



Success Stories on User Engagement

Global Science & Technology, Inc.

Case Study 5: Retail and Manufacturing

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GLOBAL SCIENCE & TECHNOLOGY, INC.



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i. Success Stories on User Engagement

This report examines user engagement with NOAA's National Centers for Environmental Information's (NCEI) climate and weather data. It demonstrates the value that the free and publicly available provision of NCEI's climate and weather data has provided to the retail and manufacturing industry. The numerous interviews, and desk-based research that inform this study, detail how retail and manufacturers are using NCEI's climate and weather data, for what purpose, and ultimately what benefit is gleaned from its usage. As documented in this report, NCEI's climate and weather data are of fundamental importance to these sectors which provide essential and luxury goods to the American and international public.

1. Report Overview

This success story is based on interviews with representatives from retail and manufacturing companies, and financial firms who invest in these industries. Interviewees include retailers representing motor vehicle and parts, food and beverage and apparel, and manufacturers representing machinery, motor vehicles and fabricated metal parts. Also interviewed in this analysis are financial institutions that invest or trade stocks in manufacturing or retail companies, or use industry data alongside climate and weather data to understand variability in macroeconomic conditions. A list of companies that were interviewed for this study is provided in Appendix 1 on page 25.

This report focuses on applications of weather and climate data, products and services in NCEI's *Climate Monitoring Section*. This Section "*monitors and assesses the state of the Earth's climate in near real-time, providing decision-makers at all levels of the public and private sectors with data and information on climate trends and variability including perspectives on how the climate of today compares to the past*" (NOAA NCEI, 2017a). Two products of particular importance to retail and manufacturers include the *State of the Climate reports* (annual and monthly), and the *Regional Snowfall Index (RSI)*. This report will focus on how these products are used by these industries, detailing the benefits that are derived from their use.

Acronyms used

MoM: Month over Month

NCDC: National Climatic Data Center (now, NCEI)

NCEI: National Centers for Environmental Information (formerly NCDC)

ND: No Date

NESIS: Northeast Snowfall Impact Scale

NOAA: National Oceanic and Atmospheric Administration

NRF: National Retail Federation

RSI: Regional Snowfall Index

YoY: Year over Year

2. Introduction

Retail and manufacturing are two industries within a broader supply chain that produce and deliver both essential and luxury goods to the American and international public. Manufacturers transform raw materials into finished products which are then sold by retailers to businesses and individual consumers in both physical and online stores. These two industries, along with other components of the supply chain, are responsible for the production and sale of everything from food products, to industrial machinery, to high end apparel, and provide items that are both essential to our health and wellbeing (i.e. food, materials for housing) and other items for pleasure and recreation.

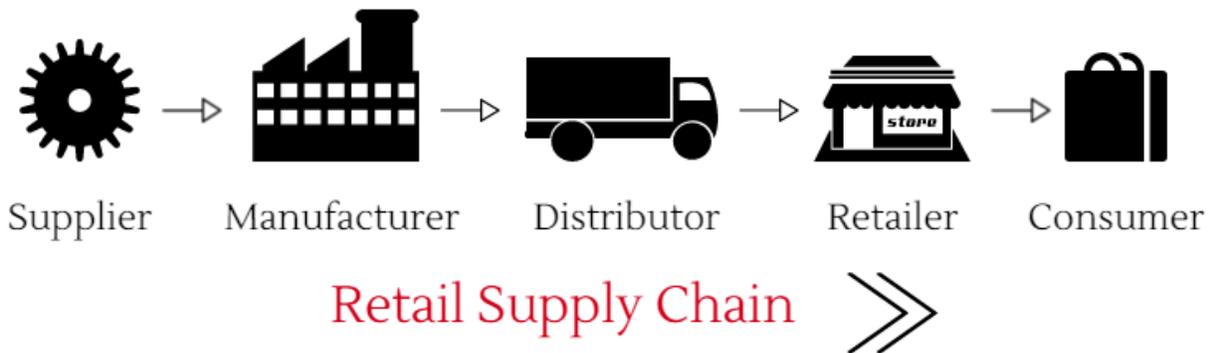


Figure 1: Manufacturing and retail are two primary components of a longer supply chain that provide goods to consumers. The primary components in the retail supply chain include supplier, manufacturer, distributor, retailer and consumer.

Source: Acclimatise

America's retail and manufacturing industries are major generators of economic growth and employment (NRF, 2014). Manufacturing contributes \$2.17 trillion or 12% to the U.S. Gross Domestic Product (GDP), while retail contributes \$1.06 trillion or 5.9% to the GDP (U.S. BEA, 2016). These industries are also major engines of employment. Manufacturing provides 12.3 million jobs, and employs 9% of the U.S. workforce, and retail employs 9.9 million people and employs 7% of the U.S. workforce (U.S. BLS, 2015). Retail activity is often used as a barometer to gauge the health of the American economy, due to the important role of this sector (RILA, 2016). Consumer spending accounts for nearly 70% of the total U.S. economic output, while government spending, by comparison, is 18% (Amadeo, 2017).

The welfare of the retail and manufacturing industries are influenced by a range of macroeconomic factors including employment rates (i.e. disposable income), customer values (i.e. fair trade, organic), government regulation, resource availability, technological advances, and weather. According to Goldman Sachs, retail and manufacturing are among the most weather-sensitive sectors, as weather

impacts both demands for goods and services, and customers shopping habits (Hatzius et al, 2015). For example, warmer weather conditions during winter months can decrease the demand for a range of costly seasonal apparel items including cashmere sweaters and down coats, industrial items such as snow blowers, and recreational items such as snowboards. On the other hand, a strong winter storm may impact the ability or willingness of customers to get to stores, or the ability of goods to get to market. However, this may prove profitable for online retailers such as Amazon that allow customers to shop from the comfort of their own homes (Hatzius et al, 2015). While the retail industry as a whole tends to suffer from unseasonal weather patterns or extreme events, weather patterns affect manufactures and retailers in complex and different ways (Anonymous Financial Analyst, personal communication, Feb 16, 2017).

While retailers and manufacturers cannot entirely insulate themselves from the impact that weather will have on their business, they can use weather and climate data to understand how weather impacts their business performance, and take actions to better plan for weather conditions. For manufacturers, this could mean manufacturing stock in accordance with forecasted weather conditions and for retailers allocating merchandise in regions where weather conditions are more conducive to sales. This information can also support investors when deciding to avoid or pursue investments in companies with weather volatility.

NCEI's *Climate Monitoring Section* offers data products that aid manufacturers, retailers, and investors in this capacity. Products of particular importance include the annual and monthly State of the Climate reports, and the Regional Snowfall Index (RSI). This success story will focus on how retailers, manufacturers and equity firms who invest in these industries, utilize NCEI's products to understand the impacts of weather on their business and make decisions accordingly.

3. NCEI data products used by retail and manufacturing

3.1. Climate Monitoring: State of the Climate Summaries

NCEI's Climate Monitoring Section offers several products that are used by retail and manufacturers. These include the State of the Climate reports, Climate at a Glance, and temperature, precipitation, and drought data. The State of the Climate reports are monthly and annual summaries that recap climate-related conditions on a national and global scale. These reports place the prior month (or year) within the historical context of all other months (or years) before that. For example, the January 2017 report ranks this month as the 18th warmest January on record, as compared to all other Januaries in the period of record (1895 - present) (NOAA NCEI, 2017a). These reports also provide more detailed information pertaining to temperature; such as minimum and maximum daytime and night time temperatures, precipitation; below average, near average, and above average regions of precipitation, information pertaining to snow coverage and ice extent, and summaries of synoptic conditions¹. The report also provides an overview of significant climate anomalies and extreme events such as tornadoes, hurricanes and tropical storms, droughts, and wildfires. In addition to nation-wide summaries, the reports further offer summaries for the six regions² provided by NOAA's Regional Climate Centers (NOAA NCEI, 2017b).

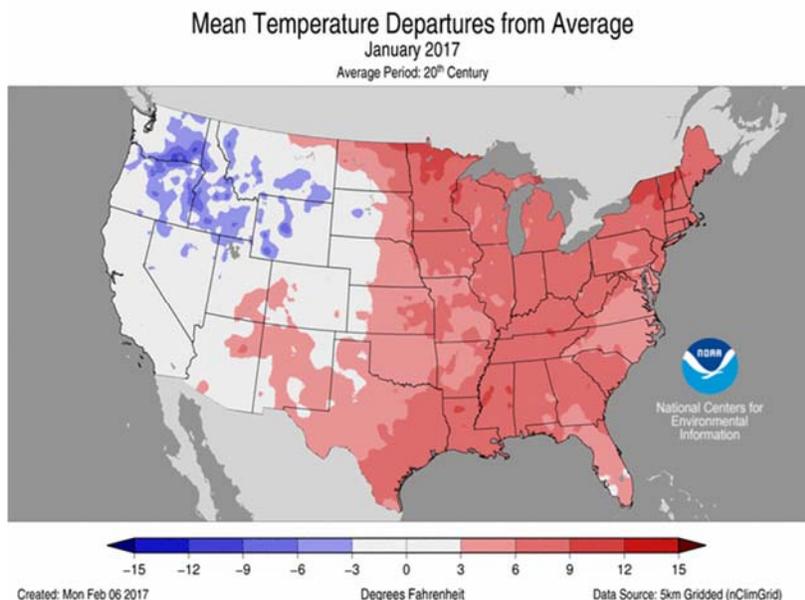


Figure 2: State of the Climate monthly reports are used by retailers and manufacturers to understand how temperature in a given month or year, deviated from average conditions
Source: NOAA's NCEI

¹ "Phenomena that cause weather including the 'jet stream, fronts and low pressure systems that bring precipitation, high pressure systems that bring dry weather and the mechanisms which control these features such as El Nino, La Nina and other oceanic and atmospheric drivers" (NCEI 2017c)

² Northeast, Midwest, Southeast, Southern, Western, High Plains

3.2. Regional Snowfall Index (RSI)

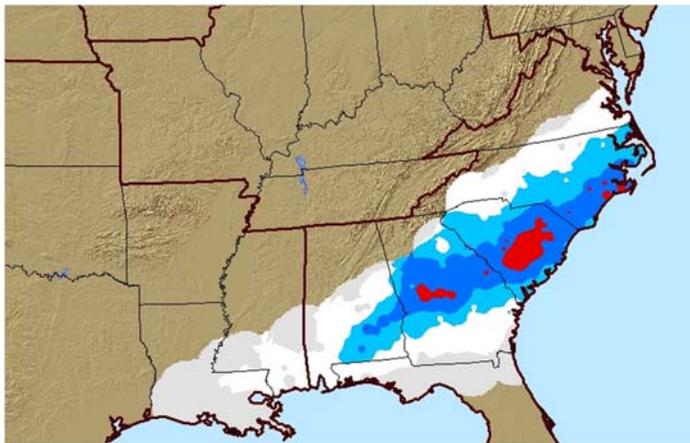
RSI is a regional snowfall index calibrated and produced for each of the six NCEI climate regions in the eastern two-thirds of the nation. It ranks snowstorm impacts on a scale from 1 to 5 based on the spatial extent of the storm, the amount of snowfall, and population based on the 2010 Census. The inclusion of population means that the index better accounts for societal impacts, as snowstorms in remote, less populated areas generally do not cause the same overall level of disruption as snowstorms in urban areas (Squires et al, 2014).



Figure 3: The six climate regions that are incorporated in RSI

Source: NOAA NCEI

The RSI evolved from the Northeast Snowfall Impact Scale (NESIS). NESIS was developed for snowstorms that have a major impact on the Northeast although it includes the impact of snowstorms on other regions as well. It is however calibrated to Northeast snowstorms, meaning that all snowstorms are compared to the Northeast baseline. The RSI, by contrast, is a regional index and therefore a separate index is produced for each climate region. It is important to discriminate by region considering that a 5-inch snowstorm in the southeast may be crippling, while in the northeast it may mean typical winter conditions (Squires et al, 2014).



RSI = 12.52, Category 4
February 9-11, 1973

Snowfall (inches)
+2" 2-8" 8-10" 10-15" +15"



Figure 4: RSI storms from category 1 to 5

Source: NOAA NCEI

3.3. How are these data products used?

The State of the Climate summaries and RSI are used by retailers, manufacturers, and investors in several capacities. They are used to help companies understand how well they are performing relative to weather conditions. This is usually done through the preparation of quarterly, year over year (YoY) and month over month (MoM) reports. YoY and MoM analysis are used to evaluate a company's performance on an annual or monthly basis, as compared with a prior year or month, respectively. These analyses highlight factors that are affecting business performance, for example weather ('Year over Year – YOY', ND). These reports can help explain 'artificially' low or high business performance to a company's Executive Board or an investor. For example, a company could perform really poorly in a month as a result of weather conditions, however it may just be a temporary phenomena and not an indicator of overall economic downturn. When paired with climate outlooks, aggregated analysis of climate and sales data help inform future-decision making such as how much product to manufacture, or how to stock items in various markets.

Investors rely on these data products to evaluate investments in companies with weather volatility. As a part of their due-diligence process on evaluating potential investments; analysts seek to understand all the factors that affect a company's performance. If weather is tied to a company's performance, investors turn to these data products to quantifiably understand these relationships, and make a well-informed decision on their investment.

Investment banks refer to these data products to understand the macroeconomic conditions. Investment firms will often release macroeconomic analysis, which highlight the external factors affecting the economy's performance. These analyses can include commentary on weather, particularly if there was an impactful weather event that affected the economy (i.e. major snow storm, heat wave, hurricane). In these instances, analysts will rely on NCEI's data to understand the impact that weather had on key economic industries including retail, manufacturing, payroll, and more. The following section details company-specific applications of the State of the Climate summaries and RSI across retail, manufacturing, and investment.

4. Applications: Climate Monitoring, State of the Climate Summaries

4.1. Company X

Company X is an American retailer that sells collegiate-inspired casual clothing and accessories. The strategic planning team seeks to understand the macroeconomic conditions that affect consumer behavior and purchases. They analyze weather trends as a component of this larger analysis, and compare it against sales performance. Like other retailers who sell outerwear, Company X has been impacted by unseasonably warm winter conditions and reduced sales of winter apparel items in the U.S. As a member of Strategic Planning notes about unseasonal weather, *“students going to school in mid-December when it’s 60 degrees [Fahrenheit] outside are not going to be thinking about buying a jacket”* (Company X, personal communication, Jan 12, 2017).

The Strategic Planning team compares the location of the company’s stores in the U.S. and Europe against the monthly State of the Climate summaries to understand how unseasonal weather conditions may have influenced consumer preferences for apparel. In particular they look for above or below average temperature and precipitation patterns relative to store locations. This information helps Company X understand how weather influenced the company’s performance in past months when preparing quarterly or MoM reports for the Board and Executive Council. It can also be used to improve product optimization in the future, by understanding how well products sell in certain weather conditions (other factors aside). The inventory and planning department can then make more informed decisions regarding product placement, if weather trends continue (Company X, personal communication, Jan 12, 2017).

4.2. Foot Locker Inc.

Foot Locker Inc. is an athletic footwear and apparel retailer that operates over 3,000 mostly mall-based stores nationwide. Over the past year Foot Locker has been using several products from the Climate Monitoring suite including; Climate at a Glance, temperature, precipitation, and drought data, and the monthly State of the Climate summaries. These data are used to understand the weather-related drivers that cause utility costs at Foot Locker’s stores to be higher or lower than budgeted. Foot Locker correlates monthly temperature data with utility costs from corresponding stores locations, to understand how utility bills correlate with temperatures. An analysis performed by Foot Locker in January 2017 shows that a 1.5°C increase in January temperatures nationwide meant that heating demand was down and therefore utility bills for store locations were lower than expected. Foot Locker found that the January 2017 temperature increase of 1.5°C compared to January 2016’s national

average, correlated to 1 cent per square foot savings in energy costs that month (Anonymous, personal communication, Mar 9, 2017). As the average Foot Locker store in the U.S. is 4,000 square feet, this could mean savings of roughly \$120,000 for the month of January alone (Foot Locker, Inc., 2017).

Foot Locker requires access to a range of data sources to validate any changes in their expenses when reporting to the Executive Committee. This information can not be anecdotal or based on assertions but needs to come in the form of hard verifiable, trusted data. With respect to climate and weather data, Foot Locker is pleased with NCEI as it provides a trustworthy and authoritative source of information.

Foot Locker's future objectives are to retrospectively correlate historical temperature data over a 3, 5, or even 10-year time period for budgeting purposes. If a retrospective temperature versus utility cost analysis were performed for all months and viable temperature scenarios, Foot Locker would be better informed on how temperature impacts their utility costs and therefore better equipped for budgeting. This information could then be paired with climate outlooks, and used to determine how much budget to allocate for future utility costs. More accurate budgeting would mean that more funding could be allocated toward capital investments, which would contribute to the overall profitability of the company (Anonymous, personal communication, Mar 9, 2017).

4.3. Kohler Engines

Kohler Company is an American manufacturing company best known for its plumbing products, however the company also manufactures furniture, cabinetry, tiles, engines, and generators. Kohler Engines is a manufacturer of gasoline, diesel, and alternative fuel engines. On the consumer side these engines are used in lawnmowers, tillers, and pressure washers, while on the industrial side they are used in forklifts and heavy duty construction equipment. Retailers that sell lawnmowers which contain Kohler engines include Home Depot, John Deere, Lowe's, and the Tractor Supply Company.

Kohler Engines refers to the monthly State of the Climate summaries along with the Drought Monitoring Products, particularly in spring and summer months to understand demand for lawnmowers. Warm and wet conditions are prime for grass growth, creating more favorable market conditions for lawnmower sales. A prolonged winter or late start to the spring season can delay sales, and in turn cause retailers to stock, rather than sell, inventory. Kohler is an avid user of NCEI's drought products as they provide current drought information on a county basis which can be paired with forecasts of future drought conditions to inform demand forecasting.

Kohler Engines refers to the State of the Climate summaries on a monthly basis to understand temperature and precipitation trends relative to prior years. This information is used to develop MoM reports which are sent out business-wide, providing staff and leadership with a sense of how the season is shaping up and whether Kohler is on track to meet its sales targets. This information could be used to tweak demand forecasts if weather conditions are creating more or less favorable conditions for lawnmower sales (Scott Smith, personal communication, Feb 10, 2017).

4.4. Conagra

Conagra Brands, Inc. headquartered in Chicago, is one of North America's leading branded food companies. Conagra provides a range of food products to dozens of large supermarket chains including Company Y.

Conagra Brands supplies a range of food products to Company Y, including dry grocery products (like canned tomatoes and hot cocoa) where sales performance is closely tied to weather. These items sell well in winter months when people are using canned tomatoes to make chili or other crock-pot dishes, or drinking hot cocoa on a cold day. As Conagra Brands supplies a high volume of these products to Company Y, they are interested in keeping tabs on the weather trends to inform their forecasting of product sales.

Conagra uses the monthly State of the Climate reports to generate end-of-season and MoM reports. This information is broken down into Company Y regions for each part of the country. As shown in figure 5, Conagra compares January 2016 temperatures (left graph) and sales, with January 2017 temperature and sales (right graph) and notes an overall increase in temperature and an overall decrease in January 2017 sales performance. National average temperatures for January 2017 increased by 0.76°C (+4.35%) as compared with January 2016, and sales declined by 0.61% as compared with January 2016 sales. Conagra attributes the decline in sales year over year to rising temperatures in key areas of the country. This is further indicated in Figure 5 where it shows that above average January temperatures cost the company over \$100,000 in revenue in the Mid Atlantic and Southeast regions. The post-analysis report also notes major winter storm events, although despite their occurrence, sales in all regions but one decreased as compared to 2016. This is the result of consumers being unable to get to stores.

This type of analysis is performed at the end of every month, and at the end of every season, to understand sales performance relative to other months and seasons. This also provides Conagra Brands with an understanding of how their products perform under certain weather conditions. When paired

with weather outlooks, this information can be presented to Conagra’s leadership team and Company Y, to advise on optimal stocking in Company Y’s sales regions. Without the monthly State of the Climate reports, Conagra would be missing a key piece of data to support these analysis (Anonymous, personal comm, Feb 24, 2017).

FY17 January

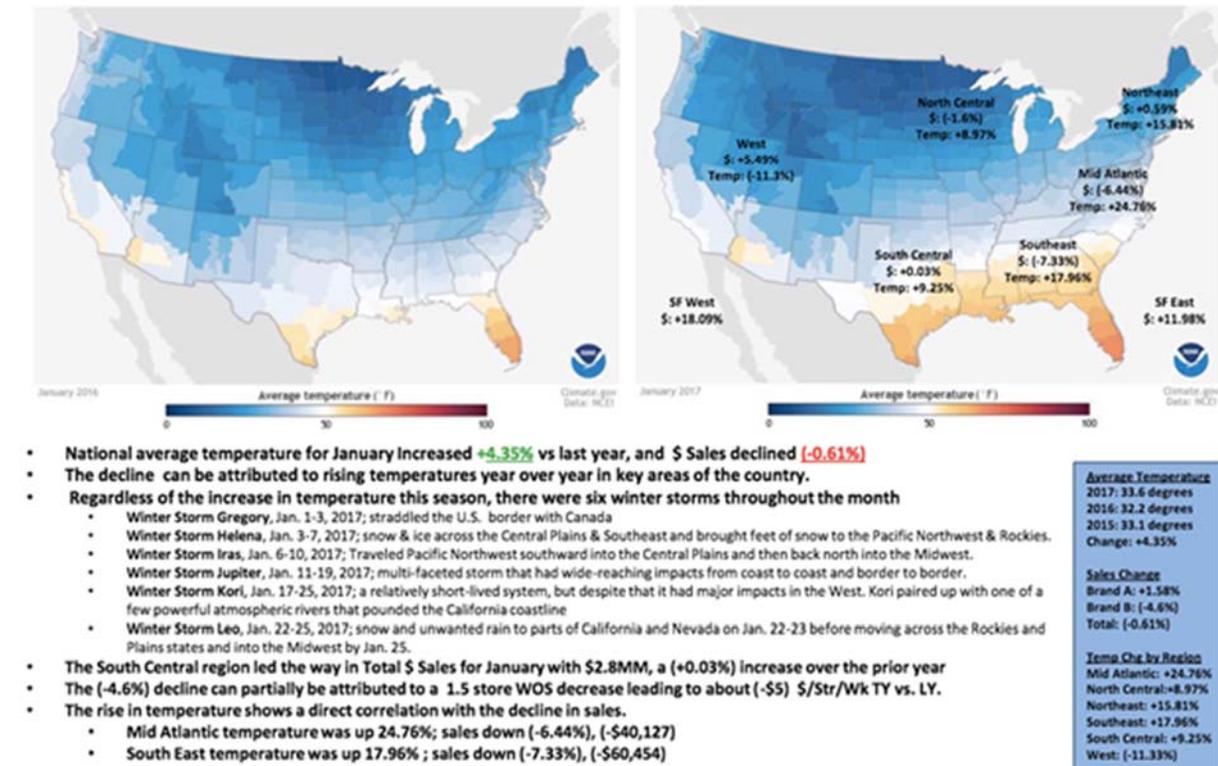


Figure 5: January 2017 Month-over-Month report for brand A and brand B (unknown)

Source: Conagra

4.5. Silvercote

Silvercote is a manufacturer of high-quality metal building insulation products, designed to project specifications. Its products are used in the construction of pre-engineered metal buildings (warehouse type), including six Costcos, two 1,000,000 square foot FedEx distribution centers, and 205 O’Reilly Auto Parts stores, each year (Robert Tiffin, personal communication, February 7, 2017). These metal buildings can have up to 600 foot walls, and require large amounts of insulation to stabilize the structure’s interior temperature and prevent moisture from entering through condensation (‘Insulate your Steel...’, 2017).

Precipitation and cold temperatures create unfavorable conditions for construction. Concrete,

which holds the anchor rods for supporting metal columns (pieces) of metal buildings, will not set when it's too wet or cold. The columns are the primary structure within which Silvercote manufactures custom insulation. Additionally, accumulation of rain or snow, may make the job site unsafe for construction. If construction jobs are delayed, Silvercote's orders may be pushed back causing revenues to shift into later months.

Silvercote uses the State of the Climate summaries to create a YoY and MoM analysis, to understand how business is operating relative to prior years and months. This helps Silvercote understand when money 'fell off the table' meaning that revenues shifted into later months or the next year, due to construction delays. When pairing these analyses with weather forecasts, they can also be used to understand whether they need to make adjustment to their sales territories. For example, if a region is not meeting sales targets due to weather, and similar trends are projected to continue, Silvercote could consider readjusting the size of the sale territory or prioritize sales in regions where weather conditions are anticipated to be more favorable for construction. NCEI's data helps inform important decisions to improve the company's performance (Robert Tiffin, personal communication, Feb 7, 2017).

"As a sales leader in our company, in projections going forward or explanations going backward, one of the active tools that I use now is the NCEI data. I've shown that it's credible data, I've shown that it's reliable data, and [within] our company, my boss and his boss in particular has accepted it, and is now actually starting to ask for it" - Robert Tiffin, Silvercote

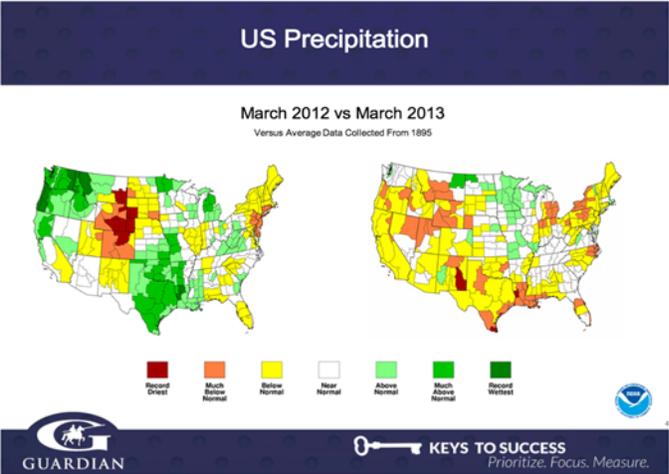


Figure 6: Month over month precipitation analysis created by Guardian BP, the parent company of Silvercote, to understand precipitation impacts on sales in March 2013, versus March 2012. **Source:** Silvercote

5. Applications of RSI

5.1. Ridgemont Equity Partners

Ridgemont Equity Partners is a Charlotte-based middle market buyout and growth equity investor. Since 1993, the principals of Ridgemont have invested over \$3.5 billion across more than 135 companies. The firm focuses on investments of \$25 million to \$100 million in several different industries including basic industries and services, energy, healthcare, and telecommunications/media/technology (Seth Greene, personal communication, February 6, 2017).

Ridgemont explored an investment in an automotive repair business, an industry whose performance, they heard anecdotally, was closely correlated with snowfall and winter storms. During winter storms the debris that lies on the road can flick up and hit windshields, creating small cracks. If precipitation sets in these cracks and freezes over, it can cause the entire windshield to crack. Further, winter storms and icy roads can create dangerous driving conditions, increased collisions, and thus higher demand for automotive repair parts and services.

As a part of due-diligence processes in reviewing new investments, Ridgemont sought to understand how snowfall and winter storms correlate to the performance of the automotive repair company. This information would provide Ridgemont with an overall understanding of how weather correlates to the company's performance, and whether the company's earnings have been artificially low, or artificially high in recent years. An 'artificially low' performance, meaning that a lack of snowstorms in recent years have made the company look like it is underperforming, would present a good opportunity to buy.

Ridgemont obtained RSI data from NCEI and plotted it against the company's revenue over a multi-year period to see how closely they aligned. **They found that the charts were nearly identical**, thereby confirming their speculation that the company performs best during and following winter storm conditions.

As weather is so closely tied to the company's performance, having the right data to inform this piece is critical to the overall investment decision, and how the investment deal is structured. "An important aspect of investing is being able to predict the revenue and profitability of a business over time which can be more difficult when external factors cause significant swings. In this case weather affects the financial performance of the automotive repair business which brings some concerns that we have to consider," explains Seth Greene of Ridgemont. In the absence of RSI, Ridgemont would potentially be making a decision worth tens of millions of dollars with incomplete information. Weather isn't the only factor governing the decision to invest in the auto repair company, however it is one of many important

factors. If Ridgmont didn't have this information, they would be making less informed decisions, or basing decisions on anecdotal information, rather than official data sources (Seth Greene, personal communication, February 6, 2017).

5.2. Honda Power Equipment (RSI)

Honda Power Equipment is a worldwide manufacturer of outdoor power equipment for landscape, garden, construction, industrial, and recreation. Some of its products include lawn mowers, snow blowers, tillers, string trimmers, and water pumps. Honda Companies also produce cars and motorcycles. Honda Power Equipment relies on RSI both to explain a prior month or year's sales, and for regional and national forecasting and merchandise allocation of snow blowers.

In highly populated areas of the upper northeast and midwest, winter snow conditions are common, however major snowstorms occur much less frequently near the coastline of the northeast. With significant snowfall within 50 miles of the I-95 corridor, a highly-populated region, sales of snow blowers increase. As the RSI factors in both population data and snow data into its calculation, this provides Honda Power Equipment with an understanding of how sales of snow blowers are performing, relative to the population. When Honda Power Equipment performs a MoM and YoY analysis, they overlay their sales data with RSI, to understand how snow conditions, or lack thereof, impacted their sales.

Another important application of RSI relates to merchandise allocation. When large snowstorms occur late in the winter, the pre-season (fall) is likely to be strong on snow blower sales. Retailers will stock inventory on their floors in late summer or early fall, and target their advertising towards snow blower sales. Customers will start buying snow blowers as early as August as snow storms from the previous winter are still fresh in their memory. Naturally, the greater the population density, the higher pre-season demand for snow blowers. Honda Power Equipment can use RSI to identify highly populated regions where snowstorms occurred late in the season, and make recommendations to retailers to stock their merchandise in the most strategic locations to optimize sales.

Honda Power Equipment also frequently uses the Drought Monitoring Products to understand how drought conditions will impact their sales of lawn mowers, particularly recently in the Western part of the country (Warren Reid, personal communication, February 20, 2017).

5.3. Sears

RSI HELPS SEARS MEET ITS CUSTOMERS NEEDS AFTER, AND BEFORE, SNOW STORMS

Sears, the major U.S. retailer with nearly 800 stores, has long struggled to meet demand for snow blowers when major snowstorms hit. Sears needed a way to make better-informed guesses about where and how many snow blowers to have ready. Sears needed help to understand this uncertain business to get ahead of demand.

When first faced with this problem Sears tried to see if commercial climate data providers could help but found that none offered what they needed. A product manager at Sears found that NCDC's RSI offered the best data on snowfall available, both at the right level of granular weather detail and with the crucial addition of population (this manager did have to convert Sears' corporate regional divisions to match the RSI divisions). This societal emphasis was crucial, since, for example, a snowstorm in Maryland affects sales very differently than an identical storm in Buffalo.

Sears also uses RSI to forecast the coming year's demand for snow blowers. By comparing past sales data and RSI, they found that a past year's snowfall was a major determinant in sales of snow blower next year. They particularly noticed how snowfall late in one year drives early performance at the start of the next winter. Sears also uses RSI to respond to major snow events. It is hard to predict snow, so Sears looks to historical data from RSI to optimize its inventory at the beginning of each season so that when a big blizzard hits they are ready with inventory in stock. RSI provides the data they need to take full advantage of their existing competitive advantage: a wide network of retail location and sophisticated logistics.

Sears was appreciative of the help they got from NCDC, but noted the initial challenge of finding and then initially using RSI on the website. However, they stressed the high value of these kinds of contextual, easy-to-interpret tools that are accessible to people not specialized in data/weather (Roderick McInnis, Sears, pers. comm. 2014)

Box 1: Text box retrieved from 2014 NCDC* Products and Service Market Analysis (Adams, 2014). NCDC*: NCEI's predecessor

5.4. U.S. Auto Parts Network Inc.

U.S. Auto Parts Network Inc. is a leading online retailer of aftermarket, replacement auto parts selling performance engine and collision auto parts. A significant portion of the business is the sale of collision auto parts which sell particularly well during winter months when there is ice and snow on the roads and a higher number of accidents.

U.S. Auto Parts Network Inc. began searching for reliable weather data as they recognize that winter weather events are correlated with their sales performance. The company came across RSI in early 2017 and is beginning to use this data source to help understand sales performance. They will aggregate their sales using the same RSI geographies and analyze sales performance with respect to RSI scores over time. The inclusion of the population component in RSI will make it especially relevant for this analysis as it can contextualize demand within population.

U.S. Auto Parts Network Inc. will use this data for explaining sales performance YoY and providing context to quarterly reporting. *“The data will be helpful in understanding the correlation between major winter weather events to our sales, and explaining big variances in sales year-over-year due to extent and timing of winter weather events,”* explains Sarah Gustafson of U.S. Auto Parts Network Inc. Having access to meaningful and reliable weather data in an easy-to-use format will be a very useful resource for the company (Sarah Gustafson, personal communication, February 8, 2017).

5.5. Investment Bank X

Investment Bank X provides financial services to a range of clients including financial institutions, corporations, governments, and individuals. The firm’s research division produces reports that are used by financial institutions, hedge funds and mutual funds to understand the current state and trajectory of the U.S. economy. These reports discuss whether economics data is weak in a given month due to a slowing economy, or whether there are external factors that are causing a temporary dip in the economy. As retail trade and manufacturing are important indicators of economic well-being, analysts often look at these industries data to inform their macroeconomic analysis.

On average, several times a month, weather features as a prominent factor in these reports. Weather can influence economic activity and economic data in dramatic ways, particularly in the winter. For example, a snowstorm or harsh winter can severely disrupt economic activity in the form of lost wages for hourly employees, loss of consumer spending at restaurants and retailers, and cancelled travel plans. One estimate of the 2014 ‘polar vortex’ claims that the economy suffered \$5 billion in losses from lost

wages, airline cancellations, and damaged water pipes (“Cost of the Cold”, 2014). However, the economy tends to bounce back following winter storm events and the economic setbacks are usually temporary. The availability of data to quantify, track, and estimate the impacts of weather is important to understand the strength of the economy.

Analysts at the research division are frequent users of the RSI and NESIS. During winter months, analysts monitor and download the RSI and NESIS indices and compare them against different measures of regional economic activities, including retail and manufacturing. These indices tend to be statistically significant in explaining deviations from season norms and are very helpful in predicting and explaining winter storm disruptions to economic activity. An analyst from the research division finds these data very valuable noting that while there is a lot of readily available data on temperature and precipitation on a national and local scale, snowfall and winter storm data is difficult to come by. One recommendation offered by the analyst is that the RSI be updated more frequently as it can sometimes take a couple weeks following a major storm before it is added to the RSI. The division also relies on the products in the Climate Monitoring suite, particularly the monthly State of the Climate summaries, to identify any unusual weather occurrences in prior months that may have affected the economy.

The reports help readers understand how economic activity and economic data are being influenced by severe weather. They can help predict quarterly GDP, inform how to invest or adjust fiscal and monetary policy goals, and inform understanding of the economic outlook. NCEI’s data is an important source of information in these reports, when winter weather activity has an influence on the economy’s performance (anonymous, personal communication, Feb 2, 2017).

5.6. Guggenheim Partners (RSI)

Guggenheim Partners is a global investment and advisory financial services firm that provides investment banking, capital market services, investment management, investment advisory, and insurance services to a broad clientele. The Macroeconomics Research team releases periodic publications that focus on the economy, and cover topics that are relevant to the performance of financial markets. In the winter of 2014 several snow storms impacted economic growth, primarily in the Northeast. Guggenheim Partners analyzed significant temperature deviations from the average winter month using Heating Degree Days (HDD) and snowfall extremes from RSI. When these two data points crossed a certain threshold they were classified as a severe winter. The team combined several severe winters and analyzed the patterns of retail sales against those conditions, and then compared

them against retailing patterns of average winter weather conditions. They found that while severe winters strongly impact retailers in the short term, there tends to be an economic bounce-back later in the year.

There were concerns at the time that the economy was heading back into a recession, based on what the economic data was showing. However, the analysis, informed by RSI, showed that the impact of severe winter weather was only causing a temporary dip in the market, and that the economy would bounce back in the following quarter. The analysis recommended that investors should maintain the course with their investment decisions. NCEI's data helps Guggenheim Partners tease out the influence of weather impacts on economic activity and data, and contribute to the investor's guidance (Matt Bush, personal communication, February 14, 2017).

6. Conclusion

Retail and manufacturing are two industries with high sensitivity to weather. Companies that manufacture or sell high-cost seasonal items can see drastic reductions in sales when weather is unseasonal. Even companies that do not manufacture or sell seasonal products can be impacted by weather if it impacts consumers shopping habits, or the ability of goods to get to market. Economic losses caused by weather can further cascade to the equity firms who invest in these companies. As retail and manufacturing are considered top indicators of economic well-being, when these two sectors underperform the whole economy is impacted.

Retail, manufacturing, and investment firms require access to a range of data sources to understand how external factors impact sales performance. Weather, one of these external factors, has been acknowledged by the interviewees to pose a material impact to their business. While the weather cannot be controlled, having the right data to understand, quantify, and measure its economic impacts is an asset for information-driven companies.

The companies interviewed in this analysis all rely on NCEI's climate and weather data to understand the past and plan for the future. Products from the Climate Monitoring Suite are of particular importance and include; Climate at a Glance, precipitation, temperature, and drought data, monthly and annual State of the Climate summaries, and the Regional Snowfall Index. Retail and manufacturers use these products to create annual, quarterly, and monthly reports and also to inform future decision-making. Companies can combine past sales data with climate data to understand how their businesses perform relative to certain weather conditions. They can then pair this aggregated information with climate outlooks to decide how much product to manufacture, or how to stock items in various sales regions. Investors also rely on these data to understand macroeconomic conditions by analyzing the effect that weather is having on an industry-wide scale.

This analysis has detailed trajectories of data usage, rather than one-time applications. Companies are continuing to discover applications for climate and weather data to understand risk and opportunities, and are becoming increasingly sophisticated in their usage. Retail and Manufacturers continue to turn to NCEI as a trusted and authoritative provider of climate and weather data and information.

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Appendix 1: Firms and personnel Interviewed

Interviews conducted by and/or in person.

Retailers

- Company X, anonymous, 1/12/2017
- Foot Locker Inc., anonymous, 3/8/2017
- Conagra, anonymous, 2/24/2017
- US Autoparts Network, Sarah Gustafson, 2/8/2017

Manufacturers

- Silvercote, Robert Tiffin, 2/7/2017
- Kohler Engines, Scott Smith, 2/10/2017
- Honda Power Equipment, Warren Reid, 2/20/2017

Finance and Equity Firms

- Investment Bank X, anonymous, 2/16/2017
- Anonymous Financial Analyst, 2/16/2017
- Ridgemont Equity Partners, Seth Greene, 2/13/2017
- Guggenheim Partners, Matt Bush, 2/14/2017

NOAA:

- NOAA NCEI: Deke Arndt, 12/20/2016
- NOAA NCEI: Jake Crouch, 1/20/2017
- NOAA NCEI: Mike Squires, 2/10/2017

Appendix 2: Industry sub-sectors

Retail trade sector includes the following sub-sectors:

- Motor Vehicle and Parts Dealers
- Furniture and Home Furnishing Stores
- Electronics and Appliance Stores
- Building Material and Garden Equipment and Supplies Dealers
- Food and Beverage Stores
- Health and Personal Care Stores
- Gasoline Stations
- Clothing and Clothing Accessories Stores
- Sporting Goods, Hobby, Book and Music Stores
- General Merchandise Stores
- Miscellaneous Store Retailers
- Nonstore Retailers (U.S. BLS, 2017)

Manufacturing sector includes the following sub-sectors:

- Durable goods:
 - wood products,
 - nonmetallic mineral products,
 - primary metals,
 - fabricated metal products,
 - machinery,
 - computer and electronic products,
 - electrical equipment,
 - appliances and components,
 - motor vehicles, bodies and trailers, and parts,
 - other transportation equipment,
 - furniture and related products,
 - miscellaneous manufacturing
- Nondurable goods:
 - food and beverage and tobacco products,
 - textile mills and textile product mills,
 - apparel and leather and allied products,

- o paper products,
- o printing and related support activities,
- o petroleum and coal products,
- o chemical products,
- o plastics and rubber products (U.S BEA, 2016)