CALIFORNIA FIRE SCIENCE CONSORTIUM

JOINT FIRE SCIENCE PROGRAM

Research Brief for Resource Managers

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Lightning-ignitions are Unlikely for Santa Ana Wind-Driven Fires

Bendix, Jacob, and Hartnett, Justin. 2018. Asynchronous lightning and Santa Ana winds highlight human role in southern California fire regimes. *IOP Science* https://iopscience.iop.org/article/10.1088/1748-9326/aace39/meta

Many of the most destructive wildfires in southern California occur during Santa Ana wind events. When a wildfire ignites under Santa Ana conditions, the result is a wind-driven fire that spreads quickly across multiple fuel types and is difficult to suppress. Given the fire-adapted and fire-dependent ecosystems in Southern California, there has been some debate over whether human or natural ignition sources were the major factor in shaping the fire regime. The authors of the paper demonstrated that lightning was unlikely to be the main ignition source of Santa Ana winds-driven fires in the area as lightning season and Santa Ana winds very rarely occurred at the same time.

Santa Ana wind-driven fires mostly occur in autumn, when the undergrowth is still dry, whereas lightning strikes mostly occur during the summer. The authors also showed that one potential explanation–summer lightning strike ignitions that smolder until the Santa Ana winds arrive–was also unlikely.
To assess the potential of lightning-ignition during Santa Ana winds, the authors collected data on lightning and fire occurrence from a 25 year period (1986-2010) in the five southern counties of Los Angeles, Orange, Riverside, San Bernardino, and San Diego. The five conditions explored included:

1. The number of days on which both Santa Ana winds and lightning strikes occurred
2. The amount of time that elapsed between lightning days that occurred before the winds, and the time the winds first started
3. The density of lightning strikes in proximity to Santa Ana wind days
4. The seasonal differences for condition 2
5. The presence of large fires resulting from both the lightning and winds

Management Implications

- Currently and historically, Santa Ana wind driven fires were unlikely started by lightning.
- Human ignition may be a much larger factor than lightning is.
- Climate change is drying out fuel sources, which may mean that winter lightning storms could ignite the fuel during Santa Ana winds.

The data on lightning strikes was collected from the National Climate Data center. The authors used a published compilation of days that the Santa Ana winds occurred, which was determined based on analysis of sea level pressure gradients and lower tropospheric advection. The fire data was compiled from California's Fire and Resource Assessment Program. Any fire above 400 ha was considered a large fire based on previous literature. Fires smaller than this were not included in the analysis.

The results showed that it was very rare (less than one day a year) for a lightning strike to occur on the same day as the Santa Ana Winds. For Los Angeles County, there were no lightning strikes during the wind events within the 25 year study period. The results also showed it was unlikely for smoldering lightning fires to be the cause of fires during Santa Ana winds, as there were only an average of 12.1 days a year when lightning struck that was followed by Santa Ana winds within 10 days (the median interval between lightning and Santa Ana Winds was actually much greater – 52 days) . These lightning events have a very low density of strikes and occurred during seasons with more precipitation, further lowering the chance that these lightning events resulted in eventual Santa Ana wind-driven wildfires.

Out of 261 large fires in this study area and time, only 14 were linked to lightning-ignitions. These fires were not within 10 days of Santa Ana winds and burned far fewer acres than human-ignited fires, especially fires ignited during Santa Ana winds.

The authors arrived at the conclusion that human ignition may have been a significant factor in causing fires during Santa Ana winds, because fire occurrence is more frequent than the lightning record would account for. The data also suggest that anthropogenic ignition may have been a significant cause of ignition before EuroAmerican settlement in southern California. Of more current relevance, the frequency and non-seasonal occurrence of modern anthropogenic ignition means that fires are now much more likely to occur during the most severe (Santa Ana) fire weather conditions than would be the case in a "natural" (lightning-dependent) fire regime.

While lightning ignitions during Santa Ana conditions have been rare in the past, predictions under anthropogenic climate change project drier fuels during the winter months when lightning and Santa Ana winds are more likely to occur simultaneously, increasing the future potential for devastating wildfires.

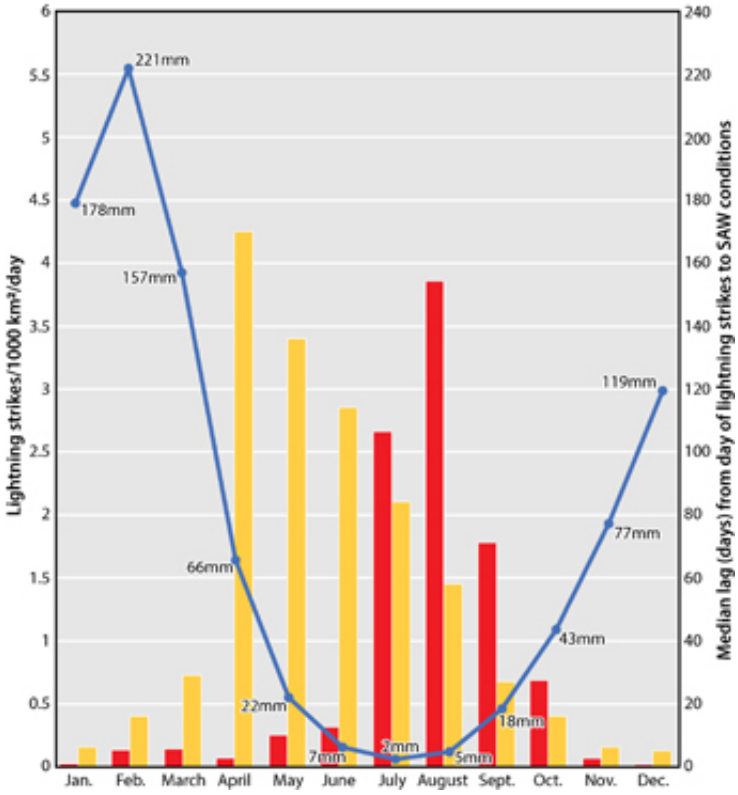

Figure 1. The red bars mark lightning strike density, while the yellow bars show the time that elapsed between lightning strikes and the Santa Ana winds. The blue line shows the monthly precipitation at Mt. Wilson. (Precipitation data from (www.ncdc.noaa.gov/cdo-web/datatools/normals).