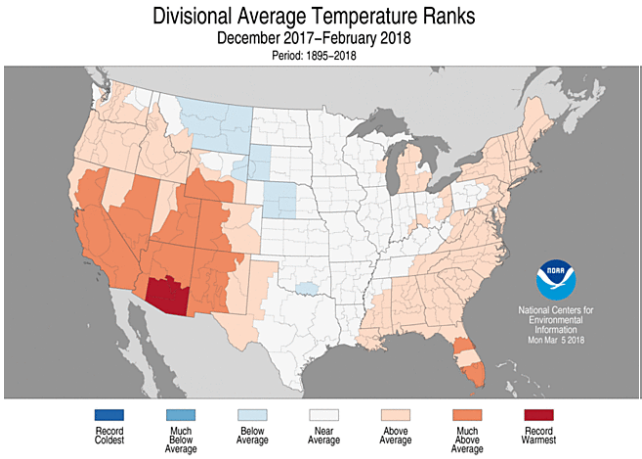
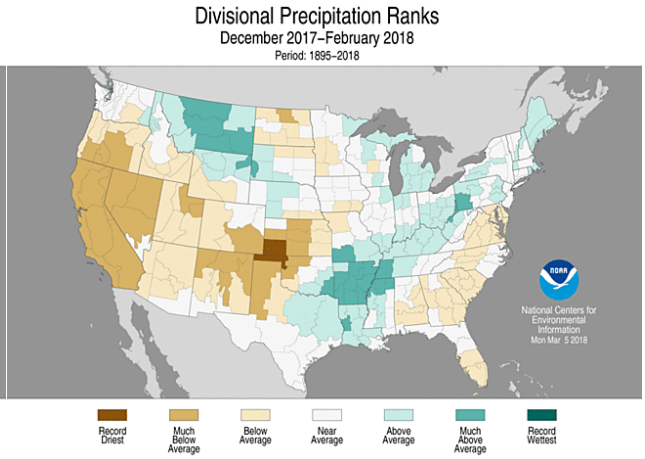
EARLY WINTER 2018-19 LOOKING INTERESTING FOR MIDWEST AND SOUTHERN TIER AS COOL TEMPERATURES COLLIDE WITH SUBTROPICAL MOISTURE TAP…

Outlook Overview

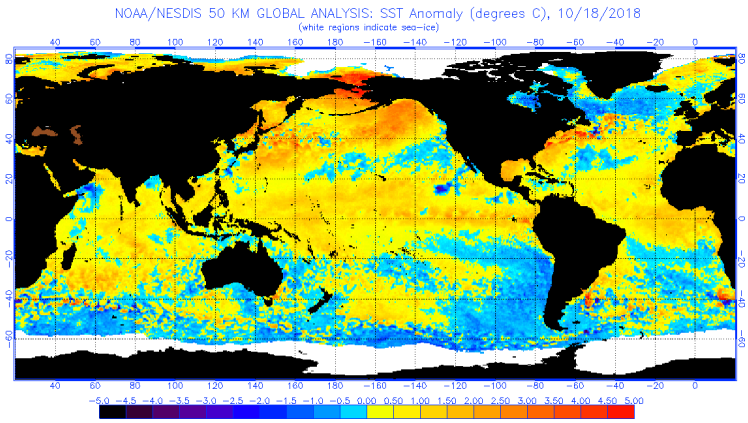
- **A weak El Nino is developing in the central Pacific. Unusually, this event will be based relatively far west, and is likely to peak by January as a weak ENSO event. There are unusually few analog years arising from this ENSO trajectory and matches to other key forecast inputs.**
- **A weak, central Pacific El Nino, a low point on the solar cycle, and a favorable Pacific mid-latitudes set-up mean relatively elevated chances of above normal precip for the southern tier, mid-Atlantic, and Ohio Valley between November and January, along with a drier tilt in the Northern Plains. Expect normal to somewhat below normal temperatures centered over the Plains and across the southern tier.**

Snow and Ice Outlook for Central and Eastern U.S.

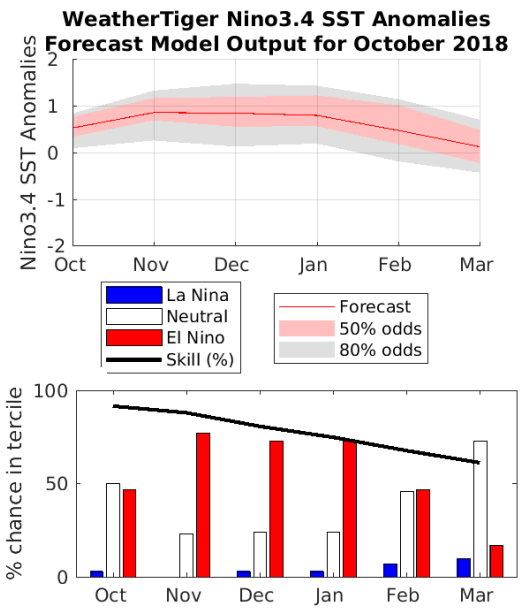


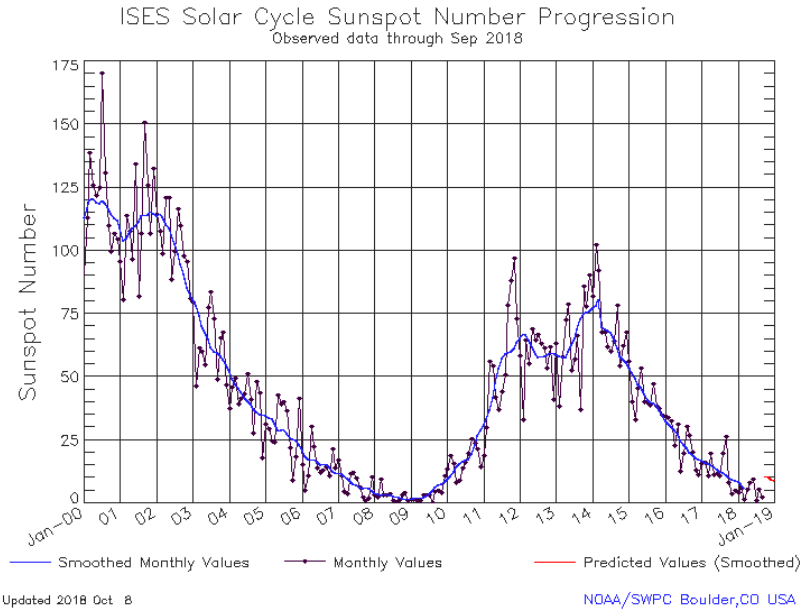


The winters of the 2010s have been marked by wild swings between extremes of temperature and precipitation, but they have generally failed to bring much snow to the interior U.S. even as the East Coast has seen some memorable storms. In 2015-16 a major El Nino event brought extreme warmth to the East, punctuated by several very powerful winter storms; two years ago, a La Nina winter was again very warm in the east, and wasted most precip as rain in the Ohio Valley and Midwest. Last year, the Deep South, mid-Atlantic took a number of significant snow event hits, most notably from the "BOMB" cyclone in a frigid January, and a series of 4 Nor'easters late in the winter. The Plains and Midwest did not get in on the act until the very end of winter, March and April, with below normal accumulations prior to that (see above for DJF temp and precip anomaly maps).

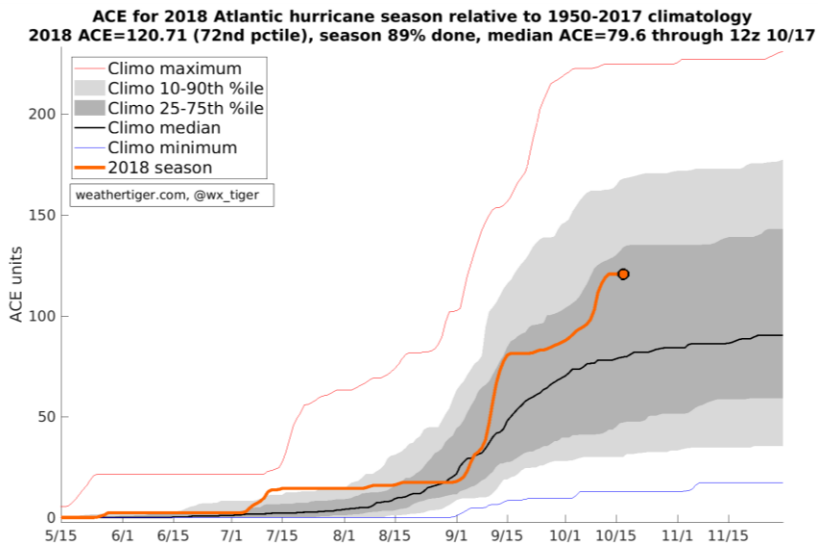


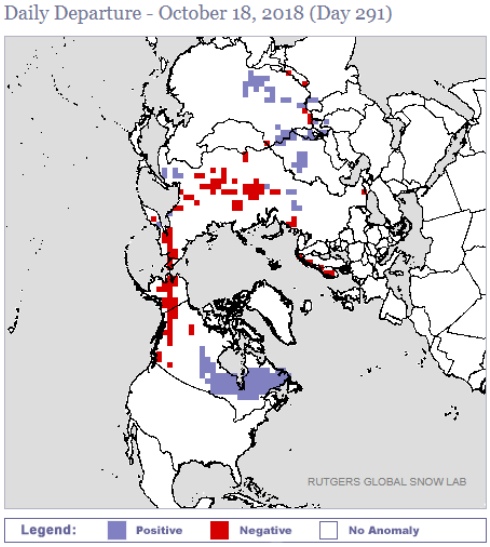
The natural question is whether this pattern of extremes will repeat again in 2018-19, especially on the heels of numerous disappointing winters in a row across the U.S. Midwest and Southern Plains. WeatherTiger's first step towards constructing a qualitative seasonal forecast is to identify cases in the historical record in which the primary driver of Northern Hemisphere winter weather patterns—the El Nino/Southern Oscillation, or ENSO— is a reasonable match for this year's expectations. In general, I believe seasonal forecasting is done best with a simple methodology with strong physical arguments, so this look ahead will only consider a few variables: Equatorial Pacific SST anomalies, Atlantic hurricane activity, solar activity, Northern Hemisphere snowpack, and mid-latitude forcing. This outlook will focus on temperature and precipitation anomalies in the central and eastern U.S. over the first half of winter, or November 2018 through January 2019.





In 2018, a long-forecast El Nino event is just now getting underway. The central Pacific is seeing +0.5 to +0.75C SST anomalies (at left, previous page). The uncertainty regarding the future evolution of this +ENSO event is starting to decline; most models, including WeatherTiger's proprietary "ENSO Whisperer" shown above left suggest a little more additional warming over the next couple months. Our model is a little quicker to peak this event in December and January and show a decline into the spring, and never gets El Nino past the roughly +0.7-0.8C anomaly mark. It should also be noted that our objectively derived analog set for the Pacific strongly favors a Central (rather than Eastern) Pacific-based ENSO event. This is a rarer flavor of ENSO, and often results in a west/north shift in the subtropical jet flow of moisture into the southern U.S. Note that the CFS model used to generate NOAA winter outlooks is continuing to demonstrate a characteristic warm bias in ENSO strength through the winter, resulting in NOAA's seasonal outlooks resembling a stronger, east-based ENSO temperature and precipitation anomaly map. The CFS is simply far, far too strong with this El Nino (as it has been for months) and it's messing up NOAA's winter forecast. Thus, the set of potential analog winters begins with years in which ENSO expectations for the upcoming winter are for a weak or moderate, central Pacific-based El Nino. This is relatively rare, with only 5-7 decent matches since 1950.



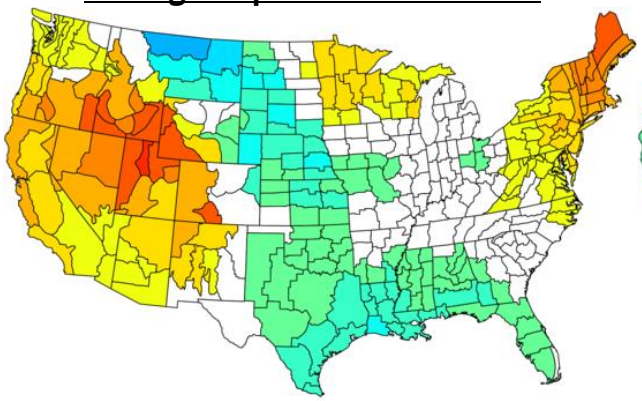


Another key consideration is the phase of the sun along the 11-year sunspot cycle. There is peer-reviewed evidence that quieter phases of the sunspot cycle are more favourable for colder and snowier winters, as solar output declines slightly and stratospheric warming (linked to surface cold) events are more common. As seen at right on the previous page, after poor solar conditions between 2013-16, sunspot activity has fallen rapidly over the past year and is currently negligible heading into 2020's cycle low. Another step is to eliminate years in which tropical cyclone activity is not aligned with the near normal (120% of average, though it felt like more than that) values observed in 2018 (left). As tropical cyclones balance energy flow from the Equator to the Poles, less busy than usual Atlantic hurricane seasons sometimes prefigure active winters. This year, we don't want to see extremely inactive or hyperactive years heavily weighted in the analog set.

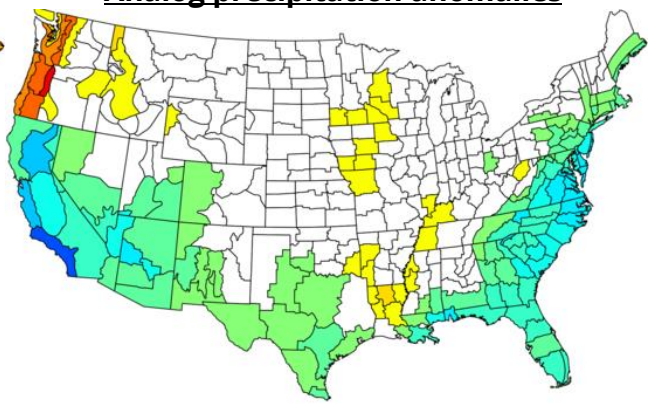
Additionally, above average Northern Hemisphere high-latitude snowpack in fall can sometimes more Arctic airmass outbreaks in the winter, though this relationship has weakened in recent decades. This year (right), Asian snowpack is below normal, but above normal following an early season snowstorm over much of central and eastern Canada (that also spread snow to the Plains). These stipulations prove to be too much for the already thin set of workable analogs; no year since 1950 satisfied the requirements of having a weak, CP El Nino, low solar activity, near normal hurricane activity, and above normal snowpack. Employing a two out of three ain't bad (or, 3 out of 4, more properly) filter to our set, the resulting recent analog year set spans six years: 1977-78, 1979-80, 1994-95, 2004-05, 2009-10, and 2014-15. These years match the general configuration of Pacific and Indian Ocean tropical SST anomalies to first order, and the other predictors to various degrees. Temperature and precipitation anomalies are shown top left and right, respectively, on the next page.

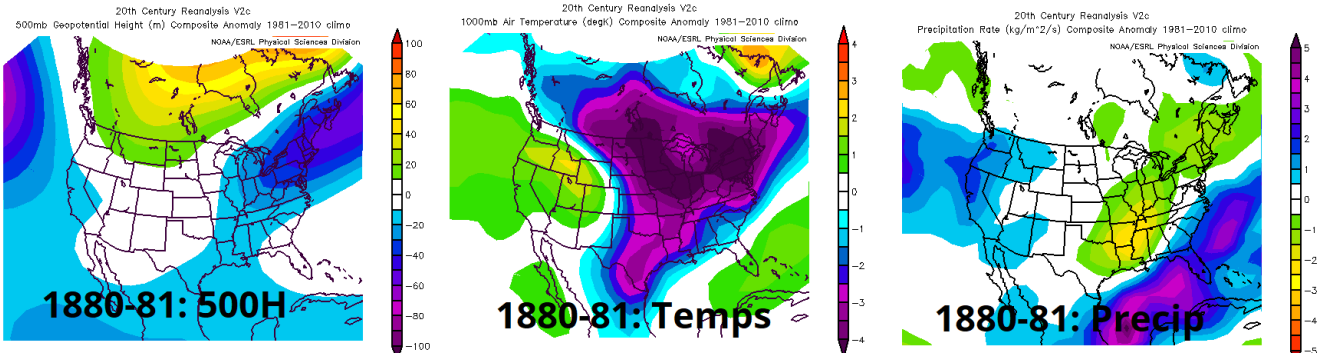
Expanding our search parameters back into the mists of early meteorological history, there is a possible good match on all fronts in the winter of 1880-81. In this year, there is evidence for a weak CP El Nino (though lingering into spring) during a low point of a solar cycle, following a slightly more active than normal hurricane season. This was a very cold, though slightly drier than average winter across the central and eastern U.S. In general, wet anomalies were rather farther south than they are expected to be this year, though overall the pattern similarities may otherwise be significant.

Analog temperature anomalies



Analog precipitation anomalies





Both the 20th and 19th Century analogs, as well as most dynamical models, suggest that a weak to moderate El Nino will keep the U.S. southern tier cool and wet, with a tendency for below normal temps across the interior and the CP-ENSO tendency for the storm track to range from the East Coast to the potential for Lakes cutters. There are a few unique caveats for 2018-19 that need to be discussed at this juncture. As shown on the SST anomaly map on page 1, note the massive gradient between abnormally warm and cold pools in the North Pacific Ocean, with a dominant warm "blob" taking up residence in the Gulf of Alaska. This warm pool over cold pool is linked to weaker zonal jet streams over the Pacific (the Pac jet was responsible for the very warm winter of 2016-17, flooding the U.S. with maritime airmasses), as well as increased tendency for high-latitude blocking. This means increased potential for U.S. cold outbreaks, as well as a trough being favoured over the central U.S. This is likely to allow for quite a bit of volatility in the central and eastern U.S. weather pattern this year. Winter is already off to a quick start in the central and eastern U.S.; late October through early November are looking cooler than average, and accumulating snowfall has already been noted from Kansas north to Wisconsin, with Kansas City seeing the earliest measurable snowfall on record since 1895 on October 14th. (It was only 0.2", but still.) Overall, winters that get off to a quick start do often set the tone for the remainder of the year, particularly in a case in which El Nino is likely to take three steps forward, two steps back for the next few months.

With these caveats in mind, WeatherTiger's estimated early winter 2018-19 temperature and snow/ice anomalies are given for major U.S. regions below:

Forecast Region	November-January Temp. Anomaly vs. Normal	November-January Precipitation as % of Normal
Mid-Atlantic (PA, NJ, MD, DE, WV, VA, NC)	Slightly below	Somewhat above
Deep South (LA, MS, AL, GA, SC, TN)	Somewhat below	Above
Ohio Valley (KY, OH, IN, IL, MI)	Slightly below	Near normal
Southern Plains (KS, OK, TX, MO, AR)	Near normal	Slightly above
Northern Plains (ND, SD, NE, IA, MN, WI)	Near normal	Slightly below

A general tendency for east-central U.S. troughing and an active subtropical jet periodically meandering north into the Midwest is likely to bring cooler than average temperatures to the central U.S. through the end of January. A forecast of "near normal conditions" across the mid-Atlantic is smuggling significant pattern variability; I think there will both be periods of well above and below average temperatures over the course of the winter in the eastern U.S. Likewise, the "near normal" in the Plains is hiding some geographic variance, with warmer temps likely west and cooler closer to the Great Lakes. This region, however, is likely to lie north of the favoured storm track, with a weaker Pac jet and a stronger southern branch. In the Ohio Valley, the mean trough position in NDJ being nearby may undercut moisture availability much of the time, but it is at least likely that storm potential periods will not be undercut as severely by temps too warm to support frozen precip as in recent winters based on the solar contribution and Pacific SSTs. The Deep South is likely to stay cool and wetter than normal, as typical of ENSO years, but as usual in El Ninos may struggle to see truly cold airmasses remain over the southern tier due to the subtropical jet influence. Finally, the Southern Plains are likely to pick up periodic storm threats due to the CP-shift of the subtropical jet (especially south). A wet and cool pattern is already off and rolling in the Southern Plains, especially eastern sections, and may return again in late November after a break in early/mid November.

One drawback to winter forecasting generally is that precipitation outlooks have been unable to break out what proportion of the precip is falling as snow vs. rain, a key distinction for many economic interests. For winter 2018-19, WeatherTiger is partnering with T&N, Inc. to produce real-time, objectively modelled seasonal guidance of the expected number of significant snow and ice events at the region- and state-level across the central and eastern U.S., updated each month; contact T&N for more information about this advanced predictive-analytical model output. Overall, winter 2018-19 is sending a number of intriguing signals at this early stage that it is likely to be a somewhat active one from a snow/ice perspective, particularly in the south central and eastern U.S.

Forecaster: Dr. Ryan Truchelut (ryan@weathertiger.com**)**