

The importance of ignitions in determining fire regimes in southern Africa

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6th KNP Network Meeting April 2008

To start a fire you need:

- Appropriate weather conditions
- Fuel
- An ignition source



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Ignitions in Africa

- People have been lighting fires for at least 200 000 – 300 000 years.
- People can change both the FREQUENCY and the SEASON of burning.

Ignitions in Africa

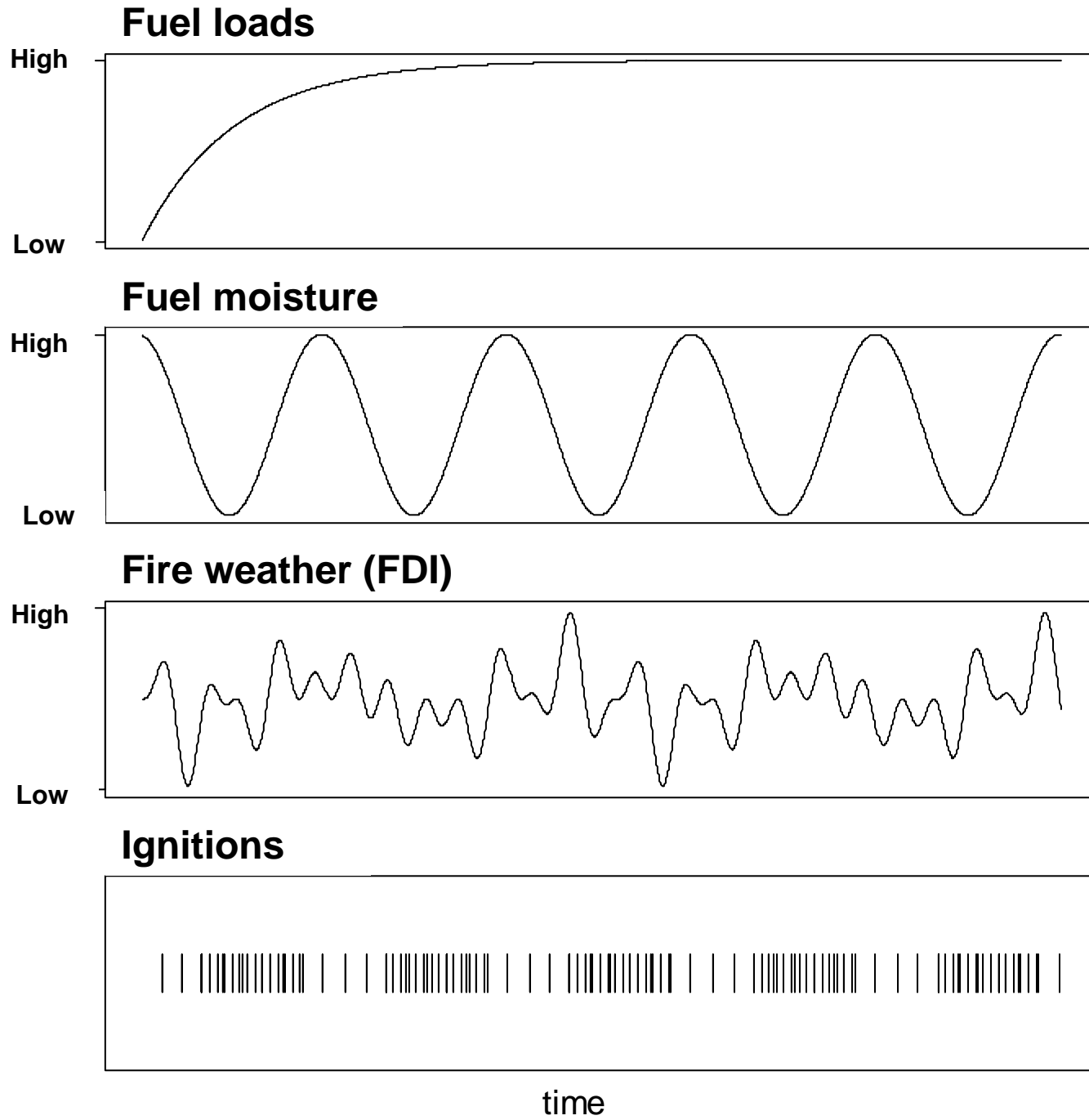
- People have been lighting fires for at least 200 000 – 300 000 years.
- People can change both the FREQUENCY and the SEASON of burning.
- **Questions:**
 - **Are African systems ever limited by lack of ignitions?**
 - **Were they limited in the past when people weren't around?**
 - **What is different about fire regimes under lightning and human ignition?**
 - **Season of burn?**
 - **Total burnt area – i.e. fire return period?**
 - **Fire size?**

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 - **Fire size?**
- **No data:**
 - Don't know ignition frequencies
 - Don't know percentage of lightning/human ignitions
- **Use modelling to explore the possibilities.**
 - Gain insights into what is going on at present.
 - Gain understanding of what changes occurred as humans learned to control fire.

How do fires work?

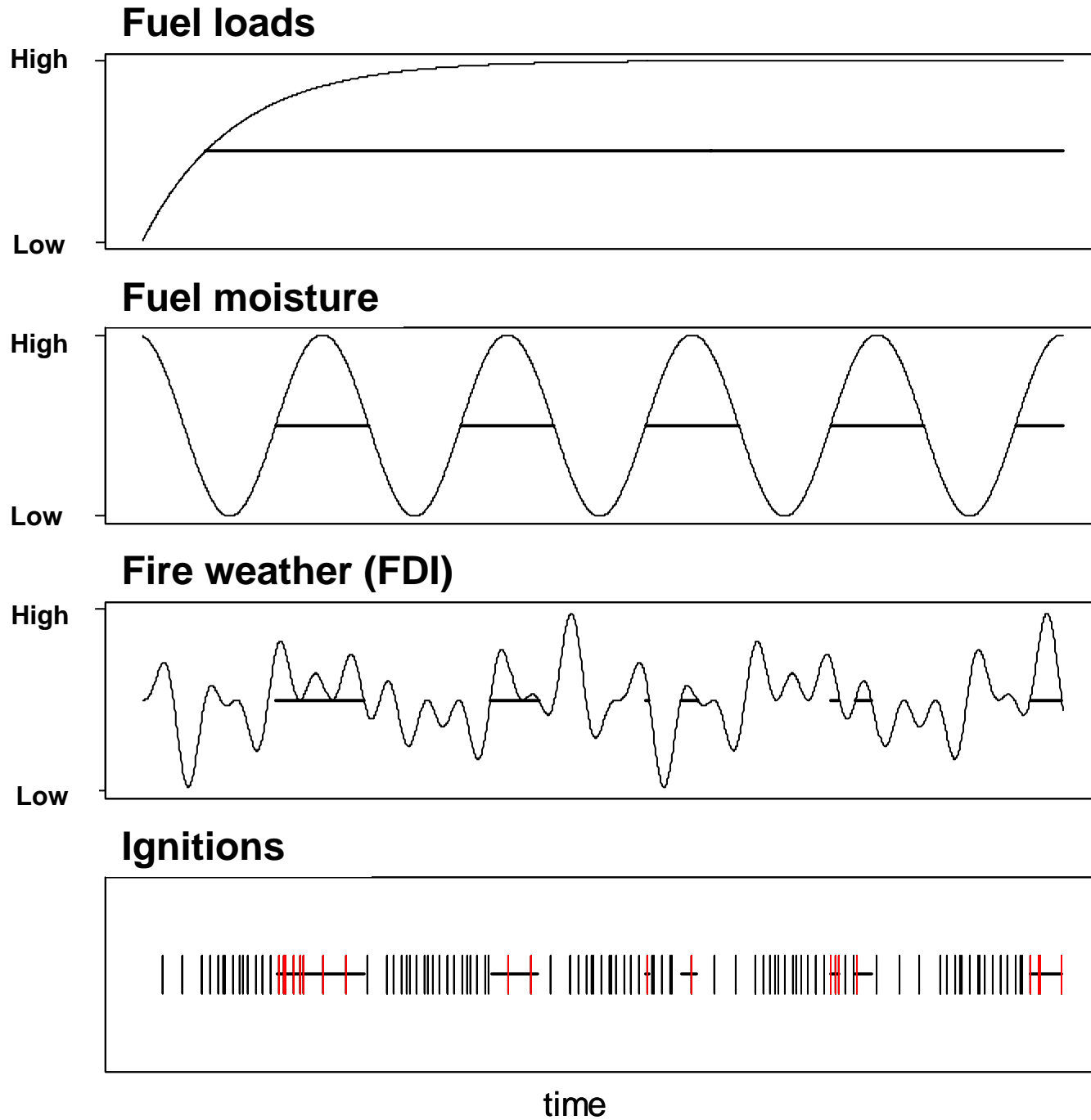
How do fires work?



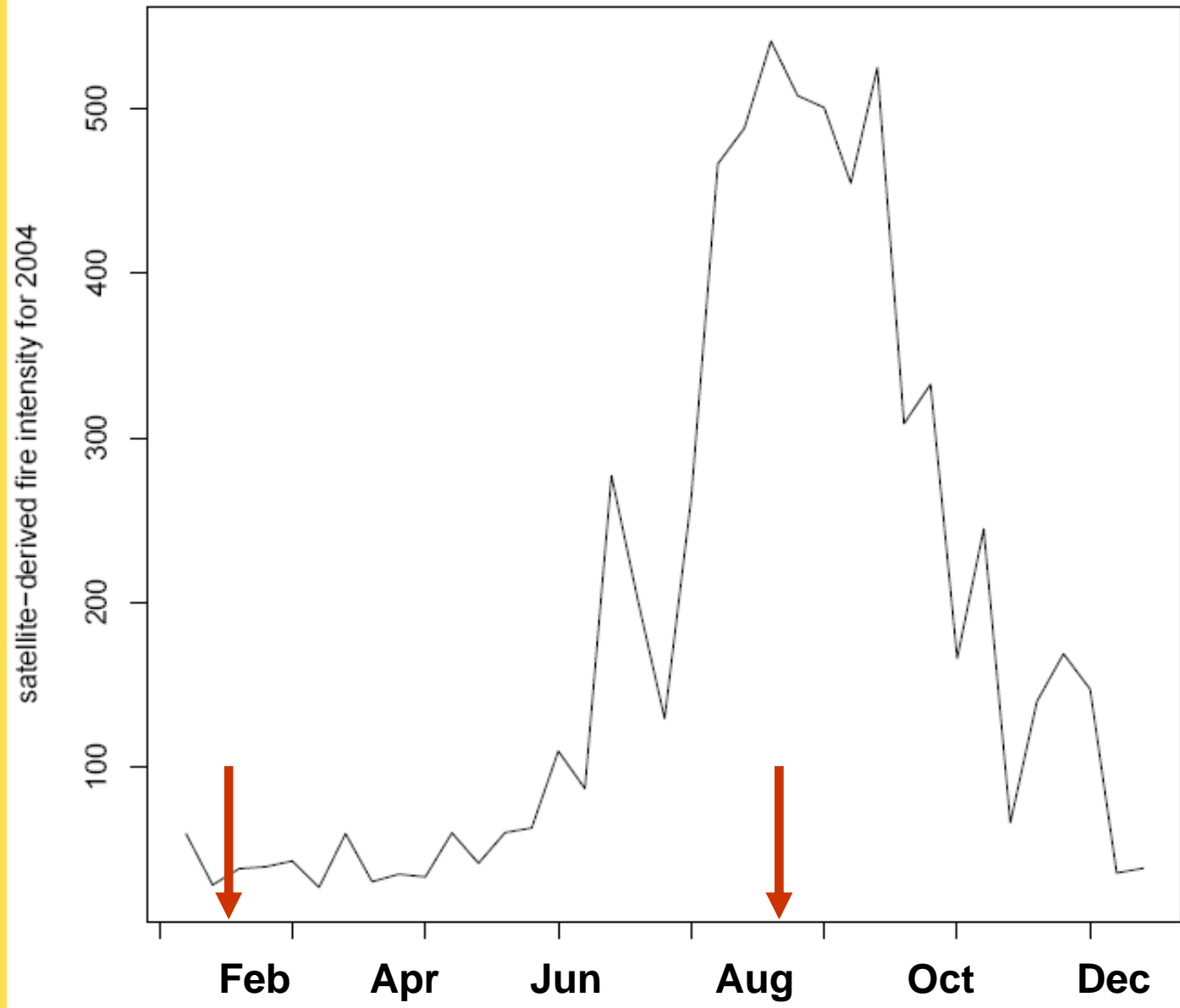
time

How do fires work?

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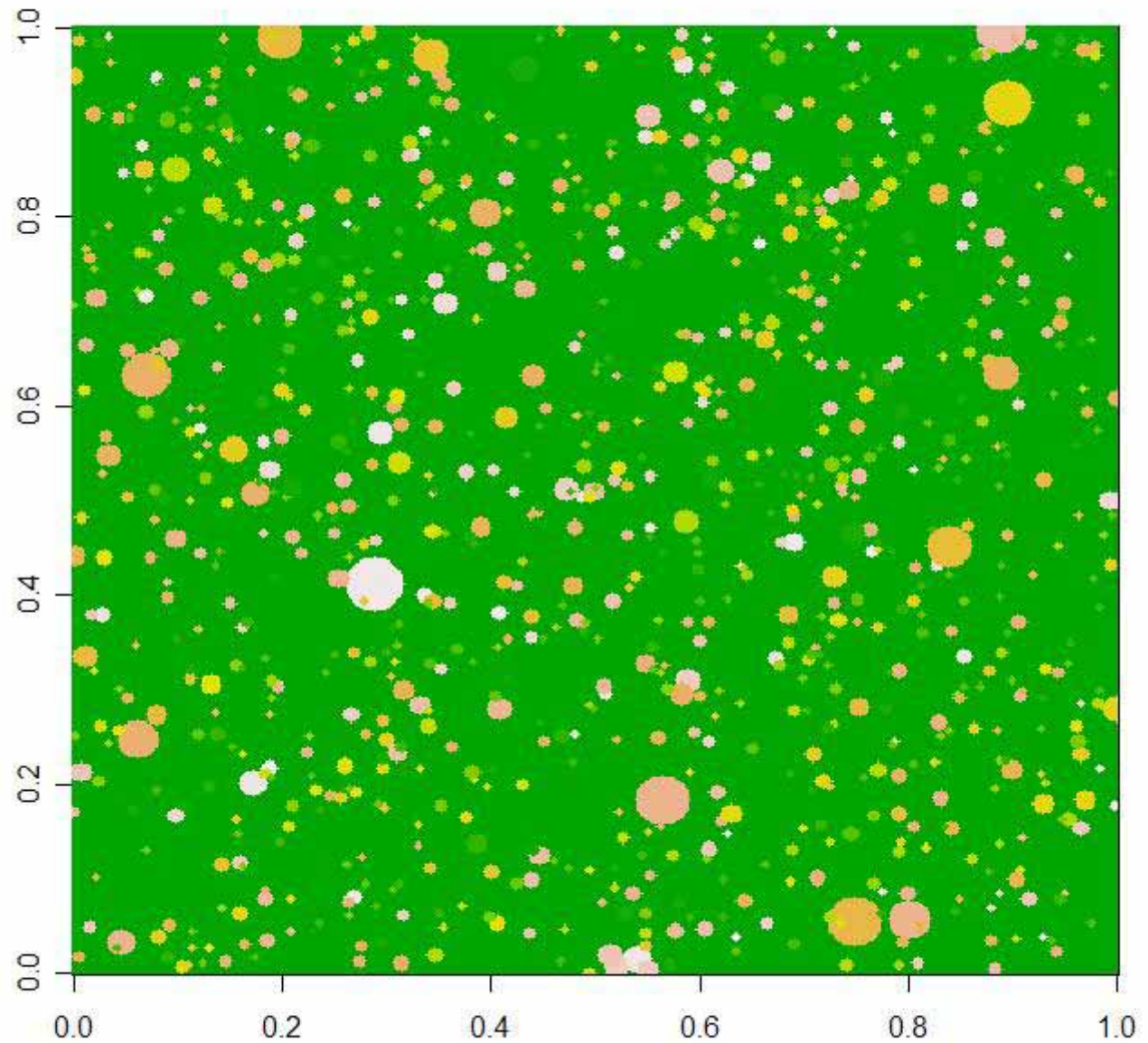


time



Simulation model

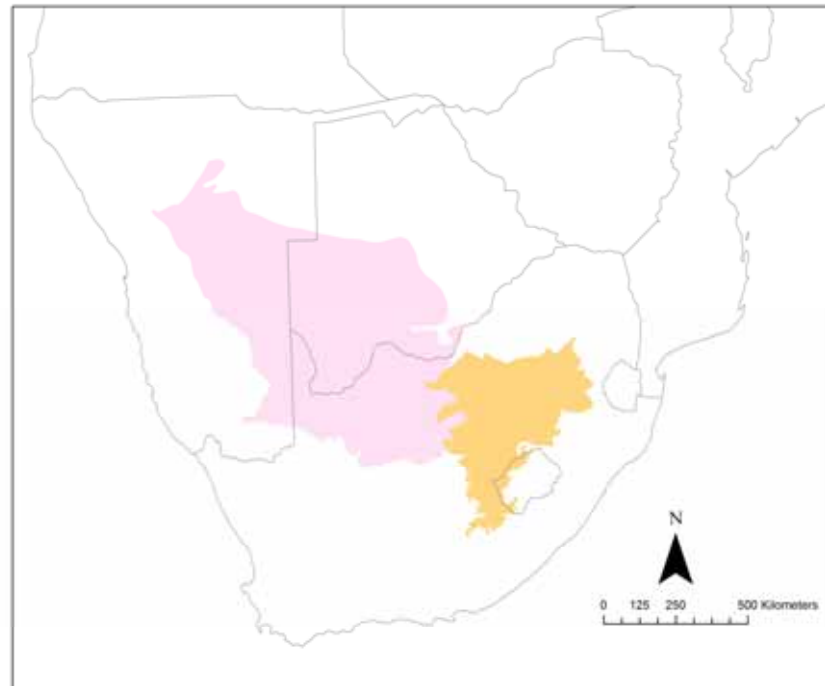
- Accounts for seasonal patterns of fire intensity and fire size
- Incorporates variation in daily weather conditions
- Simulates spatial dynamics of fire



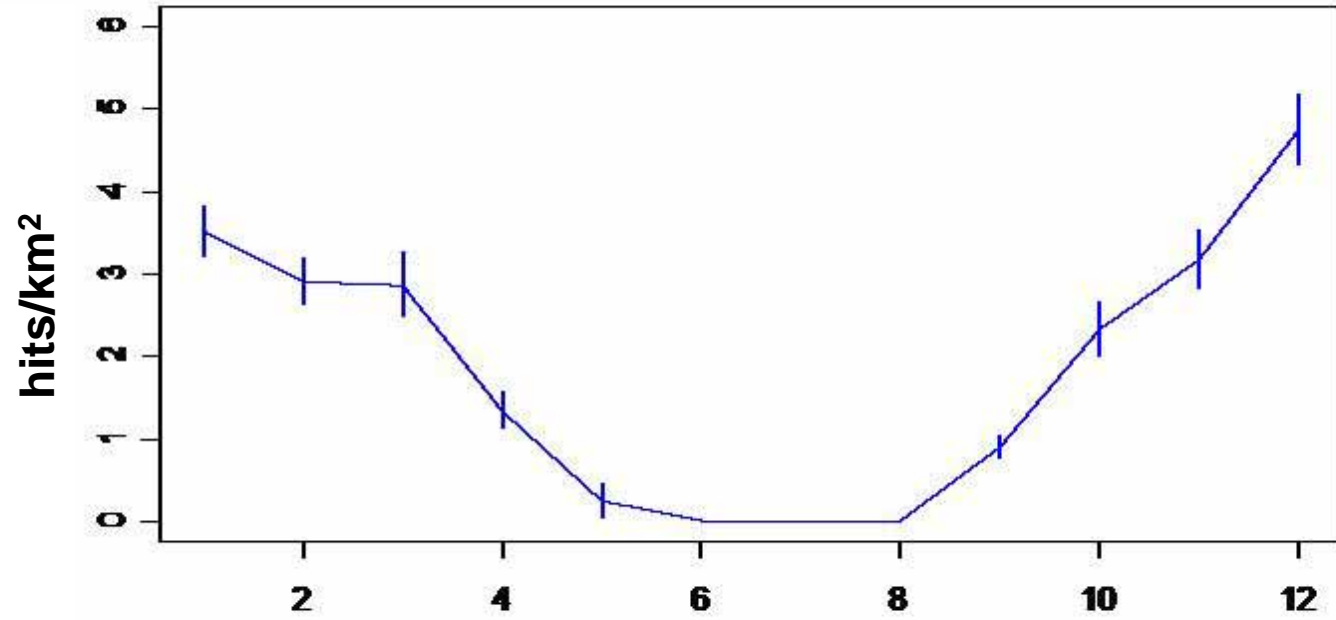
Simulated burnt landscape



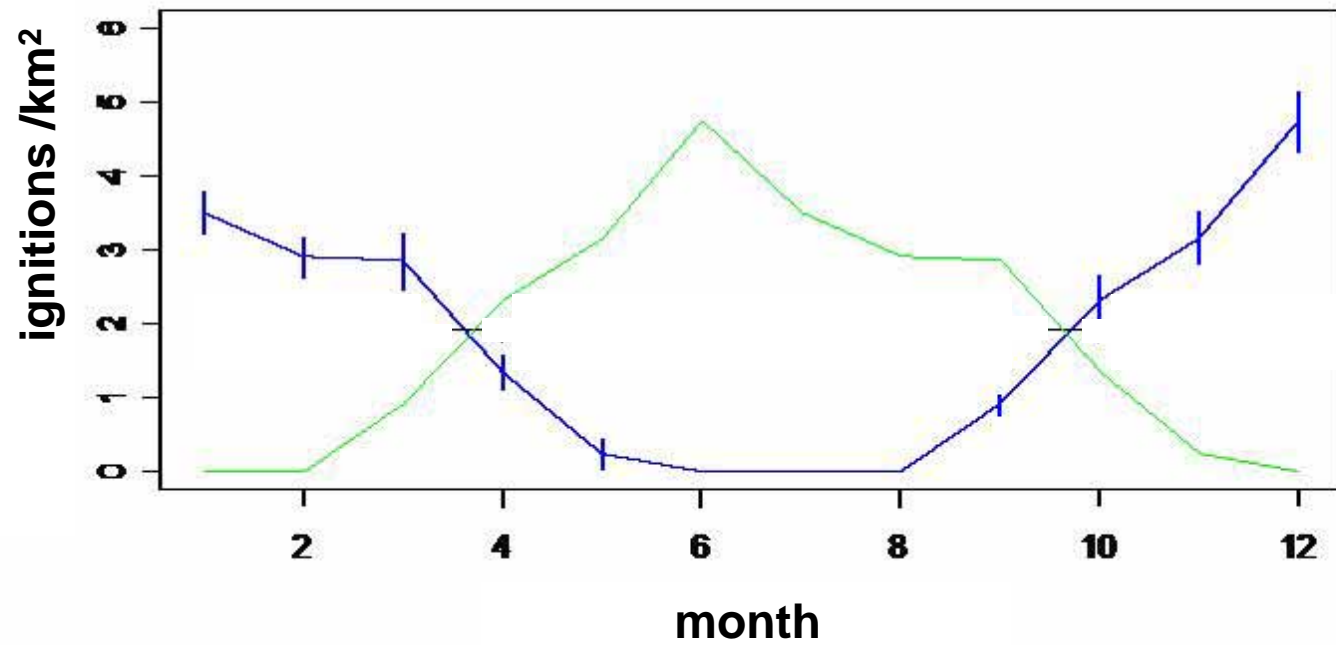
	Highveld	Kalahari
annual rainfall	400-900	150-500
landscape	Flat landscapes, highly fragmented by human activities	Flat landscapes, largely untransformed.
lightning strikes km ² /year	1.1	0.6
# fires/km ² 2003	0.02	0.0008
Reported burnt area	33 % Pilanesburg National Park	7.6 % Okavango
average fire size	2.7 km ²	3.5km ²
average fire intensity (FRP)	82 MW/pixel	77 MW/pixel



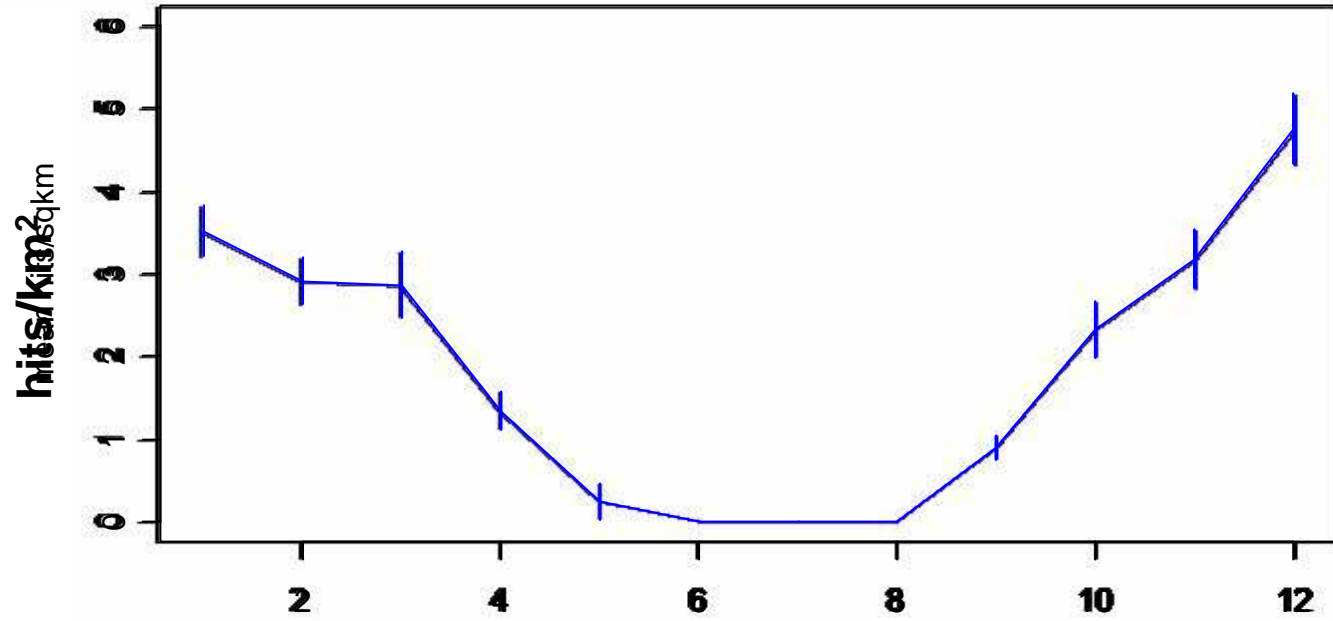
Lightning frequency over the year



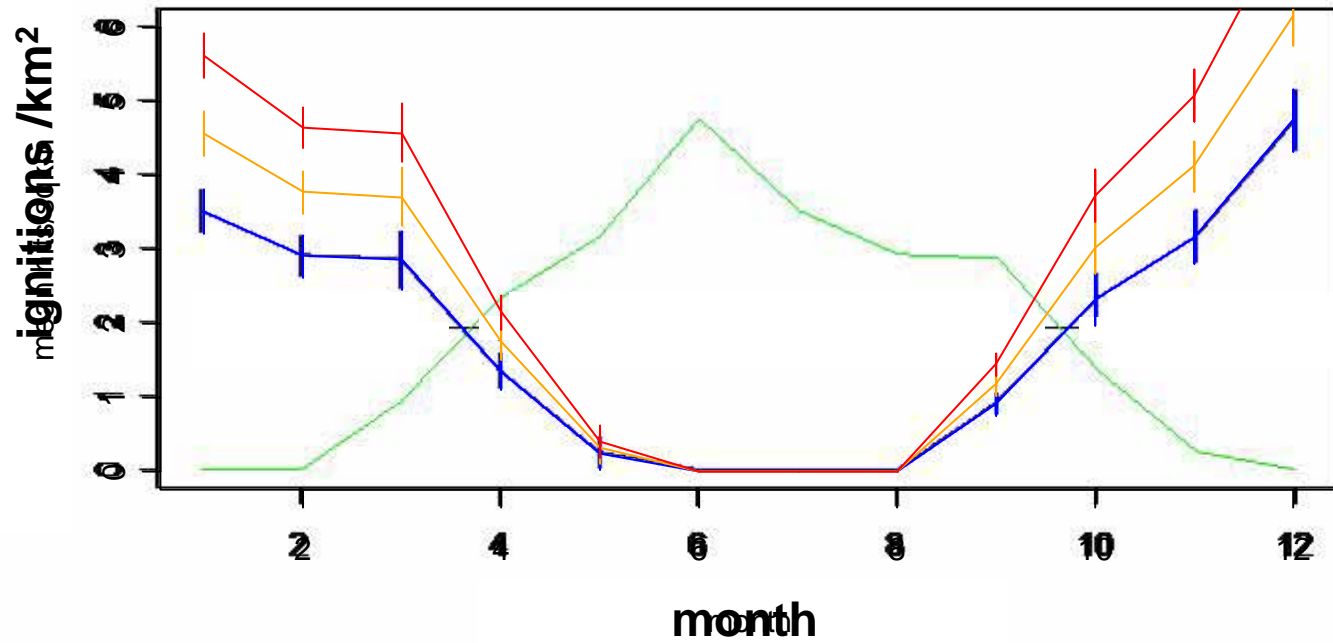
Simulated ignitions over the year



Lightning frequency over the year

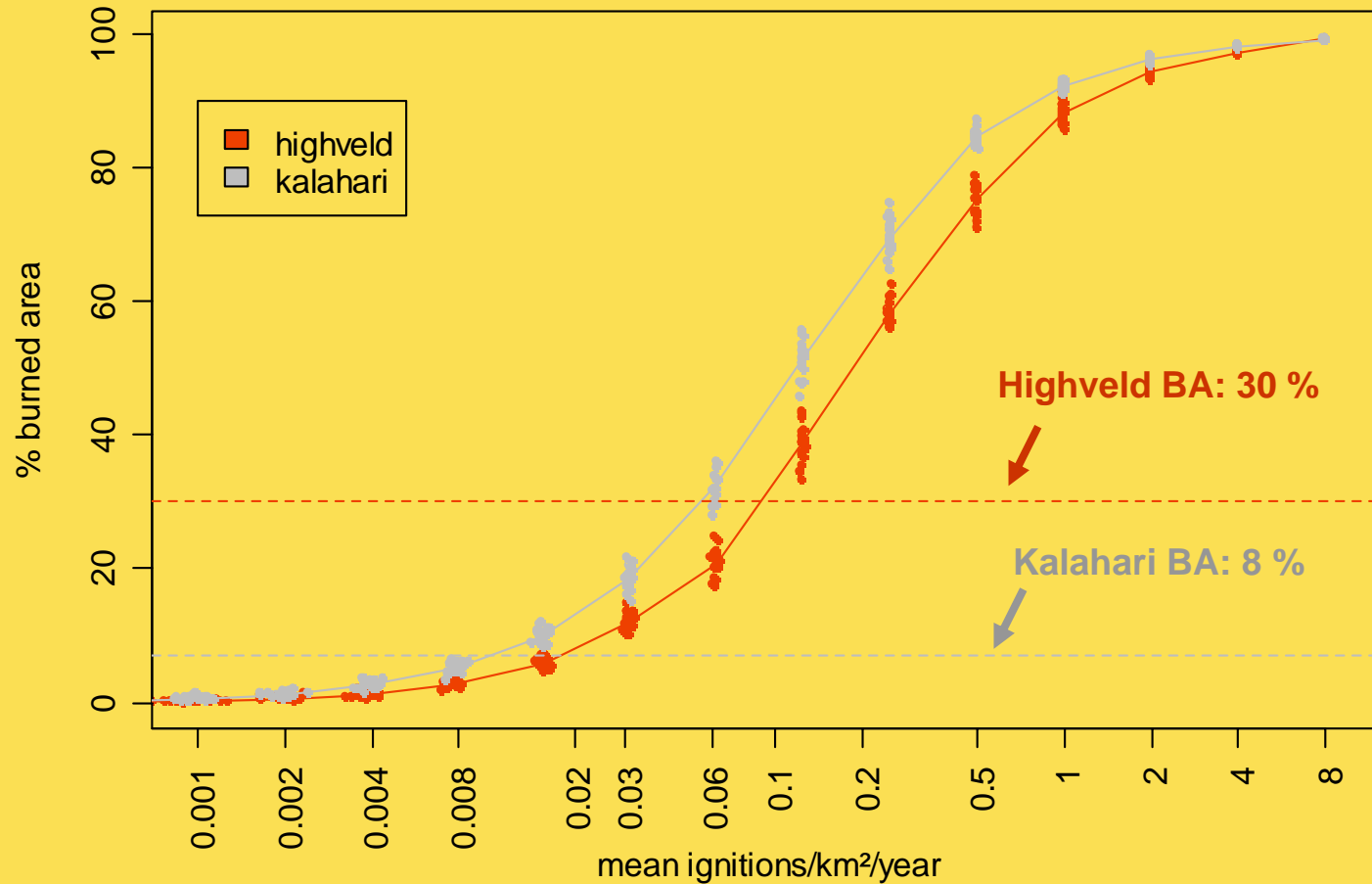


Simulated ignitions over the year



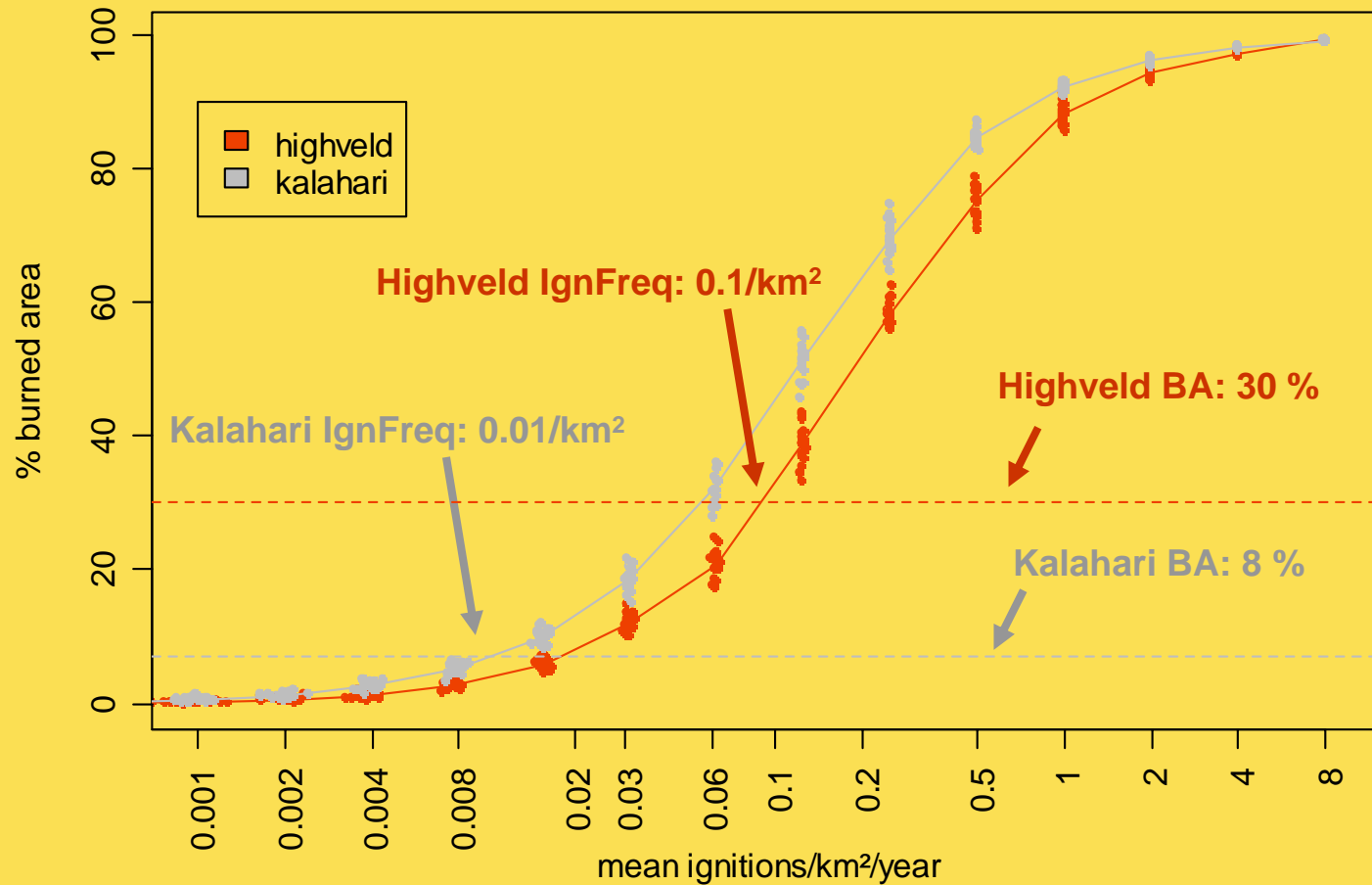
Response variables

- Total burnt area
- Season of burn
- Fire size/ fire size distribution
- Ignition success probability



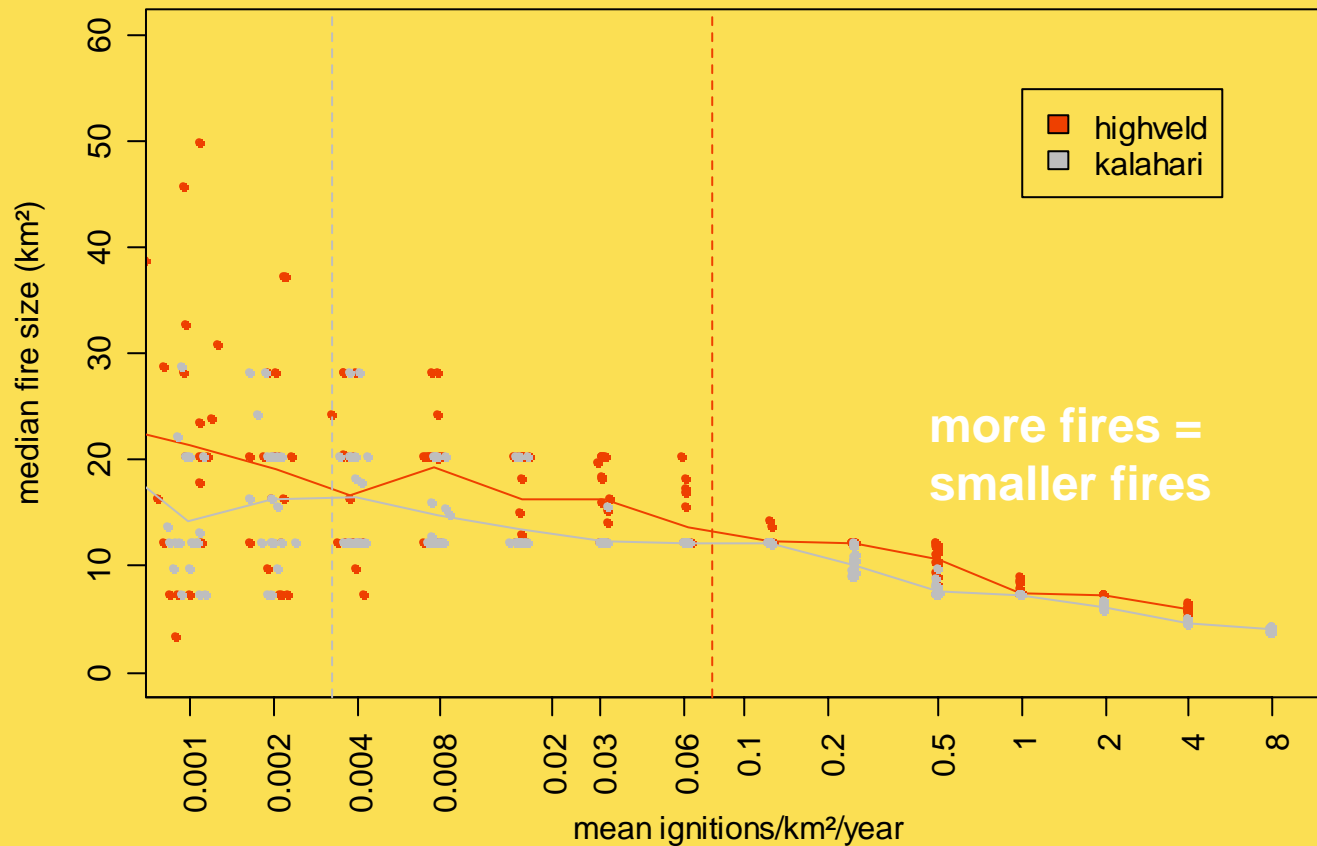
Total burnt area – lightning simulation

For the same ignition frequency the Kalahari has a higher burnt area.



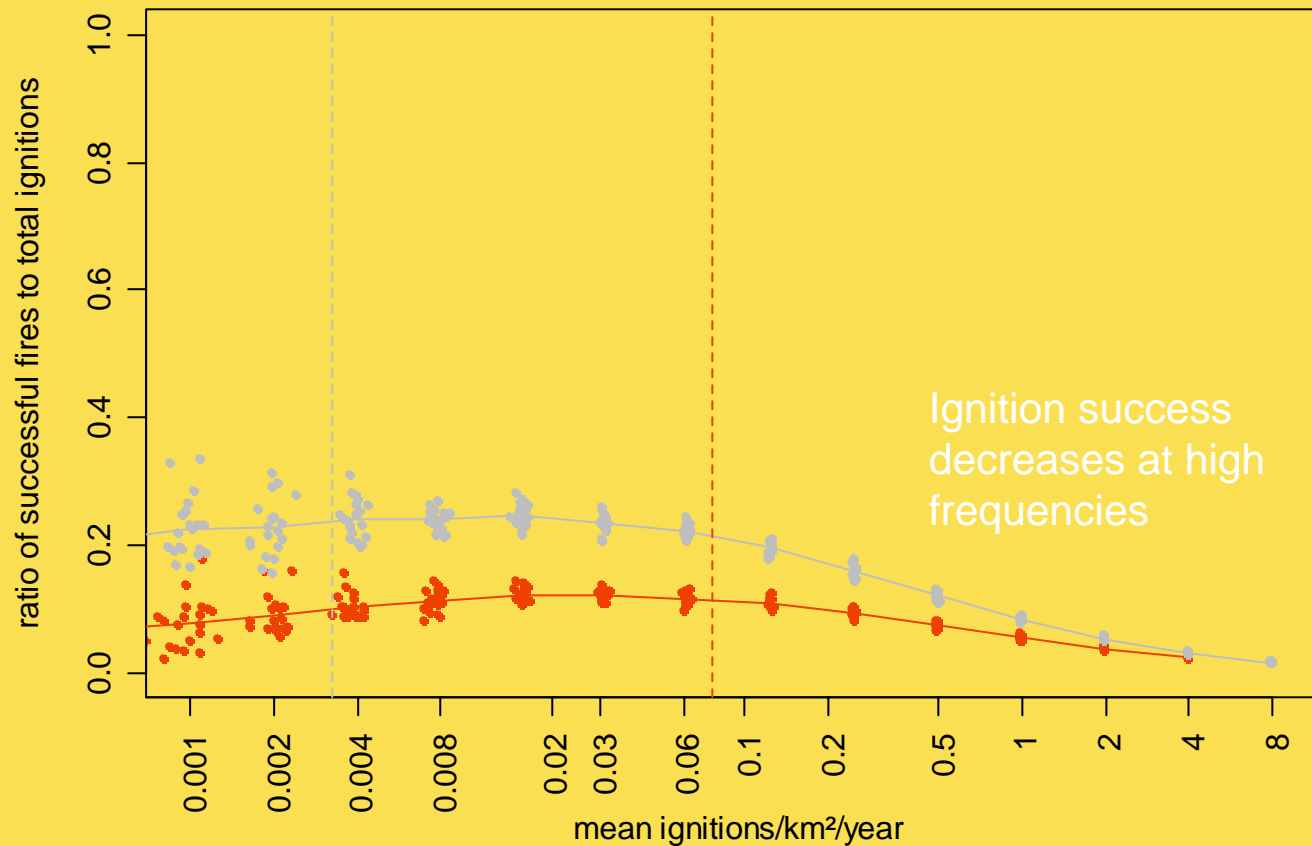
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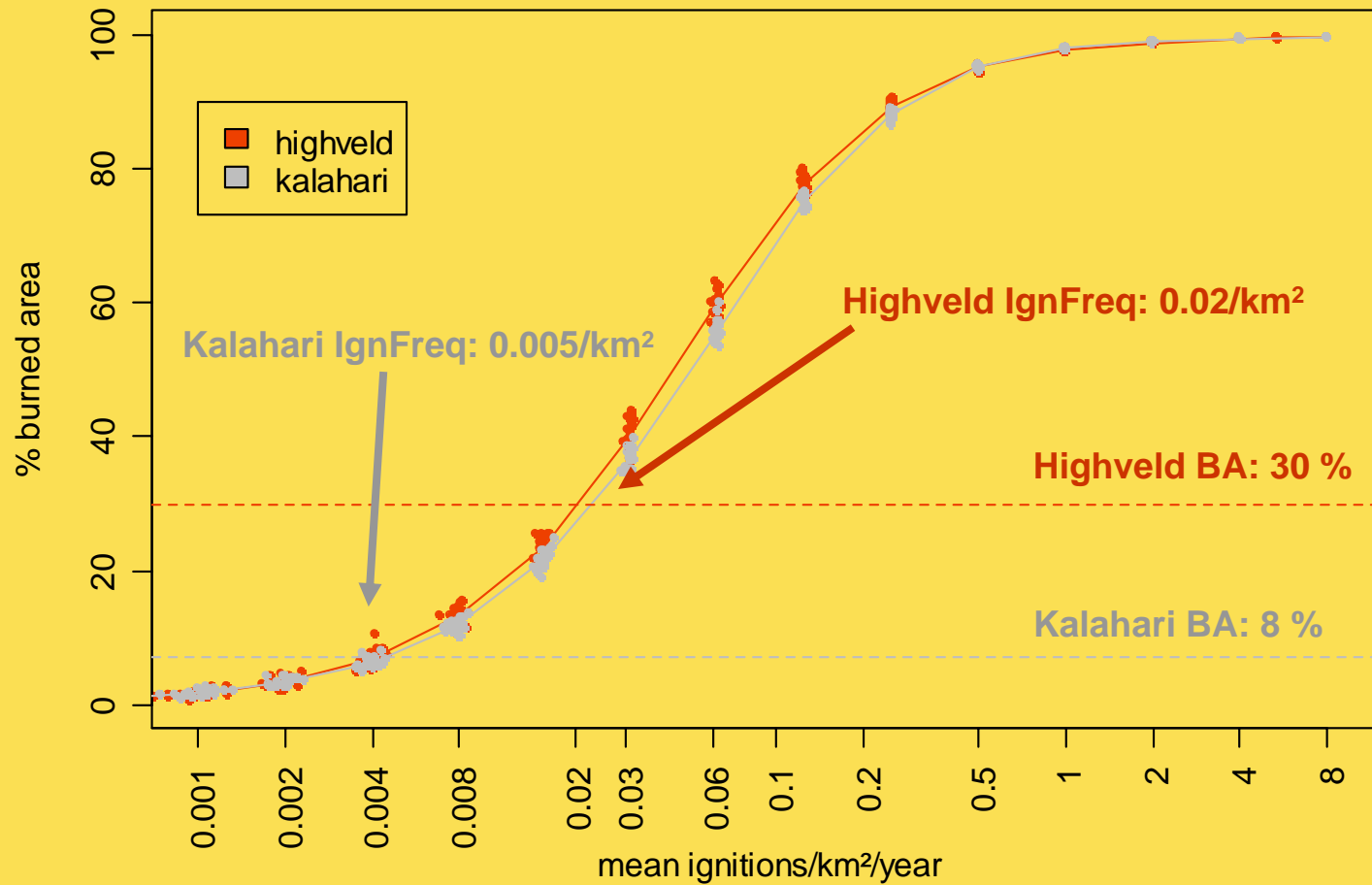
Fire size - lightning simulation

Fire size decreases and becomes less variable as ignition frequency increases, but no difference between environments



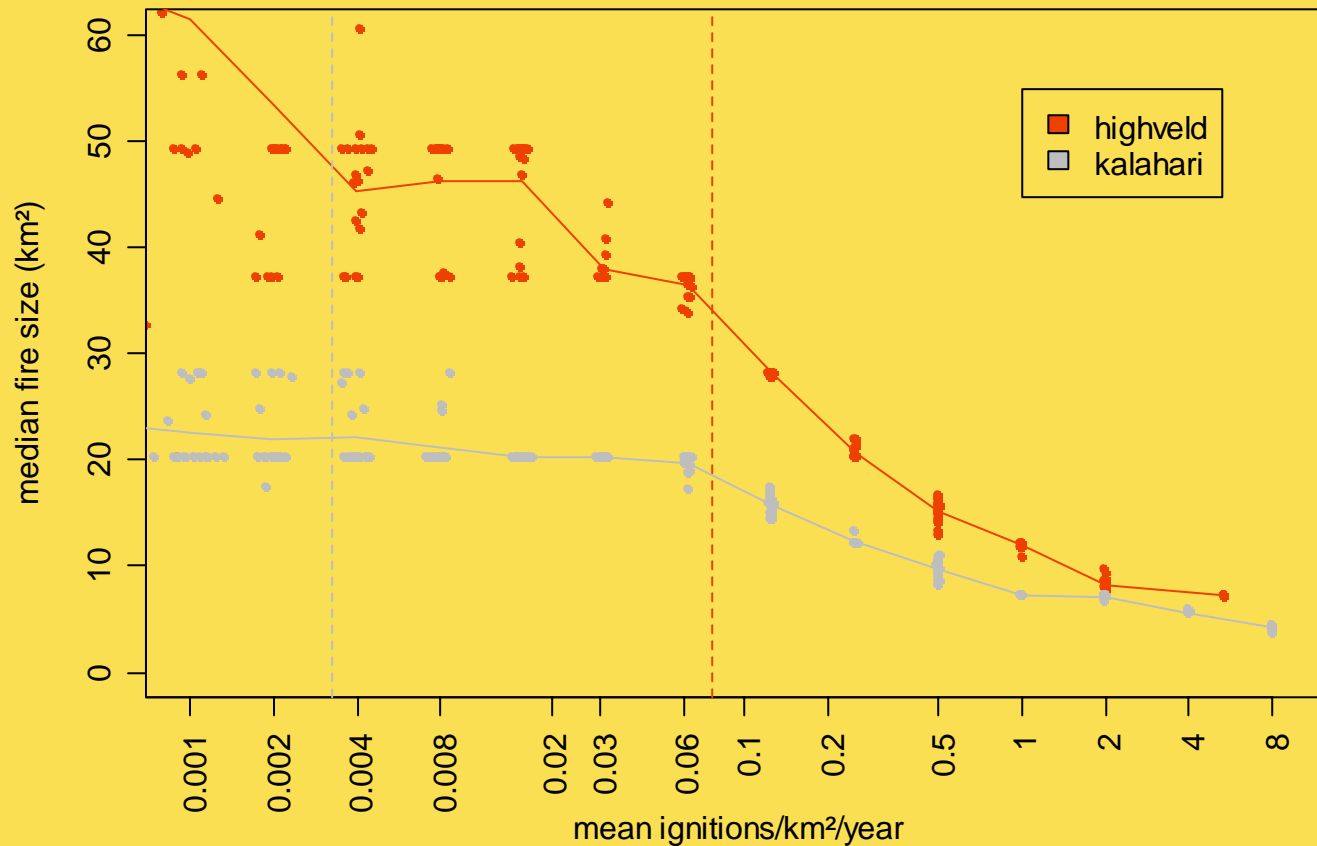
Ignition Success - lightning simulation

The drier, hotter Kalahari always has a higher probability of having successful ignition



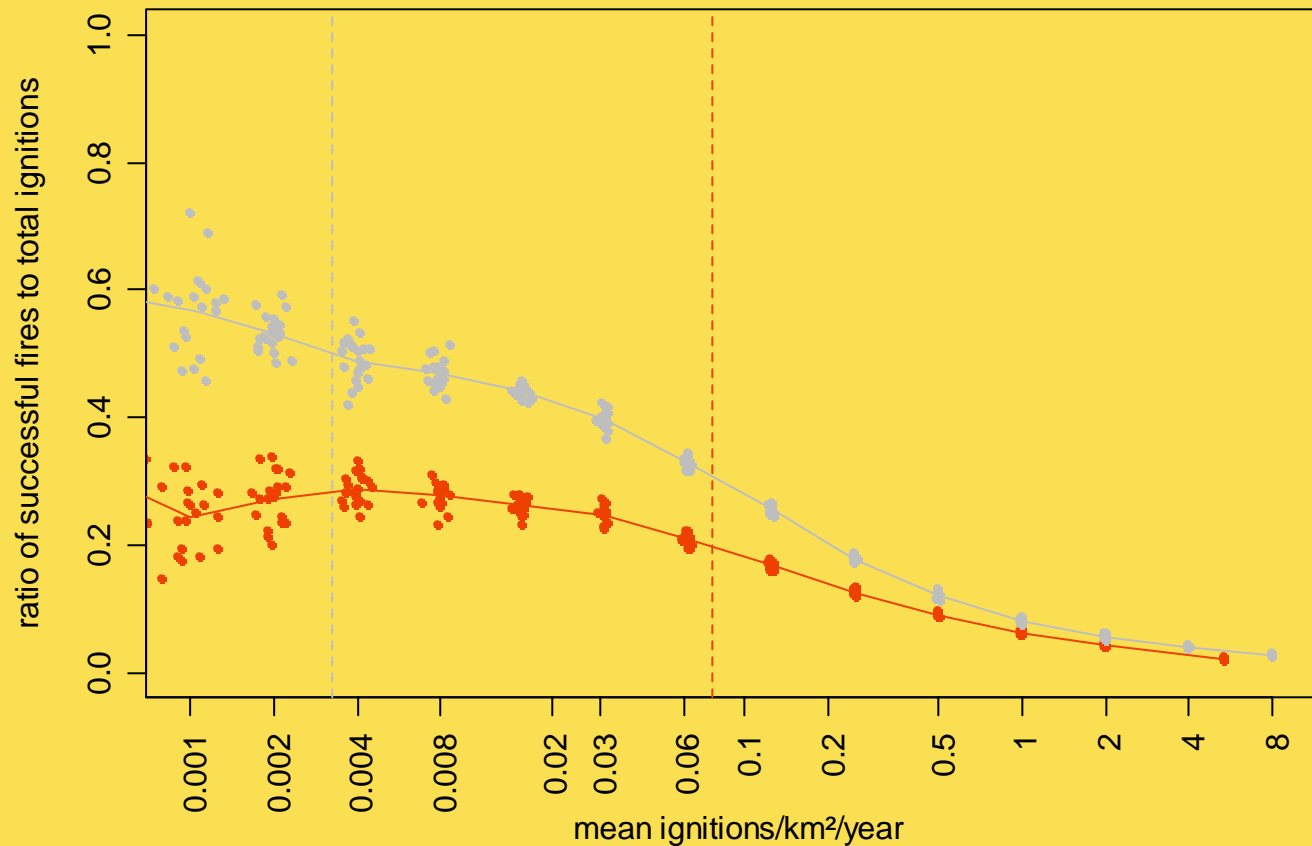
Total burnt area – dry-season simulation

Kalahari and highveld show similar responses to ignition frequency. Need fewer ignitions to burn the same area.



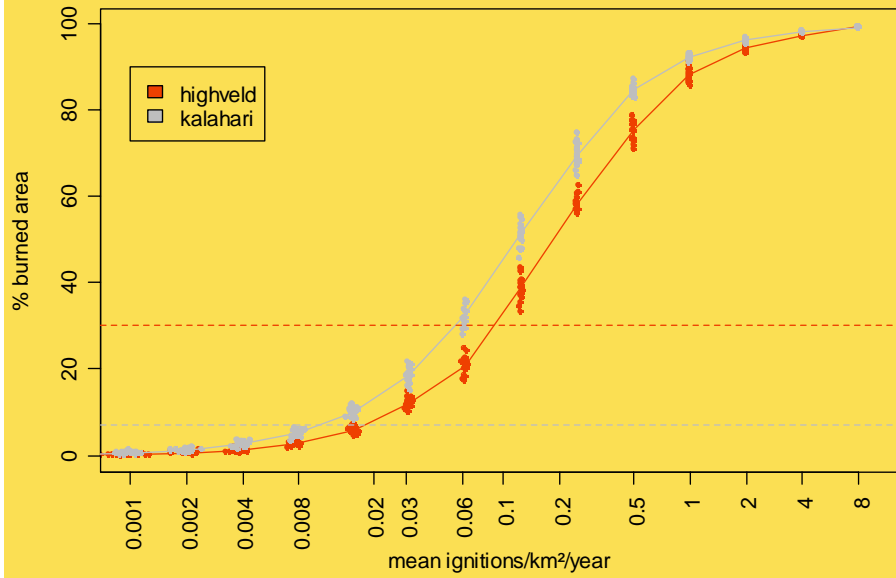
Fire size – dry-season simulation

The high-rainfall highveld area has much larger fires when burning occurs in the dry season.

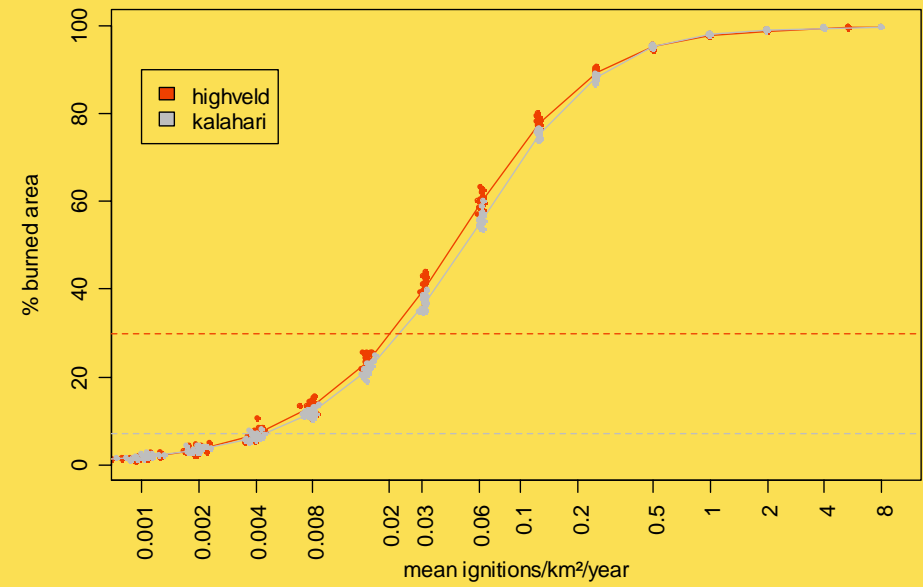


Ignition Success – dry-season simulation

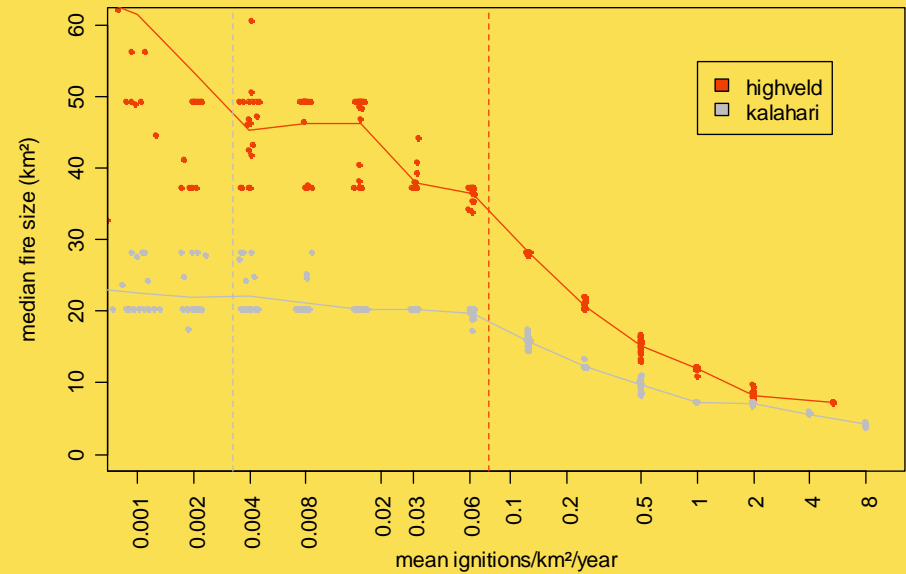
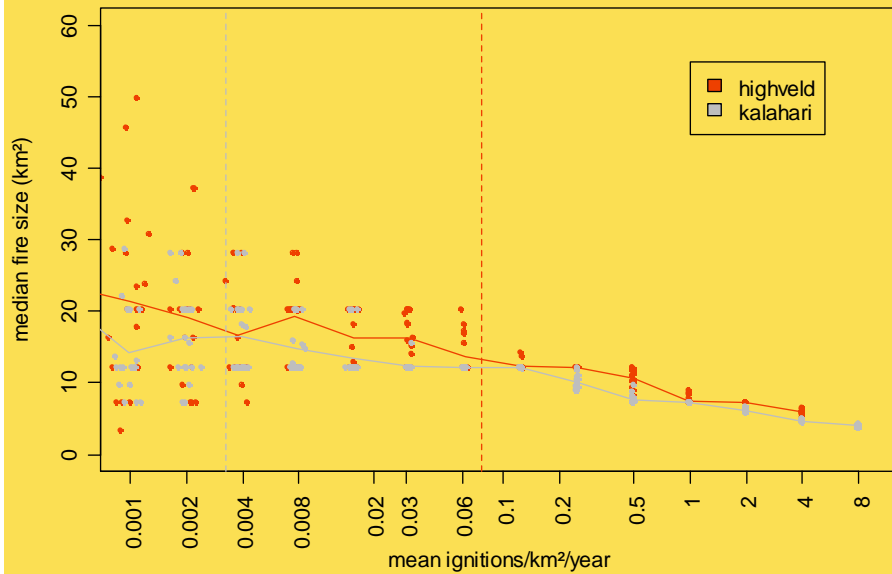
Both the Kalahari and the Highveld have higher ignition success in the dry season.

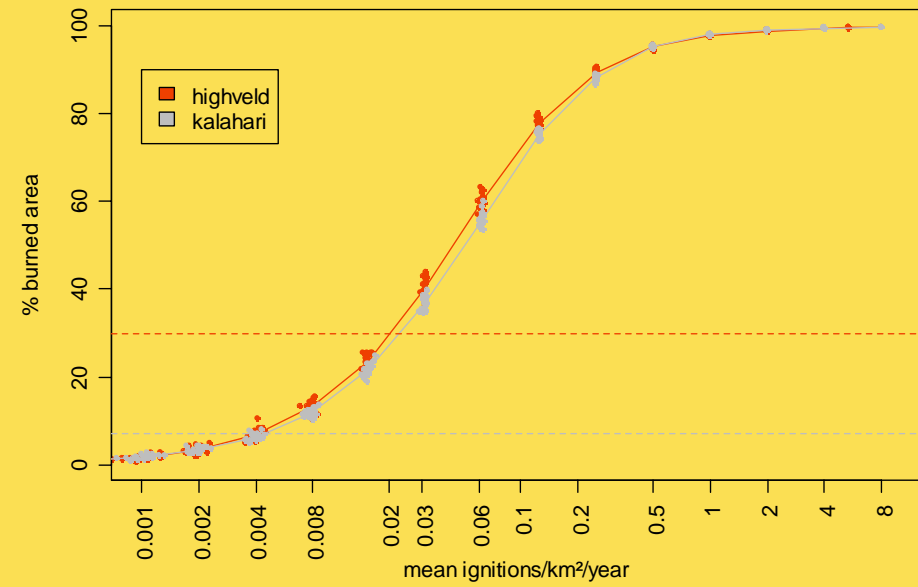
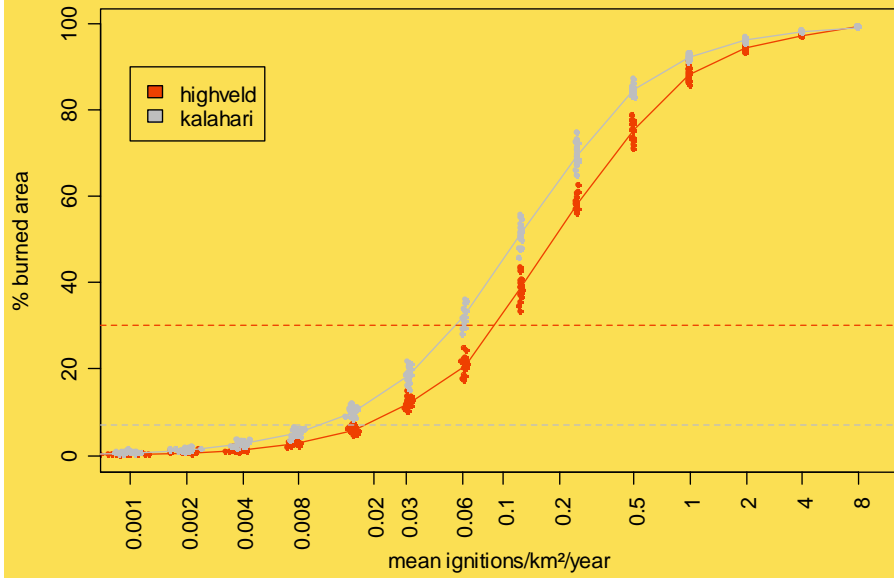


LIGHTNING SIMULATION

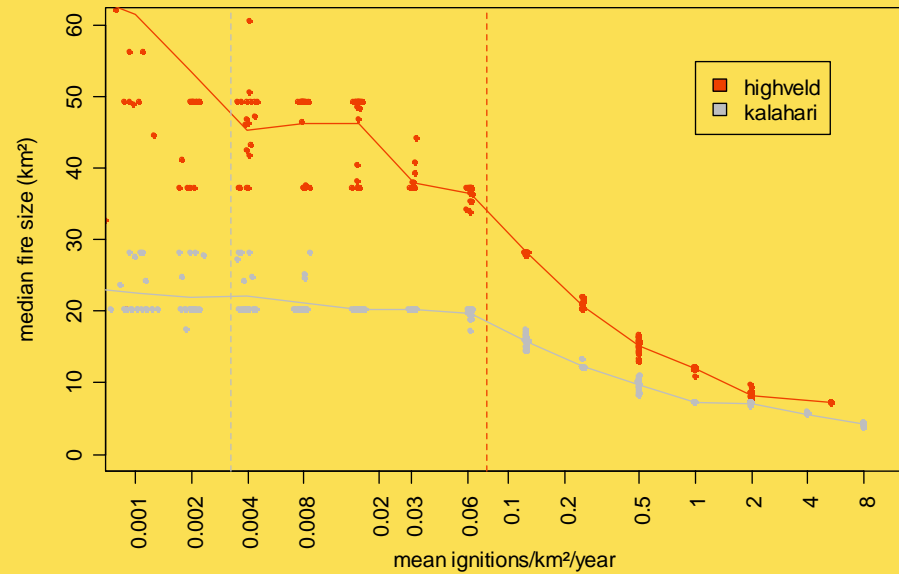
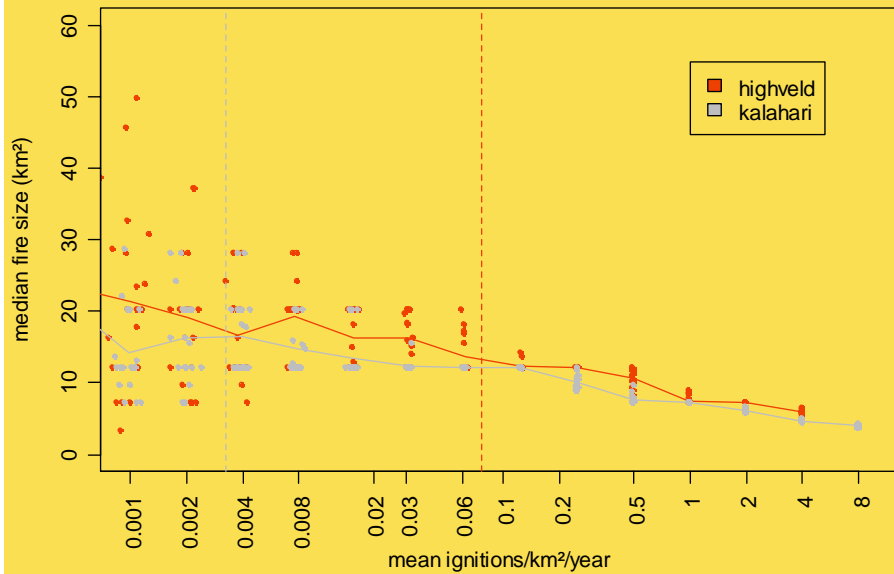


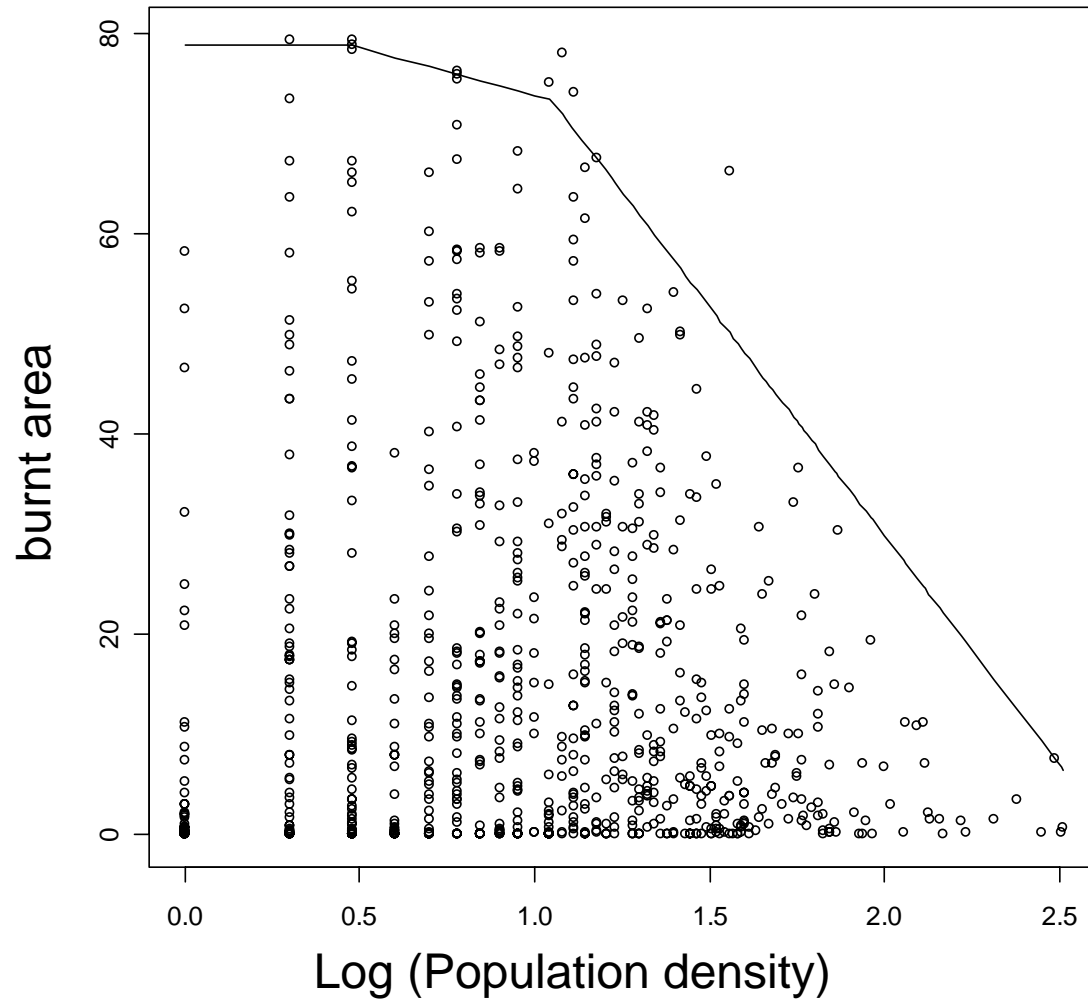
DRY SEASON SIMULATION





**ACTUALLY: KALAHARI FIRES ARE LARGER THAN HIGHVELD FIRES:
Kalahari has three times as many large fires (> 5000 ha)**





People:

- Graze cattle
 - Build roads
 - Plant crops
- = Fragment the landscape

This only happened in the last 2-5000 years

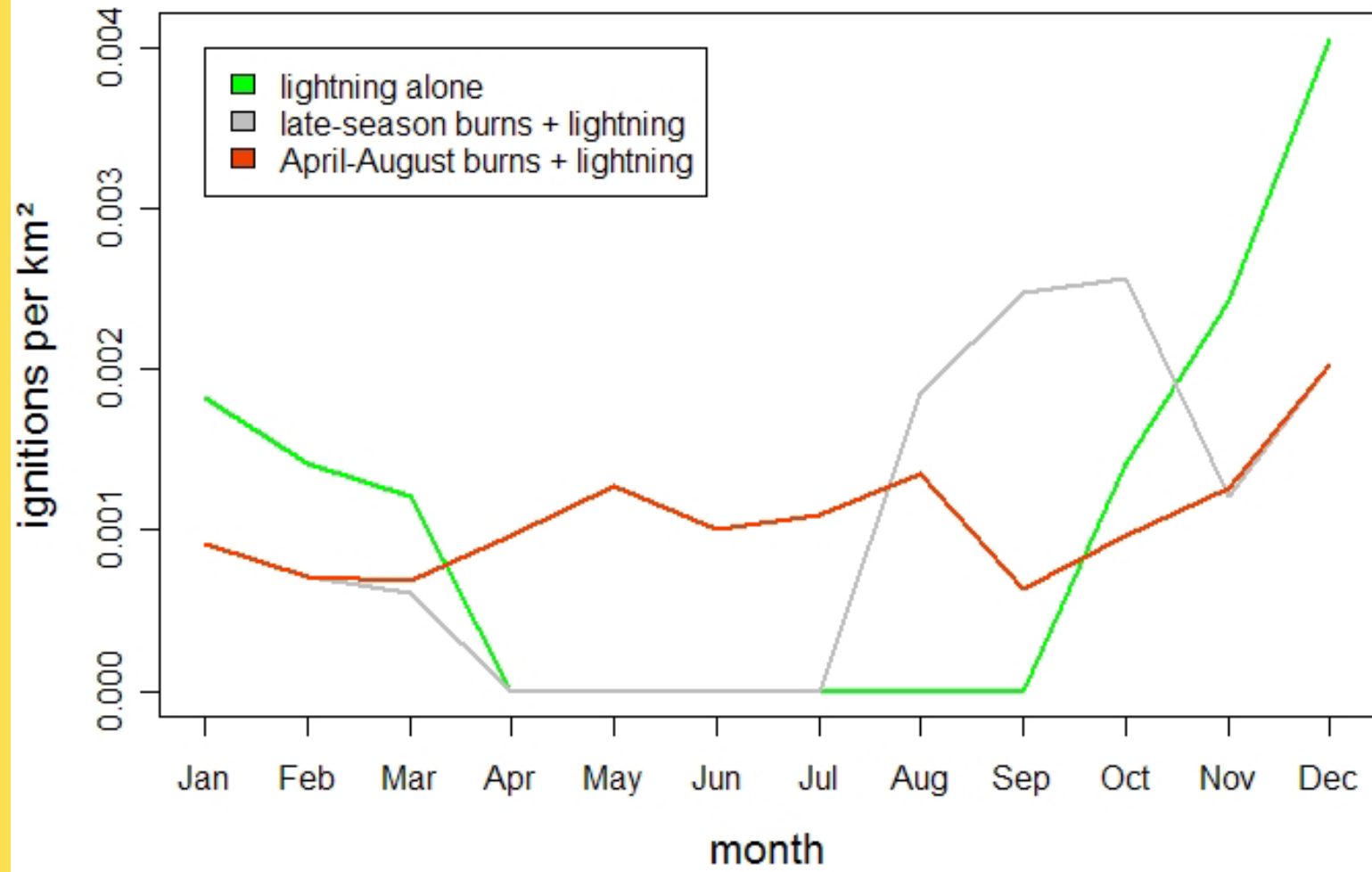
Effect on ignitions > 200 000 years

Kruger National Park

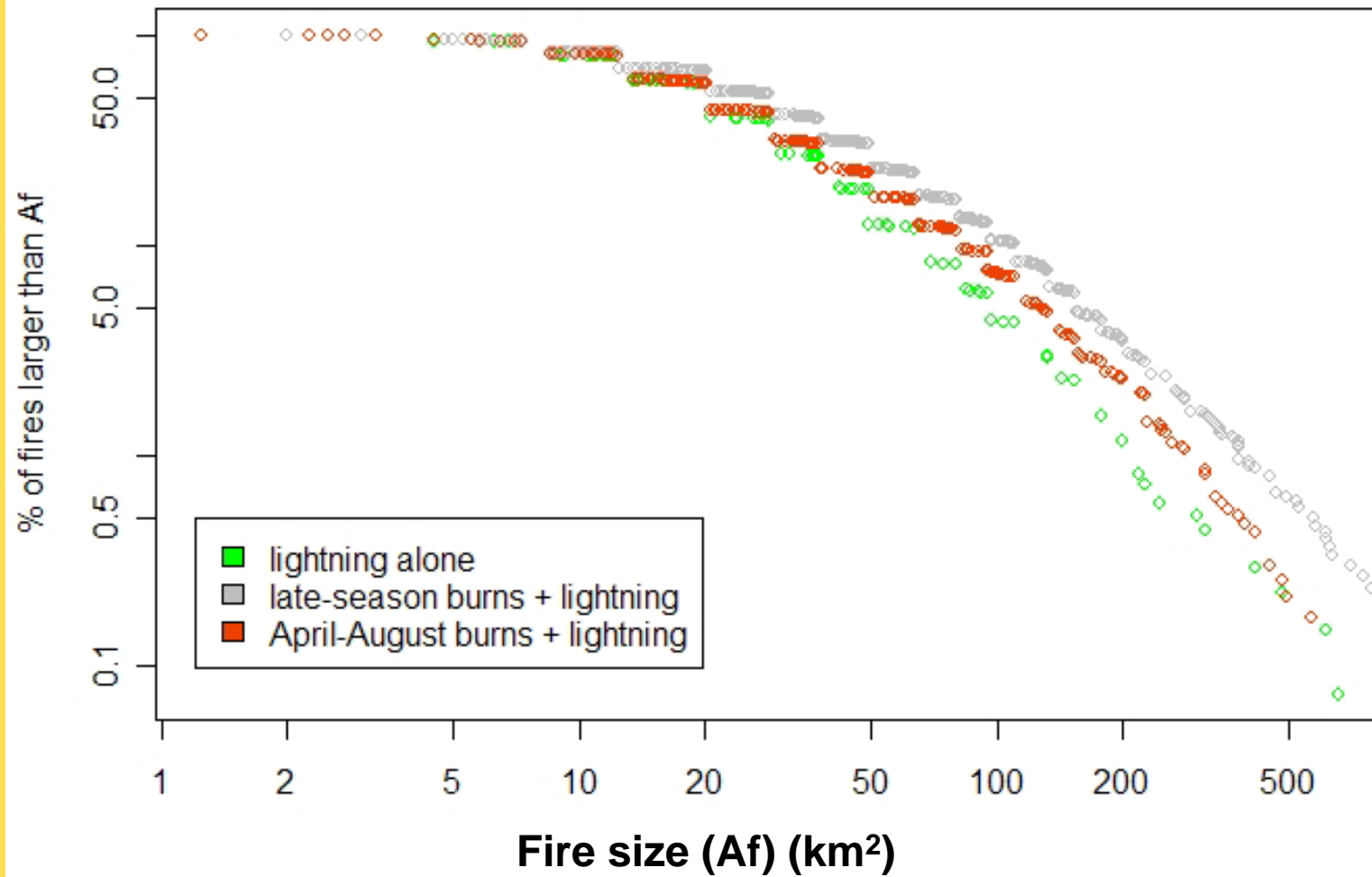
In kruger, often we do know the source of ignitions.

A lot of research and monitoring has been done:

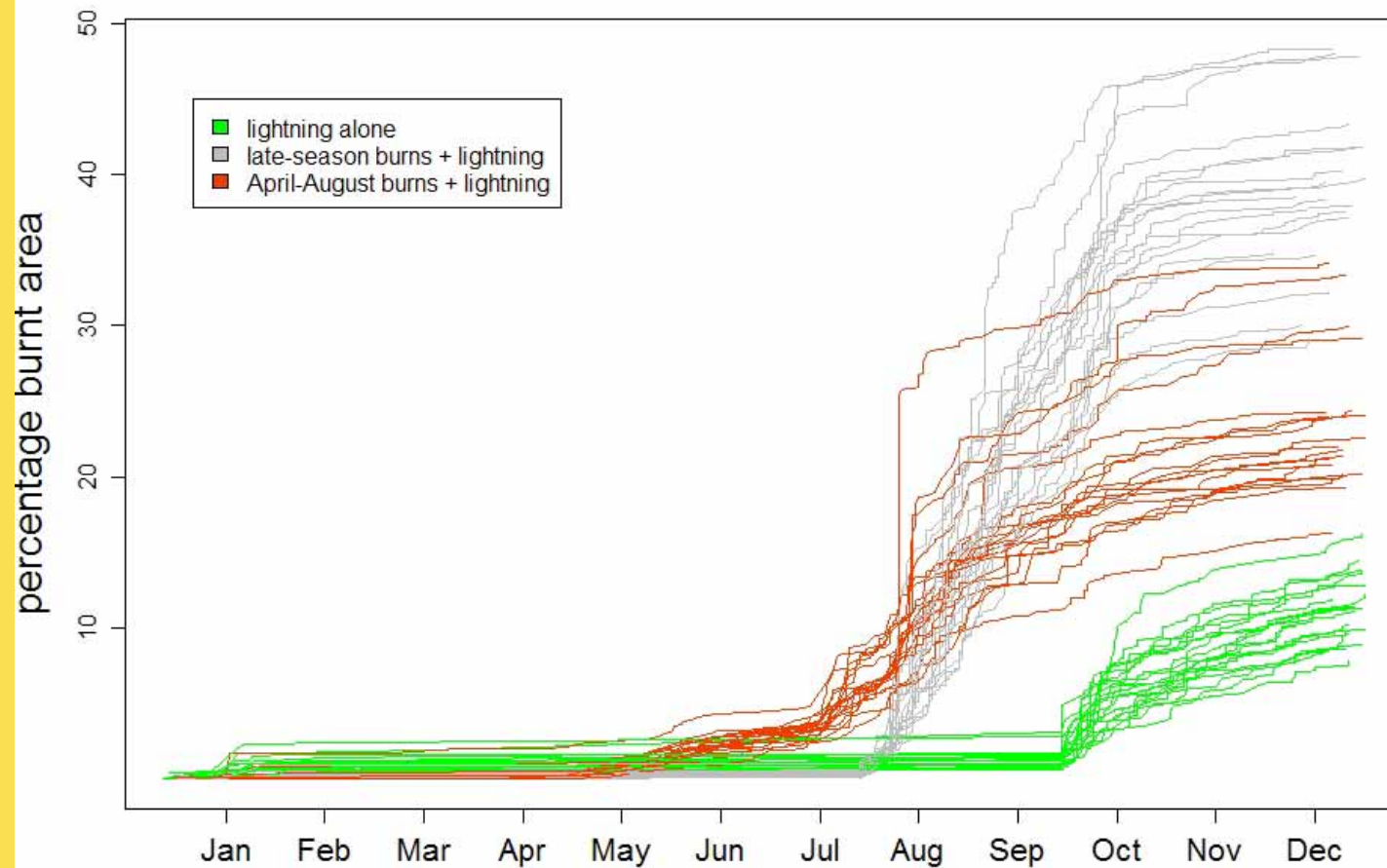
- We know that even when we try to create a lightning-driven fire regime, people end up lighting most of the fires.
- We know that we can affect fire season
- We suspect that we can't affect total burnt area
- We THINK we can affect fire-size distribution



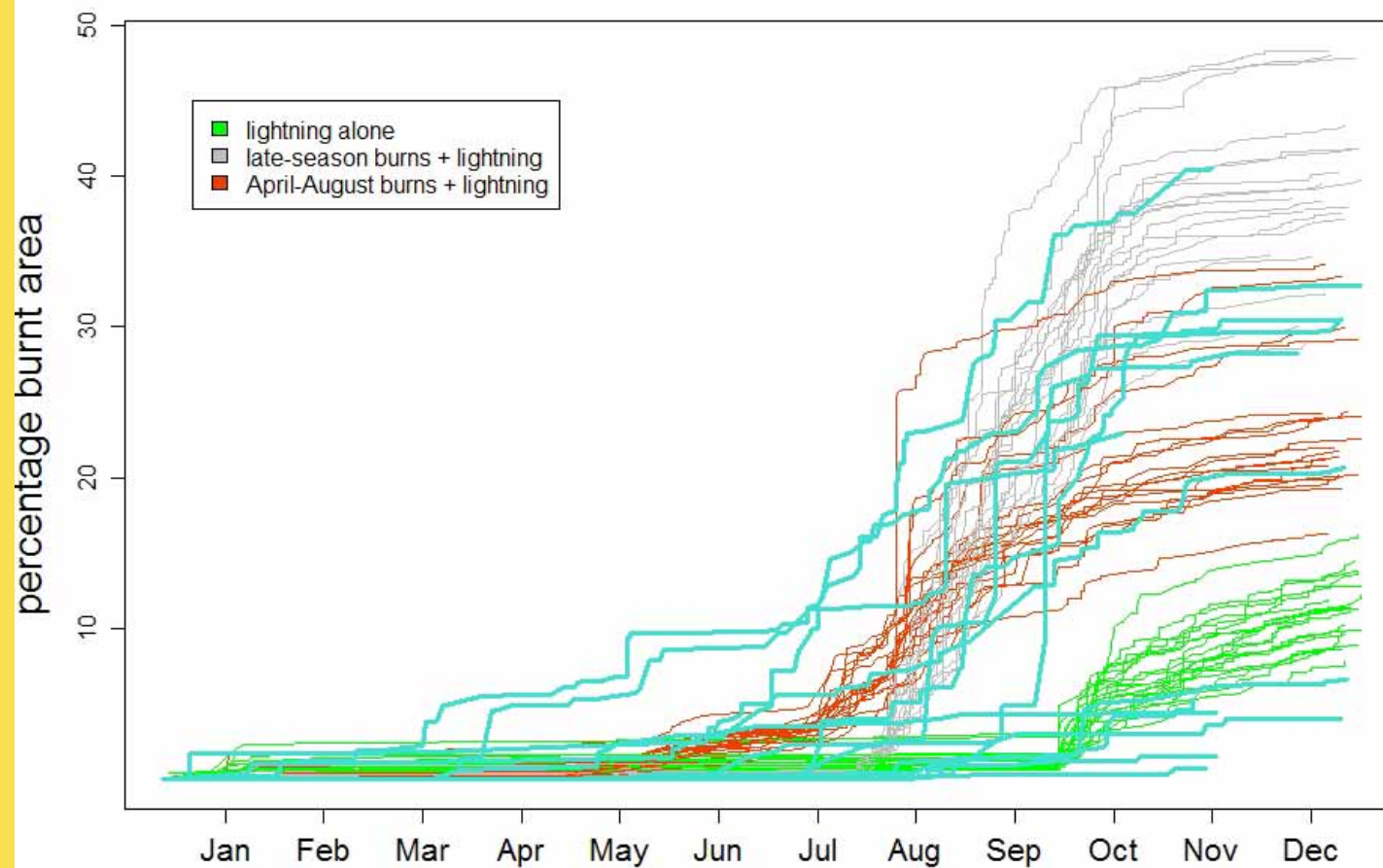
Kruger: three different simulated management regimes



Kruger fire size distributions: three different simulated management regimes



Kruger cumulative burnt area: three different simulated management regimes



Kruger cumulative burnt area: three different simulated management regimes

So... any clarity?

- Long-term human impacts on fire
 - The effect of increasing ignition frequency is more pronounced with DRY SEASON ignitions so the greatest impact of humans would have been when they learned to create fire, rather than simply using lightning fires.
 - Arid and wet areas have different responses to changing ignitions.
 - Modelling can be used to separate human effects on FUEL from effects on IGNITIONS.
- Fire management in Kruger
 - Changing ignition season can change the fire size distribution, and affect patchiness of burns
 - Simply changing burn season can affect total burnt area.
- Are ignitions ever limiting? Still need to work this out.
 - This model indicates that the trade-off between ignition success (higher in dry areas) and fire size (higher in wet areas) is important.

Thank you:

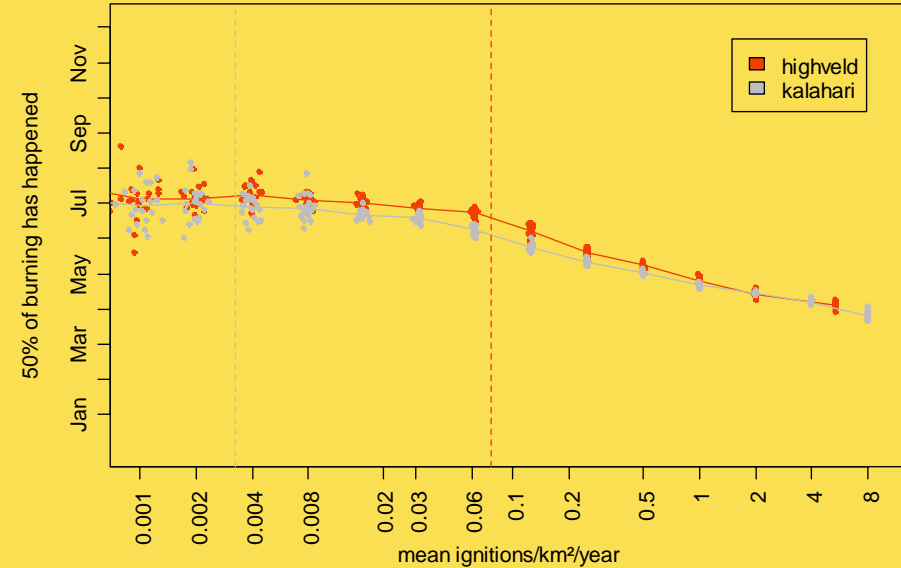
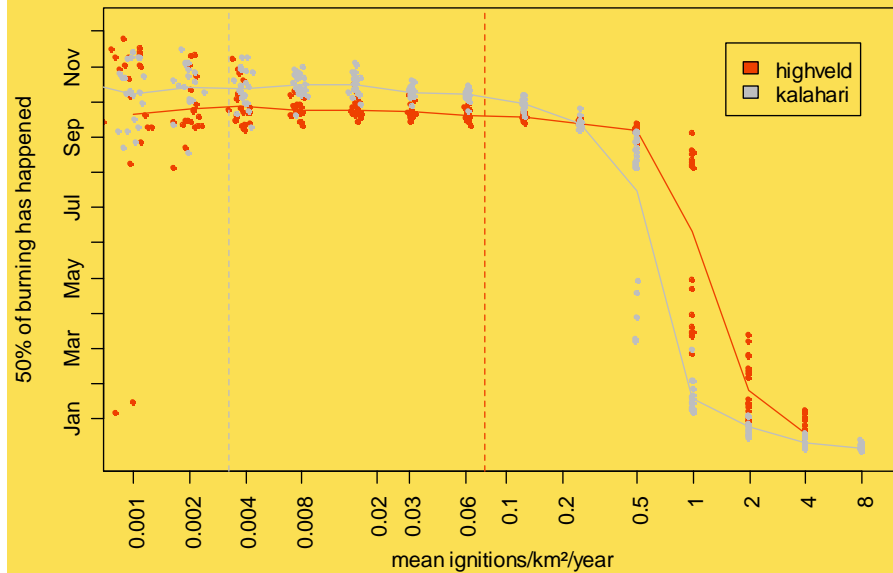
Martin Wooster and Gareth Roberts (KCL) for providing fire intensity data

LPJ modelling group (Jena) for providing daily weather data

David Roy and SanParks for providing fire size data

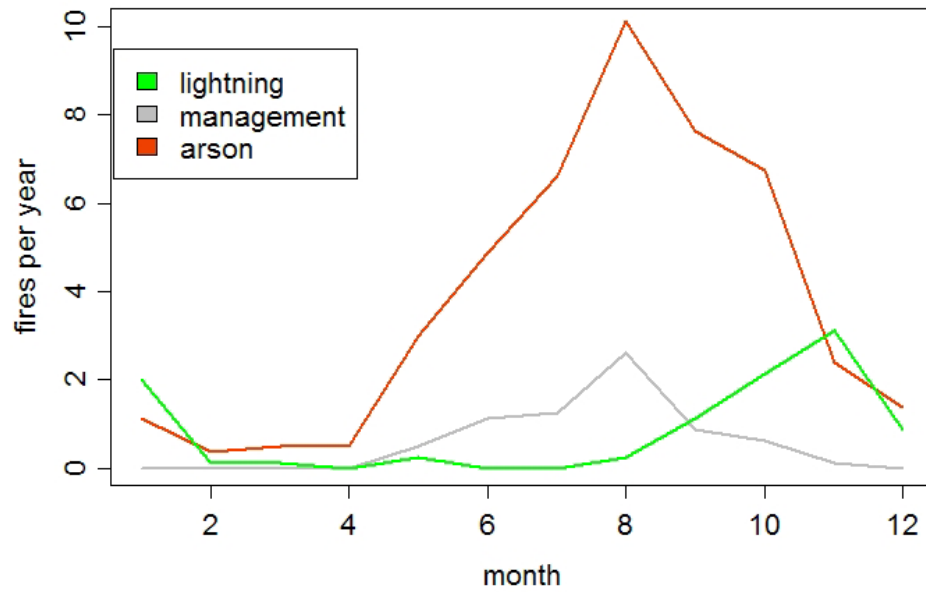
EPD research group and Brian van Wilgen for constructive comments





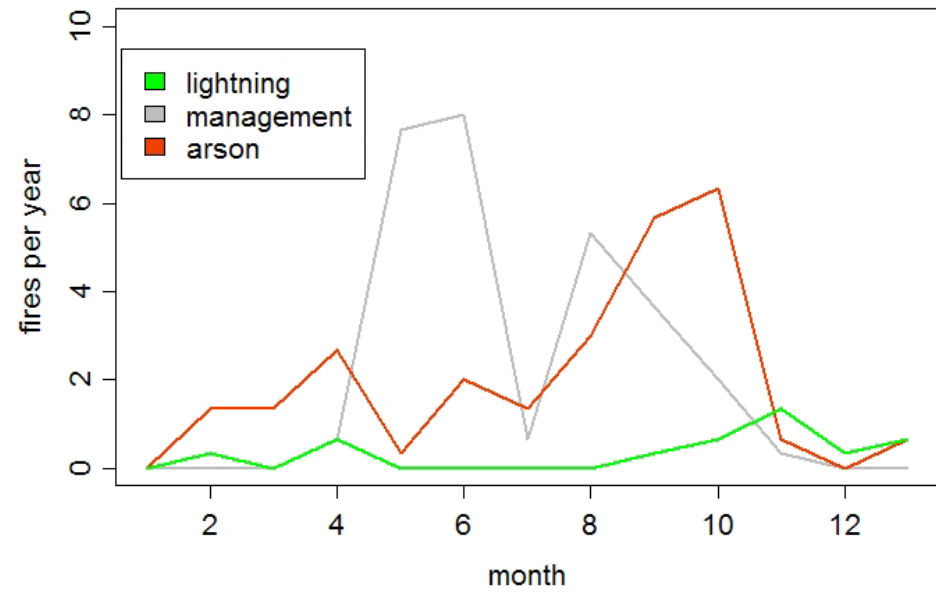
Fire season:

Frequency of burning seems to have very little effect on fire season: Most fires occur after September for lightning ignitions, and after June for dry season ignitions.



Lightning management period (1992-2001):

15% lightning, 70% arson, 15% planned

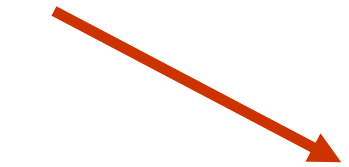
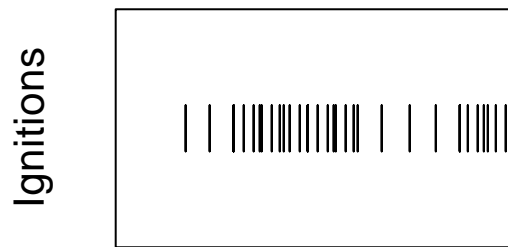
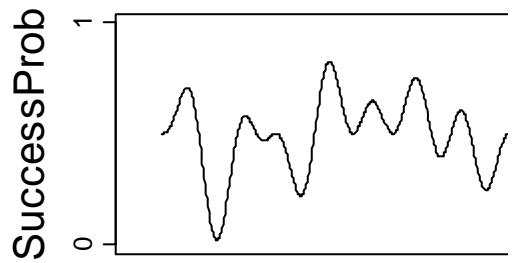
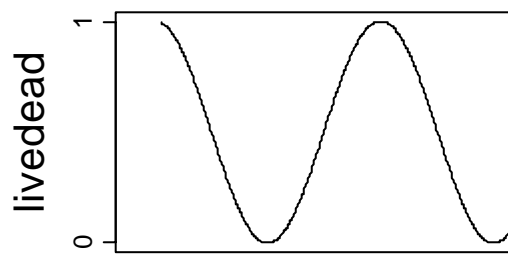
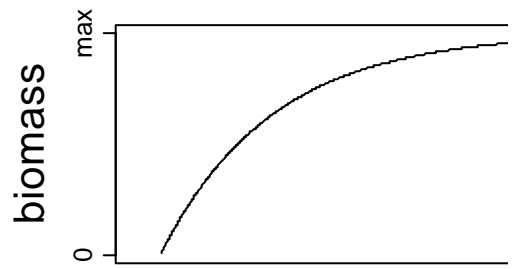


Proactive management period (2001-2005):

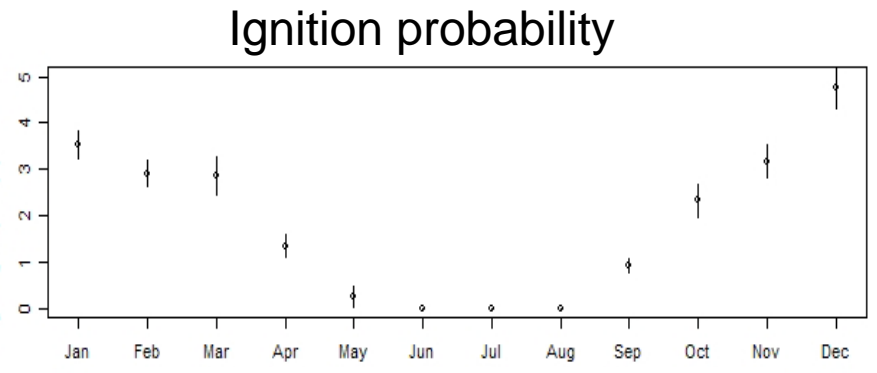
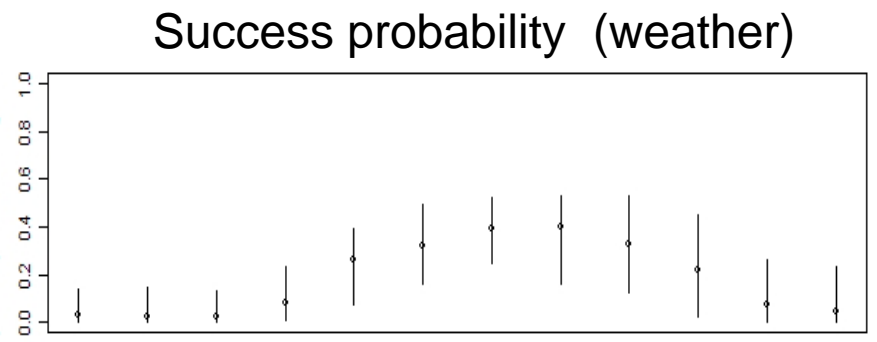
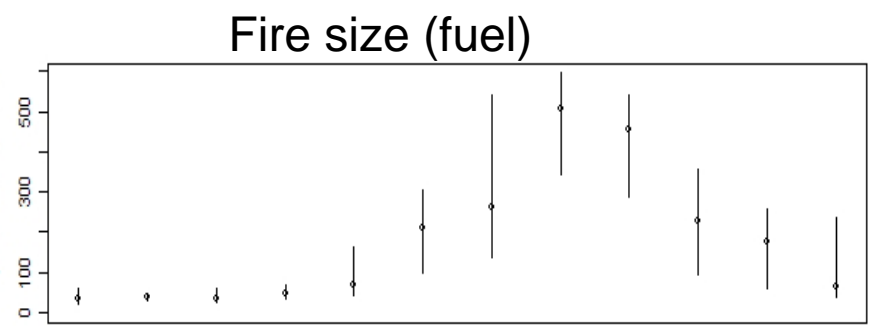
5% lightning, 35% by arson, 60% planned

What does this mean for plants?

- Increased frequency of fire:
 - tree recruitment,
 - nitrogen cycling
- Changing season of fire:
 - flowering phenologies,
 - loss of carbon/nutrients
- Changing fire size-class distribution:
 - heterogeneity,
 - grazing resource.

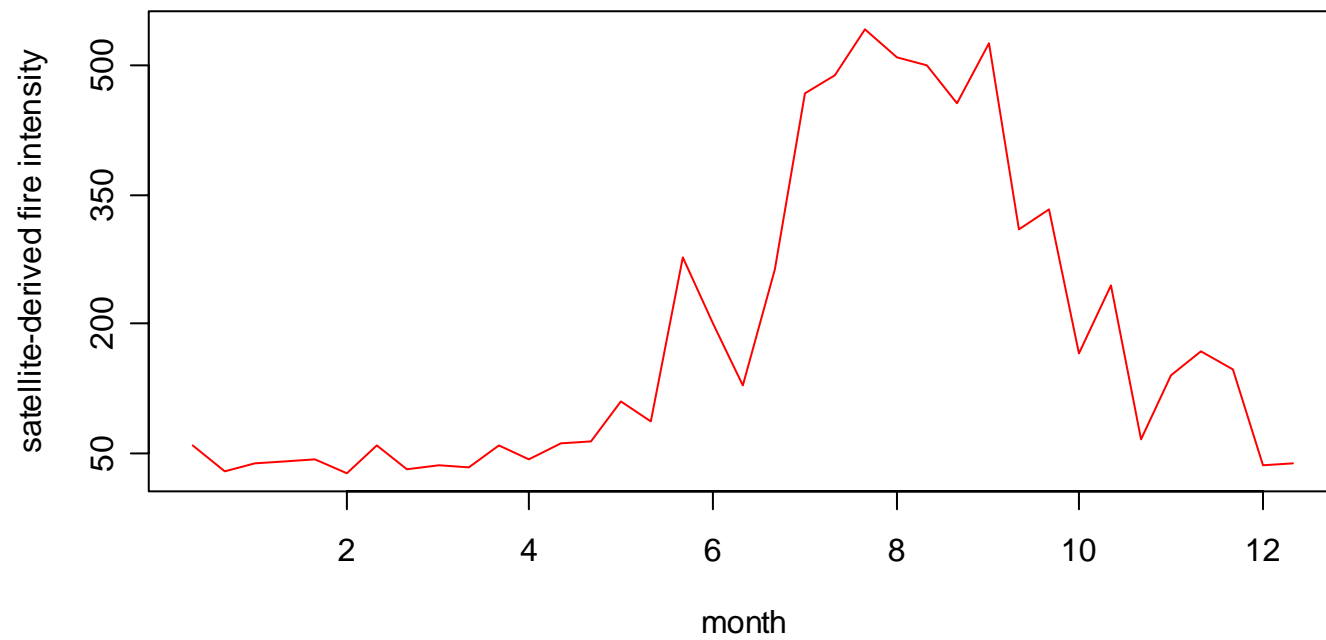
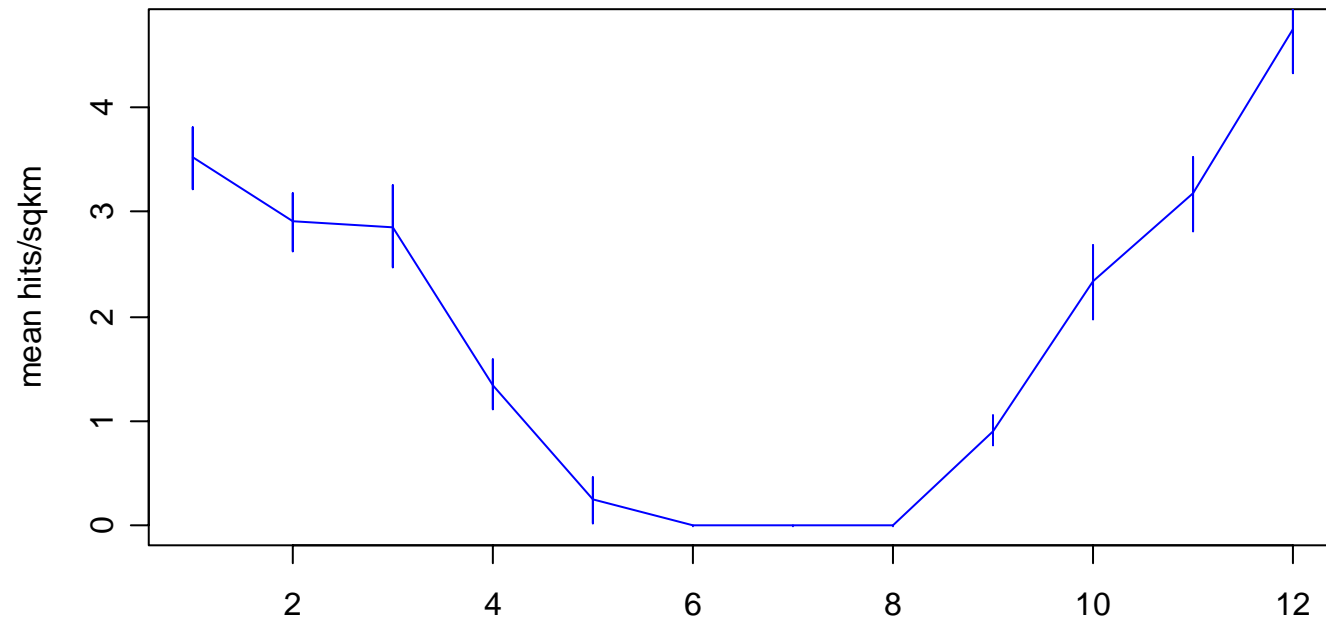


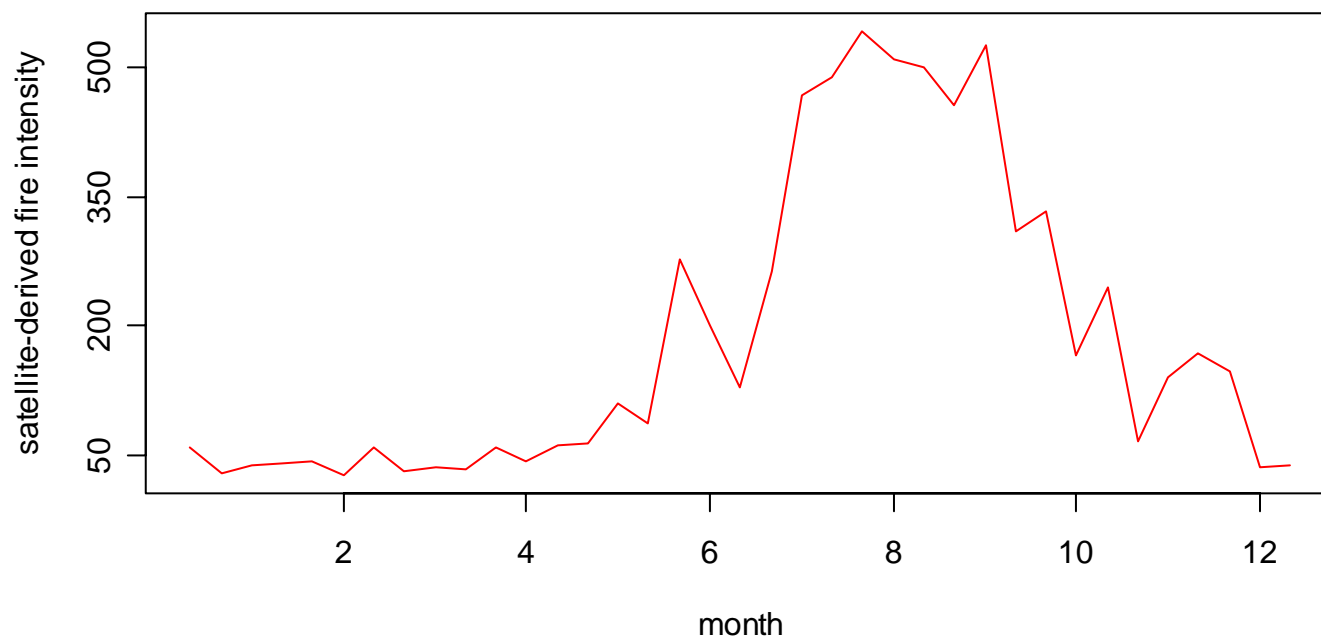
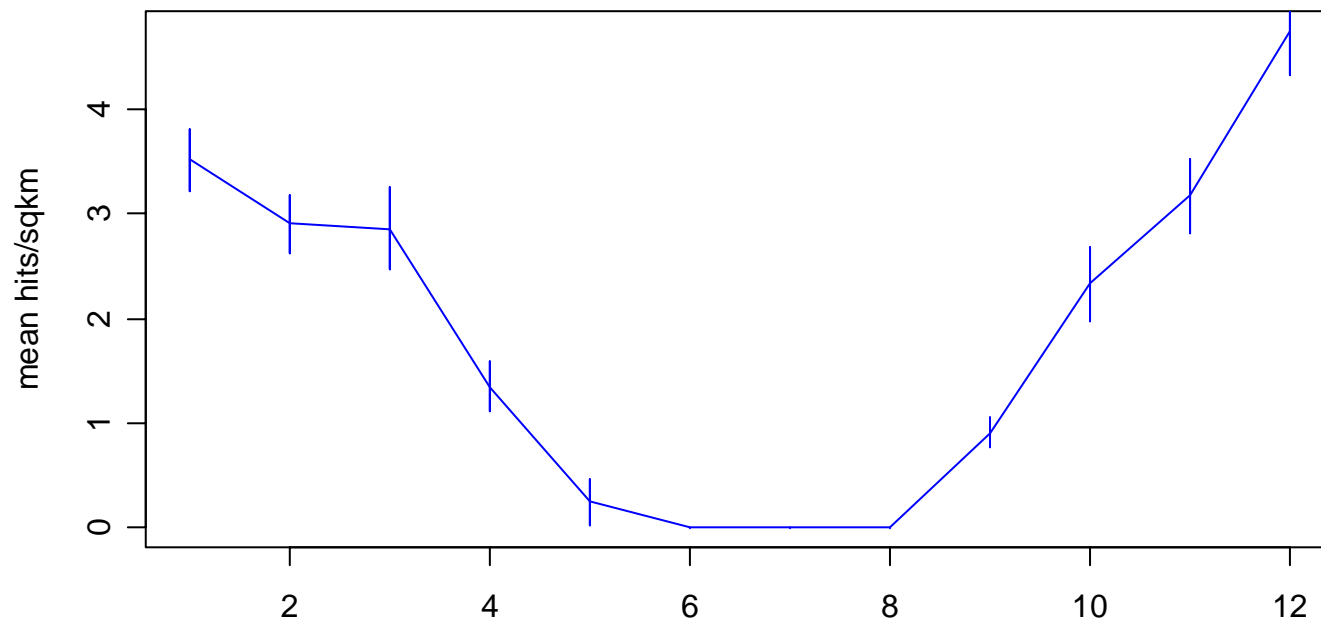
MODEL INPUTS



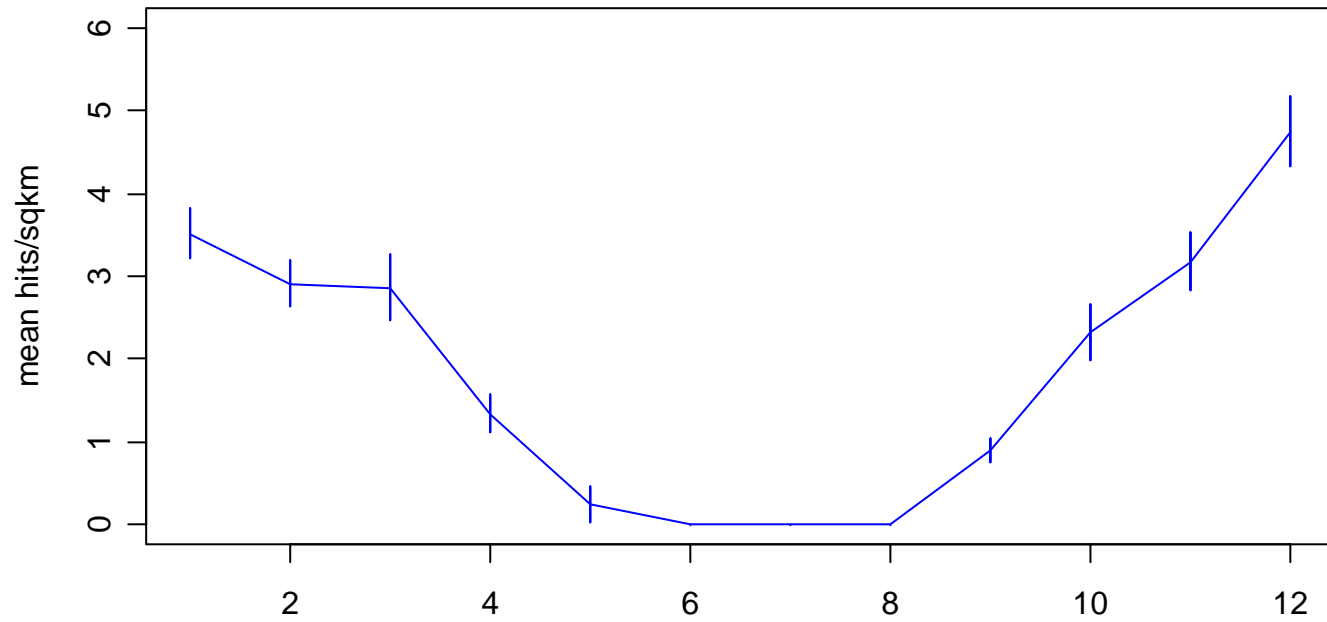
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec

Month of the year





Current lightning ignition regime



simulated ignition regime

