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# SKYWARN NEWSLETTER

National Weather Service

STATE COLLEGE, PA

## The Summer of 2018 in Review

John La Corte - Lead Meteorologist

It was wet! In fact it was VERY wet!!

The summer of 2018 will surely go down as the summer of flooding here in Central Pennsylvania! The meteorological summer runs from June through August and a glance at Figure 1 shows that all of Pennsylvania was wet to very wet with the exception of a small portion of the Northern Mountains.

June was wetter than normal in most locations, but the true deluges began in July when the eastern half of the state really lit up with several rounds of heavy flooding tropical downpours. Figure 2 shows this stripe of

Departure from Normal Precipitation (in)  
7/1/2018 - 7/31/2018

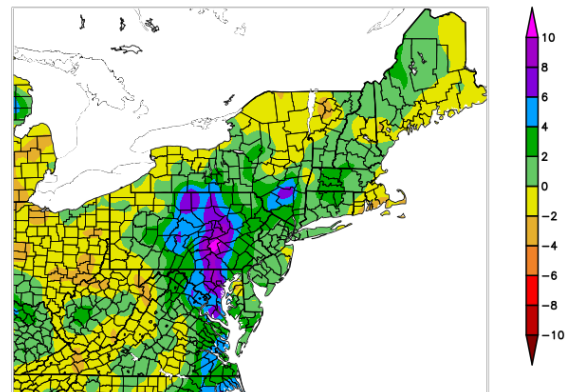
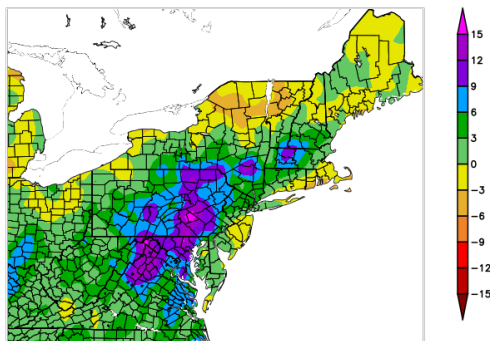


Figure 2. Rainfall departure for July

Departure from Normal Precipitation (in)  
6/1/2018 - 8/31/2018



Generated 9/10/2018 at HPRCC using provisional data. NOAA Regional Climate Centers

Figure 1. Summer rainfall departure from normal

extreme rainfall from the northern Chesapeake up the along the length of the Susquehanna Valley.

What was most remarkable about the heavy rain for the summer, none of it came from tropical cyclones. It's not unusual for the region to experience heavy rains from the decaying remnants of Tropical Storms or Hurricanes that move inland along the Gulf or Atlantic coasts, but until what was left of Gordon brought some

rain in early September, the repeated local deluges were the result of an unusually persistent upper air trough over the Ohio Valley that brought deep tropical air into the region along with several slow moving disturbances that caused repeated rounds of locally heavy flooding rains.

July was by far the wettest of the three months, but the traditional summer culminated with perhaps the worst of the flash flooding during the early afternoon hours of August 31st when somewhere between 9 and 14 inches of rain fell in just a 3 hour window in the vicinity of Manheim and Mt. Joy in Lancaster County. Numerous evacuations and water rescues were necessary, but luckily no one was killed in the flooding that hit fast and furiously.

It all contributed to record or near record rainfall for the summer months. Table 1 shows the summer rain compared to normal, as well as the rankings. State College, Williamsport and Lancaster all had their wettest summers, while Harrisburg and Altoona came close. It's notable that at several locations the wettest summer was 1972, made famous by the flooding of Hurricane Agnes in June of that year.

	2018	Normal	Rank	Prev	Year
State College	22.14	11.34	1st	2003	19.83
Harrisburg	21.37	11.30	2nd	1972	23.33
Williamsport	23.73	11.95	1st	1972	22.30
Altoona	16.39	9.77	5th	1972	17.77
Lancaster	21.39	11.61	1st	1986	19.12

Table 1. Summer rainfall and historical ranking

## TEMPERATURES

With all the rain and flooding, it's almost overlooked that the summer was warmer than normal over the region. Figure 3 shows almost everyone along the east coast and northeastern U.S. experienced above normal temperatures.

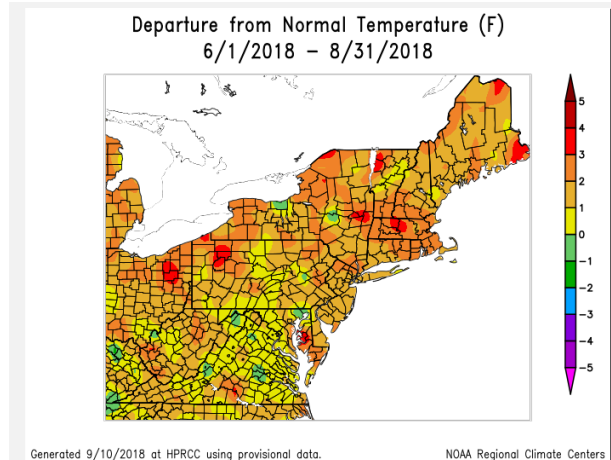


Figure 3. Summer temperature departures

While it was warm, high temperatures and heat waves were not noteworthy. Table 2 summarizes some temperature data. We often look at the number of days with high temperatures of 90 or warmer as measure of the summer's severity. With the exception of Lancaster, most cities sampled showed the number of 90 degree days very close to normal.

	Max of >=90		Min of >=60		Min of >=70	
	2018	Normal	2018	Normal	2018	Normal
State College	4	7	64	50	12	4
Harrisburg	19	18	78	73	32	19
Williamsport	13	13	61	52	10	5
Altoona	8	7	68	48	8	3
Lancaster	27	16	72	63	24	11

Table 2. Summer temperature summary

Where the warmth really showed up was with the overnight low temperatures. The number of nights with lows of 60 degrees or warmer was well above normal at all the sites selected. The number of 70 degree nights was even more remarkable. Harrisburg for example normally sees about 19 muggy nights (70 degrees or warmer), this year they had 32, more than one entire month's worth out of the summer! That and the fact that the humidity seemed to be unusually persistent and oppressively high made for some tough sleeping conditions for those without air conditioning.

With the leaves soon to turn cover and the nights to begin turning frosty, we like to look forward for the forecast of the upcoming winter. The months of December through February make up meteorological winter, and the Climate Prediction Center (CPC) is showing a slightly elevated probability of the winter being a warm one (figure 4).

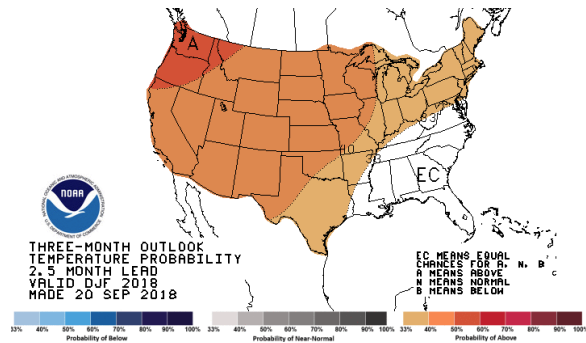


Figure 4. CPC winter temperature outlook

As for precipitation, the CPC has our region in the EC zone. An EC or “equal chances” forecast means that there is an equal probability of the winter ending up wetter, drier or near normal because the atmospheric “signal” is too weak to give confidence in any one of the outcomes. What we do know is the equatorial Pacific is warming, and while it is now what we call “ENSO neutral”, an El Nino is expected to develop before the year is out and continue into 2019. During such years, east coast storms tend to be scarce at our latitude, but occasionally one or two big storms become real headline makers.

So what do the gurus of long range prognostication have to say about the upcoming winter? The Old Farmer’s Almanac which has been around since 1792 is calling for a warm and wet winter with near to below normal snowfall over central Pennsylvania. While the CPC uses a variety of atmospheric indices and an array of sophisticated climate

prediction models, the soothsayers at the Almanac employ a secret formula that they boast to be over 90% accurate. As always, we here at the National Weather Service State College will keep a sharp eye out day-to-day for any nor’easters or bone chilling cold on the horizon, and keep you updated. Have a safe and happy winter!

*In 1934, during the Great Depression, Congress passed and President Franklin D. Roosevelt signed the Migratory Bird Hunting Stamp Act, aka the "Duck Stamp Act."*

*This act made the possession of a stamp mandatory for hunters of migratory waterfowl and created a fund for the proceeds of those stamps. Ninety-eight cents of every dollar raised from the sale of duck stamps is used to purchase and conserve waterfowl habitat. The program has raised over \$800 million and protected over 6.5 million acres of wetlands since the passing of the Duck Stamp Act.*

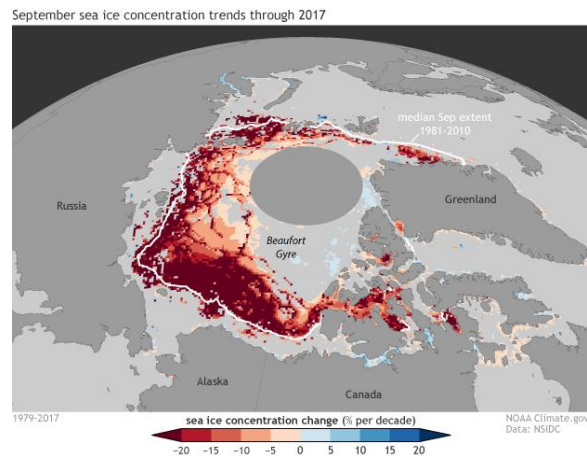
- US Fish and Wildlife Service and The Old Farmer’s Almanac

## 2018 Arctic sea ice minimum continues longer trend

By Michon Scott - Climate.gov

Arctic sea ice has probably reached its annual minimum for 2018, according to the National Snow and Ice Data Center (NSIDC). Sea ice extent dipped to 1.77 million square miles (4.59 million square kilometers) on September 19, and again on September 23. After that, ice extent began to rise, signaling an end to the summer melt season. The 2018 minimum was nowhere near the record-low extent of 1.31 million square miles (3.39 million square kilometers) recorded on September 17, 2012, but it was nowhere near the 1981–2010 average, either. It was tied with 2008 and 2010 for the sixth-lowest extent in the nearly 40-year

satellite record. The 12 lowest Arctic sea ice minimums have all occurred in the last 12 years.



September 2018 observations continue a longer trend of Arctic sea ice decline. This map shows trends in September sea ice concentration for 1979–2017. (September 2018 figures will not be available until October.) Ocean waters are light gray. Landmasses are dark gray, and so is the area around the pole where satellite sensors have not acquired data every year. Areas of increasing trends per decade appear in shades of blue, and areas of decreasing trends appear in orange and red. Decreasing trends dominate the ice pack, and those trends are especially strong along the ice pack perimeter north of western Canada, Alaska, and eastern Siberia—in the Beaufort, Chukchi, and East Siberian Seas.

Warm water from the North Pacific enters the Arctic Ocean through the Bering Strait, and in recent decades, this warm water has exerted an increasing influence on Arctic Sea ice. Decades ago, the Beaufort Gyre north of the Alaskan and Siberian coasts served as a sea ice nursery. Ice could remain in that gyre for years, thickening over time, but by the late 1990s, ice had begun to diminish in the southern arm of the gyre. Multiyear started to melt or be transported out of the Arctic, leading to younger, thinner ice more prone to melt. First-year ice that has not survived a single melt season now dominates the Arctic.

Sea ice extent in the Arctic is declining in all months, but the decline is largest in September, which is historically the end of the summer melt season. But these sharp declines in summertime ice extent are beginning to extend into the fall freeze-up. In November 2017, sea ice scientists noted a dearth of sea ice in the Chukchi Sea, as well as the Bering Sea to the south.

Such a widespread absence of sea ice has implications for indigenous hunters who rely on animals that depend on sea ice, and sea ice loss combined with permafrost thaw contributes to coastal erosion. When sea ice is slow to re-form in the fall, Arctic coastal communities are especially vulnerable to battering waves and flooding that accompany winter storms.

## References

NSIDC. [Arctic sea ice at minimum extent for 2018](#). Accessed September 27, 2018.

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Perovich, D., Meier, W., Tschudi, M., Farrell, S., Hendricks, S., Gerland, S., Haas, C., Krumpfen, T., Polashenski, C., Ricker, R., Webster, M. 2017. [Sea Ice](#). *Arctic Report Card: Update for 2017*.

## Ship Wrecks Unearthed by Hurricane Michael

From the Tallahassee Democrat



Around mid-day on October 10<sup>th</sup>, Hurricane Michael slammed ashore, devastating a portion of the Florida panhandle just south of Panama City. The storm made a direct hit on the section coast from Tyndall Air Force Base (a wind gust to 129 mph was measured at the base) to Mexico Beach.

Michael was the “perfect storm” in that it began to intensify rapidly during the 24-36 hours prior to landfall and continued to deepen right up to the point of going ashore, the worst

case scenario. It hit the coast as a high end Category 4 storm with winds of 155mph (a Category 5 has winds stronger than 155mph).

At a place called Dog Island, which was actually east of where the eye of Michael went ashore by more than 50 miles, the severe storm surge worked to unearth ships that had washed ashore and were wrecked during the Carrabelle Hurricane of 1899. That storm at the time would be categorized as a Category 2 hurricane, but weather forecasting being what it was back in the day, caught the area largely unaware leading to the ship wrecks. The storm also destroyed all but 9 houses on the island, killing one woman who was crushed by a house.

See additional information and pictures at:

<https://www.tallahassee.com/story/news/2018/10/20/ships-wreck-dog-island-1899-unearthed-hurricane-michael/1697720002/>

Strongest US Landfalling Hurricanes by Pressure				
Storm	Year	Landfall Pressure (millibars)	Top Winds (mph)	Landfall
Labor Day	1935	892	185	Florida Keys
Camille	1969	900	175	Mississippi
Michael	2018	919	155	Florida Panhandle
Katrina	2005	920	125	Louisiana
Andrew	1992	922	165	South Florida

## A Look at Near Earth Objects, Meteorite Hunting, and Meteor Showers for the late fall through spring season

By Barry Lambert - Lead Meteorologist

### Happy 20<sup>th</sup> Anniversary to NASA's Center for Near Earth Object Studies!

The first great accomplishment of the Center for NEO Studies was to put the world's mind at ease, that the newly discovered one-half mile wide, Asteroid 1997 XF11 had no chance of striking earth. This came after news spread rapidly via a message from the Minor Planet Center in Cambridge, Massachusetts that there was a chance that the object could strike Earth with widespread devastation in 2028. Many media outlets painted true doom and gloom for Earth.

Thankfully, Don Yeomans (who was the leader of the Solar System Dynamics group at NASA's Jet Propulsion Laboratory in Pasadena, California at the time), along with colleague Paul Chodas, provided great relief and emphatically stated, "The 2028 impact was basically impossible." Chodas is currently the director of NASA's Center for Near-Earth Object Studies (CNEOS), located at JPL. Read more of the details on this important scientific research center here -

<https://www.jpl.nasa.gov/news/news.php?feature=7194>

We often plan to view these celestial events late on a clear spring or summer night (perhaps a crisp autumn or winter evening). Meteorites may be much more valuable on the ground rather than in the sky. There are a certain

group of individuals with a great passion for hunting these space rocks, and they can make quite a decent profit doing so. Meteorite collectors and sellers use metric units of grams and kilograms to calculate their weight and value. This Geology.com article describes the various facets of meteorite collecting along with buying and selling these gems from outer space.

<https://geology.com/meteorites/value-of-meteorites.shtml>

Here is a listing of the major meteor showers over the next 9 months or so (and a detailed description of each in the following link) -

<https://www.amsmeteors.org/meteor-showers/meteor-shower-calendar/>

1. **Orionids** - Active from September 23rd to November 27th , 2018; *Peak night Oct 21-22 2018*
2. **Southern Taurids** - Active from September 23rd to November 19th , 2018; *Peak night Oct 28-29 2018*
3. **Northern Taurids** - Active from October 19th to December 10th , 2018; *Peak night Nov 10-11 2018*
4. **Leonids** - Active from November 5th to November 30th , 2018; *Peak night Nov 17-18 2018*
5. **Geminids** - Active from December 4th to December 16th

- , 2018; *Peak night Dec 13-14 2018*
6. **Ursids** - Active from December 17th to December 23rd , 2018; *Peak night Dec 21-22 2018*
  7. **Quadrantids** - Active from January 1st to January 10th , 2019; *Peak night Jan 3-4 2019*
  8. **Lyrids** - Active from April 16th to April 25th , 2019; *Peak night Apr 21-22 2019*
  9. **Eta Aquariids** - Active from April 19th to May 26th , 2019; *Peak night May 6-7 2019*
  10. **Southern Delta Aquariids** - Active from July 21st to August 23rd , 2019; *Peak night Jul 29-30 2019*
  11. **Alpha Capricornids** - Active from July 11th to August 10th , 2019; *Peak night Jul 26-27 2019*
  12. **Perseids** - Active from July 13th to August 26th , 2019; *Peak night Aug 11-12 2019*

The following Table from NASA’s Jet Propulsion Laboratory – Center for Near Earth Object (NEO) Studies shows a list of all close approaches to Earth by near-Earth objects over the upcoming year.

<https://cneos.jpl.nasa.gov/ca/>

NEO “2015 EG” (measuring between 19-43 Meters in Diameter) has the closest approach at a nominal or most likely Lunar Distance of 1.16 on March 4, 2019 around 4 pm EST (give or take about 45 minutes). The following link shows detailed orbit of this NEO.

<https://ssd.jpl.nasa.gov/sbdb.cgi?sstr=2015%20EG;old=0;orb=1;cov=0;log=0;cad=0#orb>

A short but interesting video describing the much closer passage of a similar-sized space rock is here -

<https://video.nationalgeographic.com/video/news/predicting-meteorite-impacts-vin>

Here are some videos pertaining to the very close passage of the large, nearly quarter-mile wide asteroid Apophis (Discovered on June 19, 2004) that orbits around the sun and will visit nearby our orbit several times over the next 50 years (the first two visits coming in 2029 and 2036, both on April 13th). The initial passage in the spring of 2029 will come very close (only 19,400 miles) and within the orbits of our Geostationary Satellites. Initially, there was somewhat dire news that there was a 1 in 37 chance (2.7%) chance of striking Earth. Calculations via radar observations soon after indicated that there was virtually no chance of this large asteroid hitting Earth. Its second passage will be 14 million miles away. So, it appears we are safe (at least from this monstrous rock) until 2068.

<https://www.youtube.com/watch?v=LmVpx8P4GHM>

<https://www.youtube.com/watch?v=BskYeb1Uhbo>

[https://www.youtube.com/watch?v=f\\_ZuERImMEU](https://www.youtube.com/watch?v=f_ZuERImMEU)

For completeness, here is a video created in May of 2018 describing the Top 5 threats from NEOs over the next few centuries –

<https://www.youtube.com/watch?v=mYygBT6bi1M>