Can We Trust Trends? Long Term Rising Temperature Trends in Los Angeles

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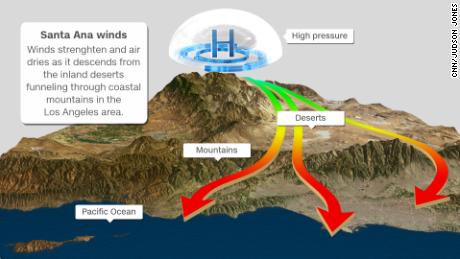
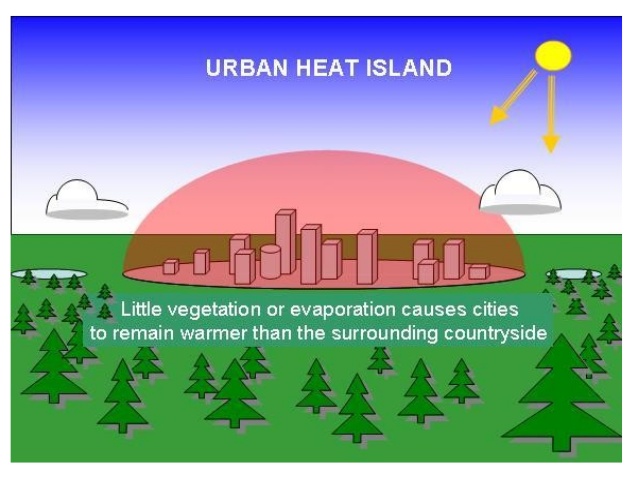


Figure 1: Downtown Los Angeles, California (Source: Konstantin Sutyagin/Shutterstock)

Most people in the United States likely remember the series of catastrophic fires that hit California in the summer of 2018, with over 8,500 fires burning an area of about 1.8 million acres of land in California, including parts of Los Angeles. It would be hard to forget such mass destruction. What some may have forgotten so quickly is that accompanying these fires were scorching heat waves. This heat left a soon to be retired mail deliverer dead in her truck, fueled fires leading to hundreds of evacuations, and left thousands without power for up to 24 hours. Since heat waves have such harmful potential, it is crucial to focus in on areas where they will be most influential. Records suggest that LA will be among the first areas to experience major heating in California. To better understand the long-term trends of Los Angeles temperature, I analyzed temperature data with the following hypothesis: there is a positive relationship between temperature in Los Angeles and time. To put this information in context, I will first clarify what a heat wave really is.

## What is a Heat Wave, Anyway?

Noting that definitions vary by region in the United States, Tamrazian et al. (2007) states that a heatwave can be defined most commonly as “a period of at least three consecutive days above 90°F (32°C)” The urban heat island effect (Figure 2) and Santa Ana winds (Figure 3) major causes of heat waves in Los Angeles are ). The urban heat island effect can occur in metropolitan areas where the surface is covered in concrete and asphalt. When weather is already warm, these structures absorb and subsequently release heat much more slowly than plants and other natural structures, causing them to warm the surrounding air for longer. Santa Ana winds can contribute to heat waves by introducing unusually warm wind as the marine layer breaks up in the summer, and winds begin to blow from the land to the sea (Thompson 2018).



## Heat Rising



Figure 4: People cooling off from a Los Angeles heat wave (Source: LA Times)

In California, and Los Angeles specifically, heat waves are increasing on average by 3 events annually over the 100-year period (Tamrazian et al. 2008). In addition, in the July 2006 heat wave, temperature in Los Angeles County reached an all-time high 119°F (48 °C). The increasing trend displayed in my more recent data analysis of LA temperature suggests that these trends may have continued, if not increased, since Tamrazian’s study.

## Why should I care about these trends?

So it’s hotter more often, but what do these trends really mean? Actually quite a lot…

* Wildfires: Heat waves are often accompanied by dry weather, making plants more susceptible to fire (Tamrazian et al. 2007). This is especially a concern in California, an area already prone to wildfires.
* Heat-related deaths: As temperatures rises and is sustained at a level far above normal, bodies cannot always compensate. This is exacerbated by the heat island effect, as the body has a harder time recovering from the heat of the day. Children and the elderly are especially vulnerable to this (Tamrazian et al. 2007).
* Power drain: As temperature rises in urban areas, so does energy demand, which strains water and power systems (Burillo et al. 2019).

Unjustly, yet unsurprisingly, lower income and minority communities are typically most vulnerable to this. They may not have air conditioning or adequate fans, they may not have easy access to medical care for heat related illness, they may live in hotter parts of the city, and so on. Additionally, immigrants and people who don’t speak English may be at risk of being harmed by heat waves because they don’t understand emergency warnings in English. Similarly, people with low income and people experiencing homelessness may have limited to no access to news sources to even see those warnings (Kahn 2010).

## Breaking Down the Temperature Trends in LA

In addition to the heat waves, a long-term trend in temperature may be linked to climate change. One way to determine relies on climate data curated by NOAA that spans over a century. I obtained these publicly available data to determine if trends exist, and if they are statistically significant and how much of the variation in the record is explained. Of the two types of records are available for downtown LA – min and max daily temperatures, both show a dramatic increase since the 1920s (Figure 5 and 6). When evaluating each month individually, 10 of the 12 months had a positive and significant increasing trend, all but November and December. Similarly, for minimum air temperatures, only 2 months (January and November) had trends that were not statistically significant. Of the 10 remaining statistically significant months, 9 showed an increasing trend. Furthermore, the annual mean graphs for both maximum and minimum temperatures (see figures 5 and 6) show highly statistically significant increasing trends (p= 1.258e-11 and p= 1.964e-11 respectively). Additionally, 37% of the change in both annual mean maximum and minimum temperatures can be explained by time (in years). This percentage may seem small, but it is important to consider that R-squared values used to calculate these percentages do not have the final say on the value of the data. Coefficient estimates frequently have biases, such as in the way the regression predicts the data. Thus, I can still rely of the p-values in this case for the final say on my hypothesis. Furthermore, annual temperature spikes (shown in figures 5 and 6) tell a story of recent heat waves. For example, two major spikes in temperature in 2006 and 2018 correspond to the documented heat waves in those years. With all this analyzed, I was able to reject my null hypothesis, suggesting that temperature is increasing in Los Angeles.

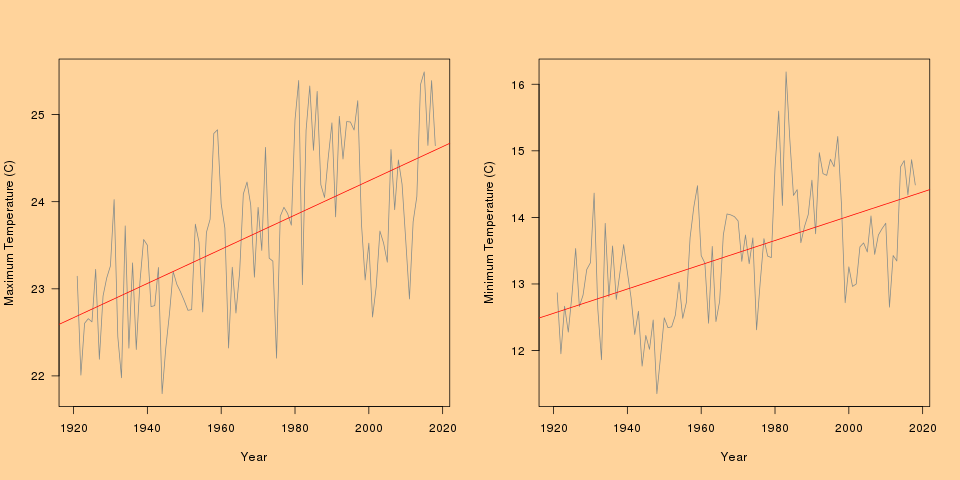


Figure 5: Annual mean regression for maximum air temperature between1920 and 2019. Figure 6: Annual mean regression for minimum air temperature between 1920 and 2019

## Conclusion

The bottom line is that Los Angeles is warming and we know it has been doing so since data was first recorded. As of 2006, the average annual maximum temperature in Los Angeles had warmed by 5°F (3°C), and the average annual minimum temperature had warmed by 4°F (2°C) (Tamrazian et al. 2007). Consistent with my analysis, Tamrazian et al (2007) found that the greatest rate of change was during the summer months for both maximum and minimum temperature, with late fall and early winter having the least rates of change. As discussed above, this could have serious implications for power, both electrical and socio economic. Fires, heat related deaths, and power strains can be expected, to name a few, as this trend continues. The good news is there are potential solutions. While these solutions are not the primary focus of this blog, they are crucial to tackling climate issues, and should be highly supported on multiple levels, from the government, to private entities, to individuals. Some solutions currently in practice include cool pavement, greenroofs, and having more trees. Thus, I encourage careful readers to look a little deeper and question what they can each do to help. Equally important is actively seeking out trends to reference whenever a claim is made. Keeping these two practices in mind, we can spread awareness about climate change events, and do something about it.

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