Science Topics 09-18-2023

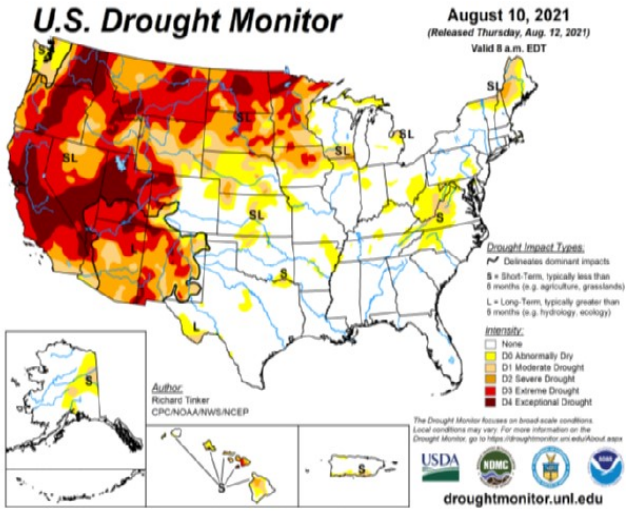
CliSciPol

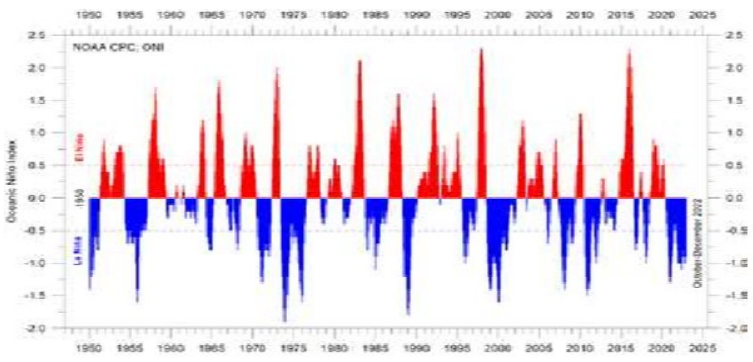
Climate Science and Policy for Nonscientists

One picture is worth a thousand words.

California Weather Variability, the El Nino, And How these Promote Wildfires

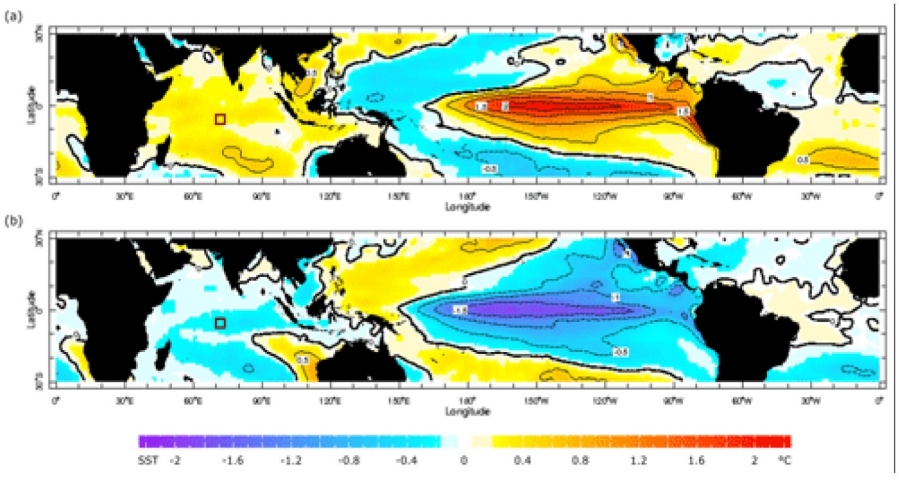
In 2021 all of California was in drought. California government officials claimed California was on the "front lines of the climate crisis." But climate is the long term average of the weather with "long term" usually understood to mean at least 30 years. Unfortunately, California has a major weather problem, in that its weather varies dramatically from year to year with the El Nino/La Nina Cycle, which scientists call ENSO, the El Nino Southern Oscillation.



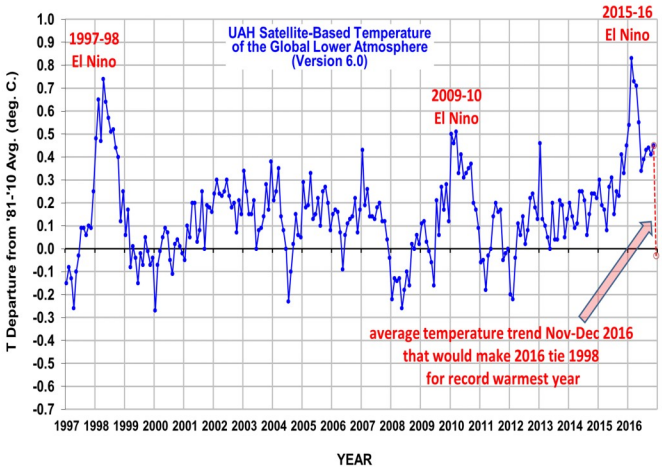


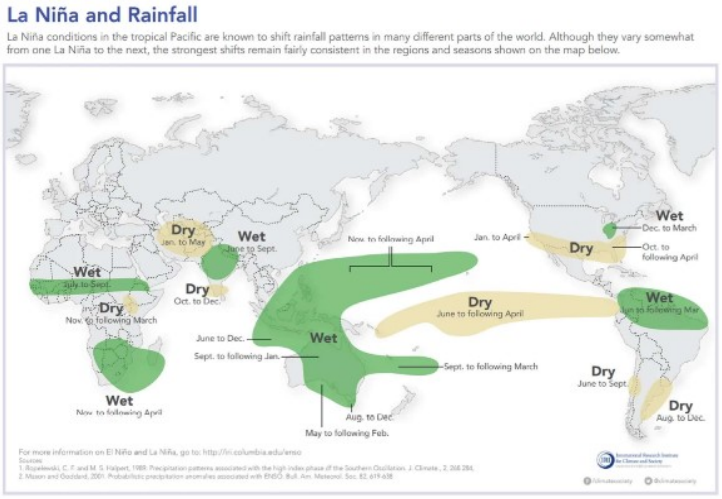
ENSO flips between hot and cold phases on an unpredictable 2-7 year cycle. The intensity of each cycle also varies unpredictably. Scientists have not as yet found any long-term change in the length of the cycle or in the intensity of the temperature swings. Our best computer models can not successfully model ENSO.

The ENSO temperature swings are large in terms of number of degrees, and they effect huge areas of the Pacific Ocean.



The El Nino hot phase is so strong that it has significant effect on the measured temperature for the entire world.

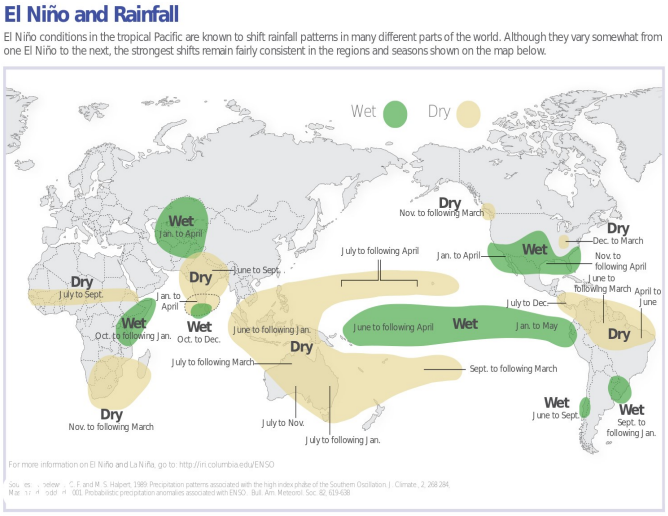


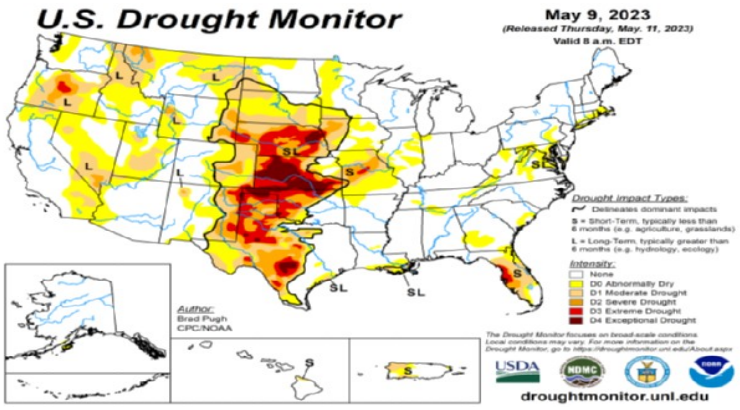


Source: NOAA

The La Nina phase brings drought to California, as in 2021-2022 (see the first image above), and rain to Australia and India.

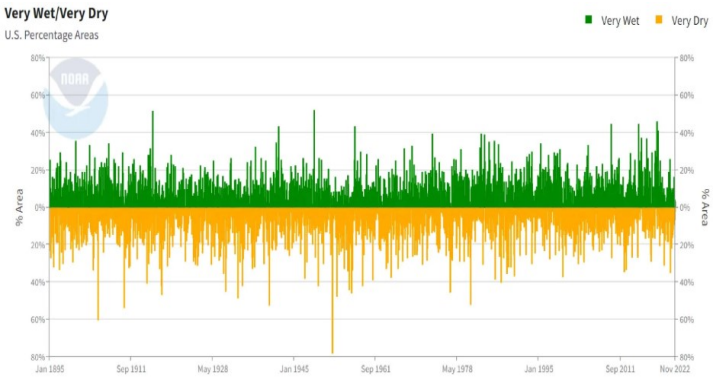
The El Nino phase brings rain to California and other Southern parts of the US while causing serious droughts in Australia and India (where resulting famines have killed millions of people over the last century). The El Nino also increases the frequency and intensity of Atlantic hurricanes.





This past winter the California drought was over, and Californians were complaining about "atmospheric rivers" delivering torrential rains and floods. The snow was so heavy it crushed houses around Lake Tahoe. The drought had moved Eastward and is now centered in Kansas.

Since 1895 wet and dry periods have moved around the US a lot from year to year and from one area to another with no apparent trend (hence no apparent climate change), except there is arguably a slight decline in the percent of the US "very dry" since the horrendous year of 1954.



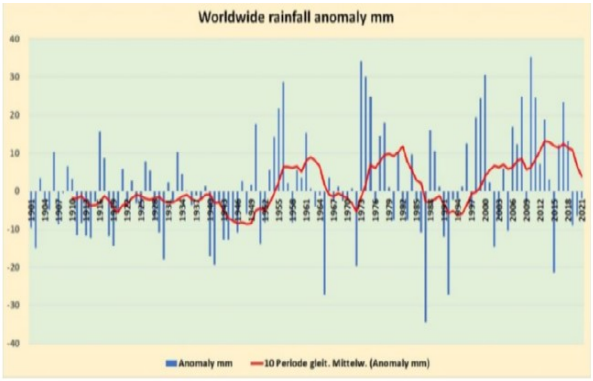
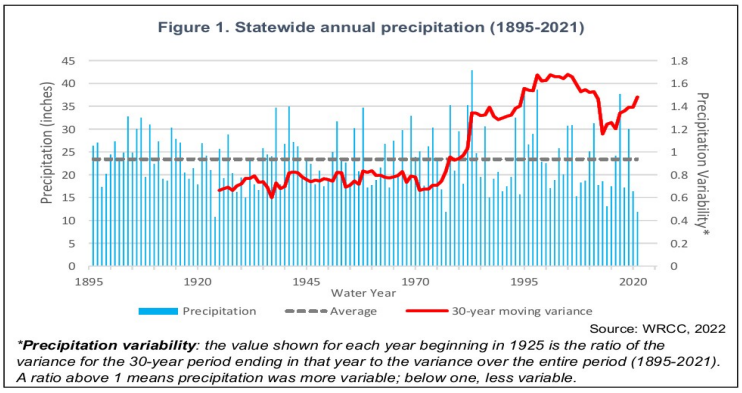


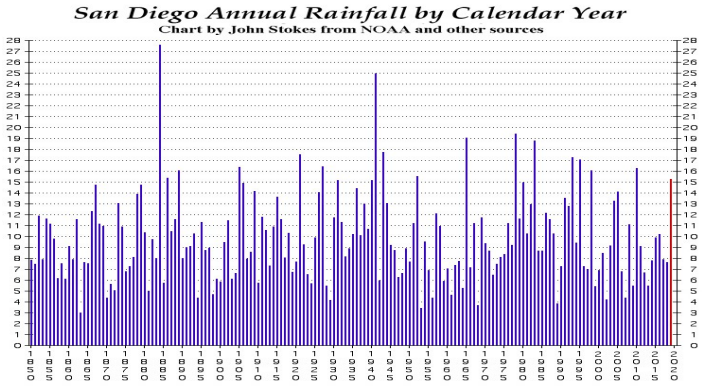
Fig. 6. The worldwide rainfall anomaly from 1901 to 2021 shows only a very weak upward trend of about 1 mm per year. Data: EPA 14) (Note that this graph shows only anomalies, not the full quantities as would be preferable. Given that the source

The climate models and the IPCC AR6 predict that world rainfall will be increasing, and, in fact, a "very weak upward trend" has been measured. The world rainfall per year has been very erratic since around 1955.

The California data shows no rainfall trend either up or down but shows a significant increase in variability (the red line) since around 1980. Rainfall in 2021 was unusually low.

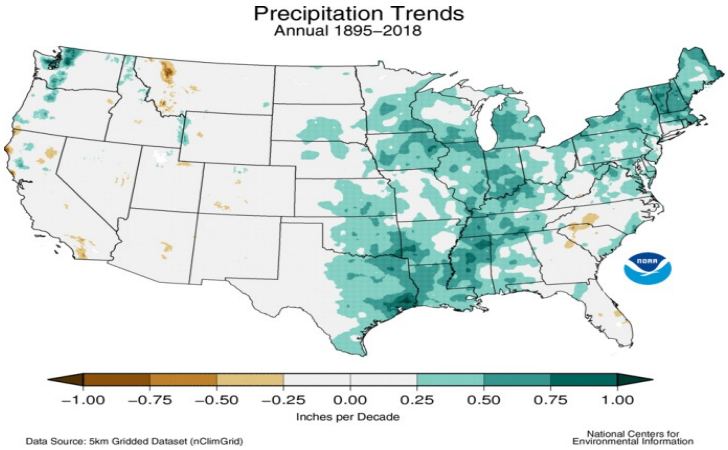
While the amount of annual precipitation over time shows no statewide trend, year-to-year variability has increased since the 1980s. In recent years, the fraction of precipitation that falls as rain instead of snow has increased in the Sierra Nevada and Southern Cascades, reducing the water stored in the snowpack that provides most of California's water supply.

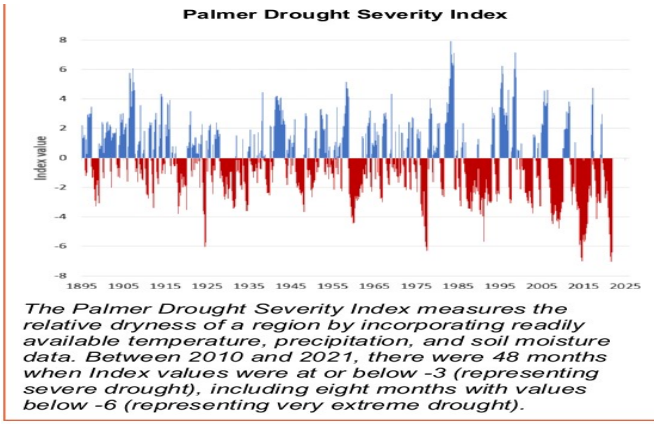




The rainfall data for San Diego going back to 1850 shows remarkable variability.

The data for the US as a whole since 1895 shows a pronounced regional difference - rainfall is increasing over the Eastern half of the US but not changing much over the Western half generally. Today the Great Lakes are brimming while Lake Mead and Lake Powell are extremely low.

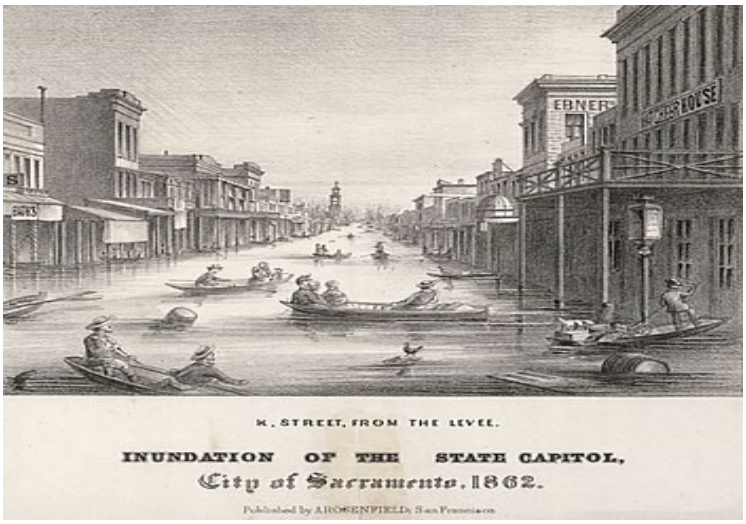


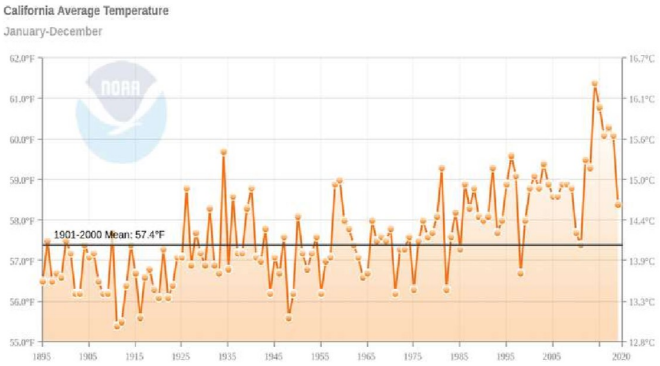


The Palmer Drought Severity Index measures the relative dryness of a region by incorporating readily available temperature, precipitation, and soil moisture data. Between 2010 and 2021, there were 48 months when Index values were at or below -3 (representing severe drought), including eight months with values below -6 (representing very extreme drought).

Although the rainfall data shows no downward trend for California, the Palmer Drought Severity Index for California shows a steadily increasing level of dryness through 2021, before the recent drought ended. The IPCC AR6 detected an increase in "fire weather" around the world, which is defined as an increase in drought and temperature.

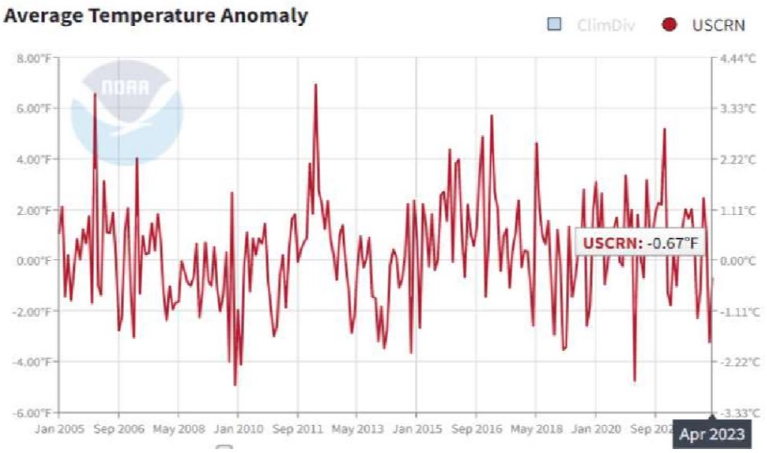
Since 1980 California has had 5 droughts. California also has had periods of torrential rains and a lengthy history of floods. For example, the Great Flood of 1862 covered almost one-third of the state. The storm lasted for 45 days. Sacramento was so flooded that the newly elected governor had to take a rowboat to get to his inauguration.

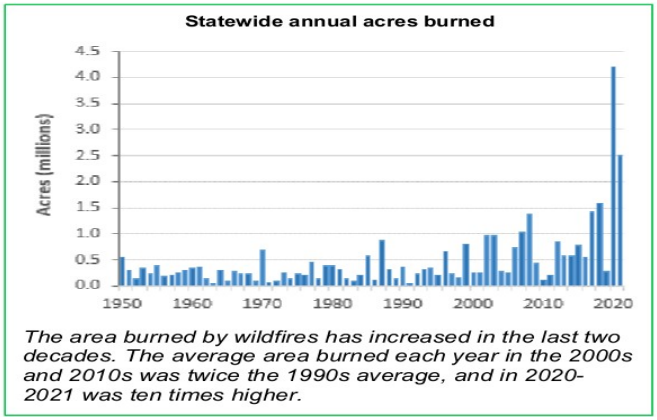




NOAA data shows California warming, particularly since about 1975. The 2015-2016 El Nino spike stands out dramatically. The rise per century has been about 2 F (from about 57 F to 59 F) or a little more than 1 C. The IPCC AR6 says that the world temperature has risen about 1.1 C since the preindustrial period.

But for the whole of the US there has been no temperature change since 2005 according to NOAA's most accurate dataset, the Climate Reference Network. Thus the increase in California temperature and the decrease in the Palmer Drought Index appear to be local variations and not typical of the continental US.



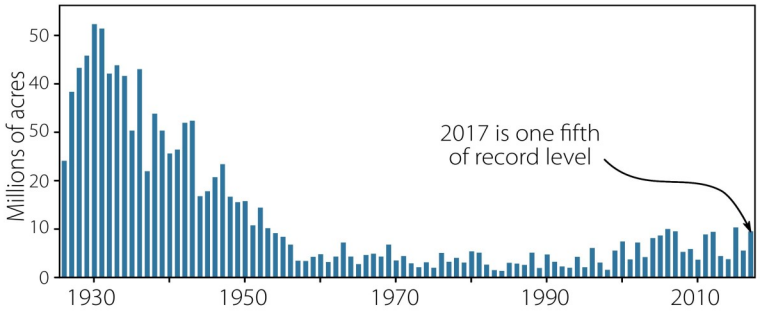


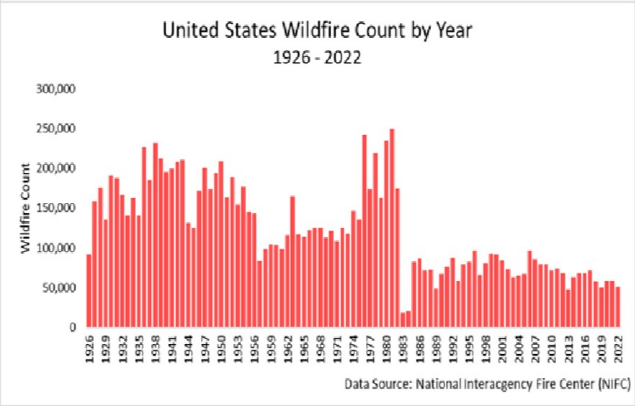
In California acres burned per year by wildfires have risen dramatically since about 1983. Of all the states California has the worst problem with wildfires. The variability of California's weather is a major contributing factor. Wet periods produce rapid growth of grasses and low shrubs, which then dry out and provide excellent kindling that promotes the rapid spread of wildfires.

Figure 11: US forest area burned by wildfires, 1926–2017.

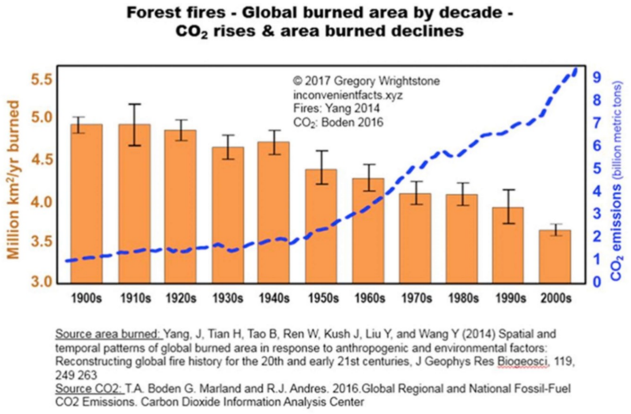
Source: National Interagency Fire Center.[52]

For all the US acres burned per year were far worse in the 1930s and 1940s

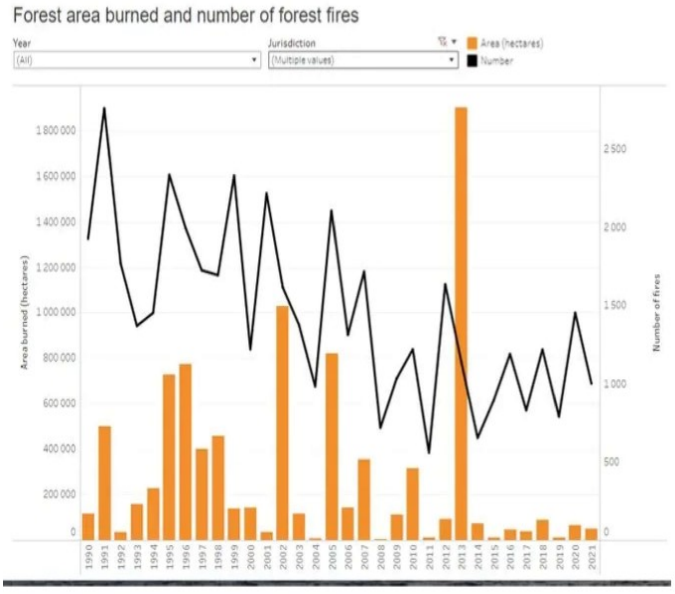




Prior to 1880 wildfires in North America were much worse than since 1880.

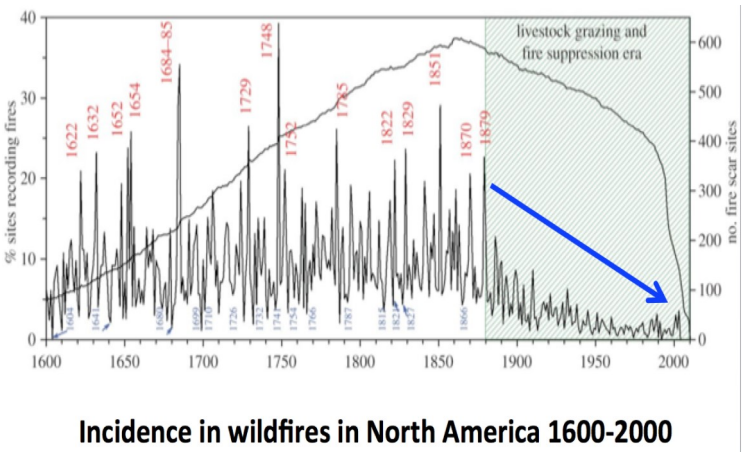


The world data per year 2003-2022 clearly shows the declining trend continuing, despite the IPCC AR6 detection of an increase in "fire weather."



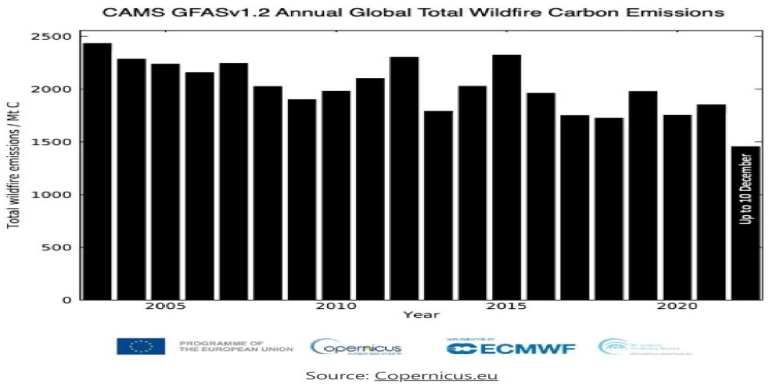
Forest fires in Quebec. Source: NFDP

And the number of wildfires per year in the US has been declining significantly since the 1930s



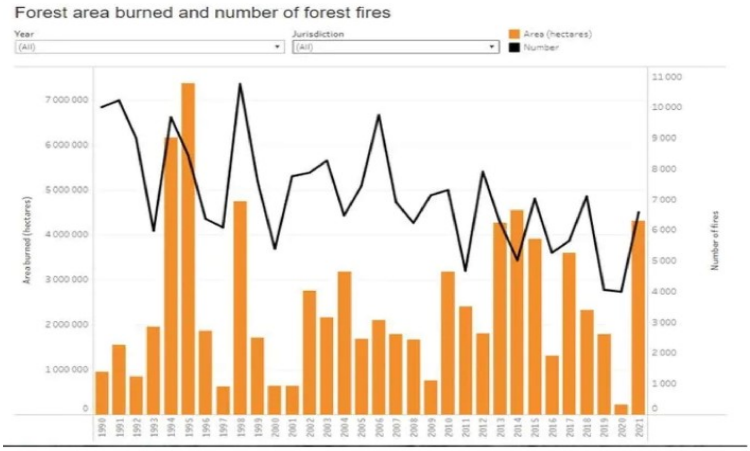
Incidence in wildfires in North America 1600-2000

World area burned per decade has been steadily declining since 1900.



In the spring of 2023 wildfires in Quebec caused major air pollution problems for New York and other Eastern US cities. The data shows a decreasing trend since 1990 in the number of Quebec fires per year, and also shows an extreme variability in acres burned per year with arguably a downward trend since the 1990s. It is usual for Quebec to have a large number of fires per year. For virtually the entire period of the graph there have been more than 1,000 fires per year.

The data for all of Canada shows a decreasing number of fires per year since 1990. Acres burned per year show high variability with little apparent trend.



Forest fires in Canada. Source: NFDP

Conclusion

The ENSO cycle, not climate change, explains why California weather is so variable, and why California has more of a wildfire problem than other US states. But why has the wildfire problem worsened in California and in the US over the last 30 years or so while wildfires have been trending downwards in the world as a whole and in Canada? The ENSO cycle does not appear to have changed over the last 30 years, so it has not been the cause of more wildfires.

The California climate appears to be warming and the California drought index is declining, but these changes appear to be local and not typical of the continental US as a whole. California rainfall is remaining steady (although highly variable) as is overall rainfall in the continental US.

Causation of the increase in wildfires is disputed. California government officials insist the cause is climate change and hence not their responsibility. But many scientists maintain that government forest mismanagement and other government environmental polices are a significant cause. For example, Scott Stephens, a professor of fire science at the University of California Berkeley believes that 20-25% of wildfire damage in California comes from climate change and 75% from the "way we manage lands and develop our landscape."

Basic forest management practices are not followed in California, e.g. (1) controlled logging to remove old and dead trees and to thin the forests, (2) cutting fire breaks and roads through forests at risk of fire, and (3) controlled burns of particularly vulnerable areas (which is usually done in the late fall when the risk of the fire escaping control is minimal).

Since the 1980s environmentalists in California have had significant success at banning basic forest management practices in order to preserve "mature and old-growth" forests, in part, supposedly, to protect endangered species such as the spotted owl. Unfortunately, such "mature and old-growth" forests tend to be high risk for dangerous wildfires.