



Winter weather resilience: Mitigating risks and minimizing losses via IoT sensor technologies

HSB, a Munich Re company, is a technology-driven company built on a foundation of specialty insurance, engineering, and technology, all working together to drive innovation in a modern world.

Overview

by Robin Luo, Senior Vice President, ATS

The climate has changed at an ever-accelerating pace. The way we experience climate change is through the weather and, across the board, individual weather events are becoming more demonstrably extreme. No one needs to tell us this: We all have direct personal experience of weather events that go way beyond the norm. Be they the intense fire-promoting droughts out West and — a recent development — on the East Coast, or the “bomb cyclone” rain events that have recently become seasonal occurrences in the Pacific Northwest, the weather has become a major, regular disruptor of day-to-day life. And it seems they are intensifying both in magnitude and frequency in comparison to historical precedent.

Severe winter weather takes many forms, from telegenic ice-storms and blizzards to punishing “arctic blasts,” multi-day freeze events that, while less newsworthy, wreak havoc on infrastructure, commerce, and daily life. While a new generation of prediction models, like Google’s GenCast¹, are enabling greater accuracy in forecasting, we’re still only able to see about 15 days into the future with any reasonable expectation of reliability. Larger, systemic predictions for winter 2025 center around the La Niña² current in the Pacific, a long-term driver of weather patterns. But the extreme event has become the norm, and we — especially we in the insurance industry — need to work expectations of the anomalous into our risk profiles because we’re on the front line of dealing with

¹ “The New York Times, 4 December 2024, “Google Introduces A.I. Agent That Aces 15-Day Weather Forecasts”. <https://www.nytimes.com/2024/12/04/science/google-ai-weather-forecast.html?searchResultPosition=2>

² National Weather Service 2024-2025 Winter Outlook. <https://www.weather.gov/arx/winter2425outlook>

their effects and bottom-line implications. In this white paper, we will focus on this latter category of events and ways that we, as insurers, can mitigate the risks they pose and minimize the losses they inflict through the deployment of increasingly sophisticated, networked sensor technologies.

Right now, the adoption of these technologies is relatively sparse, and the challenges we face are as much about changing mindset and attitudes as they are technical. One thing is already clear, though: Where these technologies are in place, the results in terms of averted crises (and the associated savings) we believe, have been nothing short of dramatic, as we will discuss below.

Notable recent winter weather events

It is instructive to look at the recent past to develop a sense of the challenges — and opportunities — we might face. In the past two years alone, there have been at **least three anomalous occurrences of widespread, severe winter weather**, each of which carried significant consequences:

– Winter Storm Elliott (December 21-26, 2022):

Elliott was a historic extratropical cyclone (in other words, a weather pattern typical of the summer months that occurred during the winter and brought distinctly wintry weather with it). Straddling the Christmas holiday, it affected nearly every state in the contiguous U.S., including typically warm places like Texas and Florida, imposing severe wind chill conditions on over 110 million people. In the Midwest and Northeast, windchills dipped to 30 degrees below zero (Fahrenheit). Elliott was a major news story — the media covered it extensively. Overall economic losses from the storm (due to business interruptions, repairs, and uninsured damages) were estimated at \$13 billion to \$15 billion; insurers paid out over \$5 billion in claims³. But the story that we were getting, as told through the network of sensors we have in place in customer locations, revealed the often-hidden consequences of a storm like this, and it told this story in real time:

- HSB sensors started detecting alert-worthy freeze conditions first across western states, notably Texas, and then sweeping across to the East Coast.
- Texas was especially hard hit because being a typically “warmer” state, there were fewer protections in place both on an electrical grid level and on a localized insulation level. Activity from our sensors increased by 500% over normal during the storm.
- Over \$15 million in total losses were prevented, based on HSB data. Customers confirmed over \$7 million in these. Significantly, there were no notable losses at sensed sites — the early warnings triggered highly effective preventive actions.
- Because the storm hit over Christmas, many facilities were unoccupied, meaning premises that did not have sensors were at especially high risk.

• Case study — A day school in Colorado:



Loss event

School was closed for an extended period due to holidays. A pipe located in the basement admin office burst and water started gushing out.



Action

After receiving the alerts, the customer went to the school to inspect. They found the issue, shut off the water, cleaned, and vacuumed up the water on the floor. They also called a plumber and scheduled to get the pipe repaired.



Impact

- The location manager stated that the water could have run for 10 days since the school was closed for holiday break. He was glad they had the sensor alert to make them aware of the issue.
- Insurer stated that a full limit loss could occur if water leakage was not alerted until school reopens.



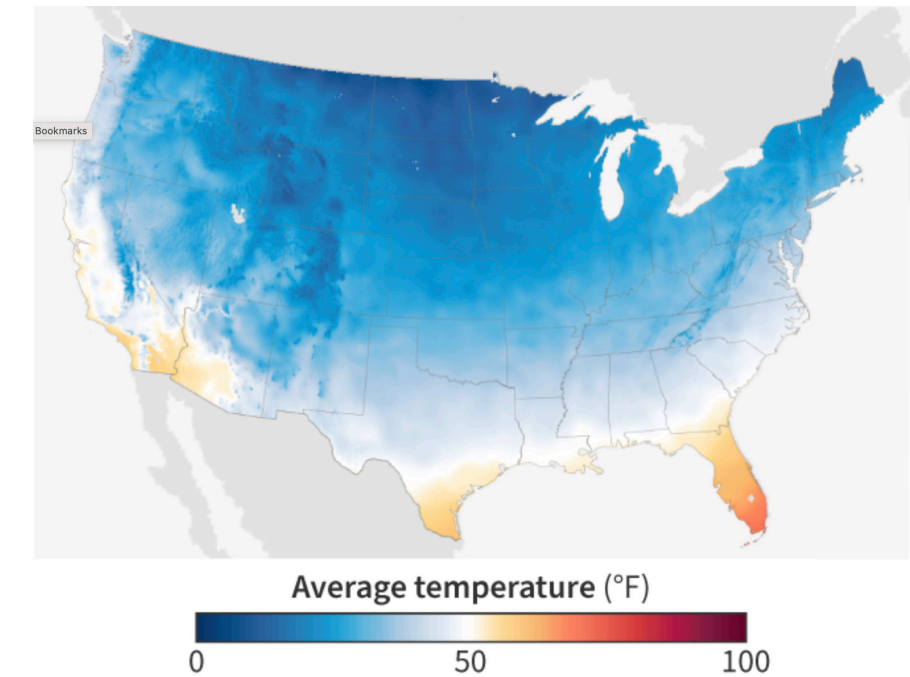
³ Reinsurance News, 29 December 2022, “KCC estimates Winter Storm Elliott insured losses at \$5.4bn”. <https://www.reinsurancene.ws/kcc-estimates-winter-storm-elliott-insured-loss-at-5-4bn/>

– **Arctic Blast I** (January 10-16, 2024):

The Arctic Blast⁴ differed from Elliott in its impact largely due to the fact that it didn’t straddle a major holiday.

- The freeze, attributed to a “polar vortex,” was sudden and extreme. Some places suffered temperatures 40 degrees below normal, with a significant portion of the country recording lows below 0 degrees Fahrenheit.

• **Average temperatures in the continental U.S. for January 2024***



*NOAA Climate.gov Data NCEI

- HSB had an extensive network of leak and freeze sensors deployed on client sites in the affected area, numbering in the tens of thousands. Alert activity increased 400% during the freeze, with approximately 5% of deployed sensors generating actionable alerts. The vast majority (over 70%) of these related specifically to freeze conditions.

– **Case study: Sprinkler leakage at University (Ohio), January 15, 2024**

 Loss event A fire suppression line broke during a very cold night, potentially due to freeze. A large amount of water started to leak into the facility.	 Action After receiving the alerts, the customer went to the school to inspect. They found the issue, shut off the water, cleaned, and vacuumed up the water on the floor. They also called a plumber and scheduled to get the sprinkler pipe repaired.	 Impact – The location manager stated that the water would have run for hours since the building was closed for the evening. He was glad they had the sensor alert to make them aware of the issue. – Insurer stated that a large amount of damage could occur if water leakage was not alerted right way.
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⁴ National Centers for Environmental Information, 8 February 2024, “Assessing the U.S. Climate in January 2024”. <https://www.ncei.noaa.gov/news/national-climate-202401>

– **Arctic Blast II** (February 3-4, 2024):

The second Arctic blast in 2024 — related to the collapse of a polar vortex⁵ — was fast and vicious, bringing punishing cold to the Northeast, particularly New England, where wind chills were over 100 degrees below zero (on Mount Washington).

- On Saturday, February 4, the whole of New England experienced wind chills well below 0 degrees:



- In Maine, which had the highest alert-per-sensor rate, almost one-quarter of all installed sensors triggered warnings, underscoring the importance of regional preparedness.
- Massachusetts saw a **700% increase** in sensor-based alerts, which helped to avert potentially catastrophic disruptions and losses in one of the **country's** biggest educational risk pools.

The role of networked sensor technologies (IoT)

IoT sensor technologies can play a pivotal role in IoT programs to mitigate the effects of severe winter conditions. The effectiveness of these technologies relies on a sophisticated array of **interrelated capabilities** that, in concert, identify adverse conditions, alert relevant parties, and enable the swift actions that prevent costly damages. Some of the most important elements of an effective IoT approach include:

- **High-quality sensors are the foot soldiers of the network.** There are different kinds of sensors to detect water leaks, fluctuations in temperature, and deviations in flow. Above all, sensors must be accurate, durable, and resistant to the extreme instances of the environmental forces they're deployed to measure.
- **Real-time monitoring and alerts**, enabled by continuous data transmission, allow immediate notification of relevant parties via multiple methods, including SMS, email, and mobile apps.
- **Robust connectivity** via Wi-Fi, cellular, and/or LoRaWAN networks, with built-in backup options to ensure redundancy (for example, during power outages).
- **Advanced analytics**, built on predictive algorithms, identify trends and potential failures well in advance; in addition, the insights gleaned over time inform proactive maintenance and risk management.
- **User-friendly interfaces** that feature highly intuitive tools and dashboards and focus attention on the most important, actionable information are bolstered by training and support for end-users.

⁵ Severe Weather Europe, 8 February 2024, "Polar Vortex collapse event is about to unfold, but how will it impact United States weather patterns?" <https://www.severe-weather.eu/global-weather/polar-vortex-collapse-event-2024-february-cold-weather-pattern-shift-united-states-fa/>

The insurance angle

From an **insurance perspective**, the benefits are multiple and significant:

- For the **end customer**, of course, fewer weather-related incidents result in lower (or no) damages and lower costs, as well as circumventing downtime due to lost capacity.
- From the **insurers'** point of view, benefits include:
 - **Reduced claims volume**, enabled by early intervention that identifies adverse conditions well in advance.
 - **Lower operational costs** due to reduced claims and the corresponding savings in resource costs.
 - **Rich data streams and advanced analytics enable deeper insights** into the insurer's overall book; if data reveals better performance — notably reduction of losses — in certain sectors attributable to sensor activity, it might increase their appetite to innovate and take on new lines of business in that sector, as well as honing specific coverage more closely tailored to individual customers' needs.
 - **Increased customer engagement and loyalty** based on proactive alerts, maintenance reminders, and insights into best safety and asset management practices.

Implementing an effective IoT strategy

Networked technology is only part of the solution; without a well-thought-out strategy for rollout and deployment, performance can fall short of expectations. Insurers must tailor their operational models to meet the unique needs of their client bases. Moreover, these technologies often represent a fundamental shift in how insurers and clients interact, requiring significant learning and behavior changes for all parties involved. To ensure the success of an IoT strategy, effective operational models should focus on the following key areas:

- 1 **Secure senior executive sponsorship:** Gain buy-in from senior business unit executives to ensure alignment with strategic goals and organizational priorities.
- 2 **Establish KPIs and operational roles:** Define clear key performance indicators (KPIs) and delineate roles and responsibilities within the organization to drive accountability and performance.
- 3 **Design scalable and ROI-focused solutions:** Develop sensor kits and configurations that prioritize scalability and demonstrate a clear return on investment (ROI).
- 4 **Educate stakeholders through marketing campaigns:** Launch targeted marketing efforts to educate key stakeholders, including customers, agents, and brokers, about the benefits and usage of IoT solutions.
- 5 **Adopt a multi-pronged enrollment strategy:** Implement diverse and flexible approaches to effectively onboard end customers and drive adoption.
- 6 **Streamline installation and activation:** Establish robust installation and activation protocols supported by an effective escalation loop to address challenges promptly.
- 7 **Monitor key metrics via dashboards:** Utilize program dashboards to closely track critical operational metrics and ensure ongoing performance monitoring.
- 8 **Leverage data for insights:** Maximize the value of IoT initiatives by harnessing data and generating actionable insights that enhance decision-making and operational outcomes.

By addressing these elements, insurers can unlock the full potential of IoT technology, transforming their operations and delivering meaningful value to their clients.

What the future holds

The widespread adoption of sensor technologies has gathered steam in recent years, but there is still a long way to go. Effective protection for property owners is contingent not only on the sensors themselves, but also on the collaborative efforts of insurers, property managers, municipalities, and legislators to promote, even mandate, the widespread implementation of these solutions. In addition, we look at the following emerging trends as pointing the way forward:

- **AI-driven predictive maintenance:** Just as sensors can detect adverse conditions in real time (conditions requiring immediate action), they are also able to identify potential weaknesses and problems in systems that require attention long before those adverse conditions occur.
- **Increased integration with IoT platforms** like smart-home systems, providing deeper, more nuanced insights into not only the performance of sensed elements but also their relationship to the broader ecosystem in a home or facility.
- **Enhanced “voice of the customer” monitoring:** Interactions with customers and close observation of risk-mitigation actions they take (often revealed in their interactions with tech interfaces) increasingly become part of the feed, informing the background analytics and insight generation.
- **Tech-enabled integrated insurance products** tailored to customers’ specific needs, providing additional value and, potentially, with enhanced terms and conditions.
- **AI-enabled automation of the claims process:** The ability of sensor networks to identify alertable conditions also enables them to not only identify failures in systems but also to trigger claims automatically should they be warranted. While still in its relative infancy, automated claims promise to revolutionize much of the way that we, as insurers, do business.

Conclusion

The main thing we can predict about winter weather is its inherent unpredictability and the fact that the formerly freakish event has now become the new normal. As such, the need to be able to identify adverse conditions early and take preventive action where possible has become ever more important. A new generation of IoT sensor technologies already exists and enables us to monitor key systems at a granular level, preventing adverse situations before they happen, reducing claims and improving customer satisfaction.

The challenge, however, is to get these technologies out “in the wild” as rapidly as possible. The cultural and organizational challenges are still formidable, and we need to do a better job collectively to make sure that insurers and their customers understand the benefits of pivoting in a more tech-heavy direction.

Winter’s return is inevitable. Now is a perfect time to invest in the proactive solutions that will help ensure a safer and more resilient future.



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Robin leads sensor solutions sales engineering and customer delivery functions at HSB. He started his career at HSB 20 years ago. He has held various positions with increasing responsibilities in the areas of data analytics, underwriting, ceded reinsurance, enterprise risk management, and innovation. Prior to joining HSB, Robin served as the chief electrical engineer on-board of ocean cargo vessels and worked as a commercial engineering manager for WIKA GmbH, a Germany-based sensor automation and instrumentation engineering company.

Robin has a BS in electrical engineering and an MS in statistics and finance. He holds CPCU and ARe designations. He also holds an insurance producer's license and surplus line broker's license in Connecticut.

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