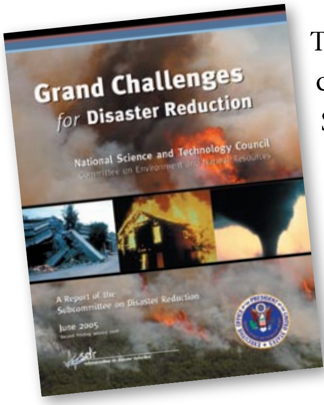
WINTER STORM



The *Grand Challenges for Disaster Reduction* is 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 winter storm-specific implementation plan. See also **sdr.gov** for other hazard-specific implementation plans.

What is at Stake?

DEFINITION AND BACKGROUND. Each year, nearly every state in the United States faces the hazards of winter weather, heavy snow and rain, freezing rain, strong winds, and cold temperatures. Despite the societal and economic impacts, the natural processes that produce severe winter weather and its effects are not well understood. Real-time measurements of the structure and composition of clouds, which are important for understanding the processes producing precipitation, do not exist. Techniques for measuring snow and snowfall depend solely on manual observations, and the resulting datasets are often incomplete and inaccurate. In fact, two different datasets of weather-related mortality report opposite findings. One dataset (the National Climatic Data Center's Storm Data) records more heat-related deaths per year than cold-related deaths, whereas another dataset (the National Center for Health Statistics Compressed Mortality Database) records the opposite, with nearly four times the number of cold-related deaths than heat-related deaths.[1]

IMPACTS. Currently, forecasting winter weather is difficult and high-risk because the same weather event occurring at different times of the day can produce drastically different societal results. For example, an inch of wet snow during rush hour on a weeknight will produce a dramatically different impact than an inch of wet snow on Saturday night. Also, imprecise winter weather

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An element of the National Science and Technology Council predictions lead to expensive, reactive economic accommodation of winter weather rather than a more proactive economic stance that could minimize costs.

Weather information providers and consumers have not embraced a probabilistic approach to these forecasting challenges that would help significantly decrease the nearly 7,000 deaths, 600,000 injuries, and 1.4 million accidents a year that occur due to adverse winter driving conditions, by extending winter weather watch and warning lead times.[2]

Grand Challenges for Disaster Reduction: Priority Interagency Winter Storm Implementation Actions

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

- ■ Assess and fill gaps in observations, training, technology, capacity, and organization that may prohibit efficient exchange of information;

- ■ Establish a depository for winter weather data in a common data format;
- ➤ Provide accurate identification of precipitation type and area of occurrence to within 10 km (6 miles) resolution to emergency managers and response personnel;
- ➤ Develop GIS-data-based, integrated weather information, road availability information, satellite tracking, satellite delivery, and interaction to support an integrated winter weather decision support system.

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

- ■ Understand the transition region between rain and snow by researching the thermodynamic, dynamic, and microphysical environment;
- ➤ Measure precipitation at the surface and aloft, from multi-wavelength polarization radar, from moisture information in the transition zone, and vertical air motion;
- ➤ Develop 36-hour geo-reference forecast for counties that describes the probability of severe winter weather;
- ➤ Deploy networks of automatic snow sensors to measure liquid equivalent in real time;
- ➤ Develop new remote-sensing and *in situ* techniques for measuring the constituent particles inside clouds, and lower-atmospheric temperature and moisture fields;
- ➤ Develop flexible and adaptable decision support tools based on radar/satellite/*in situ* observations that, through joint data assimilation, provide critical information on cloud microphysics,

Key: ■ Short Term Action (1-2 years) ➤ Medium Term Action (2-5 years) ◆ Long Term Effort (5+ years) rain/freezing/frozen precipitation, banded structures, orographic influences, and spatial patterns and their evolution;

➤ Develop accurate quantitative precipitation forecasts, especially for freezing rain and snow accumulations, which use improved observational, assimilation, and modeling techniques (e.g., space resolution observations of atmospheric pressure).

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

■ Understand social and economic barriers to and incentives for adoption of mitigation strategies and winter storm preparations;

◆ Expand winter storm climatologies to provide improved engineering standards for ice, wind, and snow on structures (e.g., buildings and communications, electricity, gas, sewage, transportation and water infrastructure).

GRAND CHALLENGE #4: Reduce the vulnerability of infrastructure.

■ Educate individuals and emergency managers about the varying impacts of winter weather on critical infrastructure based on specific meteorological and sociological parameters (e.g., time of day, day of week, urban vs. rural, surface temperature);

➤ Develop protocols and standards for rapid repair and restoration of critical infrastructure and other essential facilities subjected to wind, snow, and ice loads;

➤ Model the potential effects of severe winter weather on critical infrastructure and essential facilities in advance of storms and immediately after to predict and reduce vulnerability in the short-term and long-term;

◆ Develop improved engineering standards, smarter transportation systems, more resilient critical infrastructure and essential facilities in addition to cost-effective technology to ensure that these facilities maintain robust operations during severe winter weather.

GRAND CHALLENGE #5: Assess disaster resilience.

■ Develop community response, contingency, and evacuation plans based on knowledge of extreme weather events derived from long-term data analysis;

■ Coordinate inter-agency, detailed post-storm assessment of damage, injuries, and deaths;

■ Develop flexible and effective mitigation plans for transportation infrastructure and public health preparedness.

GRAND CHALLENGE #6: Promote risk-wise behavior.

■ Improve individual understanding of probabilistic forecasts through a coordinated national outreach effort;

■ Improve education and outreach at the individual (e.g., automated calls to those at risk), community, state, and Federal levels;

■ Develop a weather communication system for transportation systems (e.g., weather alerts along interstates, smart highways);

■ Deploy a seamless suite of reliable and accurate probabilistic winter-weather forecasts, warnings (0–12 hours), watches (12–72 hours), weekly outlooks (3–8 days), and seasonal outlooks.

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 winter storm-specific implementation plan will create a more disaster-resilient America. Specifically:

Relevant hazards are recognized and understood. Accurate regional winter weather climatologies will include probabilities of ice storms and blizzards to enhance public awareness of weather hazard risks.

Communities at risk know when a hazard event is imminent. More precise, detailed forecasting for snow, sleet and/or freezing rain in each community, neighborhood, and specific street addresses will yield better, more actionable warnings. More accurate winter weather watches and warnings can be issued with more time to prepare and mitigate.

Individuals at risk are safe from hazards. Standards and technologies will enable cost-effective, state-of-the-art winter storm resilient provisions to be adopted as part of state and local building codes and improved resilient design of transportation systems.

Disaster-resilient communities experience minimum disruption to life and economy after a hazard event has passed. Accurate, localized predictions of winter weather impacts will offer significant payoffs to maintain infrastructure and lifelines services for communities with minimal interruption.

References

1. Dixon, P.G., D.M. Brommer, B.C. Hedquist, A.J. Kalkstein, G.B. Goodrich, J.C. Walter, C.C. Dickerson, S.J. Penny, and R.S. Cerveny, 2005: Heat Mortality Versus Cold Mortality: A Study of Conflicting Databases in the United States. Bull. Amer. Meteor. Soc., 86, 937–943.
2. **http://www.publicaffairs.noaa.gov/releases2005/jul05/noaa05-091.html**