



Identifying shift in fire regime from trends in burnt area controls

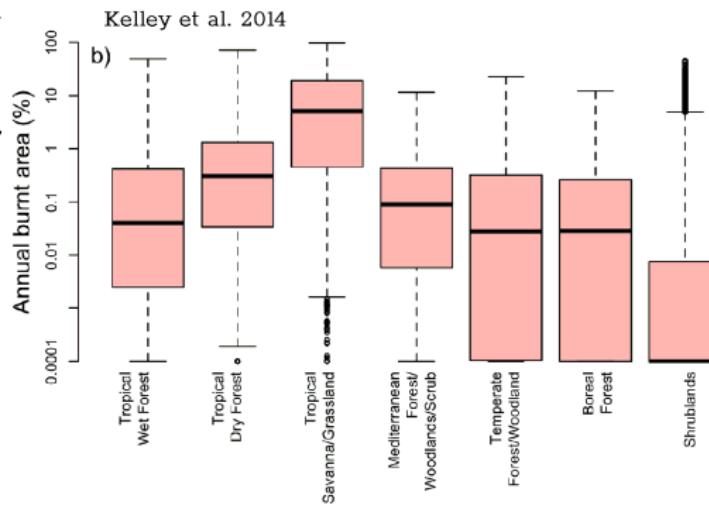
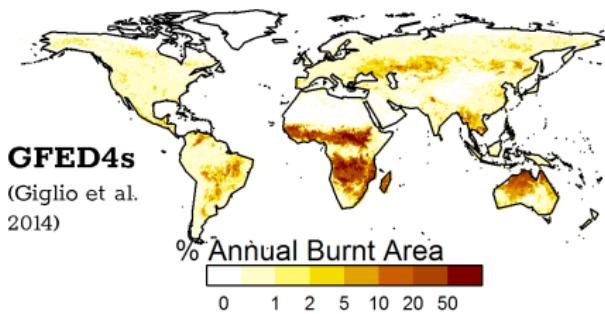
Sensitivity of burnt area to different controls

Douglas Kelley, Ioannis Bistinas, Rhys Whitley, Chantelle Burton

16th January 2018

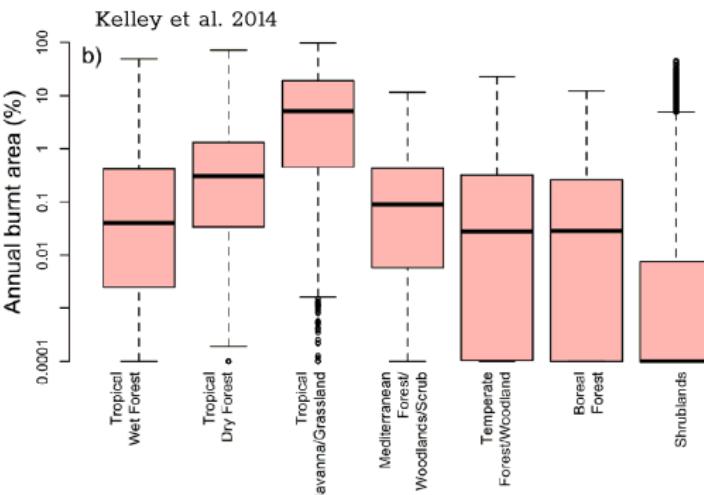
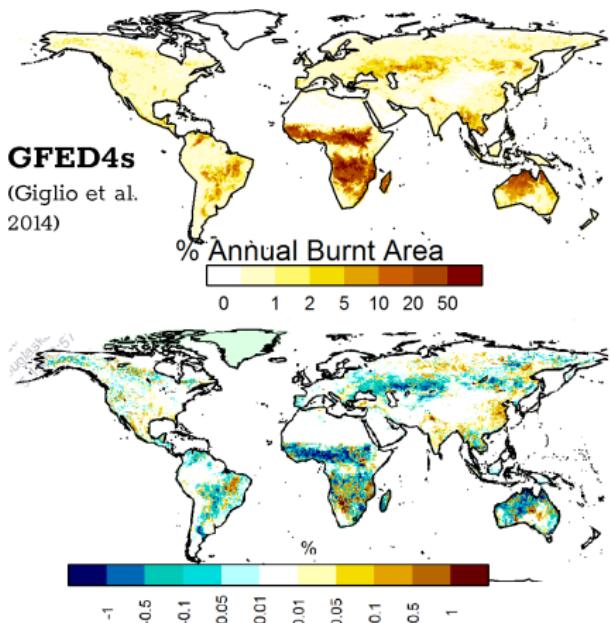
Burnt Area

By ecosystem



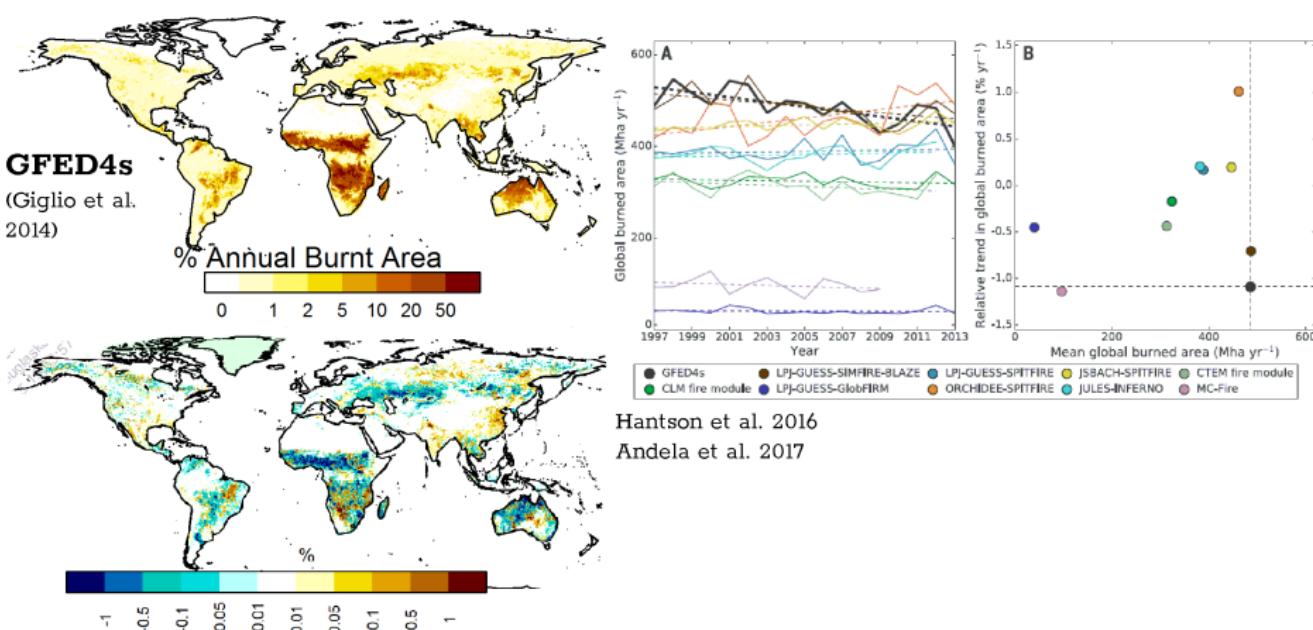
Burnt Area

Trends



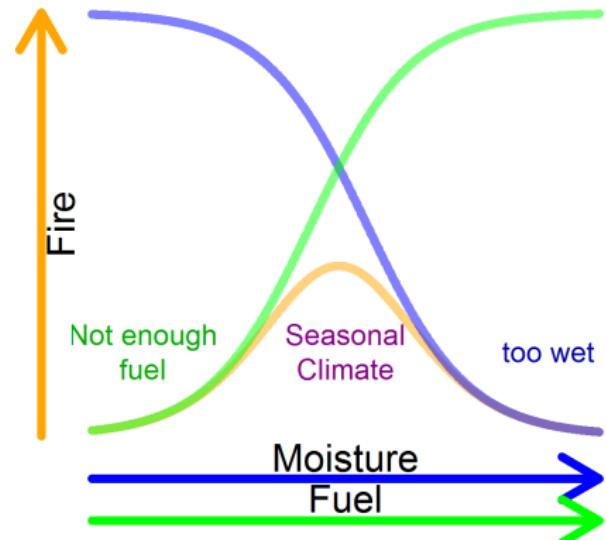
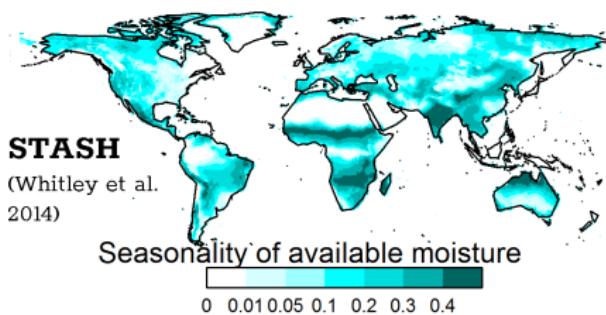
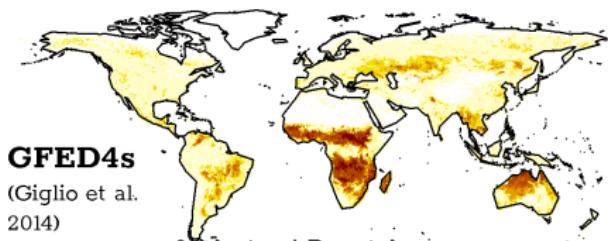
Burnt Area

Fire model performance



It burns where it rains (a bit)

Uni-modal relationship with moisture



What about everywhere else?

- What controls fire outside of tropical savanna?

What about everywhere else?

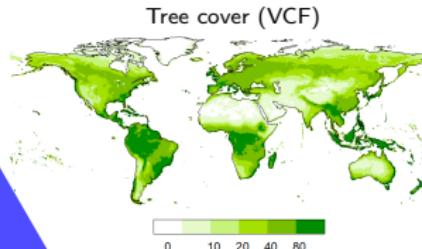
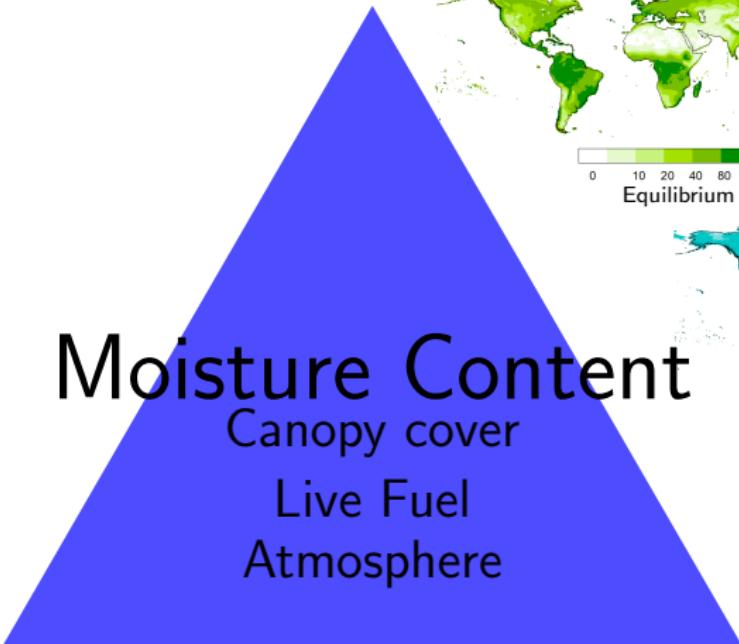
- What controls fire outside of tropical savanna?
- How much is people, how much is vegetation and how much is climate?

What about everywhere else?

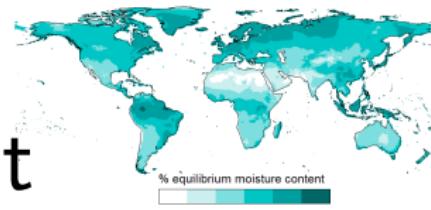
- What controls fire outside of tropical savanna?
- How much is people, how much is vegetation and how much is climate?
- How sensitive is fire to changes in these controls?
- Are there detectable trends in controls?

Fire limitation framework

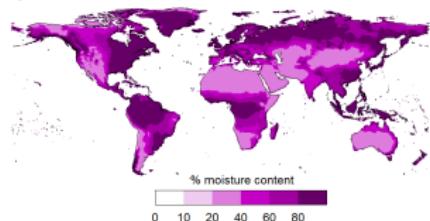
Spatial and Temporal controls on burnt area



Equilibrium Fuel Moisture Content (Kelley et al. 2014)

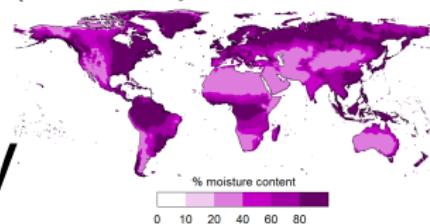
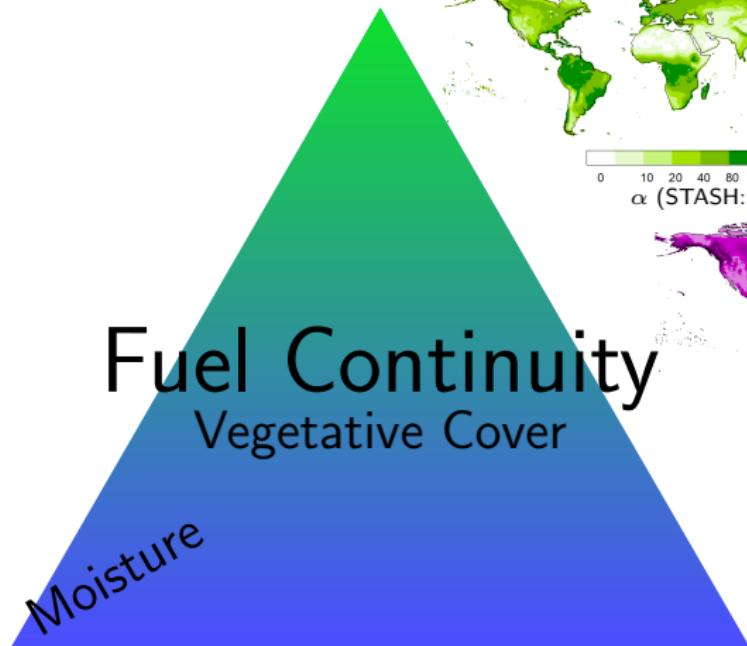


α (STASH: Whitley et al 2014; Davis et al 2014)



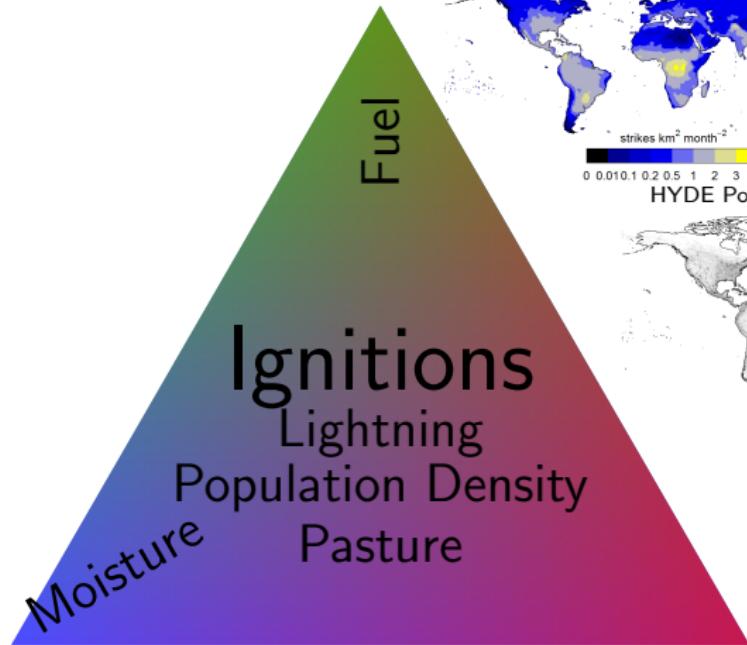
Fire limitation framework

Spatial and Temporal controls on burnt area

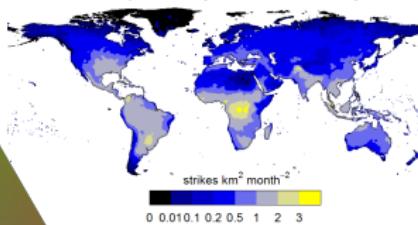


Fire limitation framework

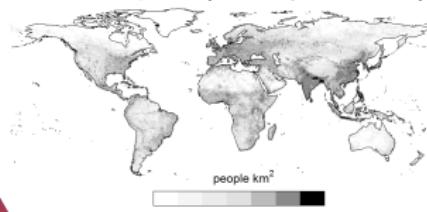
Spatial and Temporal controls on burnt area



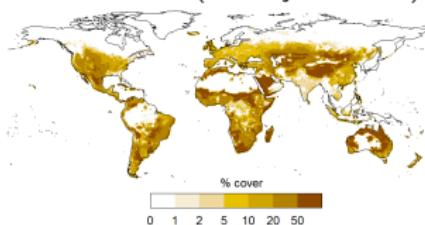
LIS/OTD (Christian 1999)



HYDE Popdens (Goldewijk et al 2011)



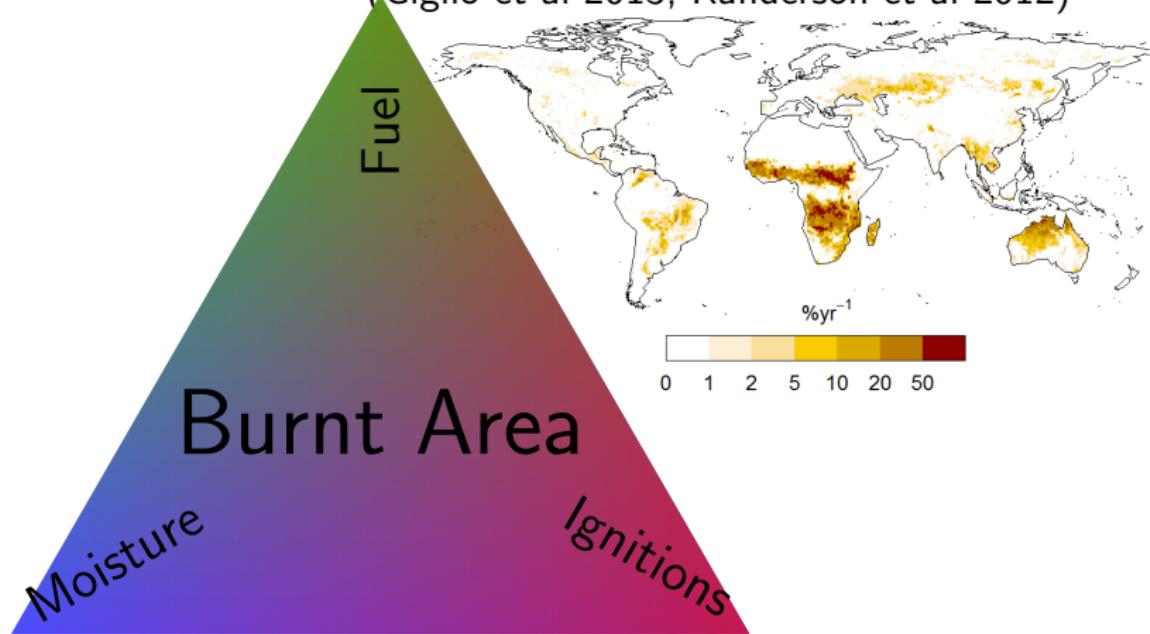
HYDE Pasture (Goldewijk et al 2011)



Fire limitation framework

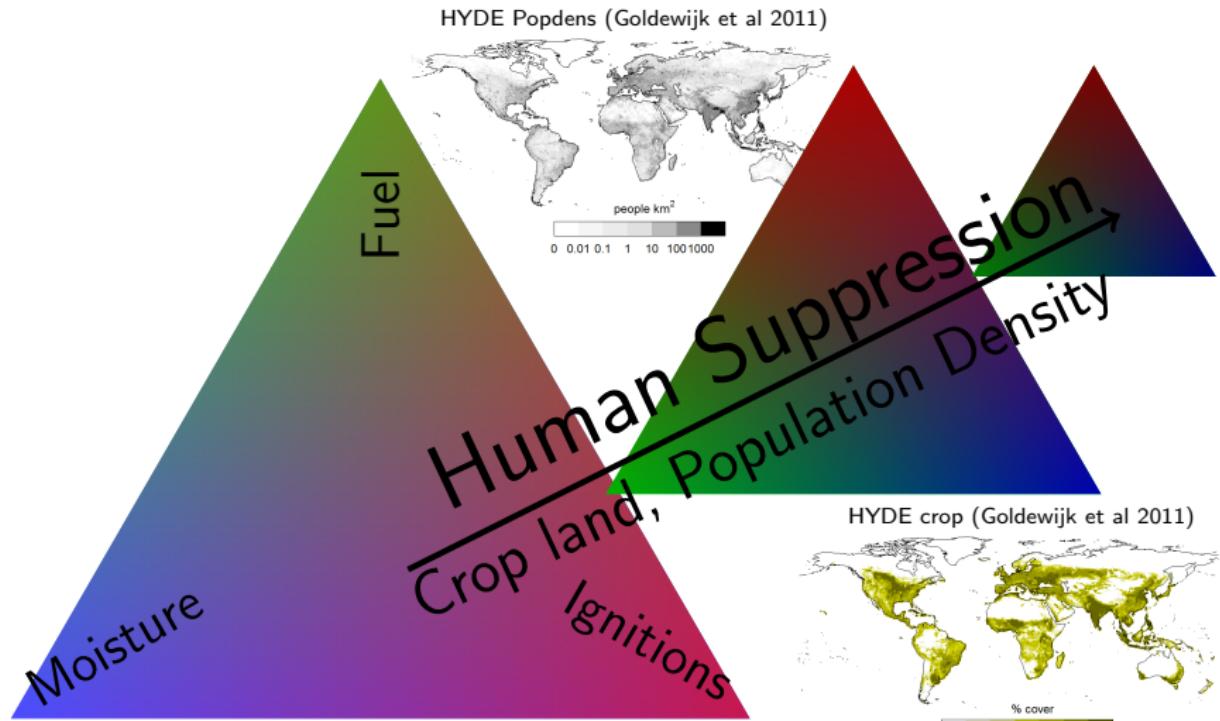
Spatial and Temporal controls on burnt area

Global Fire Emission Database 4s
(Giglio et al 2013; Randerson et al 2012)



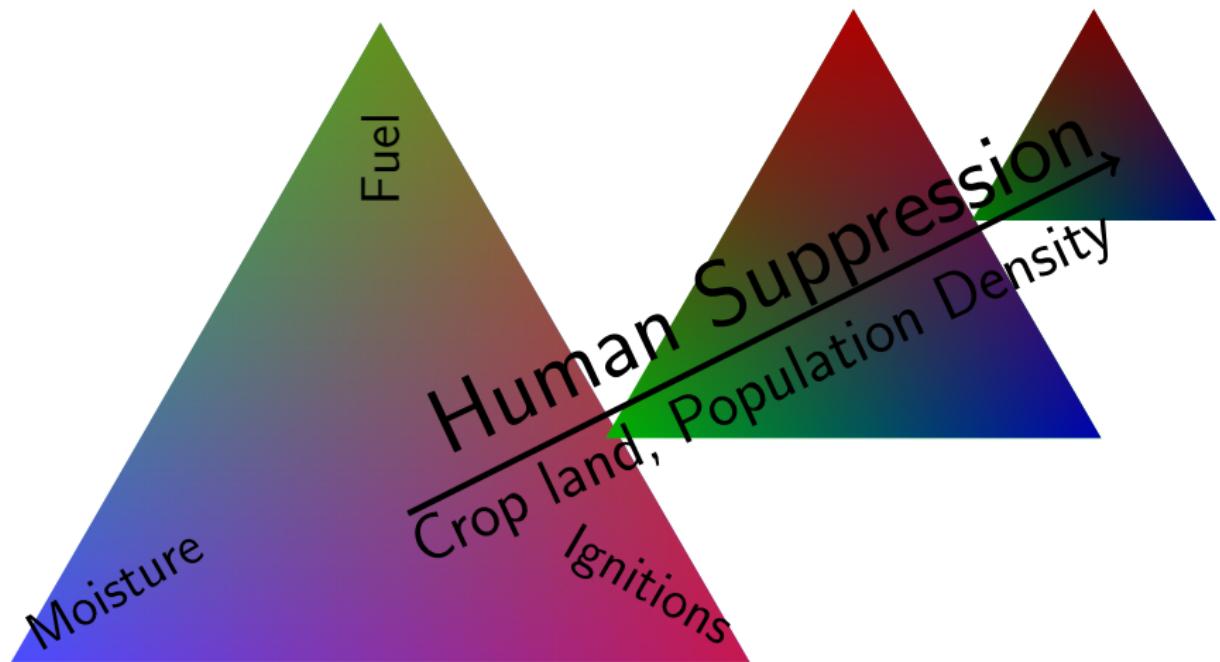
Fire limitation framework

Spatial and Temporal controls on burnt area



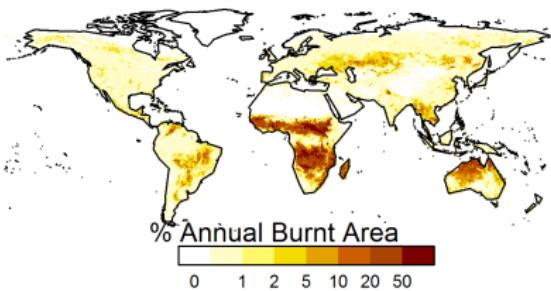
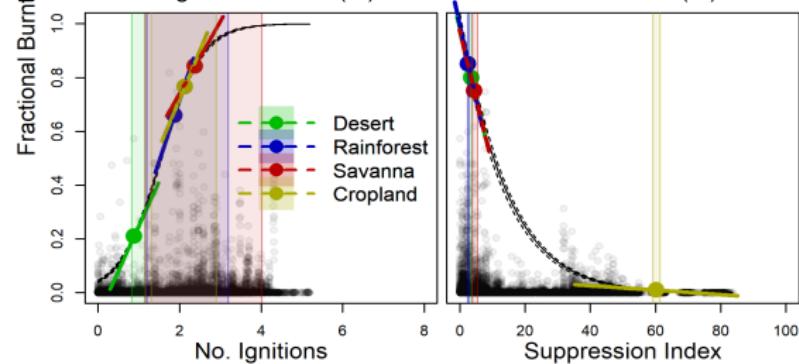
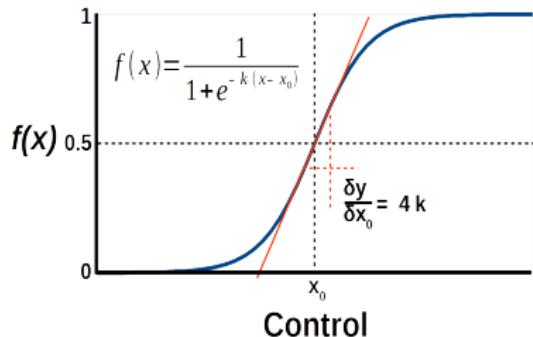
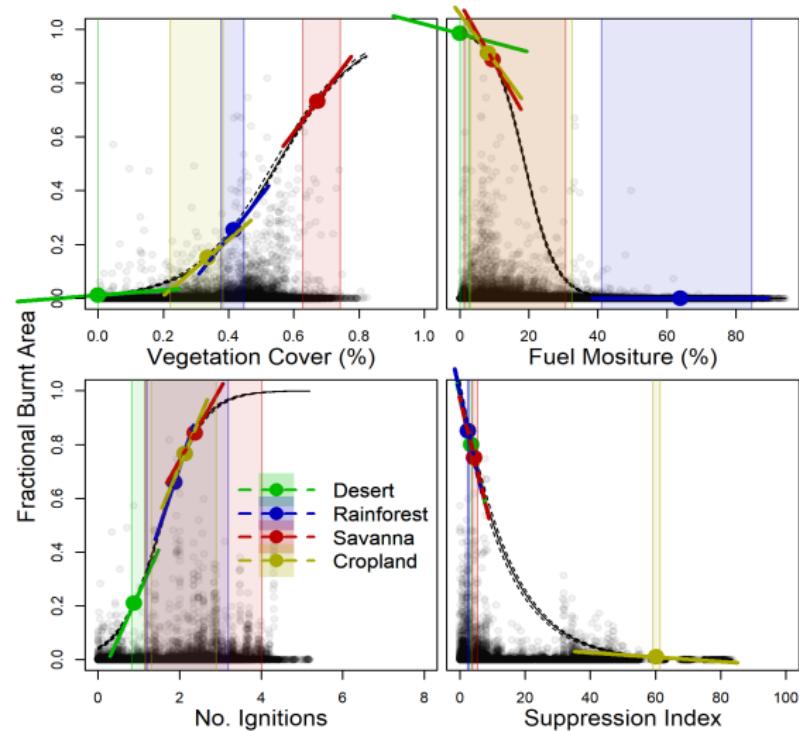
Fire limitation framework

Spatial and Temporal controls on burnt area



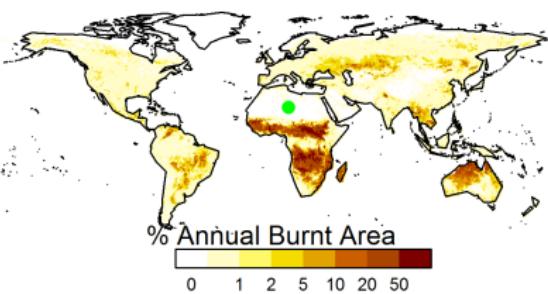
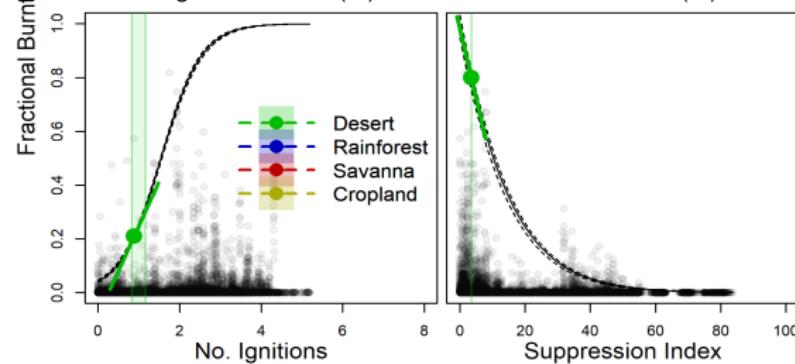
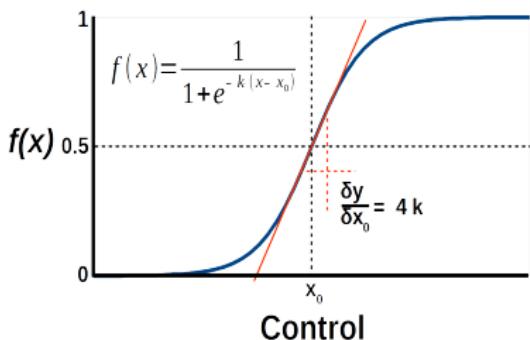
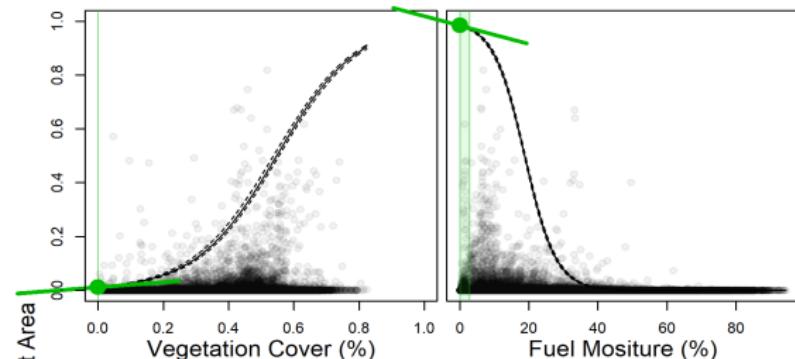
Controls on fire

"Raw" limitation



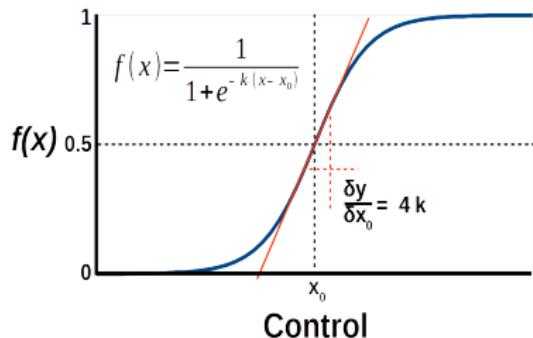
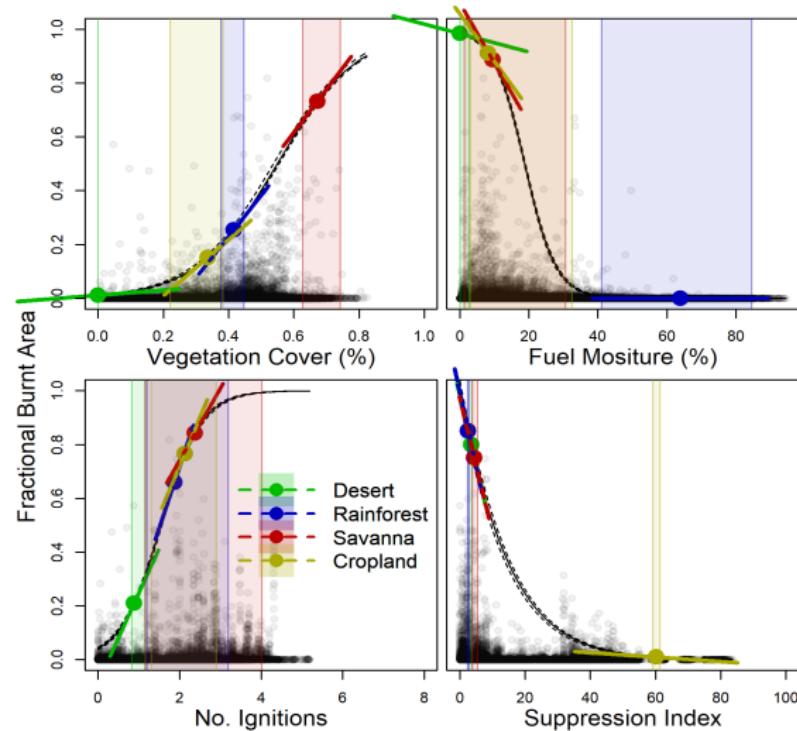
Controls on fire

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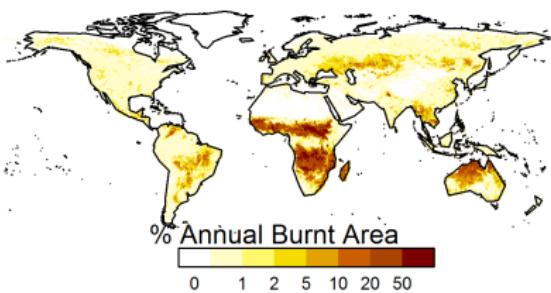
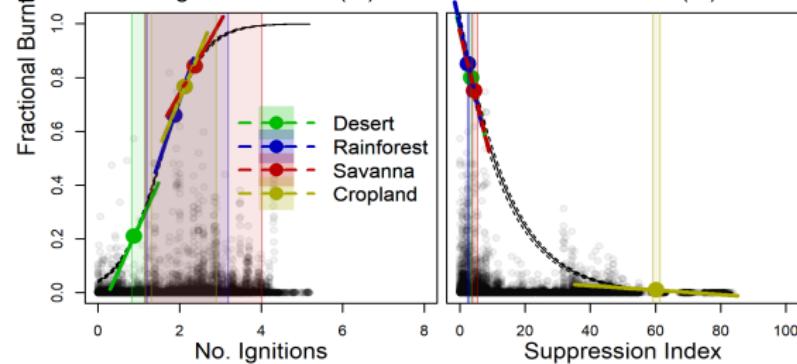


Controls on fire

"Raw" limitation

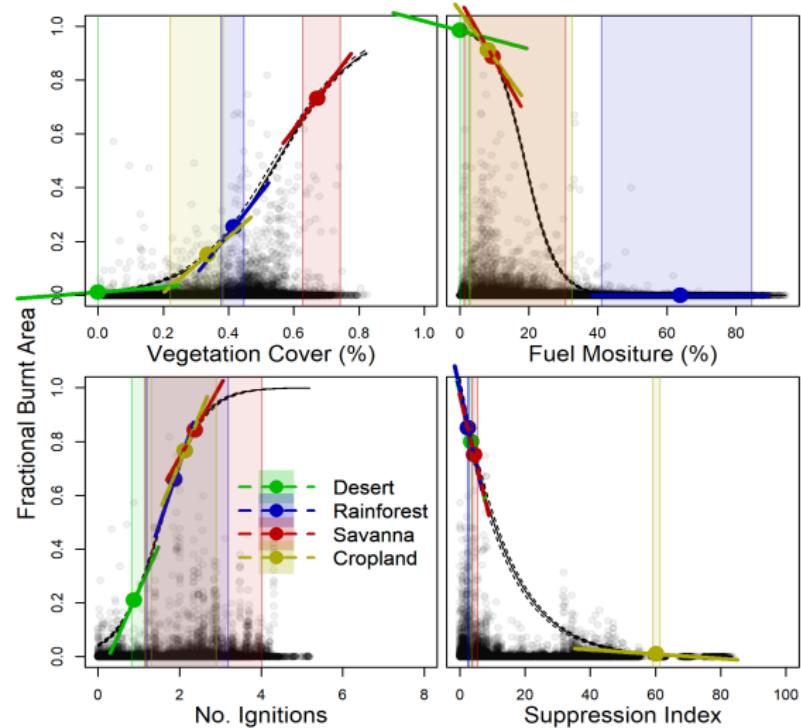


Control

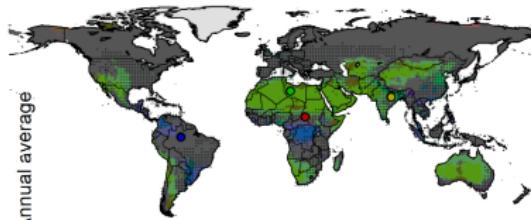


Controls on fire

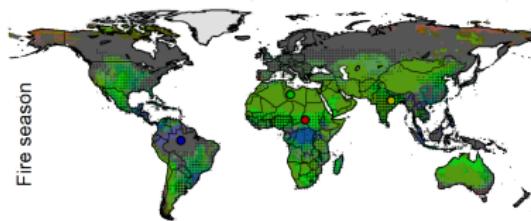
“Raw” limitation



a) Raw limitation



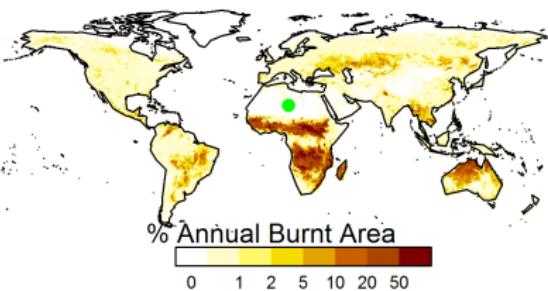
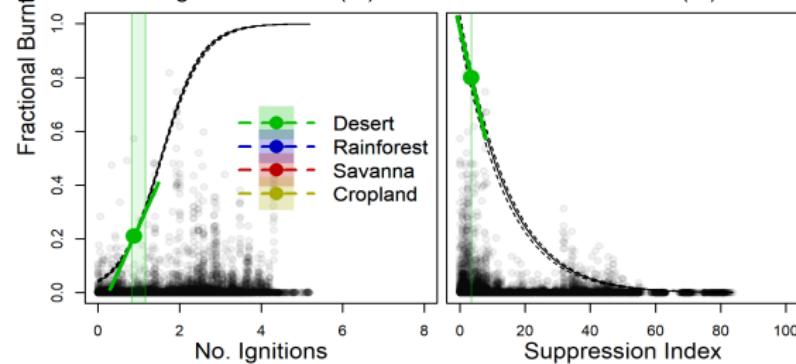
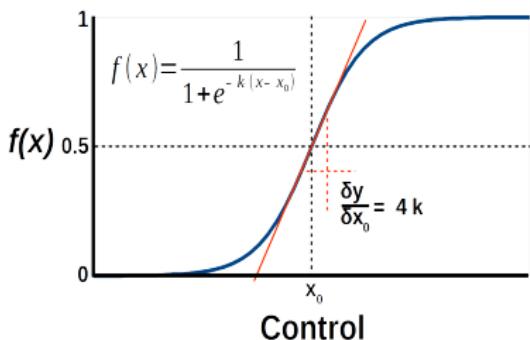
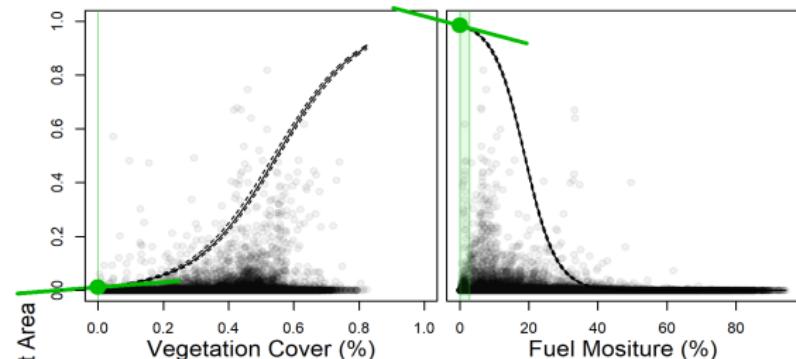
Annual average



Fire season

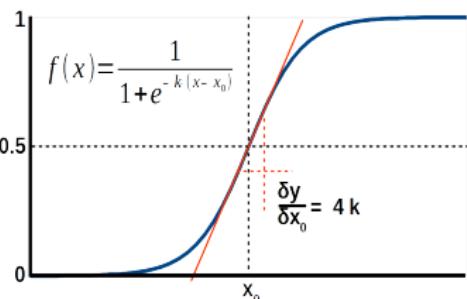
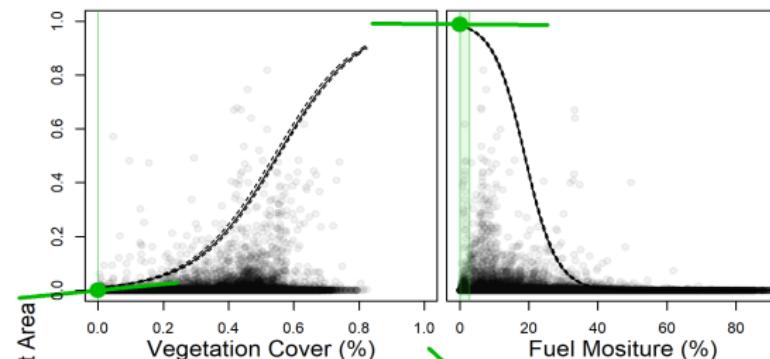
Controls on fire

“Potential” limitation

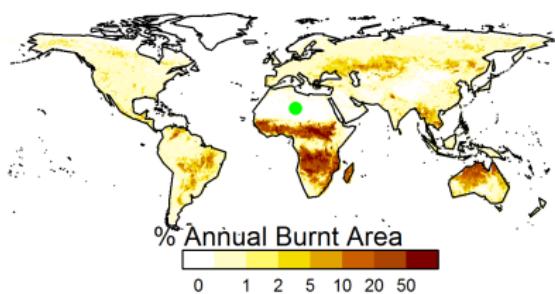
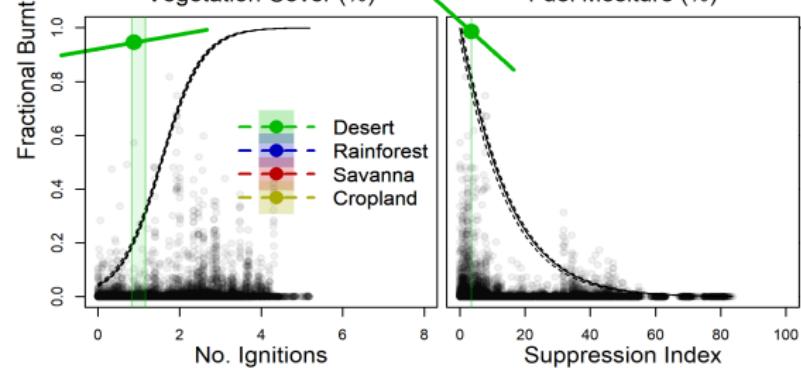


Controls on fire

"Potential" limitation

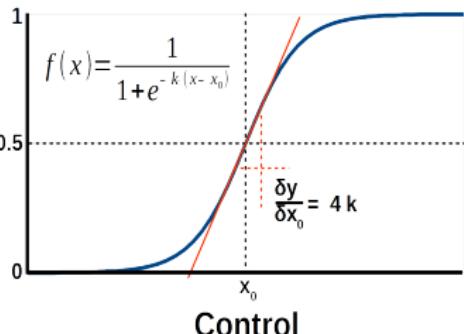
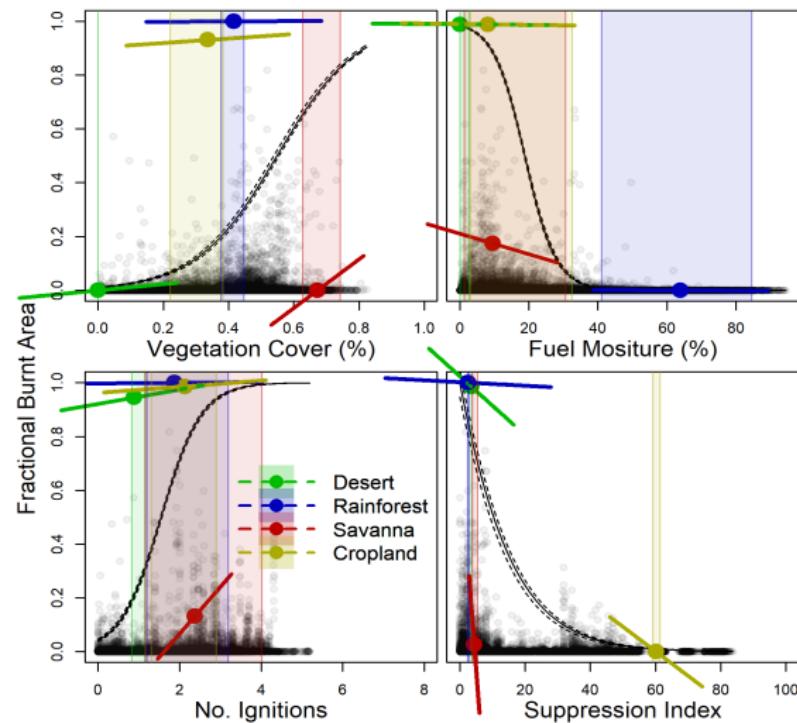


Control

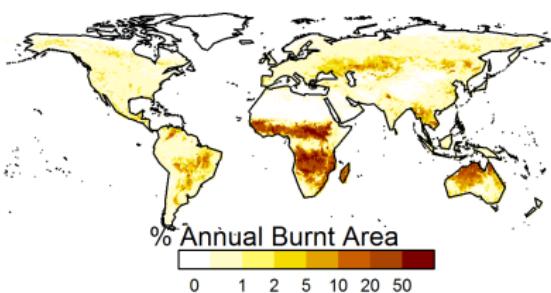


Controls on fire

"Potential" limitation



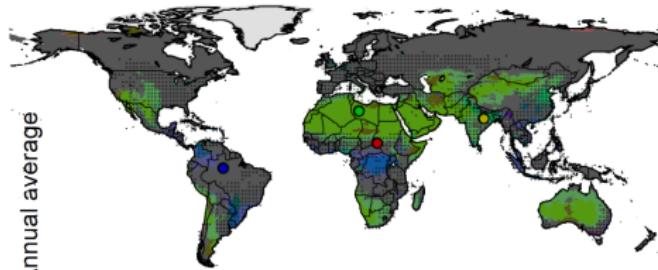
Control



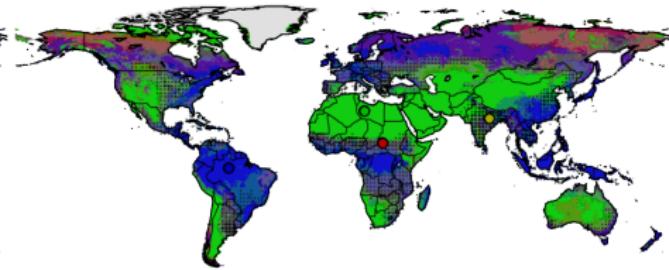
Controls on fire

“Potential” limitation

a) Raw limitation

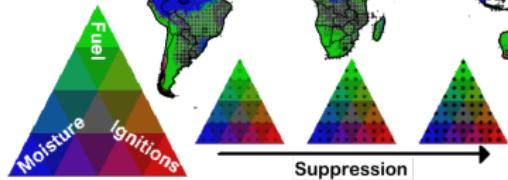


b) Potential limitation



Annual average

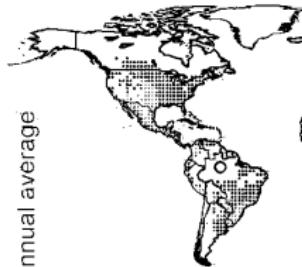
Fire season



Controls on fire

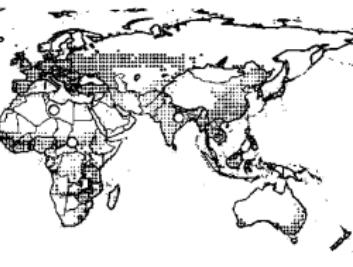
"Potential" limitation

a) Raw limitation



Annual average

b) Potential limitation



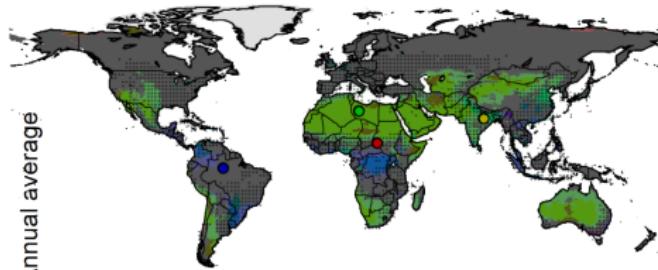
Fire season



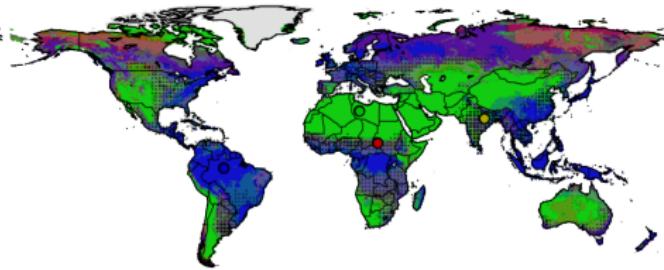
Controls on fire

“Potential” limitation

a) Raw limitation

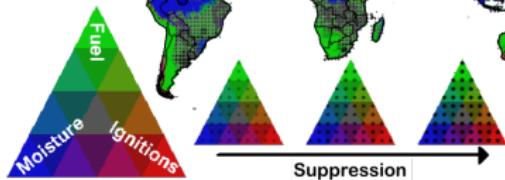


b) Potential limitation



Annual average

Fire season

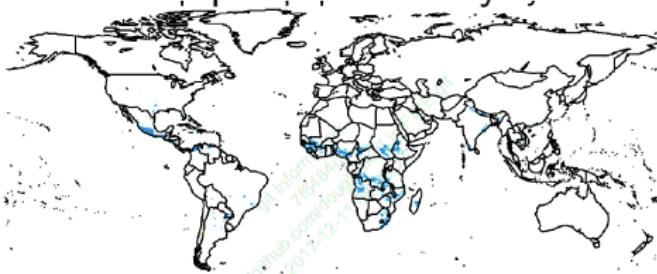


Human Impact

Suppression & Fragmentation

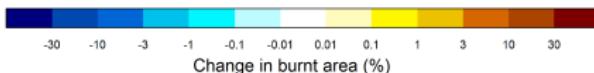
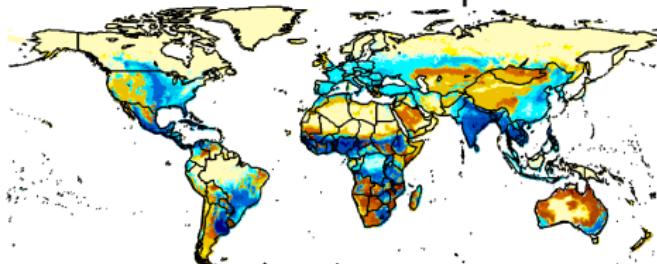


Population density



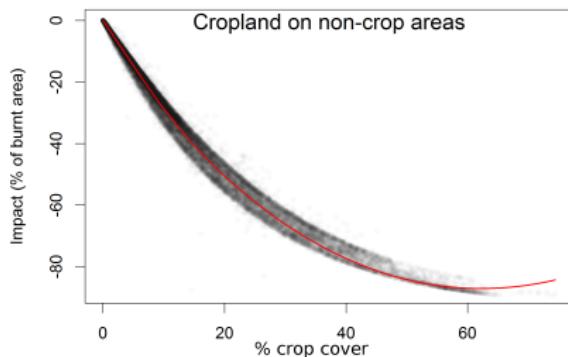
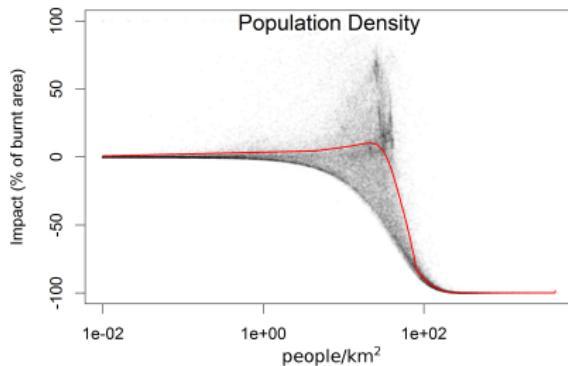
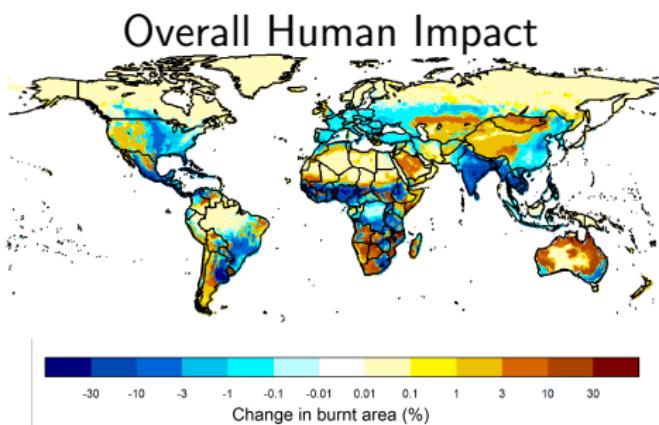
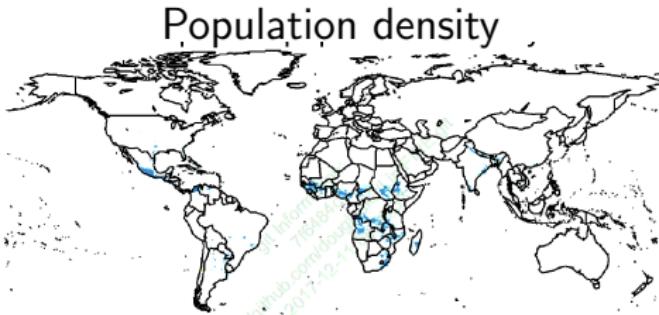
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Overall Human Impact



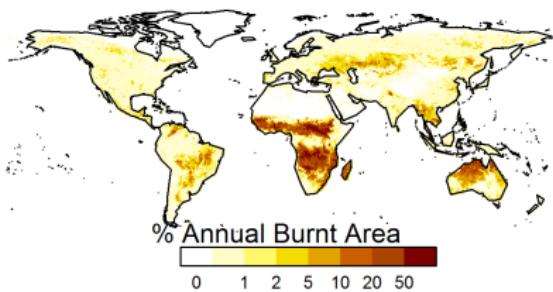
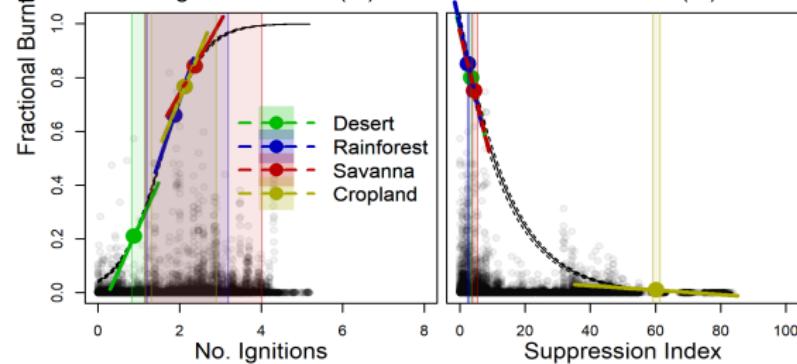
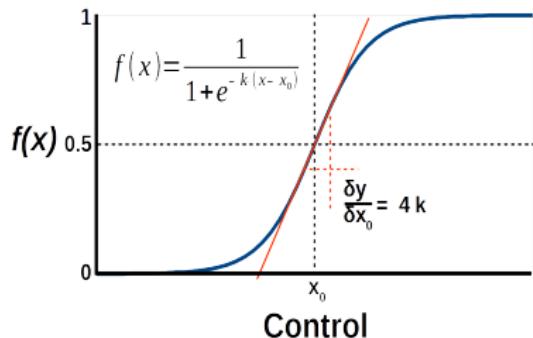
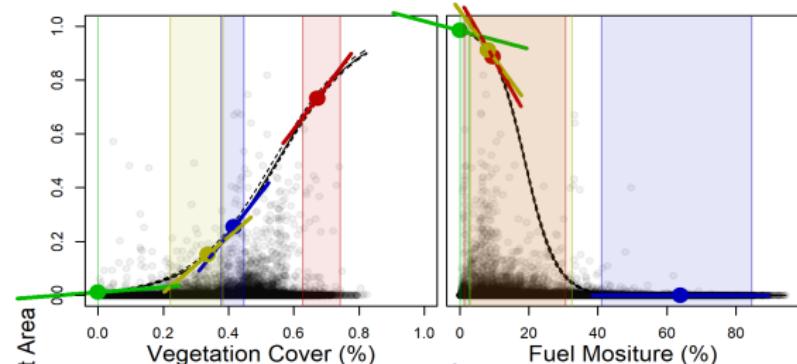
Human Impact

Suppression & Fragmentation



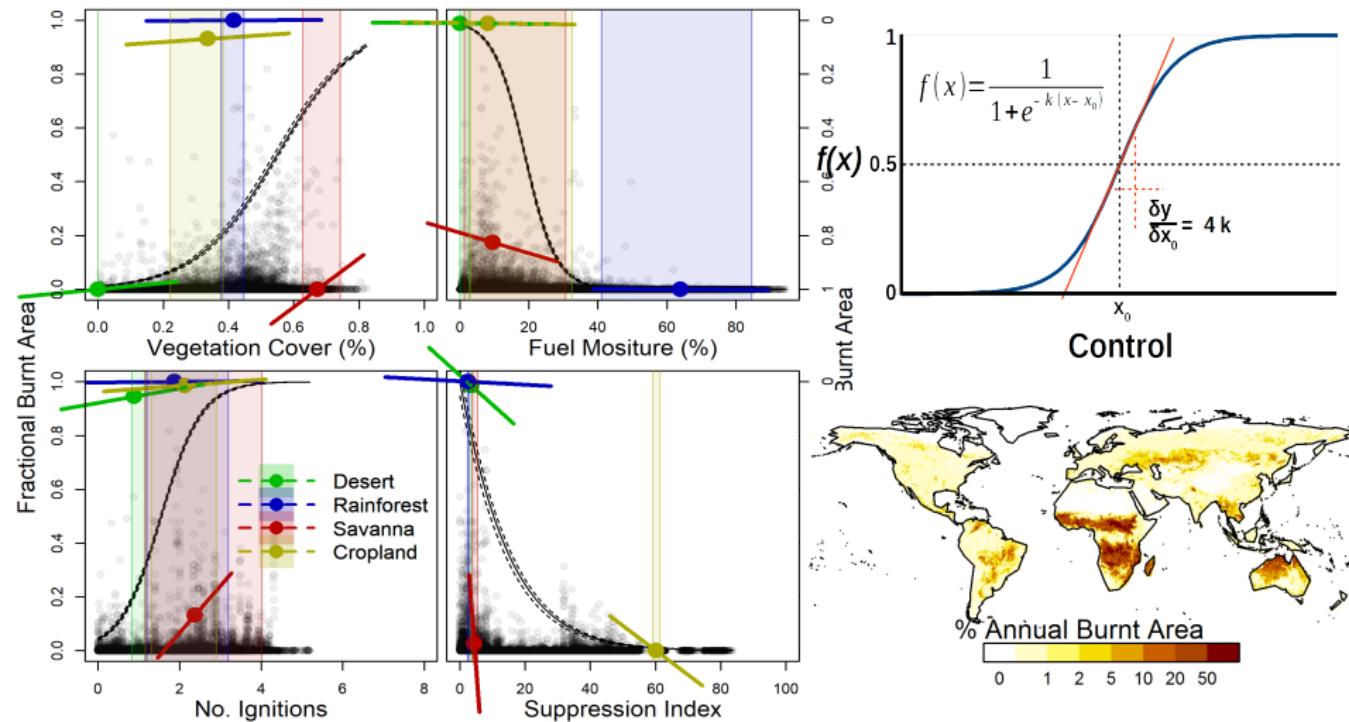
Controls on fire

Sensitivity



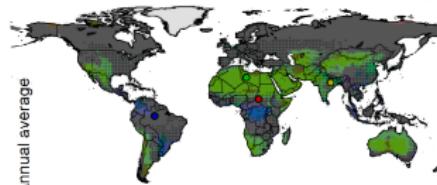
Controls on fire

Sensitivity

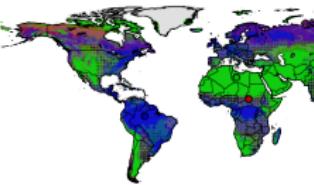


Controls on fire Sensitivity

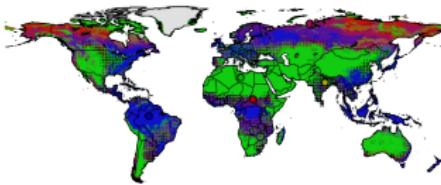
a) Raw limitation



b) Potential limitation

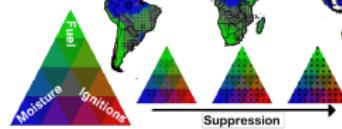


c) Control sensitivity



Annual average

Fire season



Controls on fire Sensitivity

a) Raw limitation



b) Potential limitation



c) Control sensitivity



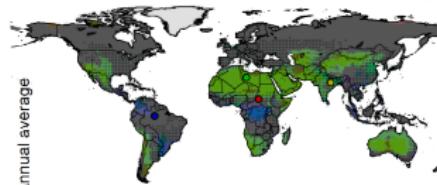
Annual average

Fire season

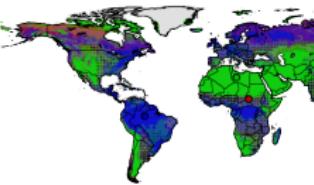


Controls on fire Sensitivity

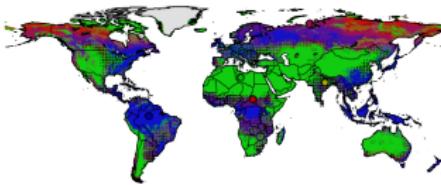
a) Raw limitation



b) Potential limitation

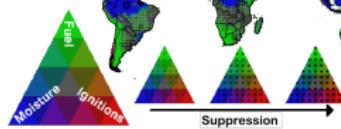


c) Control sensitivity



Annual average

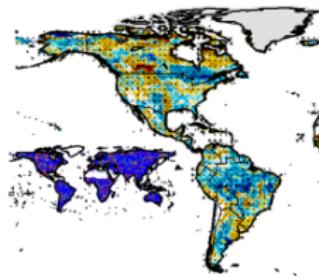
Fire season



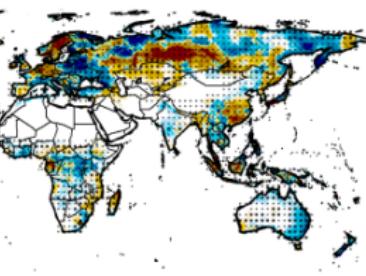
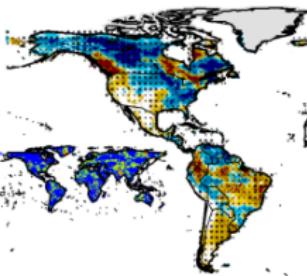
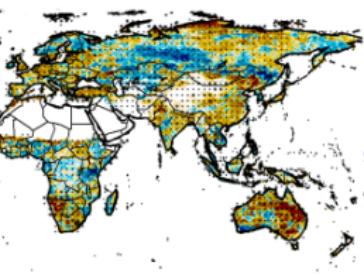
Trends in fire controls



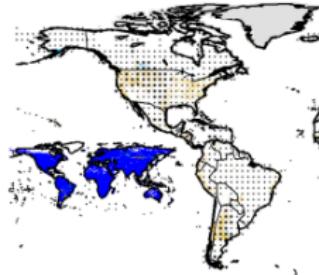
a) Fuel



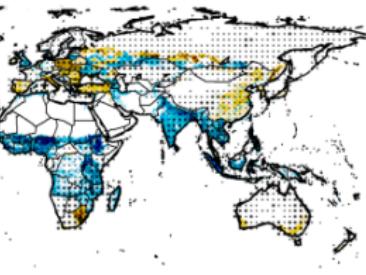
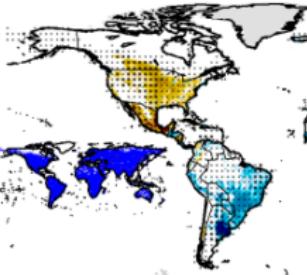
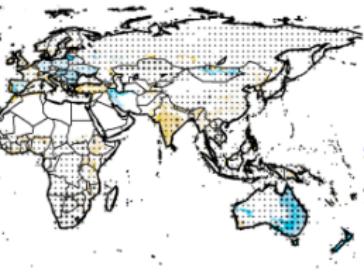
b) Moisture



c) Ignitions



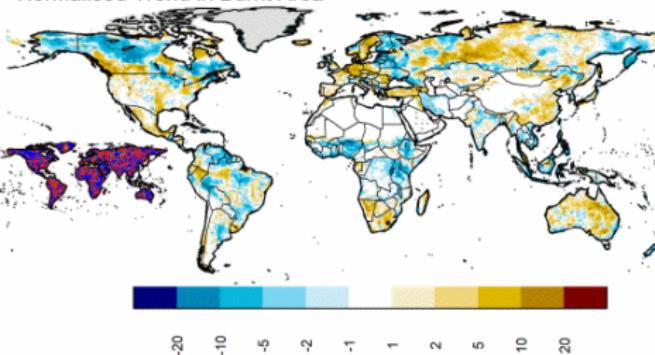
d) Suppression



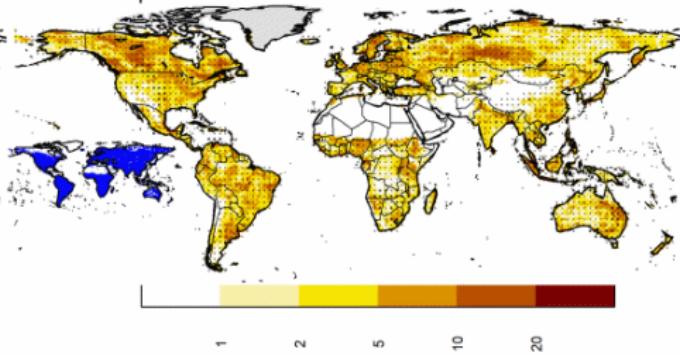
Trends in fire controls



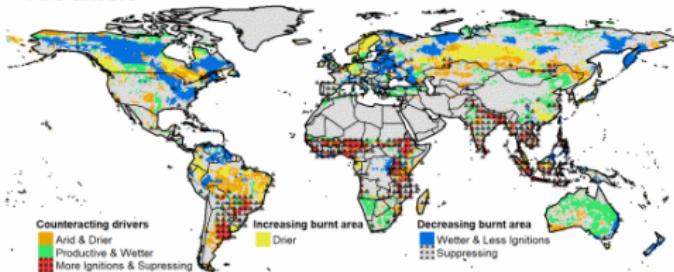
Normalised Trend in Burnt Area



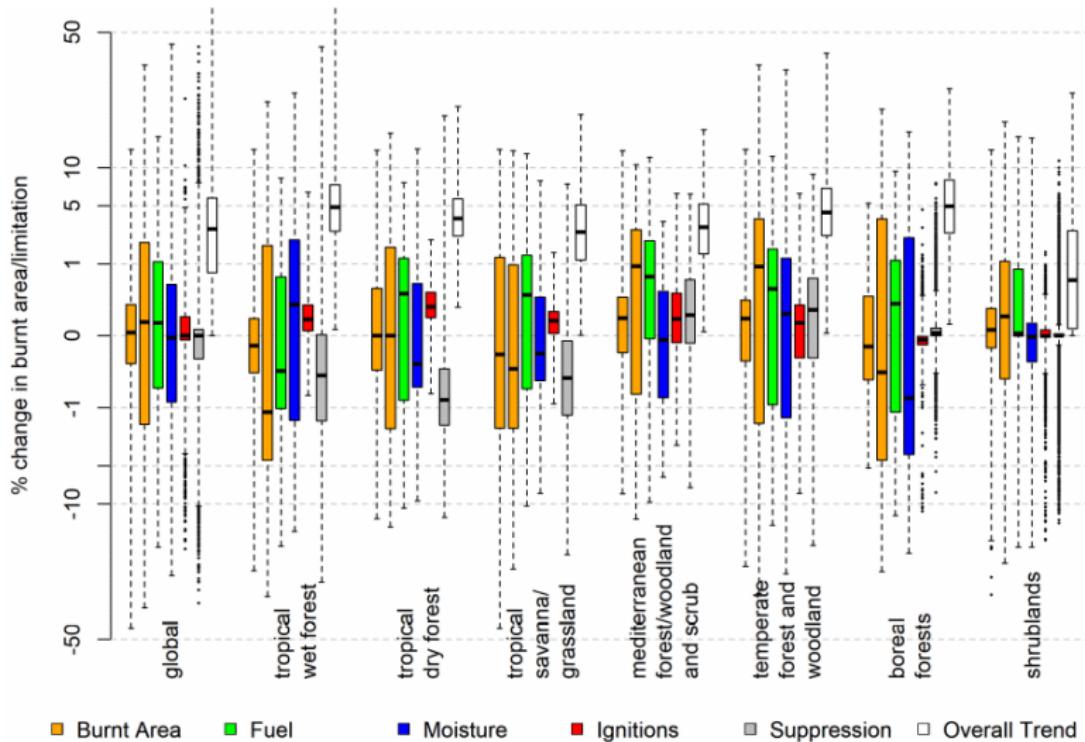
Trend Hotspot index



Fire drivers



Trends in fire controls



Humans reduce burnt area

- Ignitions generally do not limit burnt area
- Human suppression have much bigger impact
- Cropland shows significant fragmentation affects

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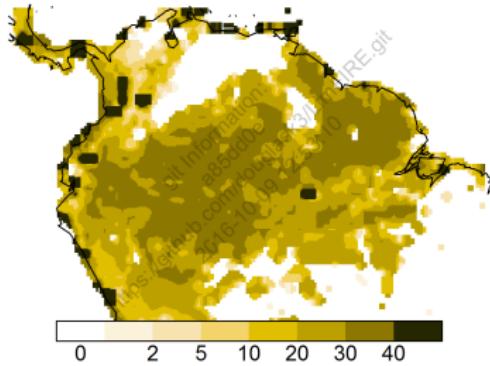
BUT...

- Marginal changes in burnt area could be sensitive to changes in ignitions
- Human fires are a significant ignition source, particularly in pasture areas

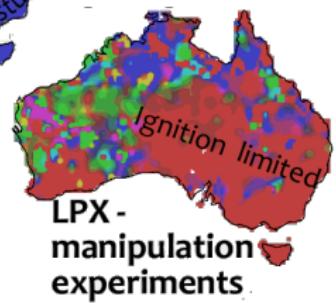
Trends in Burnt Area

- Underlying shifts in burnt area controls much greater outside of tropical Savanna
- Boreal and tropical forests show biggest shifts
- from abstract

Tipping points & model assessment



%change in fuel moisture to reach "tipping point"



Ignitions

Which is more important

