CALIFORNIA FIRE SCIENCE CONSORTIUM

Research Brief for Resource Managers

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Climate change is narrowing and shifting prescribed fire windows

Swain, Daniel L., John T. Abatzoglou, Crystal Kolden, Kristen Shive, Dmitri A. Kalashnikov, Deepti Singh, and Edward Smith. 2023. Climate change is narrowing and shifting prescribed fire windows in western United States. Communications Earth & Environment 4, 340. https://doi.org/10.1038/s43247-023-00993-1

Prescribed fire can be an important tool in mitigating the increase in fire frequency and severity in the Western United States, but there are many constraints in implementing this solution. These constraints often result in the underutilization of burn windows—periods during which ambient vegetation and weather conditions are within acceptable bounds. Although climate has not yet been the primary inhibitor to the implementation of prescribed burning, climate change has increasingly caused indirect impacts on prescribed burning by forcing reallocation of limited fire resources to suppression and recovery activities and potentially altering perceived and/or actual risk, potentially adding to existing challenges. Considering calls for a substantial increase in prescribed burning, current constraints need to be addressed, which includes an understanding of potential shifts in burn windows to maximize the potential for prescribed fire implementation into the future.

In this study, the authors used observed weather and climate data, as well as climate model simulations, to project shifts in the frequency and seasonality of burn windows in the Western United States. Real-world burn plans were used to calculate median upper and lower prescription values for weather, climate, and vegetation parameters. These upper and lower median values determined days that were suitable for prescribed fire (RxDay) at a given location, in both the past and in a warmer climate future.

Management Implications

- Days suitable for prescribed burning (RxDays) are likely to decrease across much of the Western United States, though with large regional variability
- On a "West-wide" basis, RxDays generally decrease most strongly in spring and summer, with weaker trends (and even sub-regional increases) in winter
- Increasing temporal flexibility through management, funding, and regulatory policies is essential in adapting to the projected changes in burn windows
- Widespread decreases in large-diameter fuel moisture are becoming an increasingly important consideration for risk and contingency planning purposes

Climate data from 1981 to 2020 was used to calculate the total annual number of RxDays, which ranged from 10 days in wetter regions, to greater than 70 days per year, with the highest values in areas mainly characterized by non-forest vegetation types. These regions also experienced high seasonal and interannual variability in RxDays.

Climate model simulations, 2021-2060, were used to determine that climate change will decrease RxDays across most of the Western United States in a "medium warming" scenario, with significant decreases of approximately 15 to 30 RxDays per year in the southern half of the region (including much of California). However, projected trends in the northern half of the region range from modest decreases to little change, or localized increases.

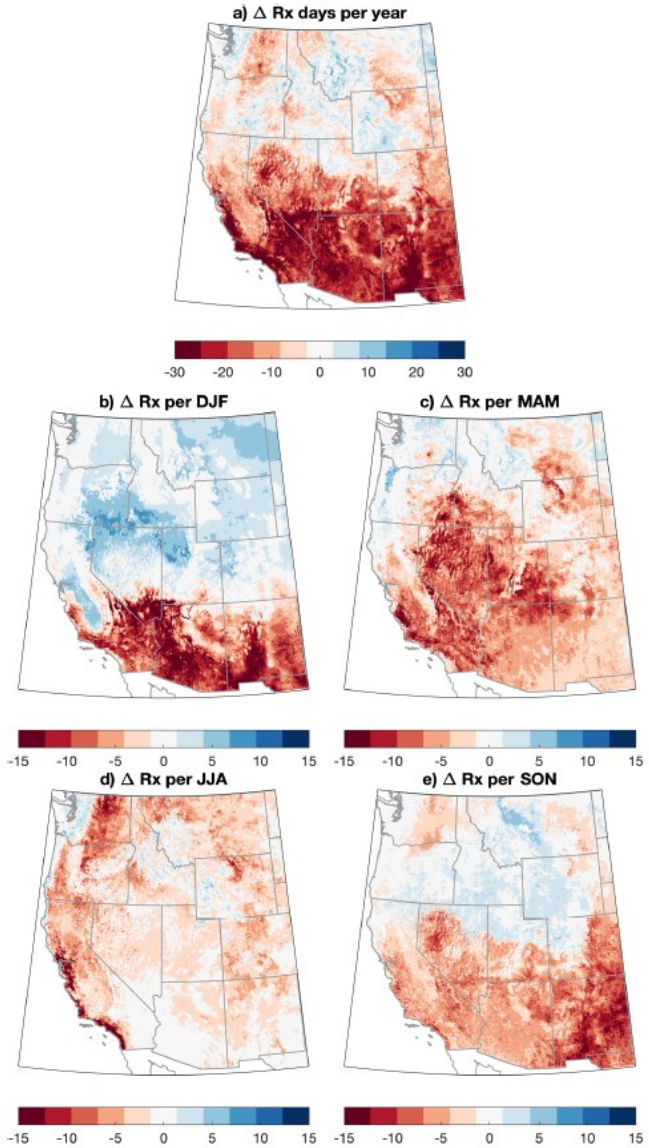

*Figure 1: Maps depicting the projected change in the number of RxDays across the western United States (WUS) on an annual (**a**) and seasonal (**b**–**e**) basis. The change in projected RxDays is calculated as the difference between the RxDay counts during 2021–2060 vs. 1981–2020 on a "moderate warming" (RCP4.5) trajectory using meteorological data from the downscaled CMIP5 climate model ensemble dataset (MACA).*

Projected trends vary strongly by season, with notable decreases in the spring and summer across most of the region as well as during the winter and autumn across the southern tier, with the strongest decreases being shown along the coastal regions of central and southern California and portions of the Great Basin. In winter, however, the study finds either little trend or modest increases in RxDays across most of the West (including northern California) except for southern California, southern Nevada, Arizona, and New Mexico. On a "West-wide" full study domain basis, projected decrease strongly in the summer, spring, and (to slightly lesser extent) fall, but there are slight increases in the winter.

These findings suggest that climate change will add additional barriers to the implementation of prescribed fire by narrowing burn windows and exacerbating extreme wildfires, potentially monopolizing already scarce fire management resources and increasing perceived and/or actual safety concerns. However, this study also emphasizes the value of prescribed fire as a risk management tool and emphasizes the locally extensive opportunities to potentially expand its scope by capitalizing on remaining favorable RxDays in non-traditional calendar months and/or during anomalously favorable years, requiring significant investment and policy changes.

These findings support calls for an expanded year-round fire management workforce, whose duties extend beyond fighting wildfire to encompass implementation of prescribed fire, while also highlighting the importance of increasing funding and the removal of regulatory barriers, especially regarding cultural burning practices. Additionally, the results suggest smoke emission thresholds and constraints need to be reevaluated regarding prescribed fires to reduce the risk of extreme air pollution from catastrophic wildfires. Increasing flexibility through management, funding, and regulatory policies is essential in adapting to the projected changes in burning windows throughout the Western United States and reducing the wildfire hazards of a warming climate.