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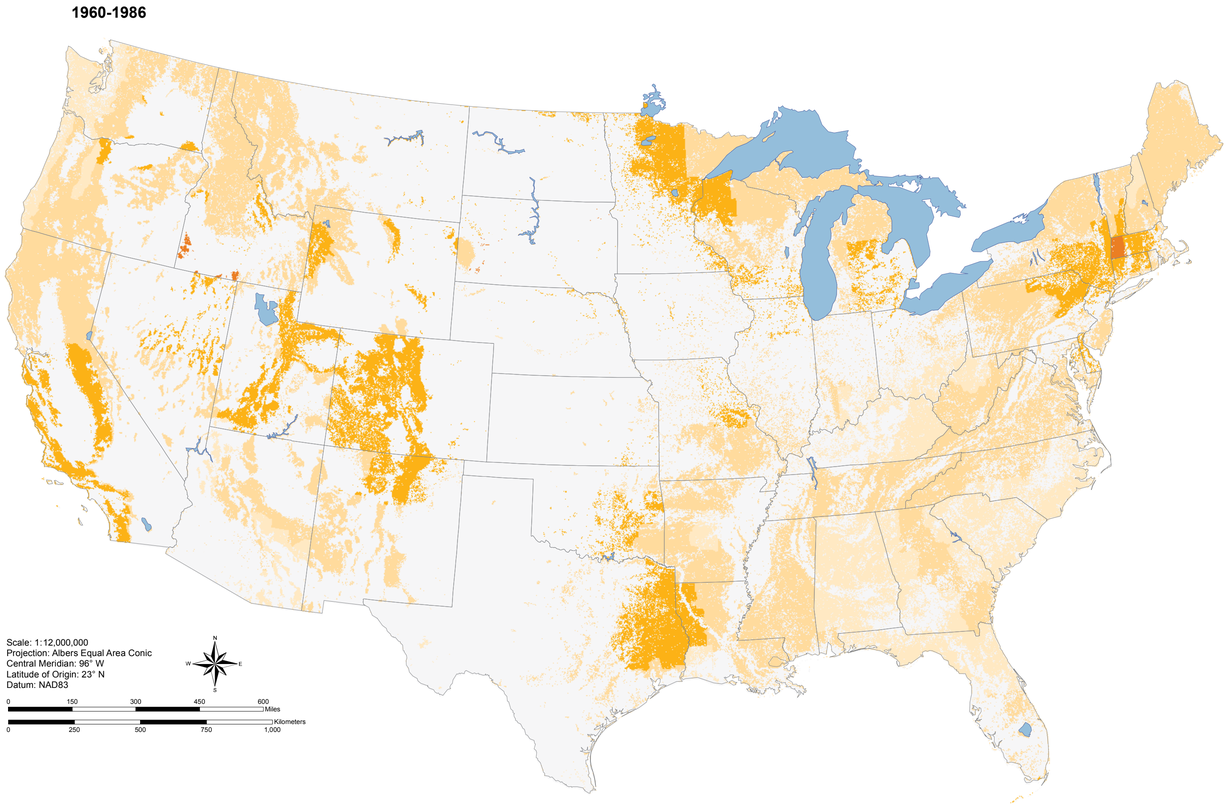
Spatio-temporal Drought Trends by Forest Type in the Conterminous United States, 1960-2013

Matthew P. Peters, Louis R. Iverson, and Stephen N. Matthews



Data Sources:
National Climatic Data Center. 2014.
North American Drought Monitor Indices
http://www.ncdc.noaa.gov/temp-and-precip/drought/nadm/indices.php?
U.S. Forest Service and U.S. Geological Survey. 2000. Forest Cover Types.
http://www.fia.fs.fed.us/library/ maps/

Map Description

Droughts are common in virtually all U.S. forests, but their frequency and intensity vary within forest ecosystems (Hanson and Weltzin 2000). Accounting for the long-term influence of droughts within a region is difficult due to variations in the spatial extent and intensities over a period. Therefore, we created a cumulative drought severity index (CDSI) (Fig. 1) for the United States using weighted monthly frequencies of Palmer Drought Severity Index values reported at climate divisions for the periods 1960 to 1986 and 1987 to 2013 (National Climate Data Center 2014, Palmer 1965). The occurrences of 'severe' conditions (index value of -3.0 to -3.9) receive a weight of 2 and 'extreme' (index value of ≤ -4.0) receive a weight of 3 to reflect the increased magnitude of these events.

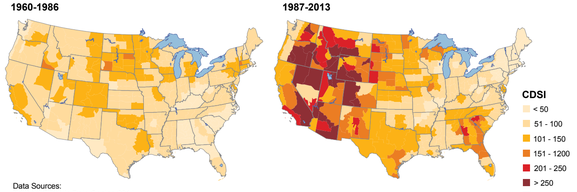


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Figure 1. Cumulative drought severity index values, which are a weighted summation of monthly drought occurrences, are mapped among climate divisions of the conterminous United States for the periods 1960 to1986 and 1987 to 2013. Forest cover types defined by the U.S. Forest Service were used to mask nonforested land depicting the impact of droughts within forests (large map and inset right).

Forest cover types defined by the U.S. Forest Service include 21 distinct groups that were used to mask nonforested land and summarize weighted frequencies of drought occurring during each 324-month period. Additionally, forest cover types were combined within eastern and western United States and drought frequencies among climate divisions were summarized for the two periods (Figure 2).

Drought severity has increased throughout the West, Southeast, and Lake States (see map at right). The Northeast and Mid-Atlantic States have not experienced such severe droughts in the latter period. The mapped areas show that the frequencies of drought conditions in forests have significantly increased in the West compared to the East.

Drought frequencies for forested land of the conterminous United States during the period 1960-2013 were adjusted for the number months per climate division. For each forest type, drought conditions were summarized as the percentage of months during the 324-month period (27 years) among climate divisions that contained the forested land (Table 1). Data used to create these maps can be obtained by contacting the author: matthewpeters@fs.fed.us.

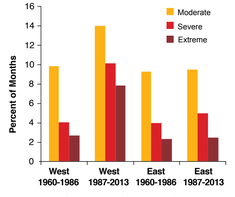

Figure 2. Comparison of Palmer Drought Severity Index classes among eastern and western U.S. forested land for the period 1960–2013.

Table 1. Percent of drought occurrence among major forest types of the conterminous United States and relative cumulative drought severity index (CDSI) scores. Droughts reported at climate divisions containing each forest type were used to aggregate values and calculate percentages of the 324-month period.

		1960-1956 Percent of Record				1987-2013 Percent of Record			
Forest Type	U.S. area (km^2)	MD[1]	SD[1]	ED[1]	CDSI	MD	SD	ED	CDSI
Aspen-birch	106,263	8.6	4.0	4.3	29.5	7.5	4.3	2.7	24.2
Elm-ash-cottonwood	21,481	8.5	4.2	3.4	27.1	8.7	5.0	3.5	29.2
Loblolly-shortleaf pine	235,600	10.0	3.9	1.0	20.8	11.5	6.0	2.5	31.0
Longleaf-slash pine	81,888	10.7	3.7	0.7	20.2	11.8	6.1	2.7	32.1
Maple-beech-birch	204,826	8.6	3.9	2.9	25.1	8.7	4.5	2.3	24.6
Oak-gum-cypress	119,125	10.2	4.0	1.0	21.2	11.4	5.9	2.5	30.7
Oak-hickory	501,134	9.3	4.0	2.2	23.9	9.6	5.0	2.5	27.1
Oak-pine	192,825	9.5	3.8	1.4	21.3	10.1	4.9	1.9	25.6
Spruce-fir	58,803	8.7	4.2	3.2	26.7	7.7	3.9	2.2	22.1
White-red-jack pine	71,113	8.9	4.1	3.4	27.3	8.2	4.3	1.9	22.5
Chaparral	52,182	10.8	4.5	2.3	26.7	14.4	12.2	9.7	67.9
Douglas-fir	153,728	9.4	4.5	3.0	27.4	13.2	10.2	9.6	62.4
Fir-spruce	76,688	9.7	4.2	2.5	25.6	13.2	10.3	9.5	62.3
Hemlock-Sitka spruce	17,596	10.9	2.0	1.0	18.2	13.0	5.8	1.6	29.4
Larch	11,439	7.9	4.1	4.0	28.1	15.6	12.5	8.3	65.5
Lodgepole pine	117,396	9.6	4.7	3.7	30.1	12.8	10.2	9.9	62.9
Pinyon-juniper	224,678	11.1	4.8	2.0	26.7	13.7	11.0	8.3	60.6
Ponderosa pine	221,476	10.0	4.5	3.1	28.3	13.0	10.2	8.7	59.5
Redwood	5,998	11.1	3.0	1.5	21.6	16.7	6.7	1.3	34.0
Western hardwoods	65,993	9.9	4.3	2.8	26.9	13.6	10.6	8.9	61.5
Western white pine	9,048	7.9	3.5	3.7	26.0	15.1	12.3	10.7	71.8
Eastern Forest	**1,593,058**	**9.3**	**4.0**	**2.3**	**24.2**	**9.5**	**5.0**	**2.5**	**27.0**
Western Forest	**956,222**	**9.8**	**4.0**	**2.7**	**25.9**	**14.0**	**10.2**	**7.9**	**58.1**

MD= moderate drought (-2.0 to -2.9); SD=severe drought (-3.0 to -3.9); ED=extreme drought (≤ -4)

Data Sources

Palmer Drought Severity Index values were obtained from the National Climatic Data Center (2014) and used to calculate the CDSI. The forest cover types layer was provided by the U.S. Forest Service and U.S. Geological Survey (2000) and used to mask nonforested land.

Suggested Citation

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The Authors

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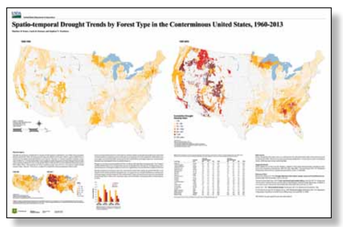

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