

Extreme Cold Temperature Outbreaks: A Call to Action for Better Preparation

A Best Practice Statement of the American Meteorological Society
(Adopted by the AMS Council on 20 December 2021)

A Call to Action

The cascading impacts brought by the February 2021 Arctic cold outbreak across Texas and much of the central United States demonstrate how compound disasters can quickly occur in the absence of adequate preparation by businesses (specifically essential services), communities, and individuals. The extreme cold event highlights the need for stronger community resilience should essential services (e.g., water, electricity) fail for extended periods of time. Prolonged Arctic outbreaks will occur again and will find vulnerabilities in critical infrastructure if mitigation and preparedness efforts are not taken. This statement focuses on how local governments, businesses, community organizations, and individuals can contribute to improved preparedness and resilience to Arctic outbreaks to minimize loss of life and damage to property. This statement, however, does not address specific actions for utilities, which goes beyond the scope.

Motivation

As witnessed during February 2021, the unusually prolonged and anomalous subfreezing temperatures in Texas led to an unusually widespread power outage. This power outage resulted in the loss of potable water supplies as well as increased scarcity of food and fuel. Entire communities became uninhabitable when homes were damaged from burst plumbing and shortages of necessities became widespread. The estimated damage to homes and lost economic productivity is likely to exceed \$200 billion, according to a report from the University of Houston's Hobby School of Public Affairs (hereafter referred to as the Hobby Report; see <https://uh.edu/hobby/winter2021/>). This easily matches the losses from Hurricane Harvey (which occurred in 2017). Over 150 Texans lost their lives in this Arctic outbreak with most of them succumbing to carbon monoxide poisoning or hypothermia (Trevizo et al. 2021). According to the Hobby Report (based on 1500 survey participants representing 213 counties), over 70% of surveyed Texas residents lost power, 50% suffered a loss of water, and 31% experienced water damage to their homes. Black, Hispanic, and Asian residents tended to be more vulnerable to carbon monoxide poisonings (Trevizo et al. 2021). Blacks, Hispanics, and Asians also suffered from the cold as they were less likely to go to a warm shelter or find alternative means of heating their homes (Ura and Garnham 2021).

If no meaningful action is taken to strengthen the infrastructure, power outages will continue as the threat of severe local storms, tropical cyclones, flooding, wildfires, winter storms, and extreme temperatures continues. If the past trend in the number of major power outages continues, the United States will experience even greater hardships both as our dependence on electricity increases and as a changing climate exposes us to more power-disrupting storms (Zamuda et al. 2018). As a result, it is more important than ever to prioritize actions on the part of businesses, community organizations, local governments, and individuals in improving preparedness and resilience. Community preparedness and resilience cannot be attained without all parties involved. Vulnerable populations, including those with lower income, the elderly,

children, those with preexisting health conditions, and those with disabilities, must be protected if a community is to become resilient.

The Arctic outbreak of 2021 motivates AMS to promote best practices that individuals, businesses, and community/government leaders can take to identify vulnerabilities, strengthen preparedness, and minimize loss of life and property should essential services fail in future Arctic outbreaks.

Access to and Response to Forecasts

Residents were accessing information from a variety of sources before and during the Arctic outbreak. The most widely used source, nearly 50% of residents, was local TV, according to the Hobby Report. However, they also received information from local radio and online news sites. One quarter of residents also received alerts from local government websites and city-based text alerts. Neighbors and friends were reaching about 27% of residents. Social media and newspapers appeared to be somewhat less influential but still an important contributor to the information portfolio of residents.

What the residents did to prepare and respond to the Arctic outbreak was a mix of appropriate and worrisome actions. Most residents appropriately purchased extra food and either purchased extra water bottles or stored tap water. Almost half of all residents insulated pipes, and just over a quarter purchased extra batteries. However, a significant number of residents took actions that increased their risk of property damage and injury. Of those who lost power and stayed home, a concerning number used heaters not intended for indoor use: 8% brought in a grill or smoker, 5% used outdoor propane heaters, and 26% used their ovens or cooktops.

Local governments were aware of the vulnerabilities of their residents, and the accurate forecasts by the Weather Enterprise (see <https://www.weather.gov/about/weather-enterprise>) days in advance prompted many communities to mitigate the risks, especially for those with increased vulnerabilities. They included opening more warming centers than typical to account for social distancing requirements) and to increase the number of available beds (e.g., in Fort Worth). Local governments used citizen academy ambassadors such as in Bellaire, Texas, to help check up on vulnerable residents. City and county emergency managers were also actively engaged with National Weather Service briefings.

As the extremely cold air arrived, local governments used social media, automated notification systems and other channels to notify residents of emergency situations. As an example, Fort Worth used their emergency notification system to disseminate a boil water advisory. Vulnerable residents were also proactively checked upon by local governments if they used the State of Texas Emergency Assistant Registry (STEAR), both before and during the Arctic outbreak. When the water supply was threatened, local governments distributed water bottles, such as in Houston, and notified residents to stop the protective action of dripping their faucets as Norman, Oklahoma, officials did when the municipal water pressure dropped to concerning levels.

After-action reviews by local governments and media reports revealed a combination of successful actions and challenges to overcome. The Bellaire after-action review found that deficiencies in integrated databases slowed down incident responses (City of Bellaire 2021). The city of Fort Worth realized that cold reservoirs facilitated water main ruptures; up to 650 ruptures occurred in the city. In San Antonio, Bellaire, and possibly others, insufficient training hindered

city council members and staff. None of the initial reviews revealed plans to anticipate and respond to potential utility failures based on the forecast.

Audience

The first set of best practices below are recommended by AMS for use by local governments, community organizations, and businesses. The second set of best practices are recommended for individuals.

Best practice actions by local governments, community organizations, and businesses

The February 2021 disaster brought on by the Arctic outbreak speaks clearly to the need to anticipate and mitigate the impacts brought on by the weather hazards as well as the loss of essential services in seasonal preparation. The temperature forecasts were accurate, but there was an information gap in converting weather predictions to societal impacts. The best practices identified here represent actions that were successful and are recommended for future winter seasons. To better prepare, local governments, community organizations, and businesses should do the following:

- **Engage with experts.** Engage with the Weather Enterprise in routine exercises and education to train their staff (including elected officials for local governments) and volunteers. Develop and implement plans from several days in advance of, to the arrival of the cold air, regularly adapting their plans to the latest forecast information from the Weather Enterprise. Work with the meteorological, climatological, hydrological, social science, and emergency management personnel, including both practitioners and researchers, to improve identification of hazard vulnerabilities and create plans for mitigation and response.
- **Anticipate potential impacts to critical infrastructure.** Adjust operations based on weather forecasts from the Weather Enterprise. They should utilize the products from a growing impacts-based forecasting sector to anticipate impacts and distribute a more efficient response. Already, forecasts are available from services provided by the Weather Enterprise that take the predicted weather and hydrologic parameters and convert them to potential impacts to utilities.
- **Work to improve outreach.** Proactively reach out to residents/customers on ways to mitigate damage to their homes, such as frozen plumbing, and reduce the risk of fires from heaters.
- **Encourage/incentivize preparedness activities.** Efforts should recognize and respond to needs of individuals with higher vulnerability (e.g., people with lower income, people of color, and those with poor English comprehension).
- **Emphasize dangerous actions.** Find ways to inform individuals on how to reduce the use of dangerous methods to heat homes through education and incentive programs for those with limited finances.
- **Strive to provide NOAA weather radios and/or other alerting capabilities.** Encourage use and/or incentivize the purchase of NOAA Weather Radios, other alerting options such as apps and phone alerts, and carbon monoxide/smoke detectors to residents that may not have the means to acquire and/or install them.

- **Promote civic participation in disaster planning.** Emphasize participation by disadvantaged neighborhoods in programs that are similar to STEAR and develop neighborhood watch groups to check on vulnerable groups (e.g., isolated, access and functional needs).
- **Establish methods for communicating weather risks internally and externally.** Encourage use of multiple sources such as traditional and social media, websites, utility bills, etc.
- **Consider best practices from peers on improving resilience.** An example organization is the Resilient Cities Network (<https://resilientcitiesnetwork.org/>).
- **Include an after-action review and planning for the next season.** Participants in the reviews would include feedback from nongovernmental organizations (NGOs), neighborhood leaders, and business partners.

Best practice actions by individuals

Whereas local governments must focus on community mindedness, residents play their part in making sure they are as resilient as possible with mindfulness toward supporting the community. The steps toward greater resilience in extreme cold include the following:

- **Build an emergency kit.** The kit should be made portable enough to take in case of evacuation. Kits should include items needed for basic survival, communication, cash, pet care, and entertainment. The sites Ready.gov (<https://www.ready.gov/kit>), CDC.gov (<https://www.cdc.gov/disasters/winter/guide.html>), and the American Red Cross (<https://www.redcross.org/get-help/how-to-prepare-for-emergencies/survival-kit-supplies.html>) provide an excellent list of items to include in a kit. Make sure to include cold weather protection in the kit such as emergency blankets, and keep perishable items fresh, like batteries.
- **Rely on multiple sources of weather and emergency communication.** Extreme heat and Arctic outbreaks are some of the most predictable hazards where the National Weather Service and commercial weather providers can give multiple days of lead time. Hazard information can greatly mitigate damage to property and life when used properly. The NWS explains their products and suggested actions to take in their Cold Weather Safety site (<https://www.weather.gov/safety/cold>). Residents should plan to receive more than one form of communication to ensure they can take timely action when the potential for communications breakdowns are at their greatest. Examples include NOAA Weather Radio, wireless emergency alerts, and commercial alerts via phone calls, text messages, or apps. Some communities provide automatic notification services to send urgent information which individuals can sign up for by checking with local emergency management or government pages. Last, many communities have check-in programs, like STEAR, to check on the more vulnerable residents.
- **Install and regularly check smoke and carbon monoxide detectors.** There are several websites with information on how to detect and avoid carbon monoxide buildup. The National Fire Protection Association (<https://www.nfpa.org/Public-Education/Fire-causes-and-risks/Top-fire-causes/Heating>) has an excellent site for tips on avoiding fires. FEMA provides tips

(https://www.usfa.fema.gov/prevention/outreach/carbon_monoxide.html) on detecting and avoiding carbon monoxide. Ready.gov provides more information on safely weathering power outages (<https://www.ready.gov/power-outages>).

- **Mitigate plumbing damage.** When the power goes out, water lines in homes may freeze resulting in inadequate shelter. There are tips available on how to mitigate damage due to frozen plumbing from several sources, including the American Red Cross (<https://www.redcross.org/get-help/how-to-prepare-for-emergencies/types-of-emergencies/winter-storm/frozen-pipes.html>) and Consumer Reports (<https://www.consumerreports.org/home-maintenance-repairs/how-to-keep-pipes-from-freezing-a2277945570/>).
- **Be community minded.** Simply checking up on neighbors creates a more resilient neighborhood. When residents plan for winter weather, they increase the likelihood of building extra capacity to be able to help their neighbors with supplies and information. The most vulnerable neighbors include those who live alone, have health issues, have limited income, lack nearby relatives or friends, and are people of color. Also, communities may ask residents to take action to save energy and water. The degree that residents work together to conserve limited resources may determine whether a community can prevent a wider disaster.

References

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[This statement is considered in force until December 2026 unless superseded by a new statement issued by the AMS Council before this date]