Anthropogenic warming drives earlier wildfire season onset in California

Research Brief • February 2026

Over the last few decades, California's wildfire season has been shifting, with increasingly severe impacts on communities. This study tracks that shift by examining when fire season truly begins across 13 ecoregions in California between 1992 and 2020, using an extensive record of fire occurrence data. In most of the state, fires are now starting earlier in the year with the strongest advances being observed in northern regions like the Cascades, the Northern Basin and Range, and the Sierra Nevada. In contrast, one of southern California's desert ecoregions, the Sonoran Basin and Range, experienced a slight delay in fire season onset. Earlier starts in the northern region are closely attributed to warmer and drier conditions, drying out fuels sooner and making landscapes more prone to fires weeks earlier than they used to be. From this analysis, it was shown that anthropogenic warming has advanced fire season onset by 6–46 days in 11 out of the 13 ecoregions, while continued warming is expected to continue to promote earlier fire onsets.

MANAGEMENT IMPLICATIONS

- **Long-term land use planning and management:** Integrate projections of continued warming and any further region-specific advances in fire onset into long-term land-use planning and management strategies.
- **Build proactive communication plans:** Incorporate earlier fire season onset data into emergency preparedness communication plans (smoke, heat, evacuation readiness), especially in communities that typically expect fire impacts later.
- **Climate-informed risk assessments:** Prioritize climate-informed risk assessments that explicitly account for anthropogenic warming as a key driver of earlier fire-season onset and not just interannual variability.

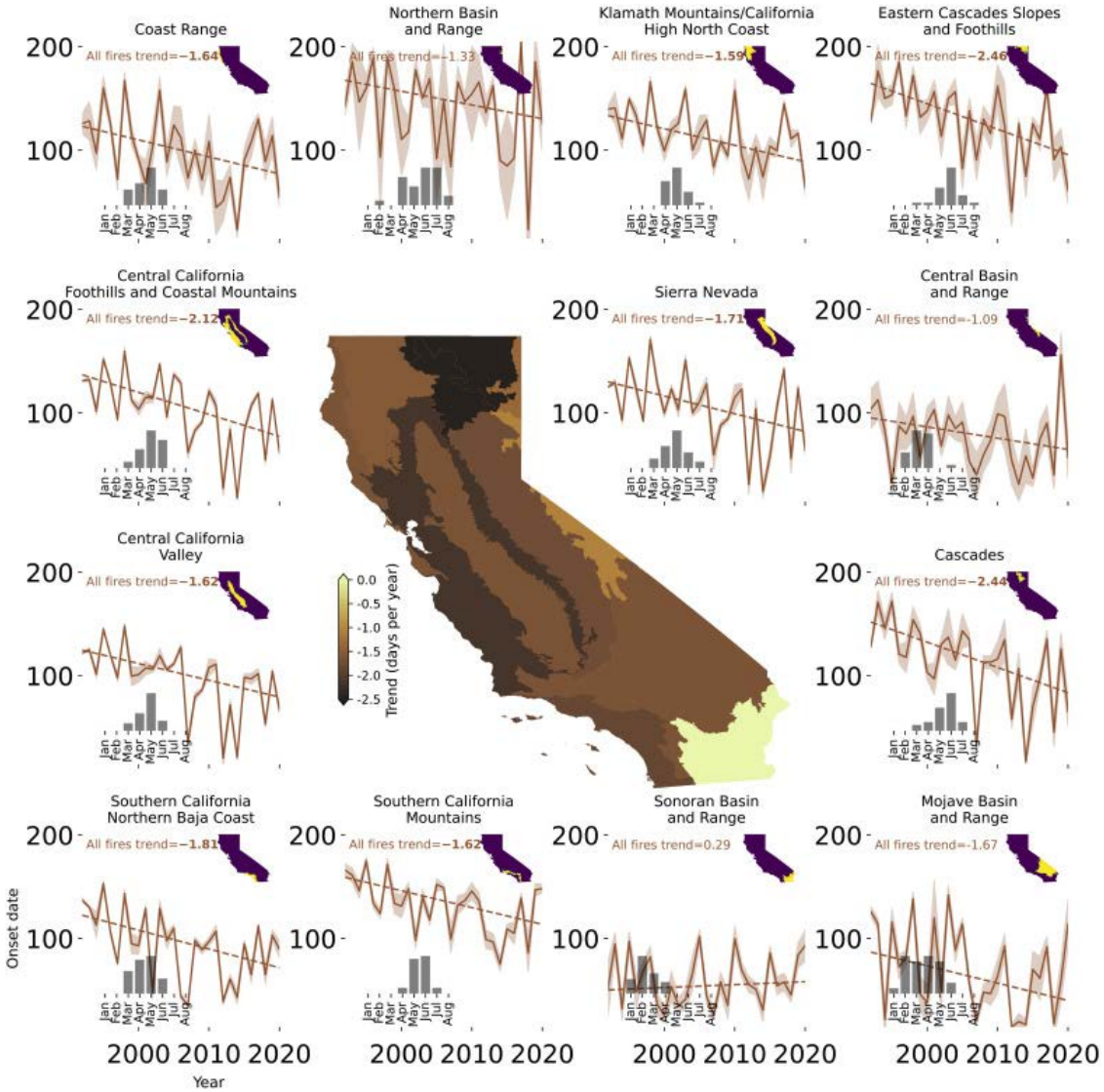


Fig. 1. Trends in fire season onset during 1992–2020. Fire season onset time series (day of the year, shown on y axis) for each ecoregion. The subpanel inset histogram shows the distribution of the detrended onset date in months January (Jan) to August (Aug). The best-fit line is shown as a dashed line, with the trend value (days per year) annotated. Regions where P < 0.05 are indicated by bold font. False discovery rate of 5% was controlled for P values before estimating the significance. X-axis ticks are shown for the years 2000, 2010, and 2020 in each subplot. Shading represents the plus or minus 1 SD for each year, estimated from 100 bootstrap samples. Best-fit lines are Theil-Sen slopes.

Additional Information

This brief is based on the following article:

Madakumbura, Gavin D., Max A. Moritz, Karen A. McKinnon, A. Park Williams, Stefan Rahimi, Benjamin Bass, Jesse Norris, Rong Fu, and Alex Hall. "Anthropogenic warming drives earlier wildfire season onset in California." Science Advances 11, no. 32 (2025): eadt2041. https://doi.org/10.1126/sciadv.adt2041

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