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Social Sciences Improve NWS's Ability to Protect Lives

by Jack Hayes*

One year ago this month, in January 2008, 29-year-old Indiana resident Megihann Leininger drove her SUV loaded down with her five young children into a flooded rural roadway. Her large, powerful Chevy Tahoe was no match for the rain-fueled torrent and was soon inundated, swept from the road, and submerged in seven feet of water. Megihann told local police she managed to get three of her children moved to the roof of the SUV but could not rescue her five- and two-year-old daughters. Her choice and the loss are devastating.

This young mother's decision to drive into the flooded road is one repeated many times each year, often with the same tragic consequences. It is a decision, like many similar ones made before hurricanes and during tornadoes, that we need to better understand as an atmospheric science community. But first, we must accept the value of the social sciences to inform our development of public education; the development of forecasts, watches, and warnings; and the interplay between the communication of uncertainty and an individual's understanding and response. The social sciences help explain and even predict how people behave in the context of both their physical and mental environments.

To many physical scientists, the term "social science" connotes ambiguity. The term is abstract and not easily quantifiable. On the other hand, to a social scientist, it is incomprehensible how a meteorologist might produce a good forecast but then fail to consider how a person in a real-world situation will respond to that information. The societal benefits and the actions taken by individuals in response to the information produced and disseminated by the National Weather Service and others should be paramount concerns for us. Without the integration of social sciences into our planning and thinking, even the most accurate forecasts and warnings won't make a dent in the large number of people who die unnecessarily from severe weather events each year.

The best information is at risk of being worthless if it is not communicated in a manner that is meaningful, actionable and understandable. At the National Weather Service, we have committed to understanding the social sciences and integrating them more deeply into our planning.

While we are experts in the practice of numerical predictions and the technology to observe our planet and disseminate information, we have traditionally not focused on *how* our products and services are perceived and acted upon. Too often we have overlooked the interdependency of physical science and social science and how they complement each other. The physical sciences help us make our forecasts and warnings more accurate; however, no matter how accurate our forecasts and warnings are, if they fail to convey risk in a manner that incites appropriate action, they are virtually useless.

Since our mission is to protect lives and property by providing weather, water and climate forecasts and warnings, engaging the social sciences is vital to our success.

We recently assigned a skilled social scientist to lead our activities and create a culture of awareness

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Riverside flooding in Cambridge, U.K. (Photo by Ilan Kelman; See http://www.ilankelman.org)

In This Issue

Strengthening Hydrometeorological Services in Southeastern Europe

by Dusan Hrcek*

An assessment of hydrometeo-rological services in Southeastern Europe was undertaken within the scope of the South Eastern Europe Disaster Risk Mitigation and Adaptation Programme (SEEDRMAP). SEEDRMAP is a collaborative initiative developed by the World Bank and the secretariat of the United Nations International Strategy for Disaster Reduction (UN/ISDR), together with the European Commission, the Council of Europe, the Council of Europe Development Bank, the World Meteorological Organization (WMO), the Finnish Meteorological Institute, and other partners. The assessment deals with the national hydrometeorological services (NMHSs) of seven countries: Albania, Bosnia and Herzegovina, Croatia, the Former Yugoslav Republic of Macedonia, Moldova, Montenegro, and Serbia.

The program's objective is to reduce the vulnerability of these countries to the risks of disasters. It addresses the loss of life, property, and economic productivity caused by weather extremes and other natural hazards. To that end, it has three focus areas: (1) hydrometeorological forecasting, data sharing, and early warning; (2) coordination of disaster mitigation, preparedness, and response; and (3) financing of disaster losses, reconstruction, and recovery, and of disaster risk transfer (disaster insurance). Strengthening the hydrometeorological services falls under the first focus area. It assesses existing infrastructure, capacity, and data-sharing procedures among the hydrometeorological services, identifying the need for staff capacity and training and for equipment and facilities.

Current Status of NMHSs in Southeastern Europe

In the Southeastern European (SEE) region, several NMHSs do not have the financial and human capacity to fully meet international obligations and the growing national need for data and services. Nor can they adequately invest in their development to achieve the productivity level of NMHSs in Western Europe.

Hydrometeorological information sharing in the SEE region is inadequate. Data-gathering capacity and data quality are declining, and there is less data sharing than there was 20 years ago. As a result, there is insufficient data for climate-trend analysis. The atmosphere is not sampled densely and often enough, and there is a lack of reliable transmission of data to the forecasting centers, as well as a lack of on-line hydrometeorological observations.

The national economies in the SEE region rely on weather-dependent sectors such as agriculture, water management, transportation, construction, and tourism and on national and regional disaster risk management and civil protection efforts. Lack of governmental appreciation and adequate financing, together with unidentified customers and end users and under-developed cooperation with the private sector, has led to a situation where some NMHSs in the SEE countries have fallen into a “poverty trap,” shown in Figure 1 on page 12. While in this trap, the NMHSs cannot improve their technical and personnel capacities to better promote the national development goals of their home countries.

Compelling reasons therefore exist to strengthen these national hydrometeorological services with international support, given their vital role in the socioeconomic development of their countries and the region.

Socioeconomic Aspects

According to the WMO, the average cost-benefit ratio for investments in developing and strengthening hydrometeorological services, in terms of reduced economic losses, is about 1:7. The ratio depends naturally on the time frame and period of amortization, the interest rate used for investments, the need for additional personnel, and operations and maintenance costs stemming from the investments. Today, it is quite difficult to get appropriate estimates of losses due to weather and climate in developing and transition countries.

The ratio of investments to benefits for the SEE countries commonly could be a bit higher than the WMO 1:7 value; in the long run (1 to 10 years) it could run from about 1:6 to 1:20, according to a study on economic impacts and assuming a certain level of economic growth. The calculated ratio also varies widely from country to country.

Because industry and other economic sectors, including aviation weather services, would benefit immediately from the investments, establishing countrywide public-private and public-public partnerships is critical to partially cover investment and operational costs. Allowing and promoting commercial services by the NMHSs would significantly promote the sustainable development of these organizations and would increase benefits from the investments.

Improved data production and data sharing will significantly contribute to European weather forecasting, and will reduce negative socioeconomic effects of weather extremes and weather-related phenomena such as floods. The economic effect from improved hydrometeorological services at the European level, however, has not been

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Economic Benefits of Meteorological Information: Two Case Studies

by Sonia Quiroga*

In September 2008 I attended the World Meteorological Organization's (WMO) Workshop on Assessment of Socioeconomic Benefits of Weather, Climate and Water Services, which was held in Sofia, Bulgaria [1]. The workshop agenda included participants' presentations to enlarge the overview of economic techniques to evaluate the economic benefits of meteorological information presented by Jeff Lazo. This article summarizes two of the case studies that I presented during the meeting.

An economic assessment of meteorological and hydrological services is not always an overall study of every service provided (Lazo et al., 2008). Depending on the information available, different approaches could be appropriate, and sometimes partial evaluations are useful even if a lack of information makes a complete benefit-cost analysis impossible.

Most of the economic methods to measure economic benefits of meteorological information fall within the following approaches:

- On one side are applied analyses, which use econometrics and statistical techniques to estimate relationships between some economic activity and the climate or weather variables affecting it. This approach can give you an idea about how much the economic output can vary as a consequence of climate or weather. This information can be used to understand which sectors or activities are more sensitive to weather and consequently to meteorological information.

- On the other side are theoretical approaches that use mathematical economics to assess optimal policies in a normative way. Considering the optimal policy under different types of meteorological information (usually climatological information versus some kind of imperfect forecast denoted as imperfect information) allows us to calculate the value of an imperfect forecast as the difference between the economic output with and without the forecast (with a more primitive information system such as climatological information).

The two case studies I review here cover both aspects, applied and theoretical, using different methods to evaluate economic value of meteorological information.

Case 1. Climate Impact Assessment for an Agricultural Sector

Production functions and calculation of elasticities have been widely used to assess impacts. Statistical models of crop yield response have been used to evaluate sensitivity and adaptation to climate, both in Spain (Iglesias et al., 2000) and globally (Parry et al., 2004; Stanger et al., 2008), and can be used to estimate the risk associated with climate variability.

The first case study I presented at the Sofia meeting is a risk assessment for cereals across different regions in Spain that we developed in Iglesias and Quiroga (2007). We estimated an econometric model derived from 60 years of empirical data for wheat and calculated the effects of climate variability over agricultural yields. The study involved five sites in Spain, and the results show both some common climatic factors affecting all the areas and also significant differences. We calculated a risk factor based on the probability distribution of the output, which allowed us to compare across different agroclimatic regions.

Equation 1

$$\ln \hat{R}_t = 2.0751 + 0.0017\, Mac_t + 0.0035\, Plutmar_t + 0.0034\, Plutmay_t - 0.0857\, Tmaxjul_t - 0.2138\, Dro_t - 1.2966\, Imp_t^{1981} - 0.7908\, Imp_t^{1995}$$

Equation 1, where R=crop yield; Mac= power of the agrarian machines in the year t; Plutmar= Total precipitation in March; Plutmay=Total precipitation in May; Tmaxjul=Maximum temperature on July; Dro=Drought; and Imp (year)=outliers on a specific year.

Here I focus on the results for one of the sites. Murcia, in southern Spain, is a highly productive area with a Mediterranean climate. The Spanish National Institute of Meteorology gave us monthly time series of maximum and minimum temperature, number of days per month with temperature below 0ºC, and precipitation for 1959-2000. The estimated crop production function for wheat in Murcia is shown in Equation 1, where R=crop yield; Mac= power of the agrarian machines in the year t; Plutmar= Total precipitation in March; Plutmay=Total precipitation in May; Tmaxjul=Maximum temperature on July; Dro=Drought; and Imp (year)=outliers on a specific year. The observed and fitted standardized wheat yields are shown in Figure 1 on page 13.

We found that the main meteorological risk for this region is its high vulnerability to drought, because the Mediterranean region has limited and competing water supplies. As we

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Theoretical Perspectives in Modern Sociology as Useful Tools for Meteorological, Hydrological, and Societal Impacts Work

by Thomas Behler*

Contemporary sociologists use three theoretical perspectives to orient their investigations and interpret their research findings: structural-functionalist, conflict, and interactionist. The following article will demonstrate the usefulness of these perspectives for meteorological, hydrological, and societal impacts analysis. Before going into the details and implications of each perspective, let's first understand exactly what a theoretical perspective is.

A theoretical perspective is a broad set of assumptions about society and social behavior that represents a point of view from which to study the social world in general or specific social problems. These perspectives help us make sense out of the phenomena or events we observe by explaining their nature and the interrelationships between them. They make the observed facts of social life more understandable by placing them within a context or framework that enables us to explain, to determine cause and effect, and to predict what may happen in the future.

Each perspective has its own unique view of human societies and human social phenomena that ultimately can be related to the study of effective weather forecasting and other more broad-based concerns for those involved in weather and society research.

The Structural-Functionalist Perspective

Sociologists with a structural-functional approach view society as a sort of organism or system of interrelated parts; they study the way each part of the society contributes to the functioning of the society as a whole. They are mainly interested in the contributions these parts make to, or the purposes they serve for, the maintenance of ongoing social life. Functionalists talk about what need of the society is fulfilled by the given element.

Weather and Society application: The NWS performs several important social functions for society, as noted in its mission statement: "The National Weather Service (NWS) provides weather, hydrologic, and climate forecasts and warnings for the United States, its territories, adjacent waters and ocean areas, for the protection of life and property and the enhancement of the national economy. NWS data and products form a national information database and infrastructure which can be used by other governmental agencies, the private sector, the public, and the global community." (See http://www.weather.gov/mission.php)

Taking the functionalist perspective even further, let's look at functions as consequences. Functions or consequences can either be intended or unintended. Functions that are obvious or intended are called manifest functions, and functions that are unrecognized or unintended are called latent functions.

Weather and Society application: The NWS has the manifest function of correctly and accurately forecasting the weather to protect life and property. Let's assume that a given forecast office performs this function extremely well: they have accurately forecast several major events for a given geographical area; this is manifestly functional. But continued accurate weather forecasting might actually have some latent functions as well, in that now such accuracy is expected all the time, with greater expectations being placed on future forecasting efforts. These heightened expectations could lead to even better forecasts.

Not all features of the social system, however, are functional at all times. Occasionally, something may actually disrupt the social equilibrium and, therefore, be dysfunctional. And, just as we saw with functions, dysfunctions can also be either manifest or latent. In fact, what often happens is that a component of the social system can be functional in one respect and dysfunctional in another.

Weather and Society application: A technically accurate weather forecast that was perceived by the general public to have been wrong and an embarrassment to weather forecasters might be manifestly dysfunctional. One latent function that could emerge from such a situation might, however, be a realization of the need to more clearly understand public perceptions and the need to more carefully craft future forecasts containing uncertainty information.

In short, the functionalist argues that we must explore the full implications of any element in the social system (its manifest and latent functions and dysfunctions). Such an exploration will help us to better understand the contributions of that element to the society, for better or worse.

The Conflict Perspective

The conflict perspective is the opposite of structural-functionalism: it tries to make sense out of social life and what goes on within human societies like ours. The approach, as its name implies, focuses on the darker sides of life, such as social conflict and opposition, rather than on social balance, need fulfillment, and equilibrium. Conflict theorists tend to take a critical or pessimistic view in contrast to the previously discussed structural-functionalists who tend to be

much more optimistic.

The conflict perspective had its origins in the work of Karl Marx, a pioneering figure in sociology. Among his many observations pertaining to conflict theory, perhaps his chief assertion was that the problems of the modern urban industrial age were caused largely by selfish struggles between what might be called the "economic haves and have nots." Marx saw these two competing or struggling groups as having mutually opposed interests, which were never going to be reconciled unless those at a disadvantage revolted and forced needed social change.

We won't go into depth here on the finer details of Marx's theoretical arguments; however, Marx's picture of relentless competitive struggle between groups with mutually opposed interests in a society ultimately formed the basis for modern conflict theory. This modern conflict theory more closely fits the realities of the contemporary western world.

More specifically, although Marx saw conflict as occurring between the "economic haves and have nots," modern conflict theorists see conflict among many groups and interests, and see it as inevitable in any society. These conflicts can involve the rich vs. the poor, urbanites vs. suburbanites, management vs. organized labor, the public vs. the private sector, or one racial or ethnic group vs. another. The things people desire, such as power, wealth, money, and prestige, are always scarce, and demand always exceeds supply. Those who gain control of these resources are able to protect their own interests at other people's expense, and will, indeed, do so. At the same time, those at a disadvantage will be forced into a mode of endless struggle where they must try to get what they can of the coveted good things in life, by whatever means necessary.

Since the competing groups generally have mutually opposed interests, conflict theorists assume that societies are in a constant state of turmoil, where conflict is a permanent and inevitable feature. This conflict doesn't necessarily always take the form of outright violence; it can be simply ongoing tension, hostility, competition, and struggle.

Weather and Society application: In studying flood emergencies, a conflict theorist would examine housing patterns in major metropolitan areas. The theorist might ask why we often find the most flood-prone residential neighborhoods to be inhabited by the more disadvantaged segments of the population. Relatedly, the conflict theorist would note how these disadvantaged residents are usually the least able to respond effectively and recover sufficiently from such situations. Conflict analysis would suggest further that these inadequacies not only exacerbate the destructive nature of major floods but also reinforce the pronounced inequalities that exist within the affected communities.

The Interactionist Perspective

The interactionist perspective takes a much more microscopic or social-psychological view of human societies and social life than the first two perspectives. It emphasizes the importance of understanding the social world from the viewpoint of the individuals who act within it. Thus, sociologists in this school of thought concentrate not on large social structures and functions, or large-scale struggles between "haves" and "have nots," but rather on the interpersonal communication and exchanges that occur when people interact in everyday, face-to-face situations. The emphasis is on the symbolic meaning of everyday events and social life as they are interpreted by individuals going about their daily business. The perspective tries to understand how people create and interpret the events and situations they experience, and it emphasizes how countless instances of social interaction produce social life as we know it.

Weather and society application: When a community is affected by a devastating weather event, people in that community pull together and help one another recover. The interactionist would examine the kinds of processes that occur and how the countless instances of interaction shape the community and its recovery in concrete, everyday terms. As people combine their efforts to recover, they grieve together and laugh together. They also selflessly share their talents, abilities, and resources to help their fellow neighbors who are in need. All these interactions play at least some role in rebuilding the community and in shaping its overall responses. They also might positively affect the community's responses to future weather events or emergency situations.

Concluding Observations

Each of these theoretical perspectives has its merits and weaknesses. For this reason, it's best to view the perspectives as interchangeable camera lenses through which we can view the world. The lenses are useful to varying degrees, depending on the particular problem. The research investigator must decide which perspective or perspectives are best-suited for analyzing a given situation. Perhaps this can best be illustrated through a brief application of some of the main arguments from each theoretical perspective to the well-known example of Hurricane Katrina and its aftermath in the New Orleans metropolitan area.

A structural-functionalist analyzing this situation would immediately be struck by the many manifest dysfunctions of the hurricane. Entire neighborhoods and many local businesses were destroyed. The ability of relevant local, state, and federal agencies to respond to the disaster was immediately challenged, and many of these entities found themselves to be completely overwhelmed by the magnitude of the event. Yet, Katrina and its aftermath also had some important latent

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From the Director: These are difficult times
by Jeff Lazo*

Today is December 23, 2008. I am sitting in Starbucks in Superior, Colorado, perusing the latest economic indicators reported in *The Economist*. As anyone who has been even marginally conscious this year knows, the US and world economies have been in a tailspin the last few months.

Officially, 10,331,000 US workers were unemployed in November 2008, or 6.7% of the workforce (the highest unemployment rate in more than 15 years). This doesn't count those who have given up looking for work—that number rose by 637,000 in November alone—nor does it count those who are "underemployed"—part-time workers who said they wanted full-time work, the number of whom increased by 621,000 in November.

The stock market (as measured by the Dow Jones Industrial Average) is down 37% from one year ago (somehow I managed to do even worse in my retirement accounts). Sales of newly built single-family homes this November were the weakest in the last 17 years. Third-quarter 2008 US gross domestic product (the measure of all US productivity) was down 0.5%, the largest drop since the quarter following the 9/11 attacks.

By the time this issue hits the streets, fourth quarter 2008 numbers will be in and aren't likely to have improved much—and may be getting worse if the sentiment expressed in *The Economist* is correct. My point here is that a lot of people are going through very difficult times right now. Unemployment, evaporation of a nest egg, loss of a home—these all translate into real impacts on real people in ways we haven't experienced in this country for decades perhaps.

What does this have to do with weather forecasting and society? Not a whole lot perhaps—or a whole lot perhaps—but I felt I couldn't pontificate on the importance of social sciences in the Weather Enterprise without recognizing the situation in the world we live in right now. These are very difficult times. But they are also a time of change and of new opportunities and challenges for the Weather Enterprise.

Even in these uncertain times, I am cautiously optimistic that the Weather Enterprise is moving toward integrating the social sciences and societal needs into their decision making. Barack Obama has nominated Jane Lubchenco to direct the National Oceanic and Atmospheric Administration. If confirmed, she will be the first woman to hold the NOAA post. Dr. Lubchenco has an outstanding record of scientific research and, from reports I've heard from some who know her personally, she understands and supports interdisciplinary research. It is up to the entire Weather Enterprise to build on this opportunity to work with her in building a fully end-to-end-to-end weather forecasting and warning system.

A draft report by NOAA's Science Advisory Board Social Science Working Group (SSWG) on the status of social sciences in NOAA is working its way through review and revision. The SSWG draft report builds on a 2003 report on the same topic. The current report largely finds that NOAA did not adequately implement the recommendations of the 2003 report. A major question for the new administration will be whether they will respond adequately to new report and build social sciences into their programmatic, research, and operational efforts.

The American Meteorological Society has the very active Board on Societal Impacts chaired by Eve Gruntfest, the AMS Policy Program headed by Bill Hooke, and the brand new journal *Weather, Climate, and Society* with Roberta Balstad as Chief Editor. This is in addition to the Ad Hoc Committee On Uncertainty in Forecasts (ACUF) under the Board on Enterprise Communication, the Users Forum on Weather and Climate Impacts under the AMS Board on Enterprise Economic Development, and undoubtedly numerous other activities building connections between the Weather Enterprise and end users and society.

The World Meteorological Organization supports the Societal and Economic Research Applications Working Group as part of the World Weather Research Program and the Task Force on Social and Economic Applications of Meteorological and Hydrological Services as part of the Applications of Meteorology Programme. Both groups are actively working to integrate social sciences into research and applications to improve the benefits from hydrometeorological services and products.

The above are largely top-down activities reshaping the Weather Enterprise. There is even more happening from the bottom up in large part because of the *Weather and Society * Integrated Studies* (WAS*IS) program. Much of this we have reported on in prior issues of *Weather and Society Watch* and much of this is regularly discussed on the Weather and Society Discussion Group (http://www.rap.ucar.edu/forums/phpBB2/). In the end, it may be these bottom-up efforts that create a truly sustainable change "integrating social science into meteorological research and practice in comprehensive and sustained ways."

As National Weather Service Director Dr. Jack Hayes writes in this issue, "Our approach to understanding and predicting the natural world must include the social sciences." In these trying times things are looking reasonably positive at the intersection of social sciences and meteorology.

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Don’t Forget the People

by Ilan Kelman*

Without people, a “disaster” cannot happen by most definitions of the word. Why, then, does so much work in weather and society forget the people?

I have seen colorful PowerPoint presentations extolling the virtues of detailed GIS maps for analyzing critical infrastructure vulnerability to weather and other events—without mentioning schools or hospitals. One GIS-based loss model for floods (and earthquakes) did not include deaths and injuries because, according to the presenter, casualties were too difficult to consider, so they were assigned a loss value of zero. Many papers are published using quantitative scales and tick boxes to understand people’s thoughts on and perceptions of weather without recognizing that numbers, scales, and judgments are always culturally contextual.

Warning systems are a frequent example. Decades of research and practice, with some bibliographic examples here, indicate that weather-related warnings are most effective when considered to be a social process rather than a technical challenge. Warning systems need to considered as a long-term endeavor, integrated into sustainability and development processes, not as a one-off event that sets up sirens or emergency radio and SMS transmissions, activated only when needed.

One aspect is that trust and credibility are essential for successful warning messages. Trust and credibility cannot be created after a message has been released. Instead, they require continual demonstration over the long term, as with any relationship. The information and information dissemination must be accepted by people and communities (irrespective of the difficulties with the concept of “community”) on their own terms rather than being maintained as separate elements until someone else decides that “they” need to know.

A good example is a flood warning system as part of local people collecting daily flow rate and water quality data, which they use for water management, drinking water, irrigation, and livestock. That is, water monitoring and interpretation are used and accepted by the community on a daily and livelihood basis, engraining water behavior into their consciousness rather than being invoked when the water becomes a flood. Installing warning technologies and techniques for flash or other forms of flood, in cooperation with the water monitors, makes the extremes more connected to the normal, enhancing warning effectiveness—while always trying to identify and strengthen any possible weak points in such a system, such as relying on a single water monitor and flood warden who takes holidays or who gets drunk.

Similarly, much hype has been on “The Last Mile” for warning systems, referring to the need to connect the top-down warning technology to the people who use the warnings. According to this discourse, that connection is The Last Mile and it should be bridged. Although the sentiment is understandable, that connection makes more sense as “The First Mile” instead.

A top-down, externally imposed system frequently fails to induce effective warning-related actions, even if it is technically perfect. In contrast, if the system is made by starting with the potentially affected locals, then the scientific evidence shows that people are more likely to accept external warning information. Of course, nothing is perfect or absolute. But by embedding a technology within an already existing social structure rather than expecting a social structure to reform itself around a technology, warning systems are liable to be more successful.

Even where the technological approach to a warning system is similar with The First Mile or The Last Mile approach, the process of creating the warning system has been different by selecting The First Mile or The Last Mile. The First Mile approach is more robust by explicitly starting with the people who will reap the rewards of the system so that the system is accepted from the beginning. In contrast, The Last Mile tends to imply (even though that is rarely the intention) that the people are an add-on at the end—the last step in the process—after most decisions have been made.

When dealing with disasters, we must always remind ourselves that we are dealing with people.

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NWS Partners to Address Flash Flood Risk

The Springfield National Weather Service (NWS) Weather Forecast Office (WFO), in coordination with the Southwest Missouri Council of Governments, hosted the Flash Flood Risk Analysis Project Partnership Symposium on the campus of Missouri State University Dec. 8, 2008. More than 60 participants representing federal, state and local organizations; private businesses; the general public; education and research institutions; and the media participated. Internationally recognized flooding expert, Dr. Eve Gruntfest, director of social science woven into meteorology at the University of Oklahoma, and Dr. Isabelle Ruin, a postdoctoral fellow at the National Center for Atmospheric Research, presented research on societal response and decision making during flooding events.

The symposium's goals were to foster open communication and joint partnerships through the sharing of information and resources and to develop and incorporate mitigation and safety preparedness strategies regarding flooding in Southwest Missouri and Southeast Kansas. Flash flooding in these areas produces substantial losses to property and infrastructure each year, including five fatalities and hundreds of reported vehicle water rescues in 2008. In fact, 2008 ranked as the fourth wettest year on record in Joplin, Mo., the fifth wettest on record in Springfield, Mo., and West Plains, Mo., and the sixth wettest in Rolla-Vichy, Mo. Each of these locations received more than 50 inches of precipitation, greater than 12 inches above the normal annual precipitation.

The purpose of the Flash Flood Risk Analysis Project is three fold:

1. Incorporate detailed physiographic, socio-economic and historical flood data that will lead to more detailed and accurate flash flood warnings, thus leading to more effective response by those in harm's way.

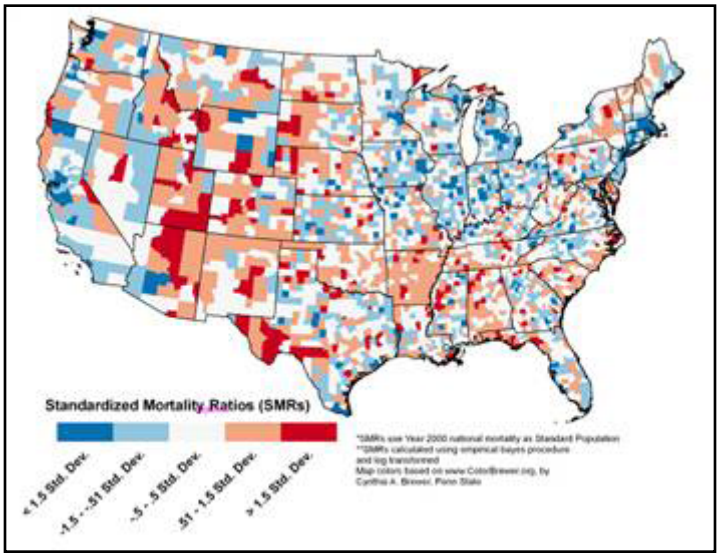
2. Equip the emergency management community, in coordination with National Weather Service warning preparedness activities, to perform more effective flood risk assessment and mitigation prior to flooding and response efforts during and after a flash flood.

3. Provide the public and other agencies with more effective flash flood warnings; investigate development of flood sensors and develop safety campaigns for the protection of life and property.

For more information on the Flash Flood Risk Analysis Project, please contact Steve Runnels at steve.runnels@noaa.gov or Kelsey Angle at kelsey.angle@noaa.gov.

Fatality Map Shows Deadliest Natural Hazards

Research by Susan Cutter and Kevin Borden at the University of South Carolina, Columbia, forthcoming in the International Journal of Health Geographics, analyzed nationwide data from 1970 to 2004 to determine the natural hazards most likely to result in death across the country. Cutter and Borden found that the deadliest natural hazards are chronic, everyday hazards rather than higher-profile, sporadic disasters such as hurricanes and earthquakes. Heat and drought were found to be the biggest offenders, responsible for nearly 20 percent of total deaths due to natural hazards, while severe summer and winter weather accounted for approximately 18 percent of deaths. Flooding, tornadoes and lightning accounted for 14 percent, 12 percent, and 11 percent of deaths respectively, while geophysical events such as earthquakes and wildfires accounted for less than 5 percent of deaths. To read the complete provisional abstract, please visit **http://www.ij-healthgeographics.com/content/pdf/1476-072x-7-64.pdf**.



Cutter and Borden's map shows that everyday hazards, such as winter and summer weather heat account for the majority of natural hazard deaths in the U.S.
(Map courtesy of Susan Cutter, Univ. of S.C.)

Jobs & Opportunities

Call for Applications: Enabling the Next Generation of Hazards and Disasters Researchers North Carolina State University

Applications are now being accepted for Enabling the Next Generation of Hazards and Disasters Researchers, a National Science Foundation-funded program that supports junior faculty members building careers in the area of hazards and disasters through mentoring and training.

Up to 16 fellows will be selected for the two-year program. Fellows will be introduced to methods and theoretical perspectives in disasters and hazards research, have the opportunity to meet with leading researchers in the field, and work closely with project mentors to plan and develop their careers. Activities include writing scholarly articles, book proposals, and grant proposals.

Fellows will be selected through a competitive application process. Tenure-track faculty members who have not attained tenure and promotion are eligible to apply. Applications from underrepresented groups such as women, racial, and ethnic minorities are especially encouraged.

The fellowship covers travel expenses and offers a modest stipend. Application materials and other information are available at the project Web site at http://www.ncsu.edu/project/nextgen/. Questions can be directed to Tom Birkland at 919-513-7799 or tom_birkland@ncsu.edu.

The application deadline is February 15, 2009.

North Dakota State University Tenure-Track Sociology, Anthropology, and Emergency Management Faculty Position

North Dakota State University seeks applicants for a tenure-track sociology, anthropology, and emergency management faculty position. The person chosen for this position must be able to teach two or more of the following: disaster preparedness, mitigation and prevention, response and recovery, special needs populations in disaster, research methods, voluntary organizations in disaster, or possibly emergency management and disaster courses in your area of interest.

A PhD in sociology, anthropology, emergency management, or a related field is required. For more information and to apply, please visit **https://jobs.ndsu.edu/applicants/jsp/shared/frameset/Frameset.jsp?time=1230929726697**.

The application closing date for the position is January 15, 2009.

Executive Director Stephenson Disaster Management Institute

The Stephenson Disaster Management Institute at Louisiana State University in Baton Rouge, Louisiana seeks an executive director to guide the institute's research and education missions; build fiscal resources; develop and support an applied, multi-disciplinary research agenda; and build partnerships with scholars, emergency responders, and the business community.

A master's degree in a related field is required. Substantial expertise in emergency preparedness and response as a senior-level practitioner in a public safety-related field is desired.

For more information, please visit **http://www.bus.lsu.edu/centers/sdmi/jobsatsdmi.asp**.

The application closing date is January 30, 2009.

Conferences & Opportunities

15th Annual Earthquakes Mean Business Seminar

Seminar Date: February 6, 2009
Location: St. Louis, Missouri
For More Information: Please visit **http://www.gatewayccc.us/earthquake.htm**

This outreach event is presented by members of the geoscience, engineering, and emergency planning communities to provide better understanding of earthquake risk in the central United States. The seminar also includes exhibits and resources about disaster preparation and business continuity planning. Registration for the seminar is free and open untiled filled. For more information, please visit **http://www.gatewayccc.us/earthquake.htm.**

2009 International Disaster Management Conference

Conference Date: February 19-22, 2009
Location: Orlando, Florida
For More Information: Please visit **http://www.emlrc.org/disaster2009.htm**

This conference highlights the role first responders and response agencies play in disaster planning, response, and mitigation. Emergency management challenges and lessons from the past year will provide the basis for many of the conference sessions. The conference will take place at the Emergency Medicine Learning and Resource Center, and cost is $390 when you register before January 23, 2009.For more information, please visit **http://www.emlrc.org/disaster2009.htm.**

2009 National Hurricane Conference

Conference Date: April 6-10, 2009
Location: Austin, Texas
To Register: **http://www.hurricanemeeting.com/**

The goal of the National Hurricane Conference is to improve hurricane preparedness, response, recovery, and mitigation; saving lives and property in the United States and tropical islands of the Caribbean and Pacific. In addition, the conference serves as a national forum for federal, state and local officials to exchange ideas and recommend new policies to improve emergency management. To accomplish these goals, the annual conference emphasizes lessons learned from hurricane strikes; state-of-the-art programs worthy of emulation; new ideas being tested or considered; information about new and ongoing assistance programs; and the ABC's of hurricane preparedness, response, recovery, and mitigation. For more information, please visit **http://www.hurricanemeeting.com/**

*2009 Weather and Society*Integrated Studies (WAS*IS) Summer Workshop*

Workshop Date: August 6-14, 2009
Location: Boulder, Colorado
For more information: **http://www.sip.ucar.edu/wasis/upcoming.jsp**

A summer 2009 WAS*IS workshop will be held in Boulder, Colo., August 6-14, 2009, contingent on funding. Applications will be available on the WAS*IS Web site by February 2009. Please visit the WAS*IS Web site for more information: **http://www.sip.ucar.edu/wasis/**

Social Sciences (continued from page 1)

throughout the NWS regarding the importance of social science tools and methodologies and the need to incorporate social science in our products and services. By integrating the social sciences we can improve the effectiveness of our products and services and better explain to people how to interpret them and make the right decisions to protect their lives. Integrating social sciences into our operations will enable us to identify new constituent needs and prioritize investments by estimating the economic and social benefits from our activities. It will also help us by incorporating human factors expertise into the design systems our forecasters use. Finally, the integration of social and physical sciences can help us improve communication and collaboration among the public, private and academic sectors, leading to improved information services of greater relevance and increased visibility.

Many NWS employees have already begun working with a growing interdisciplinary community of forecasters, researchers and stakeholders who are committed to integrating the physical and social sciences. They are actively working on the jointly funded National Corporation for Atmospheric Research and National Oceanic and Atmospheric Administration's U.S. Weather Research Program Collaborative Program on the Societal Impacts and Economic Benefits of Weather Information. This team serves as a focal point for developing and supporting a closer relationship between weather researchers, operational forecasters, relevant end users, and social scientists concerned with the impacts of weather and weather information on society.

Another tremendous activity NWS employees are participating in is the Weather and Society*Integrated Studies program, known as WAS*IS. We aim to build on those existing relationships by initiating a campaign throughout NWS to include social sciences in the end-to-end development of NWS products and services in an effort to more effectively communicate our forecasts and warnings and to integrate social science methodologies in our evolving commitment in improving decision support services. We will also integrate social sciences into our budgetary and programmatic plans and in the next generation of the NWS Strategic Plan.

As physical science disciplines, including meteorology, hydrology, oceanography, and others, come together to create interdisciplinary approaches to understanding and predicting the complex earth system we are all a part of, it is essential that the social sciences be included. Just as humans are a part of the natural world, our approach to understanding and predicting the natural world must include the social sciences.

When we advance our knowledge in the social sciences, a mother of five will understand that there is no better choice than losing time by going around a flooded road.

*Jack Hayes is the director of the National Oceanic and Atmospheric Administration's (NOAA) National Weather Service.

Heads Up

A new report entitled "Communicating Weather Forecast Uncertainty: An Exploratory Study with Broadcast Meteorologists," authored by Betty Morrow, Julie L. Demuth, and Jeffrey K. Lazo is now available online at **http://www.sip.ucar.edu/publications/PDF/ACUF-B_Final_Report_2008.pdf**.

Broadcast meteorologists—as important intermediaries between forecasters and the public—have experientially developed knowledge and perceptions about weather forecast uncertainty information. The report summarizes exploratory research conducted via focus groups with broadcast meteorologists to assess their (a) use of and preferences for current and future information on forecast uncertainty, and (b) perceptions of the public's understanding of, use of, preferences for, and potential benefits from using forecast uncertainty information.

This research was funded by the National Oceanic and Atmospheric Administration (NOAA) in support of the AMS Ad Hoc Committee on Uncertainty in Forecasts (ACUF).

For more information, please view the complete report online at **http://www.sip.ucar.edu/publications/PDF/ACUF-B _Final_Report_2008.pdf**.

Lightning strikes near Brighton, Colo., on a warm August day. (Photo by Greg Thompson; See http://www.inclouds.com)

Services (continued from page 2)

assessed in this economic analysis.

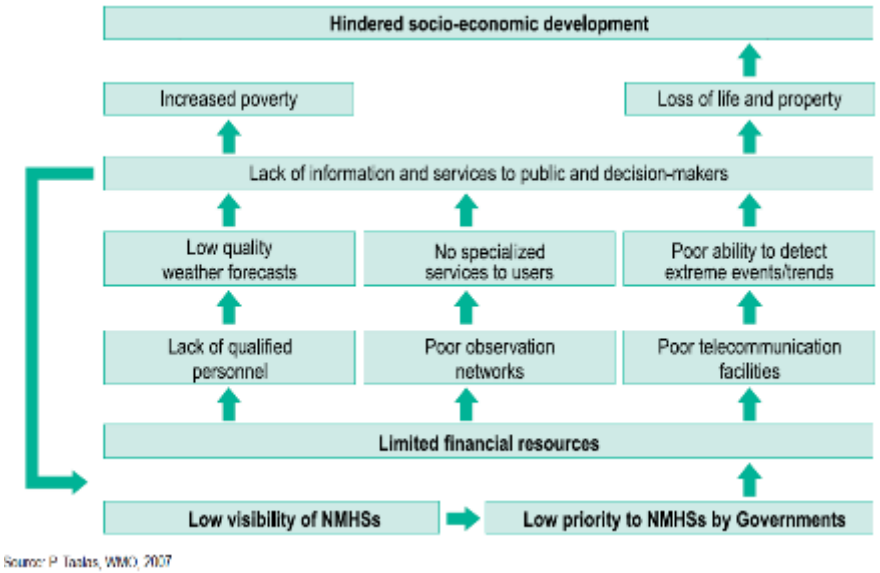
Climatological data and analyses, and accurate and timely weather forecasts, are also critical for socioeconomic development of the seven countries. Public and commercial organizations need specialized weather and climate information services to support their decision-making. The economic value of hydrometeorological services can be assessed by looking at the losses that could be avoided within different economic sectors. The value of forecasts, however, is actually more than a reduction of economic losses. Better weather forecasts and products, and better exploitation of services by end users, also help improve industrial production and promote human well-being.

The World Bank Project on Strengthening the SEE NMHSs

The goal of a corresponding World Bank project is to promote the capability of NMHSs to produce better data and tailored services to support national development and different socioeconomic sectors. It should provide the NMHSs with the necessary tools for enhancing natural disaster mitigation and adaptation to climate variability and change. These would enhance the awareness of the public, policy makers, and end-user community of the socioeconomic benefits of weather and climate information and products. The goal of the project is also to promote regional cooperation among the NMHSs in southeastern Europe and cooperation in this aspect at the European level.

Regional cooperation would have a significant effect on the size of the investment required. If the NMHSs of the seven countries were strengthened individually and without better cooperation with national aviation weather services, the cumulative investment needs (hardware plus operational costs, without interest) are estimated at about $ 126 million over five years. However, with regional cooperation and data sharing, and hardware that allows cooperation with the rest of Europe, the total investment needs for these seven countries could be reduced to approximately $ 88 million.

Figure 1 - Poverty Trap of NMHSs



Source: WMO

The financing needs for this World Bank project are calculated for five years. The budget for each component includes direct investment costs (including a service contract for some systems), annual average maintenance costs, and communication costs. Communication costs will rise because of rapidly increasing on-line data collection and data sharing. Most of the NMHSs also need additional staff, especially IT staff and meteorologists, to continuously provide analysis and forecasting services. Because of high operation costs, the timing of implementing different components has a significant effect on the total budget within the five-year window.

It was agreed that the WB/ UNISDR/WMO Feasibility Study on Strengthening of the NMHSs in SE Europe and the Sava River Project (under the same World Bank umbrella) should be the main background for the complementary project proposal to the European Commission's DG Enlargement.

The message of this project to SEE governments is "strenghening of NMHSs must not be seen as an expenditure, but as an investment."

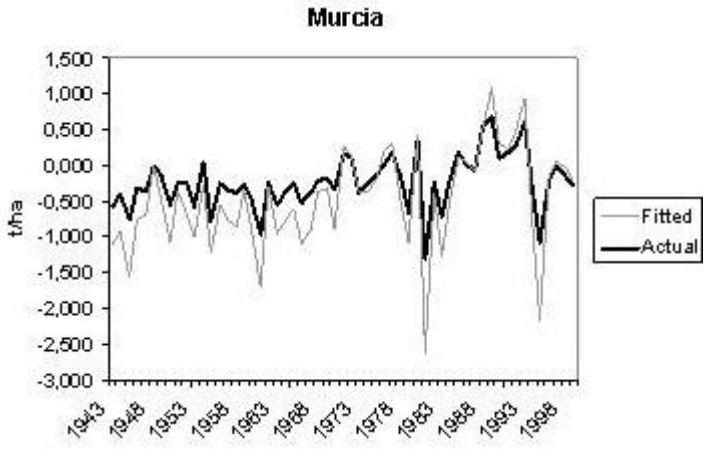
Additional Information

The main author of the original report summarized in this article is Bengt Tammelin. The Task Team Leader for the SEEDRMAP who guided the development of that report is Wael Zakout, Sector Manager in the World Bank Sustainable Development Department of Europe and Central Asia Region (ECSSD). The UN/ISDR Regional Coordinator for Europe, Paola Albrito, coordinated, facilitated, and greatly supported development of the original report. The publication can be seen at: http://www.wmo.int/pages/prog/rp/documents/strength_hydromet_SEEsenttoprinter.pdf.

*Dušan Hrček (DHrcek@wmo.int) is a former WMO Representative for Europe and is now retired.

Benefits (continued from page 3)

Figure 1 Observed and fitted standardized wheat yields in Murcia



Source: Iglesias and Quiroga (2007)

observe in the estimated crop production function, drought affects wheat yields in Murcia over 20%. The -0.2138 coefficient on Dro in Equation 1 indicates that when there is a drought crop yield decreases by 21%.

Drought affected almost ten times more people in Spain than floods over the last 50 years (CRED, 2007). The major drought of the mid-1990s affected all of the approximately 1 million farmers and more than 5 million nonfarmers with water restrictions in urban areas (CRED, 2007).

In this context, precipitation forecasts could improve farmers' choices concerning irrigation systems. Prototype decision-making models can help assess optimal behavior, and this leads me to our second case study I presented.

Case 2. Cost-Loss Decision Making Models to Calculate Information Value

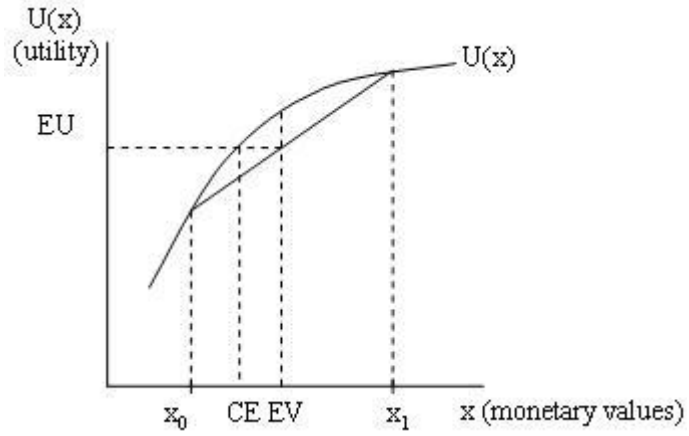
Cost-loss models constitute a long-established approach to analyzing the well-known umbrella problem. A farmer, as part of crop management, has available a technology to protect the harvest from weather effects and must make a decision that incorporates both the cost of this technology and the loss that could be avoided if the protection action were taken. Murphy et al. (1985), Katz and Murphy (1990 and 1997), and others have used this approach, considering that the farmer maximizes the expected revenues or minimizes the expected expenses.

The second study belongs to the family of theoretical models commonly denoted as cost-loss models and introduces the concept of individuals' attitudes toward risk in the decision making process. A complete report of this study is in Cerdá and Quiroga (2008a). In this study, we evaluated how optimal decisions are affected by the absolute risk aversion coefficient of Arrow-Pratt. We also estimated the economic value of the information in this context. We found a positive relationship between the meteorological information value and the risk aversion coefficient, so models developed in the framework of the assumption of a risk neutral agent seem to underestimate the economic value of forecast systems. The main difference from traditional cost-loss models is that a risk neutral agent is supposed to maximize the expected revenues or expected value (EV), while an agent with risk aversion maximizes his or her expected utility (welfare). In Figure 2, we can observe the relationship between the expected utility (EU) and the welfare produced by the expected value (revenue) for two uncertain outcomes (x_0 and x_1). The certainty equivalent (CE) can be defined as the amount of money for which the farmer is indifferent between the gamble and the certain amount CE.

Since an individual adverse to risk finds more welfare when risk is reduced, the economic value of reducing the uncertainty is higher when we consider this behavior. As in the conventional cost-loss model, we also found a quality threshold below which the information has zero value. This is because the information is not accurate enough to change an agent's decisions. However, in our model, when you consider the risk adverse behavior, the quality needed to change an agent's decisions is higher than in traditional models without risk aversion. That makes

(continued on page 14)

Figure 2. Expected value (EV), expected utility (EU) and certain equivalent (CE) for an adverse to the risk agent



Source: Iglesias and Quiroga (2007)

Benefits (continued from page 13)

sense because a risk adverse agent needs higher quality to be confident about the forecast. If not, he doesn't consider the information and, as a consequence, the information has zero value.

As an extension of these two case studies, we are currently conducting work on applying the theoretical normative model to assess irrigation policy as a practical application. A very preliminary draft on this study is presented in Cerdá and Quiroga (2008b). We calculate analytically the optimal policy for the cost-loss dynamic model with climatological information and present an application for irrigation decision making in Murcia, the implications of which are described in the first case study presented in this article.

In conclusion, we describe some tools to increase the participation of NMHSs in risk reduction planning, the importance of which is emphasized in the WMO strategic plan (WMO 2007). The case studies cover the applied and theoretical approach of the economic analysis and differentiate between the intent to compute the information value directly, as in the cost-loss models, or indirectly because the production functions allow us to understand which sectors or activities are more sensitive to a better forecasting system.

*Sonia Quiroga (sonia.quiroga@uah.es) is a professor in the Department of Statistics, Economic Structure and International Organization at the Universidad de Alcalá in Spain.

Footnote

[1] See http://www.wmo.int/pages/prog/amp/pwsp/Social_Economic_Benefits_Wkshops_en.htm for more information.

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For Further Information

Please see the following links for more information:

- http://www.fao.org/docrep/x0295e/x0295e03.htm from http://www.fao.org/docrep/x0295e/x0295e00.htm
- http://www.firstmilesolutions.com
- http://www.riskred.org/favourites.html and click on "warning".
- http://www.unisdr.org/ppew

Sociology (continued from page 5)

functions, or un-intended positive consequences. The inadequacies in dealing with the hurricane spurred serious attempts to assess and improve emergency preparedness and response capabilities, not only in the New Orleans area but in other hurricane-prone communities as well. As a result, many gulf coast communities, including New Orleans, are now at least somewhat better able to respond to and recover effectively from such events.

Regarding the conflict perspective, we've all read the findings of media reports and research studies suggesting serious inequities in the treatment of various racial, ethnic, and other disadvantaged minorities in certain New Orleans neighborhoods both during and after the storm. Conflict theorists would suggest that cases such as these clearly highlight the idea of endless struggles on the part of the disadvantaged, and the obvious advantages associated with a dominant or privileged socioeconomic class position.

Finally, the interactionist theorist would focus on the everyday people who were most directly affected by the storm. Attention would be directed toward understanding the wide variety of initial response patterns on the part of community residents, and how those response patterns changed for subsequent storms (evacuation decision-making, family preparedness, increased attention to weather watches or warnings, and so on). Interactionists also would examine the extent to which everyday residents have recovered from Katrina and how they have reconstructed their lives.

*Dr. Behler (tbehler@charter.net) is a professor of sociology at Ferris State University in Big Rapids, Michigan.

For More Information

The following sources give excellent overviews of the main theoretical perspectives in modern sociology:

Brinkerhoff, D., White, L., Ortega, S., and Weitz, R. (2008). Essentials Of Sociology, Seventh Edition (pp. 10 – 16). USA: Thomson/Wadsworth Publishing, Inc.

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Acknowledgements

I'd like to thank Betty Morrow (Professor Emeritus of Sociology at Florida International University) for reviewing an earlier draft of this article, and for her extremely helpful suggestions on refinements to some of my main theoretical perspective applications. I'd also like to thank the organizers of the Summer 2008 WAS*IS workshop for giving me the opportunity to present the initial ideas that formed the basis of this article.

Editor's note about this article

This article is the first in a series of theme articles designed to provide basic introductions to the major social sciences and major methods from the social sciences as applicable to societal impacts of weather.

Contribute to WSW

Weather and Society Watch is currently accepting items for publication in the April 2009 and July 2009 editions. We welcome soliciations for guest editorials, research articles about completed, current, and upcoming research projects, and historical and general interest articles. We are also always looking for relevant book reviews, conference, job and similar opportunity announcements, and all types of weather/societal impacts photos. If you are interested in contributing an item for an upcoming edition, please contact Emily Laidlaw at laidlaw@ucar.edu.

In addion, we always welcome your feedback of what you would like to see more—or less—of in future editions, as well as detailed comments on 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**.

Irridescent lenticularis clouds on a warm winter day in Boulder, Colo. (Photo by Emily Laidlaw)

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.

sSIP, 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.