SOCIETY OF ACTUARIES

Actuarial Weather Extremes
July 2020

Actuarial Weather Extremes: July 2020

North American Heat, Asian Flooding, Record Atlantic Basin Named Storm Count

Overview

This report examines weather extremes in temperature, precipitation, and tropical cyclone events. 2020 became the first year to have nine named Atlantic Basin tropical cyclones by the end of July. The previous record had been seven in 2005. The month of July 2020 alone had five, tying a record for July from 2005 (Figure 8).

Temperature: Several US states and Canadian provinces had the highest or nearly highest daily high temperature averages for the month of July in 2020 vs the daily high temperature averages in the previous Julys dating back to 1960. (Figure 1). Figure 2 shows individual station locations with record and near record high temperatures for July among all July months back to 1960.

Precipitation and Flooding: In China, as of July 20, 140 people had been killed and at least 28,000 homes destroyed. Around 38 million country-wide were affected. Direct economic losses had already reached Rmb70 billion (US$10 billion).[1] Stations in China and Japan (which also had very heavy rain in July) where daily recorded rainfall met or exceeded the 99.8 percentile of all July days back to 1960 are shown in Figure 3.

Tropical Cyclones: Tropical Storm Fay and Hurricane Hanna impacted the Northeastern US and Gulf Coast respectively with heavy rainfall. Stations exceeding five inches for Hanna and three inches for Fay are shown in Figures 4 and 5 respectively. Many of these daily precipitation totals were the most on a July day back to 1960. Insured losses from Hurricane Hanna will be close to $350 million[2] and the insured loss from Tropical Storm Fay will be close to $400 million[3]

Figures 7 and 8 show that 2020 has had more named storms through the month of July than any previous year back to 1851, with nine through July 2020 including five in the month of July 2020 alone. According to the Colorado State University Atlantic Basin Seasonal Hurricane Forecast for 2020, 24 named storms are expected for 2020 and the chance of a major hurricane (Category 3,4, or 5 on the Saffir-Simpson Scale) making landfall along the continental US coastline is 74%. (See Figure 6)

[1] https://insuranceasianews.com/relentless-rains-renew-focus-on-china-flood-risk/
[2] https://www.businessinsurance.com/article/20200728/NEWS06/912335826/Hurricane-Hanna's-losses-pegged-at-nearly-$350-million#
[3] https://www.insurancejournal.com/news/national/2020/07/15/575589.htm

Figure 1

Global Historical Climatology Network (GHCN) station data showing (percentile rank of 1960-2020 average daily high temperature (TMAX) for July 2020. 100% or greater indicates the warmest July among Julys 1960-2020 for which at least 25 days of data were available.

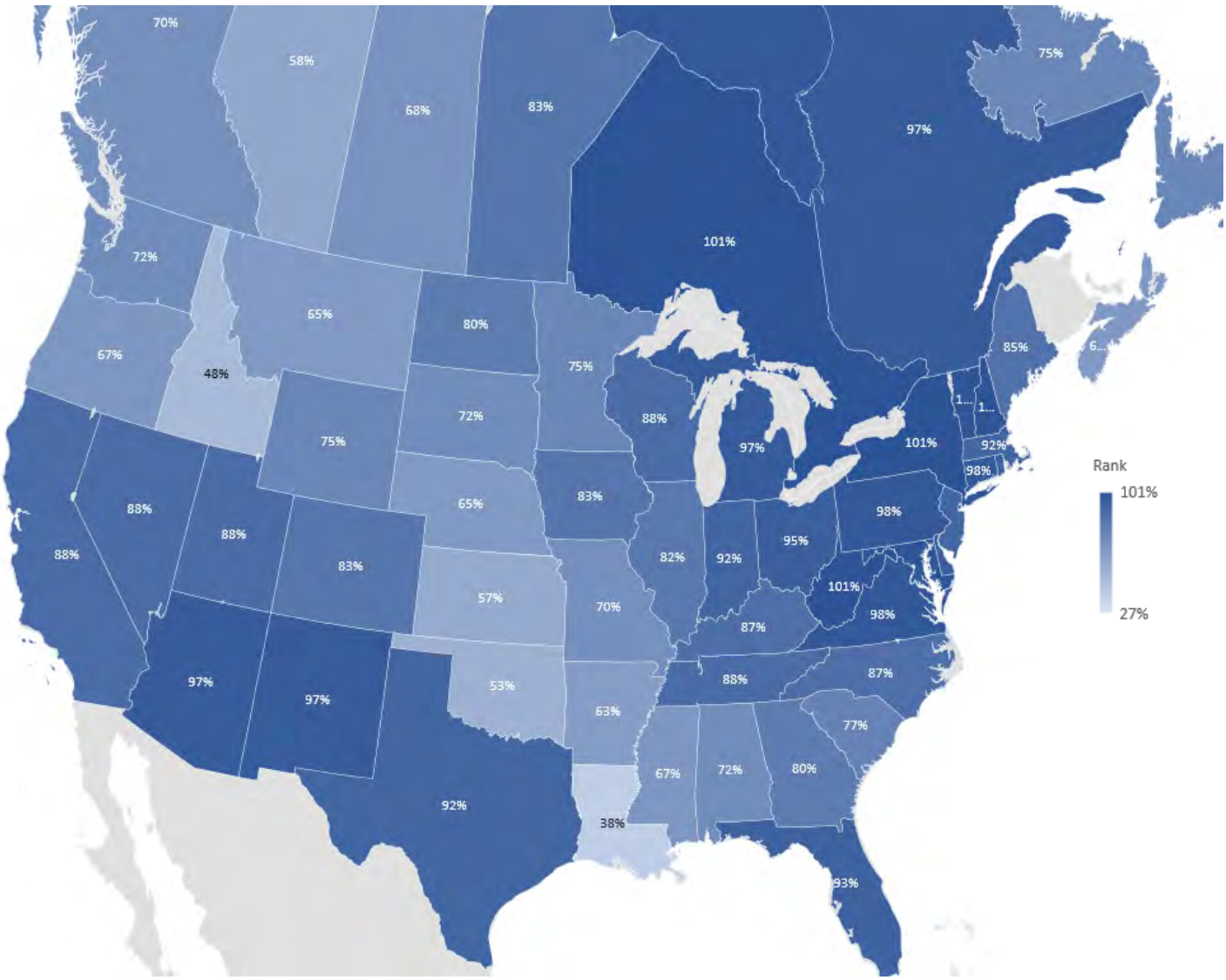

Figure 2

Stations which July 2020 average daily maximum temperature (TMAX) is among the five hottest (Rank 1-5) from 1960-2020 and five coldest (Rank 57-61) (source: Global Historical Climatology Network (GHCN) station data)

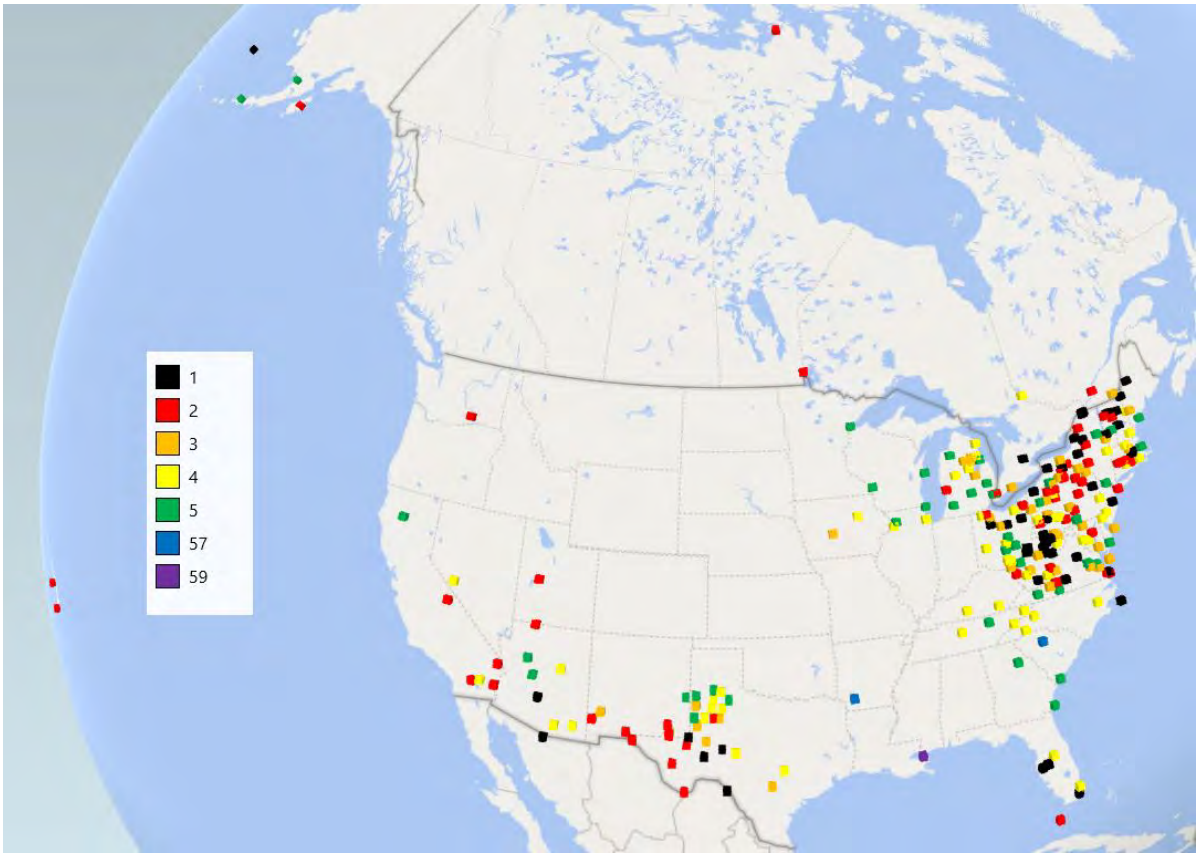

Figure 3

Stations in China and Japan for which a daily July precipitation amount was at or above the 99.8 percentile among all July days from 1960-2020 (source: GHCN station data)

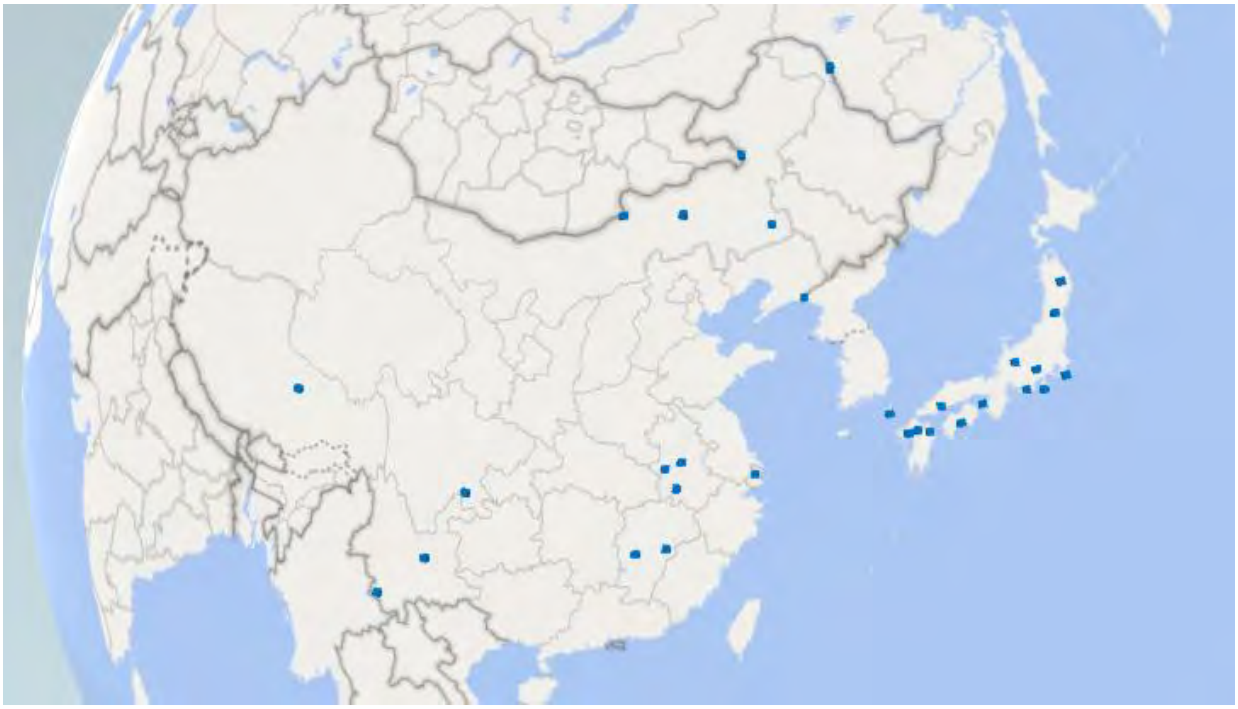

Figure 4

Stations in Texas with daily rainfall of 5 inches or more during Hurricane Hanna (July 26-27) (source: GHCN station data)

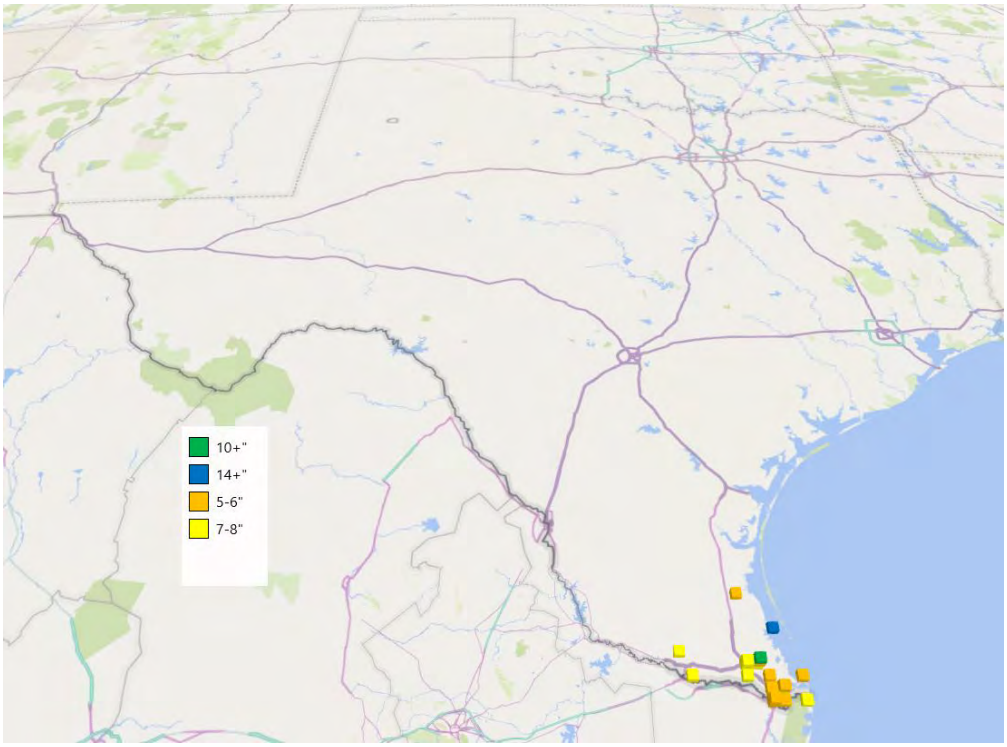

Figure 5

Stations in New York, New Jersey, Pennsylvania with daily rainfall of 3 inches or more during Tropical Storm Fay (July 11) and the most for a July day among July days in the period 1960-2020. (source: GHCN station data)

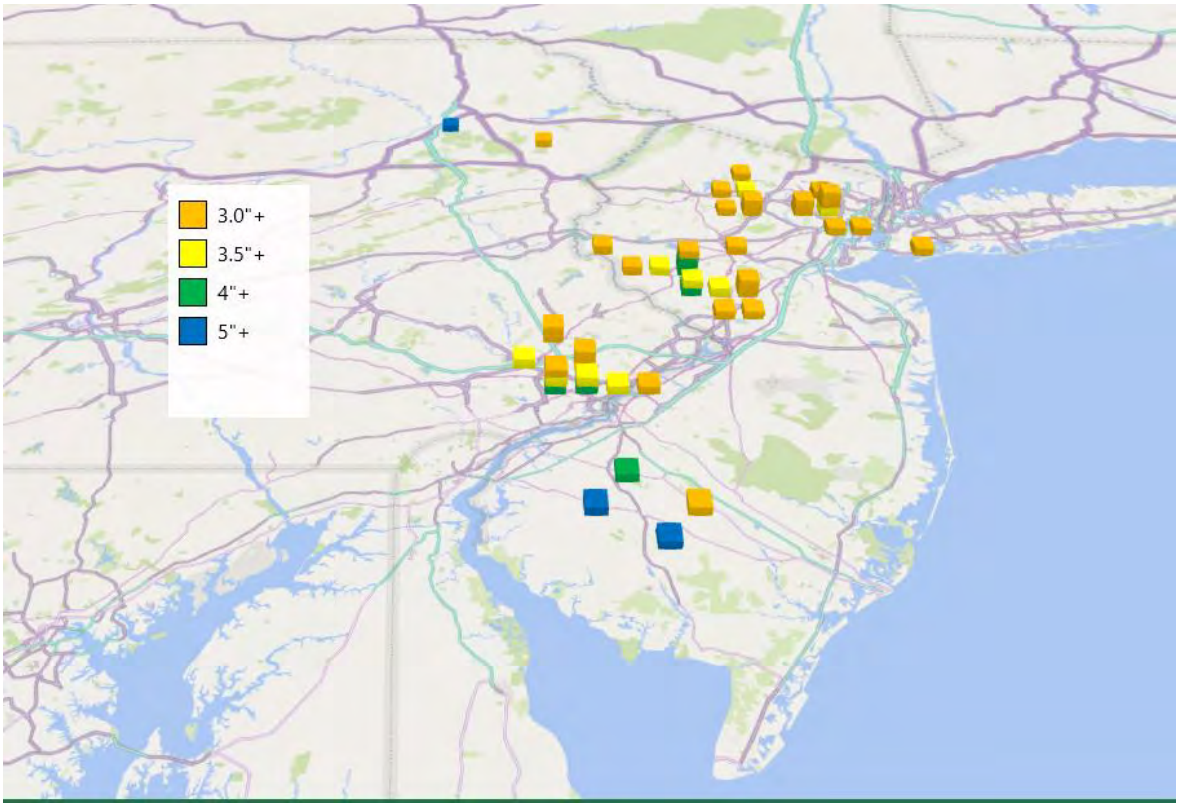

Figure 6

Colorado State University Atlantic Basis 2020 Hurricane Forecast[4]

ATLANTIC BASIN SEASONAL HURRICANE FORECAST FOR 2020

Forecast Parameter and 1981-2010 Average (in parentheses)	Issue Date 2 April 2020	Issue Date 4 June 2020	Issue Date 7 July 2020	Issue Date 5 August 2020	Observed Thru 4 August 2020	Remainder of Season Forecast
Named Storms (NS) (12.1)	16	19	20	24*	9	15
Named Storm Days (NSD) (59.4)	80	85	85	100	23.75	76.25
Hurricanes (H) (6.4)	8	9	9	12	2	10
Hurricane Days (HD) (24.2)	35	40	40	45	3	42
Major Hurricanes (MH) (2.7)	4	4	4	5	0	5
Major Hurricane Days (MHD) (6.2)	9	9	9	11	0	11
Accumulated Cyclone Energy (ACE) (106)	150	160	160	200	23	177
Net Tropical Cyclone Activity (NTC) (116%)	160	170	170	215	31	184

*Total forecast includes Arthur, Bertha, Cristobal, Dolly, Edouard, Fay, Gonzalo, Hanna and Isaias which have formed in the Atlantic as of August 4th.

PROBABILITIES FOR AT LEAST ONE MAJOR (CATEGORY 3-4-5) HURRICANE LANDFALL ON EACH OF THE FOLLOWING COASTAL AREAS (AFTER 4 AUGUST):

1) Entire continental U.S. coastline - 74% (full-season average for last century is 52%)

2) U.S. East Coast Including Peninsula Florida - 49% (full-season average for last century is 31%)

3) Gulf Coast from the Florida Panhandle westward to Brownsville - 48% (full-season average for last century is 30%)

[4] https://tropical.colostate.edu/Forecast/2020-08.pdf

Figure 7

Report from the National Hurricane Center showing nine 2020 named storms through July 31, 2020; the most since 2005.[5]

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Monthly Tropical Weather Summary
NWS National Hurricane Center Miami FL
800 AM EDT Sat Aug 1 2020

For the North Atlantic...Caribbean Sea and the Gulf of Mexico:

Five tropical storms, including two which became hurricanes, formed
in the basin in July.  One tropical depression also formed late in
the month over the far eastern portion of the basin.  The five named
storms ties the record for the most named storms forming during the
month of July, which was previous set in July 2005. The season has
been considerably more active than average so far, as typically only
1 or 2 named storms form prior to August. So far in  2020, nine
named storms have formed, including 2 hurricanes -- Hanna and
Isaias.

In terms of Accumulated Cyclone Energy (ACE), which measures the
strength and duration of tropical storms and hurricanes, activity
in the basin so far in 2020 has also been above average, about
twice the long-term mean.

Reports on individual cyclones, when completed, are available at
the National Hurricane Center website at
www.hurricanes.gov/data/tcr/index.php?season=2020&basin=atl

Summary Table

Name                    Dates          Max Wind (mph)
-----------------------------------------------------
TS  Arthur           16-19 May             60
TS  Bertha           27-28 May             50
TS  Cristobal         1- 9 Jun             60
TS  Dolly            22-24 Jun             45
TS  Edouard           4-6 Jul              45
TS  Fay               9-11 Jul             60
TS  Gonzalo           1-25 Jul             65
H   Hanna            23-27 Jul             80
H   Isaias       30 Jul-                    85
TD  Ten          31 Jul-                    35
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Hurricane Specialist Unit
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[5] https://www.nhc.noaa.gov/archive/text/TWSAT/2020/TWSAT.202008011137.txt

Figure 8

Cumulative Count of Named Storms by Month in the Atlantic Basin 1851-2020, showing years where records were set or tied for cumulative named storm counts through the month of July[6]

		Cumulative Count of Named Storms by Month											
Basin	**Year**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
AL	1851	-	-	-	-	-	1	3	4	5	6	6	6
AL	1886	-	-	-	-	-	3	4	7	9	12	12	12
AL	1887	-	-	-	-	2	3	5	7	10	16	17	19
AL	1936	-	-	-	-	-	3	5	11	15	16	16	17
AL	1954	-	-	-	-	1	3	5	7	13	14	15	16
AL	1959	-	-	-	-	1	3	5	8	12	14	14	14
AL	1966	-	-	-	-	-	1	5	6	10	10	11	11
AL	1995	-	-	-	-	-	1	5	12	15	19	19	19
AL	2005	-	-	-	-	-	2	7	12	17	23	26	27
Maximum through 2019		1	1	1	1	2	4	7	12	17	23	26	27
	2020					2	4	9					

[6] https://www.nhc.noaa.gov/data/hurdat/hurdat2-1851-2019-052520.txt https://www.nhc.noaa.gov/archive/text/TWSAT/2020/TWSAT.202008011137.txt

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:

July 2020: China Flooding, Hurricane Hanna, Tropical Storm Fay

In China, as of July 20, 140 people had been killed and at least 28,000 homes destroyed. Around 38 million country-wide were affected. Direct economic losses had already reached Rmb70 billion (US$10 billion).[7] Insured losses from Hurricane Hanna will be close to $350 million[8] and the insured loss from Tropical Storm Fay will be close to $400 million[9]

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.[10]

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

Highway damage from earthquake expected to exceed $700,000.[11]
Michigan flood and dam failure May 19 led to evacuation of more than 10,000 people.[12]

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.[13] 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.[14]
The AP News also reported water rescues, power outages and road collapse in Central Ohio on March 20, 2020.[15]
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.[16]

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

The USA Today reported that about 1000 homes were flooded in Mississippi[17], with the city of Jackson particularly hard-hit. Flooding led to an evacuation[18] of some parts of Montgomery, Georgia. Evacuations also occurred in northwest Alabama[19], where highway 231 was closed indefinitely due to flood damage[20]. In Savannah, Georgia, many roads were temporarily closed due to flooding[21].

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[7] https://insuranceasianews.com/relentless-rains-renew-focus-on-china-flood-risk/
[8] https://www.businessinsurance.com/article/20200728/NEWS06/912335826/Hurricane-Hanna's-losses-pegged-at-nearly-$350-million#
[9] https://www.insurancejournal.com/news/national/2020/07/15/575589.htm
[10] https://weather.com/news/news/2020-06-06-colorado-winds-power-outages-damage

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

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

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

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

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

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

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

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

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

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

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[22], roughly equivalent to the daily oil consumption across Turkey (the country). Ski resorts in France[23] and Japan[24] 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.[25]

September – December 2019: Wildfires in Australia

On January 6, "Business Insider" reported[26] 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[27]. On January 7, the Wall Street Journal reported[28] 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[29].

November 2019: Flooding in Venice, Italy

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

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

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

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

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

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

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

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

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

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

[31] 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/

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

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

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

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

According to the Wall Street Journal[35], 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[36].

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[37]. An article in Business Today[38] 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[39].

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[40].

August 2019: Heat Wave in Alaska

During August, large numbers of dead salmon were found in several Alaskan rivers[41]. 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[42].

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[43]; (2) in the United Kingdom, railway service was disrupted because the unusually high temperatures caused train tracks to expand or kink[44]; (3) in the United Kingdom, thousands of chickens died in a farmhouse that lacked a cooling system[45]; and (4) on a farm in the Netherlands, over 2000 pigs suffocated[46] 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.

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

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

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

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

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

[40] 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

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

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

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

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

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

[46] 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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Acknowledgements

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

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