Causes, characteristics, and consequences of California's extreme wildfire events

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Abstract

Introduction

Increasing frequency of large fires in western U.S. (Dennison et al. 2014) Increasing frequency of extreme fire conditions in California (Goss et al. 2020). Increasing severity of fires in western US (Parks and Abatzoglou 2020). Increasing area burned (Abatzoglou and Williams 2016, Williams et al. 2019) Burned area is fundamentally limited way of characterizing wildfires, particularly extreme wildfire events (Kolden 2020).

Clear link between fire activity and climate change, and a proposed link to extreme events.

Important to understand extreme wildfire events, as they are likely to be societally impactful [Balch et al. (2018); Iglesias et al., 2021].

Some efforts exist, but still focus on size (Joseph et al. 2019).

Challenge of defining "extreme wildfire events," but can be done by considering fire behavior within the context of fire's controllability, but decoupled from the societal impact (Tedim et al. 2018).

Then we can further characterize drivers of these extremes, and under what conditions they can lead to disasters (Bowman et al. 2017).

Interactions between drivers can be especially important (Balch et al. 2018). Notion of homogenization of conditions in space/time leading to more extreme behavior (continuous fuels, longer duration hot drought) Consideration of positive feedback-driven events as its own category.

Fuel, topography, weather and their spatiotemporal nexus to describe different "taxa" of extreme wildfire events.

Methods

Characterize extreme wildfire events

FIRED dataset daily fire perimeters (Balch et al. 2020). 2000 fire events in California between 2001 and 2020. MODIS active fire product (MCD14ML) (Giglio et al. 2016). Fire radiative power (FRP) to fireline intensity on a 4x daily timestep, then classification of that day based on Tedim et al. (2018). Classes 5, 6, and 7 considered "extreme wildfire events." Fire radiative power to fire radiative energy (FRE) by integrating through time course of each event. Additional characterization of "extreme" based on FRE due to smoke impact

Causes of extreme wildfire events

Collate potential causes of extreme wildfire events (or perhaps of all events; might as well?) Total fuel, fuel heterogeneity

Max wind speed from nearby RAWS station

VPD from ERA-5 or Gridmet (Abatzoglou 2013)

Wind alignment (Abatzoglou 2013) with slope (National Elevation Dataset)

Historic aridity from CWD? (Flint et al. 2013)

Characterize different taxa of extreme wildfire events, perhaps using PCA

Consequences of extreme wildfire events

Spatial join with FRAP (https://frap.fire.ca.gov/frap-projects/fire-perimeters/) and MTBS (Eidenshink et al. 2007). Simple stats on cost, lives lost, homes destroyed for each category of extreme wildfire events

Results

Figures 1. Conceptual diagram of fuel, topography, weather factors (and how they interact) to drive extreme wildfire events

1. Map of daily FIRED perimeter having active fire detections within it and delineation of fire head

1. Distribution of fireline intensity for all California fires 1. Distribution of multivariate fuel, topography, climate conditions 1.

Table 1. Akin to (Bowman et al. 2017) showing different categories of extreme wildfire events 1. Depending on how many are classified as "extreme," a table with the info joined from MTBS/FRAP

Discussion

Wildfire disasters versus extreme wildfire events.

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