Claim: Global warming is causing more and stronger tornadoes

REBUTTAL

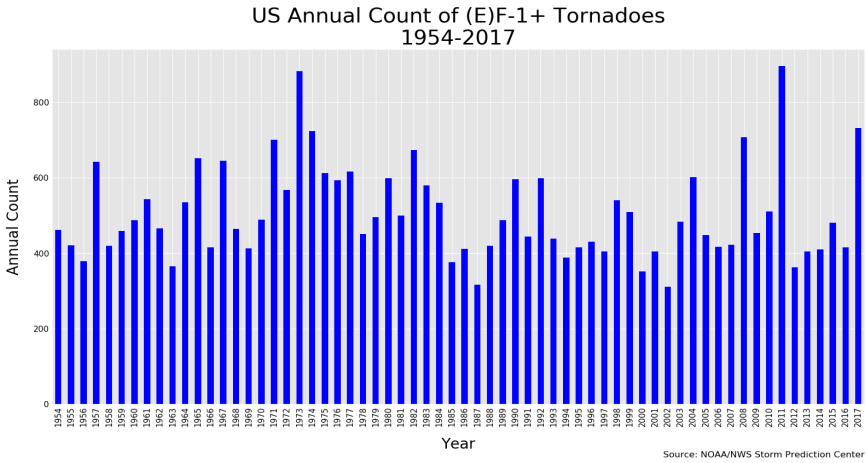
Tornadoes are failing to follow "global warming" based predictions. Strong tornadoes have seen a drop in frequency since the 1950s. The years 2012, 2013, 2014, 2015, and 2016 all saw below average to near record low tornado counts in the U.S. since records began in 1954. 2017 rebounded only to the long-term mean while 2018 activity has returned to well below the 25th percentile. This lull followed a very active and deadly strong La Nina of 2010/11, which like the strong La Nina of 1973/74 produced record setting and very deadly outbreaks of tornadoes.

Population growth and expansion outside urban areas have exposed more people to the tornadoes that once roamed through open fields.

Tornado detection has improved with the addition of NEXRAD, the growth of the trained spotter networks, storm chasers armed with cellular data and imagery as well as the proliferation of cell phone cameras and social media. This shows up most in the weak EF0 tornado count but for storms from moderate EF1 to strong EF 3+ intensity, the trend has been flat to down despite improved detection.

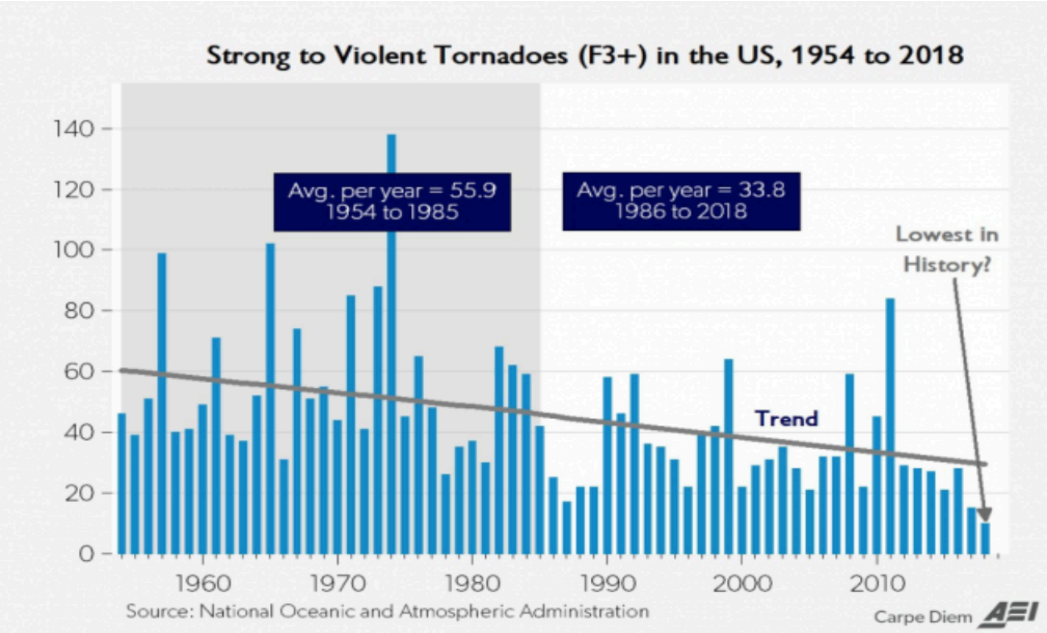
There is no support for increasing strong tornadoes.

Indeed in the US Annual count of EF1+ tornadoes, active years are shown but there is no discernible upward slope trend.



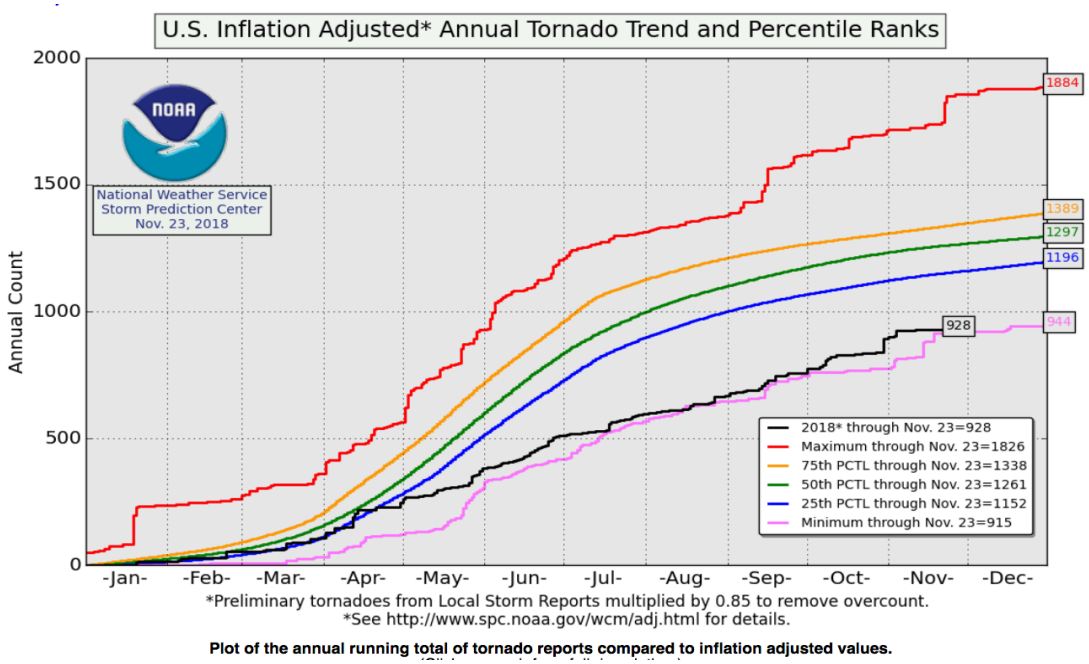
Source: Storm Prediction Center

For strong EF3+ tornadoes, there are again active years and periods. But the trend, despite better detection, has been clearly down, not up.



Source: Storm Prediction Center NOAA

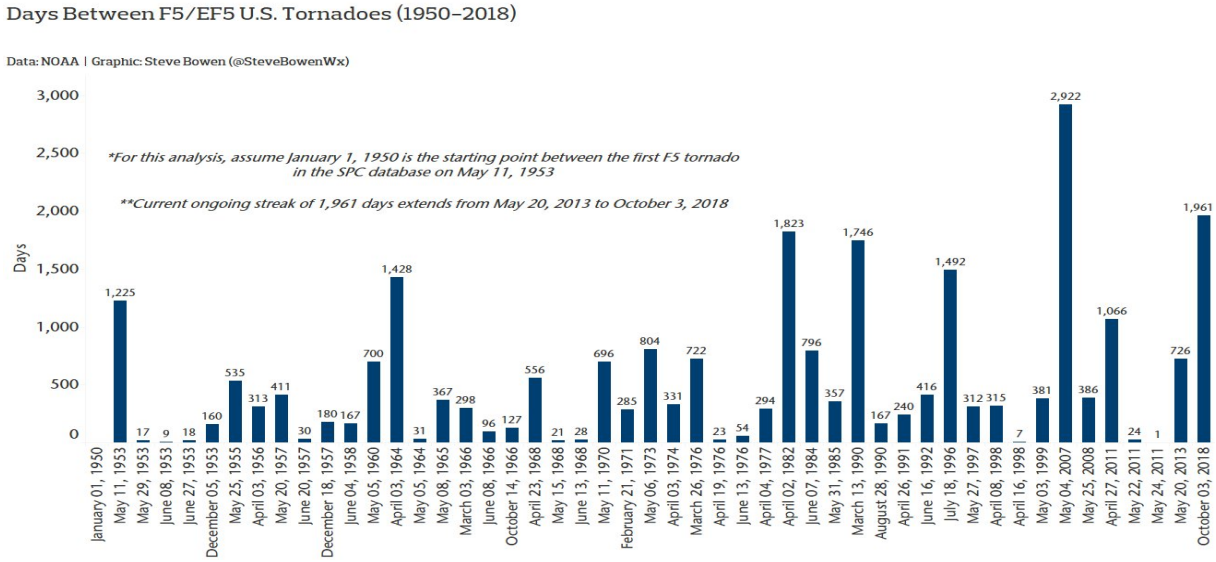
As of November 23, 2018, a03 record-low 928 tornadoes (inflation adjusted) formed in the U.S. for the year, according to the National Oceanic and Atmospheric Administration's Storm Prediction Center



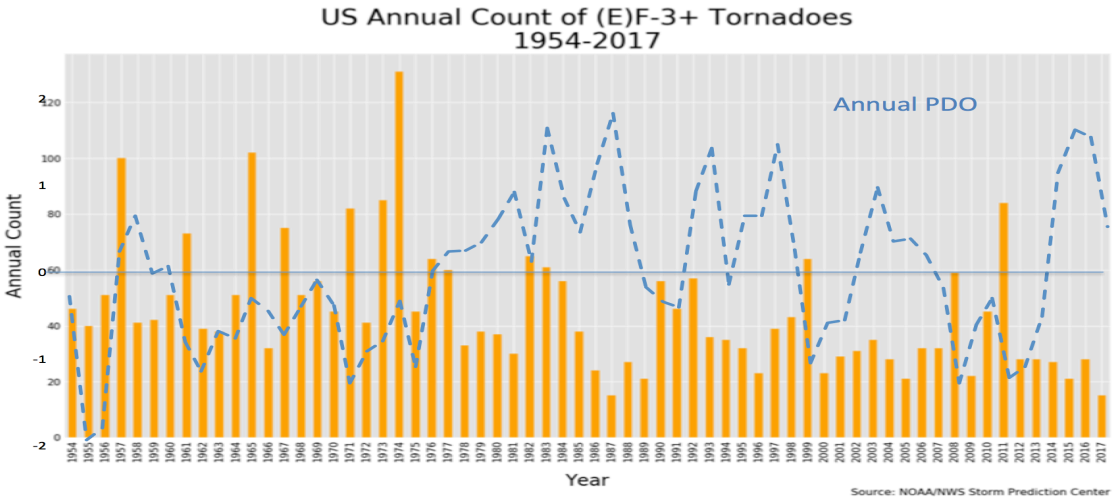
Plot of the annual running total of tornado reports compared to inflation adjusted values.

(SPC).

October 3rd 2018 marked the 1,961st consecutive day without an F5/EF5 tornado in the United States ranking as the second-longest streak since 1950. That has continued through January 2019 bringing the quiet streak to near 2,100 days.

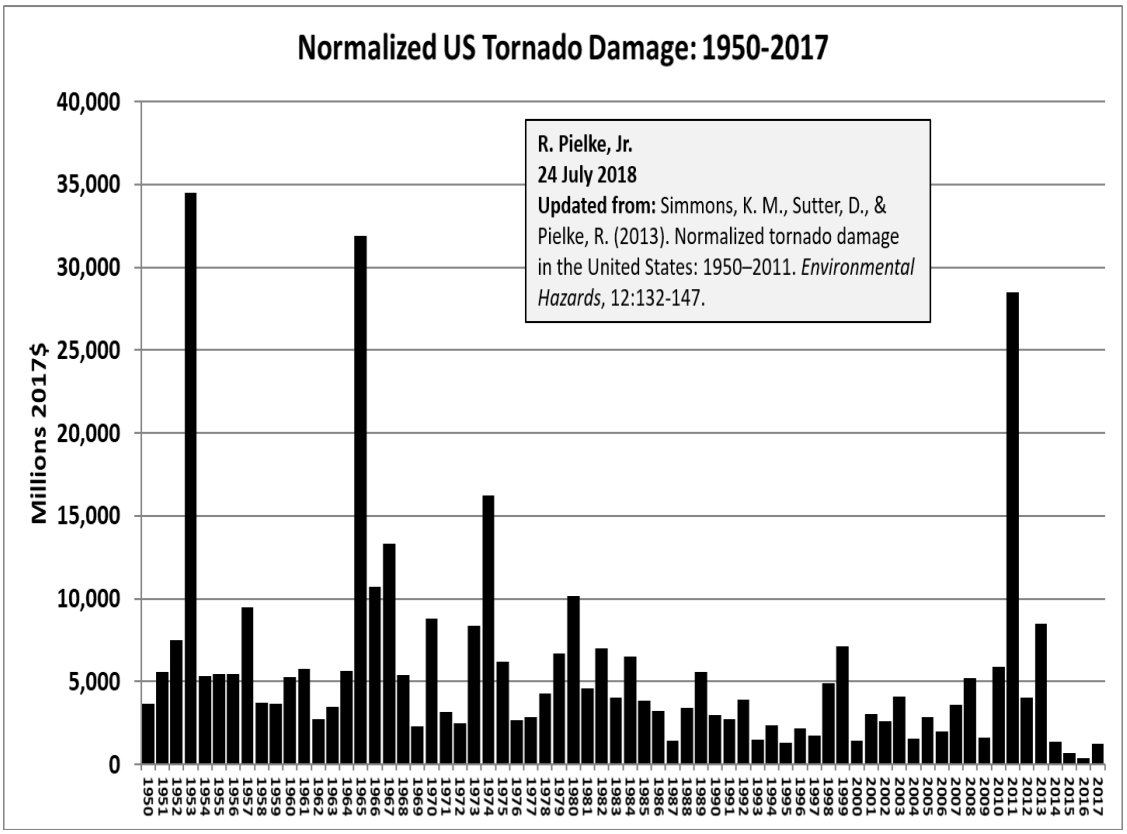


Note below how the number of strong tornadoes corresponds to cycles in the Pacific Decadal Oscillation (NOAA CPC) in the Pacific, which determines the favored state and relative strength of ENSO (El Nino or La Nina). The negative PDO favors La Ninas which produce a jet stream pattern that favors more significant tornado outbreaks and as a result, more active seasons.



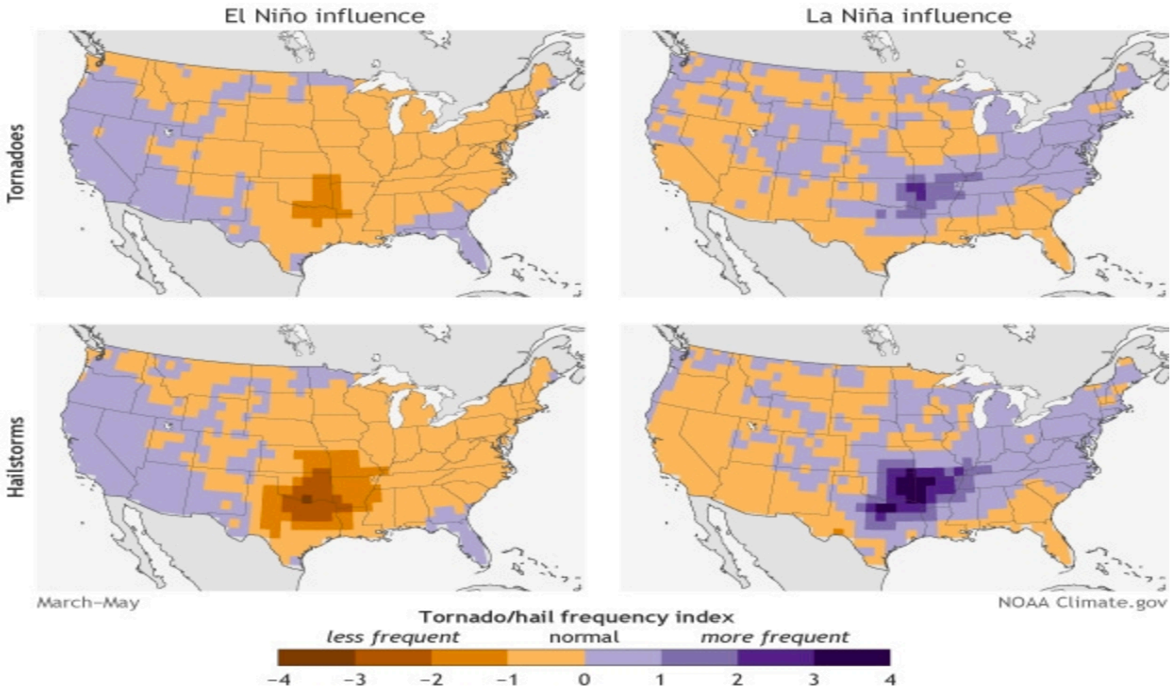
Source: Storm Prediction Center

In terms of damage, Roger Pielke Jr. has shown the normalized US tornado damage continues to decline and has been at exceptionally low levels for the last 5 years. The past 5 years have 2nd lowest normalized tornado damage of any 5-yr period since 1950 (1997 #1). 2016 had least, 2015 2nd least, 2017 3rd least, 2018 near record-low tornadoes.



ENSO (AND PDO) PLAY A ROLE

As mentioned above, tornado outbreaks of significance occur most frequently in La Nina years, which are favored when the Pacific is cold (PDO is negative) as it was in the 1950s to the early 1970s and more recently 1999, 2008, 2010 and 2011.



Source: Storm Prediction Center

The death toll in the strong La Nina of 2011 was the highest since the "Superoutbreak" in the strong La Nina year of 1974. Population growth and expansion outside urban areas have exposed more people to the tornadoes that once roamed through open fields.

The Superoutbreak of 2011

The 2011 Superoutbreak was the largest, costliest, and one of the deadliest tornado outbreaks ever recorded, affecting the Southern, Midwestern, and Northeastern United States and leaving catastrophic destruction in its wake.

The event affected Alabama and Mississippi the most severely, but it also produced destructive tornadoes in Arkansas, Georgia, Tennessee and Virginia and affected many other areas throughout the Southern and Eastern United States. In total, 362 tornadoes were confirmed in 21 states from Texas to New York to southern Canada.

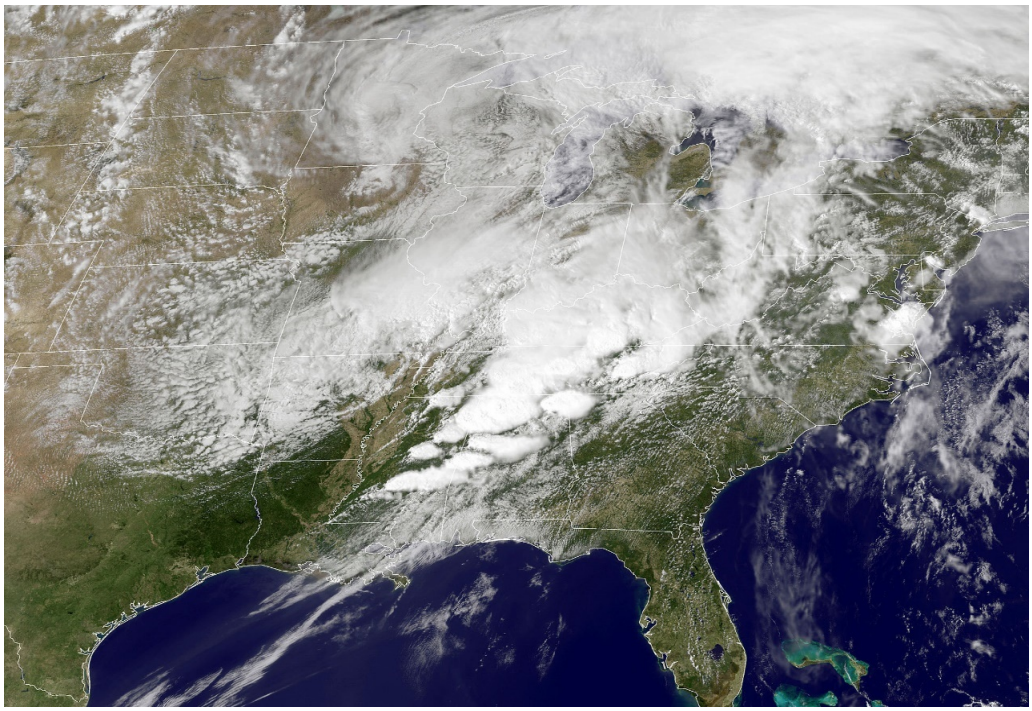
Widespread and destructive tornadoes occurred on each day of the outbreak, with April 27 being the most active day with a record of 218

tornadoes touching down that day. Four of the tornadoes were destructive enough to be rated EF5, which is the highest-ranking possible on the Enhanced Fujita scale; typically these tornadoes are recorded about once each year.

348 people were killed as a result of the outbreak, which includes 324 tornado-related deaths across six states and an additional 24 fatalities caused by other thunderstorm-related events such as straight-line winds, hail, flash flooding or lightning. In Alabama alone, 238 tornado-related deaths were confirmed.

April 27, 2011's 317 fatalities were the most tornado-related fatalities in the United States in a single day since the "Tri-State" outbreak on March 18, 1925 (when at least 747 people were killed. This event was the costliest tornado outbreak and one of the costliest natural disasters in United States history (even after adjustments for inflation), with total damages of approximately $11 billion (2011 USD).

Satellite image during 2011 outbreak (source NOAA):



The 2011 Joplin tornado was a catastrophic EF5-rated tornado that struck Joplin, Missouri, late in the afternoon of Sunday, May 22, 2011. It was the third tornado to strike Joplin since May 1971. Overall, the tornado killed 158 people (with an additional three indirect deaths),

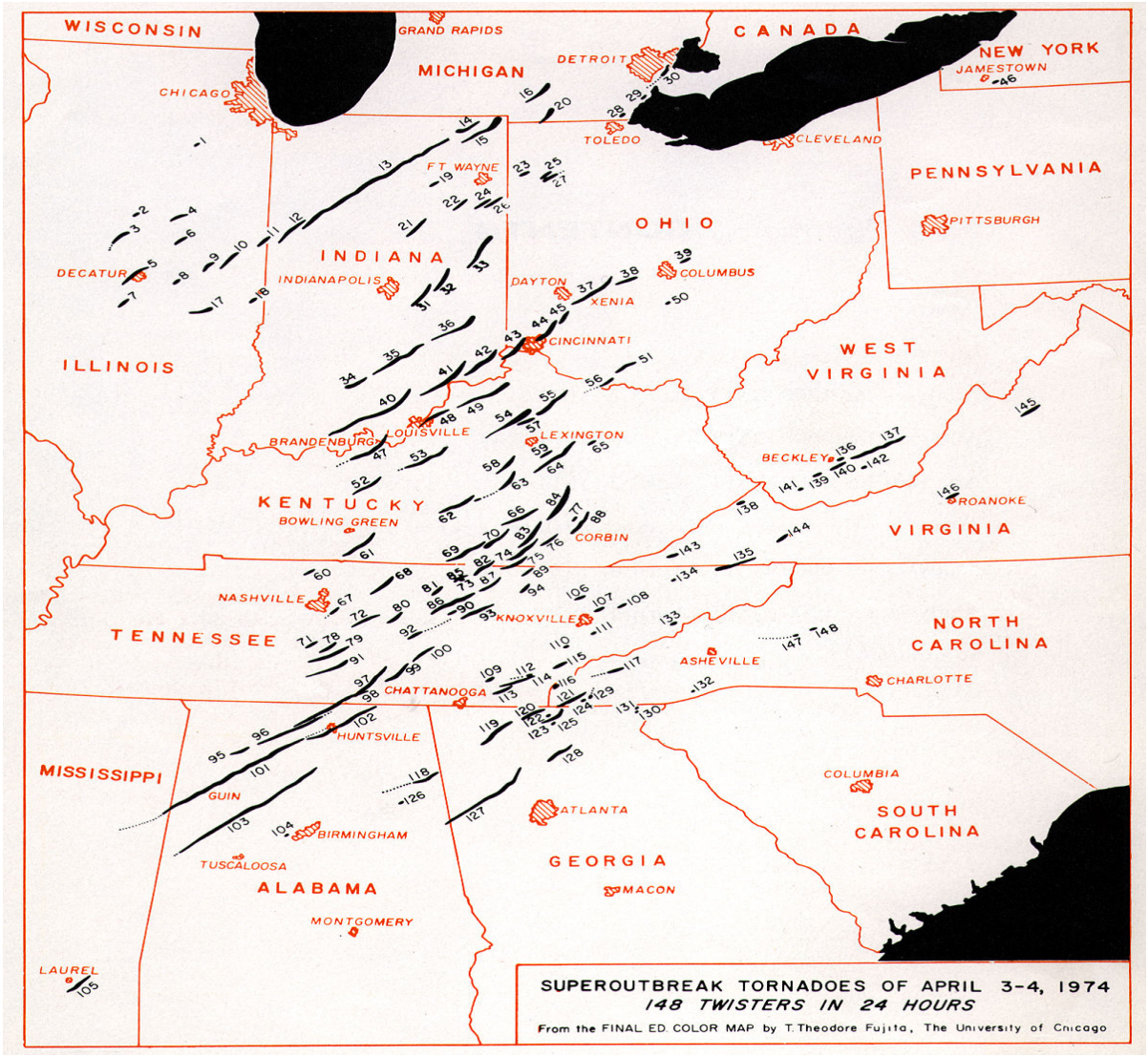
injured some 1,150 others, and caused damages amounting to a total of $2.8 billion. It was the deadliest tornado to strike the United States since the 1947 Glazier–Higgins–Woodward tornadoes, and the seventh-deadliest overall. It also ranks as the costliest single tornado in U.S. history.

It was the first F5/EF5 tornado in Missouri since May 20, 1957, when an F5 destroyed several suburbs of Kansas City. It was only the second F5/EF5 tornado in Missouri history dating back to 1950. It was the deadliest U.S. tornado since the April 9, 1947 tornado in Woodward, Oklahoma, the seventh-deadliest in U.S. history It was also the first single tornado since the June 8, 1953 F5 tornado in Flint, Michigan, to have 100 or more associated fatalities.

The Superoutbreak of 1974

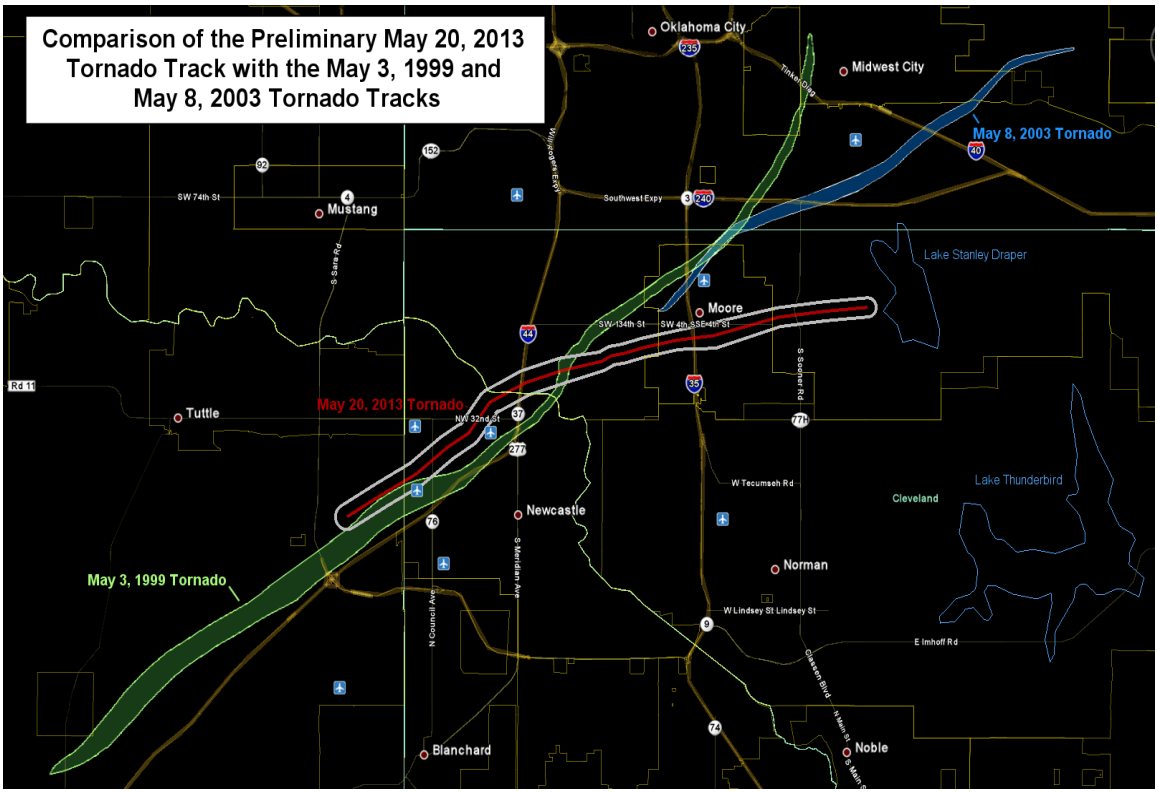
The 1974 Super Outbreak was the second-largest tornado outbreak on record for a single 24-hour period, just behind the 2011 Superoutbreak. It was also the most violent tornado outbreak ever recorded, with 30 F4/F5 tornadoes confirmed. From April 3 to April 4, 1974, there were 148 tornadoes confirmed in 13 U.S. states and the Canadian province of Ontario. The entire outbreak caused more than $600 million (1974 USD) in damage in the United States alone, and extensively damaged approximately 900 square miles along a total combined path length of 2,600 mi (4,184 km).

The 1974 Super Outbreak remains one of the most remarkable severe weather episodes of record in the continental United States. The outbreak far surpassed previous and succeeding events in terms of severity, longevity, extent, and death toll, with the notable exception of the 2011 Super Outbreak, which lasted from April 25 to 28 and killed a total of 324 people.



Source: Ted Fujita, University of Chicago

Negative PDO conditions also developed in early 2013. Nature responded. The May 20, 2013 Moore, Oklahoma tornado killed 24 and injured 377. An estimated 1,150 homes were destroyed, resulting in an estimated $2 billion in damages. It followed a roughly similar track to the deadlier 1999 Bridge Creek–Moore tornado, which was similar in size and severity; however, very few homes and neither of the stricken schools in the area had added purpose-built storm shelters in the intervening years since the earlier tornado struck Moore.



Source: National Weather Service Norman, Oklahoma.

Soon thereafter, the Moore City Council proposed a measure making twelve changes to its residential building codes, include requiring that new home construction in the city include hurricane clips or framing anchors, continuous plywood bracing and wind-resistant garage doors in order for homes to withstand winds up to 135 mph (equivalent to a high-end EF2 tornado). When the measure was passed in a unanimous vote held on March 17, 2014, Moore became the first city in the United States to adopt a building code addressing the effects of tornadoes on homes, which exceed the national standards set by the National Association of Home Builders.

The bottom line is that tornado frequency and major outbreaks relate to natural cycles both short and long term in the oceans that produce jet stream patterns that favor or suppress tornado outbreaks of significance in the U.S. Hence, the Claim that Global Warming is causing more and stronger tornadoes is invalidated by the relevant empirical data. However, when tornados do occur, expansion of populated areas puts more property and lives at risk. Fortunately, improved tornado

detection and warnings, coupled with the addition of storm shelters and improved building codes do help mitigate the death tolls and property damage associated with tornadoes.

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