

Changes in frequency of heat and cold in the United States temperature record

Summary: Have heat records increased and record low temperatures decreased as suggested by the IPCC greenhouse driven models?

Reference

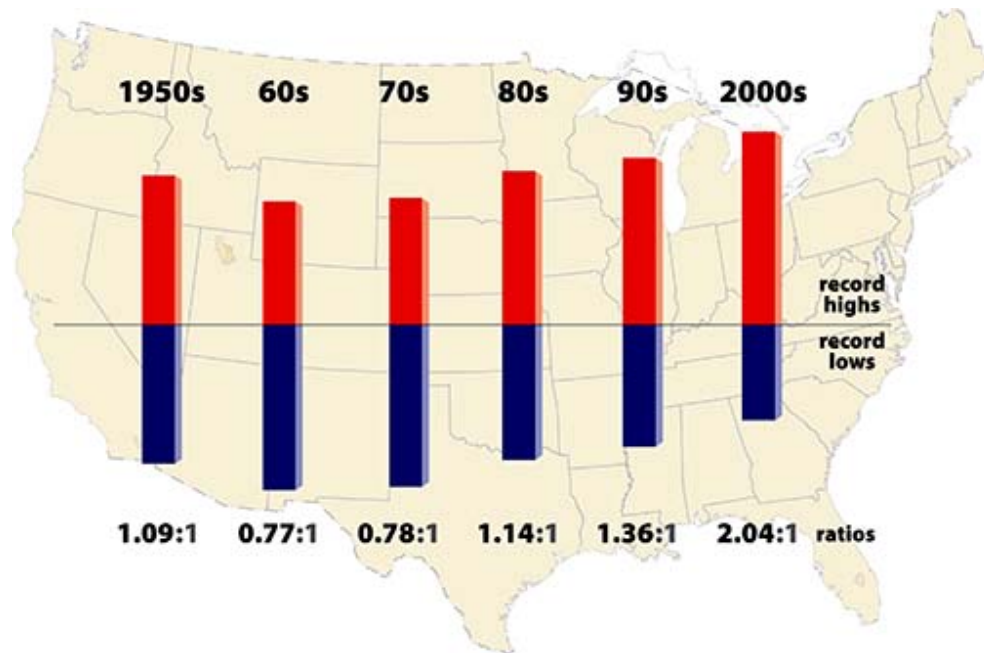
Meehl, G.A., Byun, H.R., Tebaldi, C., Walton, G., Easterling, T., McDaniel, L., 2009, The relative increase of record high maximum temperatures compared to record low minimum temperatures in the U.S., *Geophysical Research Letters*, 36, L23701, doi:10.1029/2009GL040736

The authors note "The current observed value of the ratio of daily record high maximum temperatures to record low minimum temperatures averaged across the U.S. is about two to one. This is because records that were declining uniformly earlier in the 20th century following a decay proportional to $1/n$ (n being the number of years since the beginning of record keeping) have been declining less slowly for record highs than record lows since the late 1970s. Model simulations of U.S. 20th century climate show a greater ratio of about four to one due to more uniform warming across the U.S. than in observations.

Following an A1B emission scenario for the 21st century, the U.S. ratio of record high maximum to record low minimum temperatures is projected to continue to increase, with ratios of about 20 to 1 by mid-century, and roughly 50 to 1 by the end of the century.

Spurred by a warming climate, daily record high temperatures occurred twice as often as record lows over the last decade across the continental United States, new research shows. The ratio of record highs to lows is likely to increase dramatically in coming decades if emissions of greenhouse gases continue to climb.

"Climate change is making itself felt in terms of day-to-day weather in the United States," says Gerald Meehl, the lead author and a senior scientist at the National Center for Atmospheric Research (NCAR). "The ways these records are being broken show how our climate is already shifting."



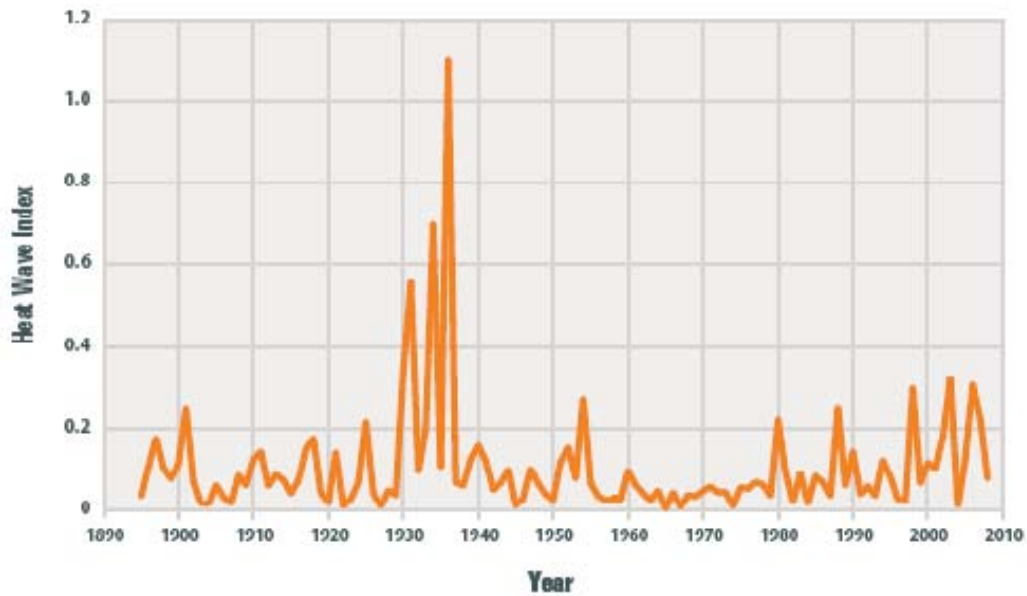
This graphic shows the ratio of record daily highs to record daily lows observed at about 1,800 weather stations in the 48 contiguous United States from January 1950 through September 2009. Each bar shows the proportion of record highs (red) to record lows (blue) for each decade. The 1960s and 1970s saw slightly more record daily lows than highs, but in the last 30 years record highs have increasingly predominated, with the ratio now about two-to-one for the 48 states as a whole.

The authors note “If temperatures were not warming, the number of record daily highs and lows being set each year would be approximately even. Instead, for the period from January 1, 2000, to September 30, 2009, the continental United States set 291,237 record highs and 142,420 record lows, as the country experienced unusually mild winter weather and intense summer heat waves.”

Comments: This study is flawed in a number of ways. First it starts after the heat wave spike in the 1930s and 1940s as shown by NOAA in the CCSP report here. That report developed a heat wave index and remarked about the 1930s super max and a steady rise after the 1960s.

Figure 1. U.S. Annual Heat Wave Index, 1895–2008

This figure shows the annual values of the U.S. Heat Wave Index from 1895 to 2008. These data cover the lower 48 states.

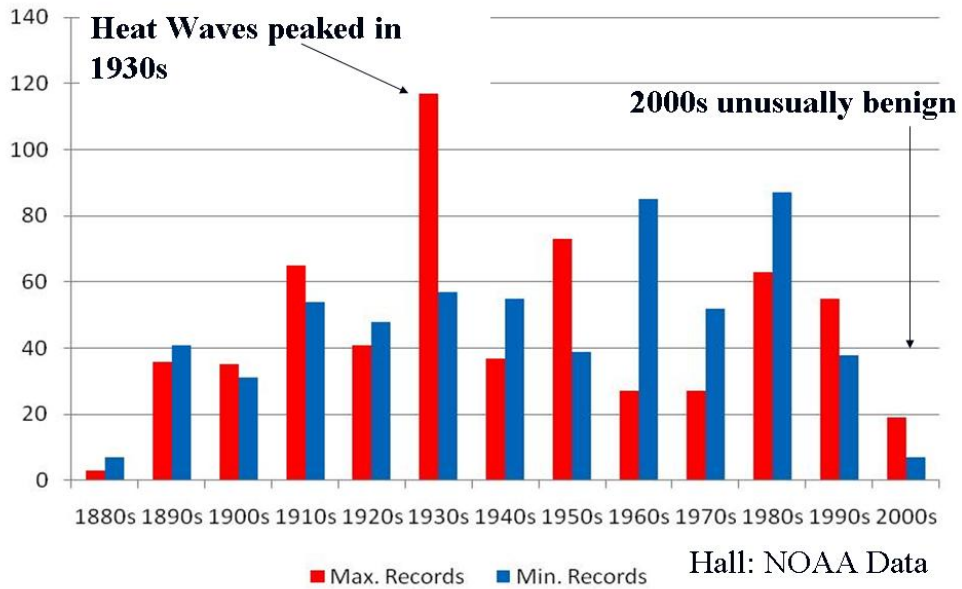


Data source: CCSP, 2009*

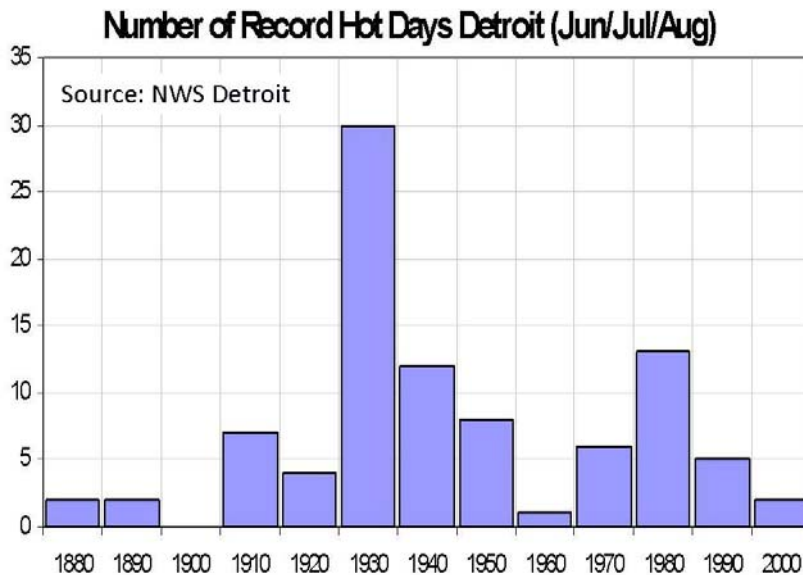
Also Hall showed using NCAR historical data for state record highs and lows the 1930s peak and a second minor peak in the 1990s but a decline in heat records after. It also shows record lows peaking in the 1960s and 1980s with a decline after.

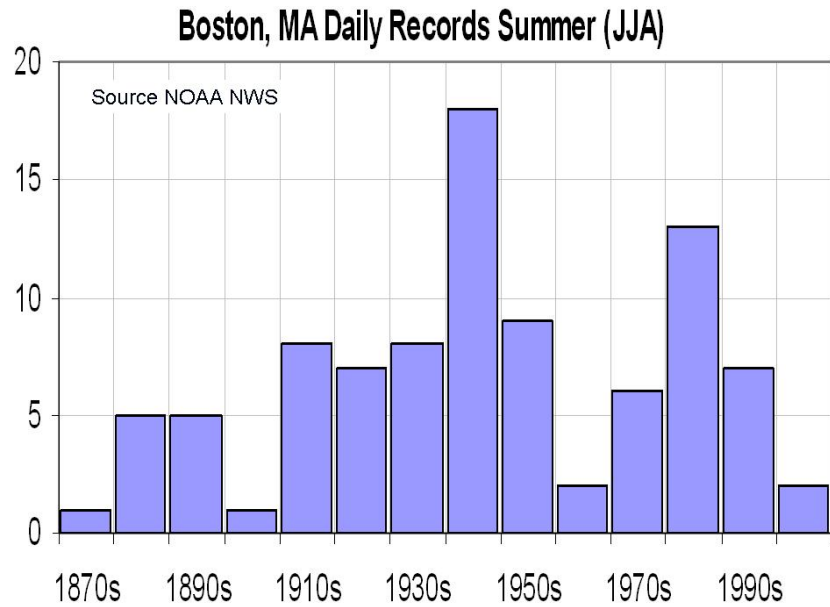
We should note with increased urbanization, we would expect fewer overnight low records since nighttime temperatures are most affected by urban heat island.

U.S. State Maximum and Minimum Monthly Records by Decade

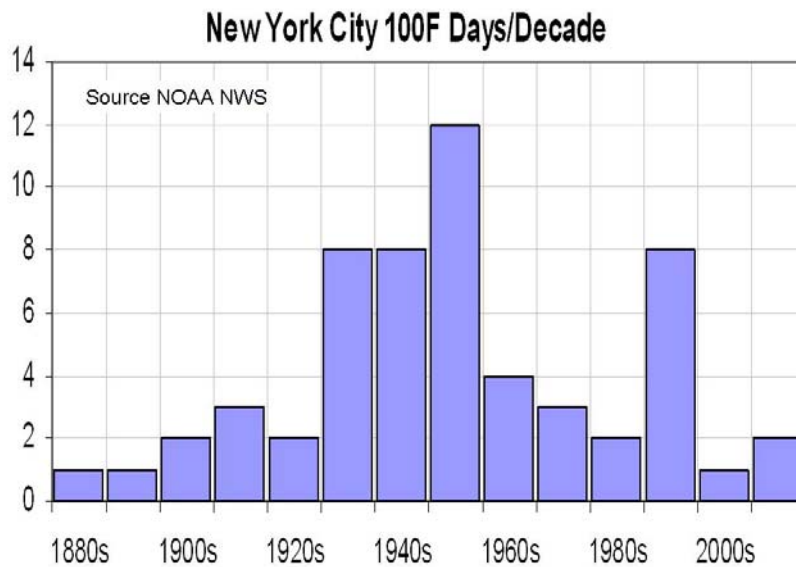


The same heat wave pattern can be seen in city decadal records all over the country as in Detroit and Boston summer heat records below (taken from NOAA city records).





New York City experienced two 100F days this past summer a year after June and July averaged the third coldest in the entire record. There was only 1 such day in the 2000s. In a similar sine wave like oscillation, one can see the 1930s to 1950s peak with a second peak in the hot days of two 1980 summers. The frequency the last two decades is the lowest since the early record in the 1880s though the 1920s.



In viewing the data above, it is clear that any increases in heat records are unremarkable compared to the early 20th century, most notably the 1930s. The changes in the heat to

cold record ratios computed by the authors was more due to the diminished cold record the last two decades, consistent with the urban heat island expansion. The number of records, both low and high, are unremarkable in recent years. Indeed the last decade was unusually benign and by this measure certainly not increasingly extreme.

NIPCC Website Topical Categories

Extremes (Temperature)