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 heat wave-specific implementation plan. See also **sdr.gov** for other hazard-specific implementation plans.

What is at Stake?

DEFINITION AND BACKGROUND. A heat wave is a prolonged period of warm season temperatures well above normal for the area, often accompanied by high humidity. Heat waves can persist from a couple of days to several weeks and are often accompanied by periods of little or no rain and, in cities, by poor air quality. Heat waves are among the most deadly of all weather events.

IMPACTS. Although extreme events such as hurricanes, tornadoes, and floods make headlines for widespread physical destruction and heavy loss of life, more than 8,900 deaths were directly attributed to excessive heat from 1979 to 2002 in the United States[1] and thousands more died as a result of heat-related causes.[2] In the summer of 1980, approximately 1,700 deaths were directly attributed to persistent and oppressive heat that affected the East and Midwest. The Midwest heat wave of 1995 killed at least 465 people in Chicago alone.[3]

Heat wave impacts are widespread. While a large number of deaths may not occur in a single city every year, the cumulative impacts across broad regions over several days to weeks can result in heavy loss of life.

In an average year, 175 Americans die from the direct effects of extreme heat[4] due to a combination of factors such as failure to take adequate precautions, high humidity, lack of adequate ventilation or air conditioning, poor health, and old age. Many more hundreds of deaths are associated with excessive heat attributed to heart attack, stroke, and also respiratory stress. Most deaths occur in urban areas where concrete, asphalt, and physical structures raise temperatures in urban heat islands, and nighttime temperatures remain above average.

Heat waves also impact farming and ranching through loss of cattle and other livestock. The 1999 drought in the United States, associated with unusually warm temperatures, led to farm net income losses of approximately $1.35 billion.[5] About 25 percent of the United States' harvested cropland and 32 percent of the pastureland were affected. Transportation is impacted by highway and railway buckling, and mechanical failures to trucks and railroad locomotives. Heat waves also can lead to water and electricity shortages and to severe and often extensive wildfires.

HEAT WAVE

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Grand Challenges for Disaster Reduction: Priority Interagency Heat Wave Implementation Actions

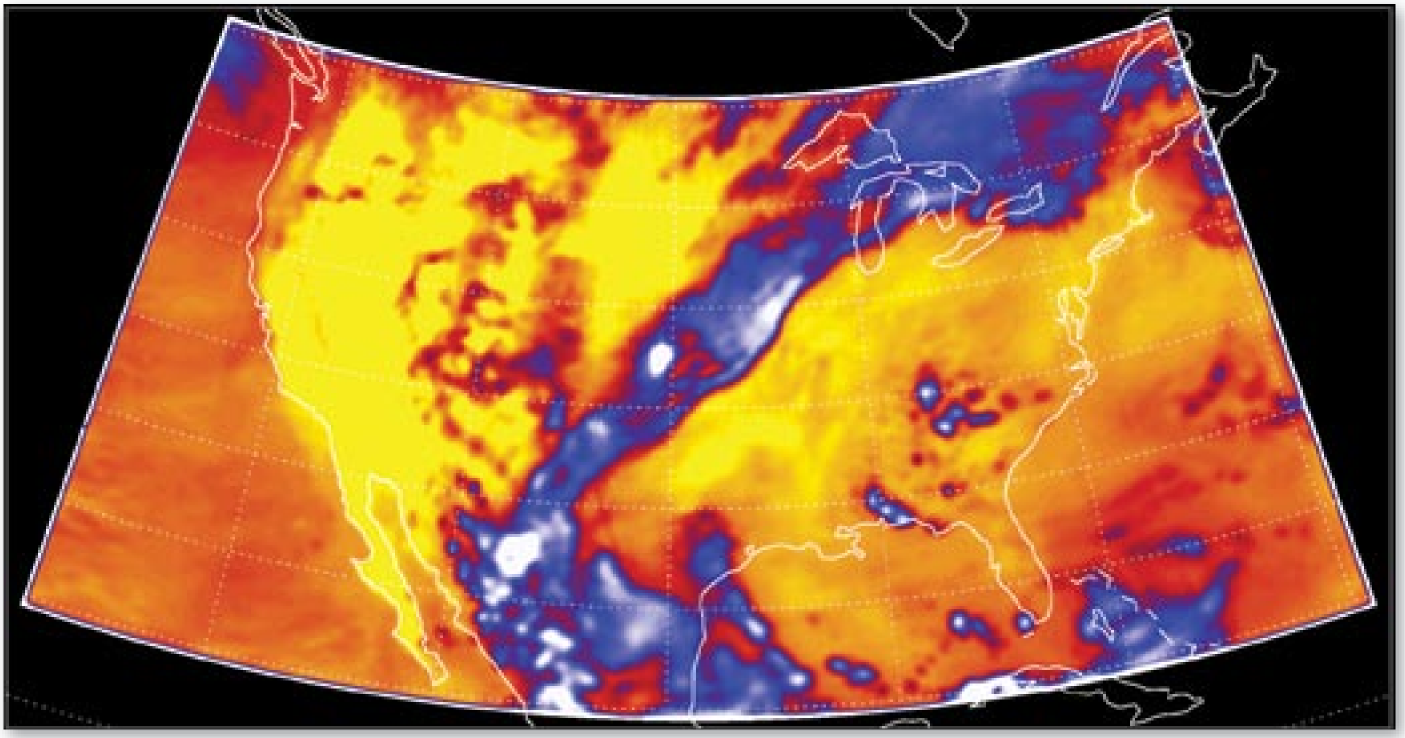
GRAND CHALLENGE #1: Provide hazard and disaster information where and when it is needed.

- ➤ Through advanced communication technology, improve reporting timeliness and accessibility to surface meteorological observations essential to monitoring and forecasting heat wave severity in urban and rural areas of the country;
- ➤ Assess and fill gaps in observations, training, technology, capacity, and organization that may prohibit efficient communication of heat wave forecasts;
- ➤ Provide near real-time reporting of weather conditions to support heat wave monitoring and forecasting through a fully integrated Federal-to-local network of surface observing systems;
- ➤ Improve forecast accuracy of daily maximum temperature by 0.6° C (1.0º F) to support energy production and delivery;
- ➤ Create monitoring and assessment tools for identifying location-specific conditions that are likely to be life threatening to at-risk individuals (e.g., Operational Heat Health Warning System for every National Weather Service forecast area in the United States, increasing the number of Weather Forecast Offices with the capability to use this system from the current 16 to over 120).

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

- ■ Develop heat wave climate indices that can be used in anticipating future heat wave events and monitoring long-term heat wave event changes based upon climate;
- ■ Identify the amplification of high-pressure areas, the roles of phenomena such as the El Niño-Southern Oscillation, and micro-scale influences that can moderate or exacerbate the severity of a heat wave;
- ➤ Improve mid- and long-range models and the accuracy of forecasted conditions that affect human health, agriculture, transportation, and power distribution.

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



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

- ■ Identify at-risk individuals, establish responsive health surveillance and alert systems, create a network of social service and support volunteers, establish infrastructure such as cooling locations/ shelters and telephone help-lines, and institute other response mechanisms to ensure essential life-saving actions are provided when needed;
- ➤ Use meteorological thresholds for each community that identify conditions conducive to the deterioration of human health by applying the synoptic air mass classification approach for heat wave assessment and forecasting.

GRAND CHALLENGE #4: Reduce the vulnerability of infrastructure.

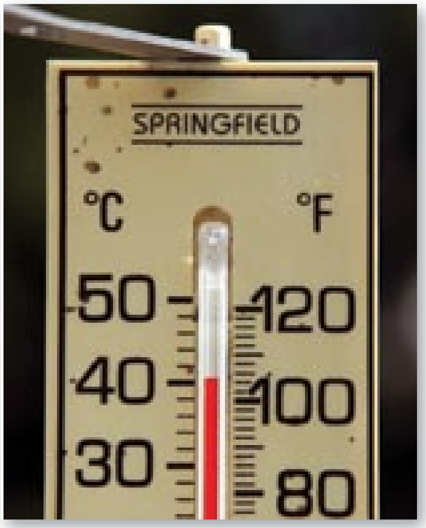
- ◆ Provide a technical basis for revised standards and codes that integrate local climatological and meteorological knowledge to improve standards for the built environment, improve safety, and increase power distribution infrastructure, railway, roadway and pipeline resistance to excessive heat.

GRAND CHALLENGE #5: Assess disaster resilience.

- ■ Study outcomes of past heat waves to distinguish effective and ineffective mitigation and response strategies and technologies;
- ■ Complete risk assessments for at-risk populations in each community.

GRAND CHALLENGE #6: Promote risk-wise behavior.

- ■ Expand the forecast areas for heat warning systems (e.g., Heat Health Warning System);
- ■ Improve individual, community, state, and Federal understanding of the serious risks associated with excessive heat and the potential for human health crises when extreme heat events occur;
- ■ Emphasize the danger signs for heat-related illnesses;
- ◆ Deploy a seamless suite of reliable and accurate heat wave forecast products to support 10 to 14-day advance notification.



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 heat wave-specific implementation plan will create a more disaster-resilient America. Specifically:

Relevant hazards are recognized and understood. Through application of local climatology, individuals are aware of the potential for heat waves in their region.

Communities at risk know when a hazard event is imminent. A national heat health warning system will identify community-specific conditions that threaten individual health and provide improved notification and warning to at-risk individuals.

Individuals at risk are safe from hazards. Public/private partnerships will foster outreach to at-risk individuals and a ready-public based on improved mid- to long-term forecasting of heat wave episodes.

Disaster-resilient communities experience minimum disruption to life and economy after a hazard event has passed. New technologies will be employed to safeguard power distribution, roads, rails, aviation, ports, and pipelines during heat waves. Individuals and businesses can plan their energy usage more effectively.

References

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