Effects of Future Climate on Chaparral Fire Regimes

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Why are questions related to climate change so challenging?

2012 MODIS Active Fire Detections from the Aqua and Terra Satellites

Active fires, shown in red, are detected using MODIS data from the Aqua and Terra satellites
Why are questions related to climate change so challenging?

(Moritz et al. 2012)
Why are questions related to climate change so challenging?

(Moritz et al. 2014)
High Variation & Uncertainty!

- Natural fire regimes are complex & have multiple drivers.

- There are great differences in how humans have impacted various fire-prone landscapes.

- Future projections from global climate models (GCMs) often disagree on key variables.
One More Challenge: California is Complex!
One More Challenge: California is Complex!
Take-home Messages:

• Future fire activity is predictable to a certain degree.

• The future depends on BOTH: 1) which climate scenario & 2) which land use scenario actually occur.

• We need to know time horizon & question of interest!
Fire Probabilities & Environmental Gradients

Species Distribution Modeling

Fire-proneness

Environmental Variable

marginal conditions

suitable conditions

too cold or wet

too hot or arid
Developed for California...

Predictions:

- **Full model**: AUC = 0.884
  - Top variables: Pot. vegetation, Nonfuel, July max. temp.

- **Climate-only**: AUC = 0.871
  - Top variables: July max. temp., March tot. precip., January precip. freq.

- **Derived climate**: AUC = 0.853
  - Top variables: Max. monthly tot. precip., Max. monthly precip. freq., Max. monthly temp.
Global Ensemble Model Projections

Training data:

(a) Fire counts

No fire  Low  High

(Moritz et al. 2012)
Functional Response Curves...

(NPP, Pann, Pdry, Tseas, Twet, Twarm)
Global Ensemble Model Projections

A. Mean change

B. Agreement

C. 2010-2039

D. 2070-2099

-0.25 Decrease  No change  Increase  0.25

Likely decrease  90%
Likely increase  66.7%
Low agreement  66.7%  90%

(Moritz et al. 2012)
Which Future to Accommodate?

(Batllori et al. 2013)
Which Future to Accommodate?

For example:
Warmer-wetter Mediterranean CA:
Human Influences at Finer Scales!

(Mann et al. 2016)
Human Influences at Finer Scales!

(Mann et al. 2016)
Including Human Dimensions

(Mann et al. 2016)
More Mechanistic Variables...

[Mann et al. 2016]
Wildcards?

- Precipitation
- Winds
- Grass-fire Cycle
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This scale?
Or this?
What could better planning achieve?
Description: Annual probability of fire occurrence (%) derived from Mann et al. (2016) projections for 2026-2050. Source data represents projected mean fire return interval (MFR) derived under A2 emissions scenario in both GFDL and PCM climate models. MFR projections for two models were combined by taking minimum MFR for each cell, inverted to get annual probability, then multiplied by 100 to get percent value.
How to Apply?

Adaptation: CA Department of Water Resources
Thanks...

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