The *Grand Challenges for Disaster Reduction* outlines a ten-year strategy crafted by the National Science and Technology Council's Subcommittee on Disaster Reduction (SDR). It sets forth six Grand Challenges that, when addressed, will enhance community resilience to disasters and thus create a more disaster-resilient Nation. These Grand Challenges require sustained Federal investment as well as collaborations with state and local governments, professional societies and trade associations, the private sector, academia, and the international community to successfully transfer disaster reduction science and technology into common use.

To meet these Challenges, the SDR has identified priority science and technology interagency implementation actions by hazard that build upon ongoing efforts. Addressing these implementation actions will improve America's capacity to prevent and recover from disasters, thus fulfilling our Nation's commitment to reducing the impacts of all hazards and enhancing the safety and economic well-being of every individual and community. This is the hurricane-specific implementation plan. See also **sdr.gov** for other hazard-specific implementation plans.

What is at Stake?

DEFINITION AND BACKGROUND. A hurricane develops when a tropical storm intensifies and winds reach 74 miles per hour. On average, there are six hurricanes in the Atlantic Ocean each year during hurricane season (June–November). Over a three-year period, approximately five hurricanes strike the United States coastline between Texas and Maine.[1] When hurricanes move onto land, the heavy rain, strong winds, and waves can damage communication, transportation, and utility infrastructures.

IMPACTS. According to FEMA, hurricanes account for seven of the top ten most costly disasters in United States history. The state of Florida was struck by four major hurricanes in 2004 with losses totaling $42 billion.[2] This was considerably more than the losses resulting from Hurricane Andrew in 1992, which had set the standard for single hurricane losses in the United States. The 2005 hurricane season included 27 named storms and 15 hurricanes, 6 of which struck the United States.[3]

The losses due to Hurricanes Katrina, Rita, and Wilma in 2005 are still being determined, but early estimates place damages from Hurricanes Katrina and Rita upwards of $150 billion.[4]

This dwarfs the losses due to any disaster in the United States and approaches a significant percentage of the United States Gross Domestic Product.

Recent storms demonstrated how hurricanes can affect the entire United States and its economy, from energy to raw materials to food supplies. Minimizing the impacts of hurricanes depends upon constant, sound land-use planning and development decisions as well as effective response immediately prior to storm landfall. The multi-agency U.S. Weather Research Program, authorized by Congress in 1994, placed the improvement of hurricane forecasts as its highest priority in 1997. Since then, the program has significantly improved hurricane track forecasts and how those forecasts and warnings are communicated to individuals. In 2004, Congress recognized the unique role of wind hazards and created an Interagency Working Group consisting of NIST, NSF, NOAA, and FEMA to plan, manage, and coordinate windstorm impact reduction for the Nation.

HURRICANE

A report of the Subcommittee on Disaster Reduction
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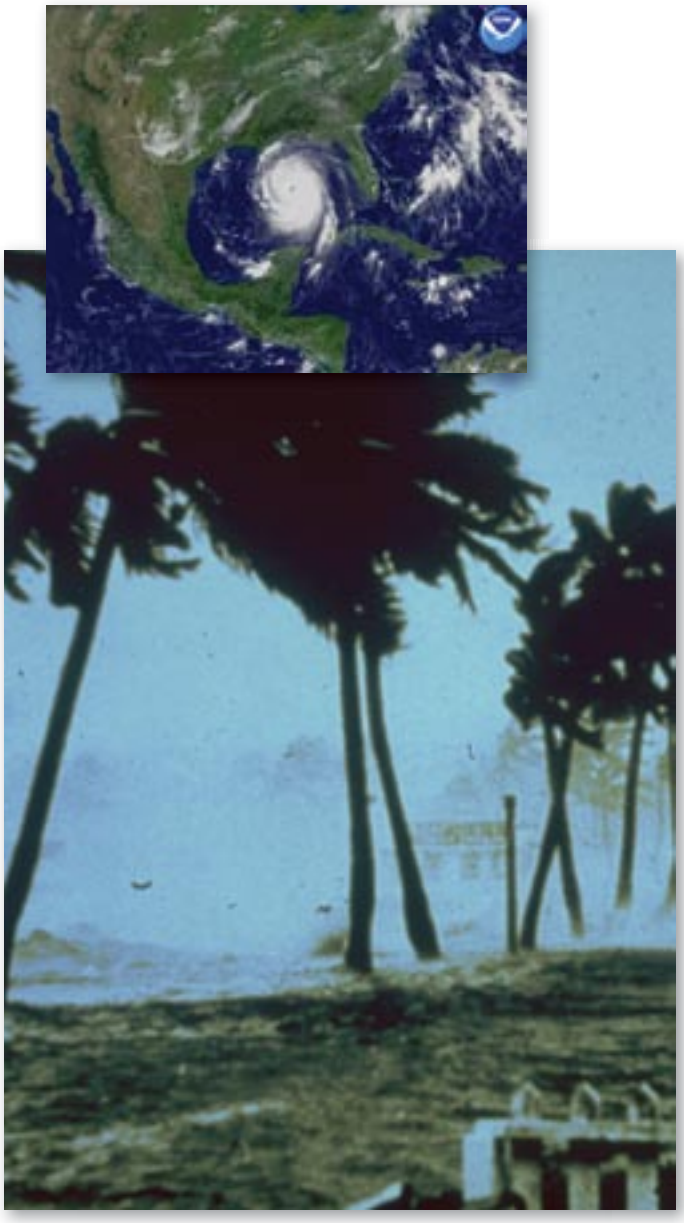
Grand Challenges for Disaster Reduction: Priority Interagency Hurricane Implementation Actions

GRAND CHALLENGE #1: Provide hazard and disaster information where and when it is needed.

- ■ Improve mechanisms for information exchange between Federal agencies involved in wind hazard reduction, state and local decision makers, and non-Federal stakeholders;
- ➤ Assess and fill gaps in observations, training, technology, capacity, information, and organization on the Federal, state, and local level;
- ➤ Accelerate development and deployment of integrated Earth observing systems, models, and forecast platforms to warn those who are directly at risk.



GRAND CHALLENGE #2: Understand the natural processes that produce hazards.

- ■ Build on accomplishments of the U.S. Weather Research Program to accelerate improvements in hurricane forecasts;
- ➤ Improve global coverage of scatterometer and radiometer space-based remote sensing systems;
- ➤ Develop high-resolution global and regional cloud-resolving forecast models to simulate and forecast hurricane structure, track, and intensity;
- ➤ Improve understanding and modeling of atmosphere-ocean interactions; understand the physics of hurricane genesis;
- ➤ Improve airborne observing capabilities, including the use of remotely piloted vehicles;
- ➤ Increase density of and strengthen *in situ* and surface-based remote sensing platforms over land and ocean and develop mobile platforms and networks to opportunistically gather data needed for post-storm assessment and model enhancements;
- ◆ Develop sophisticated decision support systems (e.g., HAZUS) for risk assessment and impact prediction.

GRAND CHALLENGE #3: Develop hazard mitigation strategies and technologies.

- ■ Exchange information between all levels of government about interpreting hurricane risk assessments, forecasts, building codes and best building practices, protection of critical infrastructure, and public education on risk, response, and mitigation. Pay particular attention to individuals who are often at greatest risk, such as the economically, socially, and medically disadvantaged;
- ➤ Develop a comprehensive wind storm climatology to provide the technical basis for improved building codes and predictive numerical engineering models of wind effects on structures;
- ➤ Identify expected inter-annual, decadal, and multi-decadal changes in hurricane activity and intensity;
- ➤ Develop improved methods for assessing risk, social vulnerability, and ecosystem impacts to inform mitigation choices in coastal areas.

GRAND CHALLENGE #4: Reduce the vulnerability of infrastructure.

- ➤ Examine the interaction between wind, storm surge, and shallow water waves to determine the impact on building foundations, critical infrastructure, and vegetation;
- ➤ Assess the vulnerability of critical communication, transportation infrastructure, and essential facilities to hurricanes;

Key: ■ Short Term Action (1-2 years) ➤ Medium Term Action (2-5 years) ◆ Long Term Effort (5+ years)

- ➤ Develop an improved loss estimation modeling tool (e.g., HAZUS);
- ◆ Create robust and storm-ready communication systems, essential facilities, and transportation infrastructure.

GRAND CHALLENGE #5: **Assess disaster resilience.**

- ■ Assess structural and non-structural hurricane protection, including natural barriers, levees, and land use;
- ■ Support intelligent community planning and investment strategies and protect natural resources with comprehensive risk assessments;
- ■ Develop comprehensive pre-event recovery plans;
- ➤ Assess response and recovery of terrestrial and coastal ecosystems to hurricane damage.

GRAND CHALLENGE #6: **Promote risk-wise behavior.**

- ■ Support social science research on individual, organizational, and community responses to disaster warnings;
- ■ Identify common characteristics of risk-wise behavior and factors facilitating effective warning compliance;
- ■ Identify obstructions to the most effective communication of risk from time scales of hours before landfall to decades in the future;
- ■ Promote individual understanding of forecast and warning statements—in particular, an understanding of the uncertainty in this information—and encourage appropriate actions;
- ➤ Facilitate more effective communication and use of communication systems (i.e., direct automated calls to those at risk) to improve public understanding of hurricane risks, mitigation procedures, and evacuation procedures;
- ◆ Improve development of appropriate response, contingency, and evacuation community plans based on knowledge of extreme weather events derived from long-term data collection and analysis.

Key: ■ Short Term Action (1-2 years) ➤ Medium Term Action (2-5 years) ◆ Long Term Effort (5+ years)

Expected Benefits: Creating a More Disaster-Resilient America

Fulfilling this hurricane-specific implementation plan will create a more disaster-resilient America. Specifically:

Relevant hazards are recognized and understood. Combined assessment methods will allow better understanding of structural, social, and economic impacts of hurricanes.

Communities at risk know when a hazard event is imminent. Through improved observation technologies and improved modeling capabilities, forecasters will have the necessary information to provide accurate and understandable forecasts of hurricane track, intensity/structure, sea state/waves, storm surge, winds, precipitation, flooding, and inundation up to 5 days prior to landfall. This improved capability will lead to improved warning accuracy and lead time and more efficient and effective preparedness, including evacuation.

Individuals at risk are safe from hazards. The coordinated distribution of information about risk and preparedness combined with effective decision-making tools will lead to more timely and accurate warnings as well as appropriate and efficient evacuation.

Disaster-resilient communities experience minimum disruption to life and economy after a hazard event has passed. New, more accurate methods for understanding and assessing risk perception and risk communication including the utilization and effectiveness of non-structural mitigation measures and improved structural design will make communities more disaster resilient.

Acronyms

FEMA	Federal Emergency Management Agency
HAZUS	Hazards United States Loss Estimation
NIST	National Institute of Standards and Technology
NOAA	National Oceanic and Atmospheric Administration
NSF	National Science Foundation

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4. Louisiana Recovery Authority. 2007. Progress Report: December 2007. Available at **http://lra.louisiana.gov/assets/quarterlyreport/LRAQuarterlyReportDecember07.pdf**