SOA Research Institute

Catastrophe and Climate

Actuarial Weather Extremes: November 2021

Extreme Precipitation, Drought, and Late Season Tornadoes

December 2021

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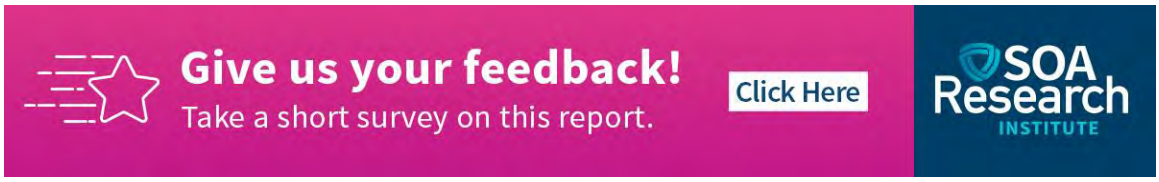

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Overview

This report examines weather conditions for precipitation, drought conditions, and late season tornadoes that are extreme in an historical context.

Extreme Precipitation in the Pacific Northwest: Many Global Historical Climatology Network (GHCN) stations in Northwest Washington state and Southwest British Columbia had record November daily precipitation amounts on November 14 and 15, 2021 when looking back to 1960. During and after those dates, many U.S. Geological Survey (USGS) stream gage stations in Washington had readouts that were from Flood Stage to Major Flood Stage.

Drought Conditions increase in Continental U.S. as Drought Moves East: Severe drought conditions in the Western U.S. dissipated somewhat, but in the Continental U.S. as a whole, the footprint where drought conditions exist has increased overall, and is driven primarily by increased drought in South-central and Middle Atlantic states.

Late Season Tornado Activity: Comparing the historical database of tornado activity and the recent activity in the state of New York, of 24 November tornadoes reported in New York since 1950, nine occurred on November 13, 2021. These late season tornadoes are rare in New York, and November 2021 was exceptionally active for these storms.

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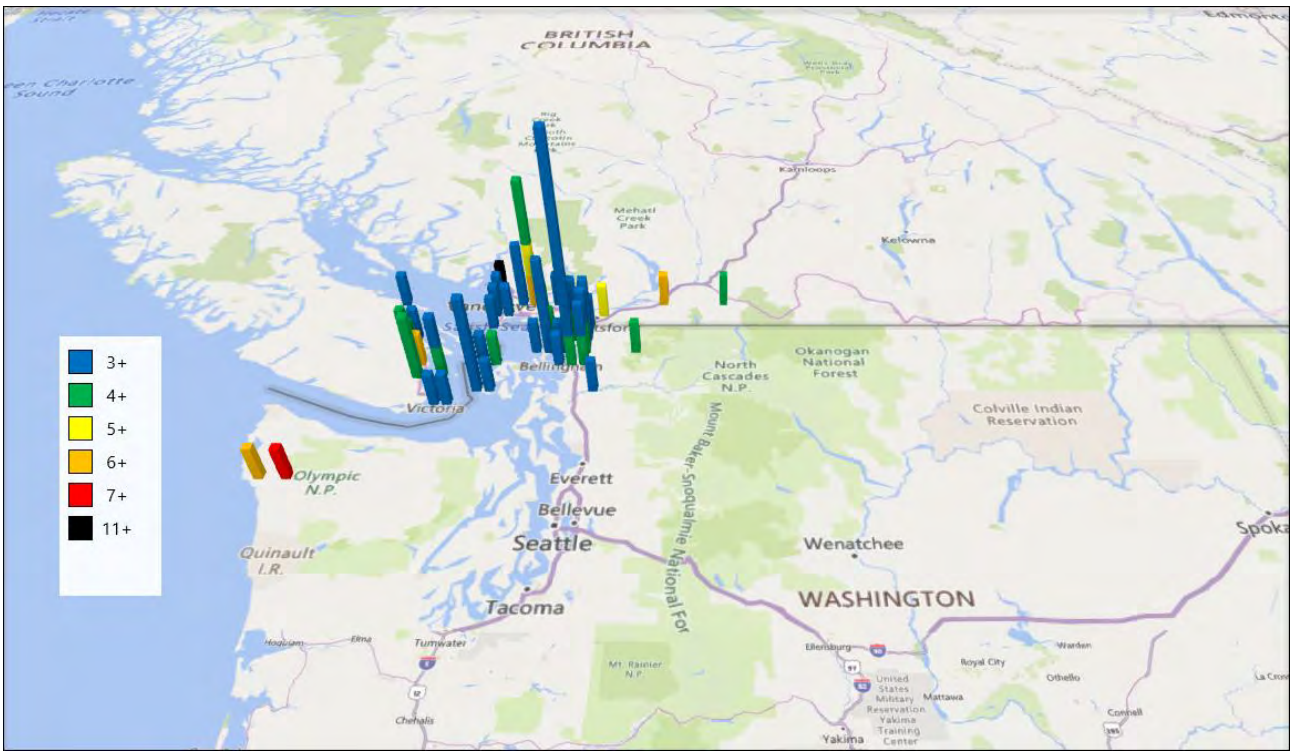
Record November Precipitation

Many GHCN stations in Northwest Washington state and southwest British Columbia had record daily precipitation amounts for November 14 and 15 in 2021, when looking back to 1960, and as seen in Figure 1, one station had more than 11 inches of rain in one day. During and after that time, many Washington stream gage stations had read-outs that were at from Flood Stage to Major Flood Stage (See Figure 2 and Table 1). According to Reuters, some 18,000 people were stranded due to flooding in the Abbotsford, British Columbia area on November 18, in "what could be the costliest natural disaster in Canadian history". [1]

Figure 1

GHCN STATIONS IN WASHINGTON AND BRITISH COLUMBIA WITH DAILY PRECIPITATION RECORDS (SINCE 1960) EXCEEDING 3 INCHES ON NOVEMBER 14-15, 2021. THIS FIGURE SHOWS INCHES OF PRECIPITATION IN ONE DAY ON NOVEMBER 14 OR 15.

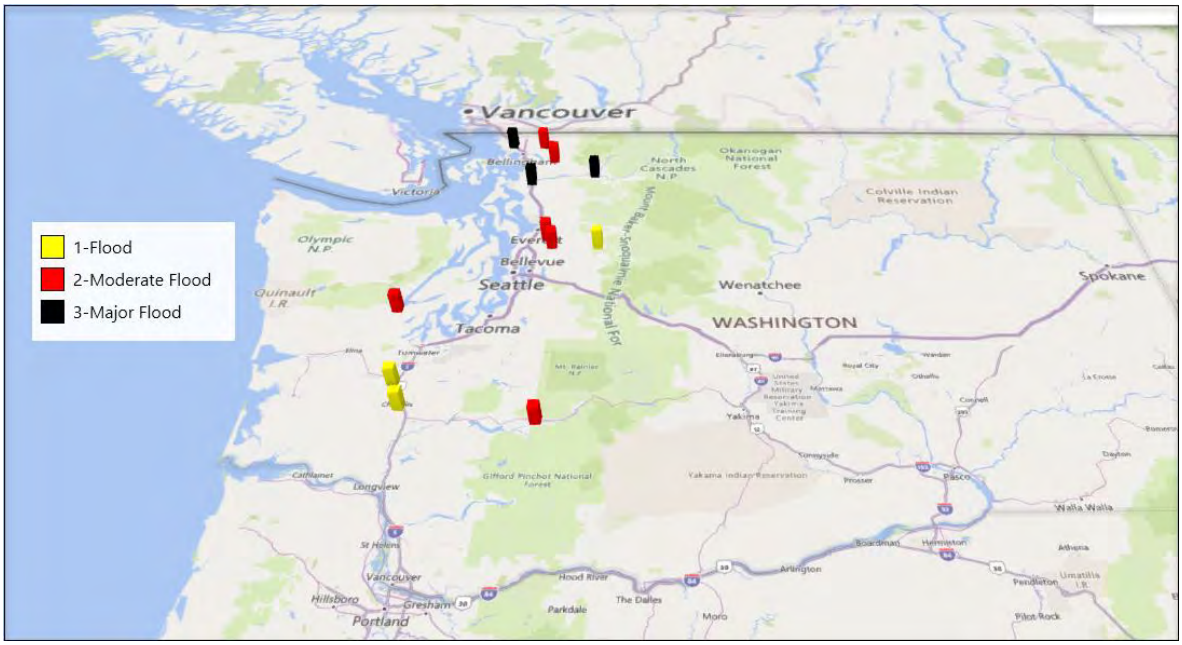


Source: GHCN station data (Accessed December 5, 2021). https://www1.ncdc.noaa.gov/pub/data/ghcn/daily/

[1] Reuters. November 18, 2021. British Columbia flooding has 18,000 still stranded, some in remote mountains | Reuters

Figure 2

USGS HIGHEST FLOOD STAGE REACHED AT STATE OF WASHINGTON STATIONS NOVEMBER 13-17, 2021



USGS Gauge Heights Real-Time Values (accessed December 5,2021): https://waterservices.usgs.gov/rest/IV-Test-Tool.html

Table 1

USGS STATIONS IN WASHINGTON STATE WHICH HIT ACTION OR FLOOD STAGE DURING NOVEMBER 13-17, 2021

Station Name	Site Number	11/13/21	**11/14/21**	11/15/21	11/16/21	11/17/21
CHEHALIS RIVER NEAR GRAND MOUND, WA	12027500	Flood	Action	Action	Action	None
COWLITZ RIVER AT RANDLE, WA	14231000	Moderate	Flood	Action	Action	None
NEWAUKUM RIVER NEAR CHEHALIS, WA	12025000	Flood	None	None	None	None
NOOKSACK RIVER AT FERNDALE, WA	12213100	None	None	Flood	Major	Flood
NOOKSACK RIVER AT NORTH CEDARVILLE, WA	12210700	None	None	Moderate	Flood	None
SF NOOKSACK RIVER AT SAXON BRIDGE, WA	12210000	None	None	Moderate	None	None
SKAGIT RIVER NEAR CONCRETE, WA	12194000	Action	Action	Major	Major	Moderate
SKAGIT RIVER NEAR MOUNT VERNON, WA	12200500	Action	Action	Moderate	Major	Major
SKOKOMISH RIVER NEAR POTLATCH, WA	12061500	Flood	Flood	Moderate	Moderate	Flood
SKYKOMISH RIVER NEAR GOLD BAR, WA	12134500	Action	Action	Flood	Action	None
SNOHOMISH RIVER AT SNOHOMISH, WA	12155500	Flood	Action	Moderate	Flood	Action
SNOHOMISH RIVER NEAR MONROE, WA	12150800	Action	Action	Moderate	Flood	Action

USGS Gauge Heights Real-Time Values (accessed December 5,2021): https://waterservices.usgs.gov/rest/IV-Test-Tool.html

Drought Conditions Increase in Continental U.S. Overall

As seen in Figure 3, severe drought conditions in the Western U.S. dissipated somewhat, but in the Continental U.S. as a whole, the footprint where drought conditions exist has increased. This is driven primarily by increased drought in South-Central and Middle Atlantic states. The most extreme drought classifications have not changed much overall, but the moderate to severe conditions have expanded materially as shown in the "By Category" portion of Figure 3 below.

Figure 3

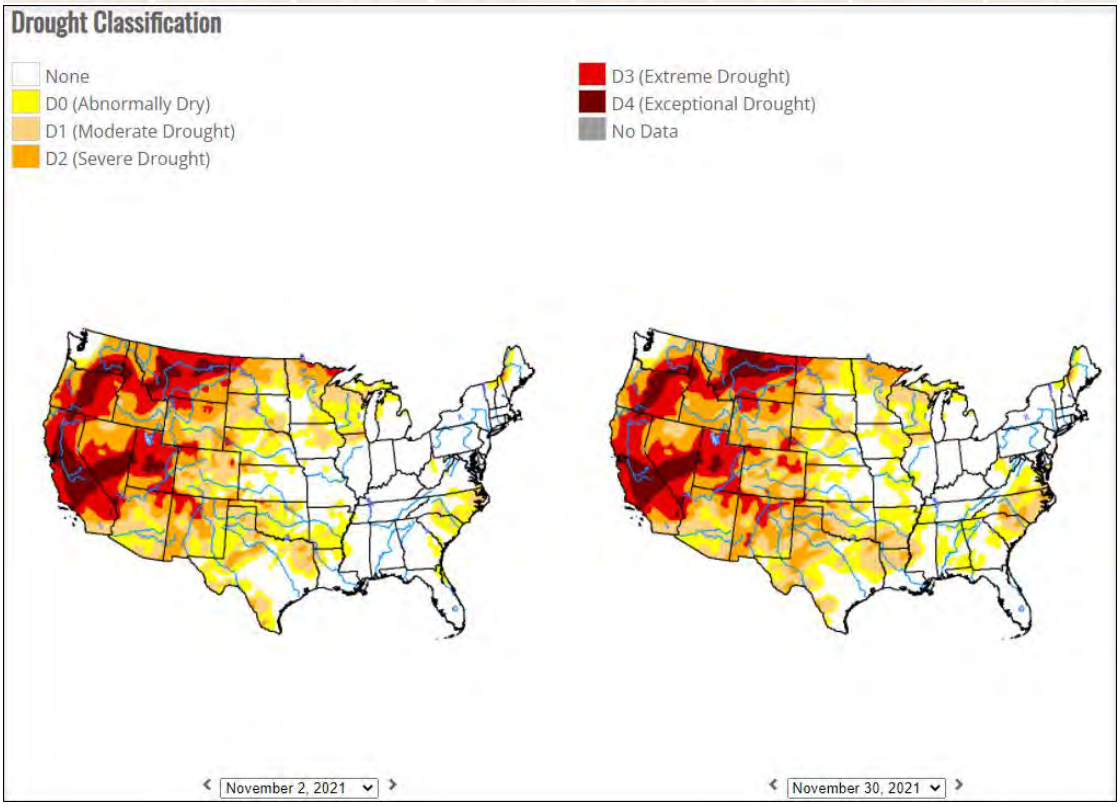
COMPARISON OF DROUGHT CONDITIONS IN THE CONTINENTAL U.S. OVER NOVEMBER 2021. AMOUNTS IN THE TABLE BELOW ARE PERCENTAGE OF CONTINENTAL U.S. IN EACH DROUGHT CLASSIFICATION

Cumulative Category Percentages

Week	None	D0-D4	D1-D4	D2-D4	D3-D4	D4	DSCI
2021-11-02	37.22	62.78	47.81	32.93	17.98	5.74	167
2021-11-30	30.95	69.05	53.42	35.11	17.77	5.33	181
Change	-6.27	6.27	5.61	2.18	-0.21	-0.41	14

Percentages by Category

2021-11-02	37.22	14.97	14.87	14.96	12.23	5.74	167
2021-11-30	30.95	15.63	18.31	17.34	12.44	5.33	181
Change	-6.27	0.66	3.44	2.38	0.21	-0.41	14

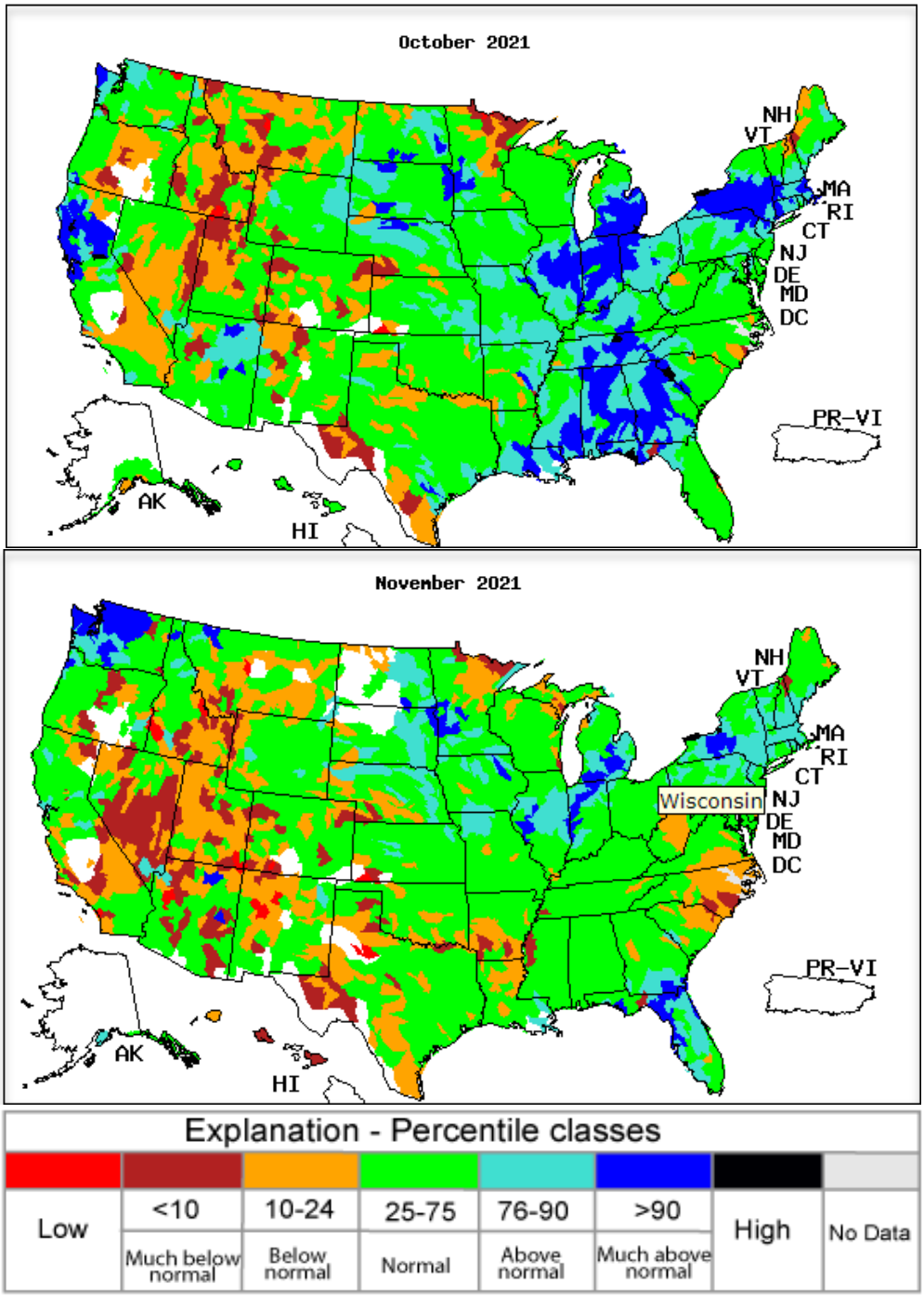


Source (Accessed December 8, 2021): https://droughtmonitor.unl.edu/Maps/CompareTwoWeeks.aspx The U.S. Drought Monitor is jointly produced by the National Drought Mitigation Center at the University of Nebraska Lincoln, the United States Department of Agriculture, and the National Oceanic and Atmospheric Administration. Map courtesy of NDMC.

Consistent with the precipitation and drought conditions over the month of November, the Continental U.S. stream flow conditions are reflected showing the shifts in highest and lowest percentile stream flows for gages with at least 30 years of data. This can be compared to October 2021 in Figure 4.

Figure 4

USGS STREAMFLOW IN OCTOBER 2021 AND THEN IN NOVEMBER 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: 11/17/21 and 12/8/21

November Tornadoes

Comparing the historical database of tornado activity and the recent activity in the state of New York, of the 24 November tornadoes reported in New York since 1950, nine of them occurred on November 13, 2021 (See Table 2). These late season tornadoes are rare in New York, and November 2021 was exceptionally active for these storms. As reported in the Washington Post, later season warm Atlantic-ocean waters can create fuel for tornado activity, and a longer-term change to this type of climate could lead to a greater incidence of late season tornado activity from the warmer waters which stay warm, even as the daylight wanes late in the season. [2]

Table 2

TORDADOES REPORTED IN NEW YORK STATE SINCE 1950

Date	County	Magnitude
11/16/1989	MADISON CO.	F0
11/16/1989	WESTCHESTER CO.	F0
11/16/1989	SULLIVAN CO.	F1
11/16/1989	ORANGE CO.	F1
11/16/1989	HAMILTON CO.	F0
11/16/1989	SARATOGA CO.	F1
11/16/1989	SARATOGA CO.	F0
11/16/1989	RENSSELAER CO.	F0
11/8/1996	CHENANGO CO.	F0
11/8/1996	CHENANGO CO.	F0
11/16/2006	CHEMUNG CO.	F1
11/17/2010	COLUMBIA CO.	EF1
11/14/2011	CHAUTAUQUA CO.	EF2
11/14/2011	CHAUTAUQUA CO.	EF2
11/12/2021	DUTCHESS	EF-1
11/13/2021	NASSAU	EF-0
11/13/2021	NASSAU	EF-0
11/13/2021	NASSAU	EF-0
11/13/2021	SUFFOLK	EF-0
11/13/2021	SUFFOLK	EF-0
11/13/2021	SUFFOLK	EF-1
11/13/2021	SUFFOLK	EF-0
11/13/2021	SUFFOLK	EF-0
11/13/2021	SUFFOLK	EF-0

Source: NOAA National Center for Environmental Information: https://www.ncdc.noaa.gov/stormevents/ Date Accessed: 12/5/2021
Source: SPC: https://www.spc.noaa.gov/climo/reports/211113_rpts.html Date Accessed: 12/5/2021

[2] The Washington Post. November 14, 2021. Tornadoes strike Long Island and Connecticut in rare November storm - The Washington Post

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

National Weather Service Storm Prediction Center Reports

SPC: https://www.spc.noaa.gov/climo/reports/211113_rpts.html
This page will show all Tornado, Wind, and Hail reports for 11/13/2021
Select the "211114 Reports" button at the top to move to the next day

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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