



Weather of Bluestone National Scenic River, Gauley River National Recreation Area, and New River Gorge National River

Eastern Rivers and Mountains Network Summary Report for 2012

Natural Resource Data Series NPS/ERMN/NRDS—2013/561



ON THE COVER

Mist over insignificant rapid, Gauley River, Gauley River National Recreation Area.

Photograph by: Jim Vanderhorst.

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Natural Resource Data Series NPS/ERMN/NRDS—2013/561

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The National Park Service, Natural Resource Stewardship and Science office in Fort Collins, Colorado, publishes a range of reports that address natural resource topics. These reports are of interest and applicability to a broad audience in the National Park Service and others in natural resource management, including scientists, conservation and environmental constituencies, and the public.

The Natural Resource Data Series is intended for the timely release of basic data sets and data summaries. Care has been taken to assure accuracy of raw data values, but a thorough analysis and interpretation of the data has not been completed. Consequently, the initial analyses of data in this report are provisional and subject to change.

All manuscripts in the series receive the appropriate level of peer review to ensure that the information is scientifically credible, technically accurate, appropriately written for the intended audience, and designed and published in a professional manner. This report received informal peer review by subject-matter experts who were not directly involved in the collection, analysis, or reporting of the data. Data in this report were collected and analyzed using methods based on established, peer-reviewed protocols and were analyzed and interpreted within the guidelines of the protocols.

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List of Key Acronyms

| | |
|--------|---|
| ASOS | Automated Surface Observing System |
| BLUE | Bluestone National Scenic River |
| COOP | National Weather Service Cooperative Observer Program |
| CWOP | Citizen Weather Observer Program |
| ERMN | Eastern Rivers and Mountains Network |
| GARI | Gauley River National Recreational Area |
| GOES | Geostationary Operational Environmental Satellite |
| IFLOWS | Integrated Flood Observing and Warning System |
| NADP | National Atmospheric Deposition Program |
| NARR | North American Regional Reanalysis |
| NCDC | National Climatic Data Center |
| NERI | New River Gorge National River |
| NOAA | National Oceanic and Atmospheric Administration |
| NPS | National Park Service |
| NR | National River |
| NRA | National Recreation Area |
| NSR | National Scenic River |
| NWS | National Weather Service |
| PDSI | Palmer Drought Severity Index |
| POR | Period of Record |
| PRISM | Parameter-elevation Regressions on Independent Slopes Model |
| RAWS | Remote Automated Weather Stations |
| USDM | United States Drought Monitor |
| USGS | United States Geological Survey |

Introduction

Weather and climate are widely recognized as key drivers of terrestrial and aquatic ecosystems, affecting biotic as well as abiotic ecosystem characteristics and processes. Global and regional scale climatic patterns, trends, and variations are critical to the cycling of elements, nutrients, and minerals through ecosystems and can deliver pollutants from regional and even global sources (National Assessment Synthesis Team 2001). These variations and trends influence the fundamental properties of ecologic systems such as soil-water relationships and plant-soil processes and their disturbance rates and intensity. Information obtained from meteorological monitoring will be useful to interpreting and understanding changes in species composition, community structure, water and soil chemistry, and related landscape processes (Marshall and Piekielek 2007).

The purpose of this report is to provide a concise weather and climate summary for the period from January 1 through December 31, 2012, and to place current patterns and trends in an appropriate historical and regional context (Marshall et al. 2012). It is our intention that this report will satisfy an inherent interest in meteorological phenomena and meet a portion of the Eastern Rivers and Mountains Network (ERMN) Weather and Climate Monitoring objective:

- Document current status and long-term trends in air temperature and precipitation at multiple temporal scales (e.g., daily, monthly, seasonal, annual, and decadal) and spatial scales (e.g., individual stations and aggregated stations such as climate divisions) utilizing existing weather and climate monitoring programs and datasets.

To accomplish this objective, a variety of atmospheric data streams were evaluated for their quality, longevity, and applicability to the ERMN parks. Since no single weather observing network contains all the pertinent measures of atmospheric phenomena to assess ecosystem health, an objective analysis of the data networks was developed and outlined in the Weather and Climate Monitoring Protocol for the Eastern Rivers and Mountains Network and Mid-Atlantic Network of the National Park Service (Marshall et al. 2012). Through this analysis, a select number of weather/climate observing stations were chosen as representative of each park and these are the primary data sources used to profile climate summary and trends.

In addition to a suite of summary tables, graphs, and narratives, we specifically identify a series of key weather indicators to report status and trends on an annual basis and periodically in separate and more thorough reports. These key indicators are further described in the protocol (Marshall et al. 2012) and summarized in the body of this report.

Climate of the Central and Southern West Virginia Region

Bluestone National Scenic River (NSR) is located in West Virginia (WV) Climate Division 5, “Southern,” while Gauley River National Recreation Area (NRA) is located in WV Climate Division 4, “Central.” New River Gorge National River (NR) is located within both. A climate division is a region that is reasonably homogenous with respect to climatic and hydrologic characteristics (<http://www.esrl.noaa.gov/psd/data/usclimdivs/data/map.html>) and is frequently used for compiling climate statistics. West Virginia is divided into six climate divisions.

The two climate divisions encompassing these parks are generally considered to have a humid, continental type of climate, but the varied physiographic features have a marked effect on the weather and climate of the various parts of this region. The prevailing westerly winds carry most of the weather disturbances that affect the region from the interior of the continent, with the Atlantic Ocean having only an occasional influence on the climate of the area (Davey et al. 2006). Coastal storms do, at times, affect the day-to-day weather, especially in the winter. Infrequently, storms of tropical origin can have a significant effect, causing severe floods in some instances.

Temperatures are moderately continental, with the tempering effects of the Great Lakes contributing to cloud production in the winter and mountain-valley circulation clouds reducing the heat at times during the summer. The lowest readings in the winter occur with polar air masses of Canadian origin settling over the region after a fresh snowfall. The highest readings of the summer happen when the sub-tropical fair weather system, the Bermuda high, pushes westward into the Carolinas; its clockwise circulation will direct hot, humid air from the Gulf region into the Ohio Valley and West Virginia. The humid southwest winds ascending the crest of the Appalachians can produce widespread afternoon thunderstorms. On average, Gauley River NRA tends to have a greater number of hot days (temperatures above or equal to 90.0°F/32.0°C) than New River Gorge NR and Bluestone NSR. The last freeze typically occurs in mid-May and the first frosts appear in October.

Precipitation is fairly evenly distributed throughout the year. Annual amounts generally range between 36–52 in (914–1,321 mm), while the majority of places receive 38–44 in (965–1,118 mm). Greatest amounts usually occur in the late spring and summer months, while February is the driest month, having about 2 in (51 mm) less than the wettest months. During the warm season, the uneven heating over the irregular terrain leads to numerous thunderstorms which typically form over the mountains.

Surface winds blow from the west and northwest in the cold season and from the southwest during the warm half of the year. Thunderstorms follow a frequency that matches the solar cycle, occurring between the equinoxes and reaching a peak near the summer solstice. Hail is relatively infrequent, but flash floods and damaging thunderstorm winds affect parts of the region each summer. On average, tornadoes pass through the area about once every three years. The direct effects of an Atlantic hurricane are uncommon, though remnant rains from hurricanes and tropical storms have contributed to the region’s worst floods. Ice storms, which can cause significant disruption, occur at irregular intervals and are primarily confined to the months between December and March (Kocin and Uccellini 2004).

Observing Stations

Eleven weather observing stations, comprising three observing networks, were selected around Bluestone NSR, Gauley River NRA, and New River Gorge NR. Representative stations within a 100-km range of each park were chosen based on several criteria, including proximity to the park, the representativeness of the station to the park elevation profile, the type and frequency of observations, the period of record of the data, and data availability (Marshall et al. 2012). Moreover, the percentage of time a station reports particular parameters (e.g., temperature) can influence data inclusion. No stations were excluded in 2012 due to this criterion; therefore, all 11 stations were used for this report (Figure 1, Table 1).

The average value of a climate element over 30 years is defined as a climatological normal, which is calculated and established by NOAA's National Climatic Data Center (NCDC). Every ten years, NCDC computes new thirty-year climate normals for selected temperature and precipitation elements for a large number of U.S. climate and weather stations. The current (as of 2011) normals cover the period 1981–2010. In this report, the 30-year normals established by NCDC are used as the baseline for comparisons (e.g., departures from normal). In cases where data for the 30-year normal period are not available, we use alternative comparisons such as the new pseudo-normal from NCDC or a recent 10-year period. In some cases, sufficient data may simply not be available to calculate normals. For metrics that NCDC may not routinely calculate a normal, such as the number of days with more than 2 in (55 mm) of rain or liquid equivalent, normals are calculated using the same time period (e.g., 1981–2010) as the current NCDC standard. Throughout the report, descriptions of a station's values as compared to the normals are described as a difference from the "average", "mean", "typical", "long-term value", as well as "normal", to improve the readability of the document. However, all of these terms are comparing a value from one year at that station to that station's normal, whether it be the 30-year normal or the pseudo-normal calculated on a shorter time frame.

The NCDC also calculates and provides climatological ranks for selected temperature and precipitation elements (<http://www.ncdc.noaa.gov/temp-and-precip/ranks.php>). Data and statistics are as of January 1895 providing a substantial period of record to place the current year in historical context.

In addition to the summary information available in this report, a near real-time data stream has been made available to the ERMN through a Web interface for the selected stations along with monthly, seasonal, and annual summaries. The Web interface is accessible through the following link: http://climate.met.psu.edu/gmaps/NPS_DEVELOPMENT/interface.php.

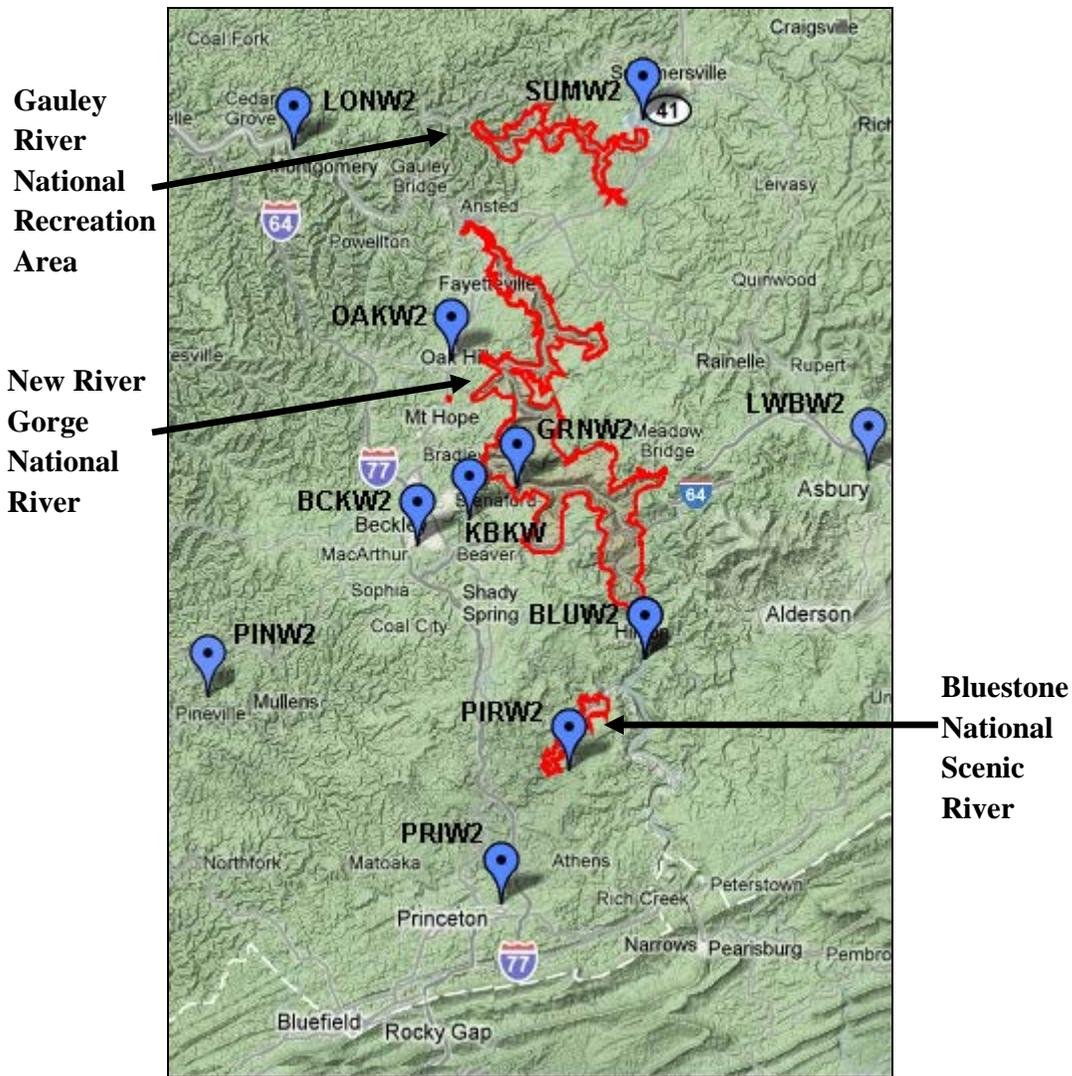


Figure 1. Location of weather observing stations around Bluestone National Scenic River, Gauley River National Recreation Area, and New River Gorge National River. See Table 1 for station names.

Table 1. List of weather observing stations around Bluestone National Scenic River, Gauley River National Recreation Area, and New River Gorge National River selected as best representative of the parks in 2012.

| Station | Observing Network | Station Name | Period of Record (POR) | | Percentage of Time Reporting Temperature for 2012 | Percentage of Time Reporting Precipitation for 2012 | Percentage of Time Reporting Temperature for entire POR | Percentage of Time Reporting Precipitation for entire POR |
|---------|-------------------|---|------------------------|---------|---|---|---|---|
| BLUW2 | COOP | Bluestone Lake | 03/01/1943 | Present | 99.7 | 100.0 | 98.4 | 99.6 |
| OAKW2 | COOP | Oak Hill | 10/01/1941 | Present | 77.5 | 81.4 | 97.1 | 97.1 |
| LONW2 | COOP | London Locks | 07/01/1934 | Present | 93.7 | 99.2 | 90.1 ¹ | 89.1 |
| SUMW2 | COOP | Summersville Lake | 02/01/1967 | Present | 83.6 | 88.8 | 97.7 | 98.7 |
| PRIW2 | COOP | Princeton | 07/01/1940 | Present | - | 100.0 | - | 98.7 |
| LWBW2 | COOP | Lewisburg 3 N | 09/11/1852 | Present | 99.5 | 100.0 | 94.2 ² | 65.0 |
| BCKW2 | COOP | Beckley VA Hospital | 12/01/1893 | Present | 98.4 | 98.6 | 78.9 ³ | 76.7 |
| KBKW | ASOS | (Beckley) Raleigh County Memorial Airport | 05/15/1963 | Present | 100.0 | 100.0 | 99.9 | 99.9 |
| PINW2 | COOP | Pineville | 01/06/1908 | Present | 90.1 | 91.8 | 62.5 | 62.5 |
| GRNW2 | RAWS | Grandview | 01/01/2005 | Present | 88.8 | 89.0 | 97.6 | 97.3 |
| PIRW2 | RAWS | Pipestem | 06/09/2005 | Present | 100.0 | 100.0 | 97.3 | 97.3 |

¹LONW2 began reporting temperature on 8/4/1936.

³BCKW2 began reporting temperature on 4/1/1896.

²LWBW2 began reporting temperature on 4/17/1900.

Temperature Summary

The 2012 calendar year averaged above normal compared with the long-term means for temperature (Tables 2, 3, and 4) and continued the warming trend noted in 2011. After a mild January, February was much warmer and March brought the largest positive departures of the year (Figures 2 and 3).¹ The average annual temperature ranged from +1.4°F (0.8°C) to +2.6°F (+1.4°C) above normal (Table 4), making 2012 the 3rd and 4th warmest in their respective climate divisions since 1895 (Table 5). For the entire contiguous United States, 2012 was the hottest in the past 118 years.

The lowest readings, which were between 9 and 15 degrees Fahrenheit (°F) (-12.8 to -9.4 degrees Celsius [°C]) during the winter, were measured on January 4, 2012 at most sections. The lowest value for the year near the parks occurred in Summerville Lake, WV, and was 9.0°F (-12.8°C) (Table 2). The number of sub-freezing days was noticeably fewer the long-term mean and the number of cold nights was below the average (Table 2). The winter ranked as the 3rd to 4th warmest in 118 years for the climate divisions encompassing the parks (59 is the mid-point; Table 5).

The spring continued the warmth though not as widespread or intense, such that the period from April to June of 2012 ranked as the 13th to 33rd warmest in 118 years (Figures 2 and 3; Table 5). Record early warmth was noted during the first week of May as readings rose to 86°F (30°C) in some locations. An outbreak of cold weather in the latter part of April brought most sections their last frost (on April 23-24), so the growing season in parts of each park began later than the average date (Table 2). Most of this spring's warmth can be attributed to very mild days and nights during May (Figures 2 and 3).

The summer months of July–August–September were warm due to hot July days (Figure 2). August and September averaged very close to normal with both months measuring slightly cooler than average minimums (Figure 3). A few record maximums were recorded during the period and the summer ranked as the 28th to 41st warmest in 118 years of records (Table 5). The highest readings of the year, above 90°F (32.2°C) occurred on either June 29 or July 8 (Table 2).

Overall, autumn ranked near the average of the last 118 years for temperature; between 41st and 62nd with 59 being the long-term mean (Table 5). Frosts and freezes occurred earlier than in recent years, with most sections noticing sub-freezing readings (<32°F [<0°C]) on October 11, but a few spots saw frost on October 21. As a result, the length of the growing season was shorter (by about 6–25 days) (Table 2) than the 1981–2010 normal lengths. While October averaged near to slightly below normal (Figures 2 and 3), it was November which had the largest negative departures of about -4°F (-2.2°C) that made this season the coolest relative to normal in 2012 (Table 4).

¹ The maps in Figures 2 and 3 were created using estimates from the Parameter-elevation Regressions on Independent Slopes Model (PRISM). PRISM uses an interpolation scheme for temperature between actual observations and corrects these estimates for changes in topography across the region (Daly et al. 2002). More information can be found at <http://www.prism.oregonstate.edu/>.

Table 2. Status of 2012 temperature indicators compared to the 30-year normal (1981–2010) at the London Locks (LONW2), Beckley Airport (KBKW), and Summersville Lake (SUMW2) stations.

| Temperature Indicator | London Locks, WV 2012 | London Locks, WV 1981-2010 | Beckley Airport, WV 2012 | Beckley Airport, WV 1981–2010 | Summersville Lake, WV 2012 | Summersville Lake, WV 1981-2010 |
|--|-----------------------|----------------------------|--------------------------|-------------------------------|----------------------------|---------------------------------|
| Average Annual Temperature | 57.6°F 14.2°C | 56.2°F 13.4°C | 54.5°F 12.5°C | 51.9°F 11.1°C | M M | 50.8°F 10.4°C |
| Average Annual Maximum Temperature | 69.3°F 20.7°C | 67.0°F 19.4°C | 64.2°F 17.9°C | 61.3°F 16.3°C | M M | 61.3°F 16.3°C |
| Maximum Temperature | 100°F 37.8°C | 94.5°F 34.7°C | 96.0°F 35.5°C | 88.2°F 31.2°C | 99.0°F 37.2°C | 89.5°F 31.9°C |
| Hot Days (days with Tmax≥90°F/32°C) | 36 | 22 | 6 | 1 | 7 | 2 |
| Average Annual Minimum Temperature | 46°F 7.8°C | 45.5°F 7.5°C | 44.7°F 7.1°C | 42.5°F 5.8°C | M M | 40.2°F 4.6°C |
| Minimum Temperature | 15.0°F -9.4°C | 3.1°F -16.1°C | 10.0°F -12.2°C | -4.8°F -20.4°C | 9.0°F -12.8°C | -5.3°F -20.7°C |
| Cold Days (days with Tmax≤32°F/0°F) | 3 | 11 | 12 | 25 | 7 | 27 |
| Sub-freezing Days (days with Tmin≤32°F/0°C) | 95 | 88 | 95 | 107 | 100 | 126 |
| Sub-zero Days (days with Tmin≤0°F/-17.8°C) | 0 | 1 | 0 | 2 | 0 | 3 |
| Growing Season Length (days between last spring Tmin 32°F/0°C and first fall Tmin 32°F/0°C) | 182 | 207 | 171 | 174 | 163 | 169 |

Table 3. Summary of monthly average temperature for 2012 for the selected stations.

| Station name | Station | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Annual |
|---------------------|---------|--------|--------|--------|--------|--------|--------|---------|--------|--------|--------|---------|---------|---------|
| Bluestone Lake | BLUW2 | 35.6°F | 38.6°F | 53.1°F | 52.4°F | 65.5°F | 67.7°F | 76.75°F | 69.5°F | 62.1°F | 54.4°F | M | M | M |
| | | 2.0°C | 3.66°C | 11.7°C | 11.3°C | 18.6°C | 19.8°C | 24.8°C | 20.8°C | 16.7°C | 12.4°C | M | M | M |
| Oak Hill | OAKW2 | 38.7°F | 40.2°F | 55°F | 54°F | 67.9°F | 70.9°F | 79.4°F | 74.6°F | 68.4°F | 57.2°F | 43.1°F | 42.1°F | 57.6°F |
| | | 3.7°C | 4.5°C | 12.8°C | 12.2°C | 19.9°C | 21.6°C | 26.3°C | 23.7°C | 20.2°C | 14°C | 6.1°C | 5.6°C | 14.23°C |
| London Locks | LONW2 | M | 37.2°F | 50.9°F | 51.1°F | 65.4°F | M | 75.7°F | 69.6°F | 63.1°F | 50°F | *36.5°F | *43.1°F | M |
| | | M | 2.9°C | 10.5°C | 10.6°C | 18.5°C | M | 24.2°C | 20.8°C | 17.2°C | 10°C | 2.5°C | 6.1°C | M |
| Summersville Lake | SUMW2 | 32.3°F | 35°F | 49.3°F | 50.8°F | 64.5°F | 66.1°F | 74.8°F | 69.5°F | 63.0°F | 50.7°F | 36.8°F | 36.2°F | 52.3°F |
| | | 0.2°C | 1.7°C | 9.8°C | 10.4°C | 18.1°C | 18.9°C | 23.8°C | 20.8°C | 17.2°C | 10°C | 2.2°C | 2.3°C | 11.29°C |
| Lewisburg 3 N | LWBW2 | 32.2°F | 34.3°F | 48.6°F | 48.7°F | 61.9°F | 63.3°F | 72.2°F | 66.6°F | 61.1°F | 48.9°F | 36.5°F | 36.9°F | 50.9°F |
| | | 0.1°C | 1.28°C | 9.2°C | 9.3°C | 16.6°C | 17.4°C | 22.3°C | 19.2°C | 16.2°C | 9.4°C | 2.5°C | 2.7°C | 10.5°C |
| Beckley VA Hospital | BCKW2 | 36.6°F | 38°F | 54°F | 53.4°F | 65.5°F | 67.2°F | 74.2°F | 69.7°F | 63.4°F | 51.6°F | 40.6°F | 39.9°F | 54.5°F |
| | | 2.6°C | 3.3°C | 12.2°C | 11.9°C | 18.6°C | 19.5°C | 23.4°C | 20.9°C | 17.4°C | 10.8°C | 4.8°C | 4.4°C | 12.5°C |
| Beckley Airport | KBKW | 36°F | 39°F | M | 54°F | 67.1°F | 68.8°F | 76.5°F | 71.4°F | M | 53.9°F | 39.9°F | 39.9°F | M |
| | | 2.2°C | 3.9°C | M | 12.2°C | 19.5°C | 20.4°C | 24.7°C | 21.8°C | M | 12.2°C | 4.4°C | 4.4°C | M |
| Pineville | PINW2 | 35.1°F | 37.3°F | 52.9°F | 50.7°F | 66.4°F | 67.9°F | 74.7°F | 71.1°F | 63.5°F | 52.4°F | 39.8°F | 39.8°F | 54.3°F |
| | | 1.7°C | 2.9°C | 11.6°C | 10.4°C | 19.1°C | 19.9°C | 23.7°C | 21.7°C | 17.5°C | 11.3°C | 4.3°C | 4.3°C | 12.4°C |
| Grandview | GRNW2 | 36.6°F | 39.2°F | 53.4°F | 54.4°F | 68.5°F | 71.3°F | 77.9°F | 74.2°F | 66.2°F | 54.3°F | 40.5°F | 40.5°F | 56.4°F |
| | | 2.6°C | 4°C | 11.9°C | 12.4°C | 20.2°C | 21.8°C | 25.5°C | 23.4°C | 19°C | 12.4°C | 4.7°C | 4.7°C | 13.5°C |
| Pipestem | PIRW2 | 35.6°F | 38.6°F | 53.1°F | 52.4°F | 65.5°F | 67.7°F | 76.75°F | 69.5°F | 62.1°F | 54.4°F | M | M | M |
| | | 2°C | 3.66°C | 11.7°C | 11.3°C | 18.6°C | 19.8°C | 24.8°C | 20.8°C | 16.7°C | 12.4°C | M | M | M |

M = missing data (Monthly statistics are reported as 'M' if more than four days of data are missing).

Table 4. Summary of 2012 departure from normal temperature based on 30-year normal (1981–2010) for the selected stations. Stations with a Period of Record less than 10 years were not included in this table.

| Station name | Station | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Annual |
|---------------------|---------|-------|-------|--------|--------|-------|--------|-------|--------|--------|--------|--------|-------|--------|
| Bluestone Lake | BLUW2 | 4.5°F | 4.4°F | 11.2°F | 0.3°F | 5.7°F | 0°F | 5.9°F | -0.6°F | -1.6°F | 1.1°F | M | M | M |
| | | 2.5°C | 2.4°C | 6.2°C | 0.2°C | 3.2°C | 0.0°C | 3.3°C | -0.3°C | -0.9°C | 0.6°C | M | M | M |
| Oak Hill | OAKW2 | 3.9°F | 2.5°F | 9.4°F | -1.6°F | 4.1°F | 1.6°F | 3°F | -0.8°F | -0.5°F | -0.4°F | -4.6°F | 4°F | 1.4°F |
| | | 2.2°C | 1.4°C | 5.2°C | -0.9°C | 2.3°C | 0.9°C | 1.8°C | -0.4°C | -0.3°C | -0.2°C | -2.6°C | 2.2°C | 0.8°C |
| London Locks | LONW2 | M | 4.8°F | 10.9°F | 1.0°F | 6.7°F | M | 5.5°F | 0.5°F | 0.5°F | -2.3°F | -6.6°F | 9.7°F | M |
| | | M | 2.7°C | 6.1°C | 0.6°C | 3.7°C | M | 3.1°C | 0.3°C | 0.3°C | -1.3°C | -3.6°C | 5.4°C | M |
| Summersville Lake | SUMW2 | 3.6°F | 2.8°F | 9.8°F | -0.3°F | 4.4°F | -1.6°F | 4.1°F | -0.5°F | 0.6°F | -1.4°F | -4.5°F | 5.1°F | 1.8°F |
| | | 2.0°C | 1.6°C | 5.4°C | -0.2°C | 2.4°C | -0.9°C | 2.3°C | -0.3°C | 0.3°C | -0.8°C | -2.5°C | 2.8°C | 1.1°C |
| Beckley VA Hospital | BCKW2 | 3.8°F | 3.3°F | 10.4°F | 1.0°F | 5.9°F | -0.7°F | 4.5°F | 0.4°F | 1.0°F | -0.5°F | -4.2°F | 4.9°F | 2.3°F |
| | | 2.1°C | 1.8°C | 5.8°C | 0.6°C | 3.3°C | -0.4°C | 2.5°C | 0.2°C | 0.6°C | -0.3°C | -2.3°C | 2.7°C | 1.3°C |
| Lewisburg 3 N | LWBW2 | 5.5°F | 3.6°F | 11.9°F | 1.1°F | 5.7°F | -0.2°F | 3.6°F | -0.1°F | 0.2°F | -1.6°F | -3.3°F | 5.7°F | 2.7°F |
| | | 3.1°C | 2.0°C | 6.6°C | 0.6°C | 3.2°C | -0.1°C | 2.0°C | -0.1°C | 0.1°C | -0.9°C | -1.8°C | 3.2°C | 1.5°C |
| Beckley Airport | KBKW | 4.4°F | 3.9°F | M | 1.1°F | 5.3°F | -1.3°F | 2.8°F | -1.6°F | M | -0.6°F | -4.3°F | 5.4°F | M |
| | | 2.4°C | 2.2°C | M | 0.6°C | 2.9°C | -0.7°C | 1.6°C | -0.9°C | M | -0.3°C | -2.4°C | 3°C | M |
| Pineville | PINW2 | 4.5°F | 4.4°F | 11.2°F | 0.3°F | 5.7°F | 0°F | 5.9°F | -0.6°F | -1.6°F | 1.1°F | M | M | M |
| | | 2.5°C | 2.4°C | 6.2°C | 0.2°C | 3.2°C | 0.0°C | 3.3°C | -0.3°C | -0.9°C | 0.6°C | M | M | M |

M = missing data (Monthly statistics are reported as 'M' if more than four days of data are missing).

Bluestone National Scenic River,
Gauley River National Recreation Area,
and New River Gorge National River
Departure from Average Monthly Maximum Temperature
2012 vs. 1981–2010

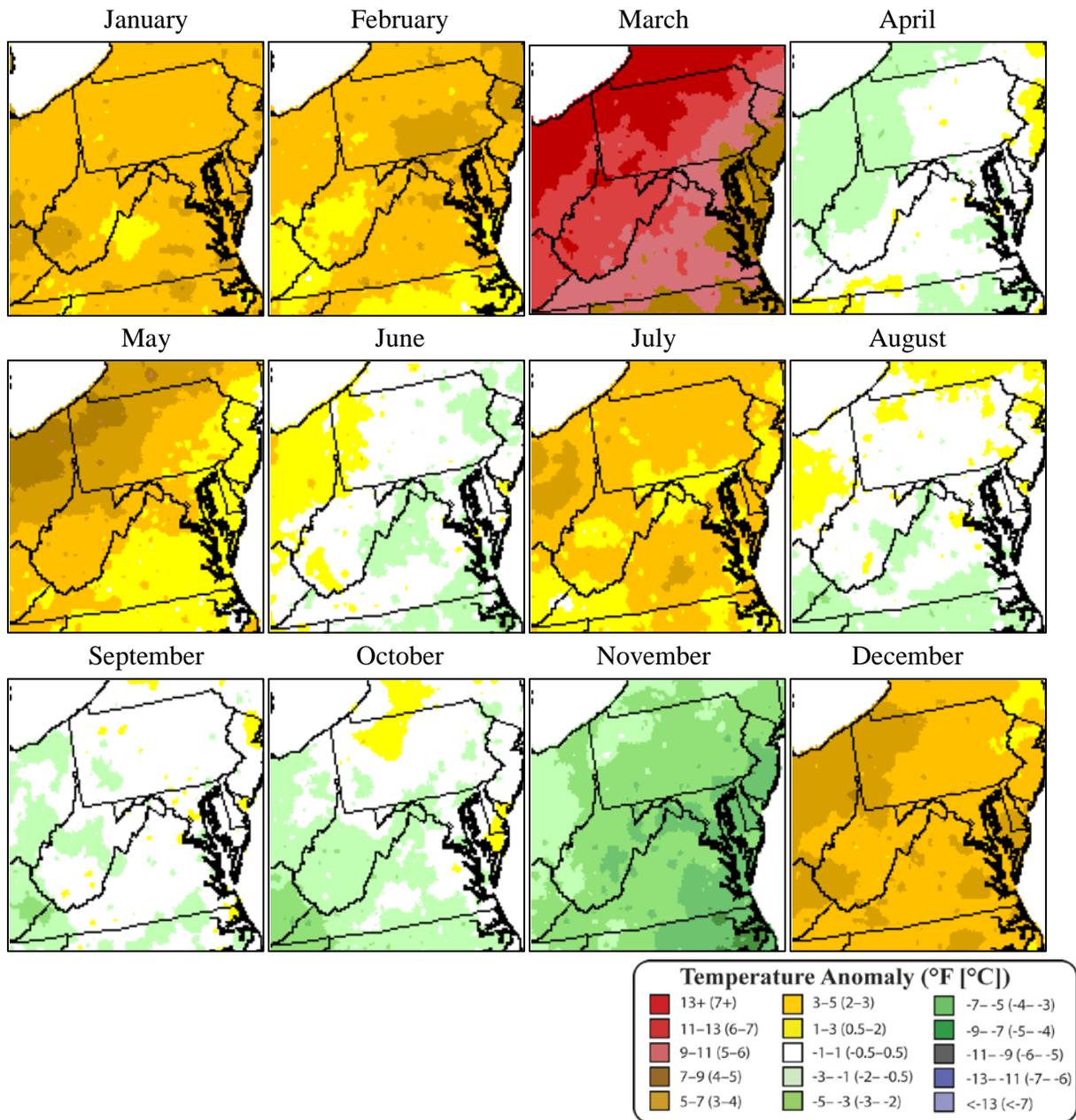


Figure 2. Maps showing departure from average monthly maximum temperature compared to the 30-year normal (1981–2010).

Bluestone National Scenic River,
 Gauley River National Recreation Area,
 and New River Gorge National River
 Departure from Average Monthly Minimum Temperature
 2012 vs. 1981–2010

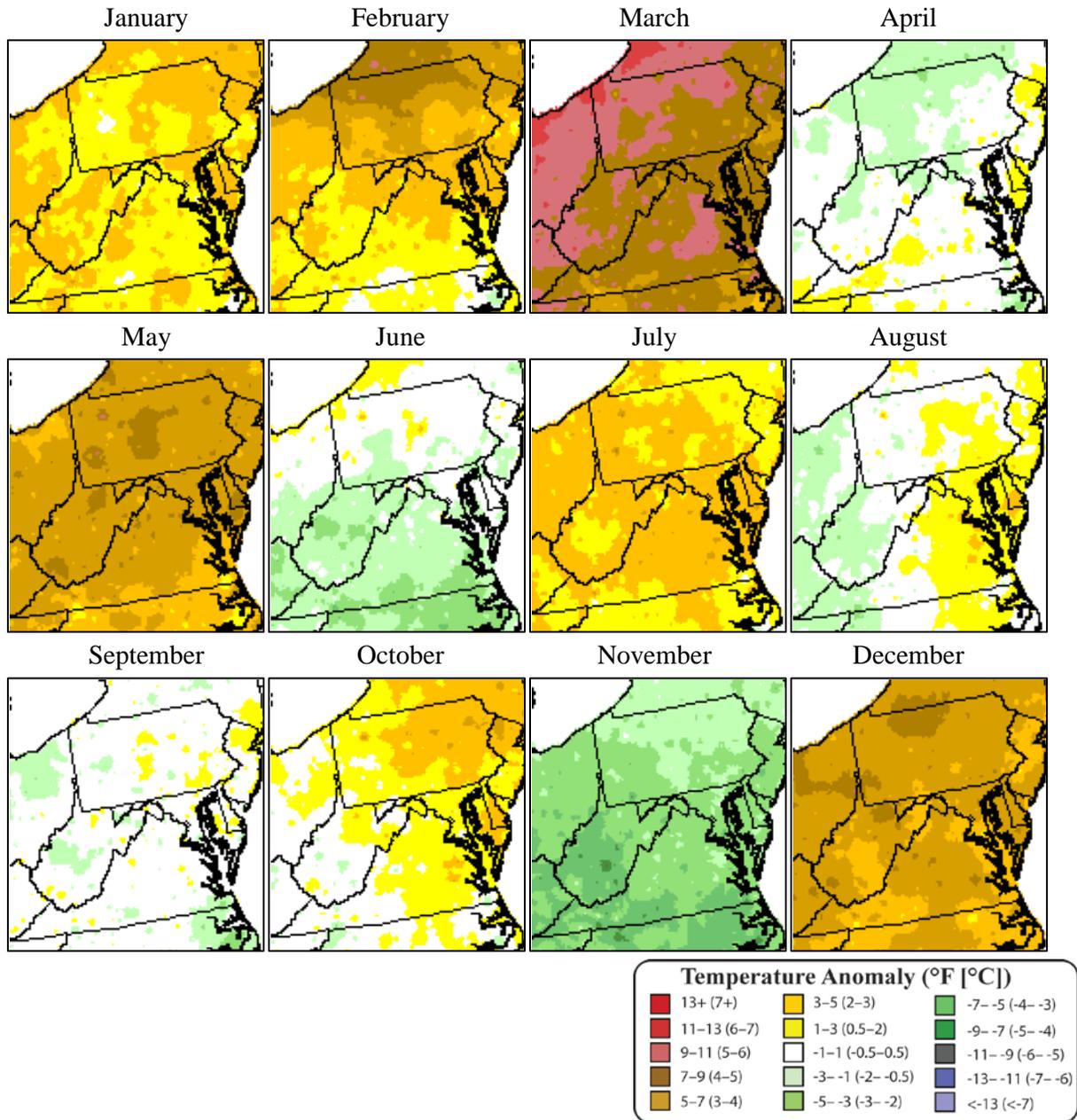


Figure 3. Maps showing departure from average monthly minimum temperature compared to the 30-year normal (1981–2010).

Table 5. Seasonal and annual temperature and precipitation rankings for 2012 over 118 years (1 = warmest/wettest year and 118 = coldest/driest year) for West Virginia Climate Division 4 (top) and 5 (bottom).

| WV Climate Division 4 Rankings "Central" | Jan–Feb–Mar WINTER | Apr–May–Jun SPRING | Jul–Aug–Sep SUMMER | Oct–Nov–Dec AUTUMN | Jan – Dec ANNUAL |
|---|-------------------------------|-------------------------------|-------------------------------|-------------------------------|-----------------------------|
| Temperature-2012 | 4 | T33 | T41 | T41 | 4 |
| Precipitation-2012 | 66 | 94 | 36 | 73 | 77 |

| WV Climate Division 5 Rankings "Southern" | Jan–Feb–Mar WINTER | Apr–May–Jun SPRING | Jul–Aug–Sep SUMMER | Oct–Nov–Dec AUTUMN | Jan – Dec ANNUAL |
|--|-------------------------------|-------------------------------|-------------------------------|-------------------------------|-----------------------------|
| Temperature-2012 | T3 | T13 | T28 | T62 | T3 |
| Precipitation-2012 | 29 | 53 | 17 | 93 | 34 |

Precipitation Summary

Liquid precipitation (rain and melted snow, ice, sleet, etc.; hereafter, precipitation) for the region averaged below the long-term mean except near New River Gorge NR where there was slightly above normal precipitation (Table 6). All of the wettest days occurred during the summer and autumn (Table 7). An unusually dry period was noted from November 6 until November 26 when there was no measurable rain (Table 7). Snowfall was near normal and similar to the tallies in 2011 (Table 6). The number of days with excessive rainfall (>1.0 in [25 mm]) was at the long-term average for south-central West Virginia (Table 6).

The winter was above to near normal (Figure 4), as January averaged approximately 119 percent of normal precipitation in Beckley, WV, and 104 percent in Bluestone Lake, WV (Tables 8 and 9). February was similar (Figure 4), with between 80 percent and 139 percent of average precipitation (Tables 8 and 9); some fell in the form of snow. Monthly precipitation in March was above normal, with 3.4–6.0 in (86–152 mm) accumulating across the central and southern districts of West Virginia (Table 8). Winter precipitation, including rain and snow (liquid equivalent), was ranked between 29th and 66th wettest in 118 years of record keeping (Table 5).

Spring 2011 brought drier conditions during May and progressively drier weather in June (Figure 4), averaging the 24th driest in climate division 4 and 65th driest in climate division 5 (Table 5). By far, April was the wettest month of this season, as 89–151 percent of normal rain was reported (Table 9). Two of the year's dry spells occurred between April 3–17 and May 29–June 12 (Table 7). May and June brought more less frequent and more sporadic rainfall. Pineville tallied only 69 percent of average rainfall, while Lewisburg measured 117 percent of normal rainfall; these stations are about 62 miles apart.

The summer months of July, August, and September showed some contrast; the southern valleys averaged near-normal rainfall, but the eastern and central mountains were wet (Figure 4). Three of the wettest days of 2012 occurred during the summer. On July 12, as an average of 1.9 in (48.3 mm) was tallied in the region, on July 27, about 1.68 in (42.7 mm) was measured, and on September 18, approximately 1.90 in (48.3 mm) fell (Table 7). The summer ranked the 36th wettest in the central West Virginia climate division, and the 17th wettest in the southern division (Table 5).

Autumn brought wetter than normal precipitation in parts of the region (Figure 4). October was damp with most sections averaging from 79–188 percent of the normal rainfall (Table 9); however, November was the driest on record in the central West Virginia climate division. For example, Beckley VA Hospital, WV, had 24 percent of normal rainfall, but Lewisburg, WV, tallied 12 percent with 0.4 in (9 mm) (Tables 8 and 9). December turned moist, with more than 154 percent of normal rain and snow tallied at London Locks, WV (Table 9). Overall, 2012 brought between 94–110 percent of average annual precipitation, which ranged from -7.1 in (-197 mm) to +2.2 in (+56 mm). It was, overall, an average year for much of the region.

Table 6. Status of 2012 precipitation indicators compared to the 30-year normal (1981–2010) at the London Locks (LONW2), Beckley Airport (KBKW), and Summersville Lake (SUMW2) stations.

| Precipitation Indicators | London Locks, WV 2011 | London Locks, WV 1981-2010 | Beckley Airport, WV 2011 | Beckley Airport, WV 1981-2010 | Summersville Lake, WV 2011 | Summersville Lake, WV 1981-2010 |
|---|-----------------------|----------------------------|--------------------------|-------------------------------|----------------------------|---------------------------------|
| Annual Precipitation | 41.9 in 1,064 mm | 43.8 in 1,113 mm | 43.4 in 1,102 mm | 41.2 in 1,046 mm | 40.8 1,020 mm | 47.9 in 1,217 mm |
| Autumn Precipitation (Oct, Nov, Dec) Precipitation | 10.6 in 269 mm | 9.2 in 234 mm | 8.4 in 213 mm | 8.5 in 216 mm | 9.3 in 236 mm | 10.2 in 259 mm |
| Heavy Precipitation Days (days with ≥ 1.0 in (25 mm) rain) | 9 | 9 | 6 | 7 | 7 | 9 |
| Extreme Precipitation Days (days with ≥ 2.0 in (51 mm) rain) | 0 | 1 | 0 | 1 | 0 | 1 |
| Micro-drought (strings of 7+ days without rain) | 6 | 7 | 6 | 3 | 6 | 5 |
| Annual Snowfall (inches) | M ¹ | 36.4 in 92.5 cm | 66.4 in 168.7 cm | 62.0 in 157.5 cm | 31 in 78.8 cm | 38.7 in 98.3 cm |
| Measurable Snow Days (days with ≥ 0.1 in (0.3 cm) snow) | M ¹ | 27 ² | 22 | 38 | 9 | 21 |
| Moderate Snow Days (days with ≥ 3.0 in (7.6 cm) snow) | M ¹ | 3 ² | 8 | 6 | 5 | 5 |
| Heavy Snow Days (days with ≥ 5.0 in (12.7 cm) snow) | M ¹ | 1 ² | 5 | 2 | 1 | 1 |

¹London Locks snowfall data is denoted with an M (missing) because the station did not report snowfall for the entire period.

²London Locks 1981-2010 snowfall data is represented by Charleston – Yeager Airport’s 1981-2010 snowfall normal values.

Table 7. Top five wettest days and top five dry spells (consecutive days with a trace or less of liquid precipitation) during 2012 from stations London Locks (LONW2), Beckley Airport (KBKW), and Summersville Lake (SUMW2).

| Wettest Days in 2012 | Dry Spells in 2012 |
|-----------------------------|--------------------|
| Sept. 18: 1.90 in (48.3 mm) | Nov. 6- 26 |
| Jul. 12: 1.90 in (48.3 mm) | May 29-Jun. 12 |
| Sept. 18: 1.88 in (47.8 mm) | Apr. 3-17 |
| Oct. 30: 1.75 in (44.5 mm) | Aug. 21-Sept. 1 |
| Jul. 27: 1.68 in (42.7 mm) | Nov. 2-12 |

Bluestone National Scenic River,
 Gauley River National Recreation Area,
 and New River Gorge National River
 Percent of Average Monthly Precipitation
 2012 vs. 1981–2010

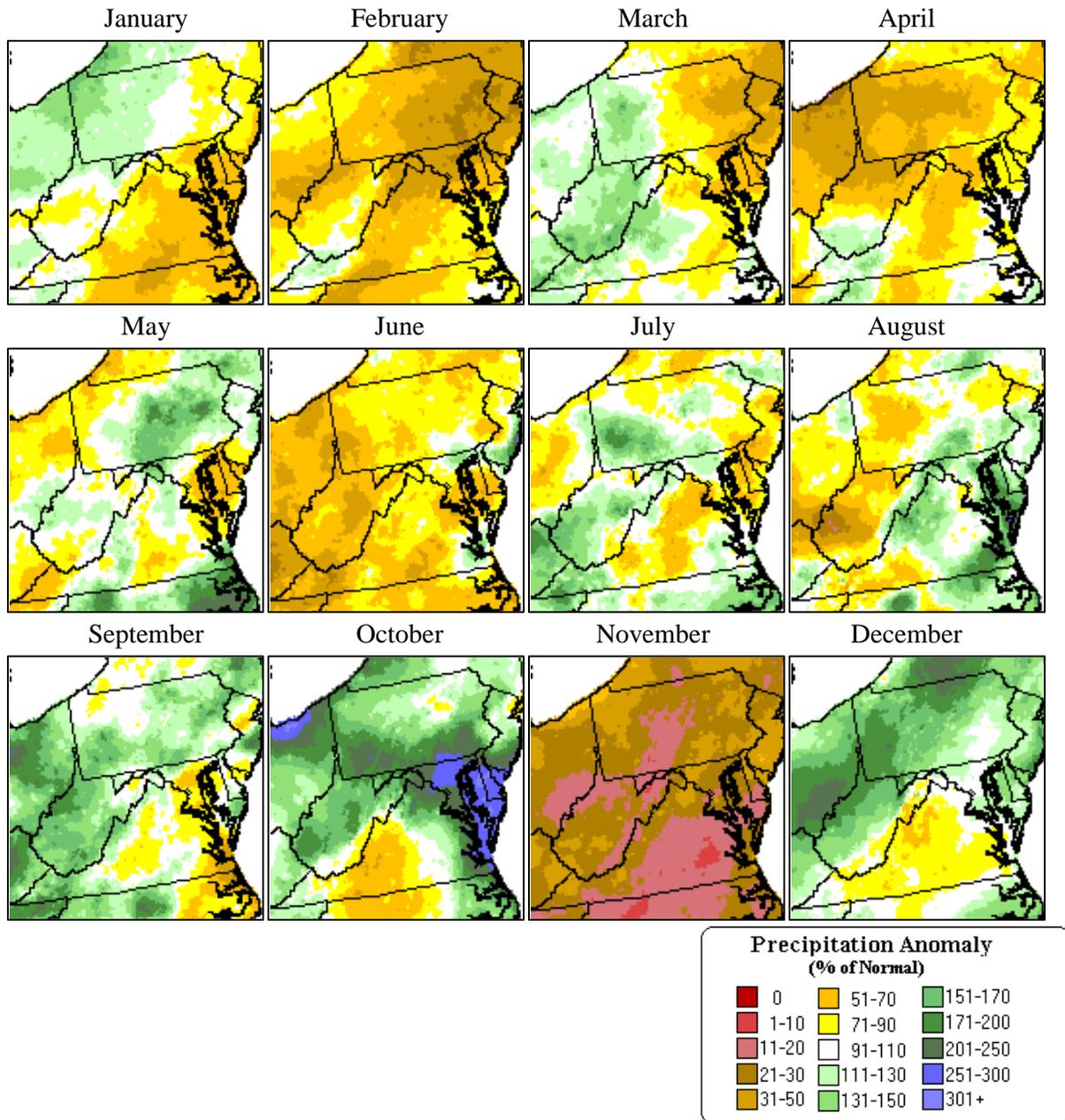


Figure 4. Maps showing percent of average monthly precipitation compared to the 30-year normal (1981–2010).

Table 8. Summary of 2012 monthly total precipitation for selected stations.

| Station name | Station | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Annual |
|---------------------|---------|----------|--------|--------|--------|--------|--------|--------|--------|---------|--------|--------|----------|----------|
| Bluestone Lake | BLUW2 | 3.0in | 2.8 in | 6.0 in | 3.1 in | 4.1 in | 2.7 in | 4.5 in | 2.3 in | 7.2 in | 3.0 in | 0.5 in | 3.28 in | 32.1 in |
| | | 77 mm | 72 mm | 152 mm | 78 mm | 104 mm | 68 mm | 114 mm | 59 mm | 184 mm | 75 mm | 14 mm | 83 mm | 815 mm |
| Oak Hill | OAKW2 | 2.9 in | 2.9 in | 4.7 in | 5.2 in | 5.1 in | 1.7 in | 8.1 in | 1.5 in | 6.0 in | 2.3 in | M | M | M |
| | | 74 mm | 75 mm | 120 mm | 132 mm | 129 mm | 42 mm | 206 mm | 39 mm | 152 mm | 59 mm | M | M | M |
| London Locks | LONW2 | 2.4 in | 2.3 in | 4.4 in | 3.3 in | 3.6 in | 1.9 in | 6.6 in | 0.8 in | 5.6 in | 4.7 in | 0.9 in | 5.0 in | 41.9 in |
| | | 62 mm | 57 mm | 112 mm | 84 mm | 91 mm | 48 mm | 169 mm | 21 mm | 141 mm | 120 mm | 22 mm | 127 mm | 1,064 mm |
| Summersville Lake | SUMW2 | *2.35 in | 2.6 in | 4.6 in | 3.7 in | 4.9 in | M | 6.5 in | 1.1 in | 5.8 in | 4.5 in | 0.5 in | *4.27 in | M |
| | | *60 mm | 66 mm | 117 mm | 94 mm | 124 mm | M | 164 mm | 27 mm | 147 mm | 115 mm | 12 mm | *108 mm | M |
| Princeton | PRIW2 | 2.4 in | 3.0 in | 4.0 in | 4.8 in | 4.1 in | 2.1 in | 3.4 in | 1.9 in | 4.7 in | 2.9 in | 0.5 in | 2.36 in | 41.7 in |
| | | 62 mm | 77 mm | 101 mm | 123 mm | 103 mm | 53 mm | 86 mm | 48 mm | 120 mm | 75 mm | 13 mm | 60 mm | 1,059 mm |
| Lewisburg 3 N | LWBW2 | 2.4 in | 1.6 in | 5.6 in | 4.2 in | 5.7 in | 3.8 in | 1.9 in | 2.4 in | 4.6 in | 2.5 in | 0.4 in | 2.8 in | 30.2 in |
| | | 62 mm | 42 mm | 141 mm | 107 mm | 145 mm | 96 mm | 47 mm | 62 mm | 116 mm | 63 mm | 9 mm | 71 mm | 767 mm |
| Beckley VA Hospital | BCKW2 | 2.8 in | 2.3 in | 4.9 in | 4.4 in | 3.6 in | 2.3 in | 6.7 in | 1.8 in | 5.3 in | 2.6 in | 0.7 in | 3.13 in | 38.5 in |
| | | 72 mm | 58 mm | 124 mm | 113 mm | 90 mm | 58 mm | 171 mm | 46 mm | 135 mm | 66 mm | 18 mm | 80 mm | 978 mm |
| Beckley Airport | KBKW | 3.4 in | 3.9 in | 4.0 in | 3.7 in | 3.9 in | 2.4 in | 6.7 in | 2.8 in | 5.3 in | 4.5 in | 0.7 in | 3.2 in | 43.3 in |
| | | 85 mm | 98 mm | 103 mm | 94 mm | 99 mm | 62 mm | 169 mm | 70 mm | 135 mm | 114 mm | 17 mm | 81 mm | 1,100 mm |
| Pineville | PINW2 | 3.5 in | 3.2 in | M | 5.1 in | 3.4 in | 3.0 in | 8.2 in | 3.8 in | *4.5 in | 2.7 in | 0.8 in | 3.5 in | M |
| | | 90 mm | 81 mm | M | 130 mm | 85 mm | 77 mm | 209 mm | 98 mm | *114 mm | 68 mm | 21 mm | 88 mm | M |
| Grandview | GRNW2 | 2.1 in | 3.3 in | 3.4 in | 3.8 in | 3.3 in | 2.6 in | 7.6 in | 0.3 in | 4.6 in | 4.6 in | 1.1 in | 4.85 in | 52.2 in |
| | | 54 mm | 83 mm | 86 mm | 97 mm | 84 mm | 66 mm | 193 mm | 8 mm | 117 mm | 117 mm | 27 mm | 123 mm | 1326 mm |
| Pipestem | PIRW2 | 3.0 in | 2.8 in | 6.0 in | 3.1 in | 4.1 in | 2.7 in | 4.5 in | 2.3 in | 7.2 in | 3.0 in | 0.5 in | 2.75 in | 42.5 in |
| | | 77 mm | 72 mm | 152 mm | 78 mm | 104 mm | 68 mm | 114 mm | 59 mm | 184 mm | 75 mm | 14 mm | 70 mm | 1,180 mm |

* M = missing data (Monthly statistics are reported as 'M' if more than 4 days of data are missing).

Table 9. Summary of 2012 percent of normal precipitation based on 30-year normal (1981–2010) for selected stations. Stations with a Period of Record less than 10 years not included in this table.

| Station name | Station | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Annual |
|---------------------|---------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|--------|
| Bluestone Lake | BLUW2 | 104 | 106 | 178 | 90 | 98 | 79 | 102 | 70 | 248 | 113 | 20 | 113 | 110 |
| Oak Hill | OAKW2 | 89 | 95 | 122 | 129 | 102 | 37 | 158 | 39 | 174 | 79 | M | M | M |
| London Locks | LONW2 | 79 | 80 | 119 | 89 | 73 | 44 | 131 | 21 | 180 | 188 | 25 | 154 | 95 |
| Summersville Lake | SUMW2 | M | 84 | 121 | 93 | 97 | M | 109 | 24 | 169 | 142 | 14 | 118 | M |
| Princeton | PRIW2 | 84 | 111 | 124 | 151 | 98 | 59 | 78 | 55 | 166 | 123 | 19 | 82 | 94 |
| Lewisburg | LWBW2 | 77 | 57 | 161 | 124 | 132 | 101 | 46 | 77 | 140 | 97 | 12 | 86 | 94 |
| Beckley VA Hospital | BCKW2 | 101 | 94 | 148 | 130 | 78 | 64 | 129 | 52 | 180 | 108 | 24 | 104 | 101 |
| Beckley Airport | KBKW | 119 | 139 | 113 | 110 | 84 | 61 | 133 | 80 | 176 | 175 | 23 | 106 | 107 |
| Pineville | PINW2 | 98 | 98 | M | 134 | 66 | 72 | 157 | 102 | M | 93 | 25 | 95 | M |

Drought Status

There are a number of drought indices used to estimate the severity of drought in an area, using algorithms that incorporate recent temperatures, rainfall, soil moisture, and other information (<http://www.drought.gov>). The main indices we report are the Palmer Drought Severity Index (PDSI) and the United States Drought Monitor (DM) – Drought Intensity Index. While both indices provide excellent summary information on broad-scale conditions, local conditions (such as at the park scale) may vary.

The PDSI is a soil moisture algorithm calibrated for relatively homogeneous regions and is calculated on a monthly basis using precipitation and temperature data, as well as the water content of the soil. The values vary between extremely moist (>4.0) and extreme drought (<-4.0), with “normal” values ranging between -1.9 and 1.9 . Monthly PDSI values for West Virginia Climate Division 4 in 2012 are shown in Figure 5 and Climate Division 5 values are seen in Figure 6.

The DM – Drought Intensity Index is a synthesis of multiple indices (including the PDSI) and impacts and represents a consensus of federal and academic scientists (NIDIS 2012). The DM produces a summary map of drought intensity for the nation and all states each week. It is on a scale ranging from abnormally dry (D0) to exceptional drought (D4). Mid-month (i.e., the second or third week) values for West Virginia and the Northeast are shown for 2012 in Figures 7 and 8, respectively.

According to the PDSI for WV Climate Division 4 for 2012, it was “normal to moderate drought” (PDSI <0 ; Figure 5) in the winter, spring and summer and “normal to moist” (PDSI >0) in the fall for the West Virginia parks. While the calendar year began normal, dry conditions set in by February and continued until August. As a result, PDSI values fell from near 0 in early February to near -2.0 (approaching “moderate drought”) by the end of August. Regular precipitation returned during September and October, raising PDSI values toward 0 (Figure 5). Dry weather returned in November, keeping the PDSI negative for the remainder of 2012. Surprisingly, WV Climate Division 5, which includes parts of Bluestone and New River, was a mirror image showing the opposite trends as seen in WV Climate Division 4, though with less magnitude. When comparing the PDSI values with recent years, 2012 showed more consistency and less variability than in 2010 or 2011.

The DM – Drought Severity Index for West Virginia (Figure 7) and the Northeast (Figure 8) indicated a near average year, with the only widespread drought conditions near the parks during the growing season (May through September) occurring in July and September 2012.

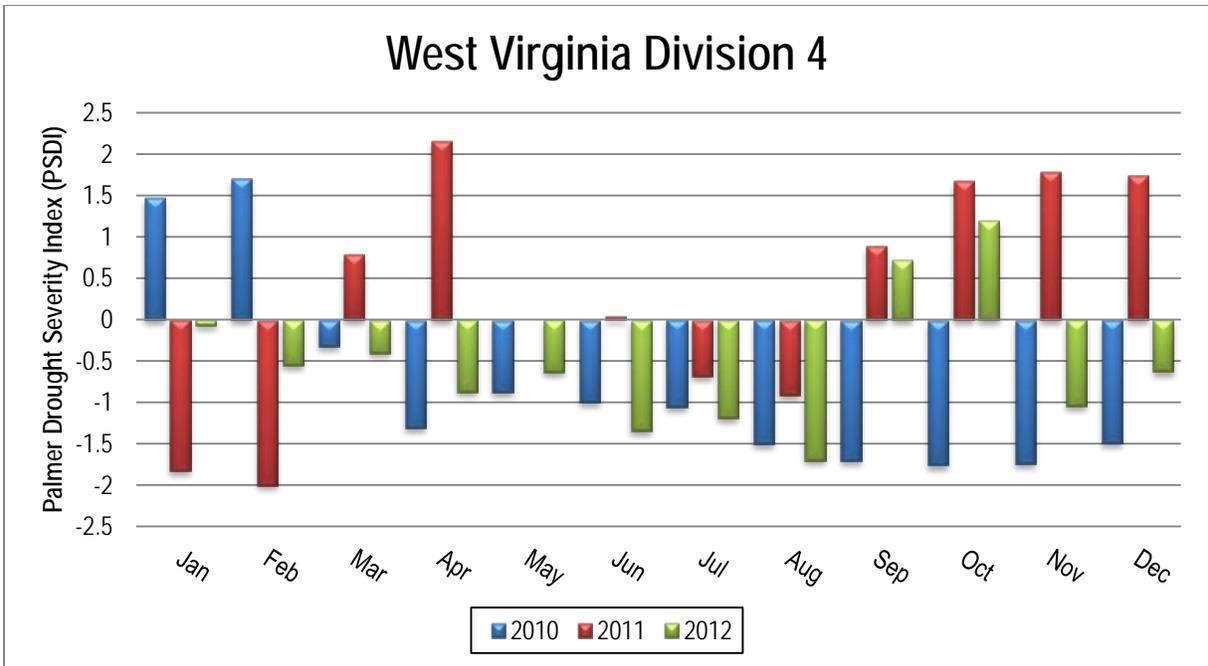


Figure 5. Monthly Palmer Drought Severity Index (PDSI) values for West Virginia Climate Division 4, 2010–2012.

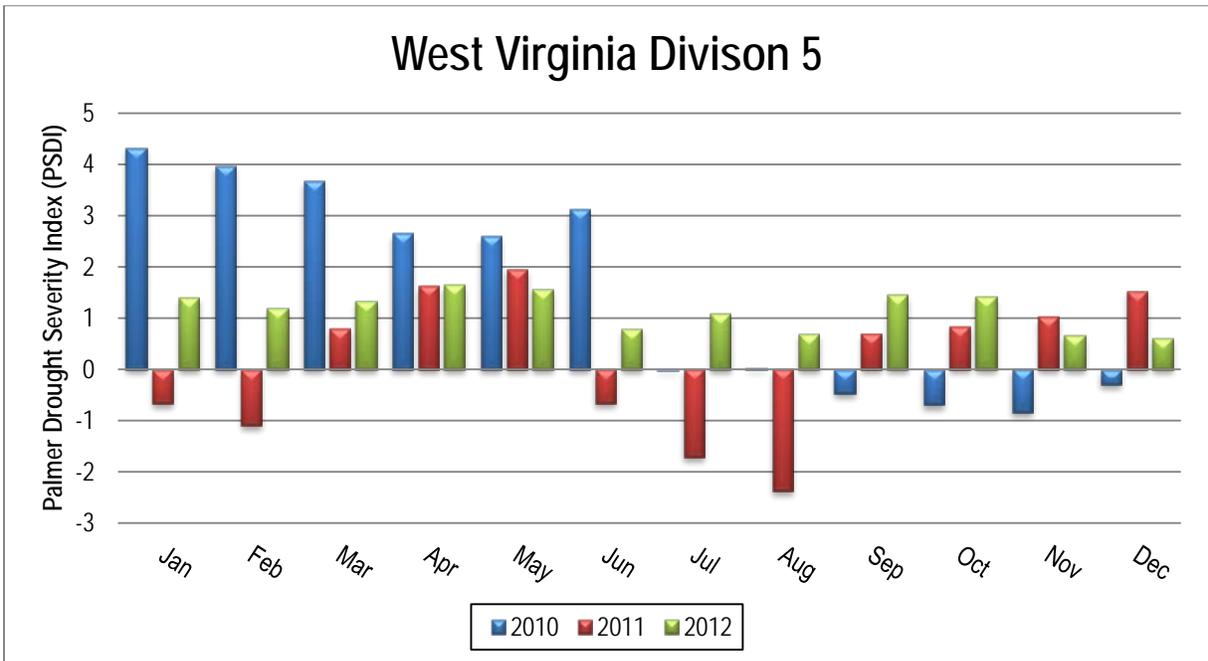


Figure 6. Monthly Palmer Drought Severity Index (PDSI) values for West Virginia Climate Division 5, 2010–2012.

Drought Severity in West Virginia during 2012

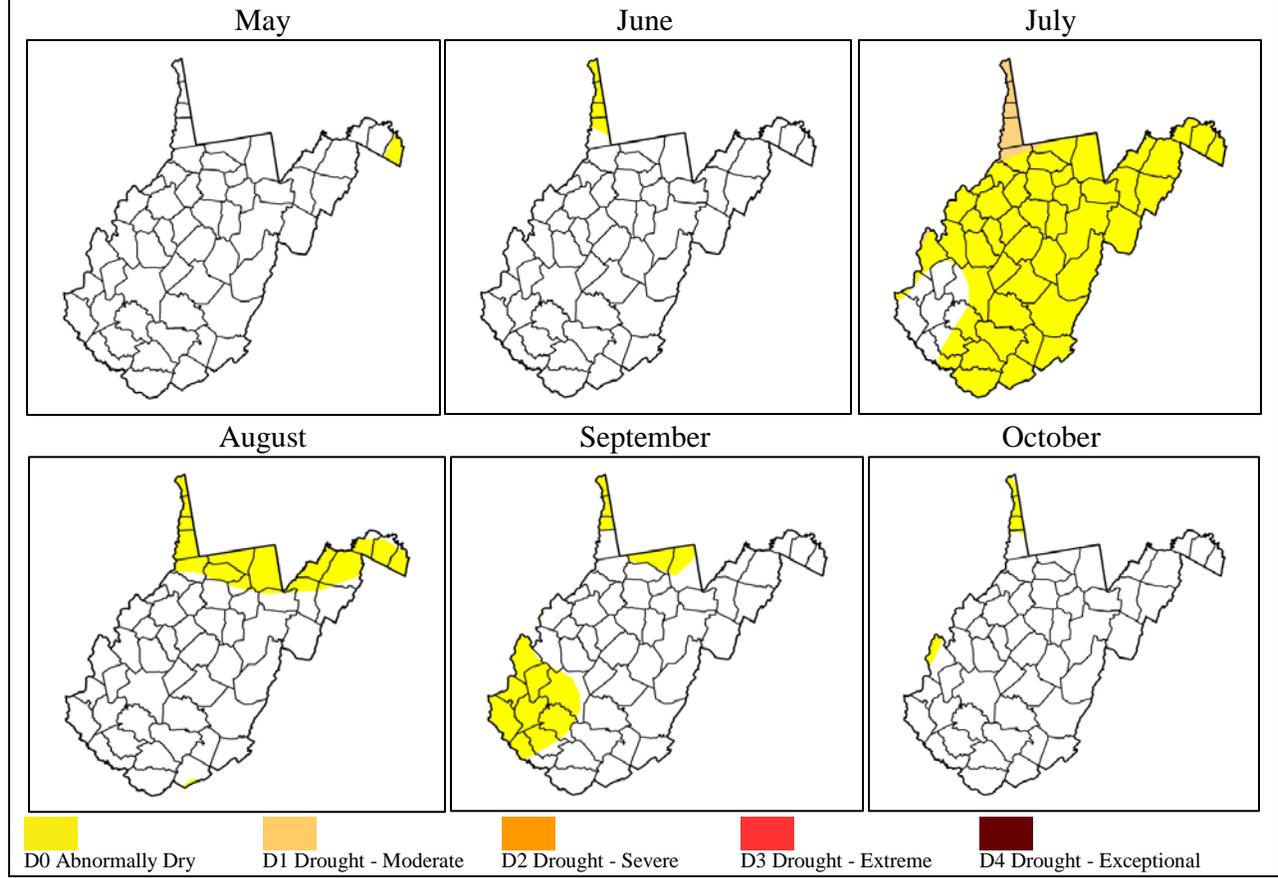


Figure 7. Mid-month values of the United States Drought Monitor (DM) – Drought Intensity Index for West Virginia in 2012.

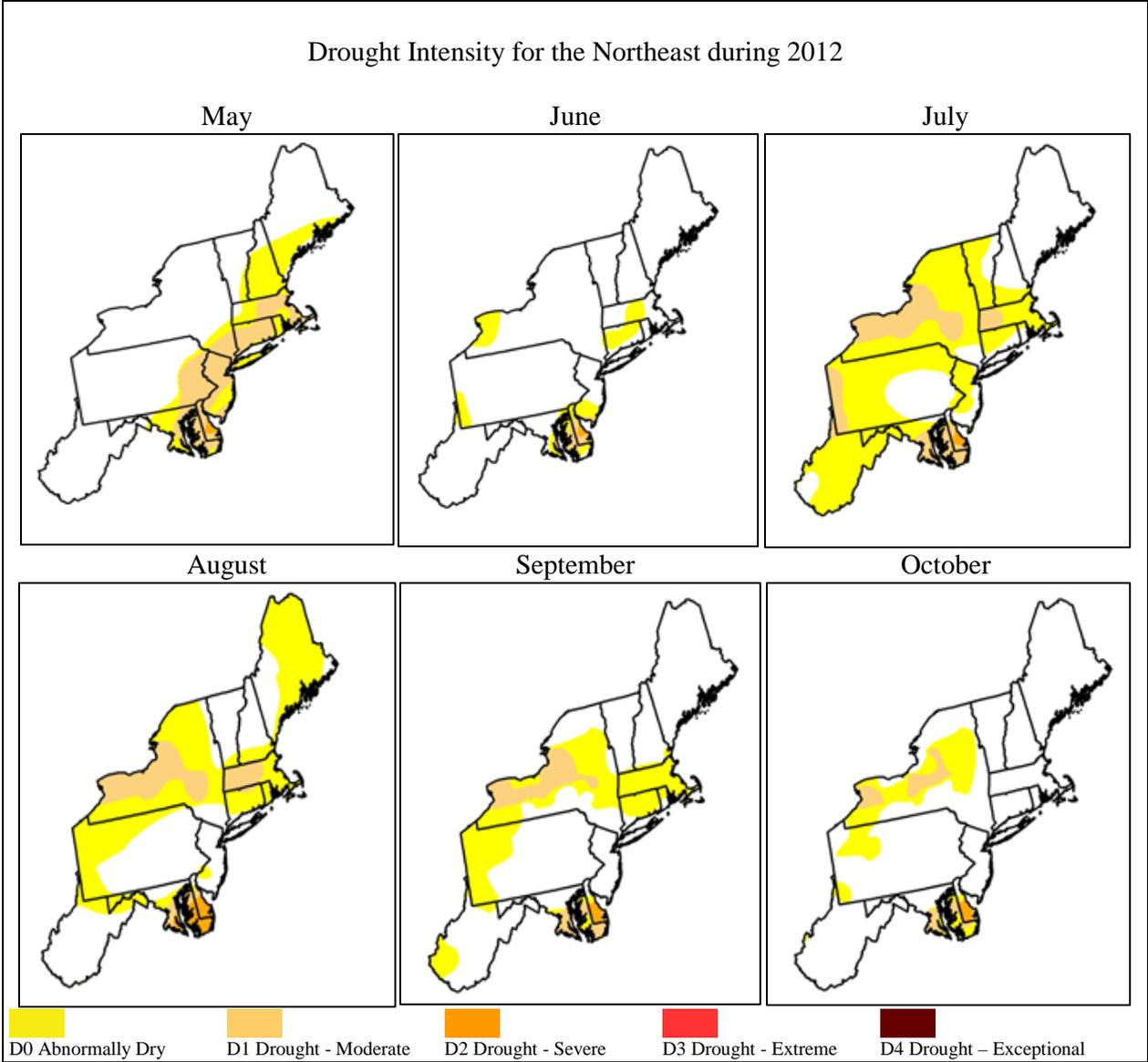


Figure 8. Mid-month values of the United States Drought Monitor (DM) – Drought Intensity Index for the Northeast in 2012.

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