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Actuarial Weather Extremes
May 2020

Actuarial Weather Extremes: May 2020

Cold and Wet Southeast U.S., record cold snap Northeast U.S., high incidence of earthquake in Nevada and major flooding, particularly in Great Lakes region.

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, flood conditions, and drought. We show May monthly analysis as well as May year-to-date analysis. We also look at individual daily extremes for temperature in May, which in the Northeast United States were record cold.

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

The Southeast U.S. / Middle Atlantic region continues in May a year-to-date trend of very high precipitation areas relative to the month of May in the reference period 1960-2019. (Figures 2-3). Heavy United States Geological Survey (USGS) monthly streamflow conditions during may reflect this (Figures 7, 8).

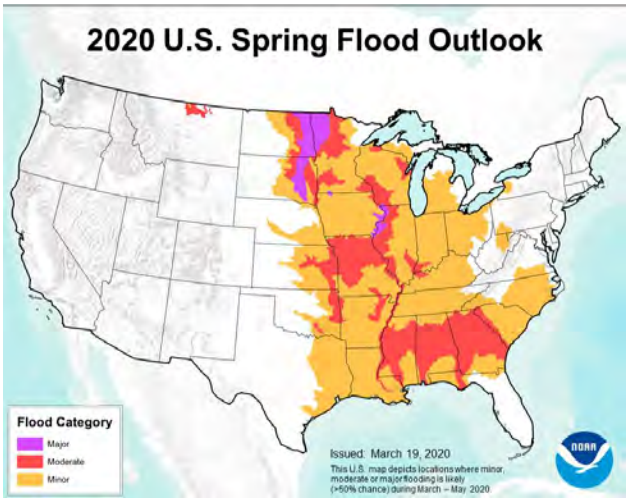
The West central U.S. was historically dry in May, 2020 (Figure 2), and Drought conditions in the Rocky Mountain states also coincide with this (Figure 9).

Figure 12 shows USGS stream gage stations that reached either action level, or one of the three stages of flooding. Major Flooding, (characterized by: "Extensive inundation of structures and roads. Significant evacuations of people and/or transfer of property to higher elevations."[1]) was widely existent in the Great Lakes region, particularly in Michigan where dam failure lead to evacuation of more than 10,000 people.[2]

Temperature: The Central and East Central U.S. region was also very cool relative to the historic month of May (1960-2019) with many stations having the lowest average daily high temperature for May since 1960 (Figure 4) The Northeast U.S. and portions of Kansas had record cold daily high temperatures at many stations; in some cases, 6-8 degrees Fahrenheit below the previous record (Figure 6).

Earthquake: There have been 595 earthquakes in the continental U.S. above magnitude 4.0 recorded in the month of May since 1952 (Figure 10). Many years there are very few. In May 2020, there were 39 magnitude 4.0 or higher earthquakes recorded in the continental U.S., which is the second highest May earthquake incidence in this region since 1952 (Figure 11). Most of these 39 earthquakes occurred in Nevada near the California border.

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



[1] https://waterwatch.usgs.gov/webservices/

[2] https://www.cnbc.com/2020/05/21/photos-show-devastating-impact-of-michigan-floods.html

Extreme Monthly Data

Figure 2

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

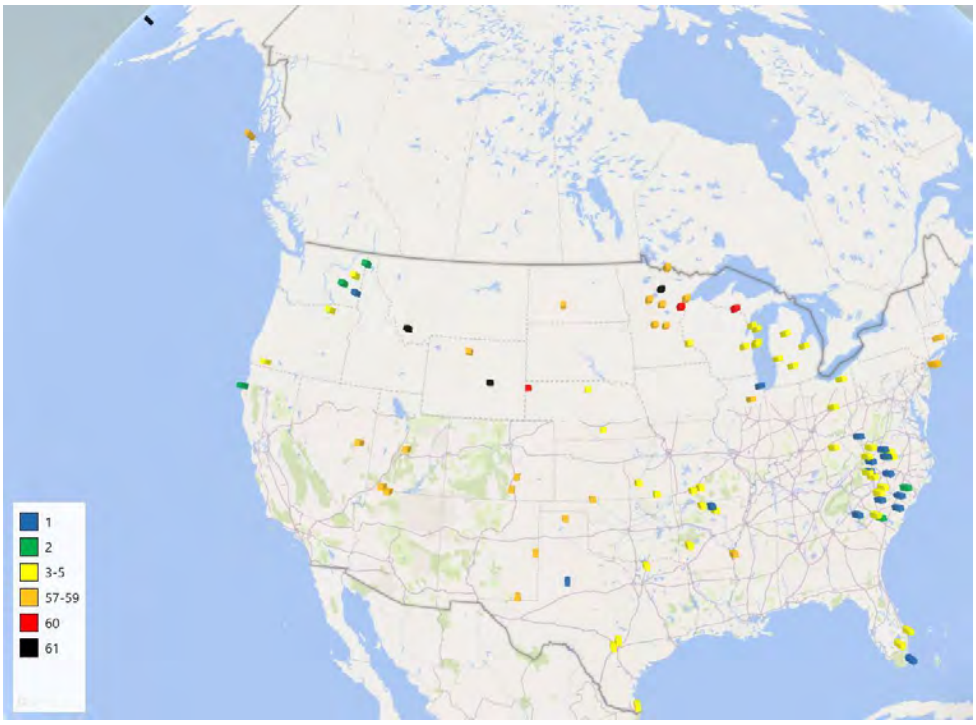


Figure 3

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

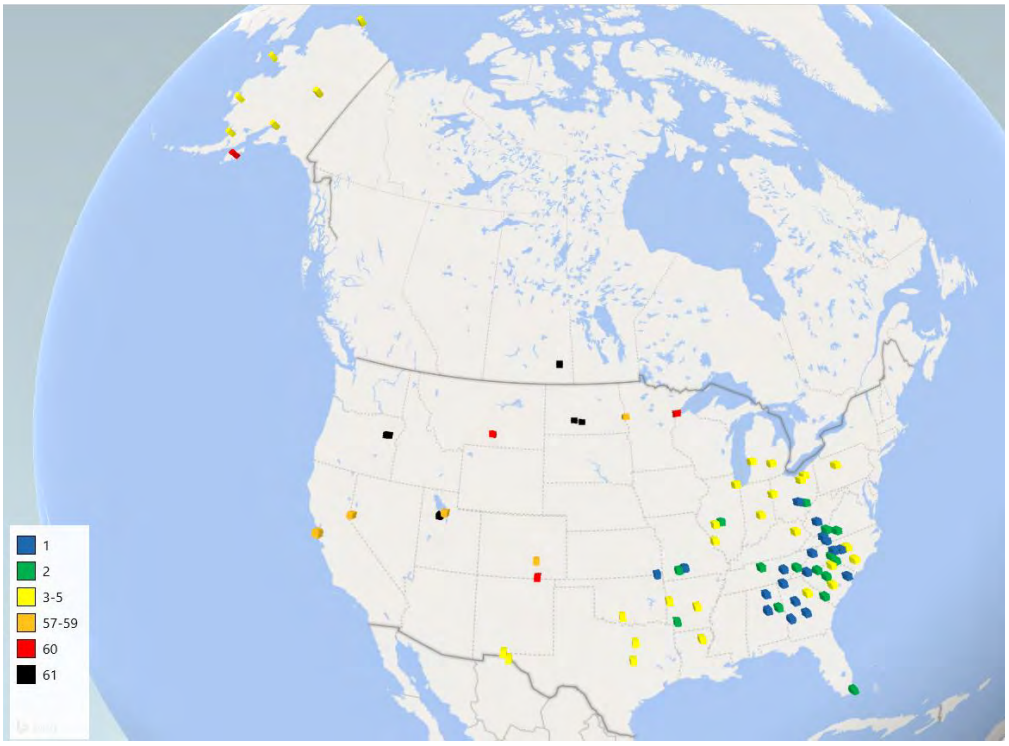


Figure 4

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

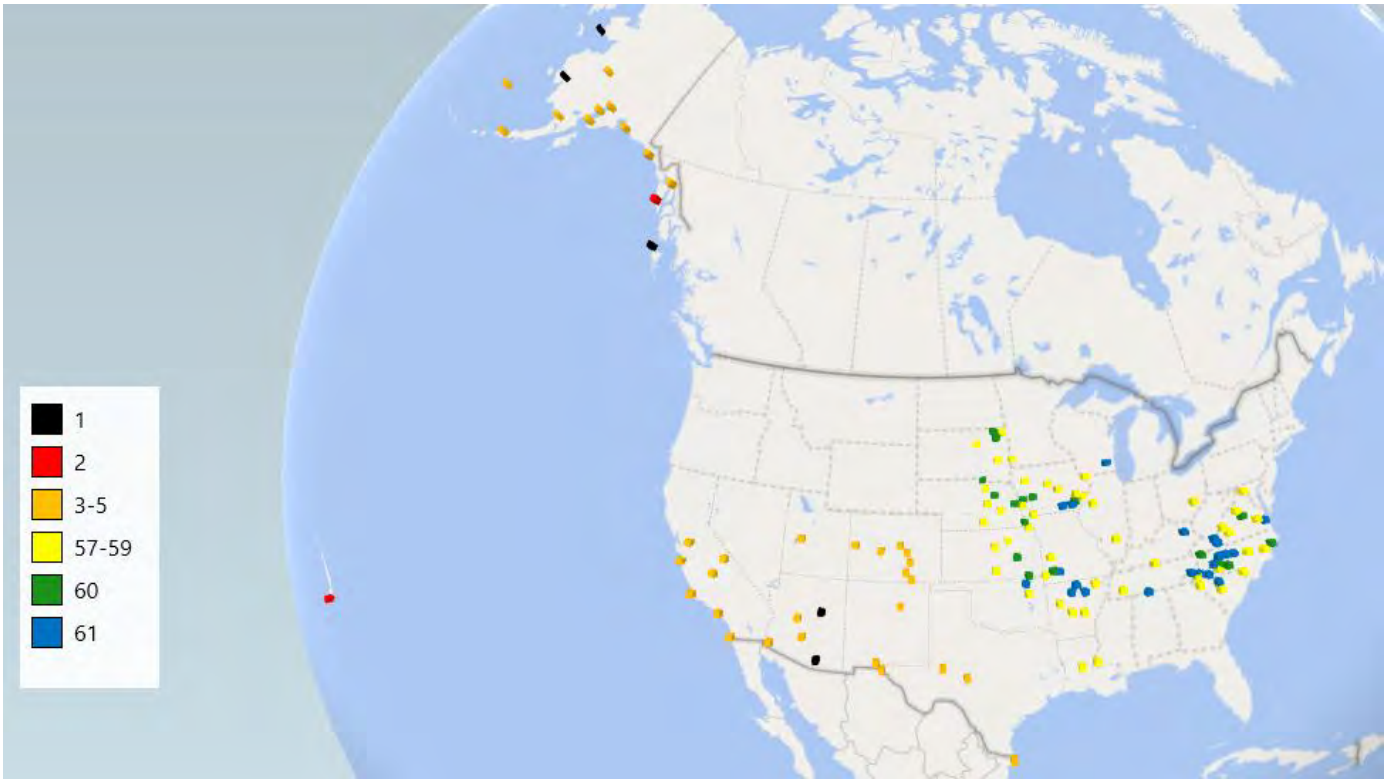
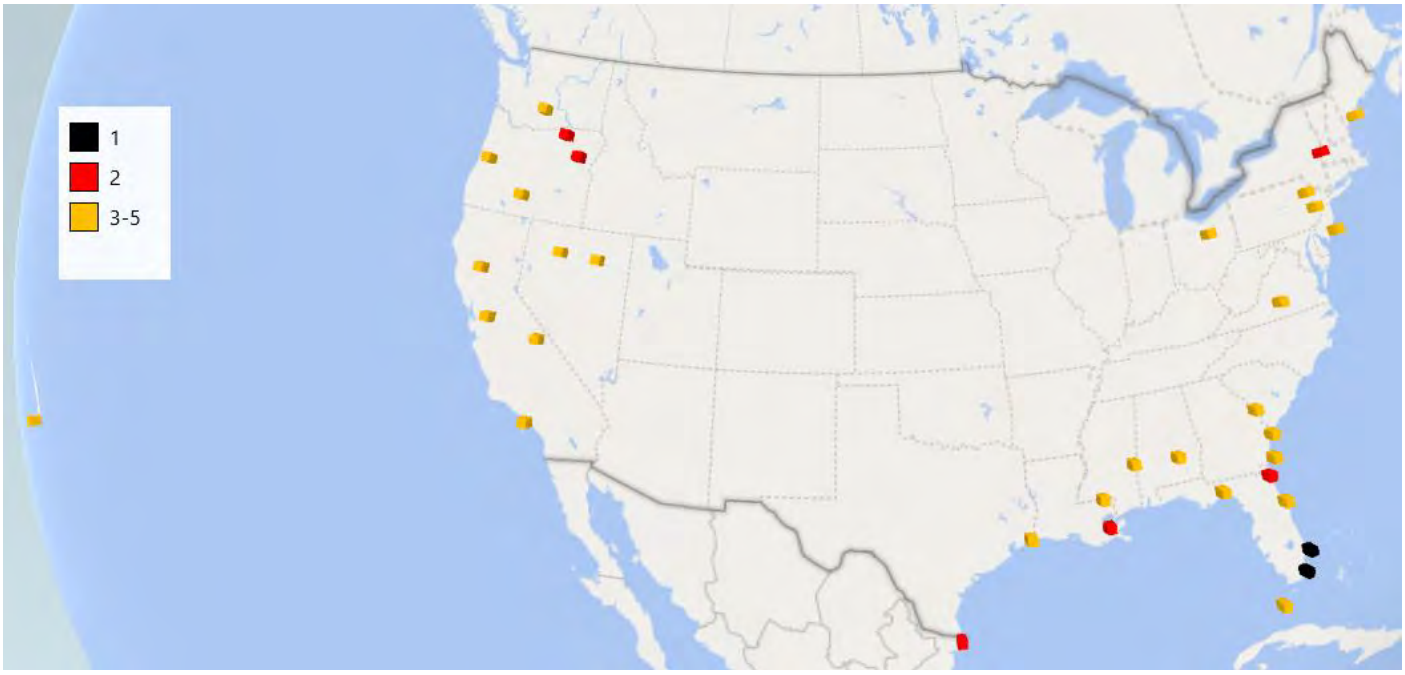


Figure 5

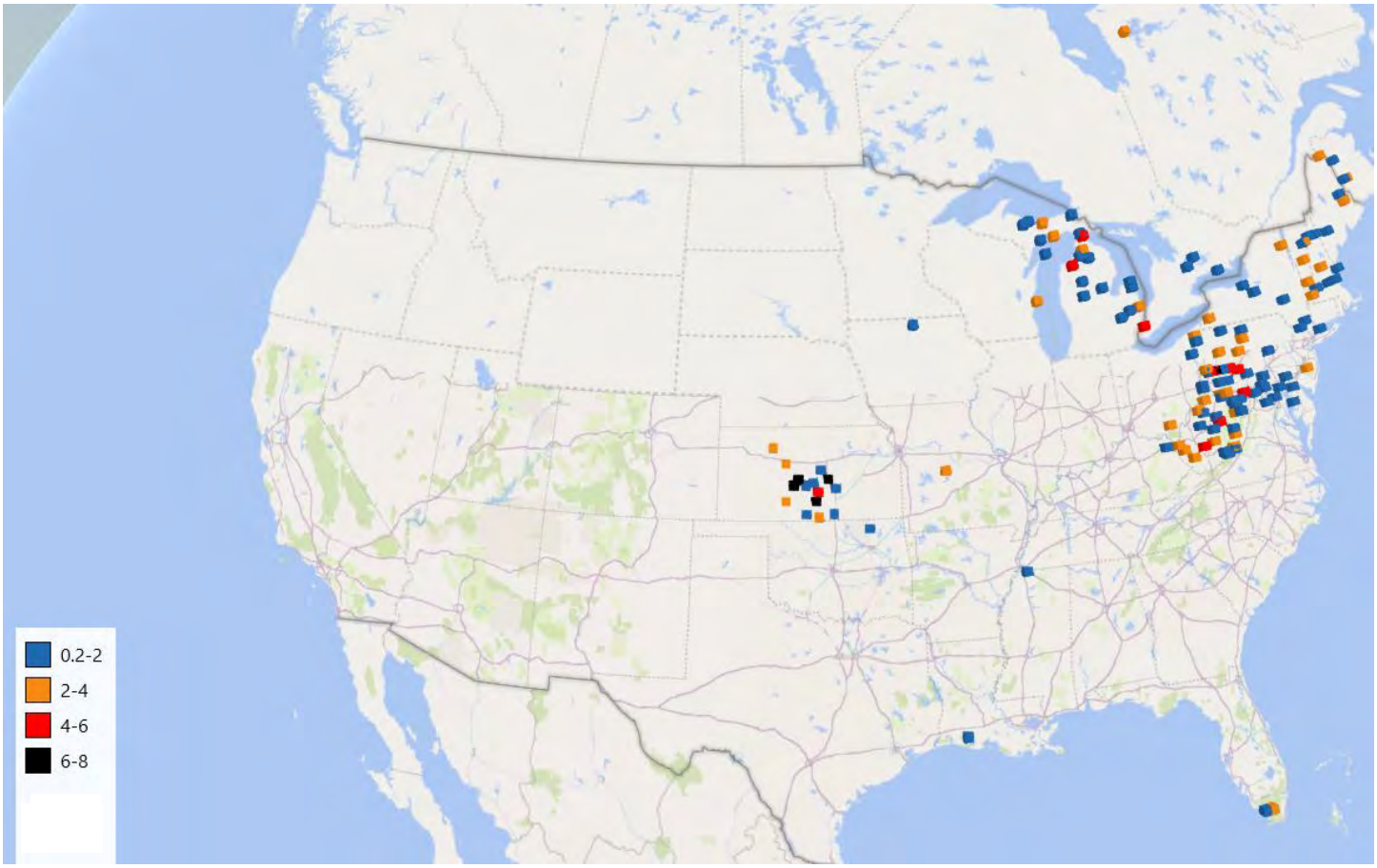
Stations which January-May 2020 was one of the hottest 5 Jan-May periods (Rank 1-5) and the coolest 5 Jan-May periods (Rank 57-61) [NONE] within the 61 Jan-May periods from 1960-2020 (source: GHCN station data)



Extreme Daily Data

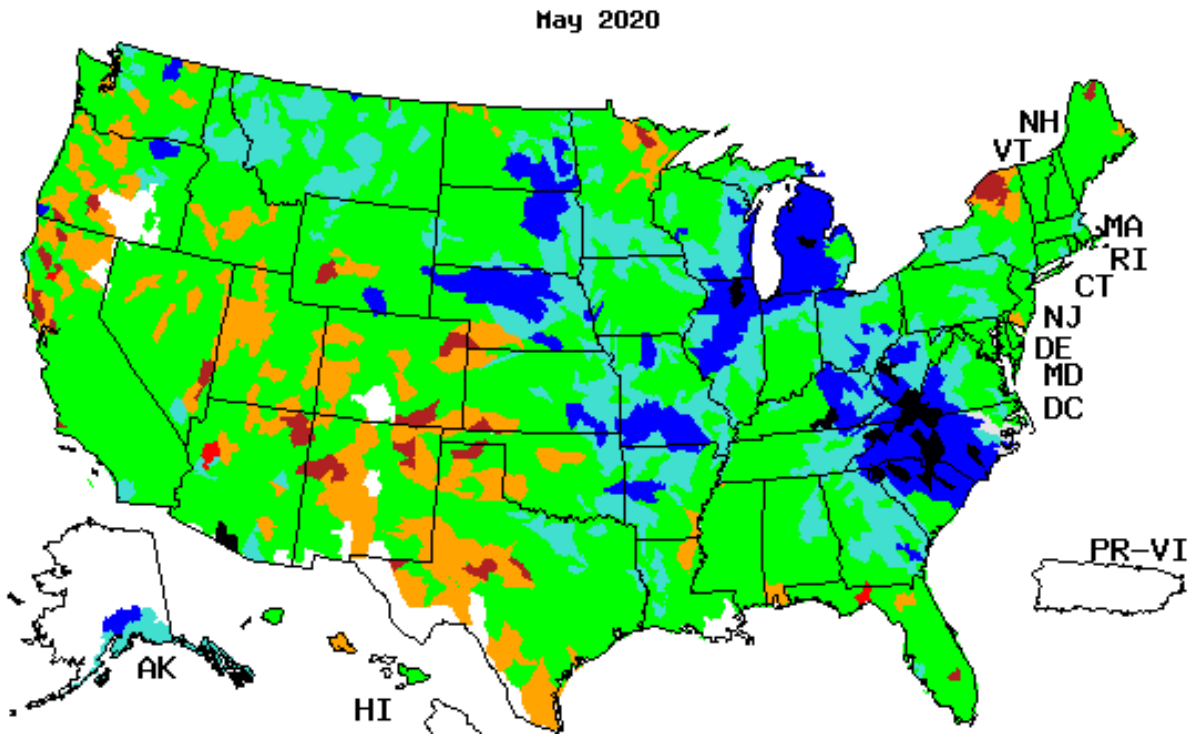
Figure 6

Record low daily high temperatures set during the period May 9 – May 13, 2020. Color coding indicates degrees Fahrenheit below previous record. (source: GHCN station data)



US Geological Survey (USGS) Streamflow Data

Figure 7
Areas of high Stream flow in May 2020 (source: US Geological Survey (USGS))[3]



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 May 2020 (Source USGS data)[4]

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		

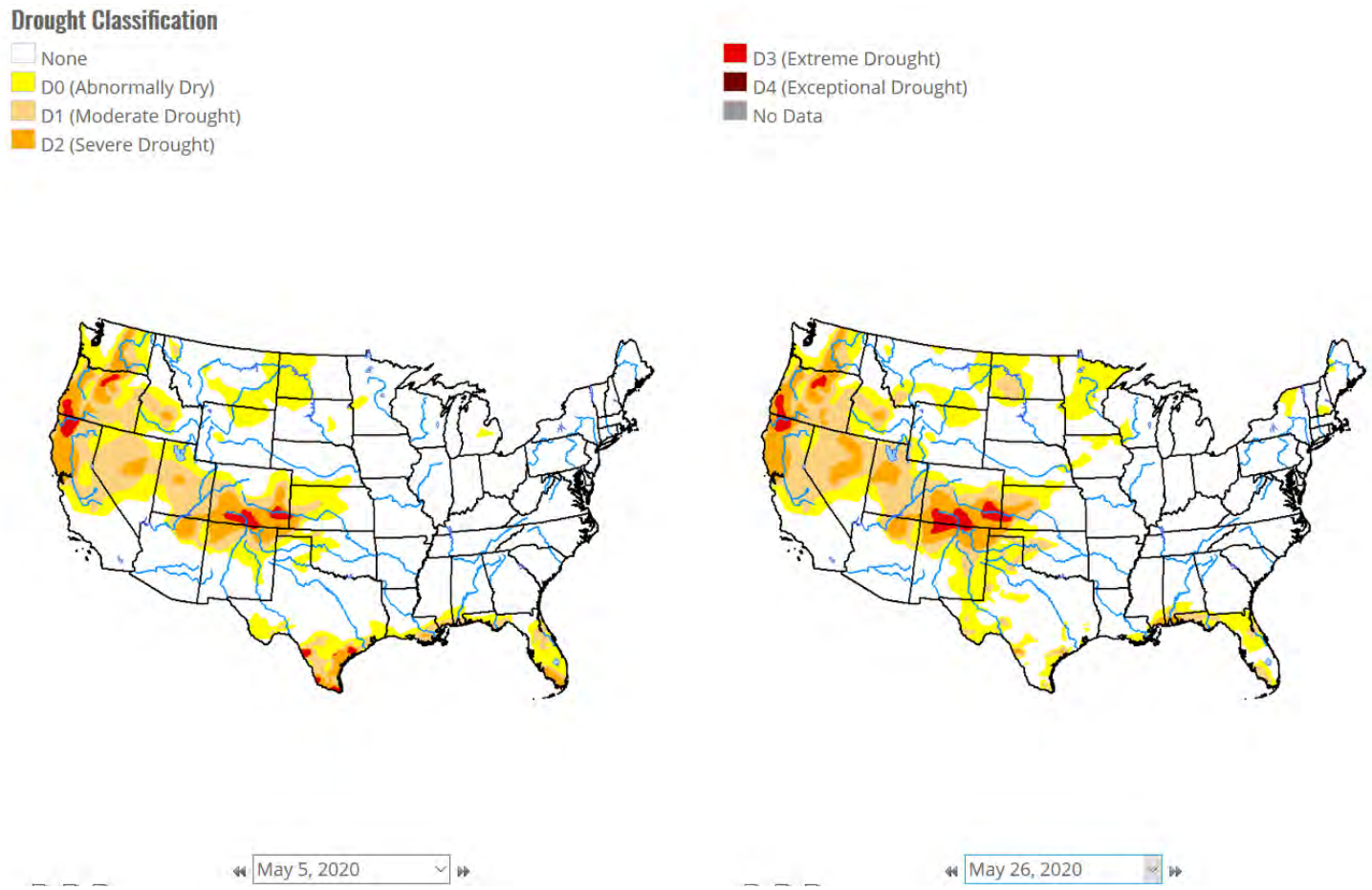
[3] This map was downloaded from the United States Geological Survey's website on June 16. It reflects streamflow conditions as of that date. URL https://waterwatch.usgs.gov/index.php?id=nwc

[4] This table was downloaded from the United States Geological Survey's website on June 16. It reflects streamflow conditions as of that date. URL https://waterwatch.usgs.gov/index.php?id=nwc

Drought Monitor Data

Figure 9

May 5, 2020 vs May 26, 2020 Drought Conditions. [5]



[5] 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

USGS Earthquake Data

Figure 10

Locations of May earthquakes, registering magnitude 4.0 and above, 1952-2020 in the US[6]

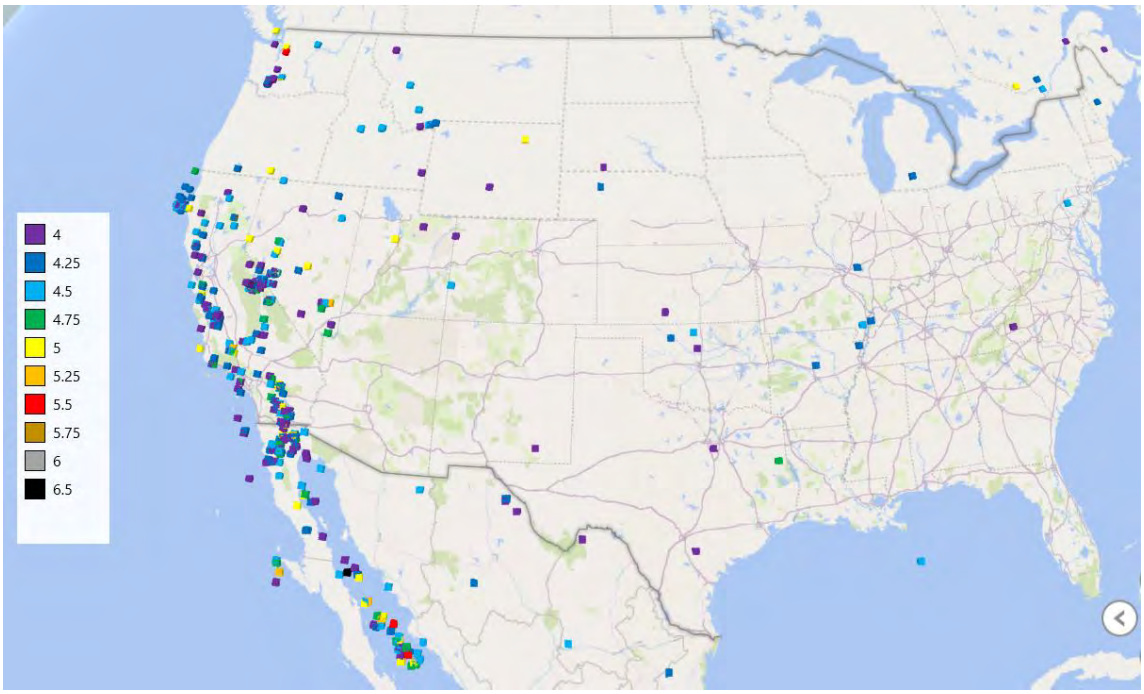
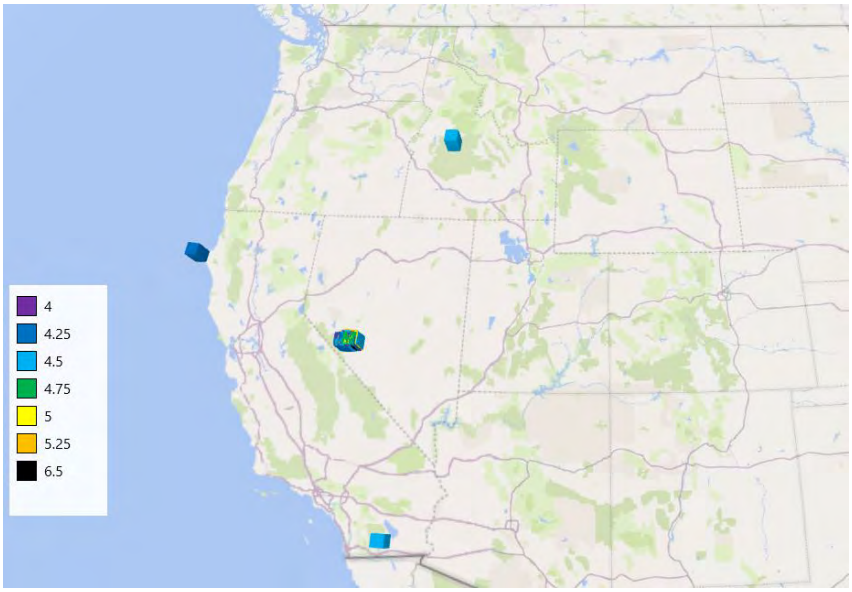


Figure 11

Locations of May 2020 earthquakes, registering magnitude 4.0 and above in the US[7]



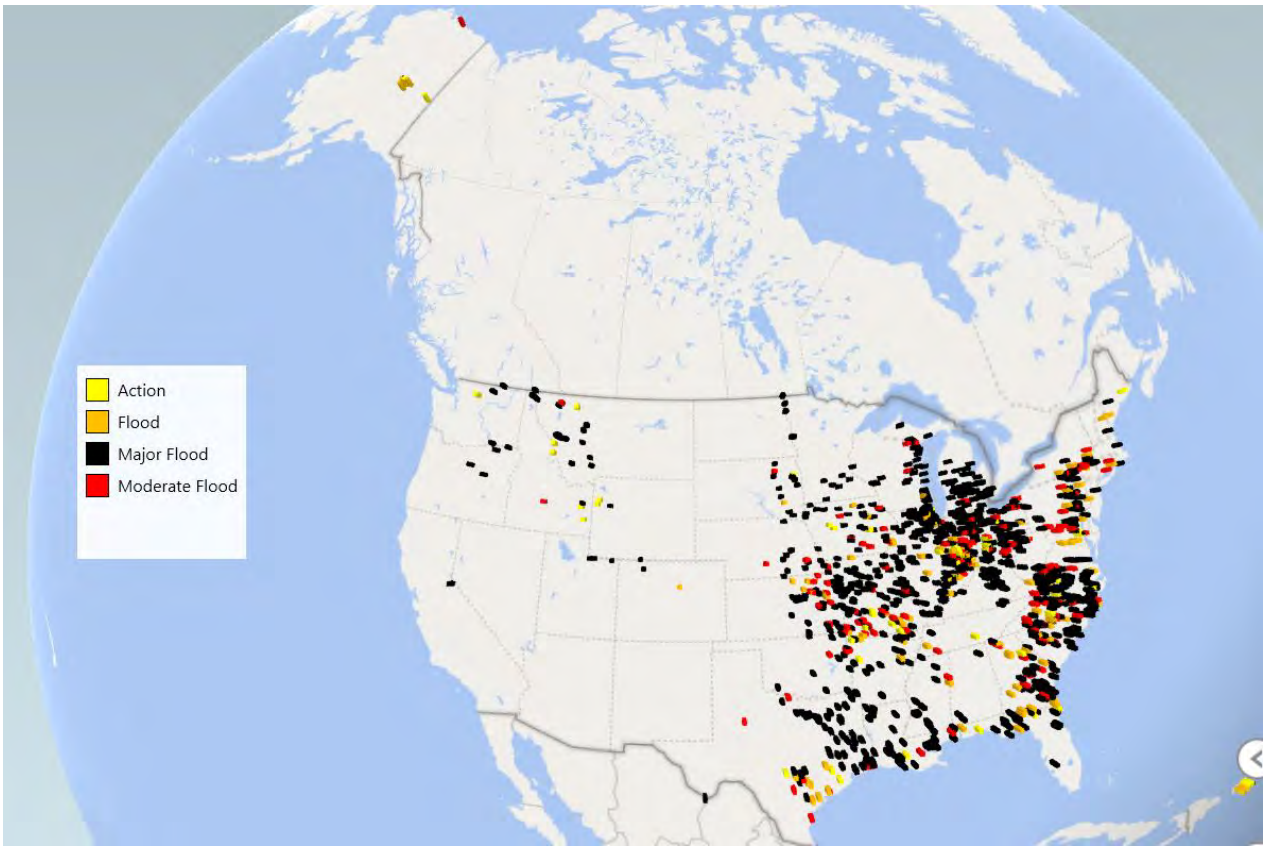
[6] https://earthquake.usgs.gov/earthquakes/search/

[7] https://earthquake.usgs.gov/earthquakes/search/

USGS Flood Data

Figure 12

USGS Stream gage Stations in the US where Action Stage or a degree of Flood Stage was reached during the month of May, 2020[8][9]



action_stage	The stage which, when reached by a rising stream, represents the level where the NWS or a partner/user needs to take some type of mitigation action in preparation for possible significant hydrologic activity. The appropriate action is usually defined in a weather forecast office (WFO) hydrologic services manual.
flood_stage	An established gage height for a given location above which a rise in water surface level begins to create a hazard to lives, property, or commerce. The issuance of flood (or in some cases flash flood) warnings is linked to flood stage. Not necessarily the same as bankfull stage.
moderate_flood_stage	The stage which, when reached by a rising stream, represents the level where some inundation of structures and roads exists near streams. Some evacuations of people and/or transfer of property to higher elevations.
major_flood_stage	Extensive inundation of structures and roads. Significant evacuations of people and/or transfer of property to higher elevations.

[8] https://waterservices.usgs.gov/nwis/iv/?format=rdb&startDT=2020-05-01&endDT=2020-05-31&parameterCd=00065&siteStatus=active&site=15052500
https://waterservices.usgs.gov/nwis/iv/?format=rdb&startDT=2020-05-01&endDT=2020-05-31&parameterCd=00065&siteStatus=active&site= "insert station number"

[9] https://waterwatch.usgs.gov/webservices/

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:

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

Highway damage from earthquake expected to exceed $700,000.[10]
Michigan flood and dam failure May 19 led to evacuation of more than 10,000 people.[11]

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.[12] 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, Tornados in Tennessee

The AP News reported that five people were killed in Indiana after two vehicles were swept from roadway by floodwaters March 20.[13]
The AP News also reported water rescues, power outages and road collapse in Central Ohio on March 20, 2020.[14]
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.[15]

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

The USA Today reported that about 1000 homes were flooded in Mississippi[16], with the city of Jackson particularly hard-hit. Flooding led to an evacuation[17] of some parts of Montgomery, Georgia. Evacuations also occurred in northwest Alabama[18], where highway 231 was closed indefinitely due to flood damage[19]. In Savannah, Georgia, many roads were temporarily closed due to flooding[20].

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 article[21], roughly equivalent to the daily oil consumption across Turkey (the country). Ski resorts in France[22] and Japan[23] 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.[24]

September – December 2019: Wildfires in Australia

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

[11] https://www.cnbc.com/2020/05/21/photos-show-devastating-impact-of-michigan-floods.html

[12] 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.

[13] https://apnews.com/66c958d68ae35093b8b44c38d25dfeeb

[14] https://apnews.com/8d7fb96659bceaa1300b7bcd1d394dca

[15] https://www.accuweather.com/en/severe-weather/accuweather-estimates-the-total-damage-from-the-tennessee-tornadoes-will-approach-2-billion/697185

[16] https://www.usatoday.com/story/news/nation/2020/02/17/mississippi-flooding-swamps-southern-us/4784911002/

[17] https://www.wtoc.com/2020/02/13/flooding-causes-mandatory-evacuation-order-montgomery-co/

[18] https://www.al.com/news/2019/02/flooding-leading-to-home-evacuations-in-northwest-alabama.html

[19] https://www.waaytv.com/content/news/Highway-231-Closed-Indefinetely--567952871.html

[20] https://www.wtoc.com/2020/02/20/heavy-rain-flooding-affecting-roads-around-area/

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

[22] https://www.independent.co.uk/news/world/europe/france-ski-resort-closed-snow-mourtis-pyrenees-weather-winter-a9331926.html

[23] https://www.scmp.com/news/asia/east-asia/article/3046892/worst-winter-decades-japans-ski-resorts

[24] https://www.reuters.com/article/us-usa-economy/mild-weather-boosts-us-job-growth-jobless-rate-ticks-up-idUSKBN2010G3

On January 6, "Business Insider" reported[25] the following damage estimates related to recent and ongoing bushfires: 1600 destroyed homes, 5000 insurance claims totally $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 people[26]. On January 7, the Wall Street Journal reported[27] 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 killed[28].

November 2019: Flooding in Venice, Italy

According to a Wall Street Journal[29] 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 emerge".

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 losses[30], with more with than half of the losses due to inland flooding. According to "The Mainichi", a Japanese newspaper, at least 83 people died[31] 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 damage[32] 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 deaths[33], 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 Journal[34], 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 fall[35].

August 2019: Heavy Monsoon Rains in India

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 deaths[36]. An article in Business Today[37] 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 reduced[38].

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[25] https://www.businessinsider.com.au/australian-bushfires-cost-economy-surplus-government-spending-2020-1

[26] https://time.com/5758186/australia-bushfire-size/

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

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

[29] https://www.wsj.com/articles/in-venice-a-struggle-to-rescue-damaged-art-and-architecture-11574703868

[30] 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/

[31] https://mainichi.jp/english/articles/20191022/p2g/00m/0dm/005000c

[32] https://www.freightwaves.com/news/mother-nature-turns-midwestern-spuds-to-duds

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

[34] https://www.wsj.com/articles/flash-drought-hits-south-as-record-heat-continues-into-fall-11570058348

[35] https://www.baltimoresun.com/weather/bs-md-drought-report-20190926-yooqxwbbuvcldise7a4oisugtm-story.html

[36] https://www.reuters.com/article/us-southasia-floods/india-floods-kill-more-than-270-displace-one-million-idUSKCN1V413K

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

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

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 1953[39].

August 2019: Heat Wave in Alaska

During August, large numbers of dead salmon were found in several Alaskan rivers[40]. 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 rain[41].

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 generation[42]; (2) in the United Kingdom, railway service was disrupted because the unusually high temperatures caused train tracks to expand or kink[43]; (3) in the United Kingdom, thousands of chickens died in a farmhouse that lacked a cooling system[44]; and (4) on a farm in the Netherlands, over 2000 pigs suffocated[45] 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.

[39] 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

[40] https://time.com/5661024/alaska-high-temperatures-salmon-deaths/

[41] https://observers.france24.com/en/20190821-salmon-die-alaska

[42] https://www.reuters.com/article/us-france-electricity-heatwave/hot-weather-cuts-french-german-nuclear-power-output-idUSKCN1UK0HR

[43] https://www.telegraph.co.uk/news/2019/07/25/uk-heatwave-britain-bracing-hottest-day-record-temperature-could/

[44] https://www.independent.co.uk/news/uk/home-news/chicken-uk-heatwave-farm-deaths-lincolnshire-tesco-sainsbury-a9025516.html

[45] 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

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