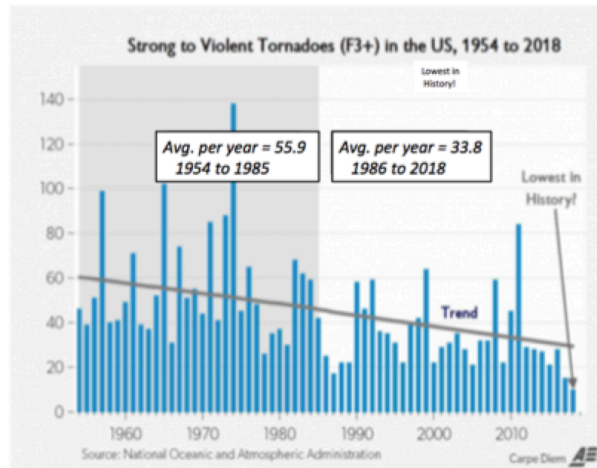


Rebutting claim: The 2019 active tornado season and spring flooding are caused by CO2 related warming

Background

Just like the hurricane impact spike in 2017 and 2018 after a record almost 12-year period without a landfalling major hurricane, tornadoes have bounced back big-time after 7 quiet years ending in 2018, the quietest in the entire record.



Although the claim being rebutted here is based on CO2 related global warming, this has been a cold winter and spring in much of the nation (except the southeast) that lingered through the entire spring.

In the cold air, snowpack has persisted in the west. Water and snowpack in the mountains of California ran 30% above normal for the Water Year (since October 1). This is true into the Rockies. The [Denver Post](#) on May 22 reported:

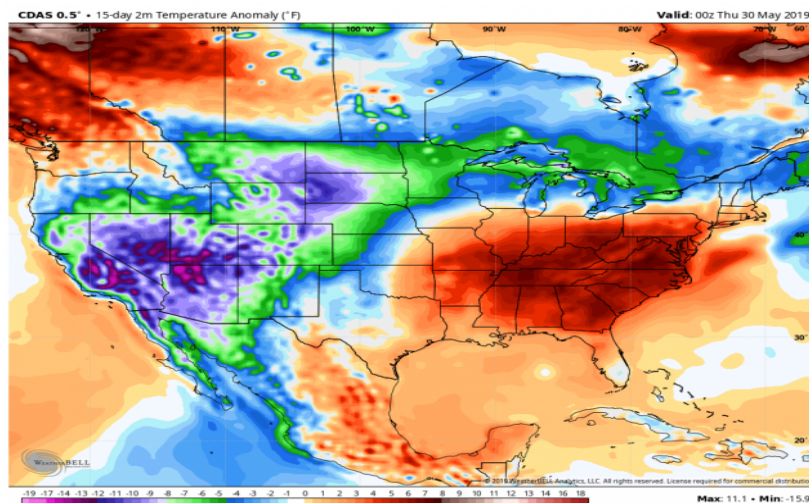
One year has made a massive difference in boosting Colorado's snowpack.

Statewide snowpack was at a remarkable 202 percent of its season-to-date average as of Tuesday, [according to official data from the National Resources Conservation Service \(NRCS\) website](#).

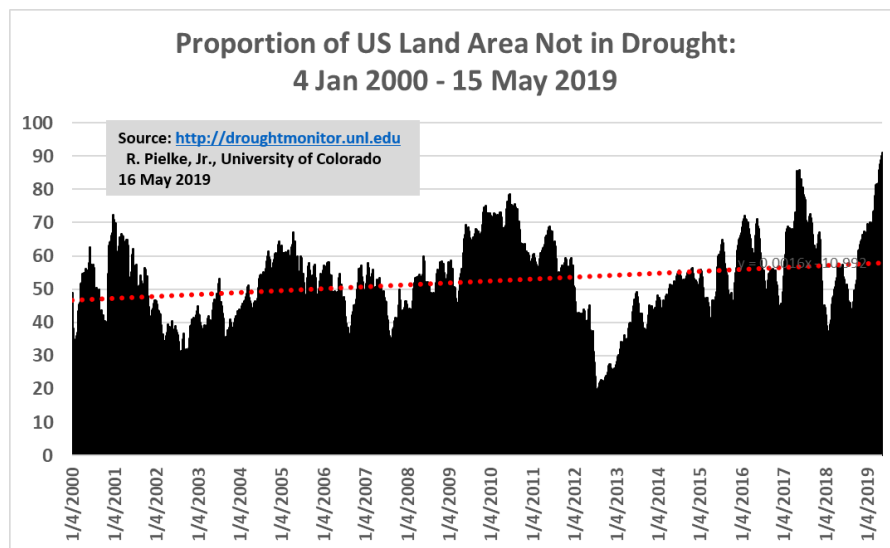
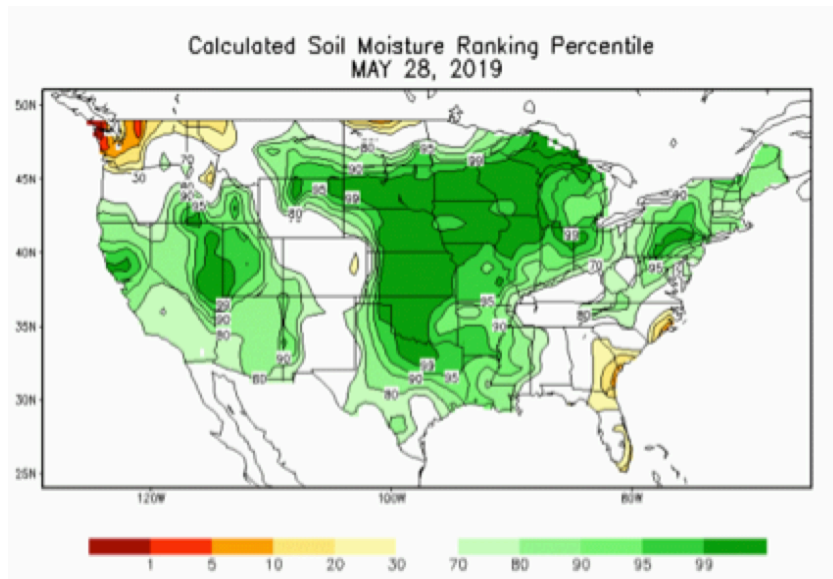
This year's snowpack is approximately five times larger than it was a year ago at this time. An NRCS estimate placed this year's Colorado snowpack at 519 percent of May 21, 2018 levels. Some parts of the state are running at more than three times their typical snow levels for the third week of May. In the San Juan Mountains, snowpack was at 302 percent of its season-to-date average. Here is a May 28 image from Silverton, Colorado.



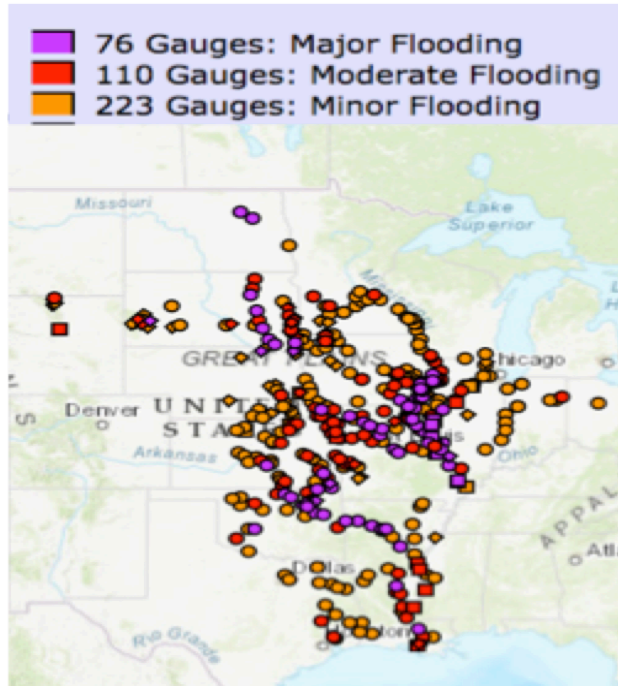
That deep and very cold for May western trough helped pump up a warm southeast ridge the last few weeks as shown below.



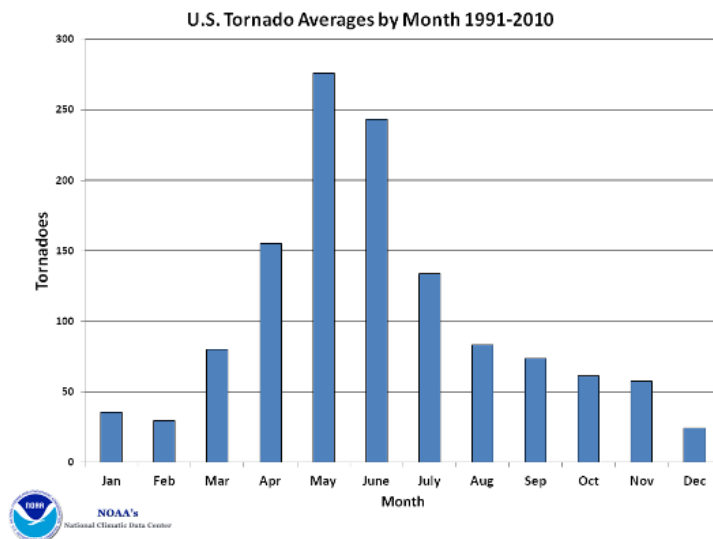
During the winter and spring the pattern was very wet for most of the nation but especially the central. The soil moisture is at the highest levels - above the 99% percentile in parts of the central and the areal coverage of drought is at the lowest level of the entire record.



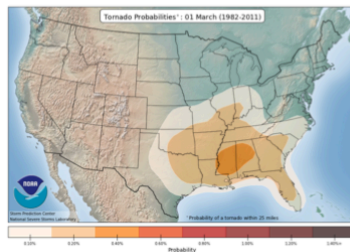
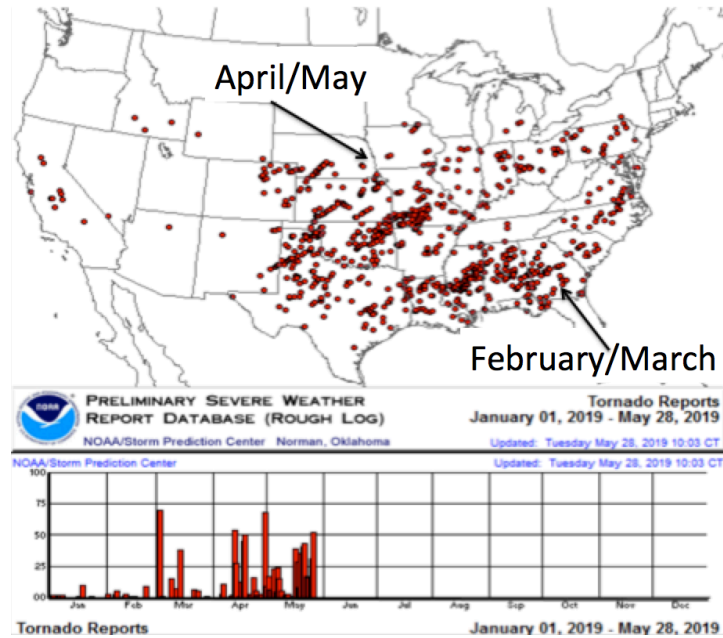
The late winter and spring rains, snowmelt and runoff from over frozen ground led to waves of extreme and in places record flooding.



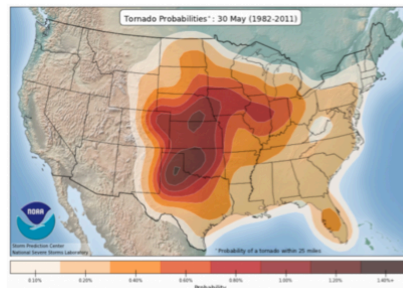
When heat energy built in the southeast ridge in Mid-May, the thunderstorms bringing heavy rains became increasingly severe, a phenomenon that meteorologists call the 'ring-of-fire'. 13 straight days of tornado outbreaks increased the tornado totals to well over 400 in May. The final tally will take months to reconcile as they remove duplication (often 15%). May is the climatological peak but June is a close second.



The early season was active, mainly in the Gulf States. Since April, action has moved north and west as climatology shows is normally the case.

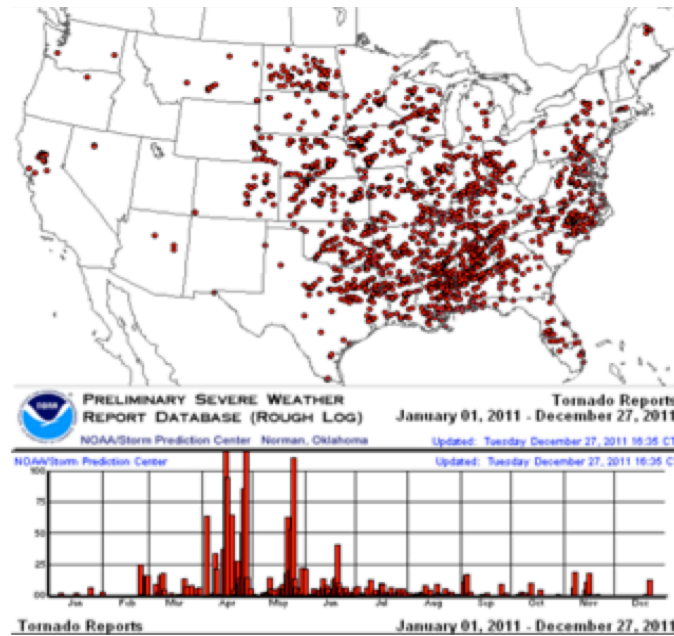


*Highest risk areas
In early March*

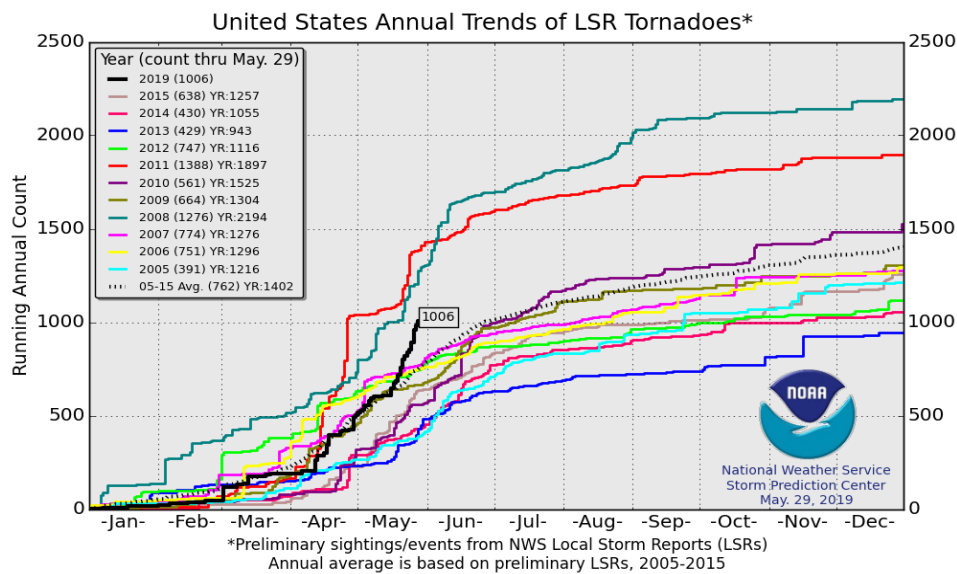


*Highest risk areas
In late May*

In 2011, the last active tornado season, the U.S. had very extreme severe weather in the spring. It quieted in June.



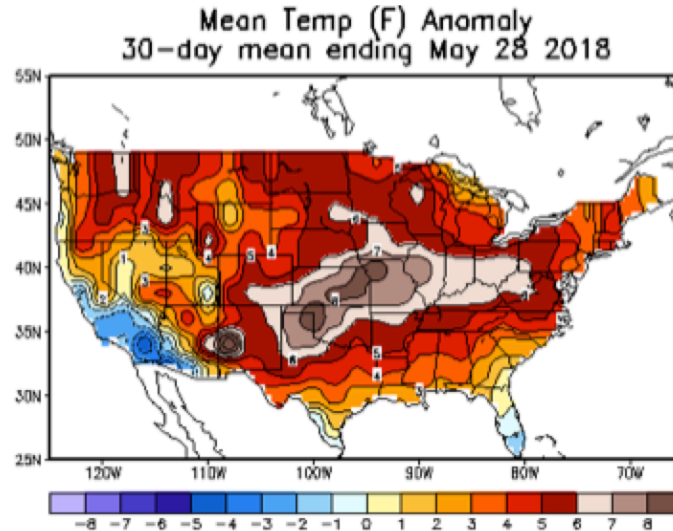
Looking at just the last 15 years, tornado activity currently trails 2008 and 2011 year to date.



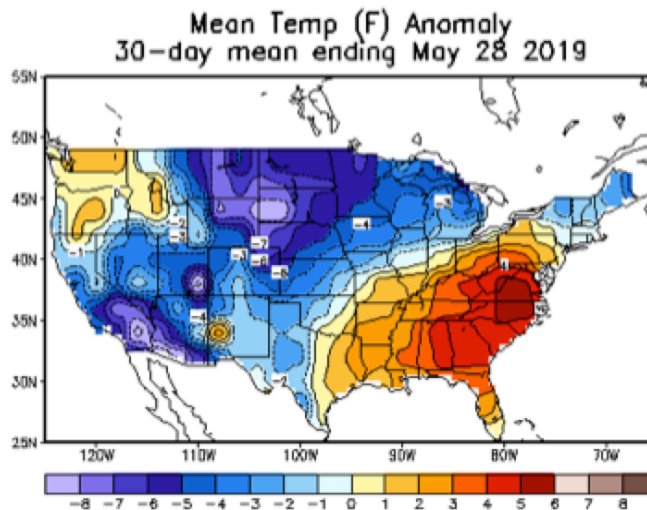
Claim Rebuttal

Claims that the increased tornadic storms in 2019 are the result of CO₂ -related climate change/global warming are not supported by climate science and the associated empirical data.

2018 was the quietest tornado season since at least 1954— with 170 tornados in May compared to 442 so far this year. 2018 had a very warm May as shown below.

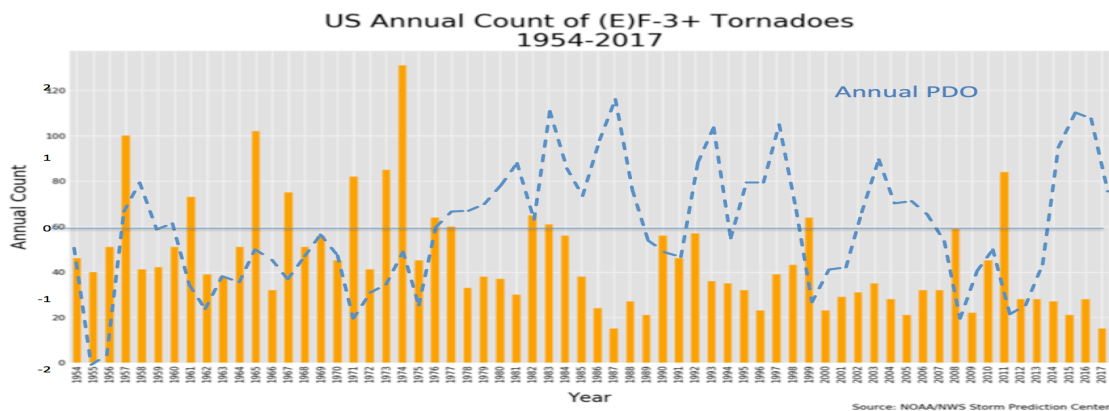


Major storms that produce heavy rains and outbreaks of severe weather occur with a rich moisture environment and strong jet streams that result from a significant contrast of warm and cold. In 2019, the U.S. faced high moisture levels and, as shown below, a very large temperature differential this spring providing the ideal environment for heavy flooding and frequent and strong tornados.



The most commonly used measure of the Pacific Basin temperatures is the Pacific Decadal Oscillation or PDO. When the eastern Pacific is cold, the PDO is negative. The chart below depicts in orange columns, the number of strong EF3+ tornadoes per year since 1954. The annual PDO is the blue dashed lines. As shown in the figure, tornados are more frequent and likely to be stronger when the eastern Pacific is cold as it was from the 1950s to mid-1970s, as well as around 1999 and 2008 and 2011. This is because, as occurred this year, a cold eastern Pacific favors cold winters and springs in the west and central U.S. as well as warmer southeastern states.

The official, final value for the number of EF3+ storms in 2018 has not yet been released, but the number of EF3+ storms reported unofficially was less than half that of 2017, a new low.



Notice how cold eras and years tend to correspond with increased tornadic activity. This year, the PDO has behaved as it did in 1999, 2008 and 2011 when there were spikes in tornadic activity as noted above. Over at least the past century, the PDO has had a multi decadal cycle, and the warm phase is now over 40 years old. Thus, totally unrelated to CO2 emissions, a return of the cold PDO mode resulting in more tornadoes on an annual average basis is certainly now possible.