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## *Research Brief for Resource Managers*


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# Forecasting Fire Regime Changes By Mapping Driver Changes Across California


*Syphard, Alexandra D. and Jon E. Keeley. 2020. Mapping fire regime ecoregions in California. International Journal of Wildland Fire: 1-7. [10.1071/WF19136.](10.1071/WF19136.)*


The fire regime is a central framing concept in wildfire science and describes how wildfire characteristics vary geographically over time. Most fire regime classifications are based on historical fire patterns, such as fire frequency, size, and severity. This approach can result in fire regime classes that encompass regions with similar fire characteristics but wide differences in ecosystem types and is not well-suited to regions where historical data are lacking.

In a new publication, Syphard and Keeley (2020) aim to devise a fire regime classification that better aligns with ecosystem types. In this new approach, fire regimes are defined by the biophysical and anthropogenic attributes that shape fire activity rather than historical fire outcomes. The authors suggest that evaluating the long-term driving variables of a given fire regime may allow for better management of fire prone regions.

In demonstration, they offer a digital **California Fire Regime Ecoregion** map and methodology for use in fire research and management planning. The authors developed the map by assembling a database of topographic, climatic, vegetation, and anthropogenic variables that have been significantly associated with geographical variation in California fire regimes (Table 1; Fig.1a). These data were normalized and mapped to a 270 m resolution grid overlaid on the state of California. A classification algorithm was then used to sort the grid cells into clusters based on the biophysical and anthropogenic variables, creating a series of fire regime ecoregions. Finally, the mapped ecoregions were evaluated against traditional, historical fire regime outcome data (Fig.1b, c).

Overall, the Fire Regime Ecoregion map (Fig.1a) corresponds well with the major land cover types for California (Fig.1d) as well as with historical fire size and frequency, suggesting that this approach may be applied to any fire prone location. The authors conclude that by focusing on fire driver variability, managers may be better able to predict fire variability, especially where

## Management Implications

- This **California Fire Regime Ecoregion** classification map (i.e., using clustered driver variability layers) may be a more robust tool for predicting future fire regime variability than the traditional practice of using past fire regime variability.

- This methodology could be useful in any fire prone region, especially where historical fire data is scarce or absent and where the fire drivers are changing.

historical fire data are scarce and the drivers are changing.

**Table 1. Variables used in the classification and evaluation of fire regime ecoregions in California**
FPA-FOD, fire program analysis fire-occurrence database; NDVI, normalised difference vegetation index

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|---|---|---|---|---|
| Fire | Historical frequency | Mean count of fires in each cell, averaged across all cells within fire regime ecoregion 1978–2015 | http://frap.fire.ca.gov/data/frapgisdata-sw-fireperimeters_download | |
| | Severity | Historical severity class (i.e. effect on landcover) for wildfire disturbance 2006–2016. Classes ranked numerically (1–4) for unburned/low, low, medium and high severity and averaged per fire regime ecoregion within disturbance footprints | https://www.landfire.gov/hdist.php | |
| | Size | FPA-FOD, 1992–2015, inverse distance weighted spatial interpolation based on fire size attribute (ha) | https://www.fs.usda.gov/rds/archive/Product/RDS-2013-0009.4/ | |
| Terrain | Elevation | Height above sea level (m) | https://www.landfire.gov/elevation.php | X |
| | Topographic heterogeneity | Range of elevation values within 810-m radius from centre cell (0–1) | Nature Serve (https://databasin.org/datasets/1f86100938b544a3b6361eee6ac05945) | X |
| Climate | Annual precipitation | Mean sum over calendar year (mm), 1981–2010 | http://climate.calcommons.org/dataset/2014-CA-BCM | X |
| | Summer precipitation | Mean sum over June, July, August (mm), 1981–2010 | http://climate.calcommons.org/dataset/2014-CA-BCM | X |
| | Annual minimum temperature | Mean minimum temperature of December, January, February (°C), 1981–2010 | http://climate.calcommons.org/dataset/2014-CA-BCM | X |
| | Annual maximum temperature | Mean maximum temperature over June, July, August (°C), 1981–2010 | http://climate.calcommons.org/dataset/2014-CA-BCM | X |
| | Actual evapotranspiration | Total annual water evaporated from surface and transpired by plants (mm), 1981–2010 | http://climate.calcommons.org/dataset/2014-CA-BCM | X |
| | Climatic water deficit | Annual evaporative demand exceeding water availability (mm), 1981–2010 | http://climate.calcommons.org/dataset/2014-CA-BCM | X |
| | Snow water equivalent | Amount of water contained within snowpack (mm), 1981–2010 | http://climate.calcommons.org/dataset/2014-CA-BCM | X |
| Vegetation | NDVI annual minimum | 30-year means of annual minimum NDVI, Landsat TM, 1984–2010 (−1 – 1) | http://climateengine.org/data | X |
| | NDVI annual maximum | 30-year means of annual maximum NDVI, Landsat TM, 1984–2010 (−1 – 1) | http://climateengine.org/data | X |
| | Vegetation type | Habitat and land cover types spanning 1990–2014 | https://frap.fire.ca.gov/mapping/gis-data/ | |
| Land use | Housing density | Derived from US Department of Commerce, US Census Bureau partial block groups, 2000, units per square km | http://silvis.forest.wisc.edu/data/housing-block-change/ | X |
| | Distance to roads | Derived Euclidean distance to TIGER line files 2015, US Department of Commerce, US Census Bureau (m) | https://www.census.gov/geo/maps-data/data/tiger-line.html | X |

**Figure. 1.** Maps showing (*a*) fire regime ecoregions with variables correlated at $r$ # 0.7; (*b*) historical fire count, (*c*) historical fire size and (*d*) land cover type in California