REPORT

of

The Weather Channel Forum

POLICY ISSUES IN HURRICANE PREPAREDNESS AND RESPONSE

A workshop developed by the

Atmospheric Policy Program of
the American Meteorological Society

Sponsored by The Weather Channel, Inc.

Washington, DC

September, 2000

TABLE OF CONTENTS

BACKROUND MATERIALS TO BE FOUND ON THE INTERNET

Opening Address and Keynote Speech (Baker, Witt)

Forecasting Position Papers

Media Position Papers

Response Strategy Position Papers

PREFACE

This report of a workshop on Policy Issues in Hurricane Preparedness and Response presents findings and recommendations that, if implemented, could position the nation to cope far better than at present with the inevitable landfall of a major hurricane on the United States.

The workshop was developed as a result of the interest of The Weather Channel, Inc. (TWC) to initiate a forum series. They asked the American Meteorological Society (AMS) to propose a topic that would be timely and raise issues important for the nation and the scientific community.

Recent U.S. experience with hurricanes provided a natural focus. Hurricane Andrew in 1992 was the costliest hurricane in history ($26.5B). In 1999, Hurricanes Dennis and Floyd triggered massive evacuations and subsequent flooding made the U.S. public once again acutely aware of the impact of hurricanes on life and property. The AMS Atmospheric Policy Program, therefore, proposed, and TWC approved, the development of a forum workshop that would invite the participation of representatives from hurricane forecasting organizations, the weather media, emergency managers, political and corporate leaders, socio-economic weather impact analysts, and academics. The workshop was designed to have interactive panel discussions on the policy issues involved in hurricane preparedness and response.

Ultimately, more than 100 representatives of those communities came together on June 6-7, 2000 for intensive discussions of the important policy issues involved in national, regional, and local hurricane preparedness and response strategies.

The Atmospheric Policy Program of the American Meteorological Society remains poised to assist in the further development and realization of the wide range of initiatives that have emerged from the Forum.

The AMS and the Atmospheric Policy Program acknowledge, with thanks, the contributions of numerous individuals and organizations to the success of the Forum. The fact that they were so numerous inhibits my ability to name them all. Of course, the Forum could not have been undertaken without the generous labors of the moderators and panelists. Four organizations, in particular, provided special assistance: The Weather Channel provided the crucial sponsorship, and staff members from the Federal Emergency Management Agency (FEMA), the National Oceanic and Atmospheric Administration (NOAA), and the American Red Cross participated in many of the core activities of the Forum. The work of Doug Stone, policy specialist on my staff, and Larry Denton, representative of TWC, was critical in the planning and execution of the Forum, while Stephanie Kenitzer of AMS and Kathy Lane of TWC, very ably handled the public relations aspects. Finally, I gratefully recognize the outstanding efforts of Jim Rasmussen, with the excellent assistance of Mark Fernau, in documenting the main outcomes of the discussions and the writing of this report.

Richard S. Greenfield
Director
Atmospheric Policy Program
American Meteorological Society

EXECUTIVE SUMMARY

The Forum on Policy Issues in Hurricane Preparedness and Response brought together experts and representatives from the emergency management, media, and meteorological science and services communities to address the following central question:

What policy changes are needed to produce weather services, media communications, and emergency management decisions that will optimize hurricane preparedness and response?

Today's hurricane warning and response system is more capable than ever before, but it is inadequate to avert a major catastrophe with its attendant large loss of life, enormous property destruction and business disruption, and long recovery times. One of every five people in the United States is at direct risk of hurricane impact, and the number is growing daily. During the last decade or two we have been very fortunate. Considering the large increases in population and development in hurricane prone areas, storms of great magnitude similar to those experienced in the past, striking the same regions now, would cause much greater losses in life and property.

As more people migrate to the coasts and concentrate in urban areas, the pace of growth in evacuation clearance times is outstripping advances in forecast skill. Populations are often asked to evacuate days before anticipated landfall, when the storm's future location and intensity are still very uncertain. For example, New Orleans requires 72 hours to evacuate. Business-as-usual approaches such as incremental improvements in prediction skill and modifications in present evacuation procedures must be augmented by substantial advances in hurricane preparedness, forecasting, and response strategies, and by more effective coordination. To substantially reduce future hurricane losses will require concerted action on the part of all levels of government, as well as private enterprise and the general public.

The Forum developed seven principal **findings**:

1. **Hurricane preparedness and response rely primarily on weather prediction and evacuation.**

The nation's hurricane policy has evolved so that it places only minimal reliance on land use strategies, structural engineering, and building codes.

2. **Present hurricane response strategies are increasingly strained.**

- Reliance on weather prediction and evacuation is increasingly strained by several factors:
- Population and economic development are growing dramatically in coastal areas.
- Forecasts of hurricane track and intensity are only slowly improving.
- Many evacuation clearance times now exceed the lead-time of high-confidence hurricane warnings.
- Many people remain in high-risk areas while the road and shelter infrastructure becomes overloaded with people at much lower risk.

3. **The strains are forcing new hurricane response strategies.**

Shelter-in-place or refuge-of-last-resort solutions are being considered to help meet hurricane threats. These solutions reduce response times but carry higher risk and less assurance of survival.

4. **There are major opportunities to improve hurricane response strategies.**

Opportunities exist in technology and science, government services and legislation, engineering and building, land use and planning, emergency management, communications, and education.

5. **There is poor understanding and application of uncertainties in hurricane forecasts, risk assessments, population responses, infrastructure capacities, and media coverage.**

Hurricane track and intensity predictions remain highly uncertain. Emergency management uncertainties include numbers of people receiving and reacting to response decisions, numbers of individuals with special needs, and infrastructure evacuation capabilities. Media uncertainties involve reporting accuracy, possible conflict between official and private forecasts, and the size of the audience for hurricane information. Inadequate appreciation for these uncertainties and poor communication of their implications result in large areas of watches and warnings, conflicting official guidance, public confusion, and ultimately, inappropriate response.

6. **Policy changes could improve hurricane response in the near term.**

Policies to improve hurricane response have been discussed over the past decade but for a variety of reasons have not been implemented.

7. **Overall, the nation pays insufficient attention to hurricane preparedness and response.**

In particular, there is a lack of attention, dialogue, and planning among the affected parties and insufficient investments to develop and implement response strategies.

The forum made five **general recommendations:**

1. **Congress should mandate a "National Assessment of Hurricane Preparedness and Response".**

The Assessment should involve all levels of government; the affected economic sectors; the academic, research, and education communities; and the media. The Assessment should evaluate the status of the existing infrastructure and services to meet hurricane threats and propose specific mitigation policies and actions.

2. **The Federal Emergency Management Agency (FEMA) should lead an effort, with its partner agencies, to strengthen the present system to a year-round, closely-coordinated hurricane response system encompassing national, regional, and local public and private agencies.**

Current collaboration among the media, emergency management, and weather prediction communities should be strengthened to provide greater year-round coordination of responsibilities and cooperation among the parties encompassing all levels of government -- local, regional, and national.

3. **Future development of the hurricane preparedness, forecast, communications and response system must address the full range of uncertainties.**

The uncertainties outlined in Finding 5 should be clearly taken into account in the response system.

4. **Government agencies should implement policies to strengthen existing hurricane programs and response procedures.**

Specifically, prediction services should use the U.S. Weather Research Program (USWRP) to accelerate research efforts on hurricane prediction and the transfer of research results rapidly into operational forecast applications.

For the provision of emergency management services, institute policies that motivate individuals and local communities to become better-prepared and foster programs and cooperative activities with the media and private sector to communicate hurricane preparedness and response strategies.

To communicate weather emergency information more effectively, seek guidance from communications experts, professional broadcast meteorologists, qualified private meteorologists, and professional meteorological associations.

5. **Congress should develop legislation to ensure funding for hurricane research, prediction, mitigation and response**.

The legislation, as a matter of urgency, should provide long-term, continuous funding, above the current budget levels, for hurricane research and for improved prediction services, communications, mitigation programs and response capability.

Elaboration of these general findings and recommendations is given in Section II of the Report, and further specific recommendations are given in Section III on forecast considerations, Section IV on media issues, and Section V on response strategies.

POLICY ISSUES IN HURRICANE PREPAREDNESS AND RESPONSE

I. INTRODUCTION

The Forum on Policy Issues in Hurricane Preparedness and Response brought together experts and representatives from the emergency management, media, and meteorological science and services communities to address the following central question:

What policy changes are needed to produce weather services, media communications, and emergency management decisions that will optimize hurricane preparedness and response?

The Forum was an important step in a process to assess the nation's vulnerability to the inevitable major hurricane landfall. In addition, the Forum set forth options and policy recommendations to reduce our exposure to the threat and was motivated by the recent experiences of the nation with hurricane events.

- In 1992, Hurricane Andrew wreaked broad devastation over the southern tip of Florida and inflicted approximately $26.5 billion in damages. Economic recovery continues today, eight years after the event.

- In 1999, Hurricane Floyd caused massive inland flooding and triggered the largest evacuation in the nation's history. In that mobilization, the region's highways and major transportation arteries were overwhelmed, as many -- not in any announced danger but nonetheless concerned -- chose to leave. Other citizens refused to clear mandated evacuation areas, leaving themselves in potentially life-threatening situations.

Andrew and Floyd do not approach the catastrophic losses of life and property the nation will face when a major hurricane makes landfall at a large population center such as Miami, New Orleans, Tampa–St. Petersburg or New York City. Death tolls could once again be in the thousands, figures not seen since the Galveston hurricane a century ago or the Lake Okeechobee, Florida hurricane of 1928. Economic losses could exceed $100 billion. It could take up to six months to reestablish basic infrastructure. Overall economic recovery could require decades. For example, experts point out that if Hurricane Andrew made landfall only some 20 miles farther north the loss of life and property would have been many times larger.

Today's hurricane warning and response system is more capable than ever before but is inadequate to avert such a major catastrophe with its attendant large loss of life, enormous property destruction and business disruption, and long recovery times. One of every five people in the United States is at direct risk of hurricane impact, and the number is growing daily. In the mid–20th century, there were very serious hurricane losses: for example, the New England

Hurricane of 21 September 1938, causing major flooding and 600 deaths; and, the East Coast Hurricane (North Carolina to New England) of 12–16 September 1944, causing 390 deaths. Considering the large increases in population and development in those areas, hurricanes of similar magnitude striking the same regions now would cause much greater losses in life and property.

As more people migrate to the coasts and concentrate in urban areas, the pace of growth in evacuation clearance times is outstripping advances in forecast skill. Populations are often asked to evacuate days before anticipated landfall, when the storm's future location and intensity are still quite uncertain, for example, New Orleans requires 72 hours to evacuate. Business-as-usual approaches, such as incremental improvements in prediction skill and slight tightening of evacuation procedures, must be augmented by substantial advances in hurricane preparedness, forecasting, response strategies, and improved effectiveness in the coordinated use of these elements. To reduce future hurricane losses will require concerted action on the part of all levels of government; the academic, research and education communities; and industry, business, and the media. No single policy or program will accomplish this.

Fortunately, the tools needed to effect such change are available today, namely:

- today's public is more sensitive than ever to the hurricane threat, and actively seeks information as storms approach;
- today's media are well equipped to bring the public needed storm information, including not only storm location and track but also a diverse range of options for individual and community action;
- forecasters and researchers are poised to significantly improve the accuracy and specificity of hurricane predictions and to provide longer lead times; and
- the emergency management community is developing plans that would supplement evacuation plans with expanded options for sheltering-in-place.

Several distinguished speakers set the tone for the Forum by emphasizing the importance, relevance, and gravity of the issues being discussed. In his opening address, Dr. D. James Baker, Under Secretary for Oceans and Atmosphere of the U.S. Department of Commerce and Administrator of the National Oceanic and Atmospheric Administration (NOAA), described NOAA programs under way that will enhance the nation's ability to forecast hurricanes. He emphasized the need to take advantage of the new technologies available to communicate weather information to the public, and described the benefits of better observations and data collection. He suggested the need for a Hurricane Hazard Reduction Act. Federal Emergency Management Agency (FEMA) Director James Lee Witt, in his keynote address, described the close working relationship between FEMA and NOAA and announced that both agencies will soon sign a Memorandum of Understanding to work cooperatively to inform and educate the public about hurricane preparation and warnings. He stressed the need for better hurricane protection, more accurate forecasts and better coordination among agencies and interested parties during evacuations. Above all, he stressed the fact that the impact of hurricanes is determined by the actions taken ahead of time to mitigate potential damage through better and enforced building

codes, advance planning, education of the public, and improvement in communication and coordination.

U.S. Representative Johnny Isakson (R-GA) stressed the importance of the Forum's work to the business and real estate communities, as well as to the general public. Governor Jim Hodges (D-SC) vividly described the experience of South Carolina in dealing with Hurricane Floyd and the resulting legislative and policy changes that resulted from that experience. Other speakers: General John J. Kelly, Jr., Director of the National Weather Service; Dr. John A. Clizbe, Vice President of Disaster Services with the American Red Cross; Cynthia Ann Nelson, Senior Staff Meteorologist with the Office of the Federal Coordinator for Meteorological Services and Supporting Research; and Jane Bullock of the Director's Office of FEMA. All of these speakers amplified common themes of cooperation, communication, and coordination among forecasters, the media, and emergency management personnel, as well as the need for better forecasts and more effective response strategies.

The work of the Forum was built around three panels, covering forecast considerations, media issues, and emergency response strategies. These panels were composed of public- and private-sector experts in the panels' subjects who prepared position papers to guide discussion. The names and affiliations of the experts are available in Appendix A and the position papers of panel members and other experts are available on the Internet at the site, http:/www.ametsoc.org/ams/atmospolicy.

Each panel was moderated by a distinguished member of the relevant community, who provided an initial overview, directed dialogue, and then summarized the sessions at the end. The forecasting panel was moderated by Dr. Richard Anthes, President of the University Corporation for Atmospheric Research. Larry Grossman, the former President of NBC News and the Public Broadcasting System, moderated the media panel. John Copenhaver, Director of FEMA Region IV, moderated the emergency management panel. The audience for the workshop was composed of many experts in, and interested observers of, the hurricane preparedness field, and much useful dialogue took place among the panels and between the panels and the audience.

This report enumerates the Forum's findings and recommendations that were formulated in the course of the discussions. Meaningful actions in response to these recommendations will require cooperative and collaborative efforts by the organizations and individuals involved in hurricane preparedness and response at the federal, regional, state, and local levels and within the public, academic, and private sectors. The actions should be undertaken with a sense of urgency to mitigate what could be the nation's largest natural disaster.

II. GENERAL FINDINGS AND RECOMMENDATIONS

The Forum made findings and recommendations at two levels -- those of a general nature that cover overall policy matters pertaining to hurricane preparedness and response, and those that relate specifically to each of the three topic areas: forecast considerations, media issues, and risk management/response strategies. The latter will be presented in sections of the report that specifically address those areas.

FINDING 1 - Hurricane preparedness and response rely primarily on weather prediction and evacuation.

The nation's hurricane policy has evolved so that it depends primarily on preparedness, prediction and evacuation and places only minimal reliance on land use strategies, structural engineering, and building codes.

FINDING 2 - Present hurricane response strategies are increasingly strained.

Reliance on weather prediction and evacuation is increasingly strained by several factors that include the following:

- Population and economic development are dramatically increasing in coastal areas vulnerable to hurricane risk.
- Forecasts and warnings of hurricane track and intensity are only slowly improving and, in fact, landfall warning areas have expanded.
- Evacuation clearance times have increased in many locations to the point where they exceed the lead-time of high-confidence hurricane warning forecasts.
- Many people directly in harm's way do not obey mandated evacuation orders, while others, though not at imminent or high risk, evacuate without reason. The result is that many people remain in high-risk areas while the road and shelter infrastructure becomes overloaded with people at much lower risk.
- Official evacuation decisions are largely made at the local (state, county, or city) level, but as the sheer numbers of people evacuating increase, mass population movements are creating severe traffic congestion and shelter shortages on a regional scale.

FINDING 3 – The strains are forcing new hurricane response strategies.

These strains are forcing emergency managers in virtually all communities on the Gulf and Atlantic Coasts away from total reliance on comprehensive evacuation strategies that are designed to ensure full safety of all populations. Instead, shelter-in-place or refuge-of-last-resort solutions are being considered to help meet hurricane threats. These solutions reduce response

time but carry higher risk (not all the population can be evacuated) and less assurance of survival. These major planning revisions have not yet been fully studied and evaluated by the communities they serve.

RECOMMENDATION 1 – Congress should mandate a "National Assessment of Hurricane Preparedness and Response"

The Forum recommended that an explicit "National Assessment of Hurricane Preparedness and Response" should be undertaken with urgency. The U.S. Congress should mandate such an Assessment, which should involve all levels of government, including the weather and emergency management services; the private meteorological community; the affected economic sectors; the academic, research, and education communities; and the media. The Assessment should involve the general public in its deliberations. The Assessment should evaluate the nation's vulnerability to hurricanes, assess and evaluate the status of the existing infrastructure and services to meet the threat, and propose specific mitigation policies and actions. The Assessment should include a study of cost and risk tradeoffs with refuge-of-last-resort strategies versus conservative, regional-scale evacuations. The federal government, as well as states and local communities must examine the feasibility of employing other national assets.

FINDING 4 – There are major opportunities to improve hurricane response strategies.

Major opportunities exist for enhancing the nation's capability to cope with the current and growing requirement for hurricane prediction, preparedness, and response. These opportunities exist in all areas: technology and science, government services and legislation, engineering and building, land use and planning, emergency management, communications, and education.

RECOMMENDATION 2 – The Federal Emergency Management Agency should lead an effort, with its partner agencies, to strengthen the present system to a year-round, closely coordinated, hurricane response system encompassing national, regional and local public and private sector agencies.

The Forum recommended that the current collaboration among the media, emergency management, and weather prediction communities should be strengthened to provide greater year-round coordination of responsibilities and cooperation among the parties at all levels -- local, regional, and national. FEMA and its partner agencies, in concert with regional, state, and local agencies, should build on current Federal Response Plans to develop an integrated hurricane response system. This system must operate on a year-round basis -- covering education, community preparedness, emergency response, and post-mortem analysis. Thus, it will prepare ***before*** the hurricane season, operate ***during*** the prediction-emergency management phase of the season, and engage in a self-evaluation ***after*** the season. The evaluation will be used to improve system performance for the next year. The system should support minimum national safety goals while respecting local differences.

The Forum further recommended that existing structures and functions be used and strengthened and, where necessary, new ones should be created on national, regional, state, and local levels to ensure cooperative and collaborative joint programs and activities that address the overall

program of hurricane preparedness and response. This integrated system must be developed by a process that permits representatives of each component to contribute to the planning, implementation, and evaluation.

FINDING 5 – There is poor understanding and application of uncertainties in hurricane forecasts, risk assessments, population responses, infrastructure capacities, and media coverage.

Uncertainties permeate all aspects of the hurricane preparedness, forecast, and response system. However, forecast uncertainties, risk uncertainties, population response uncertainties, infrastructure (power, water, and transportation) uncertainties, and media coverage uncertainties are loosely characterized, poorly understood, and unevenly applied in the development and execution of hurricane preparedness and response strategies.

The uncertainty of the prediction of hurricane tracks and intensities is reflected in the large areas of coastline placed under watches and warnings during a hurricane event. Better measures of uncertainty (confidence) can be developed by meteorologists using objective techniques. These probability parameters must be meaningful to, and used by, emergency managers in making their decisions for community action.

Among the emergency management uncertainties are the numbers of people receiving and reacting to response decisions, the number and types of individuals with special needs, and infrastructure capabilities to accept burdens of evacuation.

The media uncertainties include the accuracy and variability of the reports being transmitted, the possible conflict between dissemination of official forecasts and those issued by private meteorologists, and the numbers of citizens that are receiving the reports and response decisions. Uncertainties in all links of the chain must be identified, and actions must be taken to understand and to use them in developing an effective hurricane preparedness, forecast, and response system.

RECOMMENDATION 3 – Future development of the hurricane preparedness, forecast, communications, and response system must address the full range of uncertainties.

The Forum recommended that further development of the hurricane preparedness, forecast, and response system address the uncertainties inherent in all of its components. Each community, depending on its own requirements, will use the uncertainty information in a way that best meets its needs. Some communities require lead times for evacuation, for example, that exceed the watch-warning thresholds. In particular: the meteorological community should develop probability-based estimates of the threat; every segment of the media should evaluate how to effectively reach as many people as possible during the hurricane preparedness phase and during emergency situations; and the emergency managers should seek to have all segments of the threatened population receive, understand and act on response decisions. The resulting system must include education of those who must take the various uncertainties into account as response strategies are implemented.

FINDING 6 –Policy changes could improve hurricane response in the near term.

There are several policy changes that should be undertaken in the near term that would significantly improve the nation's capability to protect against hurricanes. These policies have been discussed over the past decade but for a variety of reasons have not been implemented.

RECOMMENDATION 4 – Government agencies should implement policies to strengthen existing hurricane programs and response procedures.

The Forum recommended that government agencies rapidly implement policy changes to strengthen support for existing hurricane prediction services and research programs and to foster and motivate hurricane preparedness and response.

Specifically, the agencies involved in providing prediction services should use the U.S. Weather Research Program to accelerate research efforts on hurricane prediction and the transfer of research results rapidly to operational forecast applications.

The agencies involved in providing emergency management services should institute policies that motivate individuals and local communities to become better prepared. The policies should foster programs and cooperative activities with the media and private sector, in order to educate the public and communicate hurricane preparedness and response strategies prior to an event, and disseminate emergency directives and information to the individual citizen during the event.

To help communicate information during weather emergencies more effectively, the media and other public information agencies should seek guidance from communications experts, professional broadcast meteorologists, qualified private meteorologists, and the professional meteorological associations.

FINDING 7 – Insufficient attention is given to hurricane preparedness and response.

The Forum found that government at all levels, as well as other institutions, is devoting inadequate attention to the issues involved in hurricane preparedness, forecasting, and response. In particular, there is a lack of attention, dialogue, and planning among the affected parties, and there is insufficient investments to develop and to implement response strategies.

RECOMMENDATION 5 – Congress should develop legislation to ensure funding for hurricane research, mitigation and response.

The Forum recommended that the U.S. Congress develop legislation, as a matter of urgency, which would provide long-term, continuous funding, above the present budget levels, for hurricane research and improved prediction services, communications, mitigation programs and response capability.

The legislation should address the following long-term needs:

1. improve the infrastructure necessary to observe the atmosphere and ocean environments in which hurricanes develop and for research to improve the accuracy of the short- and long-term forecasts of hurricane track, intensity, and effects;

2. develop and promote cost-effective mitigation programs;

3. support the research, communications, and education necessary to ensure appropriate human responses to hurricanes; and

4. support investments in hurricane programs at the federal, regional, state, and local levels, including financial assistance for the training of local emergency managers.

The syntheses in the following sections are based on the papers that were prepared by the Panel members and the discussions that they generated. These conclusions and recommendations expand upon the general findings and recommendations presented in this section.

III. FORECAST CONSIDERATIONS

The Forum, in the context of possible policy changes, considered what types of forecast and analysis products can be provided to satisfy the needs of emergency managers and the media. The Panel on Forecast Considerations addressed the following issues:

- What is needed to improve the accuracy of hurricane forecasts?
- What are the priorities for improving the forecasts?
- What policy changes are needed to make improvements available as soon as possible?

The Forum acknowledged that mitigation (protection, prevention and safety) measures involving infrastructure improvements and prior planning are the keys to saving lives and property. Nevertheless, there was a consensus within the Forum that further improvements are still needed in forecasts and that they would contribute greatly to effective response strategies and to the protection of life and property.

The Forum concluded that improvements in the prediction of hurricane tracks and intensities, and the associated phenomena of surface wind, storm-surge, precipitation and coastal and inland flooding, will continue and could be significantly enhanced and accelerated if adequate support were directed toward research and development and toward the transfer of the research results to the operational weather services. In this regard, the Forum noted with concern that the level of funding for hurricane research has declined in recent years.

The Forum pointed to the U.S. Weather Research Program's Hurricane Landfall Project goals as specific targets that the scientific community feels are justifiable and attainable. These goals can be found in their original, more complete form at the USWRP web site (http://uswrp.mmm.ucar.edu/uswrp.html) but are restated more simply here, as follows:

- Reduce landfall track and intensity forecast errors significantly;
- Increase warning lead-time without increasing area warned;
- Make skillful forecasts of hurricane-force winds with increased lead times; and
- Extend quantitative precipitation forecasts to three days and improve skill needed to facilitate inland flooding forecasts.

Research pertinent to the improvement of hurricane prediction is under way at many academic institutions and government laboratories across the nation. However, the Forum found that a consistent picture emerges of inadequate funding, lack of computer resources, and major difficulties encountered in operational implementation when research results are available. In this regard, it was clear that the USWRP is seriously under-funded (currently approximately $3 million per year) and that its three priority areas of research (hurricanes at landfall, quantitative precipitation prediction, and determining the best mix of observations) are directly relevant to hurricane preparedness and response objectives.

The Panel noted that there are many scientific and technological opportunities that would contribute to improved predictions. Among the most notable are the following areas:

- Improved observations – The hurricane, because it originates and develops over the tropical ocean, presents major challenges to the observational programs. Space-based, ocean-based, and aircraft platforms are critical. Improved observations will depend on the deployment of new systems and better use of existing technology and systems. The new systems are needed to observe both the large-scale environment surrounding the storm and the structure and dynamics of the hurricane itself.

- Better data assimilation – The observations that contribute to the hurricane forecast come from a wide variety of sensors and platforms. Communicating the observations, combining them into the best possible representation of the physical structure and dynamics of the hurricane, and of the ocean and atmosphere environment in which it is embedded, poses a major scientific and technical challenge.

- Improved models – The advent of numerical weather prediction hurricane models has demonstrably improved the forecast of hurricane tracks over the last decade. There is a real opportunity to effectively incorporate the output from the improved observational resources by applying improved data assimilation schemes with numerical models having higher resolution, better physics, and coupling of the ocean with the atmosphere. If modelers have the resources necessary to take advantage of that opportunity, they could make major advances in the accuracy in predictions of hurricane tracks and intensities.

- Better ways of using models and model output – Recent research has demonstrated that ensemble techniques that combine the results of different prediction models, or forecasts run with the same model but with different initial conditions (observations), can provide consistently better forecasts than those obtained from a single model. Although these

ensemble techniques have demonstrated great potential, the most sophisticated technique tested to date requires massive computer resources beyond those available to the nation's weather services.

- Faster transition of research results into operations – It is not enough simply to demonstrate research results and assume that operational agencies will immediately be able to use the new technology. Operational prediction systems must be dependable, tested, and have adequate backup should the primary system be unable to function. The process of incorporating the results of new research into continuing operational services presents challenges at several levels: testing and validation of the proposed new system; training of operational personnel in the new technology; introduction of the new system (usually research computer program code that must be made compatible with existing operational code); and the acquisition of computing resources to accommodate the expanded operational system. It is imperative that this transition process be made as fast, as efficient, and as robust as possible.

Finally, it is not sufficient that hurricane forecasts improve. We must use these forecasts more effectively. Accordingly, the Forum encouraged continued development of social science research in parallel with physical science research and services. Definition and validation of the costs and benefits of various response strategies; better understanding and definition of impacts of hurricanes; and analysis and studies to optimize the functioning of the forecast, emergency management, and media components of the system are a few of the possible research themes that emerged in the discussion.

RECOMMENDATIONS

The Forum made the following specific recommendations concerning forecast considerations:

1. Increased funding should be devoted to hurricane research and to the development of observational systems and infrastructure. In particular, increased funding and substantial institutional support from all involved federal agencies should be provided to the USWRP as a matter of urgency.

2. Given the excellent results obtained from advanced ensemble forecast techniques being carried out in real-time at research institutions, special effort should be made to transfer these advancements to the operational facilities of the NWS.

3. Operational activities at the National Centers for Environmental Prediction (NCEP), including the National Hurricane Center (NHC), and the National Weather Service Forecast Offices (NWSFO) should be developed and supported to ensure that:

    - adequate computer resources are available to accommodate the ever-expanding computational power required for hurricane prediction;

    - institutional infrastructure, including facilities and personnel, is put in place to transfer research and development results effectively to operations;

- forecast procedures provide a smooth and unambiguous suite of advisory and warning services covering all aspects of the hurricane event -- pre-landfall, landfall and post-landfall (e.g., flooding and severe weather such as tornadoes); and

- collaborative education, training and outreach activities are undertaken that involve the National Weather Service at all levels and counterparts in emergency management agencies and the media. Such activities should address cooperation and collaboration in all phases of hurricane preparedness and response: preseason planning and preparedness; operational activities during the event, including post-landfall flooding; and post-seasonal review.

4. Predictions and forecasts produced by the NWS, whether coming from the National Centers or from the NWS Forecast Offices, should be based solely on meteorological conditions, and where appropriate, on objective models and techniques. They should include quantitative measures of uncertainty (confidence).

5. Several specific forecast products and procedures would assist emergency managers in their decision-making process and assist the media in reaching the public with the best possible information. These include:

    - high-resolution, gridded wind field forecast information;

    - wave heights added to the storm-surge levels;

    - forecast confidence measures;

    - use of the Internet to transmit high-resolution, site-specific information in the form of maps; and

    - standardization of NWS Forecast Office web sites so users can easily access information.

Additional products and procedures will be suggested as the process of collaboration/cooperation unfolds and during the proposed National Assessment (see General Recommendations 1 and 2).

IV. MEDIA ISSUES

The Forum was charged with considering how the media can provide accurate, responsible information that will assist the public to prepare for, and to respond appropriately to, the official hurricane response decisions. Specific issues included the following:

- How can hurricane forecasts and associated warnings be presented to the public in a responsible manner, thereby avoiding the “hype” problem?

- How can the media avoid conveying conflicting information about hurricane predictions and response strategies?

- What policies are needed to assure that official public forecasts are used by the media during weather emergencies without unduly restricting the full flow of information from private sources, i.e., resolving public-private prediction issues?

The media representatives noted that their role is to report the news as objectively and independently as possible and that they avoid being considered a partner of the government. They asked the counter question: what are the responsibilities of the government weather forecasters and the emergency managers to the media and, thus, the public? The media representatives further felt that the results of the discussions should be considered guidelines rather than firm recommendations or policies. The focus of the discussion became how to offer responsible coverage during a crisis without "hype", how to incorporate uncertainty into media presentations, and how various interests could best work in a cooperative environment given that a journalist prefers to be seen as independent rather than a partner of government.

The Forum emphasized the critical role played by media in all aspects of hurricane preparedness, communication and response. Especially apparent is the important contribution made by the broadcast meteorologists in this activity. Reaching the public with a consistent and factual message on hurricane risk, community preparedness plans and execution, and a specific and clear message during the event and subsequent recovery period is a daunting task. Cooperation and collaboration of the emergency management and weather forecast services with the media is necessary for public safety in response to hurricanes. Opportunities for this collaboration should be a high priority at the state, regional, and local levels, as well as nationally.

The Forum outlined several areas where cooperative efforts would be particularly helpful:

- Media and emergency managers should strengthen their efforts at coordination by establishing high-level connections through the National Association of Broadcasters (NAB) and the Radio and Television News Directors Association (RTNDA). Such connections would elevate the issue of hurricane preparedness and response within media management, help to foster a highly visible program of public outreach, and help to improve the media's role in hurricane emergency response.

- NWS and emergency management personnel at all levels should intensify their work with the media, should always be frank and open and should never appear to be taking actions that cannot be shared with the media. Spokespersons from the NWS and emergency management offices must be knowledgeable, authoritative, and available at reasonable intervals.

- Reporters assigned to hurricane coverage should be well versed in the nature of hurricanes and the limitations of the forecast processes. They also need to know emergency management plans and evacuation process and procedures.

- The NWS has taken the constructive step of establishing trained Warning Coordination Meteorologists (WCMs) at each forecast office. This has facilitated outreach from the NWS

to the communities it serves. The Meteorologist In Charge and the WCM at each forecast office in areas affected by hurricanes and related life-threatening weather (inland flooding, tornadoes, severe winds, etc.) should expand or initiate efforts to include media news managers, local broadcast meteorologists, and emergency management personnel in organized training and preparedness programs on the local level. This kind of "workshop" activity should be a continuing local activity in advance of each hurricane season. Similar activities on the national scale involving NWS, NCEP, NHC, FEMA, and the national media would also be beneficial.

- Media meteorologists will present a consistent and coordinated message to the public during a hurricane if they are more involved in the NWS process leading to the issuance of hurricane advisory, watch, and warning statements. Special briefings for media meteorologists outlining the reasoning behind specific forecasts before they are issued or the participation of media representatives as observers in the coordination calls leading to a forecast were examples of possible mechanisms that should be considered.

- NWS, emergency managers, and the media should conduct a joint debriefing at the conclusion of each hurricane season to identify needed changes in the structure and function of the system for the next season.

Alternative communication mechanisms, notably cable television and the Internet, are becoming major sources of information for a growing percentage of the population. It was noted that the present system of a forecast being furnished to emergency managers, who then use the local media to inform the public, was breaking down with the advent of these systems. The public is gaining access to information originating outside their local community, and in the case of the Internet, often without attribution or official government sanction; thus the possibility of confusion and "mixed messages" is increasing. The Forum emphasized that the three communities must learn how to address and harness the power and potential of the new technology and media as major components of hurricane preparedness and response strategies.

RECOMMENDED GUIDELINES

Several guidelines emerged from the discussion that addressed specific issues for the media and for the government agencies involved in hurricane forecasts, preparedness and response.

For the Media

1. Use graphics and scrolls to identify affected areas. "Channel surfing" is a widespread practice and viewers may not easily discern whether a story is local or not. It also benefits the deaf and hard-of-hearing viewer.

2. Do not speculate or sensationalize. It is not necessary to "hype" the story to convey the message.

3. Check facts and use official sources. It is the right of the media -- in fact it is their responsibility -- to cover different points of view. When not talking to official sources they

should focus only on how the emergency has affected the individual they are interviewing rather than drawing unwarranted, broad conclusions from the individual report.

4. Talk with emergency managers about their response plans and decision-making process before hurricane season. Take advantage of their media days; prepare ***before*** a tropical weather event.

5. Use broadcast meteorologists as co-anchors when reporting on hurricane events to ensure credible interpretation of the meteorological situation and response strategy.

6. Refrain from putting reporters in harm's way. Often this gives the impression that there is no danger and thereby implies that evacuation is not necessary.

7. Be sensitive to reaching the hearing impaired, speakers of other languages, tourists, people on the road or seeking shelters, etc.

8. Schedule earlier broadcast times if necessary to carry emergency messages.

For Government

1. Meet with news media representatives early on in the process and exchange information and educate each other about respective roles and responsibilities.

2. Make official sources of information more accessible.

3. Hold regularly scheduled news briefings, and spply sidebar stories to reemphasize the emergency management plan and procedures.

4. Provide dedicated and restricted e-mail and web sites for media access to both weather and emergency management information.

5. Be explicit about the uncertainties and complexities of the situation.

6. Recognize and be aware of news broadcast times and of reporters' deadlines; organize as far as possible the issuance of forecast updates, emergency response messages and other information to meet these deadlines.

7. Establish a Public Information Officer in each emergency management office.

V. RESPONSE STRATEGIES

The Emergency Response Panel focused on three issues:

- What additional forecast products or services could assist in making the right response decisions?

- How can the media assist more effectively in conveying important response information to the public?

- What policy changes at the federal, regional, state, and local levels would enable more effective hurricane response decisions?

Overall, the Forum found that prediction and emergency response strategies must be viewed in the context of broader mitigation strategies.

Mitigation of hurricane impacts lies largely in the development of societal resilience. Key elements include land use, structural engineering, building codes, infrastructure improvement, and public preparedness and awareness. All require prior planning. Unfortunately, mitigation in general, and emergency management in particular, are *not* priorities in most communities. This has to change. The federal government cannot solve these problems at the national level. Individual homeowners, neighborhoods and communities must address important mitigation issues. Disaster resistance must be a year-round theme of planning, standard setting and community action for any strategy to be effective.

Furthermore, hurricane vulnerabilities need to be factored into a broad range of policy and economic decisions not normally associated with disaster reduction *per se*. International experience shows the truth of this. In a period of a few days, Hurricanes Georges and Mitch undid a decade of investment by the World Bank in Central America -- more than $10B U.S. -- and reduced the Central American Gross Domestic Product by more than 50%, in part because economic development decisions across a broad front failed to take hurricane risks into account. As James Lee Witt, the Administrator of the Federal Emergency Management Agency, summed up the issue: "I can make another promise with equal certainty. The impact of the next hurricane is being decided right now … in living rooms, city council chambers and communities across America. Let's spend this hurricane season watching the skies and monitoring the seas. But let's also agree to act now -- right now -- while the skies are blue and the seas are calm -- to prepare for the next hurricane long before it strikes."

The Forum also concluded that effective emergency management in hurricane situations can be no better than the accuracy and timeliness of the forecast information upon which decisions are based and the ability of the media to inform the public of the situation and the emergency actions necessary. The panel emphasized the continued requirement for improved hurricane track and intensity forecasts, especially in long lead-time evacuation areas and in large population centers where ensuring the safety, or even the survivability, of large segments of the population will require major community services and action.

The Forum concluded that education of the general public must be a continuing focus of any strategy. The more information the public has, the better prepared the community will be. Individuals and families should understand the risks they face and what they could and should do for themselves and their families to ensure their personal safety and to protect their homes.

The Forum considered at some length the increasing reliance on evacuations as a principal response mechanism. As a result of last year's experience with Hurricanes Dennis and Floyd, the public is growing more aware that more emphasis must be placed on mitigation and on

shelter-in-place. Population density and roadway and shelter inadequacies are exceeding the ability of communities to cope. Evacuation decisions are difficult to make, to implement, or to change. Decisions to evacuate are hard to reverse and vary by jurisdiction and with each storm because of differences in topography, population density, transportation and sheltering infrastructure and political will. Worse yet, evacuations do not necessarily move the population out of harm's way -- the impact of inland flooding, for example, can be catastrophic and, in fact, often results in more casualties than any other factor.

RECOMMENDATIONS

The Forum addressed a wide range of issues and opportunities pertaining to emergency response to hurricane threats. The following set of recommendations amplify and specify in more detail the broad set of General Findings and Recommendations listed in Section II of this report. In particular, a much more comprehensive evaluation of the state of hurricane preparedness and the nation's ability to respond will emerge from the National Assessment proposed in General Recommendation 1.

The Forum recommendations concerning response strategies are arranged under the headings: Preparedness, Emergency Operations, Collaborative-Cooperative Activities, and Legislative Issues.

Preparedness

1. The Forum strongly recommended that governments at all levels (federal, state and local) urgently review and strengthen building code and land use policies and enforcement with the explicit intent to ensure the maximum possible survivability of existing structures and infrastructure. It noted that relatively simple "fixes" such as roof clips and window covers have immensely improved the capability of homes and other structures to withstand hurricane winds. Incentives, such as reduced insurance rates and property tax relief, should be sought, debated, and implemented to encourage action.

2. Policies governing development of the coastline -- especially the natural barrier islands -- must be reviewed and altered as necessary so that these natural protective landforms provide the maximum possible safety barrier from storm-surge and waves.

3. The Forum recommended that renewed emphasis be placed on education and public outreach. The message of prevention was considered the highest priority. Several mechanisms that might be employed in this effort were identified, including:

    - address-specific messages (inserts in phone or electric bills);
    - employers (outreach in the workplace);
    - schools (similar experience with fire safety has shown this to be effective);
    - phone books;

- rental agencies;
- the Internet;
- brochures and handouts with graphics down to street level detail; and
- television and radio programs.

Emergency Operations

1. The Forum, noting that evacuation is becoming more and more difficult because of high population density, as well as limits to shelter resources and roadway capacity, recommended that policies be considered that would focus on the concept of "phased evacuations", i.e., getting the people at highest risk out first. The policy would aim at minimizing the "shadow evacuation", i.e., the numbers of people who decide to evacuate even though their specific residence is not under direct threat, and decreasing the distance traveled by those under evacuation orders. This focus would aim to evacuate those under the threat of inundation from storm surge and waves, those living in manufactured and mobile homes, and the population with special needs that require uninterrupted services (e.g., electricity or medical treatment) to survive. Given that the preparedness programs have ensured that homes and buildings meet minimum standards to withstand hurricane winds, the remaining population would "shelter-in-place" and thus ease the burden on evacuation facilities. This concept is embodied in that old emergency management adage, "flee from water, hide from wind."

2. The present application of storm-surge models tends to overestimate the amount of area at risk from a specific event. Storm-surge models and their application should be reviewed and new approaches developed that are designed to reflect specific situations (storm track and storm size and intensity), and that more realistically identify the specific areas under threat. The Forum recommended that ways be sought to identify those areas (down to specific properties) vulnerable to storm-surge inundation. Materials such as color-coded large-scale (high detail) risk-zone maps, widely distributed, systematically updated, and consistently used in preparedness activities as well as during the emergency, would greatly assist in developing a coherent and clear strategy.

3. Communities should include plans for "refuge-of-last-resort" facilities as an integral component of their response strategy. Hurricanes can develop quickly near the coast or change direction and intensity and make landfall so that full evacuation plans cannot be implemented in time. In such a case, the only option will be to shelter virtually the entire at-risk population in place using designated "survivable" structures (as opposed to "safe" structures). In this regard, the Forum recommended that all-new public facilities such as schools and state and federal buildings be designed and built to serve as refuges of last resort.

4. Hurricane response strategies and evacuation decisions should be made on the basis of forecast track and intensity predictions that include an explicit measure of confidence. The use of the Hurricane Watch and Warning messages are not appropriate for this application.

The Watch and Warning definitions are useful "flags" to inform the general public, but they do not provide any measure of confidence.

5. Response strategies should explicitly address the needs and requirements of special-needs categories of the population. These categories include the transient population (e.g. tourists), people speaking different languages, the hearing impaired, the sick and infirm and the elderly.

6. The Forum recommended that plans and procedures be developed for improved emergency communications as part of each community's hurricane response strategy. The communication of emergency information and directives continues to be a major obstacle during hurricane events and during the recovery periods. Power outages limit the use of "normal" means for communication such as radio and television. People under evacuation require time-sensitive information regarding the evacuation (e.g., road and shelter conditions) while they are on the road. They also require information about the status and recovery of their communities and property during the time that they are in safe shelter. AM/FM radio stations and dedicated emergency systems such as the NOAA Weather Radio can provide means for communication to (typically battery–powered) receivers that are less vulnerable to power interruptions.

7. Recent events (e.g., Hurricane Floyd in 1999) have underscored that emergency response operations have regional impact often involving several states. Therefore the individual community emergency management plans and strategies must include coordination with neighboring jurisdictions and states.

Collaborative/Cooperative Activities

1. The realization of an effective emergency management strategy must include a wide range of collaborative efforts to inform the public of their individual vulnerability to hurricane threat and to assist them in their individual decision-making process regarding what actions to take or not to take. Cooperative activities involving the emergency management agencies, the NWS, and the various media organizations are crucial to developing a consistent, comprehensive and meaningful program of public education and outreach. Workshops and projects involving all players were suggested to develop innovative and location-specific outreach activities that effectively carry the message.

2. Techniques are needed to use forecast uncertainty (confidence) measures of hurricane track and intensities fully in the hurricane-response emergency management process and procedures. Cooperative efforts between the NWS at both the National Centers and local NWS Forecast Offices, and FEMA and the emergency management offices at the state and local levels should be initiated to develop meaningful measures of uncertainty and techniques to use this information in response strategies. Research to use such forecast probability information effectively in decision support models can contribute to improved strategies over the longer term.

Legislative Issues

Several ideas were voiced during the Forum that entailed governmental policy or possible legislation at the federal, regional, state or local levels, as appropriate. Many of these were controversial. The Forum did not attempt to analyze of these suggestions in any depth. Nevertheless, it was our sense that federal, regional, state, and local governments need to debate these issues and draw the public into a larger dialogue. The National Assessment recommended above will be one possible venue for further analysis and recommendation. The following is a list of the topics raised:

- Reduce federally subsidized coastal development.
- Amend the National Flood Insurance Program to limit new development in high-hurricane risk areas and to discourage redevelopment after a hurricane event.
- Change federal and state tax laws to ease the tax burden on insurance providers covering catastrophic losses from natural disasters such as hurricanes.
- Implement and enforce strong, hurricane-resistant building codes.
- Change insurance legislation to encourage hurricane-resistant construction of homes and businesses.
- Require all new homes in hurricane-prone areas to have a “survival room.”
- Require all manufactured home communities and mobile home parks to have a building on-site that meets hurricane shelter specifications.
- Develop policies affording owners of structures that can serve as “refuges-of-last-resort” indemnification against liability.

VI. CONCLUSIONS

The findings and recommendations of the Forum on Policy Issues in Hurricane Preparedness and Response are the result of in-depth evaluation and consideration by a multi-disciplinary group of experts and representatives of the meteorological sciences and services communities, the emergency management community, and the media. The presentation of position papers from panelists representing each of the disciplines and the subsequent discussion of the issues raised in an open interdisciplinary format led to a rich exchange of views, and clarified and focused the wide range of concerns and interests.

The resulting proposals for a National Assessment of hurricane preparedness and response and for a renewed effort toward a truly coordinated and cooperative interagency program that builds on and strengthens the existing activities of FEMA, NOAA, and the media are important first

steps in addressing the issue. The Forum, reemphasizing the fact that opportunities exist that will lead to major progress in hurricane forecasting and response, called for the U.S. Congress to develop legislation that would provide long-term funding for hurricane research and for improvements in prediction services, communications, mitigation, and response capability. This long-term, sustained activity will bring the nation into a state of unprecedented readiness to respond to the inevitable occurrences of hurricanes making landfall on our increasingly vulnerable coastal areas, with their rapidly growing populations and their vital economies.

This report includes many conclusions, recommendations, and guidance suggestions that provide depth and detail to the general findings and recommendations mentioned above. These more specific items are directed at the fields: meteorological science and services, the media, and emergency management. The individual recommendations, however, emerged from the interdisciplinary consideration of all of the issues addressed and are pertinent to the development of a truly coordinated program of hurricane preparedness and response.

The Forum was only a step in a major long-term campaign that must be mounted to address the issue of developing national, state, and local policies, programs, and actions that will further our collective capability to cope with one of nature's most powerful threats.

APPENDIX A - LIST OF PANELISTS

FORECAST CONSIDERATIONS

Dr. Rick Anthes (Moderator)
President
University Corp. for Atmospheric Research
P.O. Box 3000
Boulder, CO 80307-3000

Professor Russ Elsberry
Naval Postgraduate School
Dept. of Meteorology
Mail Code: MR/ES
589 Dyer Road - Room 254
Monterey, CA 93943-5114

Professor T.N. Krishnamurti
Department of Meteorology
Florida State University
Mail Code 4520
Tallahassee, FL 32306

Dr. Steve Lyons
Tropical Weather Specialist
The Weather Channel
300 Interstate North Parkway
Atlanta, GA 30339

Mr. Max Mayfield
National Hurricane Center
W/NP8 Bldg: Rm: 111A
11691 SW 17TH ST
Miami, FL 33165-2149

MEDIA ISSUES

Mr. Larry Grossman (Moderator)
37 W. 12th Street
New York, NY 10011

Ms. Ronnie Goodstein
Director of Public Affairs
Pinellas County, Florida
510 Bay Avenue
Clearwater, FL 33756

Mr. John Hope
Hurricane Specialist
The Weather Channel
300 Interstate North Parkway
Atlanta, GA 30339

Mr. Bob Ryan
Chief Meteorologist
WRC-TV
4001 Nebraska Ave, NW
Washington, DC 20016

Mr. Jack Williams
Weather Editor
USA Today.com -- 22nd Floor
1000 Wilson Blvd.
Arlington, VA 22229

RESPONSE STRATEGIES

Mr. John Copenhaver (Moderator)
Director, FEMA Region IV
3003 Chamblee Tucker Road
Atlanta, GA 30341

Professor Jay Baker
Department of Geography
Florida State University
Mail Code 2190
Tallahassee, FL 32306

Mr. Eric Tolbert
State of North Carolina
Director, Division of Emergency Management
116 W. Jones St
Raleigh, NC 27603

Dr. Walter Maestri
Director, Jefferson Parish, Louisiana
Department of Emergency Management Task Force
Jefferson Parish Emergency Mgt
1887 Ames Blvd.
Marrero, LA 70072

Mr. John Wilson
Dirctor of Emergency Management
Lee County Division of Public Safety
14752 Ben C. Pratt/Six Mile Cypress Pkway
Ft. Myers, FL 33912

APPENDIX B - LIST OF PARTICIPANTS

Mr. Decker Anstrom
President
The Weather Channel
300 Interstate North Parkway
Atlanta, GA 30339

Mr. Michael Armstrong
Associate Director for Mitigation
FEMA
Federal Center Plaza
Washington, DC 20472

Dr. James Arnold
NASA
Marshall Space Flight Center
977 Explorer Blvd
Huntsville, Alabama 35806

Mr. Raymond J. Ban
AMS Commission on Professional Affairs
The Weather Channel
300 Interstate North Parkway
Atlanta, GA 30339

Mr. William E. Barnard
Special Assistant
Office of the Governor, State of Maryland
100 State Circle
Annapolis, MD 21401

Mr. Daniel J. Barry
Director of Government Affairs
Risk and Insurance Management Society, Inc.
655 Third Ave.
New York, New York 10017

Mr. Michael Beeman
Public Affairs Officer, Region II
FEMA
26 Federal Plaza -- Rm. 1337
New York, NY 10278-0002

Mr. Steve Billcheck
Services Operations Supervisor
Va. Dept. of Emergency Services
10501 Trade Court
Richmond, VA 23236

Ms. Alice K. Blair
Manager, State Relations
American Red Cross
431 18th St., N.W.
Washington, DC 20006

Mr. Lee Bowman
Scripps Howard News Service
1009 Vermont Ave., N.W. -- #1000
Washington, DC 20005

Mr. William Cambio
Chief Planner
Rhode Island Emergency Management Agency
765 New London Ave.
Cranston, RI 02920

Gen. Richard Capka
U.S. Army Corps of Engineers
60 Forsyth Street, SW
Atlanta, GA 30303

Mr. T. Michael Carter
Corporate Responsibility Group
1101 17th St., N.W. -- #1200
Washington, DC 20036

Mr. Charles Chestnutt
Manager, Flood Plain Mgt. Services
HQ, U.S. Army Corps of Engineers - CECW-E
20 Mass. Ave., N.W.
Washington, DC 20314-1000

Dr. Jim Cooper
AMS Board of Private Sector Meteorology
15000 Conference Center Drive
Chantilly, VA 20151

Lt. Col. William Delehunt
USAF
3511 NW 91st Ave.
Miami, FL 33172-1217

Mr. John P. DiNuzzo
Chief of Mitigation Programs
New York State Emergency Management Office
1220 Washington Ave., Bldg. 22, Suite 101
Albany, NY 12226

Mr. Drenan Dudley
Director of Projects and Grants
Office of Sen. Ernest Hollings
125 Russell Senate Office Bldg.
Washington, DC 20510

Mr. Robert Dumont
Meteorologist
OFCMSSR
8455 Colesville Road
Silver Spring, MD 20910

Mr. Dennis Dura
Principal Planner, Operations Planning Bureau
NJ State Police Office of Emergency Management
P.O. Box 7068, Old River Rd.
West Trenton, NJ 08268

Prof. John A. Dutton
The Pennsylvania State University
College of Earth and Mineral Sciences
508 Dieke Building
University Park, PA 16802

Dr. Jenni Evans
AMS Tropical Meteorology and Tropical Cyclones Committee
The Pennsylvania State University
503 Walker Bldg.
University Park, PA 16802

Dr. Mark E. Fernau
Technical Editor
American Meteorological Society
45 Beacon St.
Boston, MA 02108-3693

Ms. Janet Foor
Department of Operations and Training
Pennsylvania Emergency Management Agency
2605 Interstate Drive
Harrisburg, PA 17110

Mr. Robert W. Foor
State 911 Coordinator
Pennsylvania Emergency Management Agency
2605 Interstate Drive
Harrisburg, PA 17110

Prof. William M. Frank
The Pennsylvania State University
Department of Meteorology
503 Walker Building
University Park, PA 16801

Dr. E. W. Friday
National Research Council
2101 Constitution Avenue, NW
Harris Building -- Room 476
Washington, DC 20418

Mr. Craig Fugate
Bureau Chief
Florida Bureau of Preparedness and Response
2555 Shumard Oak Blvd.
Tallahassee, FL 32399

Ms. Laura Goodwin
Legislative Correspondent
Office of Senator John Edwards
225 Dirksen Senate Office Bldg.
Washington, DC 20510

Dr. Richard E. Hallgren
Exec. Director Emeritous
American Meteorological Society
1200 New York Ave. N.W. -- Suite 410
Washington, DC 20005

Dr. William Hooke
Senior Policy Fellow
American Meteorological Society
1200 New York Ave. N.W. -- Suite 410
Washington, DC 20005

Mr. Kevin Kille
Planner -- Natural Hazards Section
Delaware Emergency Management Agency
165 Brick Store Landing Rd.
Smyrna, DE 19977

Dr. Scott Kiser
National Weather Service
1325 East-West Highway
Silver Spring, MD 20910

Mr. Peter LaPorte
Director, Emergency Management Agency
Washington, DC Emergency Management Agency
2000 14th St., N.W., 8th Floor
Washington, DC 20009

Dr. Stephen Leatherman
Director, International Hurricane Center
Florida International University
University Park Campus, EAS 2710
Miami, FL 33199

Mr. Rocky Lopes
Manager, Disaster Education
American Red Cross
8111 Gatehouse Rd.
Falls Church, VA 22042

Dr. Stephen J. Lord
Director
NOAA/NWS
NCEP/Environmental Modeling Center
5200 Auth Rd.
Camp Springs, MD 20746-4304

Mr. William Massey
FEMA, Region IV
3003 Chamblee Tucker Rd.
Atlanta, GA 30341

Mr. Gary McConnell
Director, Emergency Management Agency
Georgia Emergency Management Agency
P.O. Box 18055, 935 East Confederate Ave., S.E.
Atlanta, GA 30316

Mr. Peter McGough
Area Coordinator
Alabama Emergency Management Agency
P.O. Drawer 2160
Clanton, AL 35046

Mr. David McMillion
Director, Maryland Emergency
Management Agency
5401 New Saint Lo Drive
Reisterstown, MD 21136

Mr. Jason McNamara
Congressional Fellow
Office of Sen. Bob Graham
524 Hart Senate Office Bldg.
Washington, DC 20510

Dr. Ronald D. McPherson
Executive Director
American Meteorological Society
1200 New York Ave. N.W. – Suite 410
Washington, DC 20005

Ms. Mary Lynne Miller
FEMA, Region IV
3003 Chamblee Tucker Rd.
Atlanta, GA 30341

Mr. Herbert Mitchell
Deputy Associate Administrator, Disaster Relief
Small Business Administration
409 3rd St., SW
Washington, DC 20416

Dr. Pierre Morel
Science Advisor
NASA
Office of Earth Science
Washington, DC 20546

Ms. Cynthia Ann Nelson
Senior Staff Meteorologist
OFCMSSR
8455 Colesville Road
Silver Spring, MD 20910

Dr. Stephan Nelson
Program Director, Mesoscale Meteorology
National Science Foundation
4201 Wilson Blvd. -- Room 775
Arlington, VA 22230

Mr. Bryan Norcross
CBS-TV/WFOR-TV Miami
1830 W. 24th St.
Miami Beach, FL 33140

Mr. Joe Palka
President
National Science Writers Association
4620 29th Place, NW
Washington, DC 20008

Ms. Maria Pirone
Director, Global Data Products and Services
WSI Corporation
4 Federal St.
Billerica, MA 01821

Dr. James L. Rasmussen
Rapporteur
American Meteorological Society
1200 New York Ave. N.W. -- Suite 410
Washington, DC 20005

Mr. Michael L. Rodemeyer
Legislative Director, Democratic Staff
House Science Committee
822 O'Neill House Office Bldg.
Washington, DC 20515

Mr. Tom Rodgers
Director, Area II
Massachusetts Emergency Mangement Agency
400 Worcester Rd.
Framingham, MA 01702

Dr. Richard D. Rosen
AMS Scientific and Technological Activities Commission
Atmospheric and Environmental Research, Inc.
840 Memorial Dr.
Cambridge, MA 02139

Ms. Shelley Row
Director, Office of Transportation Operations
DOT, Federal Highway Administration
400 7th St., S.W. -- Suite 3401
Washington, DC 20590

Mr. Harvey Ryland
President
Institute for Business and Home Safety
175 Federal St. -- #500
Boston, MA 02110-2222

Mr. Albert Scappaticci
Executive Director, Emergency Management Agency
RI Emergency Management Agency
645 New London Ave.
Cranston, RI 02920

Dr. Robert J. Serafin
NCAR
P.O. Box 3000
Boulder, CO 80307-3000

Dr. Wilson Shaffer
National Weather Service TDL
1325 East-West Highway
Silver Spring, MD 20910

Prof. Lynn K. Shay
University of Miami School of Marine and Atmospheric Sciences
Meteorology and Physical Oceanography Dept.
4600 Rickenbacker Causeway
Miami, FL 33149

Dr. Robert Sheets
Consultant
1727 Lake Clay Dr.
Lake Placid, FL 33852

CDR Kathy Shields
Office of the Oceanographer of the Navy
U.S. Naval Observatory
3450 Massachusetts Ave., N.W.
Washington, DC 20392-5421

Lt. Col. David Smarsh
USAF
NOAA/U.S. Dept. of Commerce
14th St. and Constitution Ave., N.W. -- Room 5230
Washington, DC 20230

Mr. John Sokich
Strategic Planning and Policy
National Weather Service
1325 East-West Highway
Silver Spring, MD 20910

Ms. Margaret Spring
Oceans and Fisheries Counsel
Senate Commerce, Science and Transportation Committee
566 Dirksen Senate Office Bldg.
Washington, DC 20510

Prof. Christopher S. Velden
University of Wisconsin, Madison
Space Science & Engineering Center
1225 West Dayton Street
Madison, WI 53706

Mr. David Whatley
Program Director, Aviation Weather
Federal Aviation Administration
400 7th Street, SW -- Room 8228, ARW-1
Washington, DC 20591

Ms. Jonna Wheeler
Specialist Assistant to the Director
Georgia Emergency Management Agency
Box 18055, 935 East Confederate Ave., S.E.
Atlanta, GA 30316

Mr. Samuel P. Williamson
Federal Coordinator
OFCMSSR
8455 Colesville Road
Silver Spring, MD 20910

Dr. Hugh Willoughby
Director
NOAA/AOML
4301 Rickenbacker Causeway
Miami, FL 33149

STAFF

Mr. Larry Denton
Washington Representative
The Weather Channel
Denton Associates
P.O. Box 468
Queenstown, MD 21658

Ms. Stephanie Kenitzer
Public Relations
American Meteorological Society
1200 New York Ave. N.W. -- Suite 410
Washington, DC 20005

Ms. Kathy Lane
Brand Director, Public Relations
The Weather Channel
300 Interstate North Parkway
Atlanta, GA 30339

Mr. Doug Stone
Policy Specialist
American Meteorological Society
1200 New York Ave. N.W. -- Suite 410
Washington, DC 20005

APPENDIX C - PROGRAM AGENDA, SPEAKERS, AND PRINCIPAL PARTICIPANTS

THE WEATHER CHANNEL FORUM

POLICY ISSUES IN HURRICANE PREPAREDNESS AND RESPONSE

A workshop developed by the

ATMOSPHERIC POLICY PROGRAM
AMERICAN METEOROLOGICAL SOCIETY

DATE	TIMES	EVENT	REMARKS
June 6	8:30 – 9:00 am	Welcoming Remarks	Greenfield (AMS), Kimpel (AMS), McPherson (AMS), Anstrom (TWC)
	9:00 – 9:30 am	Opening Address	Dr. D. James Baker, NOAA
	9:30 – 10:00 am	Keynote Speech:	Mr. James Lee Witt, FEMA
	10:00 –10:15 am	Break	
	10:15 – 12:15 pm	1st Panel (initial session)	Forecast Considerations
	12:30 – 1:15 pm	Box Lunch	
	1:15 – 2:15 pm	1st Panel (continued)	Forecast Considerations
	2:15 – 2:30 pm	Break	
	2:30 – 2:45 pm	Summary from National Hurricane Conference	Ms. C. A. Nelson, OFCMSSR
	2:45 – 5:45 pm	2nd Panel Discussion	Media Issues
	5:45 – 6:00 pm	Break	
	6:00 – 7:00 pm	Reception - Willard Hotel, Crystal Room	
	7:00 – 9:00 pm	Dinner - Willard Hotel, Crystal Room	Remarks: Rep. Johnny Isakson (R-GA); Address: Gov. Jim Hodges (SC)
June 7	8:00 – 8:15 am	Response Strategy Overview	Jane Bullock, FEMA
	8:15 – 10:15 am	3rd Panel Discussion	Response Strategies
	10:15 – 10:45 am	Break	
	10:45 – 11:45 am	3rd Panel (continued)	Response Strategies
	12:00 – 1:30 pm	Forum Luncheon	Gen. John Kelly, NWS; Dr. John Clizbe, ARC
	1:45 – 4:45 pm	Plenary Discussion	Findings & Recommendations
	4:45 – 5:00 pm	Closing Remarks	Greenfield

THE WEATHER CHANNEL FORUM

POLICY ISSUES IN HURRICANE PREPAREDNESS AND RESPONSE

A workshop developed by the

ATMOSPHERIC POLICY PROGRAM
AMERICAN METEOROLOGICAL SOCIETY

SPEAKERS

Opening Address	**Dr. D. James Baker, Under Secretary of Commerce for Oceans and Atmosphere**
Keynote Speech	**James Lee Witt, Director, FEMA**
Dinner Speakers	**Rep. Johnny Isakson (R-GA)** **Gov. Jim Hodges (D-SC)**
Luncheon Speakers	**Gen. John Kelly, NWS/NOAA; Dr. John Clizbe, ARC**

PANELS

1. Forecast Considerations	Moderator: Rick Anthes, President, UCAR; Panelists: Russell Elsberry (Professor, Naval Postgraduate School); T.N. Krishnamurti (Professor, FSU); Steve Lyons (Tropical Specialist, TWC); Max Mayfield (Director, National Hurricane Center, NOAA)
2. Media Issues	Moderator: Larry Grossman, Former President, NBC News; Panelists: Ronnie Goodstein (Director of Public Relations, Pinellas County, FL); John Hope (Hurricane Specialist, TWC); Robert Ryan (Chief Meteorologist, WRC/NBC, Washington, DC); Jack Williams (Weather Editor, USATODAY.com)
3. Response Strategies	Moderator: John Copenhaver, Director, FEMA Region IV; Panelists: Jay Baker (Professor, FSU); Walter Maestri (Director, Jeff. Parish, La. Dept. of Emerg. Mgt.); Eric Tolbert (Director, NC Emerg. Preparedness Division.); John Wilson (Director of Public Safety, Lee County, FL)
Plenary Moderator	Richard E. Hallgren, Former Director, NWS; Executive Director Emeritus, AMS
Rapporteurs	James L. Rasmussen, Former Director, Environmental Research Laboratories, NOAA Mark E. Fernau, Technical Editor, AMS

APPENDIX D - LIST OF ACRONYMS

AMS	American Meteorological Society
FEMA	Federal Emergency Management Agency
NAB	National Association of Broadcasters
NCEP	National Centers for Environmental Prediction
NHC	National Hurricane Center
NOAA	National Oceanic and Atmospheric Administration
NWS	National Weather Service
RTNDA	Radio and Television News Directors Association
TWC	The Weather Channel, Inc.
USWRP	U.S. Weather Research Program
WCM	Warning Coordination Meteorologist