SKYWARNEWS

NATIONAL WEATHER SERVICE STATE COLLEGE, PA

SPRING 2017

"WORKING TOGETHER TO SAVE LIVES"

Winter in Review

John La Corte - Lead Meteorologist

For the second consecutive year, winter was pretty wimpy and almost universally snow-starved in Central Pennsylvania. If anyone is complaining, it might be skiers or snowmobilers, but paying the heating bill has definitely been a lot easier on the pocketbook than it could be. Figure 1 shows a lot of red and orange "warm" colors depicting how much warmer than normal the regional temperatures were over the traditional winter months of December through February. Table 1 quantifies this further showing that the winter ranked in the top 10 warmest in several locations. A number of places broke the top 5.

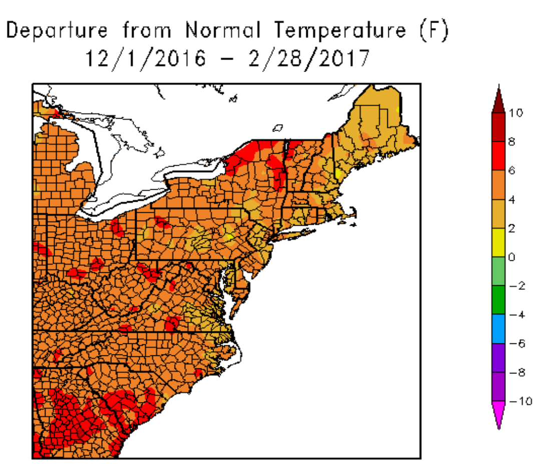


Figure 1. Temperature Departures Dec - Feb

Location	Winter 2016-17	Rank	Warmest
Harrisburg	37.7	4th	40.2 - 1932-32
Williamsport	34.0	3rd	37.0 - 1931-32
Altoona	35.1	3rd	35.9 - 1997-98
Bradford	29.4	3rd	30.9 - 2001-02
Lewistown	34.9	6th	37.0 - 2001-02
Ridgway	31.8	4th	33.7 - 1931-32
State College	33.6	6th	36.4 - 1932-32
Warren	31.4	9th	36.2 - 1931-32
Wellsboro	29.0	7th	33.3 - 1931-32
York (Pump Station)	37.9	6th	39.6 - 2001-02

Table 1. Temp Departures and Rank

Precipitation includes both rain and snow (melted down) and ended up being about 50-50, with most of eastern Pennsylvania being drier than normal, and the opposite being true in the west, with a large portion of the area being much wetter than normal. Figure 2 (page 2) shows this west to east flip flop, a signal that coastal storms were relatively scarce. It should be noted that the biggest snow storm of the year occurred in the second week of March, technically outside of what we refer to as meteorological winter. The Dec-Feb timeframe is chosen for the convenience of record keeping since the actual dates the seasons start varies from year to year.

Snowfall followed suit with the below normal precipitation totals. Figure 3 shows

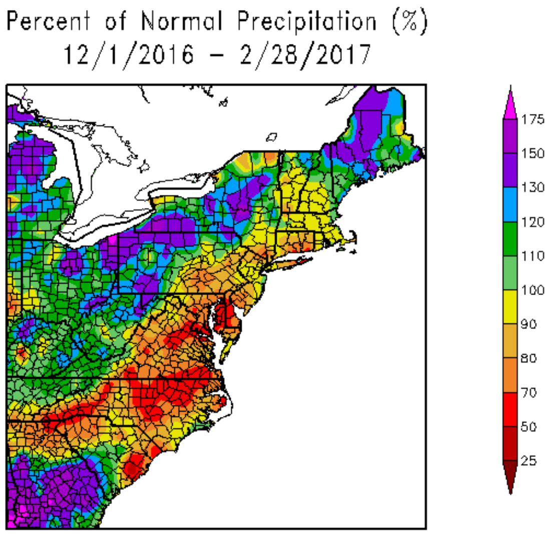


Figure 2. Precipitation Departures Dec - Feb

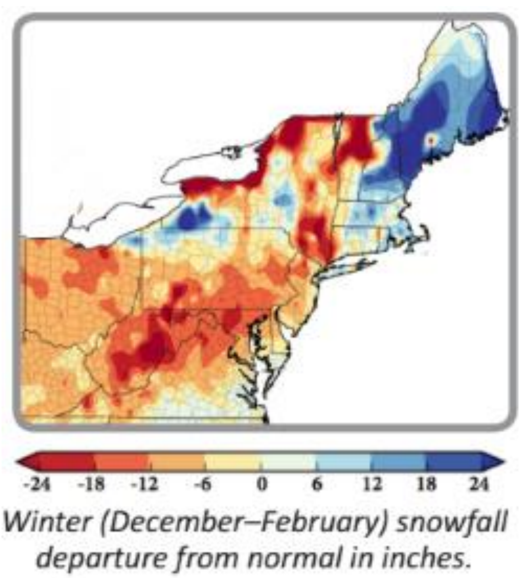


Figure 3. Snowfall Departures Dec - Feb

that with the exception of the areas near Lake Erie, snowfall was below to much below normal. It was the opposite of last winter when the coastal plain saw more snow than normal while most of the rest of northern and western Pennsylvania experienced a relatively snowless winter.

At this point we generally like to see how our seasonal forecast did from last fall. Figure 4 is a side by side comparison of the temperature forecast and what ended up happening. About the most charitable way to look at the old forecast might be to say that much of the area that ended up warmer than normal was encompassed by what the Climate Prediction Center (CPC) deemed to be an area of "Equal Chances", which means there was no clear signal in the forecast guidance indicating whether it would be warmer, colder or near normal. In this case the entirety of the eastern United States ended up warmer than normal.

To get an idea of just how warm it was over a larger area, Figure 5 (page 3) ranks the seasons using state-wide averages. Out of the 122 year history being considered, the states from Maine down into the Ohio Valley all the way to New Mexico were at least among the top 5 warmest.

Figure 6 shows the rankings for precipitation which were among the wettest in history over a wide swath from

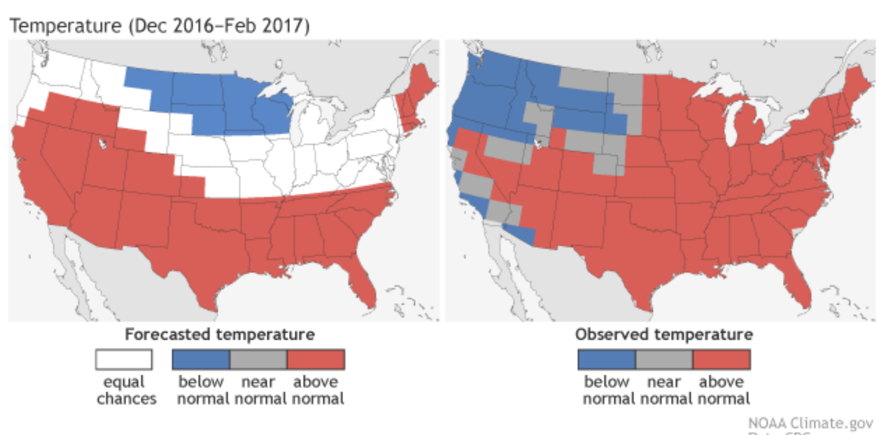


Figure 4. Temperature Forecast/Verification

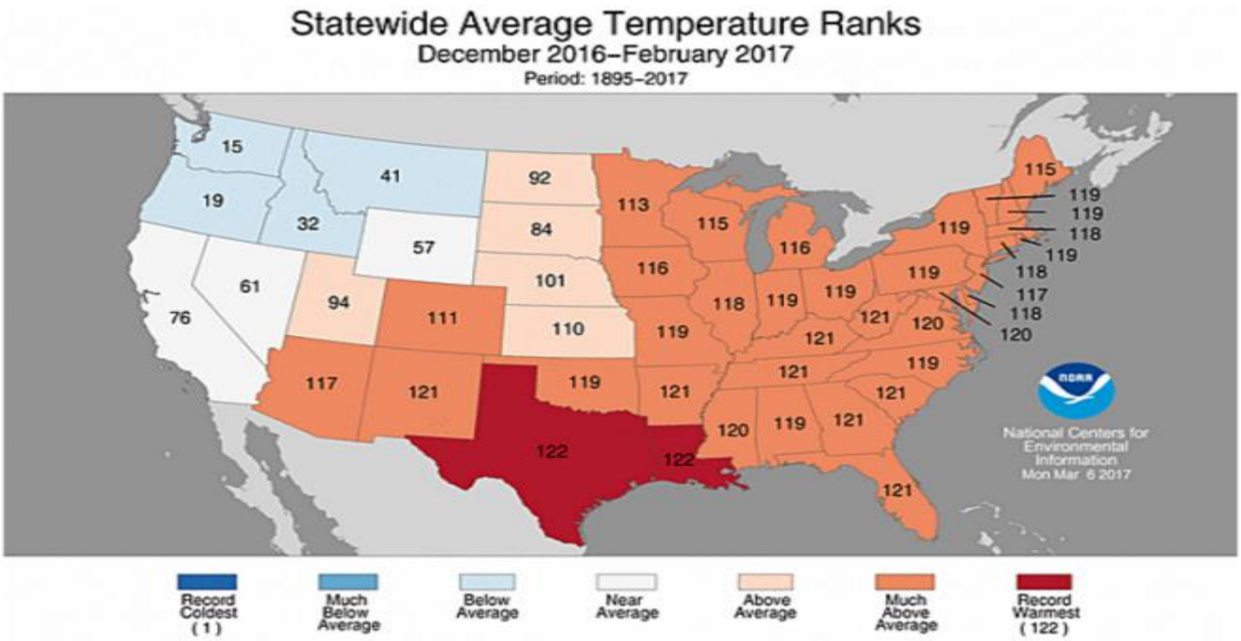


Figure 5. Temp Departure Rankings

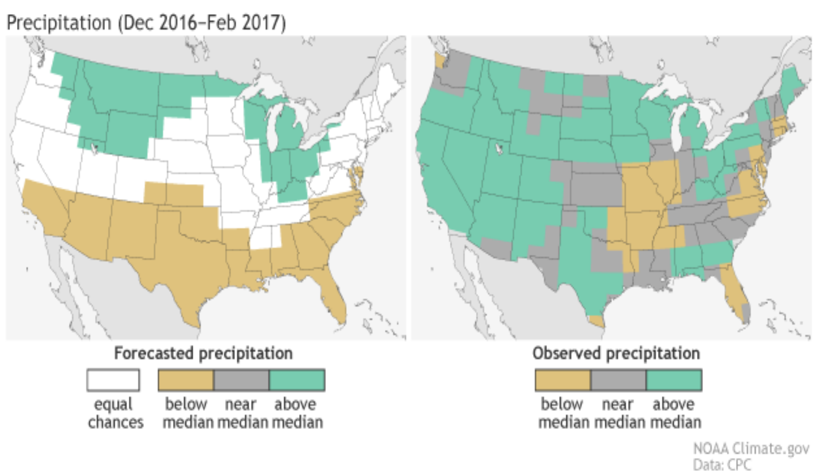


Figure 6. Precipitation Forecast/Verification

California up into the Great Lakes. It was less noteworthy elsewhere.

So what might the upcoming summer have in store for Pennsylvania? You might recall last year was very hot and dry, and this time around the CPC forecast shows a 60% chance or greater for us to have another warmer than normal summer (Figure 7). The rainfall outlook is less certain with most of the area under the "Equal Chances" outlook (not shown). Let's hope we aren't as dry as last year when much of the region ended up experiencing drought conditions.

Until then, see you in the fall.

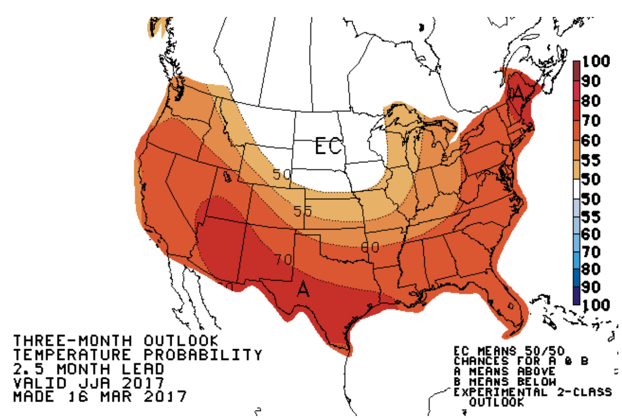


Figure 7. Summer Temperature Outlook

Comparing the Summer of 2016 to 1936

David Martin – General Meteorologist

We have seen in recent years some long periods of warm and dry weather. One such period occurred last summer. Late February and March 2016 were on the warm and dry side, with some record high temperatures. This was followed by a cold April, with even some snow across southeastern Pennsylvania early in April. By May temperatures had returned closer to normal and the near normal temperatures lingered into the first week in June.

The rest of June 2016 into early August was especially warm and dry. Temperatures averaged well above normal for the summer, upwards of 4 to 6 degrees more than seasonal norms. July 2016 was among the top 10 warmest for both Harrisburg and Williamsport with August ending up being the warmest on record at both sites. These warmer than normal conditions continued into the fall through the first part of November. A strong cold front on Saturday, November 19th resulted in the first extended period of cooler than normal weather we had seen in quite some time.

How Did 2016 Compare to 1936?

The heat wave that occurred in the summer of 1936 followed one of the coldest winters on record. This heat wave came on the heels of the warm and dry dustbowl years that lasted into the mid1930s. While extreme heat occurred during the 1936 heat wave, humidity levels in most areas were not especially high. Memorable heatwaves here in the eastern US are often accompanied by high dewpoints and oppressive humidity, such as in July 1995.

The mean temperature for summer (June-August) of 1936 for the lower 48 states was 74.6 degrees. This was the warmest summer on record since 1895. July of that year averaged 77.4 degrees. July 2016 was similarly hot, but missed the record by just 0.1 degrees. Overall the summer of 2016 was the 2nd warmest summer, with a mean temperature of 74.4 degrees.

What made the summer of 1936 one for the record books was the number of all-time record high temperatures that were set in many states.

The heat started across the western Great Plains and the Rocky Mountains in June, along with another area of extreme heat across the southeast states that month. Monthly records for all time high temperatures were set in many states. Eight of these records still stand.

July 1936 saw the area of heat shift more into the Northern and Central Great Plains. The heat wave locked into this area and remained all month. The heat expanded eastward to New York and Virginia the second week of July. This expanding area of high temperatures saw many all-time records set for the month of July. The state record for Pennsylvania was set on July 10 in Phoenixville, in Chester County, reaching

111 degrees. Even Erie PA was extremely warm with overnight lows only in the mid-80s. Corry Pennsylvania reached 110 degrees on the 14th of July.

Keeping in mind that air conditioning was still considered somewhat of a luxury back then, the very warm overnight temperatures only exacerbated the heatwave conditions. Many people slept outside or used blocks of ice and fans to gain some relief. During the height of the heat, Lincoln Nebraska managed to only drop to 91 for a low temperature on July 25th. Outside of the desert southwest, this is the highest minimum temperature on record for the 48 contiguous states.

The heat shifted southward to the Southern Plains in the month of August. Many all-time records were set that month and still remain. Oklahoma City set a record of 113 degrees on 8/11, Wichita 114 degrees on 8/12, and Kansas City 113 degrees on 8/14.

The summer of 1936 remains the benchmark season against which all heatwaves continue to be measured. While in any given year some individual records are broken, many of the records of that memorable year still stand.

The seasonal outlook for 2017 referenced in the previous article calls for a good chance that the upcoming summer will be another hot one. But to measure up to 1936, it's going to have to really cook!

Monarch Butterfly Update

David Martin – General Meteorologist

Over the last 2 years, I wrote articles on Monarch butterflies. The information gave ideas how we could aid in protecting and promoting the butterfly population.

While the population has been a little more stable over the last year or two, the current population is only around 20 percent of the historical average.

It is estimated that in 2016 that 1.6 million butterflies died. Widespread deforestation lowered the temperatures in the butterfly's winter habitat (largely Mexico and the west coast), resulting in more than half of the butterfly population to freeze to death.

If you wish to help, consult with your local agricultural centers or greenhouses and consider planting Monarch friendly flowers and shrubs.

Hydrology Update

Charles Ross – Service Hydrologist

We know it's always flood season in Pennsylvania year round. But the spring and summer seasons are usually the busiest times for flooding, with the best chances of heavy rainfall and potential flooding from convective and tropical weather systems.

It's always a good idea to review flood safety rules, which you can find here:

http://www.nws.noaa.gov/os/water/tadd/

You can monitor our river gages at
http://water.weather.gov

MMEFS:

Recently the NWS has begun producing uncertainly (probability) forecasts for many of our River Forecast Points (Figure 1). Meteorological Model-based Ensemble River Forecast (MMEFS) provides a range of river forecast possibilities based on temperature and precipitation output from the NOAA meteorological models.

The purpose of the ensemble river forecast is to provide users with a short-term situational awareness by providing the probabilistic exceedance information relative to the NWS flood categories and providing the ensemble river forecasts that in turn show a range of outcomes. Keep in mind that these forecasts are for guidance use and are not meant to replace the official rivers forecasts produced by the Middle Atlantic and Ohio River Forecast Centers. They can be quite useful for seeing what the range of possibilities, as well as the uncertainly in a forecast.

You can access the data in the following locations:

https://www.weather.gov/ctp/MMEFS (This page shows current forecasts for Central PA)

http://www.weather.gov/erh/mmefs (This page shows forecasts for the eastern US)

If you have any questions on this or anything hydrology related, feel free to email me at charles.ross@noaa.gov.

Have a great spring and summer!

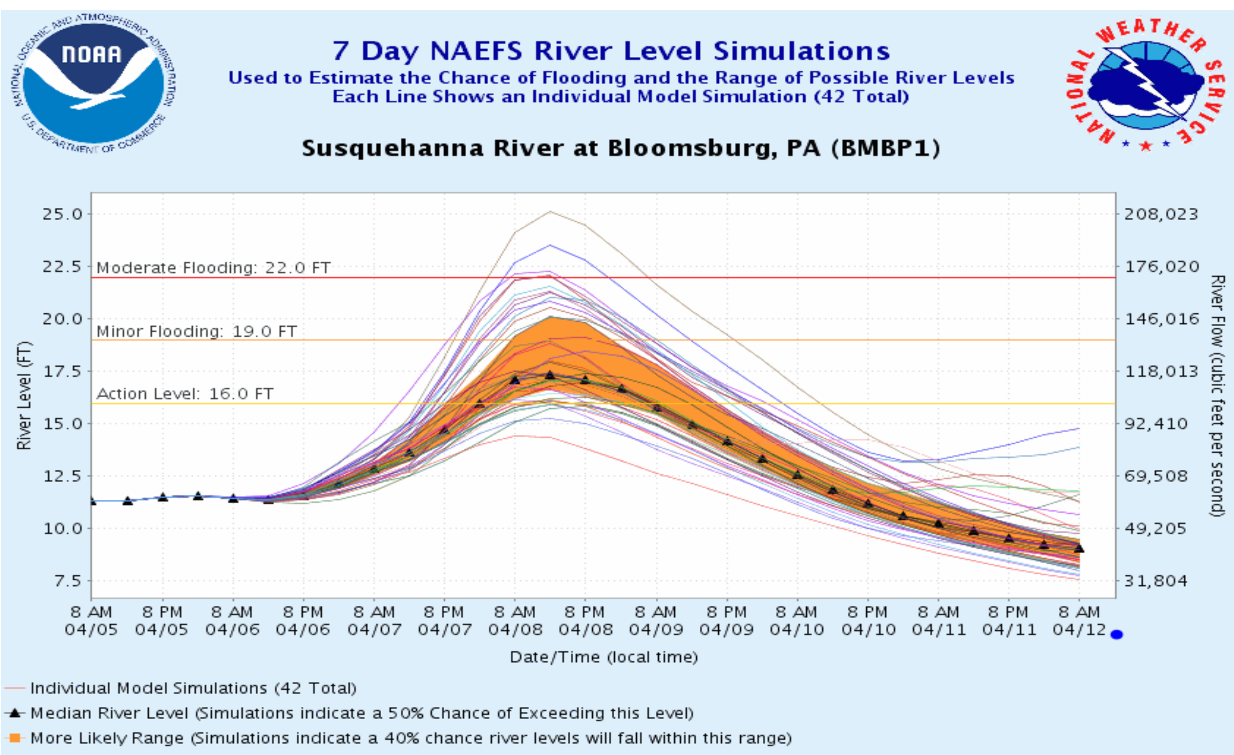


Figure 1. MMEFS Output for Bloomsburg

Research shows ocean acidification is spreading rapidly in the Arctic

Monica Allen – NOAA

Ocean acidification is spreading rapidly in the western Arctic Ocean in both area and depth, potentially affecting shellfish, other marine species in the food web, and communities that depend on these resources, according to new research published in *Nature Climate Change* by NOAA, Chinese marine scientists and other partners.

The new research shows that between the 1990s and 2010, acidified waters expanded northward approximately 300 nautical miles from the Chukchi Sea slope off the coast of northwestern Alaska to just below the North Pole. Also, the depth of acidified waters increased from approximately 325 feet below the surface to more than 800 feet.

Ocean acidification is occurring because the ocean is absorbing carbon dioxide from the atmosphere. When seawater absorbs carbon dioxide, its acidity is increased, which decreases the building blocks used by shellfish to grow their shells.

"Acidification has implications for marine life, particularly clams, mussels and tiny sea snails that may have difficulty building or maintaining their shells in increasingly acidified waters," said Richard Feely, NOAA senior scientist and a co-author of the research.

Sea snails called pteropods are part of the Arctic food web and important to the diet of salmon and herring. Their decline could affect the larger marine ecosystem, he said, and communities that depend on these popular food fish.

"The Arctic Ocean is the first ocean where we see such a rapid and large-scale increase in acidification, at least twice as fast as that observed in the Pacific or Atlantic oceans," said Wei-Jun Cai, a study co-author based at the University of Delaware.

Pacific winter water is changing Arctic chemistry

Analysis of Arctic Ocean data and model simulations showed that increased flow of water from the Pacific into the Arctic during winter, called Pacific winter water, driven by circulation patterns and retreating sea ice in the summer, is primarily responsible for the expansion of ocean acidification in the Arctic, according to Di Qi, the paper's lead author.

In recent years, melting sea ice has allowed more Pacific water to flow into the Arctic Ocean and build up there. Pacific Ocean water is already high in carbon dioxide. As the ocean mass moves, it absorbs additional carbon dioxide from decomposing organic matter in the water and sediments, increasing the water's overall acidity.

The melting and retreating of Arctic sea ice in the summer months has allowed Pacific winter water to move further north.

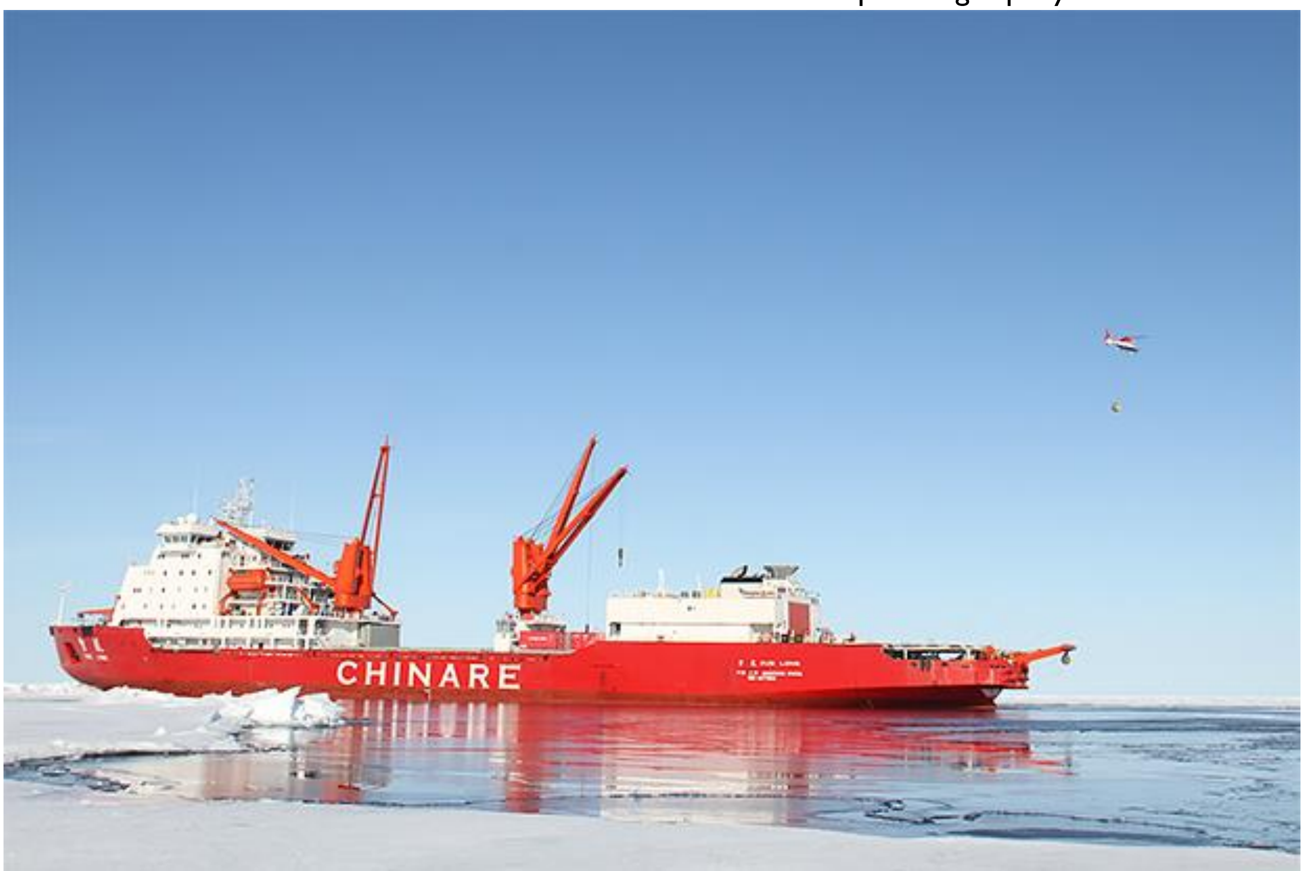
"The melting sea ice is like a pond floating on the Arctic Ocean," said Cai. "It's a thin water mass that exchanges carbon dioxide rapidly with the atmosphere above, causing carbon dioxide and acidity to increase in the meltwater on top of the seawater. When the ice forms in winter, acidified waters below the ice become dense and sink down into the water column, spreading into deeper waters."

References

Roberts, K.B. (2017, February 27). Ocean acidification. University of Delaware. Accessed March 29, 2017.

Qi, D., Chen, L., Chen, B., Gao, A., Zhong, W., Feely, R.A., Anderson, L.G., Sun, H., Chen, J., Chen, M., Zhan, L., Zhang, Y., Cai, W.-J. 2017. Increase in acidifying water in the western Arctic Ocean. *Nature Climate Change*, 7, 195–199.

https://www.climate.gov/news-features/features/research-shows-ocean-acidification-spreading-rapidly-arctic



An international team of scientists aboard China's icebreaker Xuelong conducted extensive sampling of Arctic Ocean waters to study changes in ocean acidification during expeditions in 2008 and 2010. Credit: Di Qi, Third Institute of Oceanography, State Oceanic Administration of China

A superbloom of wildflowers overtakes California's southeastern deserts in March 2017

Rebecca Lindsey - NOAA

After five years of exceptional drought, desert landscapes across southern California exploded with "superblooms" of wildflowers this March following ample winter precipitation. According to local news reports, it's the most spectacular display some locations have seen in more than two decades.

Patient plants

Wrapped up snugly in a thick, waxy coat, the seeds of desert wildflowers may lie dormant on the seemingly barren ground for years. Washed and softened by unusually heavy or frequent fall and winter rains, the waiting seeds finally crack open and push their roots into the rocky soil. Provided that spring brings sunshine, warmth, and only gentle winds, the plants will take advantage of the narrow window of favorable conditions to complete their life cycle.

WIldflowers blooming in Anza Borrego Desert Park on March 12, 2017. Photo by Kyle Magnuson, via Creative Commons license.

At least some desert wildflowers bloom in most years, but in "superbloom" years, they put on a spectacular show—a carpet of greenery and thousands of blooms stretching across acres and acres of the landscape. Like "leaf peepers" are drawn to New England in the autumn, visitors flock to desert parks to witness the phenomenon. Among the locations where seasonal climate conditions in winter 2016-17 were favorable for a spring superbloom is Anza-Borrego Desert State Park, in southeastern California.

A desert lily blooming in Anza Borrego Desert Park on March 4, 2014. Original photo by Flickr user Rob Bertholf. A color correction has been applied. Used under the terms of a CC license.

After five years of drought, a wet winter

South of Palm Springs, the park is in California's Climate Division 7, the Southeast Desert Basins, where the average winter precipitation is just shy of 3 inches (less than half of Los Angeles' normal winter precipitation of 7 inches). While the 2016-17 winter precipitation in the division was not record-shattering, it was more than twice the normal amount, and perhaps importantly, it followed the worst extended dry spell in the division's historical record.

Since 1896, the division has only experienced two other periods where precipitation during the winter wet season was below average for five years or more in a row: the five winters from 1952-53 through 1956-57, and the six winters from 1985-86 through 1990-91. While those periods might seem equal to the one that just ended, when we place these dry spells into an annual context, it becomes clear that the dry spell that began in the winter of 2011-12 was exceptional.

During the other long-running dry spells, rainfall outside of the winter months brought the annual total near or even above average in at least one year. The six consecutively dry winters of the late 1980s and early 1990s don't even show up as an extended dry spell in the annual tallies. By comparison, the drought that started in 2011 brought six relentlessly dry and extremely hot years (four of the five hottest years on record for Southeast California occurred during the recent dry spell).

The 6.11 inches of precipitation that fell across California's Southeast Desert Basins during the winter of 2016-17 was more than 200% of the division's normal 2.97 inches. In addition, the Anza-Borrego desert basin received a "bonus" soaking rain event in early fall: a station in the park recorded just over 0.5 inches of rain on September 20. The rainfall may not have been record-breaking, but the patient seeds of the desert basins' wildflowers had been waiting for that moisture for an unusually long time. As the warm, sunny days of March unfolded, the well-watered desert exploded in spectacular bloom.

https://www.climate.gov/news-features/event-tracker/march-2017-climate-conditions-finally-right-superbloom-desert

Desert sunflowers (orange-yellow), dune evening primroses (white), and desert sand verbenas (purple) blooming in Anza Borrego Desert Park on March 14, 2017. Photo by Flickr user Kevin. Used under the terms of a CC license.

SkyWarn Spotter Corner

Pete Jung – Warning Coordination Meteorologist

Greetings SkyWarn Spotters...and welcome to Spring 2017! NWS State College would like to thank you for all your reports...including your winter snowfall observations, as well as flooding and severe weather reports. As you probably know, SkyWarn Spotters make up the backbone of our ground truth verification, and your reports are very valuable to us.

<u>You can do us a favor</u> by letting us know if any of your contact information has recently changed, including a change of address, change of email address, or a new phone number. If you think this applies to you, send a quick email with an update of your information to:

william.gartner@noaa.gov.

For your convenience, a new reporting web-interface has been developed. The link is:

http://www.srh.noaa.gov/StormReport_new/SubmitReport.php?site=ctp.

Even though this interface is available to the general public, you can identify yourself as a NWS Storm Spotter and supply your spotter number when you submit a report. This is important, since it helps us identify you as a trained spotter! This is good method for reporting "routine" weather, but for fast-breaking severe reports, a phone call is still preferred.

To review some reporting guidelines for the Spring and Summer:

- Tornadoes, Funnel Clouds and Wall Clouds
  - Remember to look for rotation, and not to be fooled by ragged low clouds that are not severe
- Hail of any size
  - Remember that 1" hail (about the size of a quarter) is our threshold for severe.
- Winds gusting to 40 mph or greater.
  - Generally, it takes winds approaching 60 mph to knock down trees and begin to cause structural damage to homes and buildings.
- Rainfall and Flooding events
  - Heavy rainfall rates of 1" or more in an hour
  - Rainfall totals for an event, especially if it's over an inch
  - Any observed flooding
    - If reporting flooding, help us out by giving us your opinion on what the cause of the flooding is (i.e. clogged storm drains, creeks out of their banks, water ponding in underpasses, etc.)

In general, don't hesitate giving us a call, especially if you think something significant or unusual is going on!

Thanks....and be safe this summer!

SKYWARN