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



Forecast-Driven Supply Chains: Using Weather and Climate Data to Advance Distribution

Retail Case Study - Supply Chains

Updated August 2026

Acknowledgements

The National Oceanic and Atmospheric Administration (NOAA) acknowledges the key industry partners who contributed to the information collected by NOAA and its associated contract affiliates for this report. Their technical expertise, data sharing, and insights were instrumental in the successful development and completion of this paper.

Introduction

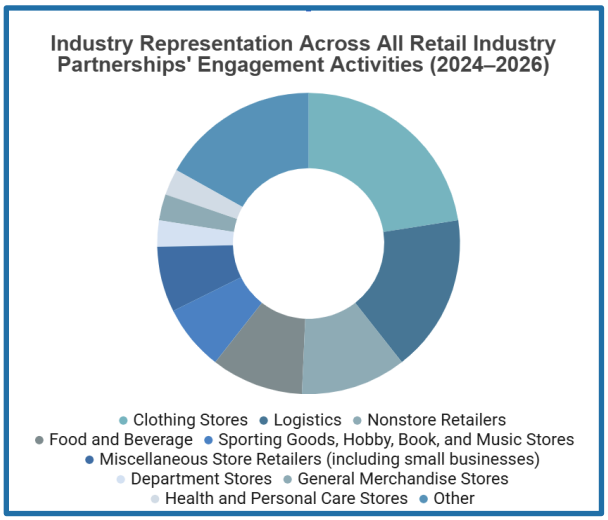
Every year, logistics and transportation managers grapple with balancing efficiency, safety, and their bottom line. When experts predict a strong hurricane season, or when wildfires, flooding, and winter storms close off shipping, rail or trucking routes throughout the country, planners and distributors must answer questions like:

- How similar will this event be to prior events?
- What are alternate routes and options that protect the specialty inventory or perishable goods?
- Which distribution center in the area is safest to send emergency supplies during this hurricane?
- Are we prepared to push out winter merchandise to stores early due to an unseasonably cold November?

Weather worldwide has the ability to disrupt every stage of the supply chain management flow[1], from sourcing and manufacturing to transportation networks, infrastructure, and product distribution. Disruptions affecting any part of the complex supply chain network can have significant operational and financial impacts. As a result, supply chains must be extremely flexible, responsive, and efficient to meet their consumer demand and protect their personnel and goods. Retail and logistics professionals are working to build proactive strategies to prepare for and respond to seasonal and major weather events.

To support the retail industry's ability to plan for and respond to these weather disruptions, the National Oceanic and Atmospheric Administration (NOAA) partners with industry leaders to address the availability, usability, and functionality of NOAA data, tools, and information resources. Through NOAA's Industry Partnerships, NOAA is co-developing weather and climate data products based on the explicit needs that industry members share to improve risk assessment, guide smarter investments, and bolster economic resilience to weather and climate extremes. Through this partnership, retail industry leaders requested an informational resource demonstrating how weather and climate data has been successfully applied to business decision-making and long-term resilience. The following sections of this paper synthesize insights from collaborative discussions with retail industry leaders conducted by NOAA's Industry Partnerships in 2025 and 2026. Interviews with individual retail companies (blue boxes) have been anonymized at their request.

[1] National Retail Federation and Planalytics, Inc., Climate-Proofing Retail: Proactively Managing the Opportunities and Risks of Weather Volatility (white paper, Washington, DC: National Retail Federation, 2024), 3.

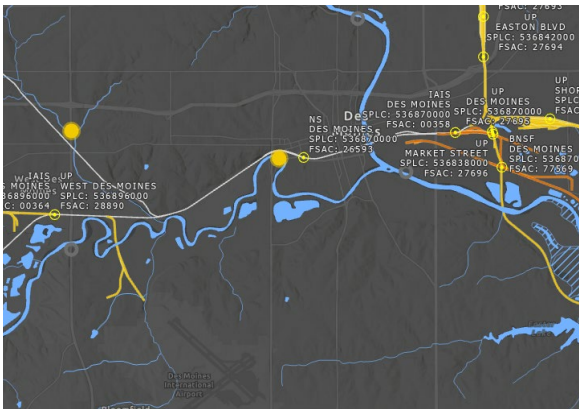


Industry Representation Across All Retail Engagement Activities (2024–2026)

Breakdown of industry segments (i.e., Clothing Stores, Logistics, Nonstore Retailers, Food and Beverage, Sporting Goods, Hobby, Book, and Music Stores, Miscellaneous Store Retailers (including small businesses), Department Stores, General Merchandise Stores, Health and Personal Care Stores, Other) represented across all Industry Partnerships' engagement activities—including interviews, conferences, webinars, and working group meetings—from 2024 through 2026.

Data in Supply Chain Distribution

NOAA weather and climate data and information resources support decision making throughout the supply chain, including shipping materials to and from production and distribution locations, retail storefronts, or directly to the consumers through last-mile deliveries. Distributors need visibility into weather conditions that can affect the availability and movement of goods, and they need it in formats they can easily overlay into their own logistics tracking systems. By creating accessible data tools based on user needs, NOAA is delivering this information in formats retailers and logistics partners can easily overlay into their own logistics tracking systems.



Dashboard interface showing real-time flood warnings near railroads in Iowa.
Image courtesy of [Railinc](#).

NOAA seasonal hazard outlooks and major event forecasts provide insight on risks such as transportation delays, inventory disruptions, and warehousing impacts that can affect distribution and delivery operations. These insights support inventory repositioning and transportation adjustments ahead of extreme weather events, reduce the cost of last-minute shipment rerouting, and help maintain continuity across retail distribution networks.

The following sections provide examples of use cases for seasonal planning, route optimization, and employee safety.

Seasonal Planning

NOAA Resources at a Glance

This section features NOAA data including:

- Climate Prediction Center's (CPC) Hurricane Season Outlook
- CPC's 8 to 14 Day Outlooks
- Storm Events Database
- Climate Atlas
- U.S. Climate Normals
- Weather Prediction Center's (WPC) 3-7 Day Hazards Outlook

While much of the attention for operational readiness falls to major storm events, there is a need to prepare for normal–or unusual–seasonal shifts. Distributors need to prepare to move seasonal goods like snow shovels, sandbags, or even lawn chairs into stores to meet consumers' needs as early as possible.

Understanding whether the current summer will come earlier than normal, be wetter or dryer than normal, or kick off a more intense hurricane season than normal all allow supply chain planners to set their facilities up for success and efficiency later in the year. However, that all requires an understanding of "what is normal?" in any given part of the country, as well as the seasonal outlooks. Products developed by Industry Partnerships—such as the Climate Atlas, the Storm Events Database (SED) and other NOAA tools like U.S. Climate Normals—provide retailers with this insight.

Historical weather data, including tools from the NOAA's Climate Prediction Center (CPC), supports retail supply chain planning by helping companies identify recurring operational risks associated with extreme temperature events, heavy precipitation, hurricanes, wildfires, and severe winter weather. This data helps retailers anticipate disruptions based on impacts from similar prior events, assess options, and make proactive decisions.

For example, a major pet supply store looks at hurricane and flood cycle forecasting for the next year, and walks through their crisis management plans as a leadership team several times throughout the year. They rely on forecasting and seasonal outlooks from Early Alert, a third-party service who synthesizes NOAA data into decision support tools.

Data in Action: Seasonal Planning for Home Improvement Supply

A national home improvement retailer relies on the sales of its onsite inventory both around major weather events and throughout the year. Should an impact from extreme weather close just one store for one week, this company stands to lose up to $2M in revenue. To this retailer, weather demand forecasting is crucial for all weather conditions, both favorable and adverse. For example, when the forecasts for next weekend anticipate nice weather, having access to NOAA data supports their seasonal preparedness to sell more lawnmowers. This retailer's operations management conducts four major seasonal planning meetings each year to ensure their plans are aligned with the seasonal forecasts.

In the spring, NOAA's Climate Prediction Center (CPC) releases its first Hurricane Season Outlook for the year, predicting whether it will be an active, average, or low-activity season. Over the following months, this retailer's operations teams leverage lessons learned from historical hurricane seasons to proactively plan inventory and distribution needs to be ready for up to three landfalling hurricanes per year.

When a hurricane forms in the Atlantic, this retailer does not panic 14 days out from landfall; instead, it activates its prepared and practiced emergency plans, which include daily meetings to review the data coming in from both private-sector sources (third-party monitoring through Accuweather Business) and NOAA CPC's 8-14 Day Outlooks and Weather Prediction Center's (WPC) 3-7 Day Hazards Outlook. Overlaying these tools with company site maps, can support better predictions and preparedness for impacts. Seven days out from landfall, this retailer escalates its Inventory Replenishment Program (IPR) and begins moving goods around. This allows stores to have the supplies they need to weather the storm, and ensures regional stores and warehouses have additional necessary supplies closer to impact.

Hurricane preparedness is a high-impact, critical part of operations. Similar steps are also taken when shifts in seasons bring unseasonable warmth or cold and there is a sudden, rapid change in the consumer demand for seasonal goods. Every morning, this retailer's operations command center team meets to discuss the environmental parameters they monitor, including the NOAA 3-7 or 8-14-day hazard tools to see where there is a risk of cold, high wind, or rain.

In late fall, this retailer brings together dozens of teams from across the company to survey and discuss how its weather-related operations worked or struggled during the previous year looking specifically for areas of opportunity to improve based on, for example, impacts from that year's hurricane season.

Route Optimization

NOAA Resources at a Glance

This section features NOAA data including:

- Event Footprint Catalog (EFC)
- National Hurricane Center (NHC) Track and Cone models
- NOAA Graphical Forecasts
- NOAA Office of Satellite and Product Operations (OSPO) Hazard Mapping System Fire and Smoke Product

Supply chain disruptions are common, making route optimization planning a strategic necessity for resilience. Organizations plan for uncertainty by building flexibility into operations, and developing the ability to pivot quickly in response to changing environments.

Having visibility of weather and climate risks– through tools such as the National Hurricane Center (NHC) Track and Cone models and other models that trace potential/ probable storm tracks–overlaid on a retailers' assets allows them to assess not only primary trucking routes, but their full logistics network in order to continuously optimize sales and delivery needs.

Real-time and near real-time weather data provide routing and scheduling teams with the data they need to make forecast-informed decisions. Anticipating extreme weather conditions and rerouting in advance can reduce costly last-minute adjustments and help ensure the timely distribution of goods to customers.

For example, a pharmacy retailer established a meteorology team during Hurricane Harvey in 2017 to assess where they could send trucks to better serve their customers located in impacted regions. The potential risk was so significant to their fleet that route optimization became the catalyst for this large retailer to begin leveraging weather data within operational decisions, which has since evolved into a more comprehensive risk management system

Data in Action: Route Optimization for Pet Store Supply Chain Management

Pet supply stores have to think about their employees, customers, and physical assets the same as other retailers, with an additional responsibility to think about the animals in their care. Not having the right plans in place could mean significant losses of their manufactured inventory as well as the lives of the animals in their care.

A large pet supply store utilizes Early Alert to stay ahead of weather and climate risks. This private company's platform relies on NOAA weather and climate data to serve their clients and provides the retailer with a dashboard that allows them to visualize hazard and risk information overlaid on their physical assets. The retailer tracks weather hazard data such as hurricane models, active tornado warnings, and even violent activity near stores that are non-weather related.

This retailer has several distribution centers in the U.S. each serving roughly 300 stores. When there is a distribution impact, they need to reroute their trucks to fulfill stores' needs. As soon as a hazard is flagged for this retailer, they activate their crisis management team within the impacted region to handle education, communication, and planning for their operations, logistics, and distribution center

teams. With insights from this team, its decision makers and on-the-ground staff can understand disruptions—such as road closures, mountain pass risks, snow level impacts, and active fire risks.

While their dashboard provides them with a suite of data tools, this retailer also leverages additional NOAA and CAL FIRE products to provide them with a comprehensive view of their risk exposure. Leveraging this weather and climate data gives them the foresight needed to adjust staff schedules and coordinate with distributors to ensure pet food, medicine, and other essential care items are on their shelves for the communities they serve.

Data in Action: Route Optimization for Pharmacy Store Supply Chain Management

Nationally located pharmacies depend on visualization across their supply chain network to not only navigate construction, major traffic accidents, or weight limit downgrades but also to avoid disruptions or losses caused by choosing suboptimal routes during extreme weather events. For a national pharmacy chain, getting ahead of such events is the difference between losing millions of dollars and failing to provide communities with crucial prescriptions, or saving millions and being a company communities can rely on when disasters strike.

This retailer is currently working to build further awareness across departments on the benefits of leveraging NOAA data within their operations. During imminent weather events, the company activates their corporate emergency operations plans, which includes having an internal meteorology team provide company specific forecasting to over 100 decision-makers within the company. These planning discussions provide the team with clarity on anticipated impacts and allow space to ask questions about hurricane landfall predictions, including timing and potential impacts. These predictions directly affect:

- Customer and employee communications
- Facility closures and distribution rerouting
- Delivery delays for prescriptions and other community essentials

In 2023 when Hurricane Idalia was approaching the Southeast, the NHC predicted it would hit somewhere between Louisiana and Northwest Florida. The retailer's meteorology team needed to decide between rerouting trucks to one of two distribution centers, where they were headed with supplies. To advise teams like sales and supply chain on risk management strategies, this retailer utilizes an Esri-developed geospatial platform. By overlaying NOAA data—such as the NHC's Track Forecast Cone and non-hurricane metrics like atmospheric pressure—with fleet and store locations, the platform flags active threats truck drivers could encounter en route.

Upon analysis of the hurricane track models, the pharmacy operations team decided to divert trucks in the region to their Tampa distribution center. This decision saved the company approximately $10 million dollars. Their dashboard allows this retailer to pull in a whole suite of crucial NOAA and other environmental data that can influence their decisions in response to potential impacts to supply chain operations, including the National Weather Service (NWS)'s wind speed data, Hazard Mapping System Fire and Smoke Product, and the Environmental Protection Agency's AirNow data.

Additionally, access to historical weather and climate data allows retailers to assess previous events in similar areas and develop alternative solutions to strengthen major post-event route optimization analyses. Multiple retailers highlighted the anticipated value of the new Event Footprint Catalog (EFC). Because the product maps a collection of past weather events characterized by their estimated impact footprint, this product fits retailers' needs for rapid, post-event response and future planning.

Employee and Fleet Safety

NOAA Resources at a Glance:

This section features NOAA data working alongside other data. NOAA data discussed includes:

- heat.gov
- NOAA Humidity Products
- Storm Events Database (SED)
- Climate Atlas
- Integrated Global Radiosonde Archive (IGRA)

Throughout NOAA's interviews with retailers, interviewees consistently named employee safety as a top priority. Without reliable weather data and communication channels, retailers risk exposing their employees to serious harm. Weather information and data that track potential threats allows retailers to respond fast when employees and assets like trucks are at risk.

E-commerce companies recognize that getting ahead of environmental risks strengthens their ability to track employee and fleet safety. Without storefronts, e-commerce retailers rely heavily on their ability to visualize a product's location from the moment it leaves the manufacturers' site to the moment it lands on their customers' doorstep.

Other top priorities such as business continuity planning and ensuring swift delivery times call for a system of constant asset oversight, enabling response planning with pinpoint accuracy.

For example, one global payment network and technology supply company leverages NOAA data during internal analyses of workforce risks such as extreme rainfall or heat exposure, to inform decisions on solutions that ensure safety and build resilience. By using NOAA's historical data, this company can get ahead of weather related system malfunctions by taking proactive steps (e.g., rerouting trucks, closing facilities) and avoid employee heat exhaustion or extreme precipitation related injuries. NOAA data and information to support extreme heat includes references to NOAA's National Integrated Heat Health Information System (NIHHIS), humidity, and other resources. Additionally, the Industry Partnerships program updated the Climate Atlas and Storm Events Database (SED) tools, which feature historical heat events and temperature anomaly variables

Data in Action: Employee and Truck Tracking for E-Commerce

A global e-commerce retailer works with thousands of manufacturers all over the world. This retailer uses a combination of NOAA and NOAA-informed data—including Integrated Global Radiosonde

Archive (IGRA), Accuweather, live television forecasting, and a third-party monitoring company AlertMedia—along with ground truth observations from employees for their weather information and emergency communications.

In emergency situations, this retailer stated that all operational decisions center on employee safety. They use Ratanjyot IT Solutions (RJS) and AlertMedia to overlay weather and event alerts with their asset and employee tracker system. The retailer can see live alerts for anywhere an employee is located or traveling to, and can see (for example) NHC's hurricane track predictions relative to their drivers and trucks.

Based on a decision to have a better understanding of potential environmental threats, this retailer installed in-house flood and lightning sensors at their operations facilities to better visualize workforce safety risk. Additionally, they train their staff on their alert notification system to minimize uncertainty during times of heightened risk exposure.

In 2024, Hurricane Helene was "the strongest landfalling tropical cyclone in the Florida Big Bend region since reliable records began around 1900."[2] Although Helene caused this retailer to temporarily close down a Florida distribution center–halting deliveries, delaying timelines, and disrupting truck routes–ultimately, the decisions they made by utilizing weather and climate tools allowed them to keep workers safe and avoid more significant impacts from this storm.

The Value of Continued Partnerships

In today's fast-paced environment, individuals don't often need to think about how goods (e.g., products, food, emergency supplies) arrive at their doorsteps. Authoritative environmental data can mean the difference between crucial supplies arriving on time, too late, or not at all.

Communities impacted by extreme weather events know all too well that when supply chains break down, their ability to function and meet basic needs comes to a halt. Stores run out of food, medications fail to reach patients, and gas stations lack the fuel needed to keep neighborhoods moving. We are all connected through supply chains, and NOAA is committed to reinforcing weather and climate supply chain resilience by refining existing sector priority data and tools and co-developing new tools based on industry input.

While the insights from the examples discussed above represent a strong foundation drawn from a select group of large-market leaders, they capture only a small segment of an incredibly vast sector. Continued engagement with the retail industry is vital to deepen NOAA's understanding of what data needs the retail sector has, particularly through the lens of planning, sourcing materials, manufacturing, warehouse management, and distribution.

"And our experience with NOAA and other partnerships is that candor, dialogue, ongoing dialogue is essential to success."

-Brian Dodge, President and CEO, Retail Industry Leaders Association (RILA)

[2] National Centers for Environmental Information, Helene in Southern Appalachia, ArcGIS StoryMaps, September 17, 2025, https://storymaps.arcgis.com/stories/8887acbd2dbd4d28a68e79fe53cbfaa3.

By working closely with the sector, through continued listening sessions, workshops, user testing, and the sharing of data applications, NOAA can ensure that the data is accessible and usable to support the supply chain process from origin to the final point of sale and back through reverse logistics. By strengthening understanding of supply chain decision-making processes, NOAA can continue to co-develop data products that support a more unified data flow.

To share industry use cases or contribute to the NOAA's Industry Partnerships engagement around retail resilience, email industryproving.grounds@noaa.gov.

Appendix A. Interview Contributors

Retail

- An e-commerce retailer, Conducted November 20, 2026
- A home improvement retailer, Conducted September-December 2026
- A pharmacy store chain, Conducted September-December 2026
- A pet supply retailer, Conducted September-December 2026

Financial Institutions

- A global payment network and technology supply company, Conducted September-December 2026

Organizations

- Retail Industry Leaders Association, Brian Dodge, 09/03/2026

Appendix B. References

National Centers for Environmental Information. "Helene in Southern Appalachia." ArcGIS StoryMaps. September 17, 2025. https://storymaps.arcgis.com/stories/8887acbd2dbd4d28a68e79fe53cbfaa3.

National Retail Federation, and Planalytics, Inc. *Climate-Proofing Retail: Proactively Managing the Opportunities and Risks of Weather Volatility*. White paper. Washington, DC: National Retail Federation, 2024.

Appendix C. Acronyms

CALFIRE	The California Department of Forestry and Fire Protection
CPC	Climate Prediction Center
EFC	Event Footprint Catalog
IGRA	Integrated Global Radiosonde Archive
NHC	National Hurricane Center
NIHHIS	National Integrated Heat Health Information System
NOAA	National Oceanic and Atmospheric Administration
NWS	National Weather Service
OSPO	Office of Satellite and Product Operations
RILA	Retail Industry Leaders Association
RJS	Ratanjyot IT Solutions
SED	Storm Events Database
WPC	Weather Prediction Center

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Working Together to Improve Resilience

NOAA collaborates with industry leaders to update and develop new data and observation products, including maps, interactive tools, and other datasets. By improving access to environmental data, NOAA connects decision makers with accurate, timely, and future-facing data products and services to support improved risk assessments and economic, community, and environmental resilience.

Together, we can empower safe, resilient, and cost-efficient decisions for short and long-term planning, which safeguards communities and the U.S. economy.



Contract #1305M423DNEEA0014
Professional, Scientific, and Technical Services Program (ProTech)
Satellite Domain – Small Business
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