National Oceanic and Atmospheric Administration
U.S. Department of Commerce



NOAA Data, Insurability, and Community Resilience

White Paper

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Executive Summary

Over the last few decades, the U.S. has seen a change in weather patterns, leading to more frequent and severe events. The rising costs of natural disasters are making it harder for insurance companies to accurately price risk, leaving some homeowners and communities more at risk to bear the financial burden of rebuilding.[1]

As traditional insurance models of risk transfer become less viable for certain hazards or regions, innovative insurance solutions that focus on risk prevention and climate resilience are emerging. Central to this shift is the integration of high-resolution weather and climate data from the National Oceanic and Atmospheric Administration (NOAA). NOAA data is the backbone for pricing risk, resilient design standards, and long-term planning; these data will continue to drive innovative solutions and improve upon users' understanding of weather and climate trends into the future.

This paper highlights four regional initiatives where innovative solutions providers are using NOAA data to bridge the gap between risk and resilience:

- **Coastal Flooding (Massachusetts):** Organizations like InnSure are conducting "insurability planning" to help historic coastal towns qualify for coverage by identifying specific structural risks and coordinating regional adaptation actions like building seawalls.
- **Wind & Hail (Alabama):** The Strengthen Alabama Homes program utilizes grants to retrofit roofs to "FORTIFIED" standards, demonstrating that a 1–2% increase in construction costs can significantly decrease insurance premiums and structural failure rates while boosting home sale prices.
- **Hail and Solar Infrastructure (Sunny States):** The company kWh Analytics models hail risks and provides real-time risk mitigation messaging to asset owners to ensure that solar photo-voltaic technologies remain insurable despite evolving weather threats.
- **Wildfire (California & Colorado):** Faura used individualized home risk reports to empower homeowners to harden their properties, resulting in better insurer-customer communication and premium discounts of 20% for proactive residents in some cases.

As intensifying weather patterns challenge traditional insurance models, the protection gap continues to widen. However, regional initiatives demonstrate that bridging this gap is possible through data-driven innovative solutions. For example, as seen in Alabama, insurance companies can reduce their own loss ratios while keeping policyholders covered when homeowners proactively mitigate their risk of roof damage; at the same time, residents receive discounted insurance premiums. The most sustainable communities are those that leverage weather and climate data to harden infrastructure before the next event occurs.

NOAA's authoritative data remains foundational to these efforts. It is critical that NOAA continues to expand its data capabilities and work to help connect users to the authoritative data most useful to them. Active engagement with the insurance industry, especially with boundary organizations, empower them to make data-informed decisions and foster more innovative solutions, ultimately strengthening the country's resilience against evolving climate hazards.

[1] Campbell, S., Torregrosa, D., "Climate Change, Disaster Risk, and Homeowner's Insurance," Congressional Budget Office, August 2024, https://www.cbo.gov/publication/60674#_idTextAnchor069

1. Introduction

Communities build homes to codes and standards that have generally met the needs of their regional climates for multiple decades. Homes in Minnesota, for example, can withstand high snow loads, and homes in Florida are made to withstand winds from some tropical systems. State and local governments enforce the most up-to-date building codes in the U.S.,[2] but many regions—like the South, Mid-Atlantic, Northeast, and Midwest—have infrastructure that predates modern building codes.[3] These structures are more susceptible to damage from the impacts of more frequent and intense weather hazards—particularly those that are in high risk areas, like within floodplains. In recent years, it has become increasingly difficult for residents to afford insurance and for insurers to continue covering these areas. Additionally, as weather patterns shift across the U.S., homes and communities are facing the impacts of flooding, wildfire, wind, and hail, in locations and frequencies that were previously less common in their region.

As the rising costs of home insurance continue, some insurance companies are increasing premium rates or stopping property coverage in certain areas. Communities in these areas risk bearing the cost of repair or rebuilding after a disaster. Homeowners can reduce their risk to some types of hazards by implementing certain measures (e.g., property improvements, infrastructure upgrades, or other resilience measures), but this can be prohibitively expensive, especially in lower-income communities.

NOAA plays a crucial role in helping American homeowners, builders, and insurers understand natural hazard risk. Data from NOAA has been the foundation of insurance financing and decision-making for decades and increasingly plays a role in helping locate where and in what ways communities need resilience measures the most. This paper highlights four examples of innovative collaborations between organizations, insurers, and communities to fortify homes and other infrastructure for the long term and to rebuild with resilience in mind after weather disasters strike.

2.1 Common Definitions

- **Communities:** Neighborhoods, businesses, individuals linked by their physical geography.
- **Insurability:** The eligibility of an individual, property, or area for insurance coverage. This often correlates with risk; something with higher risk may be less insurable. This is not a strict metric and can be subjective.
- **Insurance ecosystem:** Entities involved in the purchasing and distribution of insurance (Table 1).
- **Boundary Organizations:** In this paper, referring to organizations who may not be direct insurance policy providers but who are supporting or providing innovative insurance solutions (i.e., risk-reducing infrastructure measures) to individuals and communities at higher risk for weather-related disasters, aiming to minimize the protection gap (see section 3.2).
- **Protection gap:** The difference between the total economic loss and insured loss from a disaster.
- **Risk transfer:** Methods in which insurance companies take on a portion of the financial risk of damage from homeowners.

[2] Federal Emergency Management Agency, *National Preparedness Report*, December 2023, https://www.fema.gov/sites/default/files/documents/fema_2023-npr.pdf
[3] Federal Emergency Management Agency, *National Preparedness Report.*

2.2 The Rising Cost of Weather and Climate Hazards

The number and cost of weather-related disasters have been rising over time, due in part to the increasing intensity and severity of these events as well as the increases in the number of assets (e.g., homes, businesses, automobiles) at risk.[4] The rise in material wealth, population growth into hazard-prone areas, and aging infrastructure also contribute to this rising cost. Building codes that use weather and climate data from several decades ago may not accurately reflect the risks homeowners are facing considering the current hazards. According to the Insurance Institute for Business & Home Safety (IBHS), in 2024 "less than 35% of Americans live in communities with modern updated codes in place."[5] For example, the American Society of Civil Engineers (ASCE) reports that at least 23 million people in the U.S. reside behind levees, many of whom live in disadvantaged communities and "often lack adequate flood mitigation infrastructure, such as stormwater systems, and frequently suffer from a lack of critical resources such as flood insurance, emergency savings, and access to transportation for evacuation."[6]

The total economic loss from weather and climate-driven events has been increasing since the 1980s, along with the number of disasters totaling one billion dollars in damages or more.[7] The average number of disasters totaling one billion dollars or more in damage per year has risen from three events annually in the 1980s to 20 events annually during the last 10 years (2016-2025).[8] Insurance companies seeking to mitigate their own increasing financial risk amidst these rising damages often increase premiums in high-hazard areas to ensure they can cover losses across their risk portfolio. Consequently, property owners in these areas can face more expensive insurance.[9]

Adopting modern building codes can reduce structural damage from multiple hazards; in fact, a study from the Federal Emergency Management Agency (FEMA) found that "over a 20-year period, cities and counties with modern building codes would avoid at least $32 billion in losses from natural disasters, when compared to jurisdictions without modern building codes."[10] A specific example of reduced damages to infrastructure with modern building codes was recently reported in a study from Hurricane

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[4] Hsiang, S., S. Greenhill, J. Martinich, M. Grasso, R. M. Schuster, L. Barrage, D. B. Diaz, et al. "Economics." In *Fifth National Climate Assessment*, edited by A. R. Crimmins, C. W. Avery, D. R. Easterling, K. E. Kunkel, B. C. Stewart, and T. K. Maycock, chap. 19. Washington, DC: U.S. Global Change Research Program, 2023. https://nca5.climate.us/chapter/19

[5] Insurance Institute for Business & Home Safety, *Rating the States 2024: An Assessment of Residential Building Code and Enforcement Systems for Life Safety and Property Protection in Hurricane-Prone Regions,* Insurance Institute for Business & Home Safety, 2024, https://www.insurancejournal.com/app/uploads/2024/06/Rating-the-States-report.pdf

[6] American Society of Civil Engineers, *A Comprehensive Assessment of America's Infrastructure,* American Society of Civil Engineers, 2025, https://infrastructurereportcard.org/wp-content/uploads/2025/03/Full-Report-2025-Natl-IRC-WEB.pdf

[7] Hsiang, S., "Economics." In *Fifth National Climate Assessment.*

[8] Climate Central, "2025 in Review: U.S. Billion-Dollar Disasters," Climate Central, January 2026, https://www.climatecentral.org/climate-matters/2025-in-review

[9] Government Accountability Office, "Homeowners Insurance:
Premiums Generally Tracked Inflation but Rose More in Disaster-Prone Areas," Report to the Ranking Member Senate Committee on Banking, Housing, and Urban Affairs, February 2026, https://files.gao.gov/reports/GAO-26-107867/index.html

[10] U.S. Department of Homeland Security, *Building Codes Save: A Nationwide Study of Loss Prevention*, Federal Emergency Management Agency, November 2020, https://www.fema.gov/emergency-managers/risk-management/building-science/building-codes-save-study

Ian (2022), which found that homes and buildings built under modern codes (post-2002) had very little structural damage caused by the hurricane compared to homes built prior to 2002.[11]

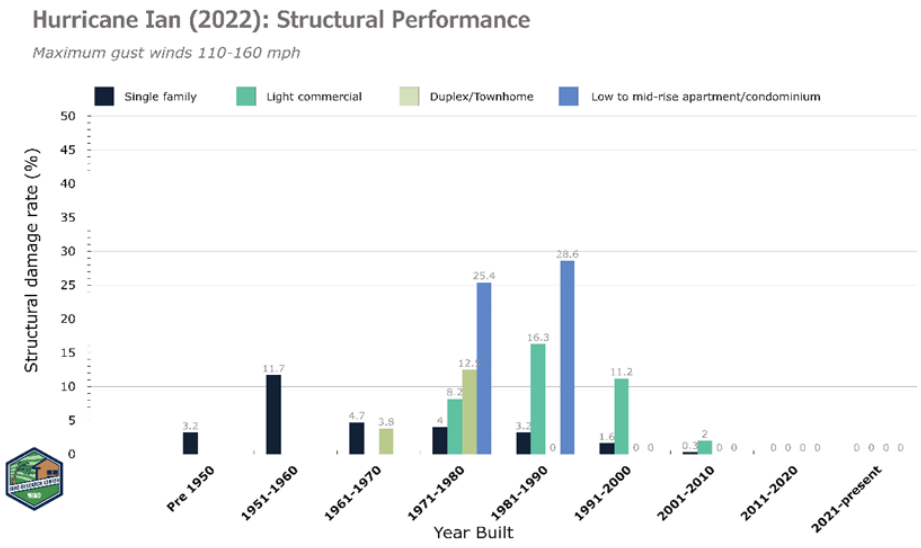


Figure 1. The structural damage rate (percentage of single-family homes, light commercial, and multifamily structures) hit by Hurricane Ian (2022) in Southwest Florida by the year they were built. Source: IBHS

Another factor that plays into the rise in damage associated with severe weather is population density. As urban areas grow in population, a higher volume of personal and commercial property (like homes and businesses) add to the total "pool" of potential loss during each event. Similarly, populations are moving into historically and future risk-prone areas, such as floodplains, where costly events happen more frequently. In the U.S., severe convective storm insured losses have risen by 425% compared to the 2000-2010 average losses, with hail damage contributing to most of this loss.[12,13] At the same time, more people are moving into counties that report the highest damages from hail in the country, particularly in the Great Plains and portions of the Midwest. These counties (highlighted in Figure 2) have seen a 36% increase in the number of housing units since 2000. In the case of hail, factors like population density and growth may be contributing to higher economic loss than changes in hazard frequency and intensity.[14]

[11] Giammanco, I., Newby, E., Pogorzelski, W., Shabanian, M., "Observations of Building Performance in Southwest Florida During Hurricane Ian," Insurance Institute for Business & Home Safety, 2022, https://ibhs1.wpenginepowered.com/wp-content/uploads/HurricaneIan_PartII_Templated.pdf

[12] Bowen, S., Kershner, B., Zheng Ng, J., "Natrual Catastrophe and Climate Report: 2024," Gallagher Re, 2024, https://www.ajg.com/gallagherre/-/media/files/gallagher/gallagherre/news-and-insights/2025/natural-catastrophe-and-climate-report-2025.pdf

[13] Gensini, V., "Extreme events and the insurance industry in a changing climate," *Environmental Research Letters* 21, no. 7 (2026), https://doi.org/10.1088/1748-9326/ae57c2

[14] Bowen, S., "Natural Catastrophe and Climate Report: 2024."

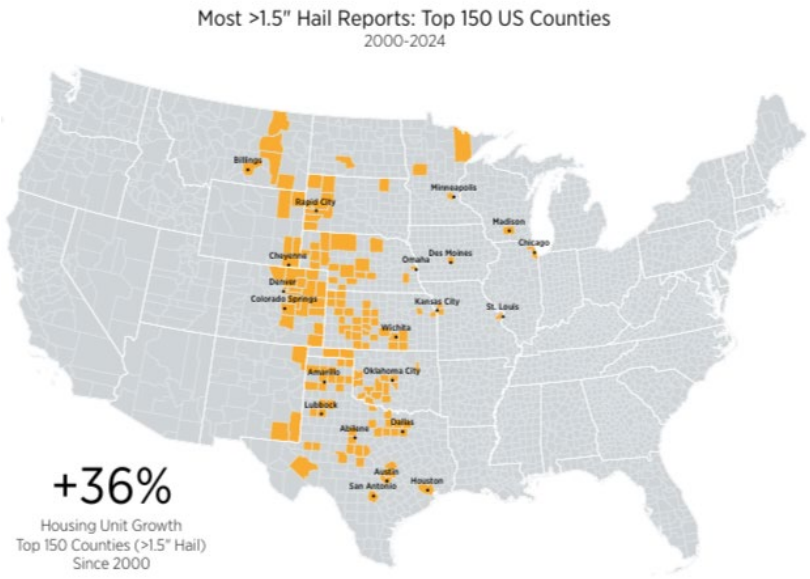


Figure 2. Top 150 U.S. counties by reported hail damage between 2000-2024.
Source: Gallagher Re

In part due to the rising cost of weather-related disasters and the trends in insurance affordability, the difference between the total economic loss and insured loss from a disaster—also known as the **"protection gap"**—has grown, meaning that more and more communities are facing the brunt of the cost to rebuild after a disaster. In 2024 for example, only 52% of losses from natural disasters (including agricultural losses) were covered by insurance in the U.S.[15] While some insurance companies are trying to reduce their financial risk in part by raising premiums or reducing coverage, some are still losing money on weather-related events year after year. If these trends continue, the protection gap may continue widening, putting more communities at financial risk after disasters.

[15] Aon, "Climate and Catastrophe Insight," 2025, https://assets.aon.com/-/media/files/aon/reports/2025/2025-climate-catastrophe-insight.pdf

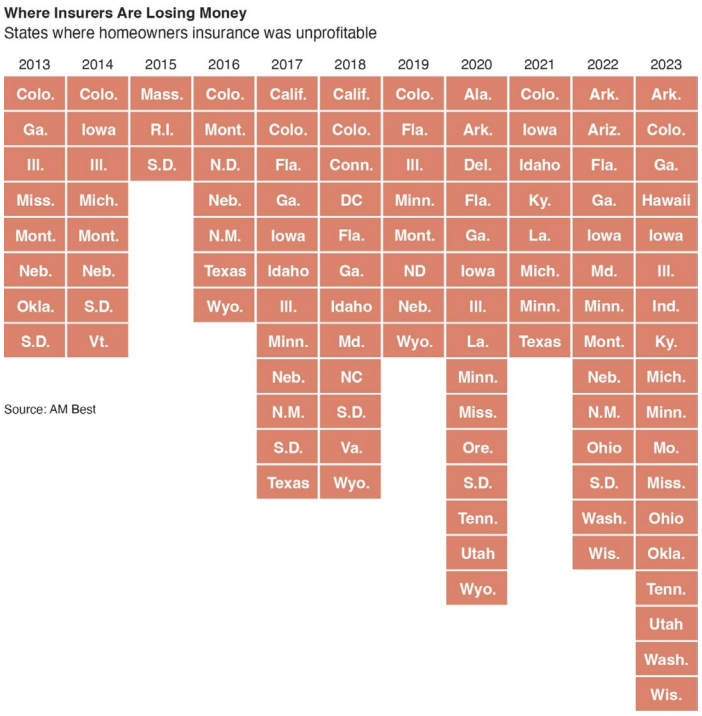


Figure 3. States where homeowners insurance companies are unprofitable. Source: New York Times[16]

At the community level, property owners—including homeowners, businesses, and municipalities—are faced with the stress of the increasing cost of premiums and the financial, physical, and psychological cost of rebuilding if disaster were to strike. For large-scale disasters, FEMA provides assistance to individuals and communities, helping municipalities cover some of the costs from public infrastructure damage, emergency response, and repairs. Especially in high-risk areas more prone for repeat or back-to-back disasters, this financial tool is an essential service for municipalities and families.

Reinsurance—or insurance for insurance companies—allows insurance companies to offset financial risk to protect against catastrophic losses. Risk transferring solutions like reinsurance helps insurance companies remain solvent and equipped to provide options for the communities they serve. However, the insurance sector is increasingly recognizing that traditional risk transfer (where insurance companies take on a portion of the financial risk of damage from homeowners) is becoming less viable as environmental threats continue to grow. Innovative insurance solutions are emerging to address this fundamental issue by pivoting toward **loss prevention** and **hazard resilience** strategies to keep communities insured.

2. The Value of NOAA Data in Addressing Weather and Climate Challenges

The insurance ecosystem—which includes the private sector (for- and non-profit), individual asset owners, communities, and government—is highly interconnected. As the costs associated with weather

[16] This analysis was based on regulatory filings from insurance companies, provided to the New York Times by AM Best. This figure, from 2023, reflects 98% of companies reporting data.

and climate hazards rise, actions taken by one sector can affect the financial impact of the others. Familiarity with these major participants is essential for understanding and developing new solutions.

Table 1. The Insurance Ecosystem

Insurers and Reinsurers	***Key role:*** Provide insurance coverage to reduce financial risk to, for instance, home and business owners ***Key challenge:*** Increasingly difficult to price risk due to factors such as shifting weather patterns and more costly events
Individual Home and Business Owners	***Key role:*** Buy insurance that covers them against hazards; upgrade properties to be more resilient against weather events, where feasible ***Key challenge:*** Rising costs of insurance premiums and property upgrades to meet modern building codes and resilience measures
Communities	***Key role:*** Understand community-specific weather preparedness and insurance needs to further educate, advocate, and be a resource to fellow community members ***Key challenge:*** Not always fully equipped to navigate the complexity of insurance options, resilience measures, and weather hazards
Boundary Organizations	***Key role:*** Develop and implement non-traditional innovative insurance solutions in areas of the country where traditional insurance is struggling to cover losses ***Key challenge:*** Need high-resolution data at the local level as well as funding
State and Federal Government	***Key role:*** Update and implement building codes; regulate the insurance market; provide insurance where private is unavailable; provide weather and climate data services ***Key challenge:*** Navigating and addressing multiple competing community priorities

NOAA data supports every entity within the insurance ecosystem—from private companies, to communities, to local and federal governmental entities. NOAA provides information that is quality-assured and credible, in formats that vary for more technical users to less-technical users; however, this information can be hard to find for most users. It is important that NOAA continues to provide quality data while also improving accessibility to these datasets.

3.1 Insurance and Reinsurance

Free, trusted, publicly available weather and climate data from NOAA help the sector better understand historic climate and weather trends to make more informed decisions. More specifically, data from NOAA are the foundation of important insurance and reinsurance models that help the sector understand and price risk. Within insurance and reinsurance roles, NOAA data informs catastrophe modeling, risk assessment, pricing strategy, post-event analysis, claim validation, and more.

Importance of NOAA Data in Insurance Sector Decision-Making During Hurricane Season

Hurricanes are the most expensive natural disaster in the U.S., causing accumulated damage costs exceeding $1.5 trillion between 1980 and 2024.[17] Insurers and reinsurers rely heavily on authoritative NOAA data to prepare for and respond to hurricanes to help ensure affected communities can rebuild as soon as possible. NOAA's outlooks, watches, and warnings; satellite products; and in-situ data contribute to situational awareness and decision making within the sector.

- **Before a Hurricane:** In the days and hours leading up to hurricane landfall, situational awareness and communication are key. Insurance and reinsurance companies communicate risks and recommendations to their clients with the best available data from NOAA's National Hurricane Center (NHC). At the same time, companies update catastrophe models with the most up-to-date data (e.g., Numerical Weather Prediction (NWP) model ensembles) to estimate potential loss from the event, which informs logistical and financial planning once a hurricane makes landfall.
- **During a Hurricane:** Industry professionals during this time closely track the hurricane as it makes landfall while constantly ingesting in-situ measurements into catastrophe models and communicating with active and pending clients. As the hurricane continues on its track, they evaluate impacts to areas directly hit and investigate physical and environmental measurements (e.g., storm surge) that have resulted from the storm. By beginning to capture the full realized impacts, insurance companies can begin preparing to respond to potential claims and other client needs.
- **After a Hurricane:** Once the hurricane has ended, insurance companies begin responding to the influx of claims and evaluate those as soon as possible to help communities rebuild where there was damage. To do so, they need to understand the timing of when certain variables like wind and storm surge occurred, data which NOAA collects. Later, real-time measurements of the storm's effects inform improved catastrophe models ahead of the next storm.

Key datasets used: Satellite imagery; NWP ensembles; NHC, National Weather Service (NWS), and Storm Prediction Center (SPC) outlooks, discussions, forecasts, in-situ measurements (e.g., radius of maximum wind, ocean surface temperatures), and the Damage Assessment Toolkit; International Best Track Archive for Climate Stewardship (IBTrACS); and Sea Lake and Overland Surge from Hurricanes (SLOSH) outputs

Access to accurate and timely weather and climate data helps insurance and reinsurance companies better understand risks to homes and businesses within communities. With it, they can analyze hazard frequency and intensity shifts throughout the country, which can aid in more informed pricing and resilience suggestions for customers. For example, data analysis can help coastal insurers work with clients at higher risk of hurricane force winds and recommend upgrading their roof and other protective measures. Better-informed catastrophe models help insurance and reinsurance companies financially prepare for high-impact events, ensuring they can process claims as quickly as possible. Accurate and credible data and forecasts from NOAA help insurers and reinsurance make better and easier decisions.

[17] National Oceanic and Atmospheric Administration, "2024: An active year of U.S. billion-dollar weather and climate disasters," January 10, 2025, https://www.climate.gov/news-features/blogs/beyond-data/2024-active-year-us-billion-dollar-weather-and-climate-disasters#:~:text=1980%2D2024%20U.S.%20costs%20and,NCEI%20Billion%2Ddollar%20Disasters%20webpage

3.2 Boundary Organizations

Boundary organizations are using NOAA data to help minimize the protection gap by offering insurance products and services that address gaps in the current market. These organizations fall outside of traditional insurance providers, and include organizations that provide research, solutions, and resources that support communities and individuals needing innovative insurance solutions.

Boundary organizations require localized hazard data to target areas and providers that can benefit from their specialized infrastructure, software, services, or non-traditional coverage solutions. Historical weather and climate data from NOAA are important to understand long-term climate trends in an area, as well as information on the built environment and surface types in the areas of interest. Much of this data is put into models that these organizations use for measuring risk and understanding solutions for protection gaps in areas subject to hazards like flood, hail, and wildfire. With these inputs, they can offer insurance solutions to communities where traditional insurance is unavailable or unaffordable.

Information from the Storm Events Database supports understanding of local weather events, particularly large-scale ones that drive losses. More technically sophisticated firms analyze climatic trends by integrating NOAA NWS Automated Surface Observing System (ASOS) observation data into models that help drive solutions. Free-of-charge, accessible, localized, and easy-to-use weather and climate data are crucial to solutions providers when they are designing and implementing innovative insurance solutions within communities. It is important that boundary organizations understand where to access specialized tools and datasets unique to their needs, with information on how the data can be used, in order to offer innovative solutions.

3.3 Local, State, and Federal Government

Local, state, and federal bodies use weather and climate data from NOAA for emergency preparedness and response as well as infrastructure design and maintenance. Storm outlooks, watches, and warnings allow states to preemptively stage emergency resources, significantly reducing the potential for loss of life and property during extreme weather events.

NOAA provides rain, wind, and storm data critical for stormwater design, floodplain mapping, roadway planning, and informing criteria used in standards such as ASCE-7 from the American Society of Civil Engineers, which is the basis for local and national building codes. For many municipalities across the country, NOAA's Atlas 14 is the backbone for runoff predictions, which officials use to manage water supplies and mitigate flooding.[18] Climate projections are increasingly important for updating building codes to withstand future weather events and guiding long-term infrastructure planning.

State-backed insurance companies are also becoming increasingly vital for homeowners unable to obtain traditional coverage with private insurers. NOAA data supports these programs in understanding local historical weather and climate risk and communicating ways to mitigate risk for communities through easy-to-use tools.

3.4 Communities and Individual Home and Business Owners

Individuals make up communities that include interconnected neighborhoods, economies, and knowledge. Everything that helps the improvement and continuity of livelihoods before, during, and

[18] Coelho, G. de A., Ferreira, C. M., Johnston, J., Kinter, J. L. III, Dollan, I. J., & Maggioni, V, "Potential impacts of future extreme precipitation changes on flood engineering design across the contiguous United States," *Water Resources Research*, 58, e2021WR031432. https://doi.org/10.1029/2021WR031432

after an extreme weather event is important to a community's resilience. With accessible and easy-to-use weather and climate information, they can better make decisions that improve individual and overall community safety. This information, however, may not be accessible to most: homeowners may not understand their growing risk of certain weather disasters without easy-to-use tools and information that helps them understand weather pattern changes specific to their area. Insurance companies or state and local governments have the opportunity to bring to light this information through transparent communication around specific, local climate and weather hazards.

Individuals have the ability to use weather and climate information from NOAA in a variety of different ways. They may use data to inform where/whether to purchase a new home and what kind of insurance coverage they want. Homeowners might use data to explore which home improvements would strengthen their resilience, and businesses might use it to cite a new warehouse or store. Coastal communities might reference the Sea Level Rise Viewer, which includes validated and authoritative coastal data in an easy-to-navigate interface, to make these types of decisions.

3. Use Cases: Innovative Insurance Solutions to Weather and Climate Challenges

Insurers, governments, and communities are beginning to tackle the challenges outlined in the previous sections through collaboration and implementation of innovative insurance solutions. The following examples across geographies and hazards outline what some groups are doing to protect homes and businesses from extreme weather and fill protection gaps in various parts of the country.

Methodology

The examples highlighted in this paper were chosen following a series of 10 interviews with insurance organizations from January to March, 2026. These examples are not a comprehensive list of all innovative insurance solutions being implemented across the U.S., but a select few that cover a range of hazards (e.g., coastal flooding, hurricanes, wildfire, hail) across different regions. In these interviews, the team explored how these entities thought about climate risk and resilience, how they thought about insurance solutions, and how they used weather and climate data to drive these decisions. Between the interviews and the time of the publication of this White Paper, the company Faura unfortunately closed its doors. This document has been revised to reflect these changes.

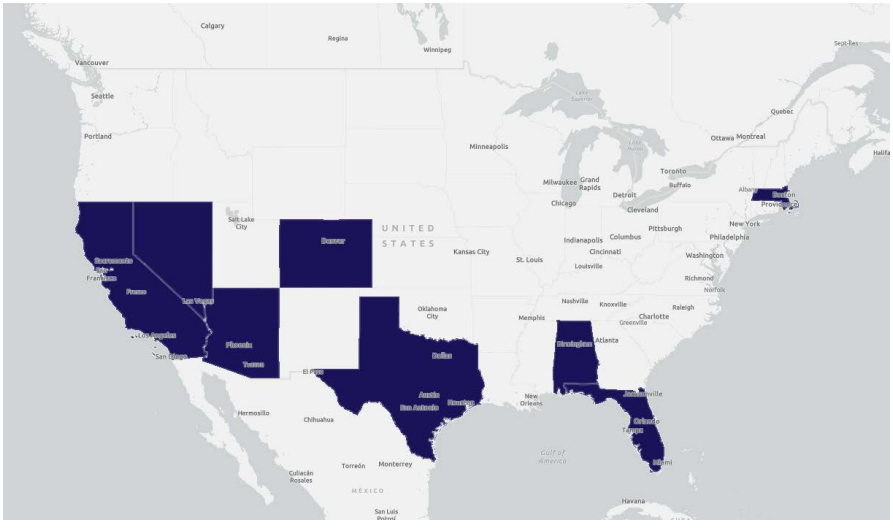


Figure 4. Sites of case studies across the contiguous U.S.

4.1 Insurability Planning to Reduce Risk of Coastal Flooding in Massachusetts Communities

Coastal areas of eastern Massachusetts are highly susceptible to flooding.[19, 20] The coast is subject to many multifaceted and often compounded hazards; for example, parts of the town of Plymouth in particular are at high risk of sea level rise, storm surge, and extreme precipitation that can result in riverine, stormwater, and coastal flooding.[21]

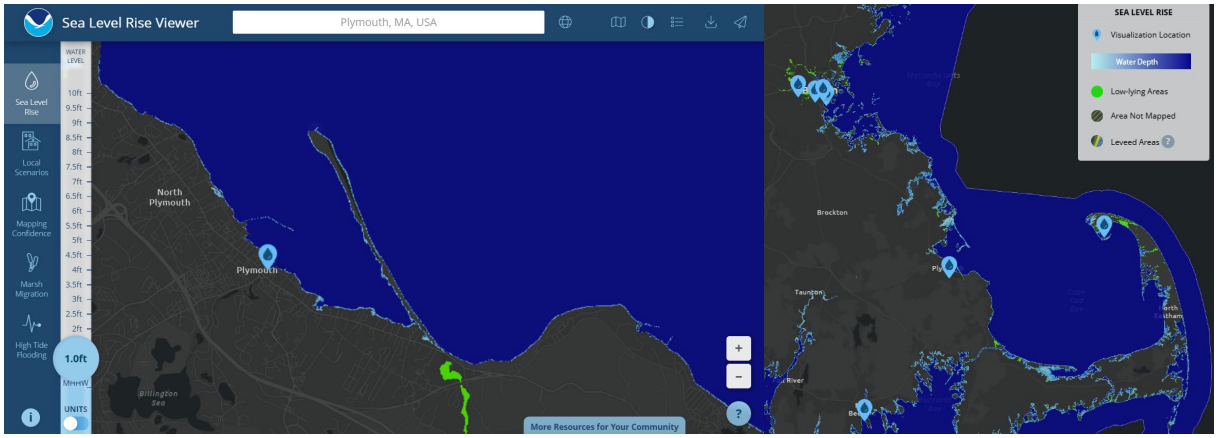


Figure 5. Mapping sea level rise along the coast of Massachusetts. Source: NOAA

Between Boston and the Cape Cod peninsula, Plymouth is a densely populated hub for commerce, shipping, local businesses, tourism, and art. The coastal flooding in the area also impacts its insurability. Nine percent of buildings in Plymouth are in zones vulnerable to 100-year flooding events.[22] Buildings on the coast that were once dry now experience water from the ocean coming right up to their doorstep—and into their basement and first floor—especially at high tides and with storm surge from hurricanes.

Coastal communities implement different mitigation strategies to protect homes and other structures from flooding damage. In Plymouth, seawalls are an important piece of infrastructure to keep water away from homes; however, neighborhoods especially susceptible to flood may struggle to find affordable insurance coverage because of the high risk of damage in the area. This risk can be difficult for insurance companies to accommodate, which then drives a gap in what infrastructure they can cover. The gap in flood and property insurance in areas like these leaves homes and businesses vulnerable to the risk of the full financial burden of rebuilding after a flood occurs. While some property

[19] Massachusetts Office of Coastal Zone Management, "Assessing Vulnerability of Coastal Areas and Properties," 2026, *Mass.gov*, https://www.mass.gov/info-details/assessing-vulnerability-of-coastal-areas-and-properties
[20] Runkle, J., K.E. Kunkel, R. Frankson, D.R. Easterling, A.T. DeGaetano, B.C. Stewart, W. Sweet, and J. Spaccio, "Massachusetts State Climate Summary 2022. NOAA Technical Report NESDIS 150-MA," National Oceanic and Atmospheric Administration/National Environmental Satellite, Data, and Information Service, 2022, https://statesummaries.ncics.org/chapter/ma/
[21] Cahill, M., McCormack, S., Sidoti, C., Brandt, S., Hamilton, K., "Plymouth Coastal Resiliency AI-Driven Flood Total Cost of Risk Economic Simulator Project," https://innsure.org/s/EBCPosterAfterJan2026Updated.pdf
[22] Town of Plymouth, "Plymouth and Non-Profit InnSure Announce Partnership for Climate Insurability Planning," Department of Energy & Environment, April 2026, https://plymouth-ma.gov/DocumentCenter/View/10591

owners do have insurance, it is uncommon; less than 10% of households in Plymouth County have purchased flood insurance.[23]



Figure 6. A concrete seawall on Plymouth Beach, damaged over time, breaks during a storm in October 2024. Source: Town of Plymouth

The town of Plymouth is conducting insurability planning, which is an innovative insurance solution designed to strategically improve a community's access to affordable insurance.[24] Insurability planning involves identifying and incentivizing adaptive interventions that officials, residents, and businesses can take to lower flooding risks. These risks can incur high insurance costs or limit insurance availability, so mitigating them can create favorable conditions within insurance markets and increase the community's insurability.

For insurability planning, coordination among stakeholders is a necessity: efforts need to involve city planners, town leadership, and even surrounding communities to make a regional plan. To understand which mitigation measures will be most effective, insurability planners need data on buildings' first floor elevation to identify the structures most at risk and cross-reference this information with flood data from agencies like NOAA and FEMA, as well as local flood models, third-party flood analysis models, insurance market data, and socioeconomic data.[25] Interdisciplinary coordination continues to be necessary to create analyses for planning purposes; these analyses consider factors including the cost of construction, the cost of maintenance, and the benefits to the community.

There are many moving pieces and challenges with insurability planning in Plymouth, and implementation logistics must balance the safety and integrity of the community. For example, city

[23] Whitehead, J.C., E.L. Mecray, E.D. Lane, L. Kerr, M.L. Finucane, D.R. Reidmiller, M.C. Bove, F.A. Montalto, S. O'Rourke, D.A. Zarrilli, P. Chigbu, C.C. Thornbrugh, E.N. Curchitser, J.G. Hunter, and K. Law, 2023: Ch. 21. Northeast. In: Fifth National Climate Assessment. Crimmins, A.R., C.W. Avery, D.R. Easterling, K.E. Kunkel, B.C. Stewart, and T.K. Maycock, Eds. U.S. Global Change Research Program, Washington, DC, USA., https://nca5.climate.us/chapter/21#fig-21-9

[24] Innsure, "Insurability," https://innsure.org/insurability

[25] Federal Emergency Management Agency, "Flood Maps," January 22, 2024, https://www.fema.gov/flood-maps

planners might identify the most effective location for a new seawall but be unable to develop this site if it is on private property or protected land. Insurability planning groups might require specific insurance data but are unable to acquire this information if it is proprietary or confidential. The lack of access to anonymized insurance claims data remains a significant hurdle; accessing this proprietary information would allow researchers and non-traditional insurance to better link physical hazards to actual economic loss. Furthermore, comprehensive risk analyses that consider multiple physical, socioeconomic, social, cultural, and behavioral factors can be expensive; engineering studies alone can cost thousands or millions of dollars to identify and design the most suitable solution.

Despite these challenges, insurability planning is important because identifying and implementing risk-reducing measures can help towns like Plymouth qualify for insurance. InnSure is an organization that is working to improve insurability in the face of weather and climate events, including coastal flooding.[26] InnSure helps municipal planners with insurability planning that focuses on lowering a community's risk of damage and finding which insurance programs could help solve the gaps it experiences. Using simulators that assess the total cost of risk, the organization is helping the town of Plymouth direct efforts towards preparedness and protection.[27] They work with traditional insurers to request anonymized claims records to analyze and understand where there are coverage gaps, where the risk lies, and how to help communities that need support with hazards like coastal flooding.

NOAA Data Highlight: The Total Cost of Risk

NOAA provides hazard mapping and underlying datasets to the public including baseline coastal flood zones and water elevations for the Massachusetts Coastal Flood Risk Model—the base model for InnSure's work in the state.[28] These include **Static Sea Level Rise Scenarios**, **Mean High Water tidal references**, and **current coastal flood zones and hurricane surge models** (from NOAA, FEMA, and the U.S. Army Corps of Engineers). InnSure's Total Cost of Risk Simulator synthesizes these data with information from a variety of other sources, including "FEMA flood hazard data and Hazus depth-damage functions, the Massachusetts Coast Flood Risk Model, OpenStreetMap building exposure data, insurance market data, socioeconomic data, Coastal Measures Ocean Data, interruption vulnerability of business income models, and more."[29] Planners use the results from the simulator to identify possible insurability solutions.

The town of Plymouth's response to protect against coastal flooding demonstrates to the broader insurance industry that high-risk locations seek to improve their insurability. Through this partnership, Plymouth now has new resilience tools at their disposal: mitigation value scores, an analysis of the local insurance market, outputs from the simulation to assist with mitigation decision-making, local-level clarity detailing the protection gap, and total cost of risk at the parcel and community level. By

[26] InnSure, "InnSure," https://innsure.org/

[27] Innsure, "Proposal: AI-Driven Flood Total Cost of Risk Economic Simulator for Community Resilience, Home-hardening & Business Resilience," https://plymouth-ma.gov/DocumentCenter/View/8821

[28] Commonwealth of Massachusetts, "Massachusetts Sea Level Rise and Coastal Flooding Viewer," Massachusetts Office of Coastal Zone Management, https://www.mass.gov/info-details/massachusetts-sea-level-rise-and-coastal-flooding-viewer

[29] Town of Plymouth, "Plymouth and Non-Profit InnSure Announce Partnership for Climate Insurability Planning," https://plymouth-ma.gov/DocumentCenter/View/10591

implementing data-fueled resilience measures, towns and innovative solution partners are actively protecting their assets from the hazards they experience.

4.2 Financial Incentives to Upgrade Alabama Roofs from Wind and Hail

Alabama is highly susceptible to both hail and wind, which can cause damage to homes, especially roofs. Alabama has experienced hailstones more than five inches in diameter as of 2018.[30] The state is especially vulnerable to high winds with increased hurricane activity.[31] The estimated total cost of damage to single-family homes during Hurricane Sally in 2020 was more than $243 million, with wind as a significant driver.[32]

Reinforcing roofs is one key loss mitigation strategy to protect homes and other structures from hail and wind. If a roof sustains damage, it leaves the rest of the structure vulnerable to further damage. A common standard for strong roofs comes from the IBHS FORTIFIED Home™ program that provides guidelines for construction and re-roofing that better withstand severe weather.[33] However, installing a new roof on a house can be prohibitively expensive for many homeowners—especially for new or short-term residents. It may also seem unlikely that an event will occur for which they need reinforcement, which drives down proactive risk mitigation actions.

NOAA Data Highlight: Underlying FORTIFIED

IBHS FORTIFIED uses underlying **NOAA ASOS data**. ASOS is a system of more than 900 stations in the U.S. that continuously record weather conditions.[34] These real-time surface observations are essential for public weather forecasting, and they also form a historical record that determines the maximum wind speeds in an area for which a structure's design should account. In FORTIFIED Gold standards, that means homes in high-exposure areas like near the coast brace for winds up to 140 mph.[35]

Strengthen Alabama Homes (SAH) is a Division of the Alabama Department of Insurance (ALDOI) that is working to increase the structural strength and resilience of residences in the state of Alabama.[36] ALDOI's innovative insurance solutions employ a voluntary approach, encouraging property owners to take advantage of financial incentives to fix, upgrade, and protect parts of their homes—primarily roofs.

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[30] National Oceanic and Atmospheric Administration, "Extreme Hail in Cullman County, Alabama: March 19th, 2018," National Weather Service Huntsville, Alabama Weather Forecasting Office, https://www.weather.gov/hun/event_03192018_hail

[31] Marvel, K., W. Su, R. Delgado, S. Aarons, A. Chatterjee, M.E. Garcia, Z. Hausfather, K. Hayhoe, D.A. Hence, E.B. Jewett, A. Robel, D. Singh, A. Tripati, and R.S. Vose, 2023: Ch. 2. Climate trends. In: Fifth National Climate Assessment. Crimmins, A.R., C.W. Avery, D.R. Easterling, K.E. Kunkel, B.C. Stewart, and T.K. Maycock, Eds. U.S. Global Change Research Program, Washington, DC, USA. https://doi.org/10.7930/NCA5.2023.CH2

[32] University of Alabama, "Performance of IBHS FORTIFIED Home™ Construction in Hurricane Sally," Alabama Department of Insurance and Center for Risk and Insurance Research – University of Alabama, May 2025, https://aldoi.gov/PDF/News/PerformanceIBHSFortifiedHomeConstructionHurricaneSally.pdf

[33] Insurance Institute for Business & Home Safety, "Fortified," https://fortifiedhome.org/

[34] National Oceanic and Atmospheric Administration, "ASOS," National Weather Service, https://www.weather.gov/asos/

[35] Insurance Institute for Business & Home Safety, "High Wind Technical Summary," 2015, https://www.smarthomeamerica.org/assets/uploads/FORTIFIED-Home-High-Wind-New-Technical-Summary.pdf

[36] Alabama Department of Insurance, "Strengthen Alabama Homes," https://www.strengthenalabamahomes.com/

Through the SAH grant program for resilience retrofits (up to $10,000), insurance discounts, and coverage to rebuild homes or commercial buildings to a higher standard after a weather event damages them, ALDOI makes it easier for asset owners to upgrade.

Much of the work that SAH does focuses on measuring risk, and NOAA information on hail and wind exposure help SAH determine which counties are eligible for grants. They analyze information about which locations, and the structures in them, are vulnerable to which hazards. SAH has helped retrofit more than eight thousand homes in Alabama.[37] This large-scale project helps prevent home damage claims before they happen and keep people safe. With a stronger roof, a home is more likely to qualify for more insurance programs and discounts, which helps insurability.

Educating multiple parties in a community is key to help the success of SAH's efforts, and this comes with its own challenges. Communities are not a monolith, no matter the size or scale; the individuals and groups within have varying opinions on what is most important. The success of SAH's initiatives is reliant on approval from **homeowners** and agreement from **builders**.

Homeowners: Community members sometimes find it unusual—and even suspicious—that an organization offers significant financial assistance for such a targeted cause. When an organization runs its own analyses in a neighborhood and sends representatives to knock on doors and connect with homeowners, residents with no prior notification about SAH's initiatives may find it unexpected and turn the help away. To foster stronger connections and spread the word, SAH looks for local ambassadors who know the community, engages with community centers, and leaves door tags where possible.

Builders have expressed concerns that changes in building codes will make their work more challenging and expensive. SAH has found that spending 1–2% more to build a house to FORTIFIED standards means its sale cost will increase by 7%, and the owners will pay less for insurance.[38] SAH has connected with builders who build to FORTIFIED standards and who understand the value and efficacy of this practice. These allies help spread the word about the program and its values and share knowledge among others (including members of state and county builders associations who may have concerns) about the value of taking on these resilience standards.

ALDOI and its programs like SAH are paving the way for other states, including North Carolina, Louisiana, Minnesota, Mississippi, Kentucky, and Oklahoma, creating a model they can follow: a grant program for resilience retrofits, insurance discounts, and coverage to rebuild homes or commercial buildings to a higher standard.[39] When insurers work with communities, it is important to understand the resources

[37] Alabama Department of Insurance, "2024 Annual Report," 2024, https://aldoi.gov/PDF/Misc/2024AnnualReport.pdf

[38] Awondo, S., Hollans, H., Powell, L., Wade, C., "Estimating the Effect of FORTIFIED Home™ Constructionon Home Resale Value," n.d., https://crir.culverhouse.ua.edu/crirresearch/estimating-the-effect-of-fortified-home-construction-on-home-resale-value/

[39] Smart Home America, "Alabama Leaders Celebrate 50,000 FORTIFIED Homes 20 Years After Hurricane Ivan," n.d., https://www.smarthomeamerica.org/news/alabama-leaders-celebrate-50-000-fortified-homes-20-years-after-hurricane-ivan

that states and residents have at their disposal to make their assets more resilient to weather damage and to prevent claims before they happen.

4.3 Designing Solar Power Infrastructure to Withstand Hail in Sunny States

Areas rich in solar resources also experience hail. In sunny regions of states including Arizona, California, Florida, Nevada, and Texas, solar energy production installations are common; however, many of these locations experience high hail risk, which is the most costly weather hazard for this asset type. Hail causes 73% of insured losses for solar panels with photovoltaic (PV) cells, and single weather events can cause hundreds of millions of dollars in damage.[40,41]

Insurance is one mitigation strategy for infrastructure losses that otherwise would limit the deployment of solar assets. This is complex, however, because the insurance industry often relies on historical insurance rates. In many cases, as technology evolves and requires advanced protection, insurers' underlying risk models fail to capture the nuanced vulnerabilities, sometimes underestimating losses by more than 300%.[42] Overestimation is common as well, and a lack of guidance puts the industry at a disadvantage when it may not grasp the true risk of assets like solar fields and PV panels, ultimately resulting in variation in rates as the insurers react to specific loss events. More sophisticated risk models can be one tool for stabilizing insurance premiums in the renewables industry.

The organization kWh Analytics, a specialized renewable energy insurance solutions provider recently acquired by Beazley, aims to help insurers understand, evaluate, and protect assets involving PV technology.[43] This group focuses on underwriting: it analyzes risk and turns data into premiums that insurers can use. Setting rates for assets like PV infrastructure requires an integrated team that includes modeling, underwriting, and subject matter expertise on renewable energy assets and their vulnerability to weather events.

NOAA Data Highlight: Hail Evaluation

NOAA data underpins kWh Analytics' insights and models. They utilize both the **NOAA Storm Events Database** and **NOAA Next Generation Weather Radar (NEXRAD)** to contextualize hail events that may have occurred at renewables sites. The basis of these outputs is a record that helps kWh Analytics understand where a hazard like hail occurred and to what extent assets in the area may have experienced a loss. Further, these NOAA data enable kWh Analytics to obtain information about potential loss-causing weather events including their intensity, extent, and duration. These data in turn allow the insurer to develop and validate a more accurate risk model when taken with actual losses from events, furthering the insurance industry's understanding of this asset class.

[40] kWh Analytics, "Solar Risk Assessment," 2024, https://kwhanalytics.com/wp-content/uploads/2025/02/Solar-Risk-Assessment-2024-1.pdf
[41] Thompson, N., Fagan, R., "Mind the Gap: are traditional models underestimating hail damage to PV?," September 2025, https://kwhanalytics.com/mind-the-gap/
[42] kWh, "Solar Risk Assessment," 2024
[43] kWh Analytics, "kWh Analytics," 2026, https://kwhanalytics.com/

There are various actions that kWh Analytics promotes to renewable energy asset owners that help make solar fields more resilient. Some are part of the design and construction: panels with thicker, tempered glass or mounted on deeper piles sustain less damage from hail and wind than those without these considerations. Some engineering firms give assessments for the purpose of asset resilience, as many of these measures should occur during the site design and construction phase. Hail "stow" is another way to protect solar panels from weather; this involves tilting each panel at an angle where the hailstones do not hit the PV cells straight-on. One study shows that this proactive practice can result in reducing risk of damage by 87%.[44] Weather alerts prompt solar operators to go into stow before severe weather hits. When kWh Analytics advises asset owners to invest in a stow protocol, which reduces the risk of damage at a site, it may result in more favorable insurance terms (including deductibles, limits, and premiums) when asset owners communicate those protocols back to insurers.

The support that kWh Analytics provides to the insurance community and renewables asset owners helps all parties align on risk and the benefits of resilience. This also encourages developers of energy production infrastructure to focus on risk reduction, which stabilizes input to the power grid and end users in each state.

Boundary organizations like kWh Analytics encounter challenges when communicating benefits to asset owners, developers, and their insurers. Currently, asset owners often do not see a clear signal that their insurance will reward them for taking **resilience measures** or that these practices are profitable in the **long term**—even when both are true.

Organizations like kWh Analytics can encourage owners to implement best practices and **resilience measures** but cannot guarantee a response in insurance premiums. This depends on what measures owners implement and their communication of those measures to their insurance providers. It is up to the asset owner to collect and share information to kWh Analytics about when they went into stow protocols—helping kWh Analytics advocate for reduced insurance premiums—however, many owners are not equipped to send this information.

Taking the **long-term** into account is another challenge. Assets like solar infrastructure are supposed to last 30–50 years, and to effectively plan for future weather risks on these sites, owners and builders consider the projected conditions. There is often extra cost for measures like installing hail-resilient panels, enabling stow, and clear communication from insurers about available incentives to lower insurance premiums can help owners choose and better understand the returns on their investments in resilience.

Insurers can account for resilience and innovation to better support increasingly common, large assets for power generation. Organizations like kWh Analytics are working to help owners and insurers alike better understand the risks and resiliencies of new technologies and insure them, but ultimately insurance rates and technical rating methods can vary widely from insurer to insurer. Insurance can be at a disadvantage when it relies on historical rates to evaluate and insure new technologies; education and improved data can significantly improve the industry's ability to provide innovations with the accurate coverage they need to succeed and develop.

[44] kWh, "Solar Risk Assessment," 2024

4.4 Engaging Homeowners to Harden Homes against Wildfire in California and Colorado

States including California and Colorado frequently experience large-scale wildfires. Increased temperatures and decreased relative humidity more frequently create conditions for catastrophic fires that can completely destroy a home or cause devastation across a whole community.[45] This intense risk of loss creates challenges for insurers who provide coverage in the area, as it is expensive to maintain protection.

It is not only up to the individual policyholder to understand and mitigate risk. Any given individual home or business owner's resilience is also dependent on how resilient their neighbors are. For example, collective data resources, communication, and understanding about wildfire spread and resilience measures can benefit an entire area—each individual's wildfire mitigation actions can slow the spread and protect nearby properties. However, increasing overall community resilience to weather and climate hazards requires large-scale buy-in from the majority of the community and some of these measures are costly. Monetary incentives, combined with awareness building, are an avenue to building resilience throughout the whole community.

There are specific strategies for physically mitigating risk for homes and neighborhoods (e.g., removing brush and flammable debris around each structure).[46] There are many options on an individual property basis; however, insurers may not have in-depth understanding of actual property characteristics that can potentially make a home less survivable. Faura, before closing their doors in the fall of 2026, was a company that worked with insurance carriers to create property-level home risk reports detailing these characteristics.[47] Faura helped companies with high-risk properties calculate a baseline for the survivability of homes across their portfolios and ground-truth yearly information on the properties. Policyholders received annual reports that show recommended mitigation action items and connected them to services and incentives that could help implement and finance these actions. When policyholders complete steps to harden the property for wildfire and notify their insurance, they can see discounts add up to more than 20% of their premiums.

Faura promoted various wildfire mitigation strategies including clearing the area around a structure, hardening the structure itself, and seeking insurance programs to assist. Clearing combustible materials, like dry vegetation or flammable garden beds, from the "defensible space" around a home helps to protect it.[48] Replacing parts of a home with fire-proof materials help to harden it against igniting. The condition and presence of roofing, siding, vents, and sprinkler systems all contribute to a building's risk: the means for air to flow, flames to spread, and systems to suppress a fire can determine if and to what extent a home sees damage.[49] Insurance companies that offer (and follow up about) loss prevention ~~programs help keep policyholder~~s in the loop about reducing their risk; communicating incentives with

[45] White, D.D., E.H. Elias, K.A. Thomas, C.E. Bradatan, M.W. Brunson, A.M. Chischilly, C.A.F. Enquist, L.R. Fisher, H.E. Froehlich, E.A. Koebele, M. Méndez, S.M. Ostoja, C. Steele, and J.K. Vanos, 2023: Ch. 28. Southwest. In: Fifth National Climate Assessment. Crimmins, A.R., C.W. Avery, D.R. Easterling, K.E. Kunkel, B.C. Stewart, and T.K. Maycock, Eds. U.S. Global Change Research Program, Washington, DC, USA. https://nca5.climate.us/chapter/28

[46] Federal Emergency Management Agency, "Wildfire Actions," March 2026, https://www.fema.gov/disaster/wildfire-actions

[47] Faura, "Faura," 2026, https://www.faura.us/

[48] Holmes, V., "Why Defensible Space is Important," Faura, June 2026, https://www.faura.us/fire-resources/why-defensible-space-is-important

[49] State of California, "Home Hardening," California Department of Forestry & Fire Protection, n.d., https://www.fire.ca.gov/home-hardening

consumers and policyholders helps them make the most informed decisions for their risk mitigation. Faura issued over 100,000 reports with recommendations like these to homeowners in all fifty states. Out of all recipients, 50% confirmed information about their property, and another 10% completed at least one of the recommended mitigation actions.

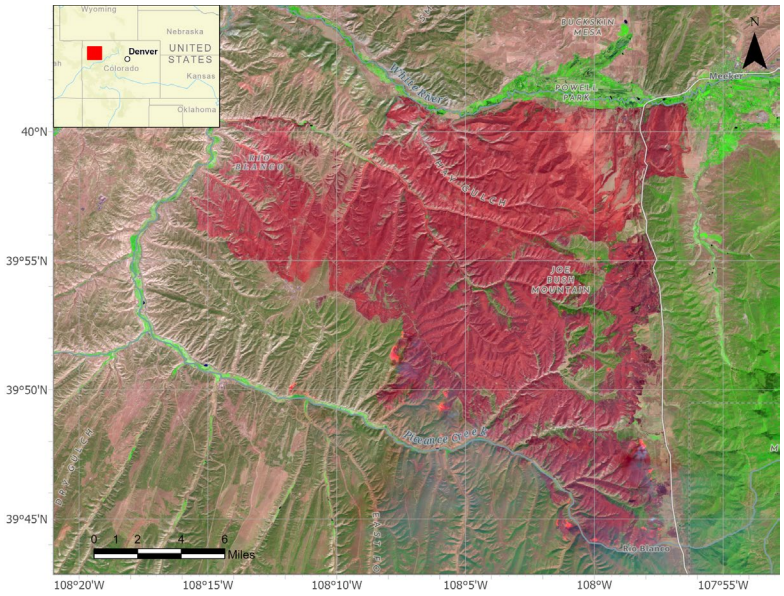


Figure 7. NOAA Hazard Mapping System Fire and Smoke Product imagery of the August 2025 Lee Wildfire in Colorado. Source: NOAA

The innovative insurance solution of creating individualized reports for homes that are updated annually helps improve engagement with homeowners, many of whom would only interact with their insurance companies for a bill or policy change. After delivering these individualized reports, insurance companies saw increased customer retention, profitability, and understanding of the risk mitigation actions that consumers are taking. In one case, distributing Faura's reports and following up about them with policyholders had a significant impact on engagement: a carrier's email open rate jumped from 17% to 52%, including some homeowners submitting corrections to the information that the carrier had on file for their properties. These impacts bolster insurability in high-risk areas and provide homeowners opportunities to have a more active role in protecting their neighborhoods from disaster.

NOAA Data Highlight: Measuring and Understanding Risk

NOAA provides hazard mapping and underlying datasets to the public including **Geostationary Operational Environmental Satellite (GOES) imagery** and the **Hazard Mapping System Fire and Smoke Product**. Faura put information like this into action, applying it as part of homes' survivability scores in reports. The organization's third-party suppliers analyzed, combined, and consolidated NOAA-sourced foundational data, including satellite imagery and hazard models.

Communities that recently experienced or anticipate soon experiencing a natural disaster are more likely to actively prioritize proactive mitigation action items. Insurance can play an important role in building on this motivation and enabling risk reduction actions on a property-by-property basis. Seeking

a better understanding of what homeowners can do and are doing to reduce their risk of loss, especially in high-risk areas of hazards like wildfire in California and Colorado, benefits property owners and companies alike. Meeting policyholders where they are and enabling easy next steps for risk mitigation protect lives, assets, and insurers.

4. Conclusion

As traditional risk transfer models struggle to maintain solvency under the weight of outdated building codes and intensifying weather patterns, the protection gap continues to widen. However, as regional initiatives in Massachusetts, Alabama, California, and beyond demonstrate: bridging this gap is possible through data-driven risk prevention and risk mitigation programs. For example, FORTIFIED standards show that when there are clear financial signals (such as discounts to premiums) for verified risk mitigation; insurance companies reduce their own loss ratios while keeping policyholders covered. Examples like this also highlight the importance of communities investing in long-term solutions. Interest in building resilience spikes after a disaster, but the most sustainable communities are those that leverage weather and climate data to harden infrastructure before the next event occurs.

NOAA weather and climate data—from official event records to ground-truth observations—remain central to innovative solutions in insurance. Solutions like insurability planning, state financing programs, informed hazard modeling, and homeowner reports rely on NOAA data like flood information, ASOS observations, event records, and satellite imagery.

It is critical for NOAA to continue to provide information like this, expand its capabilities, and work to help connect users to the authoritative data most useful to them. Especially for boundary organizations, users' improved awareness of and access to NOAA's datasets can enable and foster innovative insurance solutions. Information that users can easily find, access, understand, and use empowers them to apply it accordingly in their work. User-oriented transparency for NOAA data bolsters both traditional and non-traditional insurance work that improves safety and solvency of the American public. Engaging with users in the insurance industry, understanding their needs, and supporting their decisions continue critical access, improve usability, and promote transparency of information.

NOAA's Industry Partnerships program connects knowledge and feedback from the insurance sector with applicable environmental data tools and services. The initiative has led to improvements in existing tools and the co-development of new tools to support decision-making in the insurance industry. From improving the Storm Events Database to developing a new Event Footprint Catalog, NOAA maintains its commitment to supporting U.S. economic resilience.

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Acronym List

ALDOI	Alabama Department of Insurance
ASCE	American Society of Civil Engineers
ASOS	Automated Surface Observing System
FAIR	Fair Access to Insurance Requirements
FEMA	Federal Emergency Management Agency
GOES	Geostationary Operational Environmental Satellite
IBHS	Insurance Institute for Business & Home Safety
IBTrACS	International Best Track Archive for Climate Stewardship
NASA	National Aeronautics and Space Administration
NEXRAD	Next Generation Weather Radar
NFIP	National Flood Insurance Program
NHC	National Hurricane Center
NOAA	National Oceanic and Atmospheric Administration
NWP	Numerical Weather Prediction
NWS	National Weather Service
PROTECH	Professional and Technical Service Solution
PV	Photovoltaic
SAH	Strengthen Alabama Homes
SLOSH	Sea Lake and Overland Surge from Hurricanes
SPC	Storm Prediction Center

Appendix A. Connecting Weather and Climate Trends to Insurance-Related Impacts

Since 1850, the Earth's temperature has risen by an average of 0.11 degrees Fahrenheit per decade, or about 2 degrees Fahrenheit in total. 2024 was the warmest year on record, about 2.3 degrees Fahrenheit (1.18 °C) above the 20th-century average and 2.6 degrees Fahrenheit (1.35 °C) above the pre-industrial average.[50] Rising temperatures are influencing ecological and environmental processes around the globe, from changes to the water cycle to changes in the carbon cycle.[51] The U.S., where temperatures are warming faster than the global average, is seeing more frequent and severe droughts, more frequent heavy rainfall, and more intense hurricanes.[52] More communities than in prior years are vulnerable to the impacts of wildfire, storm surge, and flooding, highlighting the need for affordable insurance solutions to build resilience in the coming decades. The following sections provide information on some of these trends and the associated impacts to communities.

Wildfire

Wildfires are unplanned fires that occur in wildlands like rangelands, grasslands, or forests, and usually occur in the summer and fall.[53] Climate-driven changes in temperature, drought, and atmospheric moisture are increasing the risk of wildfires across the U.S., particularly in the West.[54] Since the 1980s, wildfire season length and the amount of area burned has increased, especially in the forests of the Rocky Mountains. These trends are expected to continue into the coming decades across the U.S., and more structures will be at risk.

Wildfire smoke can result in health issues that range in severity from person to person, from minor respiratory issues to premature death.[55] Wildfire can destroy homes and belongings, leaving a lasting emotional and psychological toll within communities. While traditional homeowners insurance covers wildfire damage, catastrophic damage can result in temporary displacement and months of rebuilding. In areas of the country where the risk of wildfire is growing, property owners are facing increasingly higher premiums or having difficulty finding adequate coverage.[56] In these areas of the country prone to wildfire, homeowners may opt to make their homes more resilient to wildfire damage through replacing

[50] National Oceanic and Atmospheric Administration, "Climate change: global temperature," May 2025, https://www.climate.gov/news-features/understanding-climate/climate-change-global-temperature

[51] National Oceanic and Atmospheric Administration, "Climate change: global temperature."

[52] Marvel, K., W. Su, R. Delgado, S. Aarons, A. Chatterjee, M.E. Garcia, Z. Hausfather, K. Hayhoe, D.A. Hence, E.B. Jewett, A. Robel, D. Singh, A. Tripati, and R.S. Vose, 2023: Ch. 2. Climate trends. In: Fifth National Climate Assessment. Crimmins, A.R., C.W. Avery, D.R. Easterling, K.E. Kunkel, B.C. Stewart, and T.K. Maycock, Eds. U.S. Global Change Research Program, Washington, DC, USA.

[53] U.S. Department of Agriculture, "Wildfire," https://www.climatehubs.usda.gov/taxonomy/term/398#:~:text=Wildfires%20are%20unplanned%20fires%20that,the%20last%20large%20fire%20control

[54] National Oceanic and Atmospheric Administration, "Wildfire climate connection," July 2023, https://www.noaa.gov/noaa-wildfire/wildfire-climate-connection

[55] Environmental Protection Agency, "Wildland Fire Research: Human Health," July 2026, https://www.epa.gov/air-research/wildland-fire-research-human-health#:~:text=Some%20effects%20of%20wildfire%20smoke%20include:%20*,of%20air%20pollution%20from%20wildland%20fire%20smoke

[56] National Caucus of Environmental Legislators, "Wildfires and Insurance Fact Sheet," November 2024, https://ncelenviro.org/resources/wildfires-and-insurance-fact-sheet/

roofs or exterior structures with fire-resistant materials like stone, brick, or tile. Changes to landscape vegetation, like making sure bushes are 15 feet apart from each other, is another way for homeowners to reduce their risk of damage from wildfire.[57]

When property owners cannot afford coverage through private insurance, the state might step in to provide coverage. California, for example, created the Fair Access to Insurance Requirements (FAIR) Plan in 1968 for home and business owners unable to obtain insurance in the regular market; these policies provide basic coverage similar to private insurance. Between September 2024 and June 2025, the number of FAIR Plan policies in California grew 31%, with their total exposure area growing 289% since 2021.[58,59] This jump highlights the growing risk of wildfire in California and surrounding western states.

Event Highlight: 2025 Los Angeles Area Wildfires

In January 2025, multiple wildfires—including the Palisades and Eaton fires—burned over 50,000 acres and destroyed more than 18,000 homes and structures in Los Angeles. It was the costliest weather disaster of 2025 with over $60 billion in damages, and as of April 2026, it remains the costliest wildfire event in history.[60]

Hurricanes

Hurricanes often cause large amounts of damage; storm surge, rain, and wind can damage homes, cause inland flooding, and sometimes spur tornadoes. When a hurricane approaches land, sea levels can rise 20 to 30 feet, destroying homes and infrastructure with battering waves and erosion. Inland, hurricane impacts can include flooding from torrential rainfall. With warmer sea surface temperatures, and thus more fuel for hurricanes to develop and intensify, hurricanes are expected to become more frequent and intense in the future, with increased rates of rainfall.[61] Future sea level rise also is projected to worsen the impacts of storm surge along the coasts, and more intense rainfall increases the chances of inland, riverine, and coastal flooding. These changes can raise the cost of future hurricanes, making it hard for traditional insurance to cover losses year after year.

Historically, hurricanes have driven the highest loss for insurance companies in the U.S. as reflected in the median annual cost of property insurance in Gulf coast and Atlantic coast states. These costs are highest in Florida, where the median annual cost of property insurance is over $2,200 for homes with a mortgage, followed by Louisiana.[62]

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[57] National Interagency Fire Center, “Prepare and Protect Your Home,” https://www.nifc.gov/fire-information/fire-prevention-education-mitigation/wildfire-mitigation/home

[58] California FAIR Plan Association, “Key Statistics and Data,” https://www.cfpnet.com/key-statistics-data/

[59] Hudgens, S., Nguyen, N., Macomber, E., Mastrandrea, M., Wara, M., “Examining Disaster Insurance Markets: Lessons for the Future of Wildfire Insurance,” Climate & Energy Policy Program, Woods Institute for the Environment, Stanford University, November 2025, https://tinyurl.com/CEPP-ExaminingInsuranceMarkets

[60] Climate Central, “2025 in Review: U.S. Billion-Dollar Disasters,” January 2026, https://www.climatecentral.org/climate-matters/2025-in-review

[61] National Oceanic and Atmospheric Administration, “Global Warming and Hurricanes,” Geophysical Fluid Dynamics Labratory, 2024, https://www.gfdl.noaa.gov/global-warming-and-hurricanes/#summary-statement

[62] United States Census Bureau, “Property Insurance Costs Can be High in Every U.S. Region,” June 2025, https://www.census.gov/library/stories/2025/06/property-insurance.html

Multiple programs exist throughout Florida to ensure homeowner losses are covered, including a combination of private insurers and state-operated insurance programs. In recent years, nine Florida-focused property and casualty insurance companies have gone insolvent, while the number of policies under the state-operated insurance program has increased.[63] Though property upgrades are costly, many home and business owners in hurricane-prone areas of the U.S. choose to mitigate damage by installing or upgrading roofs and windows that can withstand heavy wind.

Event Highlight: 2024 Hurricane Milton

Hurricane Milton made landfall in Florida on October 9, 2024 as a category 3 hurricane, causing significant damage (about $34 billion)[64] to the Siesta Key area due to flooding, storm surge, and tornadoes. Milton became one of the strongest Atlantic-basin hurricanes as it reached category 5 intensity in the days prior to landfall. In 48 hours, Milton transformed from a tropical depression to a category 5 hurricane in record-breaking speed, fueled in part by high sea surface temperatures.[65]

Coastal Flooding

Global sea levels have risen 8-9 inches since 1880, with the rate at which they are rising also increasing in that time. Across many communities situated along the U.S. coastline, the rate of sea level rise is greater than the global average due to the compounding nature of erosion and subsidence, especially along the Gulf coast.[66] In Galveston, Texas, sea levels have risen 15 inches from 1970, contributing to major flooding in the area.[67] Similarly, in Annapolis, Maryland, sea levels have risen 10 inches from 1970.[68] These trends are projected to continue to increase into the future; under an intermediate emissions scenario, sea levels could rise over 3 feet higher in 2100 compared to 2000.[69]

Sea level rise and other factors such as heavy rainfall, storm surge, and high tide worsen coastal flooding. The impacts of flooding and sea level rise also speed up erosion along the coast, leading to property damage, infrastructure damage, and ecosystem damage. Private insurance agencies cover damages from general weather phenomena, like wind, and the National Flood Insurance Program (NFIP)

[63] The Office of Financial Research, "Wind, Fire, Water, Hail: What Is Going on In the Property Insurance Market and Why Does It Matter?" December 2023, https://www.financialresearch.gov/the-ofr-blog/2023/12/14/property-insurance-market/
[64] National Oceanic and Atmospheric Administration, "Hurricane Costs," https://coast.noaa.gov/states/fast-facts/hurricane-costs.html
[65] National Aeronautics and Space Administration, "Powerful Hurricane Milton forms in the Gulf of Mexico, sweeps into Florida," Scientific Visualization Studio, October 2024, https://svs.gsfc.nasa.gov/5401/?utm_source=FBPAGE&utm_medium=NASA+Earth&utm_campaign=NASASocial&linkId=615766834
[66] National Oceanic and Atmospheric Administration, "Climate Change: Global Sea Level," August 2023, https://www.climate.gov/news-features/understanding-climate/climate-change-global-sea-level
[67] U.S. Sea Level Change, "Galveston Pier 21," https://earth.gov/sealevel/us/national-sea-level-explorer/?psmsl_id=161&scope=section_3
[68] U.S. Sea Level Change, "Annapolis," https://earth.gov/sealevel/us/national-sea-level-explorer/?psmsl_id=311&scope=section_2
[69] U.S. Sea Level Change, "2022 Technical Report," 2022, https://earth.gov/sealevel/us/resources/2022-sea-level-rise-technical-report/

covers flooding damage; however, NFIP only covers a maximum loss payment of $250,000.[70] As a result, coastal states feel increasing threats from declining property values, potentially resulting in economic impacts on the local level, and may continue to see this trend into the future.[71] Some communities are implementing adaptation mitigation measures that include natural vegetation buffers that serve as a first line defense to flood waters; individual homeowners can choose to upgrade their doors and windows to be more resilient to flood damage, where they can afford to do so.

Event Highlight: 2012 Superstorm Sandy

Hurricane Sandy formed in the Caribbean before it transitioned into a post-tropical cyclone prior to landfall in New Jersey in 2012. The storm caused significant impacts to the densely populated Mid-Atlantic and Northeast states, as storm surge and rainfall contributed to significant flooding in coastal and major metropolitan cities like New York.[72] The storm totaled over $88 billion in damage—the fifth most costly in history.[73]

Extreme Precipitation

Extreme precipitation describes when an area receives more rain or snow than is normal during a period of time; however, since precipitation norms vary by location, "extreme" is relative to the area and time of year.[74] In the Central and Eastern U.S., average annual precipitation from 2002–2021 was 5%–15% higher (compared to the 1901–1960 average). Changes in precipitation trends are not evenly spread across the U.S.; although precipitation has increased in the Northeast, Midwest, and Northern/Southern Plains, the annual precipitation has decreased in areas of the West and Hawai'i.[75] Across much of the country, extreme precipitation is becoming more frequent and intense—the total precipitation on the heaviest 1% of days has increased across the majority of the U.S. (from 1958–2021), with the largest change occurring in the Northeast.[76]

Homes and businesses are at risk of flooding during extreme precipitation events. The number of NFIP payment claims has been rising since 2005, indicating that more homes and businesses across the U.S.

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[70] Horn, D., "A Brief Introduction to the National Flood Insurance Program," Congressional Research Service, April 2025, https://www.congress.gov/crs-product/IF10988

[71] Envionmental Law Institute, "The Coastal Property Insurance Crisis: Policy Options in a Time of More Severe Storms and Rising Seas," Read ahead for the March 13, 2024 webinar, https://www.eli.org/sites/default/files/files-general/2024-03-13%20Coastal%20Property%20Insurance%20Read%20Ahead%20Document.pdf

[72] Blake, E., Kimberlain, Todd., Berg, R., et al., "Tropical Cyclone Report: Hurricane Sandy," National Oceanic and Atmospheric Administration National Hurricane Center, February 2013, https://www.nhc.noaa.gov/data/tcr/AL182012_Sandy.pdf

[73] National Oceanic and Atmospheric Administration, "Costliest U.S. Tropical Cyclones," National Centers for Environmental Information and the National Hurricane Center, https://www.ncei.noaa.gov/access/billions/dcmi.pdf

[74] Environmental Protection Agency, "Extreme Precipitation," August 2026, https://www.epa.gov/climatechange-science/extreme-precipitation

[75] Marvel, K., W. Su, R. Delgado, S. Aarons, A. Chatterjee, M.E. Garcia, Z. Hausfather, K. Hayhoe, D.A. Hence, E.B. Jewett, A. Robel, D. Singh, A. Tripati, and R.S. Vose, 2023: Ch. 2. Climate trends. In: Fifth National Climate Assessment. Crimmins, A.R., C.W. Avery, D.R. Easterling, K.E. Kunkel, B.C. Stewart, and T.K. Maycock, Eds. U.S. Global Change Research Program, Washington, DC, USA.

[76] ibid

have been experiencing damages from flooding in recent years.[77] This statistic may also showcase the change in geographic distribution of extreme precipitation events, where some areas of the country that extreme rainfall events historically have not impacted are now facing the effects. As the frequency of extreme precipitation events increases, it may put more homes and businesses at risk of damage. Some communities, especially those that are exposed to riverine flooding, have invested in floodplain restoration to reduce downstream flooding. Individual homeowners also choose to raise their building foundation to prevent floodwaters entering their homes.

Event Highlight: 2016 West Virginia Flooding

On June 23, 2016, intense rainfall led to flash flooding that killed 23 people in West Virginia. Seven inches of rain fell in a 24-hour period, leading to record-breaking crest of the Gauley River. During this event, the water washed out roads, damaged homes and businesses, and rendered thousands of households out of power. The damage totaled $1.2 billion (Consumer Price Index-adjusted).[78]

[77] U.S. Department of Homeland Security, "Historical NFIP Claims Information and Trends," Federal Emergency Management Administration, https://www.floodsmart.gov/historical-nfip-claims-information-and-trends?map=countries/us/custom/us-all-territories&region=us&miny=all&maxy=all&county=&gtype=country

[78] National Oceanic and Atmospheric Administration, "The Historic 2016 Late June Flooding Event in West Virginia," National Weather Service Charleston, West Virginia Weather Forecasting Office, https://www.weather.gov/rlx/2016-historic-june-flooding

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