

National Oceanic and Atmospheric Administration

# Social Science Strategic Plan for Weather and Water



DRAFT

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National Oceanic and Atmospheric Administration

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for Weather and Water**

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# Contents

<b>SOCIAL SCIENCE STRATEGIC PLAN FOR WEATHER AND WATER.....</b>	<b>1</b>
INTRODUCTION .....	1
ACHIEVING THE WEATHER & WATER GOAL REQUIRES SOCIAL SCIENCE.....	2
<i>NOAA's Weather and Water Strategic Goals</i> .....	2
<i>How Social Science Furthers the Strategic Goals</i> .....	3
<i>Weather and Water Has a Social Science Gap</i> .....	5
SOCIAL SCIENCE STRATEGIES AND PRIORITIES FOR WEATHER AND WATER.....	7
<i>Social Science Strategies</i> .....	7
<i>Social Science Analytic Priorities</i> .....	9
FILLING THE GAP .....	13
<b>REFERENCES .....</b>	<b>16</b>
<b>APPENDIX A: PREVIOUS WEATHER AND WATER ECONOMICS AND SOCIAL SCIENCE ACTIVITIES.....</b>	<b>19</b>
<b>APPENDIX B: SOCIAL SCIENCE COMMITTEE OF THE NOAA RESEARCH COUNCIL.....</b>	<b>23</b>
<b>APPENDIX C: THE SOCIETAL IMPACTS PROGRAM AT NCAR.....</b>	<b>24</b>

## Preface

The Weather & Water Social Science Strategic Plan (Plan) is intended to advance a strategy of strengthening and integrating social science in support of the Weather & Water Mission Goal. *Integrating social science with programs and decision systems can support improved decision-making.* The Plan seeks to foster and guide research and analysis, encourage cooperation, coordination, integration and outreach, generate support and stimulate improved understanding of social science contributions throughout NOAA and its stakeholder communities. The focus is on decision support for priorities that most directly involve weather and water programs, recognizing the importance of activities related to weather and water throughout NOAA.

The Plan is an outgrowth of several years of effort by the NOAA Research Council, the NOAA Executive Council, and the Office of Program Planning and Integration in cooperation with the NOAA Mission Goal Teams and line offices to stimulate the use of social science in planning and decision-making. Discussions within NOAA included meetings with the National Weather Service (NWS) leadership, the Office of Atmospheric Research (OAR), the Social Science Committee of the NOAA Research Council and with other Mission Goal Teams.

This Social Science Strategic Plan for Weather & Water is intended to be formally integrated into the research and development portfolio of the Weather & Water Mission Goal Team and the Programming, Planning, Budgeting and Execution System (PPBES) process. Implementation plans to follow up on these issues should address social science activities, their approaches, expected outcomes and uses, organizational arrangements, budgets, timetables and processes for infusion into planning, decision-making and education.

# Social Science Strategic Plan for Weather and Water

## *Introduction*

Weather and water programs will have to serve in an environment of extensive change. NOAA and its weather and water programs will face increasing demands for program budget justification and a need to communicate priorities and decision criteria to an increasingly involved and diverse set of constituents. A driving force is the imperative of understanding customer needs.

### **Changing Conditions Are Creating Great Challenges and Opportunities**

Powerful trends are expanding demands for weather and water information and increasing the need for understanding of societal factors influencing how services are used and the nature and magnitude of their benefits. Trends expected over the next decade and beyond include:

- Demographic changes, including population growth in vulnerable areas, urbanization affecting air quality, strains of population growth on fisheries resources, a sunbelt shift that includes retirement to more remote areas, growth of leisure activities with the wave of baby boom retirements and the challenge of replacing the skills of retiring baby boomers.
- Economic growth, including rising incomes and growth of international commerce.
- Federal budget pressures with soaring health and retirement expenditures.
- Decadal variations in drought affecting the Southwest U.S.
- Climate variability and change, including possibilities for more weather and water extremes.
- The peaking and ebbing of the solar cycle affecting space weather.
- Advancement of communications technologies that allow delivery of more timely and specific forecasts and warnings.
- Evolution of observing systems generating massive amounts of data and creating opportunities for new and improved products.
- Growth in the private sector share of the weather and climate enterprise, including data collection infrastructure.
- More global sharing of technological resources and environmental information and attendant needs for interaction.
- Growing customer ability to make use of weather, climate, water and other environmental information in decision-making and operations with improved tools and increased knowledge and interest.

Social sciences offer ways of marshalling evidence and tools for use in decisions about programs and policies as well as providing evidence to garner support. Social science can help to understand impacts and implications of critical trends, assess opportunities, focus priorities, choose among alternatives, structure incentives and contribute to measurement of performance.

NOAA and its weather and water programs will face increasing demands for program budget justification and a need to communicate priorities and decision criteria to an increasingly involved and diverse set of constituents.

Social science can be an integrating factor, providing an overview of issues and choices and bringing together different types of information and analysis for decision-making. It can enhance the value of physical and natural sciences by improving the ability of programs to assess, understand and meet customer needs and demonstrate and articulate the value they create.

While a foundation has been laid, utilization of social science in NOAA’s weather and water programs has fallen far short of the level of effort needed to meet today’s challenges. With growing understanding of social science and its use in weather and water activities, this is an opportune time to build on the gains to achieve increased and sustainable penetration of social science into planning and decision-making.

The goal of the Social Science Strategic Plan for Weather and Water is to *create a stronger, more distributed, and coordinated social science capability that is integrated with programs and decision systems in support of improved decision-making.*

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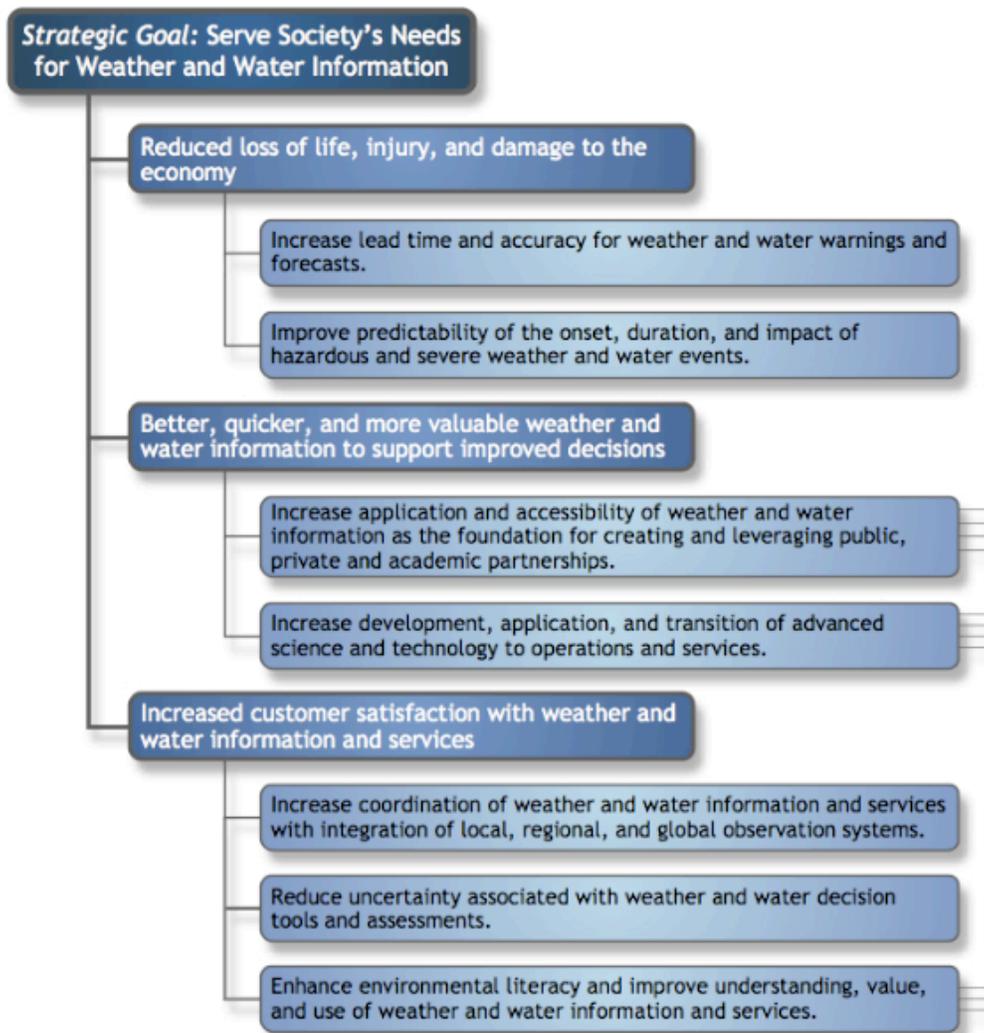
## ***Achieving the Weather & Water Goal Requires Social Science***

### **NOAA’s Weather and Water Strategic Goals**

Floods, droughts, hurricanes, tornadoes, tsunamis, wildfires, and other severe weather events cause \$11 billion in damages each year in the United States. Weather is directly linked to public health and safety. The Societal Impacts Program (SIP) at the National Center for Atmospheric Research (NCAR) estimated year-to-year variations in weather can affect the economy by as much as 3.4% or about \$500 billion.

NOAA is making far-reaching investments in new observations systems, data assimilation, computing, modeling and product development and addressing a widening array of weather, water and environmental phenomena. These initiatives have the potential to transform weather and water activities and bring extensive benefits to the nation.

The outcomes that stem from NOAA’s Weather & Water Goal to “serve society’s needs for weather and water information” is described in the NOAA Strategic Plan as follows:



The specifics of NOAA’s plans for Weather and Water and related activities constantly changing and are reflected in extensive five year budget requests, documentation and resulting budget outcomes. This Plan is intended to provide a flexible framework for guiding many kinds of efforts under current and emerging conditions.

### **How Social Science Furthers the Strategic Goals**

Social science includes a range of disciplines with differing techniques and emphasis. Social science encompasses economics, sociology, anthropology, psychology, demographics, geography, management sciences and a variety of other specialties. Different social sciences can offer alternative approaches that may be useful. For example, understanding of how customers respond to weather and water information may benefit from economists’ focus on incentives and markets, anthropologists’ insights into culture and group behavior, and/or psychologists’ focus on perception. Each application must consider what discipline or combination is better for each task and develop experience that guides decisions about which social sciences to rely on.

### **Some Uses of Each Social Science**

#### **Economics**

- Valuing benefits of programs.
- Cost-benefit and cost-effectiveness analysis to determine payoffs to programs.
- Examining industries and consumers and estimating/forecasting demand for products.
- Understanding incentives of participants in organizational and economic processes.

#### **Sociology and Anthropology**

- Analyzing vulnerability of populations to weather and climate changes.
- Examining adaptation to global change.
- Tailoring resource management policies and programs to cultural environments to increase effectiveness.
- Examining NOAA organizational structures.
- Designing community participation and governance structures for resource management councils.

#### **Demography**

- Assessing population pressures on coastal resources.
- Identifying populations that are vulnerable to changes in the availability of marine life.
- Understanding changes in labor force sources for NOAA.

#### **Geography**

- Defining environmentally sensitive areas.
- Tracking movements of marine life.
- Defining ecosystem boundaries and analyzing interactions among ecosystems.
- Designing configurations for integrating global observing systems.
- Understanding choke points in inter-modal transportation with alternative configurations to assess the potential benefits of improved data.

#### **Psychology**

- Providing methods for survey data collection, analysis and interpretation.
- Understanding how constituents perceive and use data and services.
- Designing stakeholder education materials to improve communication.

#### **Political Science**

- Analyzing pressures for programs and reactions to programs and regulations.
- Understanding governance structures.

Understanding roles of NOAA products in economic sectors, demands of specific applications and roles of private providers and intermediaries can improve the ability to plan for new products and delivery mechanisms. While some progress has been made, demands for analyses that social science can provide are large and growing. More needs to be understood about how industries, commercial organizations, public entities and households obtain, respond to and benefit from weather & water information.

Information and analysis are needed to strengthen understanding of how local emergency managers, coastal managers, water authorities and others use information, how the information provided relates to their perceptions of need, and how training can improve the effectiveness with which they use information.

NOAA makes large investment decisions in facilities and equipment, people and programs that require analyses to help determine value and the best course of action.

Social science can contribute to weather and water efforts across NOAA, including not only the National Weather Service and the Office of Ocean and Atmospheric Research, but also such programs as Coasts, Estuaries and Oceans and support activities such as the satellite missions of NESDIS.

Social science can contribute to Weather and Water goal through the objectives of:

- Improving understanding of the user base, the demands for services and the use of distribution systems.
- Articulating and demonstrating the benefits of programs.
- Assessing the vulnerability of industries, communities and ecosystems.
- Analyzing program alternatives and use of resources.
- Improving measurement and decision tools.
- Providing information and analytic support for advocacy efforts within NOAA.
- Developing and evaluating approaches for education and communication.

### **Weather and Water Has a Social Science Gap**

Despite the importance of social science in addressing these critical questions, Weather and Water has lagged behind other NOAA mission goals in the use of social science. The 2003 findings of the Social Science Review Panel of the NOAA Science Advisory Board (SAB) continue to hold in Weather & Water:

*“NOAA’s capacity to meet its mandates and mission is diminished by the under-representation and under utilization of social science.”<sup>1</sup>*

In recommending expanded use of social science in NOAA decision-making, the Panel noted:<sup>2</sup>

“Social science can do more than simply calculate the value of scientific plans and programs, for

... Weather and Water has lagged behind other NOAA mission goals in the use of social science. The 2003 findings of the Social Science Review Panel of the NOAA Science Advisory Board (SAB) continue to hold in Weather & Water.

<sup>1</sup> NOAA Social Science Review Panel, *Social Science Research within NOAA: Review and Recommendations*, Final Report to the NOAA Science Advisory Board, March 18, 2003 [http://www.sab.noaa.gov/Reports/NOAA\\_SocialSciencePanelFinalReport.pdf](http://www.sab.noaa.gov/Reports/NOAA_SocialSciencePanelFinalReport.pdf)

<sup>2</sup> NOAA Social Science Review Panel, *Social Science Research within NOAA: Review and Recommendations*, Final Report to the NOAA Science Advisory Board, March 18, 2003, p.13 [http://www.sab.noaa.gov/Reports/NOAA\\_SocialSciencePanelFinalReport.pdf](http://www.sab.noaa.gov/Reports/NOAA_SocialSciencePanelFinalReport.pdf)

example the frequently mentioned need for cost-benefit information. More fundamentally, social science can produce research results that help to identify the scope and content of science plans and programs.

Instead of public relations and marketing, social science can contribute to enhancing a more informed and participatory constituency with education and outreach programs on constituent needs and expectations. Social science can also evaluate the degree to which NOAA products and services are satisfying constituent needs.”

The 2003 SAB Social Science Panel’s recommendations were to improve social science literacy at all levels in NOAA, develop and support social science research strategies, plans, and programs, and integrate social science into NOAA’s management structure. NOAA senior management accepted these recommendations, asked the Research Council to oversee their implementation and PPI to coordinate with other NOAA elements to implement specific recommendations.

In the 2005-2009 edition of the NOAA Research Plan, the NOAA Research Council reiterated the importance of social science to NOAA’s mission:

“The mission of the National Oceanic and Atmospheric Administration (NOAA) demands a forward-thinking, interdisciplinary perspective....NOAA must continue to develop a robust social science capability to link societal benefits to the services and research we provide. This capability will assist in research planning, advance our understanding of linkages between economics and social processes relevant to NOAA activities, and improve decision-making based on enhanced products and services.”

“NOAA has an extensive focus on physical, chemical and biological sciences, including increased attention to the newer sciences. There is only limited experience within the agency in using social sciences. Uses of social science in support of its decision-making are evolving in the line offices and mission goal teams and in the Office of Program Planning and Integration. Sustained concentrations of effort have been made in dealing with fisheries and oceans.”<sup>3</sup>

The NOAA 2008-2012 Research Plan, the Research Council emphasized that

“...social science is explicitly tied to NOAA’s mission: how the agency affects people and how people effect their environment. Research toward these ends is *programmatic*; it is an essential part of normal operations of any NOAA program to achieve its stated outcomes.”<sup>4</sup>

Of the NOAA Mission Goals, Weather and Water has the most direct and immediate social and economic impact. Yet it has limited analytic capability to effectively demonstrate or maximize its benefits. Over the last decade, resources for weather research in NOAA have decreased, while

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<sup>3</sup> NOAA Research Council, *Research in NOAA: Toward Understanding and Predicting Earth’s Environment, A Five-Year Plan: Fiscal Years 2005-2009*, January 2005, pp.1-2.  
[http://www.nrc.noaa.gov/plans\\_docs/research\\_nocover.pdf](http://www.nrc.noaa.gov/plans_docs/research_nocover.pdf)

<sup>4</sup> NOAA Research Council, *Research in NOAA: Toward Understanding and Predicting Earth’s Environment, A Five-Year Plan: Fiscal Years 2008-2012*, February 2008, p7  
<http://www.nrc.noaa.gov/plans.html>

investments in research in other Goals have increased or remained steady, and social science has been constrained by the overall decline.

According to an analysis performed by the NOAA Chief Economist, social science efforts relating to Weather & Water, however, have been sporadic. Most of the studies have been done in the Office of Program Planning and Integration; some have come through the U.S. Weather Research Program. The table below shows social science budget and staffing data for NOAA Goals and Line offices for FY 2005.

Budget and Staffing for Goal Teams and Line Offices in FY 2005		Budget (\$M)	Total Social Science Staff	Social Science Series FTEs	Additional Social Science Staff	Economics	Sociology & Anthropology	Other Social Science
GOALS	ECO	18.726	89	66	23	68	10	11
	W&W	0.630	1	0	1	1	0	0
	CLI	4.092	15	3	12	0	11	4
	C&T	0.400	0	1	-1	0	0	0
	MIS	0.575	2	1	1	1	0	1
LINES	NMFS	10.520	68	54	14	58	10	0
	NOS	5.877	21	12	9	10	0	11
	NWS	0.630	1	0	1	1	0	0
	OAR	6.421	15	3	12	0	11	4
	NESDIS	0.400	0	1	-1	0	0	0
	PPI	0.575	2	1	1	1	0	1
<b>Total</b>		<b>24.423</b>	<b>107</b>	<b>71</b>	<b>36</b>	<b>70</b>	<b>21</b>	<b>16</b>

While there are some social scientists in the Coasts, Estuaries and Oceans program and persons with some social science training in weather offices and positions of policy and law, there is a need for personnel with greater formal training and expertise that is focused on analysis for decision-making.

## *Social Science Strategies and Priorities for Weather and Water*

### **Social Science Strategies**

NOAA's weather and water social science objectives can be accomplished through ongoing strategies of:

- Long term capacity building.
  - Developing a small cadre of NOAA social scientists with weather and water expertise who can interface with programs and external social science analyses, develop data, conduct applied studies and oversee consultant studies.
  - Developing institutional arrangements for marshalling external social science expertise.
  - Training NOAA physical, natural and biological scientists in the use of social science for planning and decision-making and integrating social science into programs.
- Developing methods, analyses and data for decision support.

- Analyzing customer needs, utilization of services and delivery systems, outcomes benefits and costs.
- Examining efficiency of production and alternatives for producing data and services and achieving outcomes.
- Infusing results of analyses into decisions and programs to improve products and services.
  - Social science analyses can support a service delivery proving ground through efforts in close collaboration with programs and test beds.
- Improving the use of social science through:
  - Broadening the mix of social sciences.
  - Coordinating social science research within NOAA.
  - Coordinating and/or integrating with research in physical and biological sciences where beneficial.
  - Coordinating with, fostering and drawing on social science research outside of NOAA, working with external research and professional organizations
  - Improving communication with and education of colleagues and constituencies.
  - Continuing to set and refine priorities for analysis.
- Assuring an appropriate level of effort for social science in Weather and Water to meet growing needs.

Short term strategies for social science to contribute to NOAA decisions and operations include:

- Conducting and building capabilities for studies in priority areas.
- More fully examining external research to assure that available studies are utilized so that NOAA's social science resources are applied without unnecessary duplication.
- Developing analyses that can assist in setting priorities in the FY 2012- 2016 and subsequent Program Operation Plans (POPS), including coordination with test bed programs.
- Facilitating efforts of the NOAA Science Advisory Board's Social Science Working Group and implementation of its recommendations.
- Continuing to increase coordination through the NOAA Research Council Social Science Committee.
- Supporting and extending the NOAA-Wide Economics Web site to include other social sciences such as sociology, anthropology, psychology, geography and management sciences.
- Developing cooperative grant relationships with organizations such as the National Science Foundation and THORPEX.<sup>5</sup>

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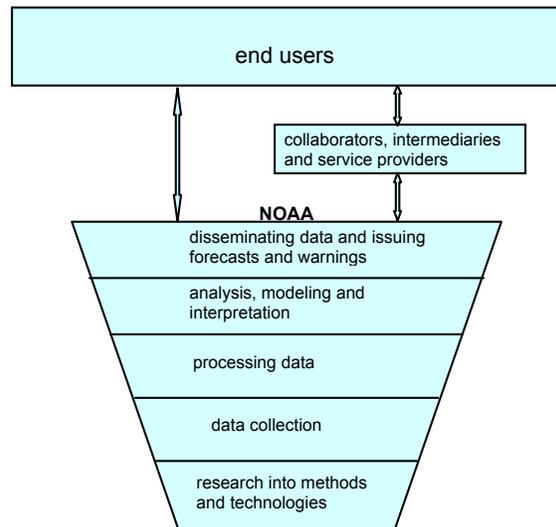
<sup>5</sup> See R.E. Morss, *et. al.*, "Societal and Economic Research and Applications for Weather Forecasts: Priorities for the North American THORPEX Program," *Bulletin of the American Meteorological Society*, (March 2008).

- Strengthening NOAA’s support for and relationship with the Societal Impacts Program at NCAR.

### Social Science Analytic Priorities

Social science data collection and analysis priorities which are most directly related to weather and water programs include:

- User needs assessment, including:
  - Understanding perceptions of and responses to various types and forms of weather and water information by user types of users, including current and potential demand for services and distribution methods.
  - Development and application of user relevant information methods.
- Communication of forecast uncertainty and communicating complex information that is understandable and actionable by users.
- Use and impacts of more localized forecasts and warnings to help in determining what kinds of forecasts will be most useful, and demonstrating the benefits of those forecast efforts to NOAA’s constituencies.
- Understanding the societal effects of high impact events and implications for designing and implementing programs and determining their effectiveness.
- Addressing interrelated needs of communities and regions.
- Examining skill-specific workforce needs and arrangements for fulfilling those needs (e.g. buy or rent) in view of growing technological demands, workforce retirements and budget constraints in NOAA and other science-based agencies.
- Valuation of program benefits and other decision support services.
- Communicating with and educating stakeholders.



Some of these are discussed below.

### Use of Newer Communications Technologies

Understanding how users of forecasts and warnings obtain, interpret and act upon information from newer communications technologies such as cell phones, PDA's and the Internet is essential for planning services and understanding their potential payoffs. A critical distinction is between "push" technologies which provide information automatically to the user (e.g. RSS feeds) and "pull" technologies under which the user initiates the request for information. Analyses should include more common types of forecasts in several types of localities with differing mixes of conditions and users, to explore user perceptions and behavior in response to sources and extent of information availability. For example, energy producers will use temperature information differently than trucking companies and reactions of individuals to precipitation forecasts will not be the same in coastal recreation areas as in cities. The experience with user relevant information techniques can help to structure the analyses.<sup>6</sup>

### **Communicating Forecast Uncertainty**

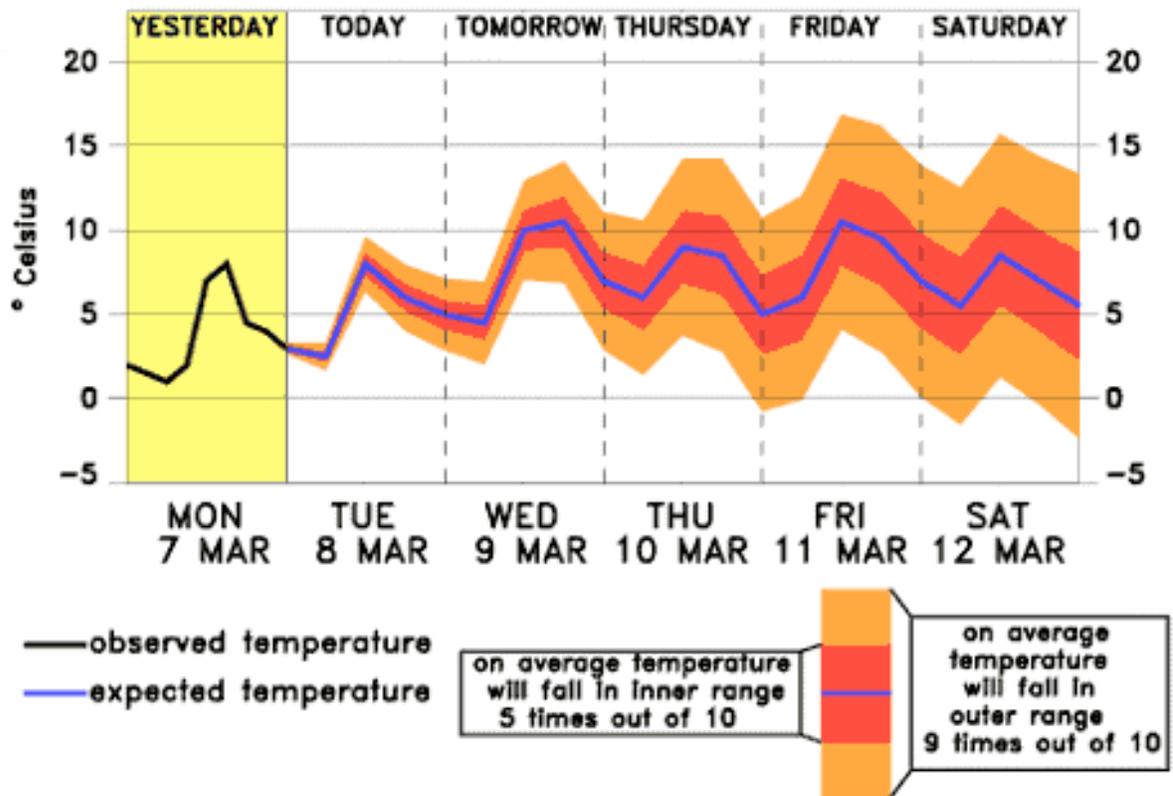
Understanding how the public and weather and emergency service professionals perceive and misperceive risks and respond to risk information and how to communicate complex information has become more essential. Ensemble modeling is becoming more prevalent, weather and climate models are starting to merge and weather forecasts are being provided for ever smaller geographic units. To address how the public perceives and responds to risk, work is needed that is well beyond the early stage development in the NWS Forecast Uncertainty Service Evolution (NFUSE) program.<sup>7</sup> Next stages should

### **Forecasted Precipitation Uncertainty Voted "Preferable" Out of Five Options**

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<sup>6</sup> Important work has been started in systematically defining and measuring the relevance and value of information for specific types of users. The user relevant information approach has not yet been applied on a large scale and many efforts do not yet take advantage of the understanding and experience that has been gained. See Barbara Brown, "User-Relevant Verification," National Center for Atmospheric Research, Research Applications Program, Boulder, CO, December 24, 2006.

<sup>7</sup> The NFUSE Steering Team seeks to advise and coordinate NWS activities related to the development, implementation, and evolution of forecast uncertainty products, services, and information. The work initially involves a survey under a small grant from the U.S. Weather Research Program (USWRP) to the Societal Impacts Program (SIP) at NCAR (National Center for Atmospheric Research) to study communicating uncertain hurricane forecasts (See Morss *et. al.*).



Source: A survey held by the United Kingdom Meteorological Office (courtesy of Ken Mylen, UKMet Office). (Met Office Crown Copyright 2008)

experiment with a wider range of probabilistic forecasts and uncertainty measures and graphic displays and forecasts of additional phenomena, such as hydrology as well as weather. Larger surveys should be conducted and tests should be established in which uncertainty information is provided for actual use. More social scientists with backgrounds in communication, cognitive psychology, behavioral economics and other fields should be brought into research and design of communications, with participation at early stages.

### High Impact Events

High impact events such as hurricanes, tornadoes, wildfires (fire weather), unhealthy air quality, tsunamis, thunderstorms, blizzards and ice storms have become an increasing concern of government and the public. High impact events also occur at the local level in ways that differ greatly from one community to another (fog, black ice, snow in areas where it is unusual, high winds, air quality, flooding, etc.) Greater use of social science is needed both in examining major developments such as hurricanes and in understanding diverse effects of weather that are important to localities.



Studies need to be developed that reflect the full range of the changes that are induced. Hurricane studies should examine behavior of different population groups and of responders and businesses before, during and after events, including societal changes associated with events such as legislative and regulatory responses and community cooperation (Gladwin *et. al.* 2007). Storm surge modeling could be expanded to include socioeconomic factors influencing the severity of impacts and community responses to warnings and uncertainty. For example, the tsunami program requires a societal/behavioral study to determine both the general public's and Emergency Management attitudes toward Atlantic/Gulf tsunami risk. Local community analyses could be used to build up a better national picture of the extent of high impact events and the effectiveness of information and services. A related issue is the need to develop scales of severity for a wider range of weather phenomena that can be specific to geographic areas.

### **Valuation of Program Benefits**

Studies of benefits of programs can be useful in demonstrating value and guiding investment decisions. Valuation studies provide a framework under which fundamental factors producing value such as behavior of markets and utilization of services can be examined, Valuation studies are most needed where new technologies, information and/or services are being developed or introduced and where differing alternatives are being considered.

One approach is to integrate social science into meteorology or hydrology test beds or establish parallel social science test beds that make use of the data generated by the test beds. The data can be used to examine potential users, uses and outcomes and place values on those outcomes. Another priority is examining potential uses and benefits for weather and water objectives of the large quantities of data that will be generated by new satellite, ocean and terrestrial measurement systems. For example, the United States Group on Earth Observations (USGEO) of the National Science and Technology Council emphasizes “the linkage and flow of information from observations to societal benefits.”<sup>8</sup> Recent studies for NOAA have examined the benefits of polar orbiting and geostationary weather satellites.<sup>9</sup>

### **Communicating with and Educating Stakeholders**

NOAA should develop an internal social science education program for physical, natural and biological scientists and managers on creating economic and societal benefits and

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<sup>8</sup> Interagency Working Group on Earth Observations, *Strategic Plan for the U.S. Integrated Earth Observation System*, NSTC Committee on Environment and Natural Resources, April 6, 2005, p.17 <http://www.usgeo.gov/>

<sup>9</sup> Irving Leveson, *NPOESS Economic Benefits*, prepared for the NPOESS Integrated Program Office, Leveson Consulting, June 18, 2008 <http://www.economics.noaa.gov/?file=bibliography> and Centrec Consulting Group, LLC, *An Investigation Into the Economic and Social Value of Selected NOAA Data and Products for Geostationary Operational Environmental Satellites (GEOS)*, report submitted to NOAA's National Climatic Data Center, 2007 <http://www.economics.noaa.gov/?file=bibliography>

analyzing program returns and tradeoffs. Externally, NOAA can develop methods for educating professionals and user communities on the use of weather, water and climate information and forecasts to improve outcomes and foster stewardship. To gauge the success of communication and education with stakeholders, further research should be conducted to assess the effectiveness of outreach and communication alternatives. One possibility is that the WAS\*IS program could be expanded to address some of these issues (see Appendix C).

### *Filling the Gap*

Many steps are needed to develop and impart an improved analytic basis for decision-making:

- **Advancing the Short and Long Term Social Science Strategies and Analytic Priorities.** These have been described previously. It is important that each of the initiatives receive significant attention. Several are highlighted in the next paragraphs.
- **PPBES Integration.** Social science analysis should be more fully integrated in all phases of planning, budgeting and decision-making. Beyond targeted research projects and product improvement, social science is vitally important for managing NOAA's Weather & Water portfolio and building business cases. Social science thinking and analyses can improve budget narratives, performance management, executive decision-making, and responses to OMB and congressional queries. Improved capabilities such as these could be realized with new hires of dedicated social scientists in NWS and OAR. It is important that professional social scientists be integrated into programs to incorporate data, methods and analysis at a level beyond what persons in headquarters and field offices with limited or no social science training can provide.
- **Test-Bed Integration.** Social science should be coordinated or integrated with physical, natural and other sciences where possible, in analyzing opportunities and progress, at every level from testbeds to programs and policies. Social science work would be most effective in the development of new products if it were coordinated with the natural science and engineering work in test beds such as those for hazardous weather, hurricanes and hydrology. It would serve to improve the relevance and reliability of new products, improve the communication of information about probabilities and uncertainties, and improve the transition of products from research to operations and applications.
- **External Partnering/Collaboration.** Partnering is the easiest way to expand investments in a few, targeted, social science research projects. There are a number of such opportunities:
  - Collaboration with the Societal Impacts Program (SIP) at the National Center for Atmospheric Research (NCAR, see Appendix C) and the U.S. Weather Research Program. There are opportunities to expand collaboration with the THORPEX Societal and Economic Research and Applications (SERA) Working Group ([http://www.wmo.int/pages/prog/arep/thorpex/index\\_en.html](http://www.wmo.int/pages/prog/arep/thorpex/index_en.html)) in using social science to better understand the communication and use of weather information, help create effective decision support systems, determine the benefit/cost of improved forecasts of high impact events, and develop user-relevant verification

approaches.

- Collaboration with the National Science Foundation. This is currently taking place on a social science hurricane research solicitation. The effort is an outgrowth of an 18-month-long development of a hurricane forecast and warning social science research agenda directed by the SIP. Additional efforts of this kind would be valuable.
- Continued practice of including at least one Social Scientist as a part of NWS' Service Assessment Teams as was done during the recent Super Tuesday (Feb 5-6) tornado outbreak. NWS self-initiates Service Assessments to evaluate performance following catastrophic weather events. Assessment teams are composed of internal (NWS) and external experts. They study what happened before, during, and after the event.
- Accessing research and expertise by more closely interacting with professional organizations with similar interests or complementary skills. Examples include:
  - The American Meteorological Society (AMS), which provides user forums and addresses communicating uncertainty in its Public-Private Partnership Forum.
  - Working with the natural hazards community. Weather and water programs in NOAA include many natural hazards activities. Centers studying and addressing natural hazards share many of the same interests, including addressing risk issues, and can have social science capabilities.<sup>10</sup>
  - Working with professional associations on more than an individual basis. For example, the WAS\*IS program brings social scientists together with other meteorological researchers and practitioners to facilitate learning and interdisciplinary work (see Appendix C). The Society for Risk Analysis has a membership with expertise and provides a forum for examining risk and risk communication in a wide range of applications.

Initiatives should include:

- Taking advantage of the oversight framework of the NOAA Research Council and its Social Science Committee.
  - Using the Social Science Committee to help integrate social science across NOAA, to coordinate among social sciences and to facilitate coordination with physical, meteorological and natural sciences.

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<sup>10</sup> For instance, the Natural Hazards Center at the University of Colorado maintains an extensive library with searchable online database archiving research and information about how society prepares for, responds to, recovers from, and mitigates damage and other losses from natural hazards and catastrophic events.

- Formalizing the role of the Social Science Committee in annually reviewing the budget proposals in 5-year Program Operation Plans.
- Supporting the forthcoming findings of the 2008 NOAA Science Advisory Board Social Science Working Group and facilitating implementation of its recommendations.
- Improving social science literacy among scientists, managers, decision-makers and stakeholders.

Meeting NOAA's weather and water strategic goals requires addressing many critical questions, including how to design and deliver products, how to communicate information and educate users, how to demonstrate return on taxpayer investment and how to respond to external trends and plan for a future that holds great opportunities and challenges. To further these efforts:

- The Social Science Strategic Plan for Weather and Water should formally be integrated into the R&D portfolio of the Weather and Water Mission Goal Team and the other mission goal teams. The Mission Goal Teams should develop an operational strategy and program to strengthen and integrate social science into corporate and program-level planning, analysis and evaluation. Further, the Weather and Water Social Science Strategic Plan should be coordinated with present and future versions of the social science plans of other mission goals as well as the NOAA Strategic Plan and NOAA Research Plan.
- Implementation plans should be prepared for specific areas of analysis in support of program decisions and outreach. Implementation plans should address social science activities, their approaches, expected outcomes and uses, organizational arrangements, budgets, timetables and processes for infusion into planning, decision-making and education.

Program managers, line office officials and Mission Goal teams all can provide leadership in assuring that social science efforts are developed and that their contributions are integrated into program initiatives to improve programs and decisions.

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## Appendix A: Previous Weather and Water Economics and Social Science Activities

### *Past Activities*

In the past, the NOAA Office of Program Planning and Integration (PPI) has, through the Chief Economist:

- Developed and applied methodologies for valuing weather & water forecasts, e.g. U.S. households, electricity generation, urban heat wave warnings.
- Built a small community of academic and research economists with interest and capabilities in NOAA weather/water.
- Encouraged and assisted with development and use of social science in mission goals and line offices.

Many of the reports deal with weather and water. Reports are available at [www.economic.noaa.gov](http://www.economic.noaa.gov) along with a summary report: *Economic Statistics for NOAA*. (This annual publication will be superseded by the NOAA-wide economics Web site that is in development.)

National Weather Service programs have focused on operations and emphasized physical sciences. NWS has not developed a systematic internal economics and social science capability *per se*. It has largely relied on assistance from PPI, studies in other parts of NOAA and external studies which it has supported through the U.S. Weather Research Program and other contracting arrangements. Some internal work has been done on user needs assessment and some social science components have been proposed in recent Program Operation Plans (POPS) for budget years that are several years away (see later discussion of POPS).

The U.S. Weather Research Program's (USWRP and to some extent U.S. THORPEX- (THE Observing system Research and Predictability EXperiment ) has begun to develop a base for social science activity (both through the Societal Impacts Program at NCAR). These complement NOAA's efforts.

A variety of analyses have been done over the years. However, there are large gaps in the subjects covered, the approaches used, and the level of detail and timeliness. Much of the work in weather and water has been in economics. Little has involved other disciplines or been interdisciplinary, with the exception of studies of ecosystems. Examples of economic studies include:

- A national survey to elicit household values for current and improved weather forecast services (NWS).
- An interstate analysis of the contribution of weather to variations in economic activity (OAR through Societal Impacts Program).
- Coastal benefits of regional ocean observing systems (NOS).
- Benefits of the Physical Oceanographic Real-Time System (PORTS) (NOS).
- A compendium of studies on the potential economic benefits of improving El Niño forecasts (NESDIS).

- Benefits to electric generating companies of savings in infrastructure costs from improved load management with improved weather forecasts (NESDIS and NWS).
- Value of benefits of a Heat Watch/Warning System used in Philadelphia (NWS).
- Study under way for the Sterling Warning Area examining where to focus forecast and warning product and service improvement efforts, intended as a prototype for studies in other regions (NWS).
- Cost-Benefit analyses of NPOESS and GOES weather satellites valuing benefits of improved forecasts to various economic sectors (NESDIS).
- Determining reduction of illnesses, injuries, hospital stays and efficiency, etc., and associated economic benefits from an educated public and health sector (ER visit reduction statistics completed as result of rip current education.) (NWS)

Some work has been done on user needs assessment but coverage of program areas could become more systematic more extensive analysis of programs examined is needed. User needs assessments have been done for:

- **Hydrology:** Training on use of forecast information and risk management techniques
- **Fire weather:** Requested customer needs in Florida and Georgia during early spring fire season; gathered user requirements from USFS; contributed to OFCM user needs assessment
- **Tsunami:** Tsunami Ready Summit with emergency management partners and FEMA; external assessment of Tsunami Hazard Mitigation Program to improve products
- **Air Quality:** Annual NOAA Air Quality Constituent Meeting; Air Quality Forecaster Focus Group; Federal Management Group for Air Quality for EPA as a customer, periodic regional air quality assessments – stakeholder meetings
- **Space Weather:** Annual Space Weather Week to interact with users and help determine needs

#### Social Science Information Dissemination

- PPI has been producing the annual *Economic Statistics for NOAA* (available at [www.economics.noaa.gov](http://www.economics.noaa.gov))
- PPI's Social Science website ([www.economics.noaa.gov](http://www.economics.noaa.gov)) will be superseded by the NOAA-wide economics Web site
- NCDC, working with PPI, has developed a new NOAA-wide economics Web site oriented to general users (<http://www.ncdc.noaa.gov/oa/esb/index.php?goal=home>)
- NOS Web site provides data on coastal trends in socioeconomics (<http://marineeconomics.noaa.gov/>)
- NOAA Fisheries economics and social science Web site provides data and other scientific information to meet biological, ecological, socio-cultural, and economic objectives for the conservation and management of living marine resources (<http://www.st.nmfs.noaa.gov/st5/>)

### ***Economics in the FY2010-14 Weather and Water POPS***

The 2010-2014 Weather and Water Program Operation Plans (POPS), which consolidated information from programs and the Mission Goal Teams propose budgets, provide examples of thinking about social science. The Weather and Water FY2010-2014 POPS included only a limited amount of social science. Many proposed activities do not make it through final budget or are not funded when they do, so persistent efforts and support are required for them to become a reality. The questions addressed and common themes in the proposals from the Mission Goal Teams across all NOAA areas, as analyzed by Social Science Committee of the NOAA Research Council, are noted in the accompanying text box.

## **SOCIAL SCIENCE COMMITTEE ANALYSIS OF FY 2010-2014 POPS**

**Rodney Weiher**  
**Chair**

**5-15-07**

At the request of the Research Council, the Social Science Committee reviewed the FY 2010-2014 POPS (under an extremely tight deadline).

Four general questions were posed to the reviewers:

- 1) Are there discrete social science (SS) research/analysis tasks or activities identified in the POP?
- 2) Are there any overarching SS research issues or themes that these tasks/activities are directed toward? If not, is there an implicit theme(s) that might unite the effort?
- 3) Are there tasks/activities in the POP with obvious SS research/analysis needs or gaps that would help strengthen the program?
- 4) What are the key, threshold SS questions that should be addressed in the program?

We received detail comments from 6 reviewers (attached) of each Goal that we believe would be helpful to the Programs in strengthening the design and justification of their program as well as provide quantitative performance measures.

Some common themes that run throughout the POPs include:

- 1) Social Science is increasingly finding its way into the Goal and Programs, and in some cases, is becoming a key element of the Program. Examples include Regional Decision Support in Climate, Ecosystem Observation Program in Ecosystems, Marine Transportation Systems in C&T, and Hydrology in WW.
- 2) One of the problems, however, with the existence of what becomes seen as a ‘social sciences’ program element-- particularly in Climate and Ecosystems-- is that other program elements often focus solely on the physical, chemical and biological processes in the climate system with an assumption that the necessary social sciences work will be picked up by “the” social sciences program element.” This is evident throughout many of the programs in Climate and Ecosystems. (See detailed comments).
- 3) While many POPS state or imply that the program contributes to economic and social benefits, and often identify sectors that are impacted, there is not a significant amount of investment in identifying and measuring what the marginal benefits and societal implications of the products and services would result from the program. Having a general sense-- and quantitative estimate—of those contributions would go far to developing a forceful rationale for the existence and continued investment in the program. This is particularly the case in C&T and WW. The detailed reviews provide ample examples and suggestions of where such analysis would strengthen the programs.
- 4) There are common social science research needs and themes in the POPs that need to be addressed across the Goals and Programs in an interdisciplinary manner. Examples include:
  - Decision support tools, including communication of information, customer behavior, and community impacts.
  - Understanding decision-maker needs through surveys and use of cognitive psychology.
  - Identification and analysis of key user groups.
  - Understanding of uncertainty and probabilities in product development and application.

## Appendix B: Social Science Committee of the NOAA Research Council

NOAA Research Council's mission is to ensure that all NOAA services are based on sound science, including social science. The "sound science" must be comprehensive and include rigorous analyses of the customers of the services, the producers of the services, and the dynamics of their relationships.

The Social Science Committee of the NOAA Research Council provides advice and assistance to the Research Council on policies to:

- Further integrate social science research into program planning, analysis and evaluation.
- Develop closer working relationships among natural and social scientists and foster better understanding of the nature and design of the research problems of both.
- Coordinate development and implementation of social science elements of corporate-level plans such as 5-year Research Plan and Goal Team Portfolio Analyses.

The responsibilities of the Social Science Committee are to:<sup>11</sup>

1. **Identify** corporate priorities for social science research that will support NOAA's mission.
2. **Advise** the Research Council on opportunities to expand the social science component of NOAA's research activities.
3. **Coordinate** the corporate execution of priority social science research by linking networks of social science expertise to each other, the programs, and to NOAA leadership.
4. **Evaluate** corporate planning in terms of the scale, scope and consistency of social science research. This would include evaluations of Goal Team social science strategic plans (as recommended by the Physical and Social Science Task Team), the Annual Guidance Memorandum, Goal Team Guidance to Programs, Strategic and Corporate Portfolio Analyses, Program Operating Plans, as well as revisions to the NOAA 5-Year Research Plan, 20-Year Research Vision, Strategic Plan, and Strategic Human Capital Management Plan.
5. **Assist** the Research Council on other matters of social science, including liaising with the Science Advisory Board.

In both formal and informal approaches, social science is encouraged through education, assistance, providing examples of analyses and applications, making studies accessible through Web sites and other means and institutionalizing utilization and communication within NOAA and with its constituencies.

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<sup>11</sup> NOAA Research Council, Social Science Committee, *Terms of Reference*, January 3, 2007.

## Appendix C: The Societal Impacts Program at NCAR

Collaborations that pool efforts and tap into external expertise can supplement NOAA's internal initiatives, but these also require consistent and adequate funding from NOAA to be effective. Supporting the work of the Societal Impacts Program (SIP) at NCAR is a core component of NOAA's strategy for development, continuity and utilization of social science capability to meet NOAA's weather and water social science needs.

The SIP was initiated in 2004 and is funded by NCAR and NOAA's U.S. Weather Research Program (USWRP). SIP's mission is "to create a dedicated focal point for assembling, coordinating, developing, and synthesizing research and information on the societal impacts and economic benefits of weather information." To do so, 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 weather 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. In support of its work, SIP established an advisory board of prominent users, policy experts, and social scientists in the weather community. Information on the program is available on the Web at <http://www.sip.ucar.edu/>. SIP work currently focuses in four areas:

- **Research:** SIP researchers are engaged in a variety of research projects to generate new knowledge by assembling, coordinating, developing, and synthesizing research and information on the societal impacts and economic benefits of weather information. SIP's primary research efforts focus on communication of forecast uncertainty and the economic value of weather impacts and weather forecasts.
  - The Overall U.S. Sector Sensitivity Assessment study assesses the sensitivity of U.S. economic sectors to weather using valid theory and methods from economics and historical weather and economic data. This research will inform policy makers about how weather variability affects economic productivity in different sectors and states and will form the basis for more detailed sector assessments, including studies to estimate the economic value of weather forecasts in different sectors.
  - The "Transportation Individual Sector Sensitivity Assessment" project is assessing the transportation sector's sensitivity to weather and establishing reliable methods for assessing the use and value of weather information using an expert-elicitation protocol in five major transportation subsectors: air, rail, water, truck and pipeline.
  - The "Use of Forecast Communication and Communication of Forecast Uncertainty" project involves a nationwide, controlled-access Internet survey, resulting in a sample of over 1500 households assessing (1) the public's sources, perceptions, uses and value of weather forecast information and (2) the public's interpretation of, use of and preferences for weather forecast uncertainty information.
  - SIP Staff are also working on obtaining external funding for primary research activities including a recent award from the National Science Foundation for work on Warning Decisions in Extreme Weather Events.

- Weather and Society Integrated Studies (WAS\*IS):** WAS\*IS is a grassroots movement to change the weather enterprise by comprehensively and sustainably integrating social science into meteorological research and practice by: (1) building an interdisciplinary community of practitioners, researchers, and stakeholders who are dedicated to the integration of meteorology and social science; and (2) providing this community with a means to learn about and further examine ideas, methods, and examples related to integrated weather-society work. Five workshops to date have brought together an interdisciplinary group of physical and social scientists. The workshops focus on (a) laying the groundwork for conducting interdisciplinary work; (b) teaching relevant tools (e.g., GIS, qualitative research methods) and concepts (e.g., vulnerability, risk perception); (c) learning about effective integrated research and applications through real-world examples; and (d) discussing and pursuing related research, application, and educational opportunities with colleagues. To date over 145 individuals from academia, the private sector, and government have attended WAS\*IS workshops. An Advanced WAS\*IS Workshop was undertaken in October 2007 for all NWS WAS\*IS graduates to consolidate and support federal WAS\*IS related efforts. Future work includes continuation of the WAS\*IS workshops, advanced WAS\*IS sessions, a compendium of research projects conducted by WAS\*ISers, and development of additional outreach and educational materials.
- Information Coordination:** To develop and support an active weather-societal impacts community and to respond to broader information needs the SIP supports a variety of information resources. These include a free quarterly newsletter – *Weather and Society Watch* – 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. SIP staff are updating and hosting the Extreme Weather Sourcebook, a collection of data on severe weather events, and the Societal Aspects Page, a database of consistent, relevant internet resources about societal aspects of weather and weather forecasting. Future plans include development of a searchable library of studies, reports, articles, and other reference material on the societal impacts of weather and weather forecasting.
- Community Development and Support:** SIP Staff undertake a diverse and active set of roles to develop and support the social science-weather. This includes participation in NOAA social science planning; membership on NOAA’s Science Advisory Board Social Sciences Working Group; development of a societal impacts seminar series at NOAA’s Global Systems Division in Boulder, Colorado; assisting in cooperative social science efforts between the NWS and RhosHydromet; membership on multiple panels of the National Academies of Science related to societal impacts and weather forecasting; participation in the American Meteorological Society’s Summer Policy Colloquium; membership on the AMS Board on Societal Impacts; Chairing the AMS User’s Forum; membership on the AMS Annual Partnership Topic on Hurricane Resiliency; membership on World Meteorological Organization’s Societal and Economic Research and Applications Working Group (a working group of the World Weather Research Program); chairing WMO’s Verification Working Group; membership on WMO’s Public Weather Service Forum; undertaking economics review work for the The World Bank; supporting and coordinating the Hurricane Forecast Socio-Economic Working Group (HFSEWG) and the North American Thorpex Societal and Economic Research and Applications (NAT SERA) Workshop. Future efforts will focus on developing and

supporting research agenda and funding for social science research at all levels of national and international organizations.