequately explaining the meaning of holism versus individualism and with broad generality, we could say that neoclassical microeconomics is based on an individualistic explanation approach. I submit that this may be why natural scientists find neoclassical microeconomics more understandable than many other social sciences.

It seems—to this economist at least—that social sciences such as sociology or social anthropology come more from a holistic and understanding approach. To the extent that different social scientists take different philosophical approaches, it can become difficult for, say, economists and sociologists to reach common ground, before meteorologists even join the conversation!

And now that I've talked about all this in the framework of epistemology perhaps it really is more in the realm of metaphysics defined as the study of being and knowing.

Examples and More Questions

I am by no means the first to raise philosophical questions in the meteorological community. Consider, for example, the 2007 article by Morss and Wahl, which applies an ethical framework

to an examination of the issues connected with the Red River flood of 1997. Even though forecasters knew there would be some level of flooding months in advance, the flood still caused more than \$2 billion in damages. Using concepts from medical ethics of beneficence, autonomy, and justice, Morss and Wahl (2007, p. 342) analyze “issues related to forecast generation, communication of forecast meaning and uncertainty, responsibility for the use of forecasts in decision making, and trade-offs between the desire for forecast certainty and the risk of missed events.” Their work is a primary example of how ethical analysis can play into the forecasting of, communication about, preparation for, and response to hydrometeorological events.

To the extent that different social scientists take different philosophical approaches, it can become difficult for, say, economists and sociologists to reach common ground, before meteorologists even join the conversation!

Philosophy comprises many areas of study, understanding, and knowledge I cannot even begin to touch on here (nor can I claim to have adequate capacity to represent them). Logic and metaphysics could both bring light to the discussion about the integration of social science and meteorology, but I'll leave that for another.

Let me close then with a set of philosophical questions: How far does the responsibility for protection of life and property extend for weather services that provide forecasts, watches, and warnings, especially with respect to potentially life-threatening situations? Is there a moral responsibility on the part of a forecaster who delivers a warning about a life-threatening weather event beyond that delivery? Is there

any inherent responsibility to make sure that information is properly communicated, understood, and used in response to the threat? Or, is it enough to simply put forth the best technically available forecast?

Finally, in my mind, perhaps the most important question of all: Is there a qualified philosopher out there who will discuss these questions to help better integrate social science and meteorology to truly provide “science in service to society?”

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Call for Papers

The Eighth Annual AMS Student Conference and Career Fair

The Eighth Annual AMS Student Conference and Career Fair, “Weathering Your Career—Now and in the Future”, sponsored by the American Meteorological Society, will be held Saturday and Sunday, January 10–11, 2009, as part of the 89th AMS Annual Meeting in Phoenix, Arizona. Registration, hotel, and general information will be posted on the AMS Web site (<http://www.ametsoc.org>) in late-September 2008. A registration fee of \$25 has been set for this conference.

In addition to presentations and group discussions featuring both noted professionals and fellow students, AMS encourages students to submit papers about a wide range of topics. All accepted abstracts will be scheduled as a poster.

For more information or to submit an abstract, please visit: <http://www.ametsoc.org/MEET/annual/call.html>.

Contribute to WSW

Weather and Society Watch is currently accepting items for publication in the October 2008 and January 2009 editions. We welcome solicitations for guest editorials, research articles, articles detailing upcoming weather and society projects, general weather interest articles, weather photos, conference and job announcements, and book reviews. If you are interested in contributing an item for an upcoming edition, please contact Emily Laidlaw at laidlaw@ucar.edu.

In addition, we always welcome your feedback of what you like to see more—or less of in future editions and how we can better tailor the newsletter to meet your needs. Please submit any feedback you have at any time to Emily Laidlaw at laidlaw@ucar.edu or visit the feedback page on our Web site at <http://www.sip.ucar.edu/news/submit.jsp>.

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 Weather-Zine, 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>.