SOA Research Institute

Catastrophe and Climate

Actuarial Weather Extremes: September 2021

Hot Northern Plains, Continuing Drought Western U.S., Hurricane Nicholas, Large Early Snowfall in Alaska

October 2021

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AUTHORS Rob Montgomery, ASA, MAAA
Society of Actuaries Research Institute

Matthew Self, ASA
Ascension Data Science Institute

Patrick Wiese, ASA
Society of Actuaries Research Institute

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CONTENTS

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Overview

This report examines weather conditions for daily maximum temperature (TMAX), drought conditions, and snowfall that are extreme in an historical context. The report also examines the early eighth named storm to make landfall in the U.S. (Hurricane Nicholas), ahead of the eighth landfall storm of 2020, which had a record 11 named landfall storms for the year.

Historically Warm Month of September in North Dakota and Montana: Using Global Historical Climatology Network (GHCN) data back to 1960, several stations in North Dakota and Montana had average temperatures for the month of September 2021 that were at least four standard deviations above the September mean back to 1960.

Drought Continues; mostly in the Western U.S.: As seen in Figure 2, the drought conditions persist in the Western portion of the Continental U.S., and as seen in Figure 3, the most extreme categories of drought conditions (Extreme Drought and Exceptional Drought) are impacting a larger portion of the U.S. than in the past 20 years, particularly in the Western U.S.

Hurricane Nicholas: Hurricane Nicholas (Category 1) produced losses near $1 billion [1], and affected areas of Texas and Louisiana that had been hit by Hurricane Ida a few weeks earlier. 500,000 people were left without power in Texas. [2] There was significant rainfall in Texas and Louisiana, with several stations reporting 4 inches of rain on September 14, 2021. (See Table 1 for flooding in Louisiana and Table 2 for Precipitation).

Early Start to Winter Conditions in Alaska: According to the National Centers for Environmental Information (NCEI), some of the largest early season snowfall since the 1970s occurred in South Central Alaska in September 2021. [3]

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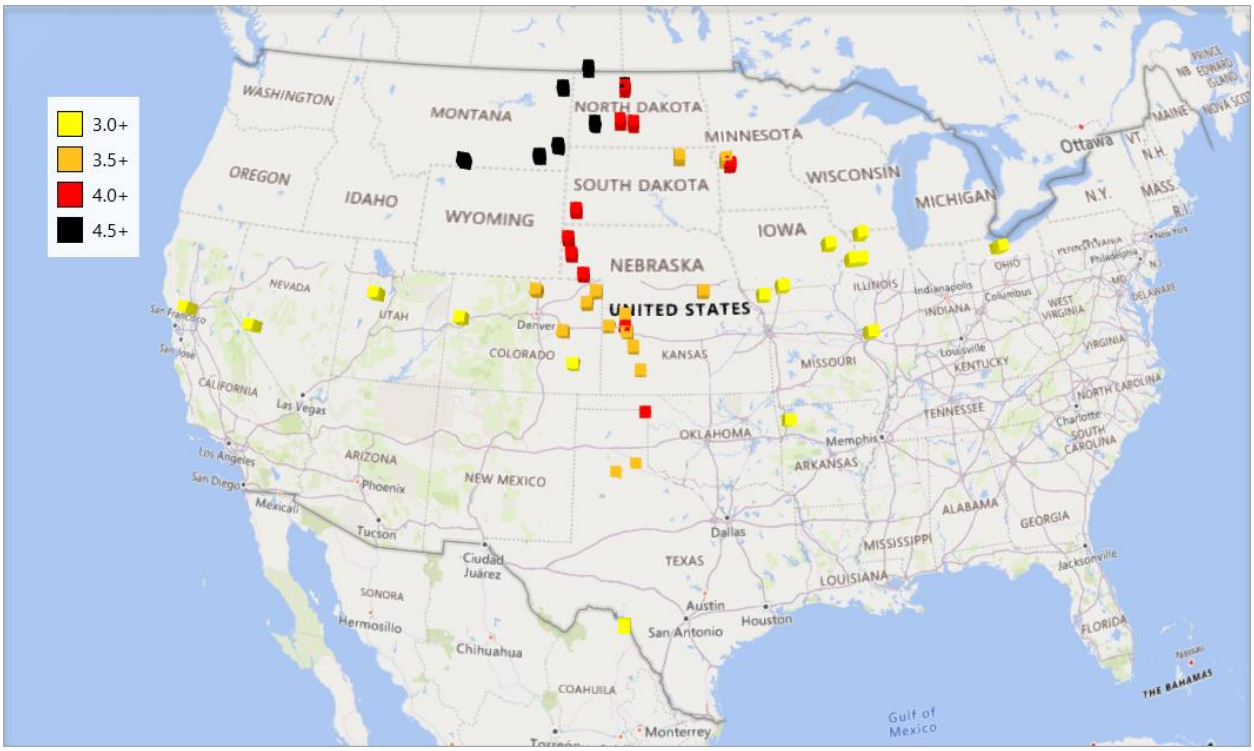
[1] Artemis. September 24, 2021 Hurricane Nicholas insured loss estimated up to $2.2bn by RMS - Artemis.bm
[2] Texas Tribune. September 14, 2021 Half a Million Customers Without Power https://www.texastribune.org/2021/09/13/texas-tropical-storm-nicholas-updates/
[3] NOAA National Centers for Environmental Information, State of the Climate: National Climate Report for September 2021, published online October 2021, retrieved on October 22, 2021 from https://www.ncdc.noaa.gov/sotc/national/202109

Historically Warm Month of September in North Dakota and Montana

As seen in Figure 1, North Dakota and Montana had very warm month of September in 2021. Several GHCN stations had TMAX values at least four standard deviations above the mean for September monthly temperatures back to 1960. Some TMAX values even exceeded 100 degrees Fahrenheit in Montana on September 18, and in North Dakota on September 28 and 29.

Figure 1

STANDARD DEVIATIONS ABOVE THE MEAN FOR SEPTEMBER MONTHLY TMAX AT U.S. GHCN STATIONS WHICH WERE AT LEAST 3.0 STANDARD DEVIATIONS ABOVE THE SEPTEMBER MONTHLY MEAN.



Source: GHCN station data (Accessed October 6, 2021). https://www1.ncdc.noaa.gov/pub/data/ghcn/daily/

Drought Continues Mostly in the Western U.S.

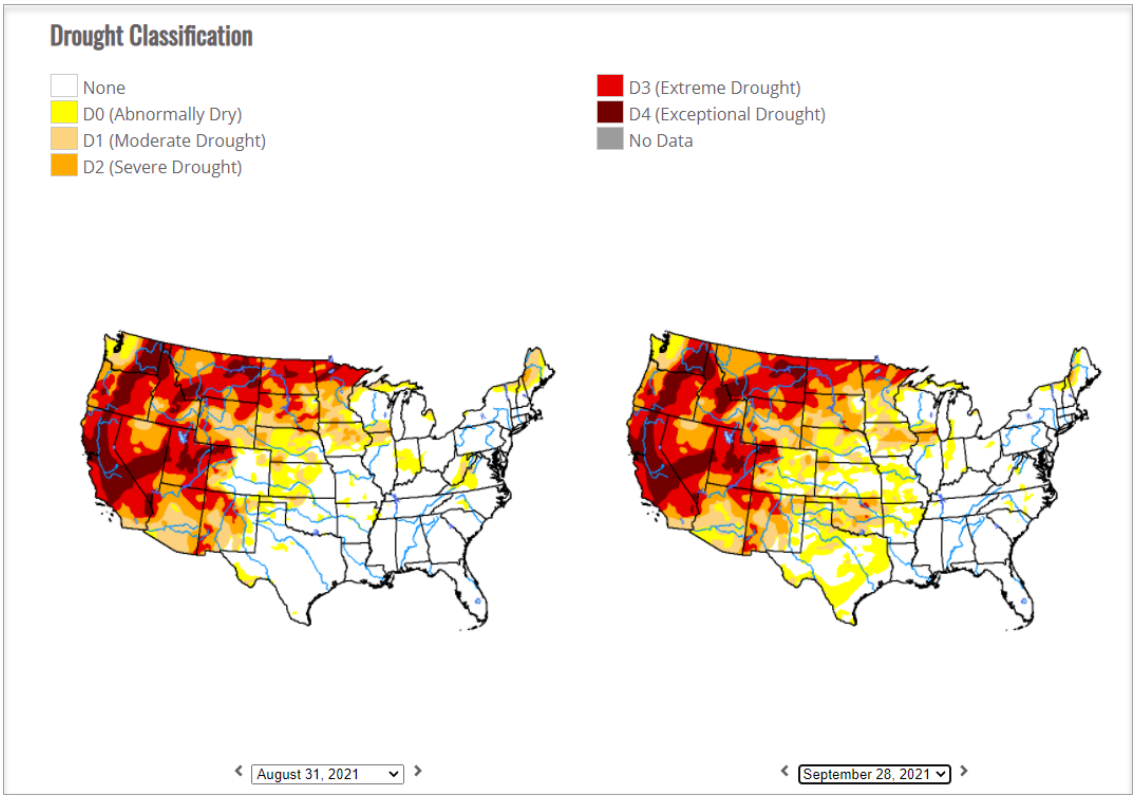
As seen in Figure 2, drought conditions persist in the Western U.S. portion of the Continental U.S., and as seen in Figure 3, the most extreme categories of drought conditions (Extreme Drought and Exceptional Drought) are impacting a larger portion of the U.S. than in the past 20 years, particularly in the Western U.S. Consequently, the streamflow in much of the Western U.S. is Below Normal and Much Below Normal, as seen in Figure 4.

The Drought has led to water shortages, threatened drinking water, hydroelectric electricity supply, and agriculture. The recent wildfire seasons have been fueled by the drought's impact on precipitation and surface moisture. Economic losses are assumed to be in the billions of dollars and won't be fully known until the drought ends. [4]

Figure 2

COMPARISON OF DROUGHT CONDITIONS IN THE CONTINENTAL U.S. OVER SEPTEMBER 2021

Week	None	D0-D4	D1-D4	D2-D4	D3-D4	D4	DSCI
2021-08-31	44.48	55.52	46.63	36.60	24.49	7.92	171
2021-09-28	37.35	62.65	47.84	36.60	23.11	7.27	177
Change	-7.13	7.13	1.21	0.00	-1.38	-0.65	6

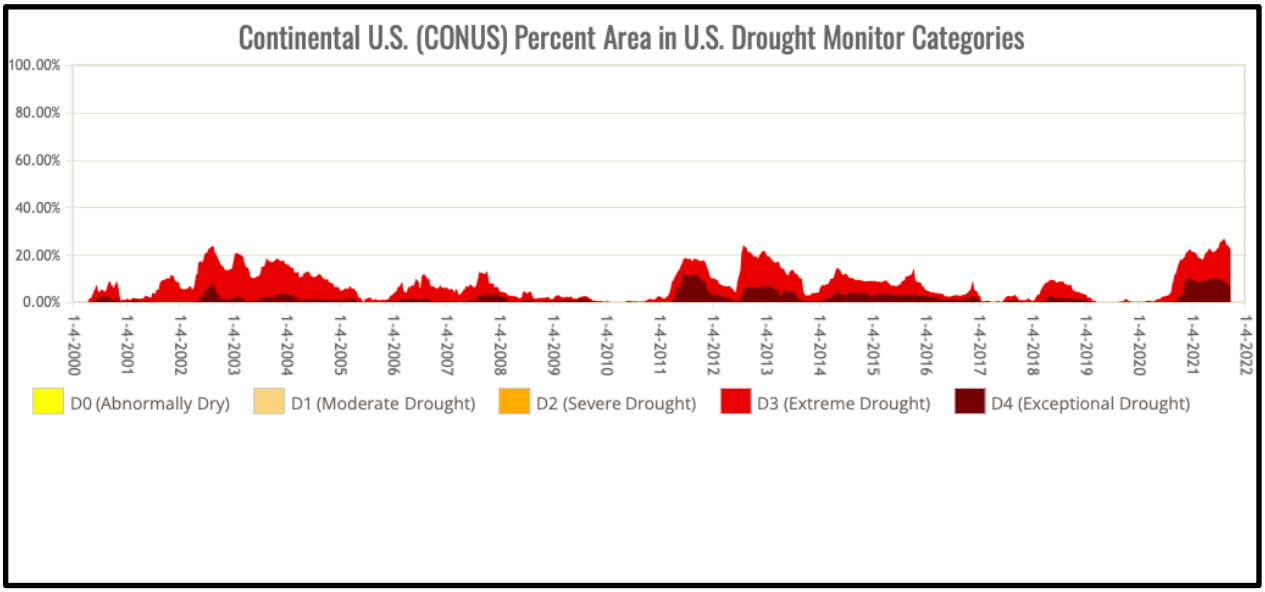


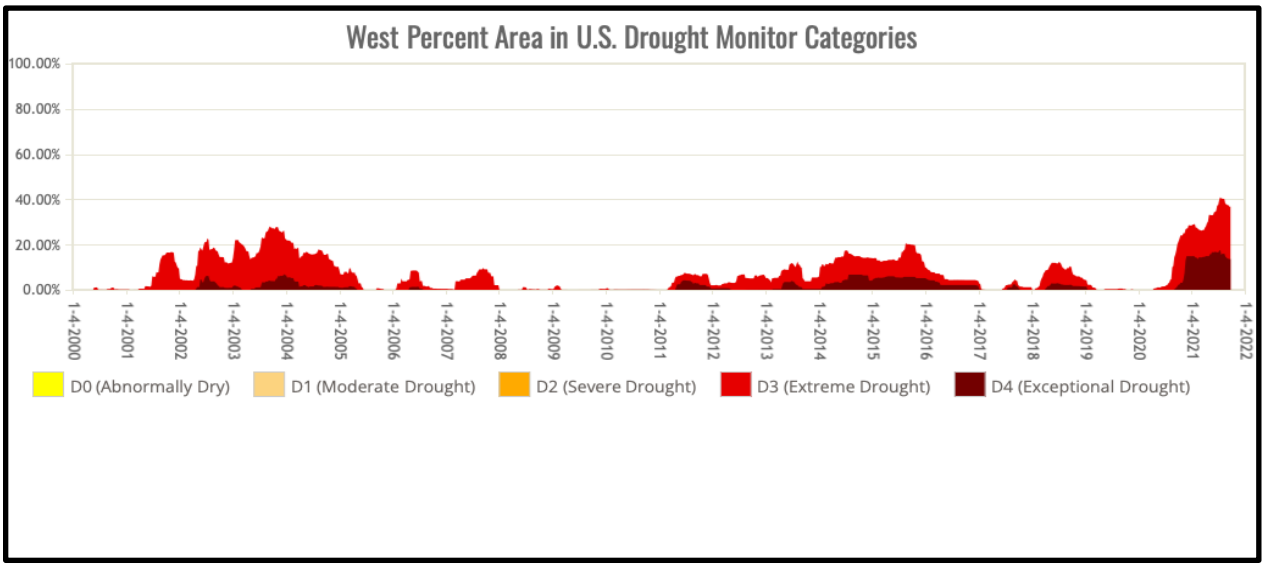
Source (Accessed October 22, 2021): https://droughtmonitor.unl.edu/Maps/CompareTwoWeeks.aspx The U.S. Drought Monitor is jointly produced by the National Drought Mitigation Center at the University of Nebraska Lincoln, the United States Department of Agriculture, and the National Oceanic and Atmospheric Administration. Map courtesy of NDMC.

[4] NOAA Climate Program Office Assessment Report. September 21, 2021. Report on Southwestern U.S. Drought (noaa.gov)

Figure 3

TIMELINE OF EXTREME AND EXCEPTIONAL DROUGHT CONDITIONS IN THE CONTINENTAL U.S. AND WESTERN U.S. SINCE 2000.

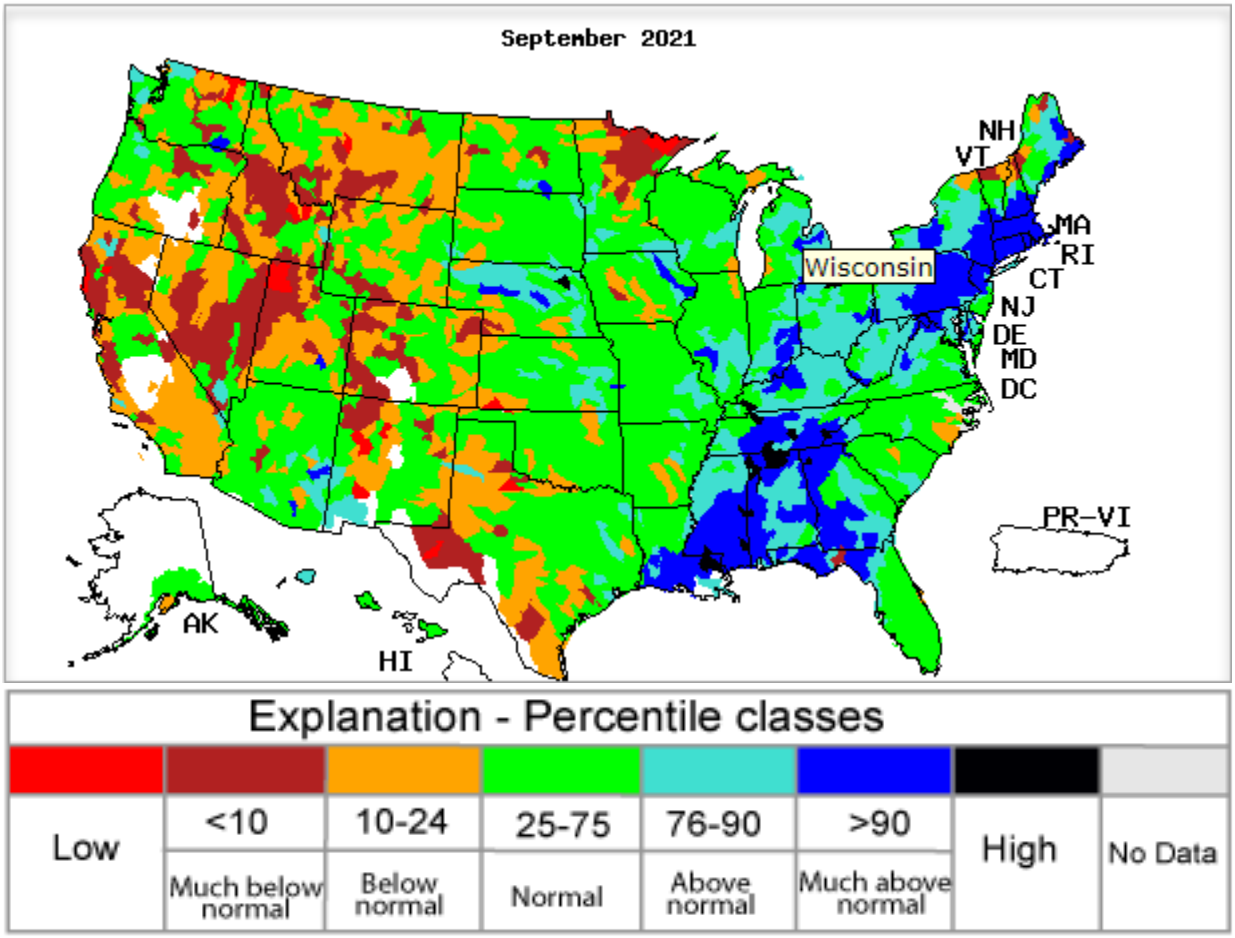




Source: GHCN station data (Accessed October 11, 2021). https://droughtmonitor.unl.edu/DmData/TimeSeries.aspx
The U.S. Drought Monitor is jointly produced by the National Drought Mitigation Center at the University of Nebraska Lincoln, the United States Department of Agriculture, and the National Oceanic and Atmospheric Administration. Map courtesy of NDMC.

Figure 4

UNITED STATES GEOLOGICAL SURVEY (USGS) STREAMFLOW IN SEPTEMBER 2021 VS HISTORICAL DATA PERCENTILE CLASSES USING STREAMGAGES WITH AT LEAST 30 YEARS OF DATA



Source: United States Geological Survey (USGS) USGS WaterWatch -- Streamflow conditions Date Accessed: 10/22/2021

Hurricane Nicholas

Hurricane Nicholas (Category 1) produced losses near $1 billion [5], and affected areas of Texas and Louisiana that had been hit by Hurricane Ida a few weeks earlier. 500,000 people were left without power in Texas. [6] Significant rainfall in TX and LA, with several stations reporting 4 inches of rain on September 14, 2021. (See Table 1 for flooding in Louisiana and Table 2 for Precipitation).

Nicholas was the eighth named storm to make landfall in the U.S. in 2021. 2020 was the record year with 11 named storms making landfall, and Nicholas occurred earlier than the eighth named landfall storm of 2020, which was Tropical Storm Beta on September 21, 2020. [7]

Table 1

FEET ABOVE FLOOD STAGE FOR USGS STATIONS FLOODING IN LOUISIANA AFTER HURRICANE NICHOLAS

USGS Station	9/15/2021	9/16	9/17	9/18	9/19	9/20	9/21
Bayou Des Cannes near Eunice, LA	-	1.6	2.3	2.6	2.4	1.7	-
Bayou Nezpique near Basile, LA	-	-	-	0.5	0.6	0.5	0.1
Bogue Chitto River near Bush, LA	-	-	0.9	1.4	0.7	0.3	-
Bogue Falaya River at Boston St. at Covington, LA	-	3.5	-	-	-	-	-
Bogue Falaya River near Camp Covington	-	0.8	-	-	-	-	-
Calcasieu River near Oberlin, LA	-	-	-	0.3	0.2	-	-
Calcasieu River nr Glenmora, LA	-	0.6	-	-	-	-	-
Mermentau River At Mermentau, LA	-	-	-	-	-	0.2	0.3
Pearl River at Pearl River, LA	-	-	0.7	1.6	2.1	2	1.1
Pearl River near Bogalusa, LA	-	-	1.2	0.6	-	-	-
Tangipahoa River at Robert, LA	-	2.3	2.7	2.5	2.4	1.8	-
Tchefuncte River near Covington, LA	-	3.3	4.5	2.2	-	-	-
Tchefuncte River near Folsom, LA	-	2.1	0	-	-	-	-
Tickfaw River at Holden, LA	-	-	-	-	-	1.6	-
Tickfaw River at Liverpool, LA	-	0.4	1.6	0.8	-	-	-
Tickfaw River at Montpelier, LA	-	-	-	1.1	0.8	-	-
Vermilion River at Surrey St. at Lafayette, LA	0.6	-	-	-	-	-	-

USGS Gauge Heights Real-Time Values (accessed October 11,2021): https://waterservices.usgs.gov/rest/IV-Test-Tool.html

[5] Artemis. September 24, 2021 Hurricane Nicholas insured loss estimated up to $2.2bn by RMS - Artemis.bm

[6] Texas Tribune. September 14, 2021 Half a Million Customers Without Power https://www.texastribune.org/2021/09/13/texas-tropical-storm-nicholas-updates/

[7] Yale Climate Connections. September 14, 2021. Nicholas brings debris, storm surge to Texas as Cat 1 hurricane » Yale Climate Connections

Table 2

INCHES OF PRECIPITATION FOR TEXAS AND LOUISIANA AUTOMATED SURFACE OBSERVING SYSTEM (ASOS) STATIONS

ASOS Network	Station Name	9/12/2012	9/13/2021	9/14/2021	3 Day Total
LA_ASOS	La Porte	0.09	2.18	2.53	4.80
LA_ASOS	PATTERSON MEMORIAL	0.17	0.02	4.47	4.66
LA_ASOS	Lafayette	0.18	0.06	4.07	4.31
LA_ASOS	OAKDALE/ALLEN PARISH ARPT	-	-	4.31	4.31
LA_ASOS	FORT POLK (ARMY)	-	-	4.29	4.29
LA_ASOS	Fullerton - Fort Polk	-	-	3.93	3.93
LA_ASOS	Sulphur	0.30	0.39	2.89	3.58
LA_ASOS	BATON ROUGE/RYAN	0.33	0.51	2.59	3.43
LA_ASOS	Jennings	0.04	0.14	3.00	3.18
LA_ASOS	New Roads	0.05	0.43	2.60	3.08
LA_ASOS	Lake Charles	0.08	0.40	2.58	3.06
LA_ASOS	Opelousas	-	0.05	2.98	3.03
LA_ASOS	New Iberia - Acadiana	0.43	0.01	2.51	2.95
LA_ASOS	Abbeville	0.07	0.01	2.59	2.67
LA_ASOS	CHENAULT AIRPARK	-	0.25	2.27	2.52
LA_ASOS	New Orleans Downtown	0.10	-	2.25	2.35
LA_ASOS	NEW ORLEANS/MOISANT	0.44	0.01	1.87	2.32
TX_ASOS	Beaumont - Port Arthur	0.21	1.52	5.33	7.06
TX_ASOS	HOUSTON (CLOVER FIELD WAS T02)	0.14	2.68	2.96	5.78
TX_ASOS	GALVESTON/SCHOLES	0.39	1.77	3.10	5.26
TX_ASOS	Orange	0.04	0.84	3.80	4.68
TX_ASOS	Alaminos Canyon Block 857	0.31	3.67	0.65	4.63
TX_ASOS	Liberty	0.72	1.56	1.89	4.17
TX_ASOS	HOUSTON/WILL HOBBY	0.04	2.16	1.75	3.95
TX_ASOS	HOUSTON/INTERCONTIN	-	1.57	1.62	3.19
TX_ASOS	CORPUS CHRISTI INTL	0.76	2.38	-	3.14
TX_ASOS	ANGLETON/LAKE JACKS	0.01	2.69	-	2.70
TX_ASOS	Houston Dunn	0.01	1.09	1.31	2.41
TX_ASOS	BAY_CITY	-	2.14	0.15	2.29

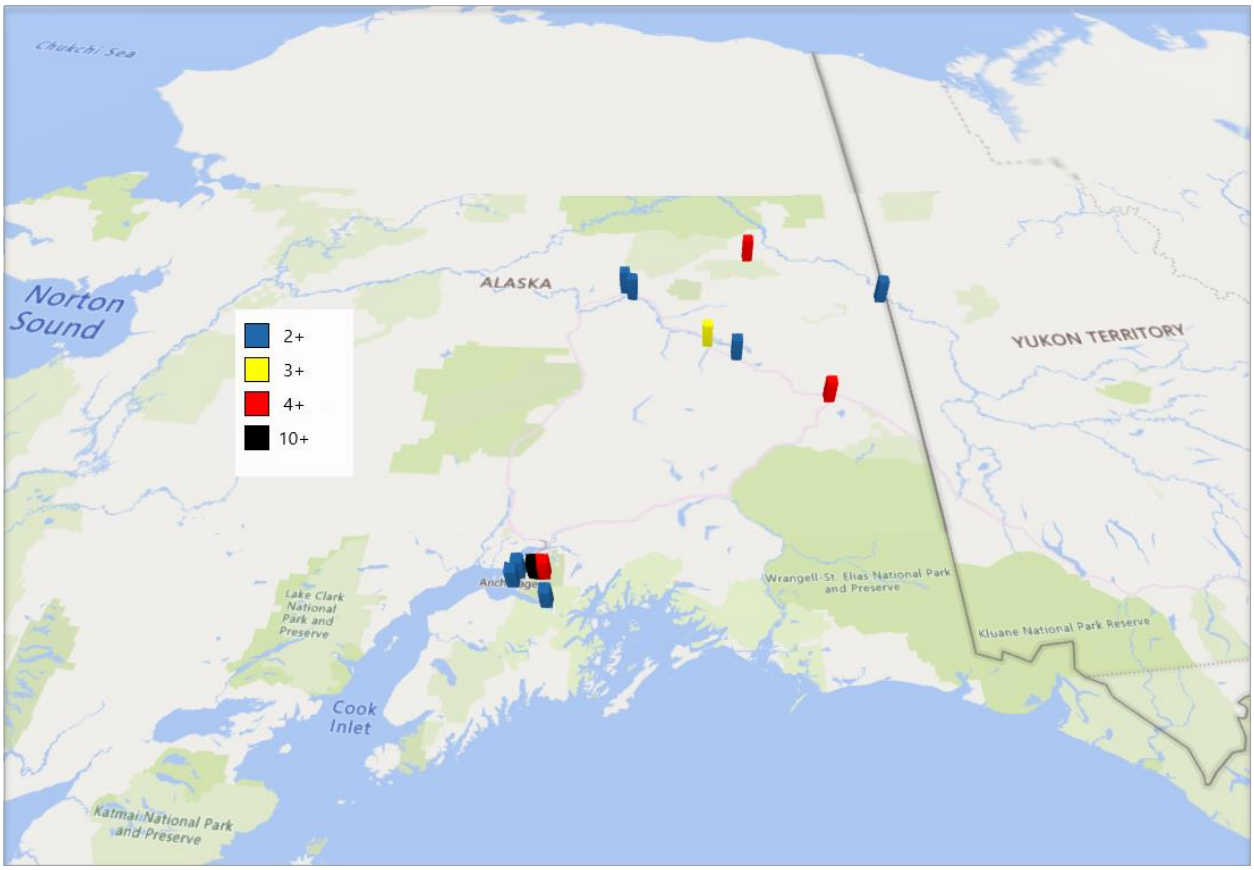
Source: IA State Automated Surface Observing System (ASOS): (Accessed October 11, 2021).
https://mesonet.agron.iastate.edu/request/download.phtml

Early Start to Winter Conditions in Alaska

According to the National Centers for Environmental Information (NCEI), some of the largest early season snowfall since the 1970s occurred in South Central Alaska in September. [8] As seen in Figure 5, stations in the Anchorage area had up to 10+ inches of snow on September 24, 2021. Additionally, power was out to thousands of customers in the Anchorage area as of September 24, 2021. [9]

Figure 5

GHCN STATION SNOW TOTALS OF 2 OR MORE INCHES ON SEPTEMBER 24, 2021 FOR SNOW TOTALS IN 99TH PERCENTILE OF SEPTEMBER DAILY TOTALS 1960-2021



Source: GHCN station data (Accessed October 6, 2021). https://www1.ncdc.noaa.gov/pub/data/ghcn/daily/

[8] NOAA National Centers for Environmental Information, State of the Climate: National Climate Report for September 2021, published online October 2021, retrieved on October 22, 2021 from https://www.ncdc.noaa.gov/sotc/national/202109

[9] Alaska News Source. September 25, 2021. Live updates: Crews will work to restore power into the weekend (alaskasnewssource.com)

Data

Temperature data and **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:

Source: https://www1.ncdc.noaa.gov/pub/data/ghcn/daily/

Filename: ghcnd_all.tar.gz

Automated Surface Observing System (ASOS) temperature and precipitation data

The steps below show how to get the hourly temperature and precipitation at the STL Airport, as an example, from the Iowa State University Automated Surface Observing System (ASOS):

IA State: https://mesonet.agron.iastate.edu/request/download.phtml
1) Select "Missouri ASOS" as the network and click "Switch to Network"

2) In the list of available stations, select the "[STL] ST. LOUIS" station, and click "Add Selected"

3) In the "Select From Available Data" section, choose the "Air Temperature [F]" and "1 hour Precipitation [inch]" options.

4) Set the date range to 2020-October-1 and 2020-October-31 (or whatever range is desired)

5) Select "Yes" for "Include Latitude + Longitude"

6) Click "Get Data" at the bottom

These steps would give you the results from the URL below.

https://mesonet.agron.iastate.edu/cgi-bin/request/asos.py?station=STL&data=tmpf&data=p01i&year1=2020&month1=10&day1=1&year2=2020&month2=10&day2=31&tz=Etc%2FUTC&format=onlycomma&latlon=yes&elev=no&missing=M&trace=T&direct=no&report_type=1&report_type=2

USGS Gauge Heights

Real-Time Values: https://waterservices.usgs.gov/rest/IV-Test-Tool.html

1. Select "List of Sites" in the Major Filters section and enter the Site Number(s) of interest
2. In the Date Ranges section, select "Return all values within an absolute date range" and enter the Date Range of interest
3. For "Parameter Codes", enter **00060** for Discharge, cubic feet per second or **00065** for Gage Height, feet.
4. At the bottom click "Generate the URL" then click "Run the Generated URL"

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