



Actuarial Weather Extremes

June 2020



Actuarial Weather Extremes: June 2020

Wet Middle Atlantic U.S. states continuing heavy streamflows. Central and Northeast U.S. states dry and drought. Rare Western U.S. states derecho. High Arctic temperatures.

Overview

This report examines weather extremes in temperature, precipitation, and event damage. For high or low precipitation, we also look at extreme conditions for streamgage flow and drought. We show June monthly analysis as well as June year-to-date analysis, along with specific event analysis for wind damage.

Precipitation: The National Oceanic and Atmospheric Administration (NOAA) 2020 Spring flood outlook is carried over from March for reference (Figure 1).

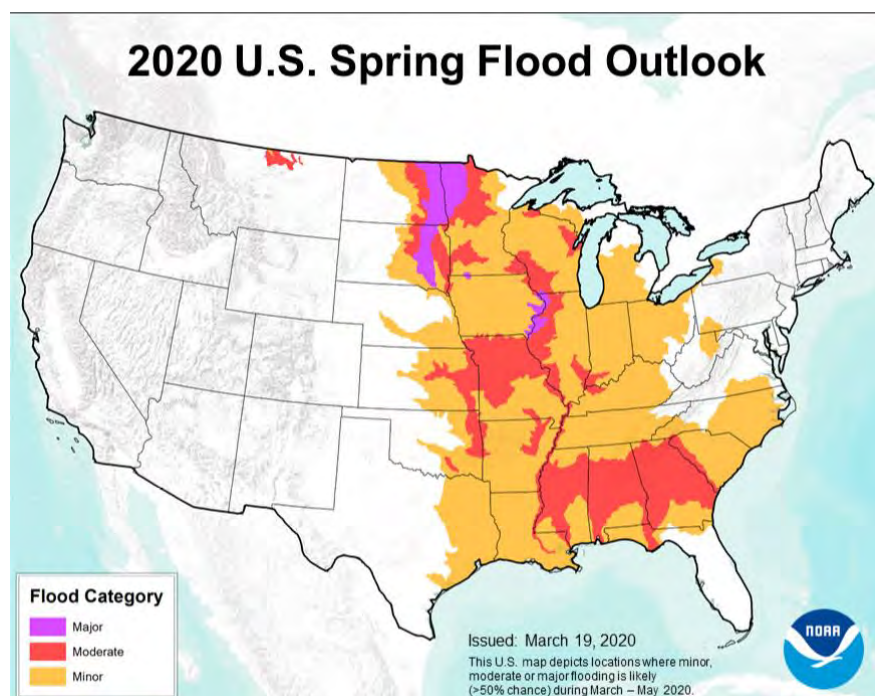
Year-to-date, the Southeast U.S., and Middle Atlantic U.S., have been among the wettest dating back to 1960, although the June 2020 averages show mostly dry extremes historically at the individual station level; concentrated in the Central U.S. states and states from Ohio and north and east. (Figures 2-3). Levels of United States Geological Survey (USGS) monthly streamflow conditions during June reflect this (Figures 7, 8).

Several stations in Central and North and East U.S. states were historically dry in June, 2020 (Figure 2), and drought and low streamflow conditions in the these areas also coincide with this (Figures 7-9).

Temperature: Many individual stations January through June 2020 temperatures are among the five warmest first half year averages dating back to 1960. In June itself, this is also the case in Western U.S. states, but Middle Atlantic U.S. states had among the coolest June months back to 1960 (Figures 4-5). On June 20, 2020, a town in Siberia may have set a record for the hottest temperature recorded in the arctic circle at 100.4 degrees Fahrenheit¹. June 20, 2020 Global Historical Climatology Network (GHCN) daily maximum temperature readings for stations north of the arctic circle (66.5 degrees north latitude) are shown in Figure 10.

Wind: A rare western states derecho occurred on June 6. According to a meteorologist at the NOAA Storm Prediction Center, only two other Western U.S. events are well documented in the literature.² A comparison of wind speeds with historical June Colorado wind speeds can be found in Figure 6.

Figure 1 <https://www.noaa.gov/media-release/us-spring-outlook-forecasts-another-year-of-widespread-river-flooding>



¹ <https://www.washingtonpost.com/weather/2020/06/21/arctic-temperature-record-siberia/>

² <https://twitter.com/WxLiz/status/1269552817351479297/photo/1>

Extreme Monthly Data

Figure 2

Global Historical Climatology Network (GHCN) station data showing the stations for which June 2020 was one of the wettest 5 Junes (Rank 1-5) and the driest 5 Junes (Rank 57-61) vs the month of June in the 61-year period 1960-2020.

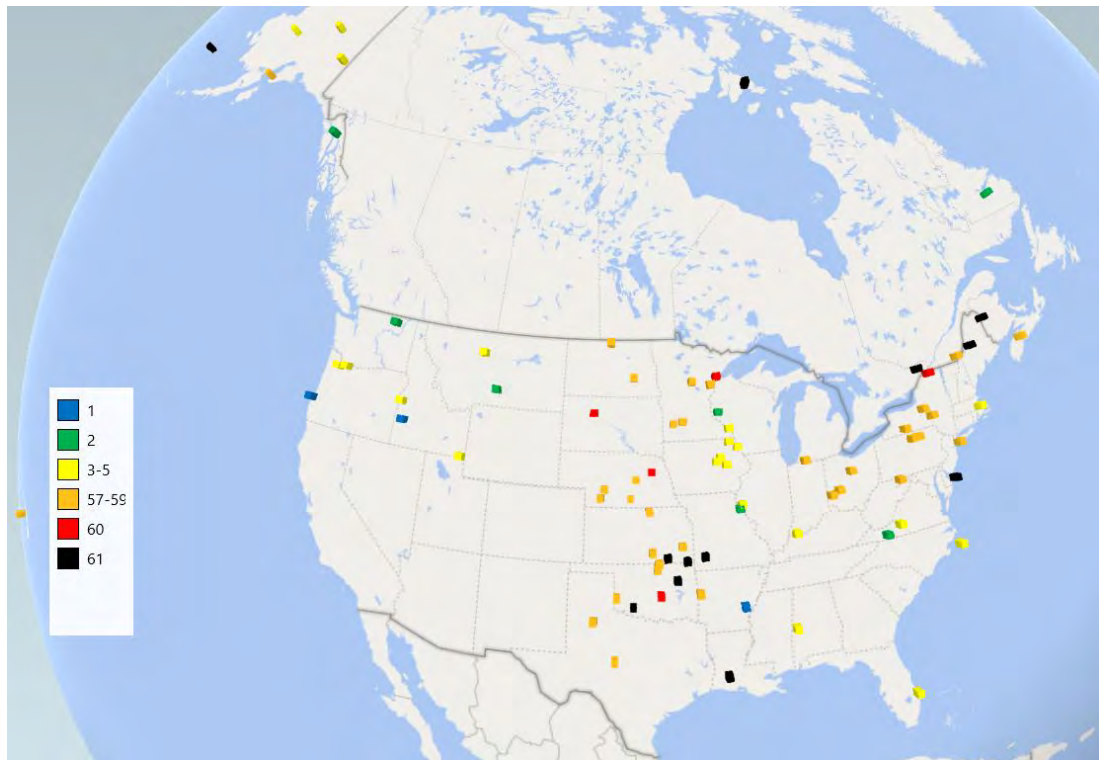


Figure 3

Stations which January-June 2020 was one of the wettest 5 Jan-June periods (Rank 1-5) and the driest 5 January-June periods (Rank 57-61) within the 61 January-June periods from 1960-2020 (source: Global Historical Climatology Network (GHCN) station data)

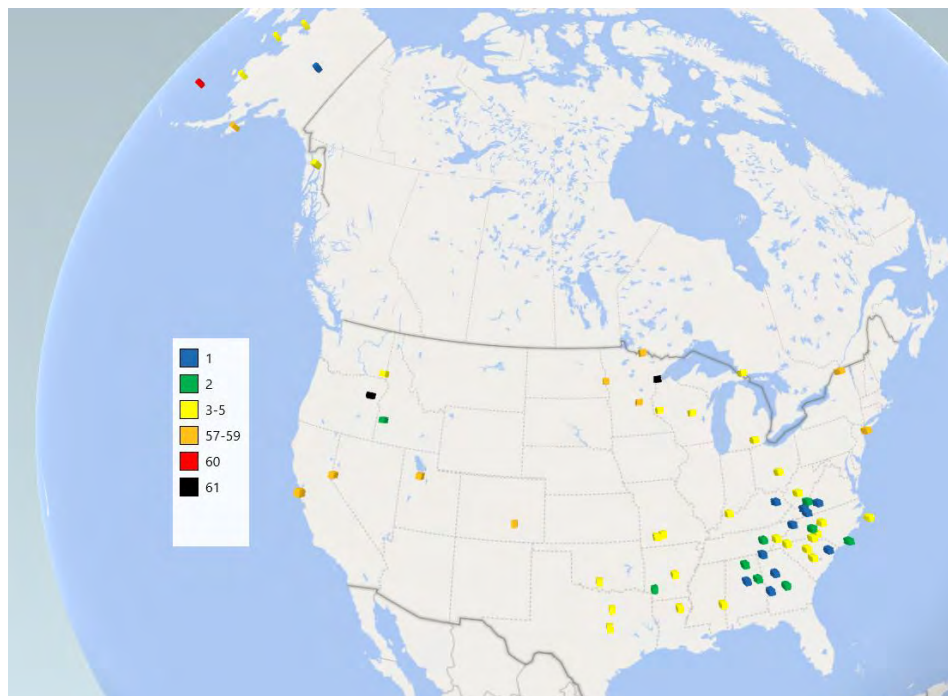


Figure 4

Stations which June 2020 was one of the hottest 5 June periods (Rank 1-5) and the coolest 5 June periods (Rank 57-61) within the 61 June periods from 1960-2020 (source: GHCN station data)

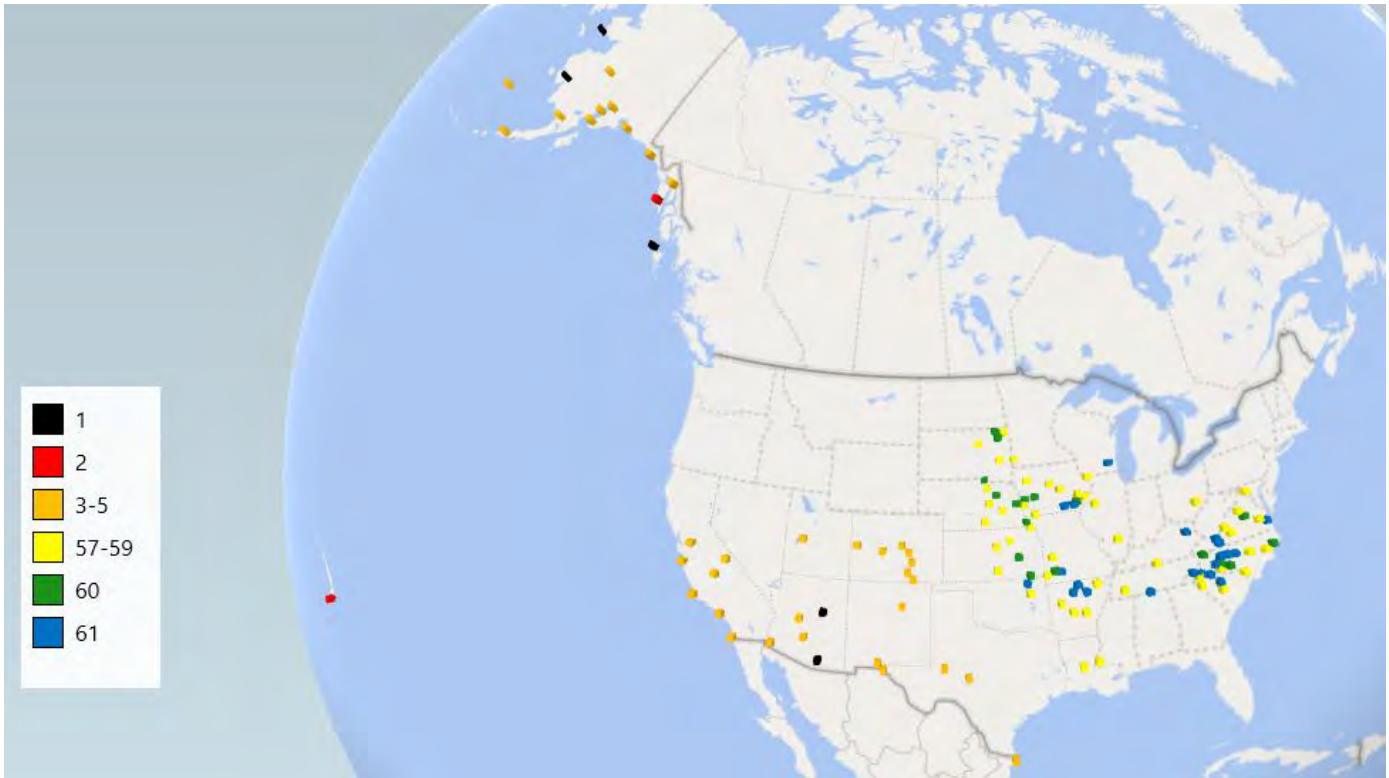
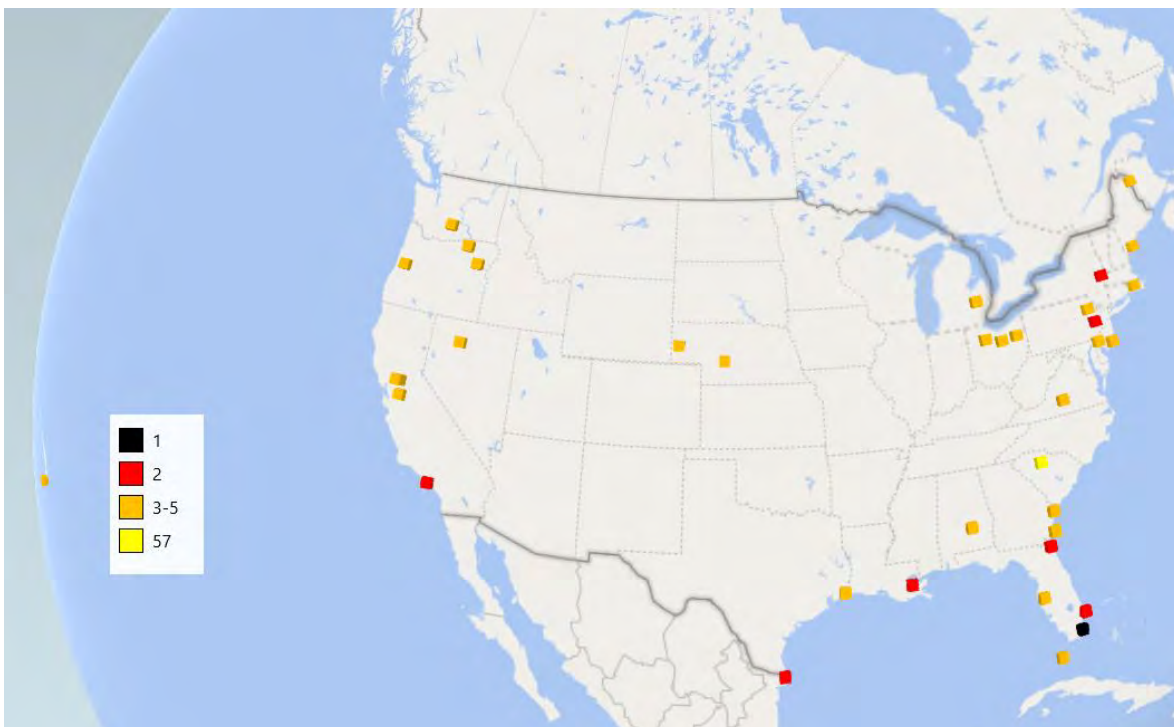


Figure 5

Stations which January-June 2020 was one of the hottest 5 January-June periods (Rank 1-5) and the coolest 5 January-June periods (Rank 57-61) within the 61 January-June periods from 1960-2020 (source: GHCN station data)



Extreme Wind Data

Figure 6

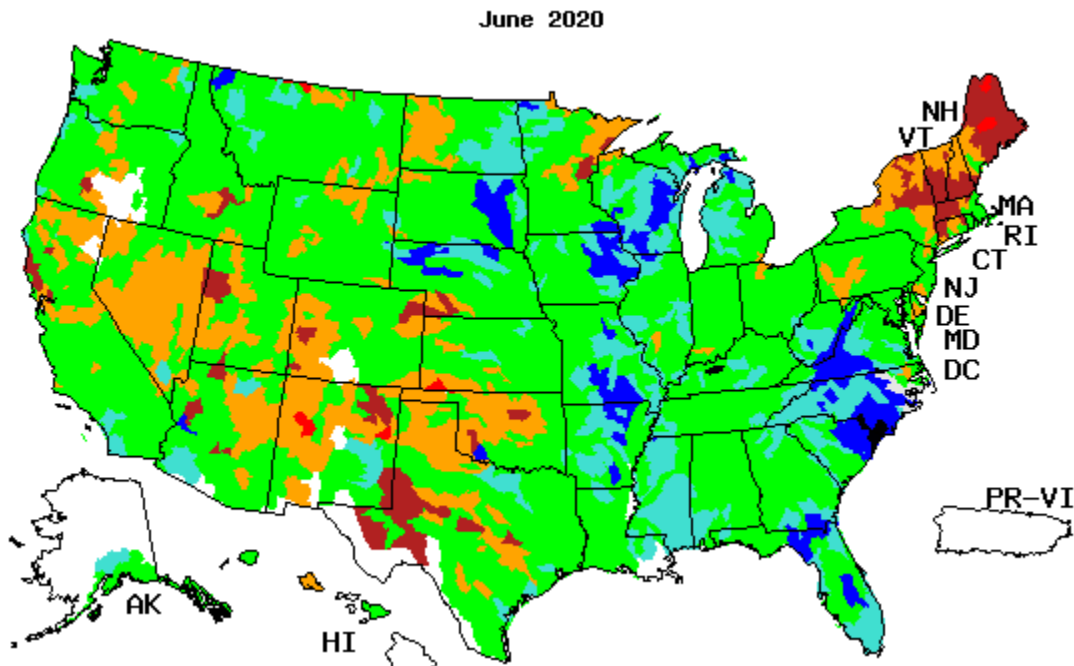
Two of the five highest recorded wind speeds in Colorado in the month of June, dating back to 1950, occurred in June 2020. (source: NOAA Storm Prediction Center and NOAA Storm Events Database)³

State	Location	Date	Wind Speed_MPH
CO	GARFIELD CO.	6/19/2000	115
CO	LINCOLN CO.	6/4/2014	110
CO	GRAND CO.	6/6/2020	110
CO	CENTRAL COLORADO RIVER BASIN	6/2/1999	104
CO	WASHINGTON CO.	6/8/2020	102
CO	LARIMER & BOULDER COUNTIES	6/6/2007	101
CO	LARIMER COUNTY	6/6/2007	101
CO	LOGAN CO.	6/30/1980	100
CO	KIT CARSON CO.	6/10/1999	100
CO	BACA CO.	6/25/2017	100
CO	BACA CO.	6/25/2017	100
CO	MOFFAT	6/6/2020	99
CO	LOGAN CO.	6/18/1980	99
CO	LOGAN CO.	6/9/1991	98

³ https://www.spc.noaa.gov/climo/reports/200606_rpts.html
https://www.spc.noaa.gov/climo/reports/200608_rpts.html
<https://www.ncdc.noaa.gov/stormevents/>

<https://www.ncdc.noaa.gov/stormevents/choosedates.jsp?statefips=-999%2CALL>

Figure 7
 Areas of high Stream flow in June 2020 (source: US Geological Survey (USGS))⁴



The "monthly streamflow" map shows the average streamflow conditions for the past month. The map depicts monthly streamflow conditions as computed at USGS streamgages. The colors represent monthly streamflow compared to percentiles of historical monthly streamflow for the month of the year. This map represents conditions adjusted for this time of the year. Only streamgages having at least 30 years of record are used.

Figure 8
 Explanations for high Stream Flow in June 2020 (Source USGS data)⁵

Explanation - Percentile classes							
Low	<10	10-24	25-75	76-90	>90	High	No Data
	Much below normal	Below normal	Normal	Above normal	Much above normal		

⁴ This map was downloaded from the United States Geological Survey's website on July 17. It reflects streamflow conditions as of June 2020. URL <https://waterwatch.usgs.gov/index.php?id=nwc>

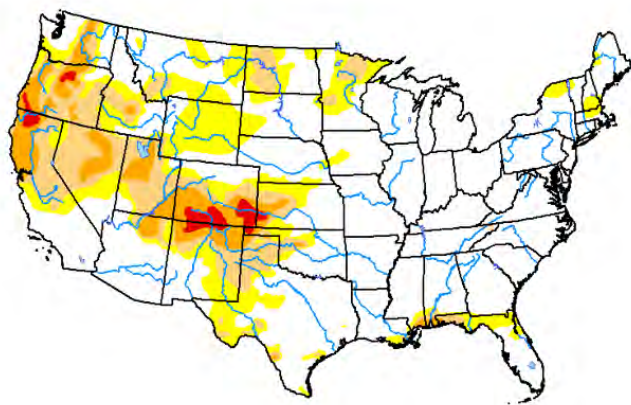
⁵ This table was downloaded from the United States Geological Survey's website on July 17. It reflects streamflow conditions as of June 2020.. URL <https://waterwatch.usgs.gov/index.php?id=nwc>

Drought Monitor Data

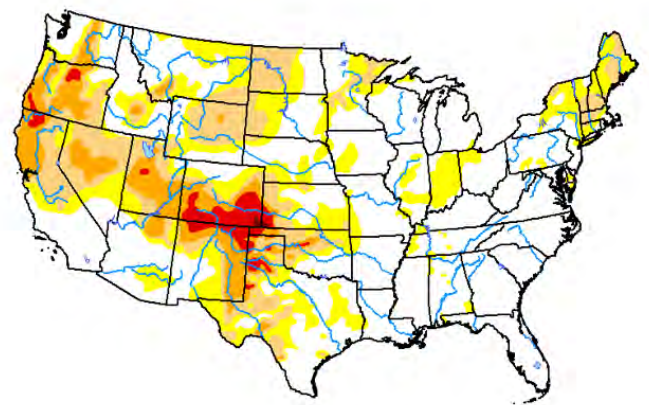
Figure 9
June 2, 2020 vs June 30, 2020 Drought Conditions. ⁶

Drought Classification

- None
- D0 (Abnormally Dry)
- D1 (Moderate Drought)
- D2 (Severe Drought)
- D3 (Extreme Drought)
- D4 (Exceptional Drought)
- No Data



June 2, 2020



June 30, 2020

⁶ The U.S. Drought Monitor (USDM) is a map that is updated on a weekly basis, illustrating the areas of the U.S. that are experiencing drought. It is developed jointly by the National Drought Mitigation Center, the National Oceanic and Atmospheric Administration, and the U.S. Department of Agriculture: <https://droughtmonitor.unl.edu/Maps/CompareTwoWeeks.aspx>

Extreme Daily Data

Figure 10

Daily high temperatures on June 20, 2020 at stations north of the arctic circle (66.5 degrees north latitude). (source: Global Historical Climatology Network (GHCN) station data)



Rough Assessment of the Losses Caused by Recent Extreme Weather

Economic and insured losses are often difficult to estimate in the immediate aftermath of an extreme weather event. With the passage of time, the extent of the losses gradually becomes clearer. Below, we offer a rough assessment of the cost of some of the weather events covered in our reports over the last few months:

June 2020: June 6 Colorado winds

According to The Weather Channel, winds gusted up to 110 mph, windows were blown out of homes, and nearly 100,000 were without power. Enough significant wind gusts were recorded on Saturday, June 6 that a record was set for most significant wind gusts in one calendar day. A derecho packing winds in excess of 75 mph moved across Wyoming and Colorado June 6, damaging homes and knocking down trees and power lines.⁷

May 2020: Magnitude 6.50 Earthquake in Nevada May 15, Michigan floods May 19

Highway damage from earthquake expected to exceed \$700,000.⁸

Michigan flood and dam failure May 19 led to evacuation of more than 10,000 people.⁹

April 2020: Tornado Activity From Texas to Maryland

At least 140 tornadoes were confirmed from Texas to Maryland April 12-13. There were 32 fatalities related to the tornadoes. More than one million homes and businesses lost power. There was large damage with costs likely to reach several billion dollars.¹⁰ We will look for developments of cost amounts for other April 2020 storm activity as it emerges.

March 2020: Heavy Rain, Flooding in Ohio and Indiana, Tornadoes in Tennessee

The AP News reported that five people were killed in Indiana after two vehicles were swept from roadway by floodwaters March 20.¹¹

The AP News also reported water rescues, power outages and road collapse in Central Ohio on March 20, 2020.¹²

AccuWeather reported that the March 3 Tornadoes in Tennessee had at least 24 deaths and losses estimated at \$1.5 billion to \$2.0 billion.¹³

February 2020: Heavy Rain in the Southeastern U.S.

The USA Today reported that about 1000 homes were flooded in Mississippi¹⁴, with the city of Jackson particularly hard-hit. Flooding led to an evacuation¹⁵ of some parts of Montgomery, Georgia. Evacuations also occurred in northwest Alabama¹⁶, where highway 231 was closed indefinitely due to flood damage¹⁷. In Savannah, Georgia, many roads were temporarily closed due to flooding¹⁸.

January 2020: Unseasonable Warmth Across Much of the Northern Hemisphere

One of the primary economic effects of the warm weather has been a reduction in the sales and consumption of fuel used for heating. According to an article in "Bloomberg Green", the loss in global oil demand due to warm weather is in the neighborhood of 800,000 barrels a day, which is, according to the article¹⁹, roughly equivalent to the daily oil consumption across Turkey (the country). Ski

⁷ <https://weather.com/news/news/2020-06-06-colorado-winds-power-outages-damage>

⁸ <https://www.usnews.com/news/best-states/nevada/articles/2020-05-21/governor-declares-emergency-after-big-nevada-quake-may-15>

⁹ <https://www.cnbc.com/2020/05/21/photos-show-devastating-impact-of-michigan-floods.html>

¹⁰ NOAA National Centers for Environmental Information, State of the Climate: Tornadoes for April 2020, published online May 2020, retrieved on May 11, 2020 from <https://www.ncdc.noaa.gov/sotc/tornadoes/202004>.

¹¹ <https://apnews.com/66c958d68ae35093b8b44c38d25dfeeb>

¹² <https://apnews.com/8d7fb96659bceaa1300b7bcd1d394dca>

¹³ <https://www.accuweather.com/en/severe-weather/accuweather-estimates-the-total-damage-from-the-tennessee-tornadoes-will-approach-2-billion/697185>

¹⁴ <https://www.usatoday.com/story/news/nation/2020/02/17/mississippi-flooding-swamps-southern-us/4784911002/>

¹⁵ <https://www.wtoc.com/2020/02/13/flooding-causes-mandatory-evacuation-order-montgomery-co/>

¹⁶ <https://www.al.com/news/2019/02/flooding-leading-to-home-evacuations-in-northwest-alabama.html>

¹⁷ <https://www.waaytv.com/content/news/Highway-231-Closed-Indefinitely--567952871.html>

¹⁸ <https://www.wtoc.com/2020/02/20/heavy-rain-flooding-affecting-roads-around-area/>

¹⁹ <https://www.bloomberg.com/news/articles/2020-02-09/energy-markets-need-winter-and-climate-change-is-taking-it-away>

resorts in France²⁰ and Japan²¹ have had a difficult year due to a lack of snow. In a positive note, the warm weather may have boosted employment growth in the U.S.²²

September – December 2019: Wildfires in Australia

On January 6, “Business Insider” reported²³ the following damage estimates related to recent and ongoing bushfires: 1600 destroyed homes, 5000 insurance claims totaling \$375 million, and 1% of GDP growth is estimated to be wiped-out. The article suggests that, after the damages are fully tallied, the cost will run into the billions of dollars. On January 7, “Time” reported that the fires have claimed the lives of at least 24 people²⁴. On January 7, the Wall Street Journal reported²⁵ that, in New South Wales, over 600 head of livestock were killed. Researchers at the University of Sydney estimate that nearly half a billion mammals, birds and reptiles have been killed²⁶.

November 2019: Flooding in Venice, Italy

According to a Wall Street Journal²⁷ published on November 25, the mayor of Venice has estimated the damage from the floods to be about \$1.1 billion. However, the estimated “cost could rise, as further damage emerges”.

November 2019: A Series of Winter Storms Across the Northern U.S.

The most widely reported impacts of the winter storms were school closings, road closings, power outages and flight cancellations. Property damage appears to have been minimal, although it is too soon to offer a reliable cost estimate.

October 2019: Typhoon Hagibis

According to AIR Worldwide, Typhoon Hagibis may generate between \$8 billion and \$16 billion in insured losses²⁸, with more than half of the losses due to inland flooding. According to “The Mainichi”, a Japanese newspaper, at least 83 people died²⁹ as a result of Typhoon Hagibis.

October 2019: Cold Spell Across the U.S. and Canadian Great Plains

Some farms have reported agriculture losses due to the unexpected cold. For example, “Freight Waves” reports \$45 million of estimated damage³⁰ to the potato crop in North Dakota and Minnesota.

September 2019: Hurricane Dorian

While Dorian had an impact in the U.S. and Canada, losses are heavily concentrated in the Bahamas where the storm was at its greatest strength. According to AON’s “Weather, Climate and Catastrophe Insight” annual report, the storm resulted in 83 deaths, economic losses of \$10 billion, and insured losses of \$3.5 billion.

September 2019: Tropical Storm Imelda

According to the USA Today, the storm has been linked to five deaths³¹, and, in its “Weather, Climate and Catastrophe Insight” annual report for 2019, AON estimates that economic losses are \$5 billion, while insured losses are \$1.2 billion.

September 2019: Heat/Dry Spell in the U.S. Southeast

According to the Wall Street Journal³², the unusual heat and dryness in the U.S. Southeast is having negative effects on agriculture. Potential effects include damage to grass used to feed livestock and damage to the cotton crop. In addition, the dry soil makes it more challenging to harvest peanuts. The Baltimore Sun (a newspaper) indicates that the drought is affecting soybean crops and could even affect next year’s wheat crop which must be planted this fall³³.

August 2019: Heavy Monsoon Rains in India

²⁰ <https://www.independent.co.uk/news/world/europe/france-ski-resort-closed-snow-mouris-pyrenees-weather-winter-a9331926.html>

²¹ <https://www.scmp.com/news/asia/east-asia/article/3046892/worst-winter-decades-japans-ski-resorts>

²² <https://www.reuters.com/article/us-usa-economy/mild-weather-boosts-us-job-growth-jobless-rate-ticks-up-idUSKBN2010G3>

²³ <https://www.businessinsider.com.au/australian-bushfires-cost-economy-surplus-government-spending-2020-1>

²⁴ <https://time.com/5758186/australia-bushfire-size/>

²⁵ https://www.wsj.com/articles/australia-fires-put-farmers-in-double-jeopardy-11578388736?mod=hp_lista_pos1

²⁶ <https://sydney.edu.au/news-opinion/news/2020/01/03/a-statement-about-the-480-million-animals-killed-in-nsw-bushfire.html>

²⁷ <https://www.wsj.com/articles/in-venice-a-struggle-to-rescue-damaged-art-and-architecture-11574703868>

²⁸ <https://www.air-worldwide.com/Press-Releases/AIR-Worldwide-Estimates-Insured-Losses-for-Typhoon-Hagibis-Will-be-Between-USD-8-Billion-and-USD-16-Billion/>

²⁹ <https://mainichi.jp/english/articles/20191022/p2g/00m/0dm/005000c>

³⁰ <https://www.freightwaves.com/news/mother-nature-turns-midwestern-spuds-to-duds>

³¹ <https://www.usatoday.com/story/news/nation/2019/09/21/texas-flooding-tropical-storm-imelda-death-toll-increases-5/2402290001/>

³² <https://www.wsj.com/articles/flash-drought-hits-south-as-record-heat-continues-into-fall-11570058348>

³³ <https://www.baltimoresun.com/weather/bs-md-drought-report-20190926-yooqxwbbuvclidise7a4oisugtm-story.html>

According to a Reuters' article published on August 14, heavy rains in the first half of August caused floods and landslides that displaced over one million persons in India and led to 270 deaths³⁴. An article in Business Today³⁵ on August 16 indicates that coffee yields in the states of Karnataka, Kerala and Tamil Nadu are expected to decline by 30% to 40% due to August's rains and floods. Sugarcane, cotton and apple yields are also likely to be reduced³⁶.

Because India's monsoon season is volatile weather phenomenon with significant rainfall variation from year to year, month to month, and region to region, flood-induced fatalities and economic losses are not unusual in India. According to data from India's Central Water Commission, across the period from 1953 to 2017 an average of 1600 persons died each year due to heavy rains and floods, and across the 5-year period from 2013 to 2017, the average was 1953³⁷.

August 2019: Heat Wave in Alaska

During August, large numbers of dead salmon were found in several Alaskan rivers³⁸. According to observers, the fish died prior to spawning, whereas salmon typically die only after spawning. Some researchers are attributing these premature deaths to unusually high river temperatures caused by a combination of high air temperatures and lack of rain³⁹.

July 2019: Heat Waves in the U.S. and Europe

Fortunately, few human lives were lost in these heat waves. In regard to economic costs, an assessment is difficult. Some examples of the impact of the heat waves are as follows: (1) in both Germany and France, a number of nuclear power plants had to be taken offline, thus temporarily reducing total power generation⁴⁰; (2) in the United Kingdom, railway service was disrupted because the unusually high temperatures caused train tracks to expand or kink⁴¹; (3) in the United Kingdom, thousands of chickens died in a farmhouse that lacked a cooling system⁴²; and (4) on a farm in the Netherlands, over 2000 pigs suffocated⁴³ after a ventilation system failed during the heat wave.

July 13-16, 2019: Hurricane and Tropical Storm "Barry"

Over \$600 million in economic losses and nearly \$300 million in insured losses, according to industry experts.

³⁴ <https://www.reuters.com/article/us-southasia-floods/india-floods-kill-more-than-270-displace-one-million-idUSKCN1V413K>

³⁵ <https://www.businesstoday.in/current/economy-politics/karnataka-floods-landslides-brew-fresh-troubles-coffee-second-year-straight/story/372972.html>

³⁶ <https://economictimes.indiatimes.com/news/economy/agriculture/sugarcane-cotton-apple-crops-hit-by-late-rainfall-pan-india/articleshow/70744401.cms>

³⁷ https://www.business-standard.com/article/current-affairs/at-107-487-india-accounts-for-1-5th-of-global-deaths-from-floods-in-64-yrs-118071900052_1.html

³⁸ <https://time.com/5661024/alaska-high-temperatures-salmon-deaths/>

³⁹ <https://observers.france24.com/en/20190821-salmon-die-alaska>

⁴⁰ <https://www.reuters.com/article/us-france-electricity-heatwave/hot-weather-cuts-french-german-nuclear-power-output-idUSKCN1UK0HR>

⁴¹ <https://www.telegraph.co.uk/news/2019/07/25/uk-heatwave-britain-bracing-hottest-day-record-temperature-could/>

⁴² <https://www.independent.co.uk/news/uk/home-news/chicken-uk-heatwave-farm-deaths-lincolnshire-tesco-sainsbury-a9025516.html>

⁴³ <https://veganuary.com/blog/over-2000-pigs-suffocate-on-factory-farm-as-ventilation-system-fails/>

June 21-22, 2019: Derecho in Central and Eastern U.S.

An extreme wind event known as a “derecho” caused damage across a 1000-mile path from Nebraska to South Carolina. Thousands of structures affected, with economic losses estimated to be over \$100 million by industry experts.

May 2019: Severe Weather in U.S. Plains, Midwest and Southeast

Tornadoes, straight-line winds, hail, flooding: close to \$3 billion of economic losses and \$2 billion of insured losses, according to industry experts.

May to June 2019: Flooding in U.S. Breadbasket

Flooding has had a significant impact on farmers’ ability to plant crops this year. Economic and insured losses are estimated to be in excess of \$4 billion by industry experts.

Data

The precipitation data used in this report was obtained from the Global Historical Climatology Network (“GHCN”) weather database, which provides daily weather observations from over 100,000 weather stations worldwide, covering over 180 countries. The database is publicly available through the National Oceanic and Atmospheric Administration (NOAA) via the following FTP site:

<ftp://ftp.ncdc.noaa.gov/pub/data/ghcn/daily/>

Filename = [ghcnd_all.tar.gz](#)

The online documentation for the GHCN dataset does not indicate whether the precipitation field contains, in addition to rainfall, the liquid-equivalent for other forms of precipitation such as snow and sleet. Therefore, for a random sample of several hundred stations, we compared daily precipitation data against daily snowfall data. We found that, without any exceptions, the precipitation data field captures both rainfall and the liquid-equivalent amount of snowfall.

SOA Research Team for This Report

Patrick Wiese, ASA and Rob Montgomery, ASA, MAAA, FLMI

Acknowledgements

The authors wish to thank Matthew Self, ASA for his contributions to the assimilation of wind data that the author’s used for this analysis.

About the Society of Actuaries

With roots dating back to 1889, the Society of Actuaries (SOA) is the world’s largest actuarial professional organization with more than 30,000 actuaries as members. Through education and research, the SOA advances actuaries as leaders in measuring and managing risk to improve financial outcomes for individuals, organizations, and the public.

As part of its work, the SOA seeks to inform public policy development and public understanding through research. The SOA aspires to be a trusted source of objective, data-driven research and analysis with an actuarial perspective for its members, industry, policymakers and the public. This distinct perspective comes from the SOA as an association of actuaries, who have a rigorous formal education and direct experience as practitioners as they perform applied research. The SOA also welcomes the opportunity to partner with other organizations in our work where appropriate.

Society of Actuaries
475 N. Martingale Road, Suite 600
Schaumburg, Illinois 60173
www.SOA.org