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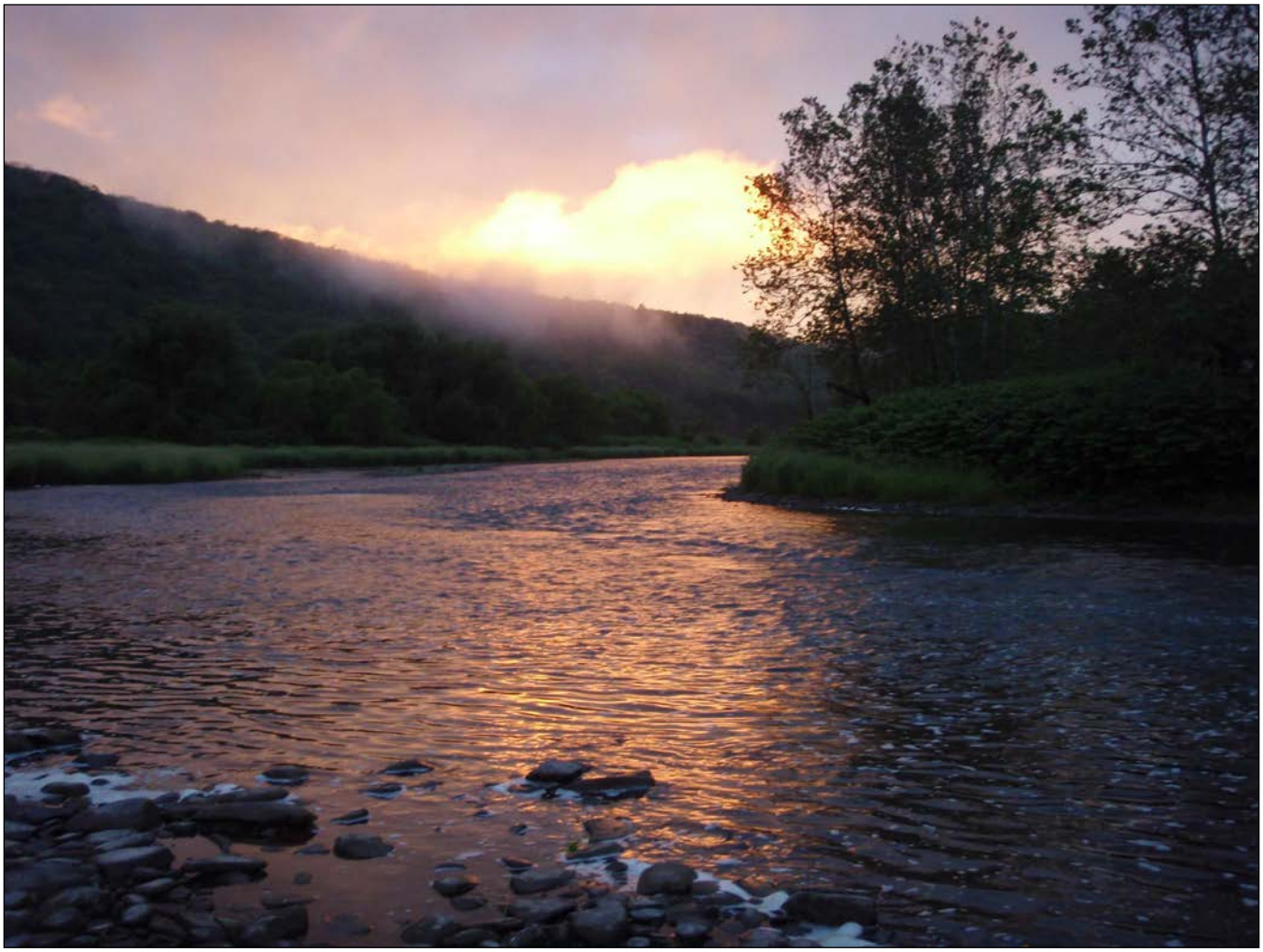
Natural Resource Stewardship and Science

Weather of Delaware Water Gap National Recreation Area and Upper Delaware Scenic and Recreational River

Eastern Rivers and Mountains Network Summary Report for 2012

Natural Resource Data Series NPS/ERMN/NRDS—2013/562



ON THE COVER
Sunset over West Branch of the Delaware River near Shehawken Creek.
Photograph by: Caleb Tzilkowski.

Weather of
Delaware Water Gap National Recreation Area
and Upper Delaware Scenic and Recreational River

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Natural Resource Data Series NPS/ERMN/NRDS—2013/562

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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
COOP	National Weather Service Cooperative Observer Program
CWOP	Citizen Weather Observer Program
DEWA	Delaware Water Gap National Recreational Area
ERMN	Eastern Rivers and Mountains Network
FAA	Federal Aviation Administration
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
NOAA	National Oceanic and Atmospheric Administration
NPS	National Park Service
NRA	National Recreation Area
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
SRR	Scenic and Recreational River
UPDE	Upper Delaware Scenic and Recreational River
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 the 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; these are the primary data sources used to profile climate summary and trends.

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 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 this report.

Climate of the Pocono Mountains and Eastern Plateau

Delaware Water Gap National Recreation Area (NRA) lies in Pennsylvania Climate Division 1 "Pocono Mountains" and New Jersey Climate Division 1 "Northern NJ," while Upper Delaware Scenic and Recreational River (SRR) lies within Pennsylvania Climate Division 1 and New York Climate Division 2 "Eastern Plateau." A climate division is a region that is reasonably homogenous with respect to climatic and hydrologic characteristics and is frequently used for compiling climate statistics (http://www.esrl.noaa.gov/psd/data/usclimdivs/data/map.html/). Pennsylvania and New York are each divided into 10 climate divisions; New Jersey has three divisions.

The three climate divisions encompassing Delaware Water Gap NRA and Upper Delaware SRR 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 the Delaware River valley. The prevailing westerly winds carry most of the weather disturbances that affect the region from the interior of the continent, so that the Atlantic Ocean has limited 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. Also, storms of tropical origin can have the greatest effect within this portion of the Pennsylvania–New Jersey–New York region, causing severe floods in some instances (Gelber 2002).

Temperatures are moderately continental, with the tempering effects of the Great Lakes contributing to cloud production in the winter and onshore winds 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 Northeast 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 Delaware River valley. The southwest winds gain additional warmth when descending the crest of the Appalachians.

Precipitation is fairly evenly distributed throughout the year. Annual amounts generally range between 34–52 in (864–1,320 mm), while the majority of places receive 38–46 in (965–1,168 mm). Greatest amounts usually occur in the late-spring and summer months; while February is the driest month, having about 2.0 in (51 mm) less than the wettest months. Precipitation tends to be somewhat greater in the mountains, due primarily to coastal storms which occasionally frequent the area. During the warm season these storms can bring heavy rain, while in winter, heavy snow or a mixture of rain, ice, and snow may be produced.

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 river valley 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

Twelve weather observing stations, comprised of three observing networks, were selected around Delaware Water Gap NRA and Upper Delaware SRR. Representative stations within a 100-km range of each park were chosen based on several criteria, which include proximity to the park, the representativeness of the station to the parks' 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 its data inclusion. No stations were excluded in 2012 based upon this criterion. Therefore, all 12 stations were used for this report despite the station at Matamoras reporting for low percentage of time (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," or "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 is the 30-year normal or the pseudo-normal calculated on a shorter time frame.

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.

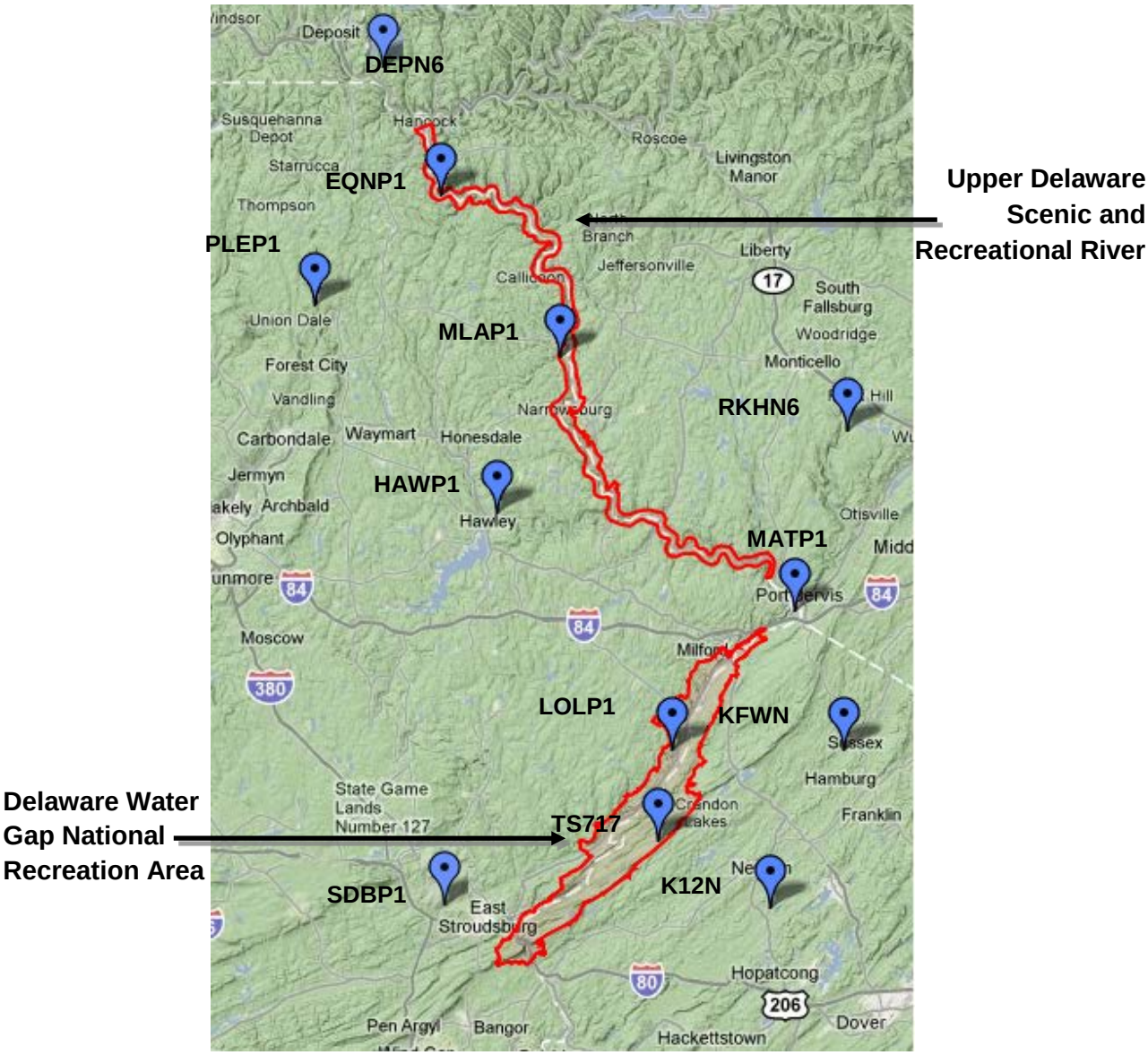

Figure 1. Location of weather observing stations around Upper Delaware Scenic and Recreational River and Delaware Water Gap National Recreation Area. See Table 1 for station names.

Table 1. List of weather observing stations around the Upper Delaware Scenic and Recreational River and Delaware Water Gap National Recreation Area selected as most 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
MATP1	COOP	Matamoras	10/01/1904	Present	23.3	23.3	90.0[1]	93.7
EQNP1	COOP	Equinunk 2 NW	03/01/1957	Present	-	100.0	-	99.2
HAWP1	COOP	Hawley 1 E	11/01/1897	Present	95.1	99.2	74.9	80.8
DEPN6	COOP	Deposit	05/01/1953	Present	74.8	74.8	98.4[2]	98.5
SDBP1	COOP	Stroudsburg	12/01/1910	Present	99.7	100.0	90.7	91.4
KFWN	ASOS	Sussex Airport	12/27/2000	Present	92.3	92.3	98.6	98.6
K12N	ASOS	Aeroflex-Andover Airport	10/25/2000	Present	92.3	52.6	84.2	78.0
RKHN6	COOP	Rock Hill 3 SW	05/01/1953	Present	99.7	99.7	99.0[3]	99.1
PLEP1	COOP	Pleasant Mount 1W	10/01/1924	Present	99.5	99.5	98.7[4]	98.0
MLAP1	COOP	Milanville	08/01/1945	Present	97.8	91.5	32.4[5]	42.1
TS717	RAWS	Blue Mountain Lakes	12/11/2007	Present	100.0	83.0	95.9	86.5
LOLP1	RAWS	Loch Lomond	01/01/2005	Present	94.0	94.0	95.1	95.1

[1] Matamoras did not start reporting temperature until 07/01/1963. The percentage time of reporting temperature is based upon this POR.
[2] Hawley 1 E did not start reporting temperature until 08/02/1962. The percentage time of reporting temperature is based upon this POR.
[3] Rock Hill 3 SW did not start reporting temperature until 07/01/1962. The percentage of time reporting temperature is based upon this POR.
[4] Pleasant Mount 1 W did not start reporting temperature until 12/01/1951. The percentage of time reporting temperature is based upon this POR.
[5] Milanville did not start reporting temperature until 06/20/1963. The percentage of time reporting temperature is based upon this POR.

Temperature Summary

Calendar year 2012 averaged above the long-term mean temperature (Tables 2–4) and was the warmest in the past 118 years for all three climate divisions encompassing the parks (Table 5).Maximum temperatures departed +2.5 degrees Fahrenheit ([°F]) or +1.3 degrees Celsius [°C]) for the year (Table 2) and minimum temperature readings averaged virtually the same departure as maximums from the 30-year mean (Table 2). All of the 2012 seasons were warmer than normal and only November had below-average temperature departures at all sites[1] (Table 4). For the entire contiguous United States, 2012 was the hottest in the past 118 years.

All of January, February, and March 2012 averaged above normal minimum temperatures and far above normal maximum temperatures (Figures 2 and 3), but, by far, March brought the largest daily and monthly departures for the year and this allowed the winter months to rank as the warmest in 118 years (Table 5). The mean temperature departures in January ranged from 2.0°F (1.1°C) at Pleasant Mount, PA, to 6.0°F 3.3°C) in Andover, NJ (Table 4). A cold episode brought morning readings below 0°F (-17.8°C) during January, with the lowest values in many sections occurring on either January 16 or 22 with minima between -7 and -2°F (-21.6 to -18.9°C) (Table 2). The number of sub-zero days at Pleasant Mount tallied three fewer than the normal of twelve (Table 2).

The spring was exceptionally mild in the region, with climate division rankings of 5th to 19th warmest in the past 118 years (Table 5). The first significant heat spell occurred from May 28th to May 30th when readings rose to near 90°F (+32.2°C). Most sections had their last freeze and frost around May 1st, though some spots noted frost on May 12th which contributed to a growing season length which was a month longer than average at Pleasant Mount, PA (Table 2). Temperatures during May averaged above normal at all sites, with departures ranging between +2.2 to +6.9°F (+1.2 to +3.9°C) above the 1981–2010 long-term mean (Table 4).

The summer period continued the very warm conditions, with virtually all stations averaging above normal for each of the three months (Table 4), with the exception of Rock Hill during August and September (-1.3°F; -0.7°C). July tallied the higher positive anomalies, with July average temperatures ranging from +1.4 to +4.6°F (+0.8 to +2.5°C) (Figure 2). Despite this season being the 2nd to 24th warmest in 118 years (Table 5), most daily record maximums were set on July 17–19.

Autumn temperatures continued above average (Tables 3 and 4; Figures 2 and 3). Frosts and freezes occurred a bit later than the long-term average date, with most sections noticing sub-freezing readings (<32°F [0°C]) on October 13. November was the only month with all stations averaging below seasonal levels. Temperatures during December had the largest departures of this season, with readings as much as 6.6°F (3.6°C) above normal (Table 4). Overall, the annual average temperature for 2012 averaged above normal (Table 2) with values of +2.4°F (1.4°C).

[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 Matamoras (MATP1), Hawley 1 E (HAWP1), and Pleasant Mount 1 W (PLEP1) stations.

Temperature Indicator	Matamoras, PA 2012	Matamoras, PA 1981-2010	Hawley 1 E, PA 2012	Hawley 1 E, PA 1981-2010	Pleasant Mount 1 W, PA 2012	Pleasant Mount 1 W, PA 1981-2010
Average Annual Temperature	M°F M°C	48.4°F 9.1°C	M°F M°C	46.5°F 8.1°C	46.3°F 8.0°C	43.9°F 6.6°C
Average Annual Maximum Temperature	M°F M°C	59.6°F 15.3°C	M°F M°C	57.7°F 14.3°C	56.1°F 13.3°C	53.6°F 12.0°C
Maximum Temperature	M°F M°C	93.8°F 34.3°C	94.0°F 34.4°C	92.1°F 33.4°C	89.0°F 31.7°C	88.3°F 31.3°C
Hot Days (days with Tmax>=90°F/32°C)	M	7	6	4	0	0
Average Annual Minimum Temperature	M°F M°C	37.1°F 2.8°C	M°F M°C	35.3°F 1.8°C	36.6°F 2.5°C	34.1°F 1.2°C
Minimum Temperature	M°F M°C	-3.5°F -19.7°C	M°F M°C	-9.5°F -23.1°C	-7.0°F -21.7°C	-12.0°F -24.4°C
Cold Days (days with Tmax<=32°F/0°C)	M	31	12*	40	48	61
Sub-freezing Days (days with Tmin<=32°F/0°C)	M	152	139*	162	165	169
Sub-zero Days (days with Tmin<=0°F/-17.8°C)	M	5	0*	10	9	12
Growing Season Length (days between last spring Tmin 32°F/0°C and first fall Tmin 32°F/0°C)	M	166	195	145	166	136

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

* - only a partial record due to missing data

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

Station name	Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Matamoras	MATP1	28.9°F	33.7°F	45.6°F	M°F	M°F	M°F	M°F	M°F	M°F	M°F	M°F	M°F	M°F
		-1.7°C	0.9°C	7.6°C	M°C	M°C	M°C	M°C	M°C	M°C	M °C	M°C	M°C	M°C
Hawley 1 E	HAWP1	28.6°F	M°F	43.7°F	44.1°F	61.2°F	63.3°F	71.5°F	67.7°F	59.7°F	50.6°F	35.8°F	32.9°F	M°F
		-1.9°C	M°C	6.5°C	6.7°C	16.2°C	17.4°C	21.9°C	19.8°C	15.4°C	10.3°C	2.1°C	0.5°C	M°C
Deposit	DEPN6	28.9°F	32.3°F	47.0°F	46.2°F	63.8°F	66.7°F	73.1°F	70.0°F	61.6°F	M°F	M°F	M°F	M°F
		-1.7°C	0.2°C	8.3°C	7.9°C	17.7°C	19.3°C	22.8°C	21.1°C	16.4°C	M°C	M°C	M°C	M°C
Pleasant Mount 1 W	PLEP1	21.9°F	26.5°F	40.4°F	42.0°F	59.3°F	61.4°F	69.8°F	65.8°F	57.5°F	48.0°F	33.5°F	29.8°F	46.3°F
		-5.6°C	-3.1°C	4.7°C	5.6°C	15.2°C	16.3°C	21.0°C	18.8°C	14.2°C	8.9°C	0.8°C	-1.2°C	8.0°C
Milanville	MLAP1	27.4°F	32.1°F	44.8°F	44.9°F	62.1°F	64.7°F	72.7°F	69.3°F	60.5°F	50.5°F	36.8°F	33.1°F	49.9°F
		-2.6°C	0.1°C	7.1°C	7.2°C	16.7°C	18.2°C	22.6°C	20.7°C	15.8°C	10.3°C	2.7°C	0.6°C	10.0°C
Stroudsburg	SDBP1	31.4°F	35.2°F	48.3°F	50.0°F	64.6°F	67.4°F	75.7°F	71.6°F	63.3°F	53.5°F	38.7°F	35.4°F	52.9°F
		-0.3°C	1.8°C	9.1°C	10.0°C	18.1°C	19.7°C	24.3°C	22.0°C	17.4°C	11.9°C	3.7°C	1.9°C	11.6°C
Rock Hill 3 SW	RKHN6	26.0°F	30.3°F	42.3°F	43.9°F	59.1°F	62.6°F	70.5°F	66.9°F	58.9°F	49.8°F	35.0°F	31.2°F	48.0°F
		-3.3°C	-0.9°C	5.7°C	6.6°C	15.1°C	17.0°C	21.4°C	19.4°C	14.9°C	9.9°C	1.7°C	-0.4°C	8.9°C
Sussex Airport,	KFWN	31.4°F	34.7°F	48.2°F	49.7°F	64.0°F	67.2°F	74.5°F	71.4°F	61.8°F	53.7°F	38.4°F	35.4°F	52.5°F
		-0.3°C	1.5°C	9.0°C	9.8°C	17.8°C	19.6°C	23.6°C	21.9°C	16.6°C	12.1°C	3.6°C	1.9°C	11.4°C
Aeroflex-Andover Airport	K12N	32.3°F	35.4°F	48.5°F	50.3°F	64.9°F	67.8°F	75.4°F	72.3°F	64.0°F	54.9°F	M°F	36.3°F	M°F
		0.2°C	1.9°C	9.2°C	10.2°C	18.3°C	19.9°C	24.1°C	22.4°C	17.8°C	12.7°C	M°C	2.4°C	M°C
Blue Mountain Lakes	TS717	27.8°F	26.7°F	42.4°F	53.2°F	60.9°F	68.4°F	73.1°F	69.8°F	64.0°F	51.1°F	40.7°F	25.2°F	50.3°F
		-2.3°C	-2.9°C	5.8°C	11.8°C	16.1°C	20.2°C	22.8°C	21°C	17.8°C	10.6°C	4.8°C	-3.8°C	10.2°C
Loch Lomond	LOLP1	27.4°F	28.6°F	43.8°F	54.3°F	62.0°F	69.7°F	74.4°F	70.9°F	65.3°F	52.3°F	41.5°F	27.0°F	51.4°F
		-2.6°C	-1.9°C	6.6°C	12.4°C	16.7°C	20.9°C	23.6°C	21.6°C	18.5°C	11.3°C	5.3°C	-2.8°C	10.8°C

Table 4. Summary of 2012 departure from normal temperature based on 30-year normal (1981–2010) for the selected stations.

Station name	Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Matamoras	MATP1	4.1°F	6.2°F	9.9°F	M°F	M°F	M°F	M°F	M°F	M°F	M°F	M°F	M°F	M°F
		2.3°C	3.4°C	5.5°C	M°C	M°C	M°C	M°C	M°C	M°C	M°C	M°C	M°C	M°C
Hawley 1 E	HAWP1	5.9°F	M°F	10.1°F	-1.1°F	5.6°F	-1.1°F	3.0°F	0.6°F	0.1°F	2.3°F	-2.9°F	4.8°F	1.7°F*
		3.3°C	M°C	5.6°C	-0.6°C	3.1°C	-0.6°C	1.7°C	0.3°C	0.1°C	1.3°C	-1.6°C	2.7°C	0.9°C*
Deposit	DEPN6	6.3°F	6.4°F	12.6°F	-0.5°F	6.9°F	1.2°F	3.8°F	1.9°F	M°F	M°F	M°F	M°F	M°F
		3.5°C	3.6°C	7.0°C	-0.3°C	3.9°C	0.7°C	2.0°C	1.0°C	M°C	M°C	M°C	M°C	M°C
Pleasant Mount 1 W	PLEP1	2.0°F	4.3°F	10.3°F	-0.2°F	6.2°F	-0.7°F	3.7°F	1.0°F	0.5°F	2.0°F	-2.8°F	4.5°F	2.6°F
		1.1°C	2.4°C	5.7°C	-0.1°C	3.4°C	-0.4°C	2.1°C	0.6°C	0.3°C	1.1°C	-1.6°C	2.5°C	1.4°C
Milanville	MLAP1[1]	6.2°F	9.9°F	11.7°F	1.1°F	7.7°F	1.3°F	4.6°F	3.3°F	1.9°F	2.8°F	-1.4°F	6.6°F	4.6°F
		3.4°C	5.6°C	6.4°C	0.7°C	4.3°C	0.7°C	2.5°C	1.8°C	1.0°C	1.5°C	-0.8°C	3.6°C	2.6°C
Stroudsburg	SDBP1	5.6°F	6.7°F	11.3°F	1.2°F	5.9°F	-0.3°F	3.8°F	1.4°F	0.9°F	2.9°F	-1.7°F	4.9°F	3.6°F
		3.1°C	3.7°C	6.3°C	0.7°C	3.3°C	-0.2°C	2.1°C	0.8°C	0.5°C	1.6°C	-1.0°C	2.7°C	2.0°C
Rock Hill 3 SW	RKHN6	3.0°F	7.6°F	9.5°F	0.8°F	2.2°F	-2.8°F	1.4°F	-1.3°F	-1.2°F	1.3°F	-3.2°F	3.3°F	1.7°F
		1.7°C	4.2°C	5.3°C	0.4°C	1.2°C	-1.6°C	0.8°C	-0.7°C	-0.7°C	0.7°C	-1.8°C	1.8°C	1.0°C
Sussex Airport	KFWN[1]	5.2°F	5.8°F	10°F	1.1°F	5.6°F	0.4°F	3.6°F	1.4°F	0.4°F	3.1°F	-2.7°F	4.5°F	3.2°F
		2.9°C	3.2°C	5.6°C	0.6°C	3.1°C	0.2°C	2.0°C	0.8°C	0.2°C	1.7°C	-1.5°C	2.5°C	1.8°C
Aeroflex-Andover Airport	K12N[1]	6.0°F	6.2°F	10.6°F	0.6°F	5.7°F	0.1°F	3.1°F	1.6°F	1.0°F	3.1°F	M°F	4.4°F	3.9°F*
		3.3°C	3.4°C	5.9°C	0.3°C	3.2C	0.1°C	1.7°C	0.9°C	0.6°C	1.7°C	M°C	2.5°C	2.2°C*

[1]Indicates a station's Period of Record is ten or more years but less than 30 years. In these cases, the departure from normal values were calculated with normals derived from data spanning the length of the station's period of record. Stations with a Period of Record of less than 10 years were not included in this table.
* indicates estimated value based on less than 12 months of data (usually 11)
M = missing data (Monthly statistics are reported as' M' if greater than 4 days of data are missing).

Table 5. Seasonal and annual temperature and precipitation rankings for 2012 over 118 years (1 = warmest/wettest year and 118 = coldest/driest year) for Pennsylvania Climate Division 1 (top), New Jersey Climate Division 1 (middle), and New York Climate Division 2 (bottom). T = Tie.

PA Climate Division 1 Rankings "Pocono Mountains"	**Jan–Feb–Mar WINTER**	**Apr–May–Jun SPRING**	**Jul–Aug–Sep SUMMER**	**Oct–Nov–Dec AUTUMN**	**Jan–Dec ANNUAL**
Temperature-2012	1	T9	2	T18	1
Precipitation-2012	112	54	48	23	54

NJ Climate Division 1 Rankings "Northern NJ"	**Jan–Feb–Mar WINTER**	**Apr–May–Jun SPRING**	**Jul–Aug–Sep SUMMER**	**Oct–Nov–Dec AUTUMN**	**Jan–Dec ANNUAL**
Temperature-2012	1	5	11	24	1
Precipitation-2012	117	57	63	27	76

NY Climate Division 2 Rankings "Eastern Plateau"	**Jan–Feb–Mar WINTER**	**Apr–May–Jun SPRING**	**Jul–Aug–Sep SUMMER**	**Oct–Nov–Dec AUTUMN**	**Jan–Dec ANNUAL**
Temperature-2012	1	T19	T24	32	1
Precipitation-2012	113	49	25	24	39

Delaware Water Gap National Recreation Area
and Upper Delaware Scenic and Recreational River
Departure from Average Monthly Maximum Temperature
2012 vs. 1981–2010

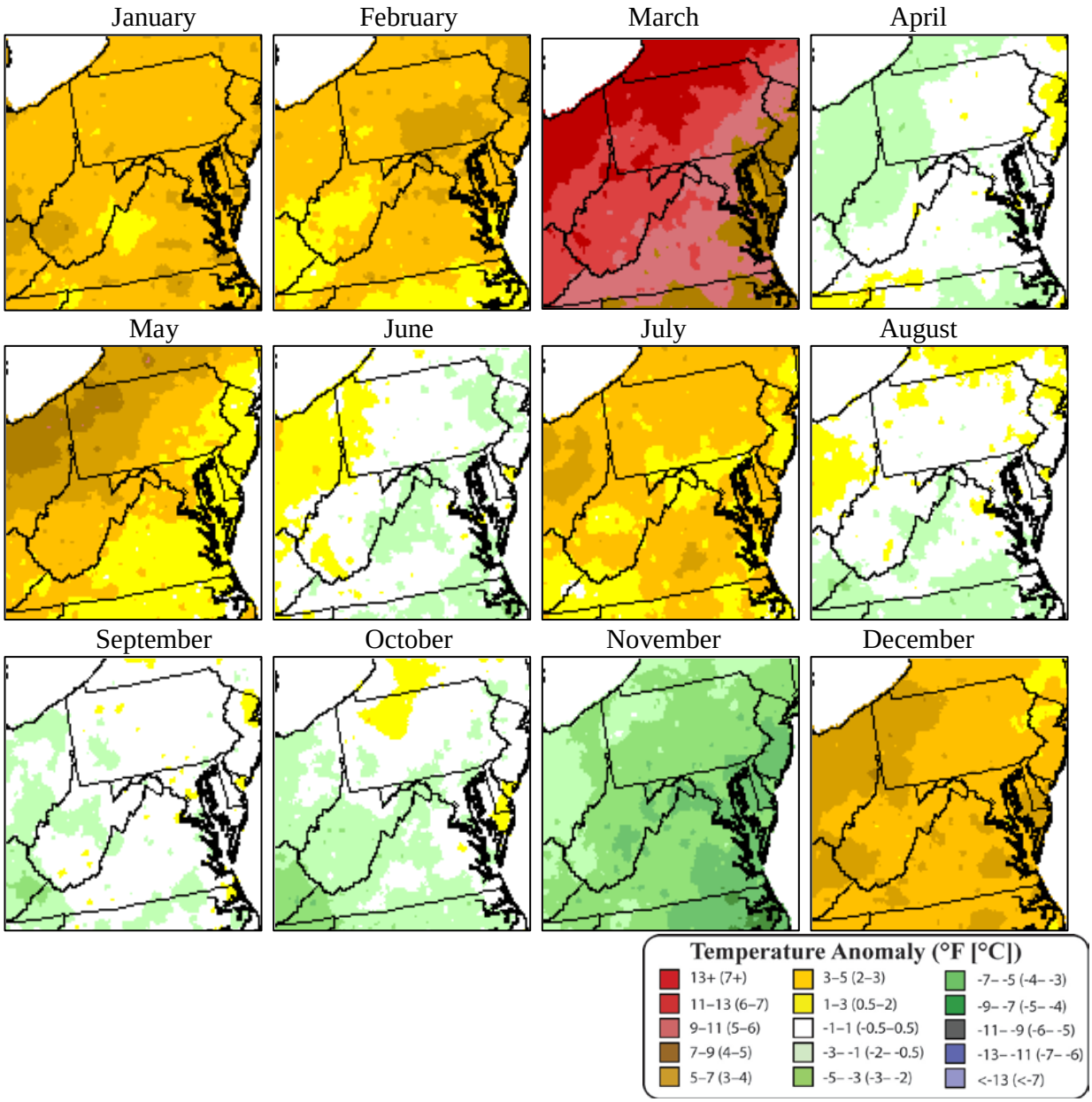

Figure 2. Maps showing departure from average monthly maximum temperature compared to the 30-year normal (1981–2010).

Delaware Water Gap National Recreation Area
and Upper Delaware Scenic and Recreational River
Departure from Average Monthly Minimum Temperature
2012 vs. 1981–2010

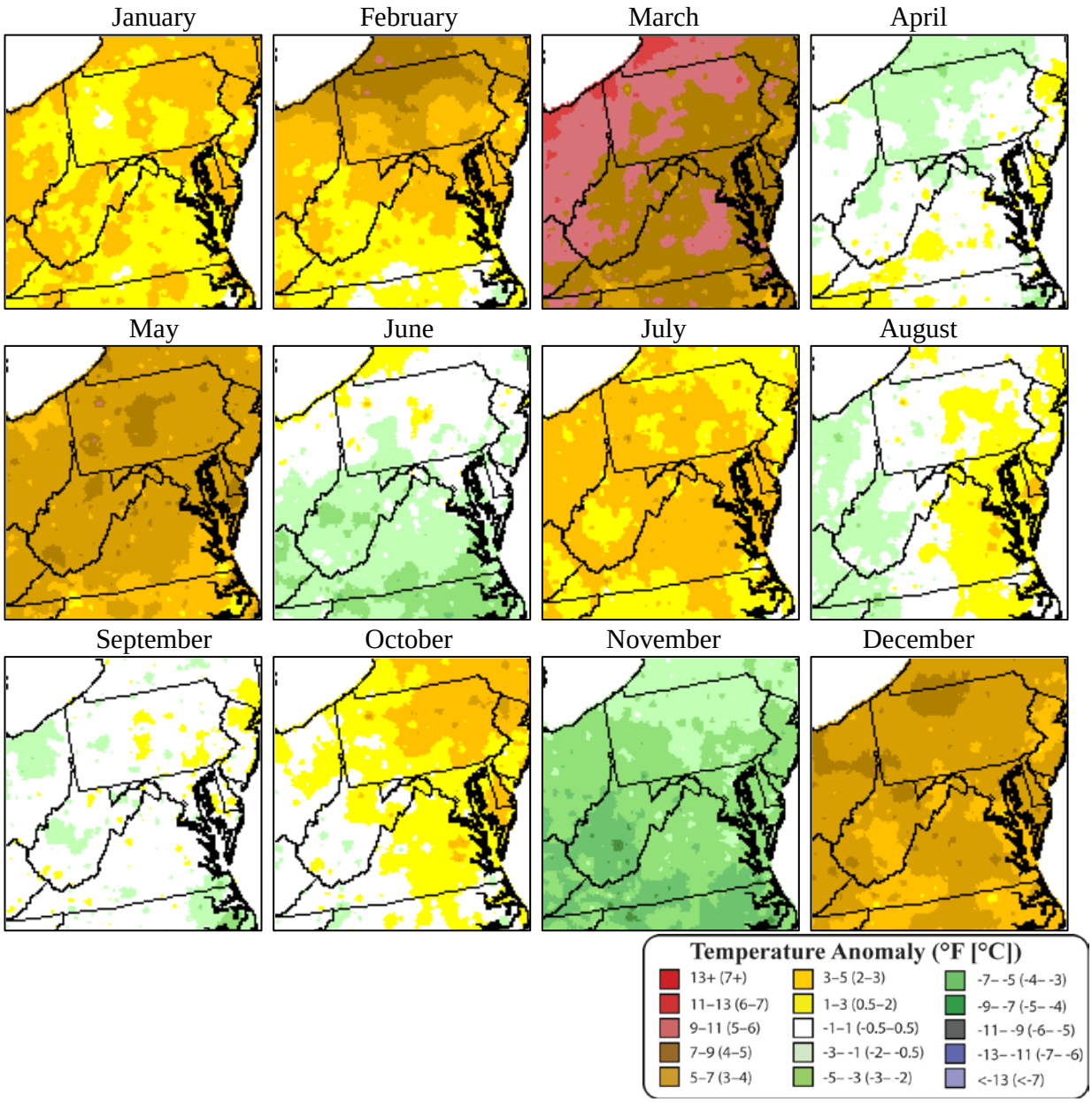

Figure 3. Maps showing departure from average monthly minimum temperature compared to the 30-year normal (1981–2010).

Precipitation Summary

For the 12th consecutive year, annual precipitation (rain and melted snow, ice, sleet, etc.; hereafter, precipitation) for calendar year 2012 averaged above the long-term mean (Table 6) in spite of having one of the driest winters of record (Table 5). Contrary to the trend of past years, four of the five wettest days occurred during the warmer half of the year (Table 7). The highest accumulated liquid occurred in late September (Table 8). Only the months of May, October, and December averaged above-normal precipitation throughout the region (Figure 4; Table 9). Dry spells were noted in January (twice), April (twice), and November, which is atypical for the winter-spring season (Table 7). Snowfall was below normal, due, in large part, to a very mild winter and spring. The number of days with excessive rainfall (>1.0 in [25 mm]) was near-to-above the long-term average for northeastern Pennsylvania (Table 6).

The year began with below-normal precipitation during January, February, and March (Figure 4). The first three months of 2012 were ranked as the 1st to 6th driest in 118 years of record keeping (Table 5). Essentially, all stations reported below-average precipitation (rain and snow) during the months of January, February, and March, with the only near normal (102 percent) tallied at Stroudsburg, PA, in January (Table 9).

Spring 2012 (April–May–June) was wetter, but only one month (May) had all station with 100 percent of normal rainfall (Table 9). This three-month period ranked from the 49th to 57th wettest in 118 years for the three climate divisions encompassing the parks (Table 5). Two of the wettest days (April 22 and May 26) and two of the longer dry spells occurred during this season (Table 7).

The summer began and ended with generally well-above-average rainfall, but the interim month (August) tallied only about 75 percent of normal (Table 9). September was rather wet, with the wettest single day of the year occurring on the 18th (Table 7). There were no direct effects of any hurricanes or tropical storms during this period.

As has been the case for much of the last decade, the autumn was generally wetter than normal, with total precipitation ranging from 13.3–13.8 in (338–351 mm) (Table 6). December was the wettest of the fall months, as stations tallied 117–308 percent of normal rainfall (Table 9). Rock Hill, NY, measured 6.62 in (168 mm), for the maximum accumulation (Table 8). November was very dry, with the majority of stations averaging less than 30 percent of the normal rainfall; this was the driest since February (Table 9). The effects of Hurricane Sandy were noted at the end of October, but the heaviest rain fell south of this region. Precipitation during the last three months of 2012 ranked between 23rd and 27th wettest for the climate divisions surrounding the parks. Snowfall during the year only tallied 51.4 in (131 cm), which was below average.

Overall, 2012 had between 85–102 percent of the normal precipitation (Tables 6 and 9); this was considerably drier than the previous year.

Table 6. Status of 2012 precipitation indicators compared to the 30-year normal (1981–2010) at the Matamoras (MATP1), Hawley 1 E (HAWP1), and Pleasant Mount 1 W (PLEP1) stations.

Precipitation Indicator	Matamoras, PA 2012	Matamoras, PA 1981-2010	Hawley 1 E, PA 2012	Hawley 1 E, PA 1981-2010	Pleasant Mount 1 W, PA 2012	Pleasant Mount 1 W, PA 1981-2010
Annual Precipitation	M in M mm	46.0 in 1,168 mm	41.2 in 1,046 mm	42.9 in 1,090 mm	51.7 in 1,312 mm	49.5 in 1,257 mm
Autumn (Oct, Nov, Dec) Precipitation	M in M mm	11.5 in 292 mm	13.3 in 338 mm	10.6 in 269 mm	13.8 in 351 mm	12.7 in 323 mm
Heavy Precipitation Days (days with ≥1.0 in (25 mm) rain)	M	11	10	10	15	11
Extreme Precipitation Days (days with ≥2.0 in (51 mm) rain)	M	1	3	1	3	2
Micro-drought (strings of 7+ days without rain)	6	4	6	5	6	5
Annual Snowfall (inches)	9.3 in* 23.6 cm*	37.8 in 96.0 cm	11.6 in* 29.4 cm	44.2 in 112.3 cm	51.4 in 131 cm	68.5 in 174.0 cm
Measurable Snow Days (days with ≥0.1 in (0.3 cm) snow)	12*	22	7*	20	22	28
Moderate Snow Days (days with ≥3.0 in (7.6 cm) snow)	1*	4	2*	5	8	8
Heavy Snow Days (days with ≥5.0 in (12.7 cm) snow)	0*	2	0*	3	4	4

M = missing data (Monthly statistics are reported as' M' if greater than 4 days of data are missing).
* missing data, summaries are only partial

Table 7. Top five wettest days and top five dry spells (consecutive days with a trace or less of liquid precipitation) during 2012 from the Matamoras (MATP1) station.

Wettest Days in 2012	Dry Spells in 2012
Sept. 18: 3.63 in (92 mm)	Nov. 14–26
May 26: 2.50 in (64 mm)	Jan. 29–Feb. 8
Dec. 21: 2.48 in (63 mm)	Jan. 2–10
Sept. 4: 2.17 in (55 mm)	Apr. 2–10
Apr. 22: 1.58 in (40 mm)	Apr. 12–20

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
Matamoras	MATP1	2.48in	0.92 in	1.45in	M in	M in	M in	M in	M in	M in	M in	M in	M in	M in
		63 mm	23 mm	37 mm	M mm	M mm	M mm	M mm	M mm	M mm	M mm	M mm	M mm	M mm
Equinunk 2 NW	EQNP1	3.08 in	1.02 in	2.41 in	2.60 in	4.66 in	2.75 in	6.03 in	2.76 in	3.71 in	5.74 in	0.10 in	5.45 in	40.3 in
		78 mm	26 mm	61 mm	66 mm	118 mm	70 mm	153 mm	70 mm	94 mm	146 mm	3 mm	138 mm	1,032 mm
Hawley 1 E	HAWP1	1.97 in	1.00 in	1.98 in	1.57 in	4.44 in	3.33 in	4.64 in	2.28 in	6.70 in	6.65 in	1.23 in	5.38 in	41.2 in
		50 mm	25 mm	50 mm	40 mm	113 mm	85 mm	118 mm	58 mm	170 mm	169 mm	31 mm	137 mm	1,046 mm
Deposit	DEPN6	2.74 in	1.26 in	2.25 in	2.67 in	4.86 in	2.77 in	6.41 in	3.93 in	5.52 in	M in	M in	M in	M in
		70 mm	32 mm	57 mm	68 mm	123 mm	70 mm	163 mm	100 mm	140 mm	M mm	M mm	M mm	M mm
Rock Hill 3 SW	RKHN6	2.56 in	1.13 in	1.25 in	2.92 in	6.66 in	3.35 in	7.67 in	3.61 in	6.79 in	6.29 in	1.09 in	6.62 in	49.96 in
		65 mm	29 mm	32 mm	74 mm	169 mm	85 mm	195 mm	92 mm	172 mm	160 mm	28 mm	168 mm	1,268 mm
Pleasant Mount 1 W	PLEP1	3.17 in	1.38 in	2.59 in	2.83 in	6.62 in	2.98 in	9.15 in	3.43 in	5.72 in	6.58 in	1.21 in	6.01 in	51.7 in
		80.5 mm	35 mm	66 mm	72 mm	168 mm	76 mm	232 mm	87 mm	145 mm	167 mm	31 mm	153 mm	1,312 mm
Milanville	MLAP1	2.44 in	1.08 in	1.34 in	0.3 in	6.55 in	3.27 in	M in	2.66 in	5.53 in	4.85 in	1.10 in	5.88 in	M in
		62 mm	27 mm	34 mm	8 mm	166 mm	83 mm	M mm	68 mm	140 mm	123 mm	28 mm	142 mm	M mm
Stroudsburg	SDBP1	3.56 in	1.62 in	1.43 in	3.38 in	8.31 in	3.39 in	3.92 in	2.48 in	6.97 in	5.92 in	1.29 in	6.38 in	48.6 in
		90 mm	41 mm	36 mm	86 mm	211 mm	86 mm	100 mm	63 mm	177 mm	150 mm	33 mm	162 mm	1,234 mm
Sussex Airport	KFWN	2.53 in	1.04 in	M in	2.44 in	3.83 in	5.18 in	4.59 in	2.76 in	5.12 in	4.16 in	0.88 in	3.91 in	M in
		64 mm	26 mm	M mm	62 mm	97 mm	132 mm	116 mm	70 mm	130 mm	106 mm	22 mm	99 mm	M mm
Aeroflex-Andover Airport	K12N	M in	M in	M in	M in	M in	M in	M in	M in	M in	M in	M in	M in	M in
		M mm	M mm	M mm	M mm	M mm	M mm	M mm	M mm	M mm	M mm	M mm	M mm	M mm
Blue Mountain Lakes	TS717	M	M	M	M	M	M	M	M	M	M	M	M	M
		M	M	M	M	M	M	M	M	M	M	M	M	M
Loch Lomond	LOLP1	2.9 in	1.1 in	1.4 in	3.0 in	5.7 in	3.9 in	5.7 in	2.4 in	10.3 in	5.8 in	1.0 in	0.5 in	43.7 in
		74 mm	28 mm	36 mm	76 mm	145 mm	99 mm	145 mm	61 mm	262 mm	147 mm	25 mm	13 mm	1,110 mm

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

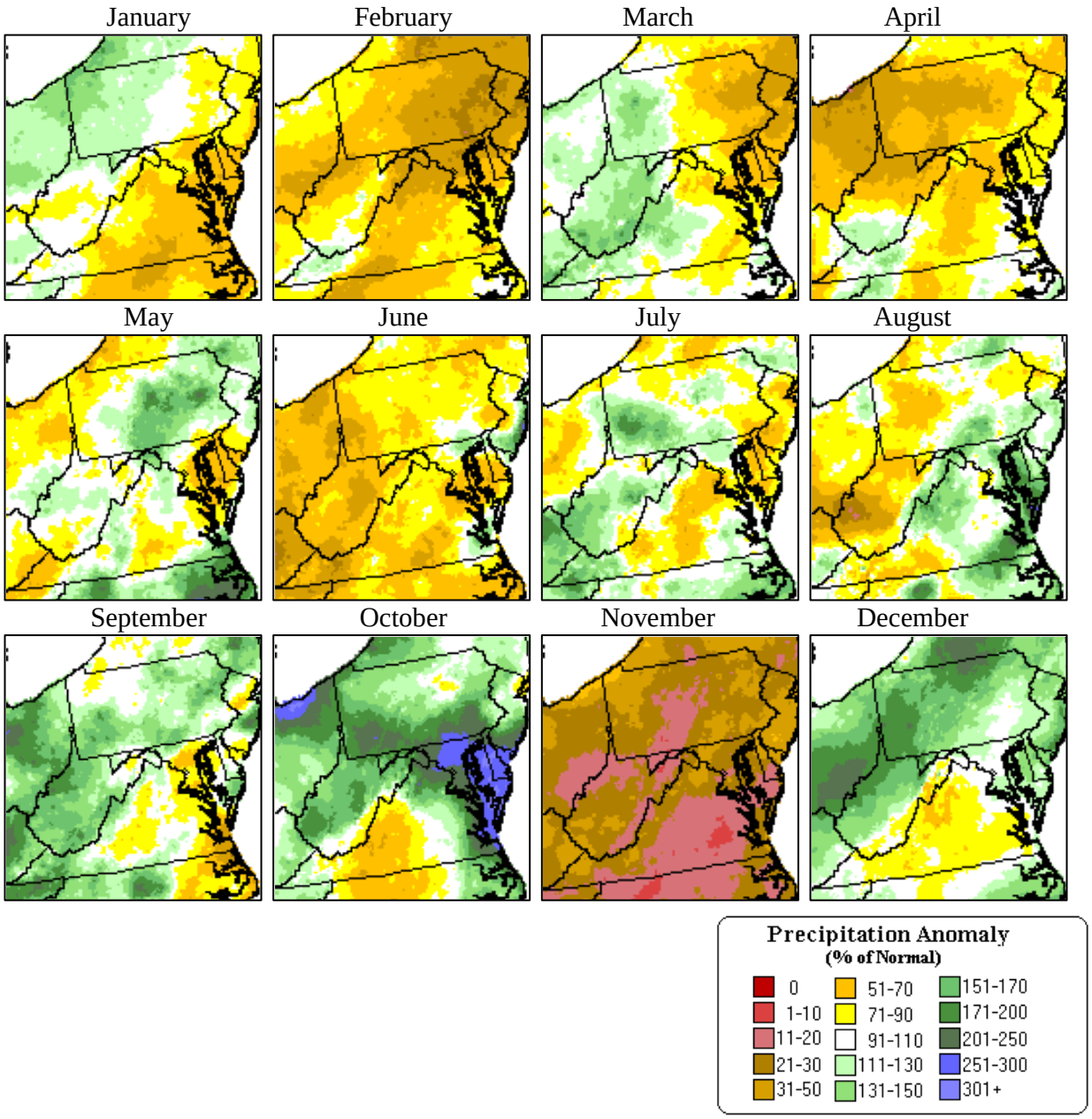

Figure 4. Maps showing percent of average monthly precipitation compared to the 30-year normal (1981–2010).

Table 9. Summary of 2012 percent of normal precipitation based on 30-year normal (1981–2010) for selected stations.

Station name	Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Matamoras	MATP1	81	32	40	M	M	M	M	M	M	M	M	M	M
Equinunk 2 NW	EQNP1	99	40	70	73	126	68	155	72	89	145	3	160	92
Hawley 1 E	HAWP1	64	45	64	42	116	75	124	64	166	177	35	155	98
Deposit	DEPN6	95	51	69	68	120	66	155	105	140	M	M	M	93*
Rock Hill 3 SW	RKHN6	74	35	30	68	146	71	182	87	145	134	27	164	99
Pleasant Mount 1 W	PLEP1	96	48	74	71	140	60	198	84	118	139	28	162	102
Milanville	MLAP11	81	41	37	8	140	78	M	60	145	165	30	166	86*
Stroudsburg	SDBP1	102	53	37	83	186	70	84	56	180	126	31	155	97
Sussex Airport1	KFWN	81	40	M	60	90	127	103	65	131	100	24	117	85*
Aeroflex-Andover Airport1	K12N	M	M	M	0	M	M	M	M	M	M	M	M	M

[1]Indicates a station's Period of Record is 10 years or more but less than 30 years. In these cases, the departure-from-normal values were calculated with normals derived from data spanning the length of the station's period of record. Stations with a Period of Record of less than 10 years were not included in this table.
M = missing data (Monthly statistics are reported as' M' if more than four days of data are missing).
*pro-rated for months available.

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 Pennsylvania Climate Division 1 in 2012 are shown in Figure 5.

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 Pennsylvania (Figure 6) and the Northeast (Figure 7) are shown for 2012.

According to the PDSI for PA Climate Division 1, every month, except January, during 2012 was within the normal range, though most were too dry. The very moist conditions at the beginning of the year were residual effects of 2011. When compared with the past few years, 2012 was the first time in this interval when near normal conditions dominated.

The DM – Drought Severity Index for Pennsylvania (Figure 6) and the Northeast (Figure 7) shows a similar pattern for the growing season (May through October); with dry weather noted in May and July.

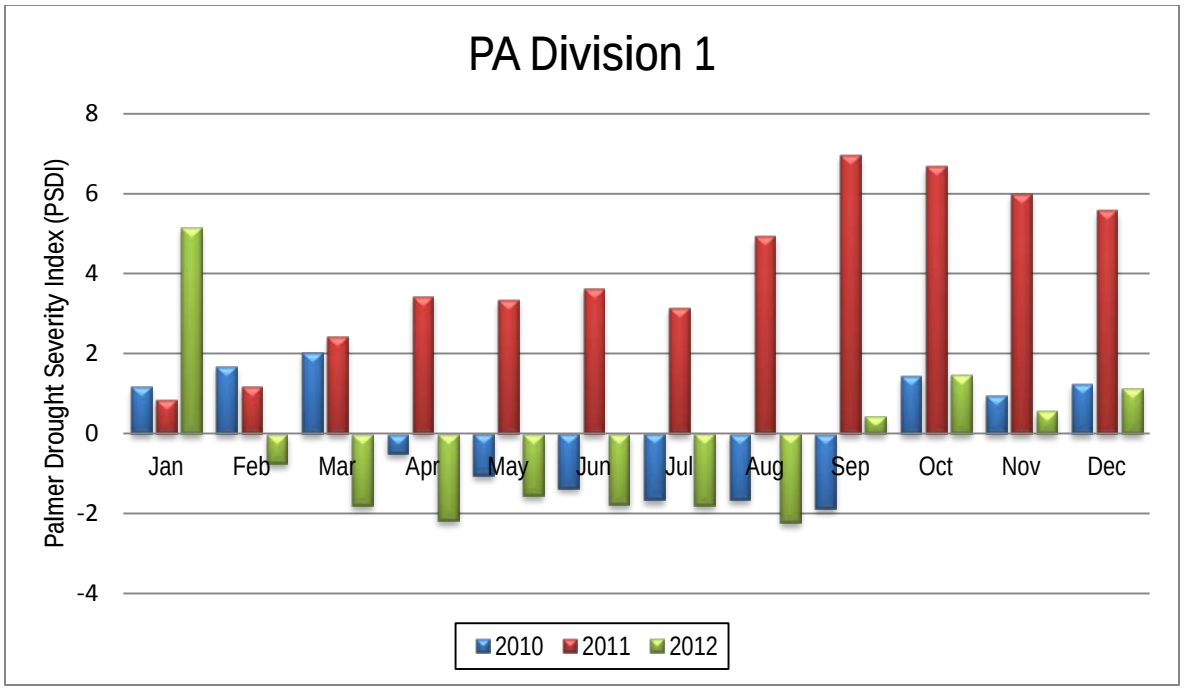

Figure 5. Monthly Palmer Drought Severity Index (PDSI) values for Pennsylvania Climate Division 1, 2010–2012.

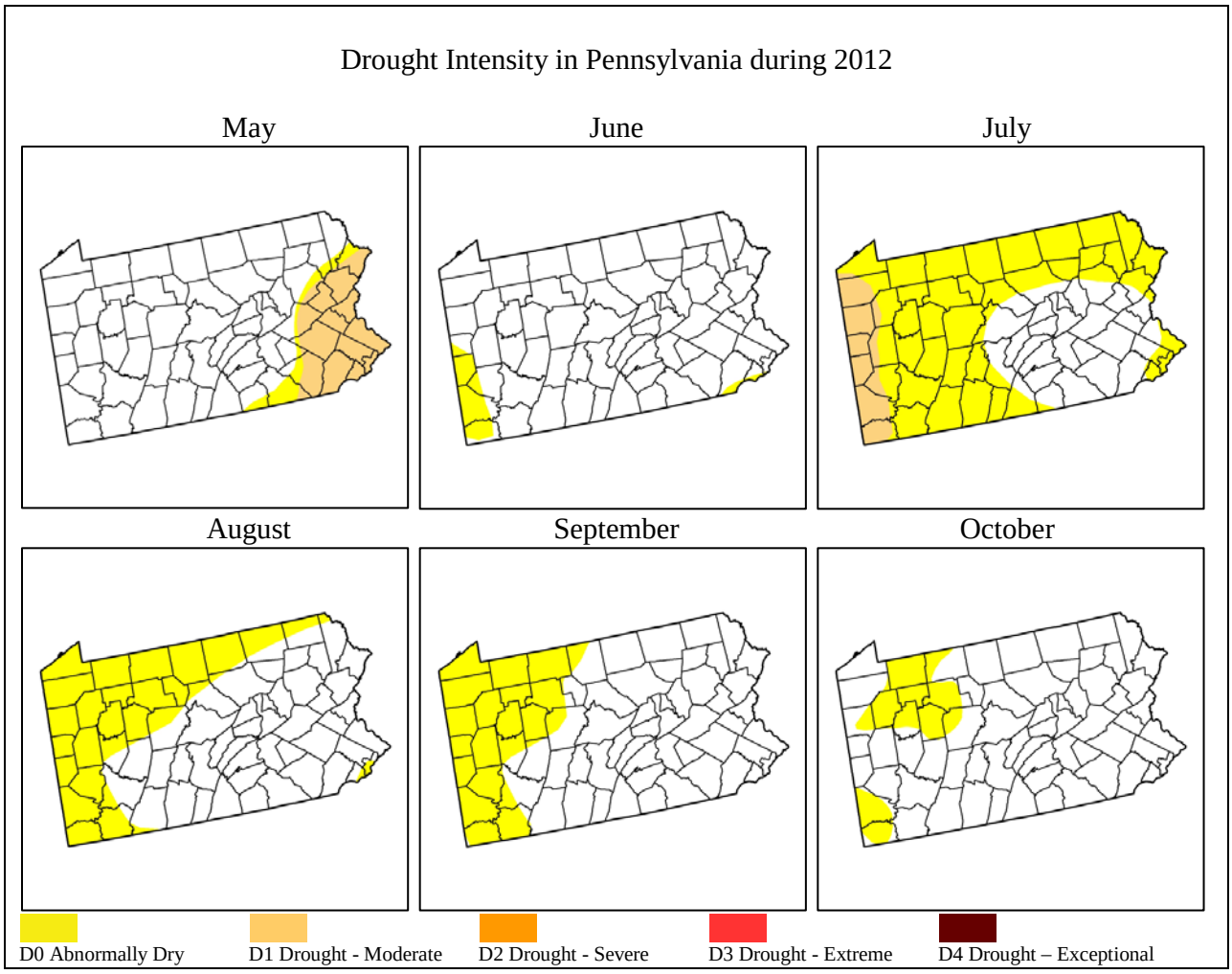

Figure 6. Mid-month values of the United States Drought Monitor (DM) – Drought Intensity Index for Pennsylvania in 2012.

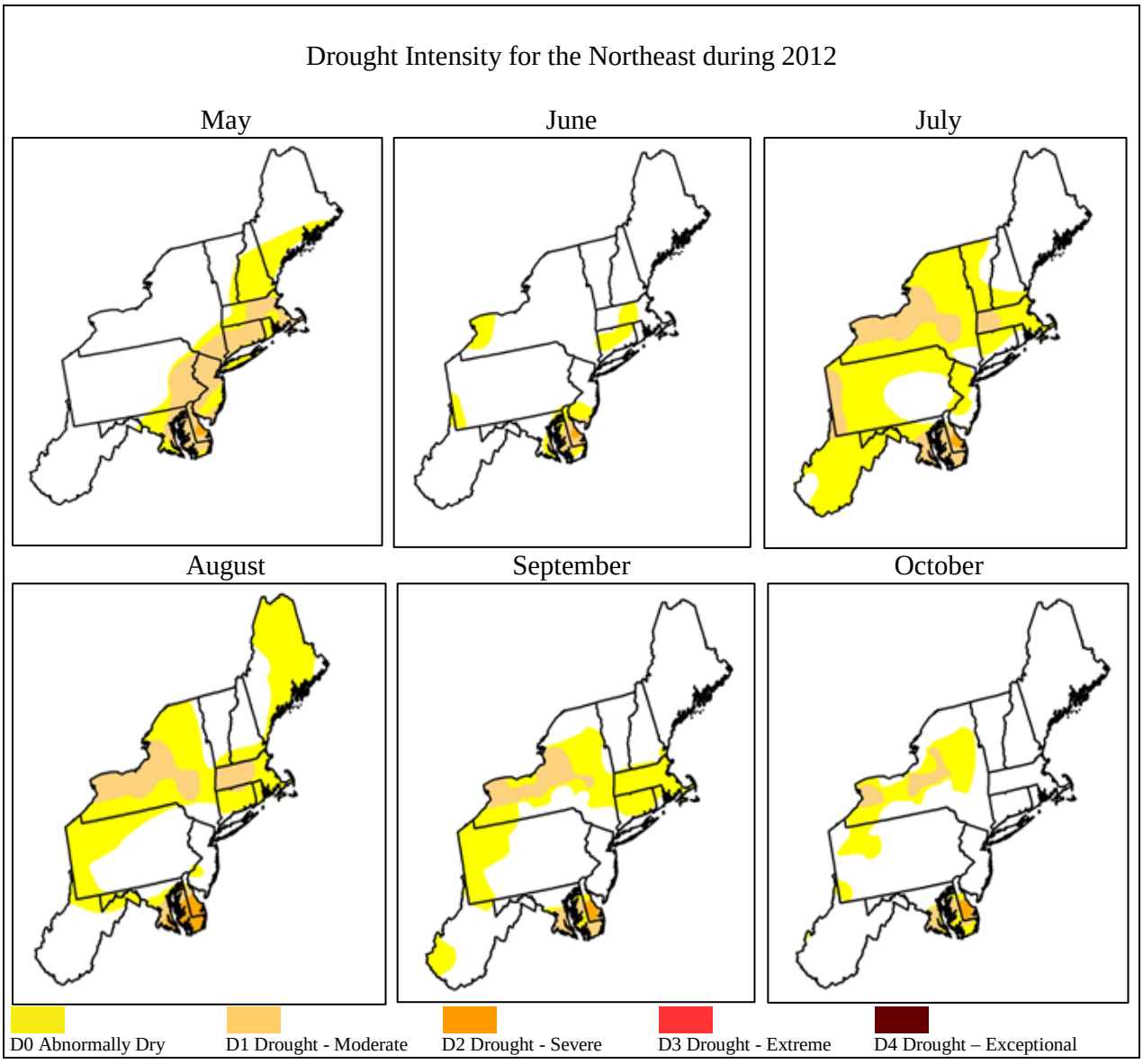

Figure 7. Mid-month values of the United States Drought Monitor (DM) – Drought Intensity Index for the Northeast in 2012.

References

Daly, C., W. P. Gibson, G. H. Taylor, G. L. Johnson, and P. Pasteris. 2002. A knowledge-based approach to the statistical mapping of climate. Climate Research 22:99–113.

Davey, C. A., K. T. Redmond, and D. B. Simeral. 2006. Weather and Climate Inventory. National Park Service. National Park Service, Eastern Rivers and Mountains Network. Natural Resource Technical Report NPS/ERMN/NRTR—2006/006. National Park Service, Fort Collins, CO.

Gelber, B. 2002. The Pennsylvania Weather Book. Rutgers University Press. New Brunswick, NJ.

Kocin, P. J., and L. W. Uccellini. 2004. Northeast Snowstorms Volume 1: Overview. Meteorological Monographs. Vol 32. No 54. American Meteorological Society. Boston, MA.

Marshall, M., Knight, P., and J. Comiskey. 2012. Weather and climate monitoring protocol: Eastern Rivers and Mountains Network and Mid-Atlantic Network. Natural Resource Report NPS/ERMN-MIDN/NRR–2012/498. National Park Service, Fort Collins, CO.

Marshall, M. R., and N. B. Piekielek. 2007. Eastern Rivers and Mountains Network Ecological Monitoring Plan. Natural Resource Report NPS/ERMN/NRR—2007/017. National Park Service. Fort Collins, CO.

National Assessment Synthesis Team. 2001. Climate Change Impacts on United States: The Potential Consequences of Climate Variability and Change, Report for the U.S. Global Change Research Program. Cambridge University Press. Cambridge, UK.

National Oceanic and Atmospheric Administration (NOAA). 20112. National Climatic Data Center. Climate of 2012 – Annual Review, Global and U.S. Summary. http://lwf.ncdc.noaa.gov/oa/climate/research/2012/ann/us-summary.html.

National Integrated Drought Information System (NIDIS). 2012. National Climate Data Center and United States Department of Agriculture. http://drought.unl.edu/dm/archive.html.

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