Characterising severe fire events in South Africa

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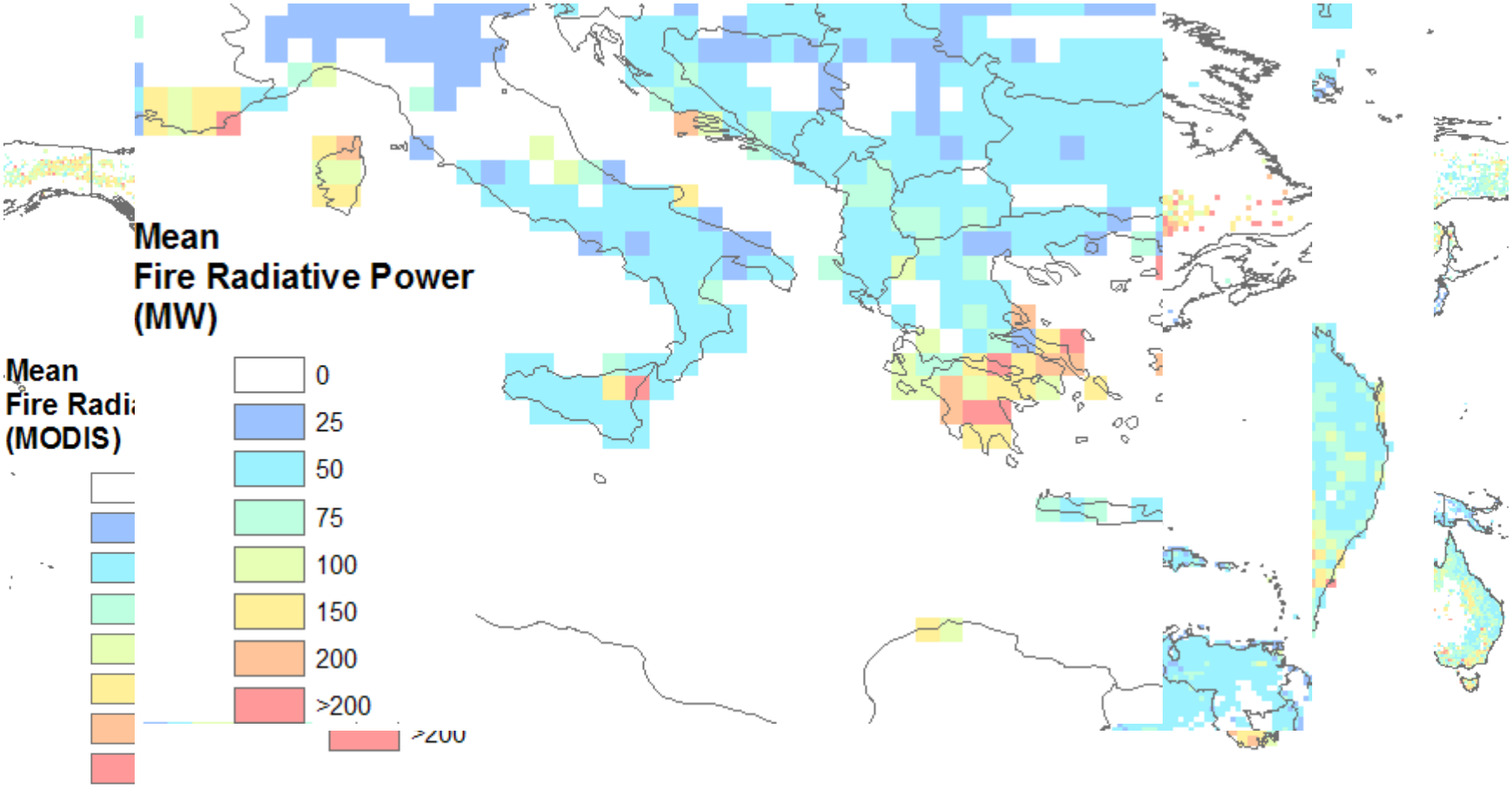
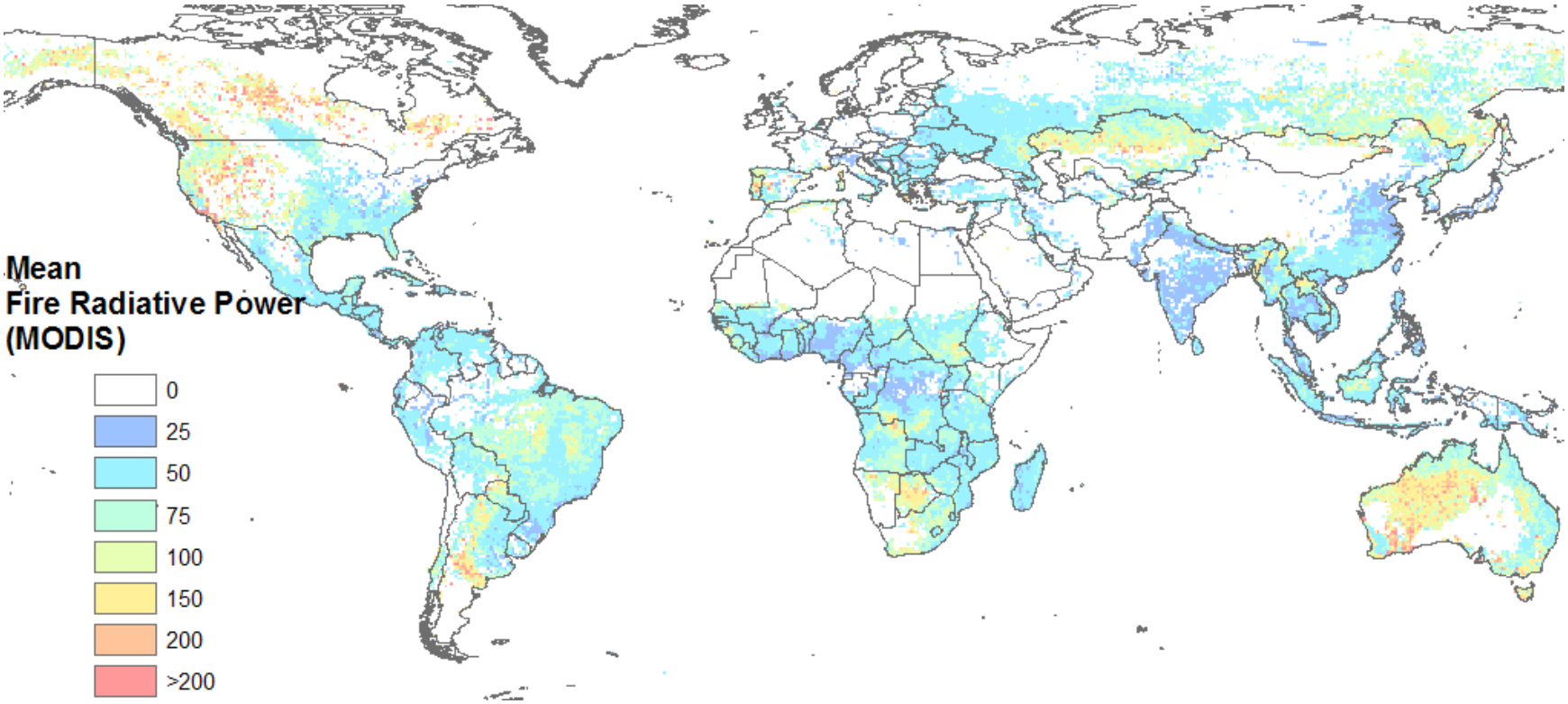
Severe fires in South Africa

- (1) What constitutes a “severe" fire in South Africa?
- (2) What damage is associated with these fires?
- (3) What conditions (weather, fuel) are associated with these large fires?
- (4) Are there any trends that can be detected, either in the fires themselves, or in the conditions that drive them?
- (5) What are the risk management implications of this analysis?

What constitutes a severe fire?



What constitutes a severe fire?



What damage is associated with severe fires?

Vegetation type	Total events reported in the media	Total deaths	Total properties destroyed	Plantation forestry destroyed (ha)*
Fynbos	41	1	93	2 256
Grassy vegetation	61	43	187	61 708
Total	102	44	380	63 964

August/September fires of 2007 in South Africa: 2 deaths, 43 properties destroyed, costs estimated at EUR 200 000

Black Saturday (Sydney 2009): 173 deaths and over 3000 buildings destroyed, costs estimated at EUR 3.4 billion.

Greece (2007): over 2000 buildings destroyed, costs estimated at EUR 1.5 billion.

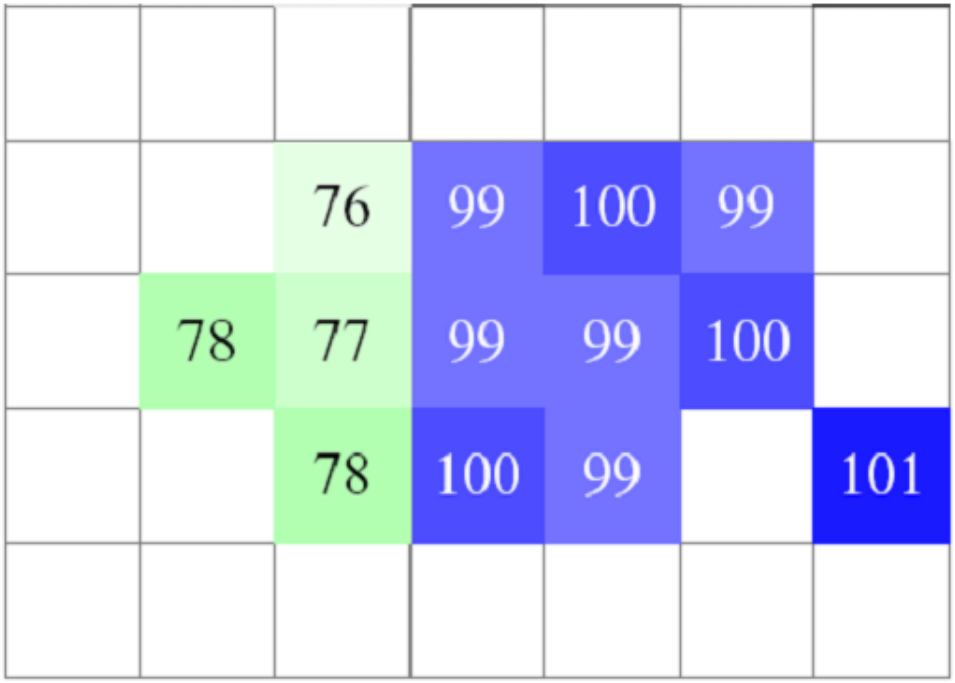
- Costs and consequences of South African fires are orders of magnitude less than most severe fires on the globe.
- BUT: still significant. Especially to plantation forestry where fires threaten viability of the industry

	Number of incidents	Percentage of incidents
No damage reported	32	31%
Only vegetation burned	21	21%
loss of livestock	10	10%
loss of plantations	5	5%
loss of property	28	27%
loss of life	15	15%

Characterising severe fires – from satellite imagery

- Identify individual fires. Assess their size, and the energy released.
- Determine an “objective” classification of a severe fire.
  - Relate this to “severe fires” identified from media reports
- Relate this to the climatic/other drivers of severe fire events

Methodology: identifying individual fires

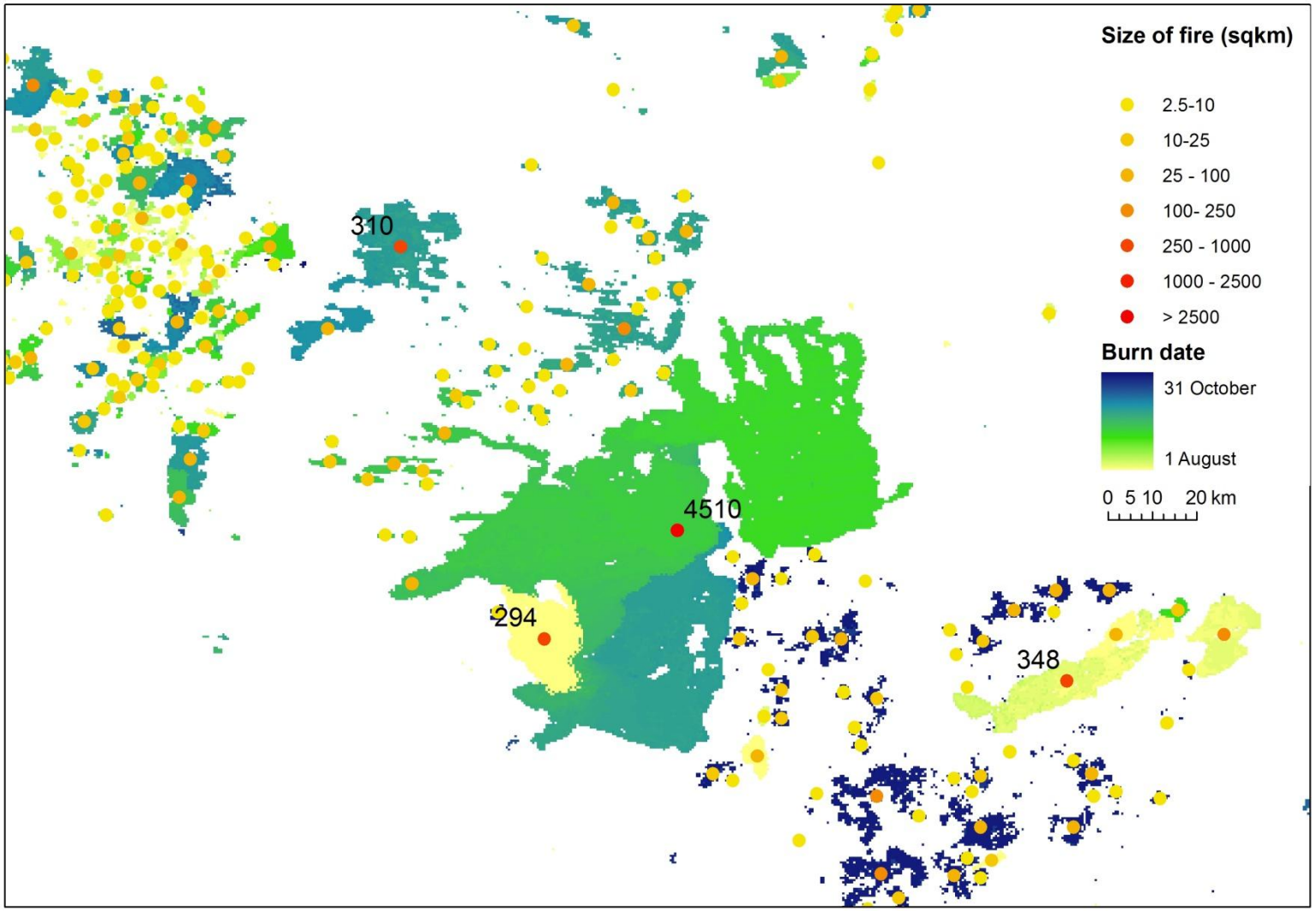


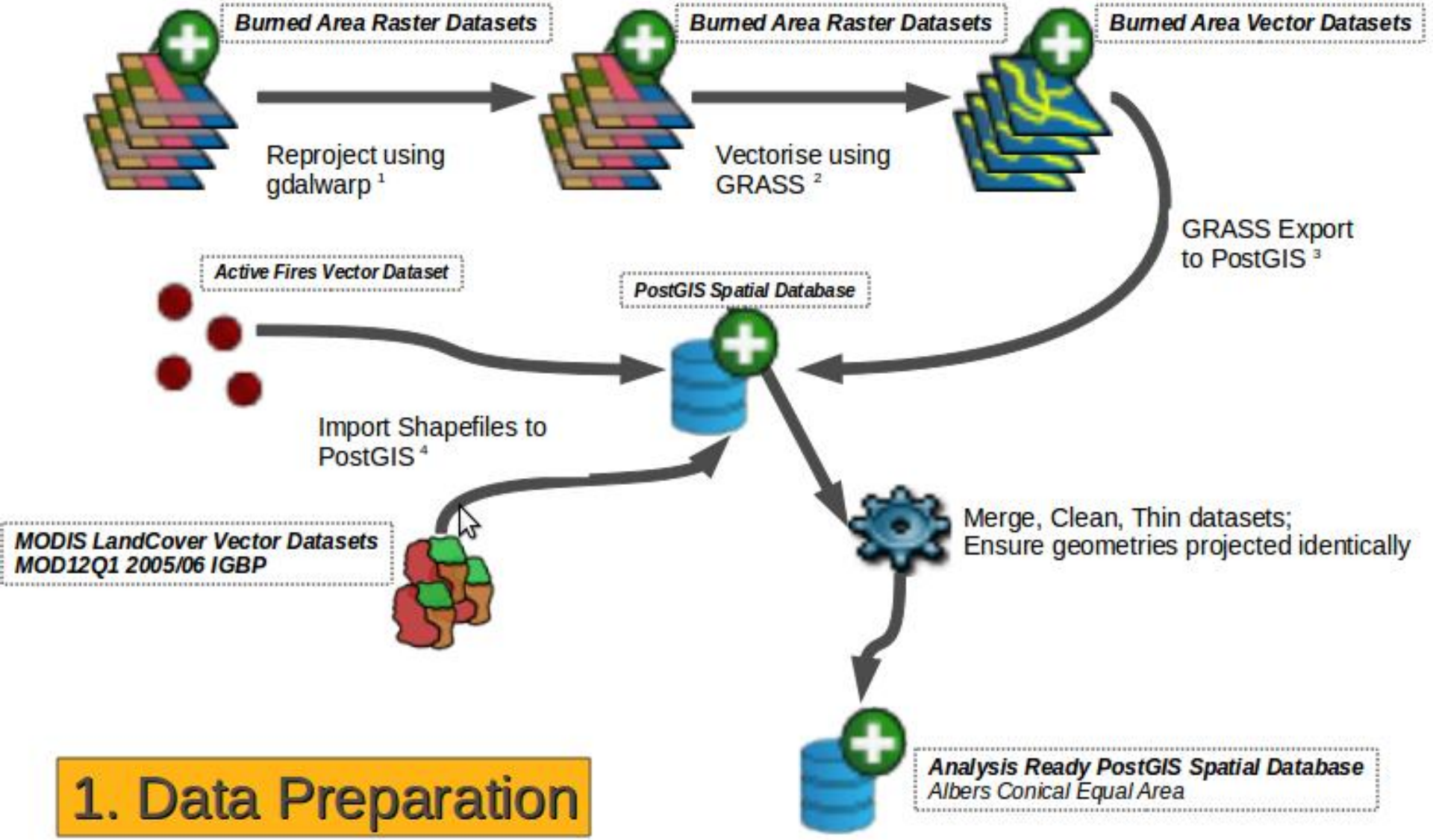
Two fires identified:

One starting on day 76 with a mean burn date on day 77.

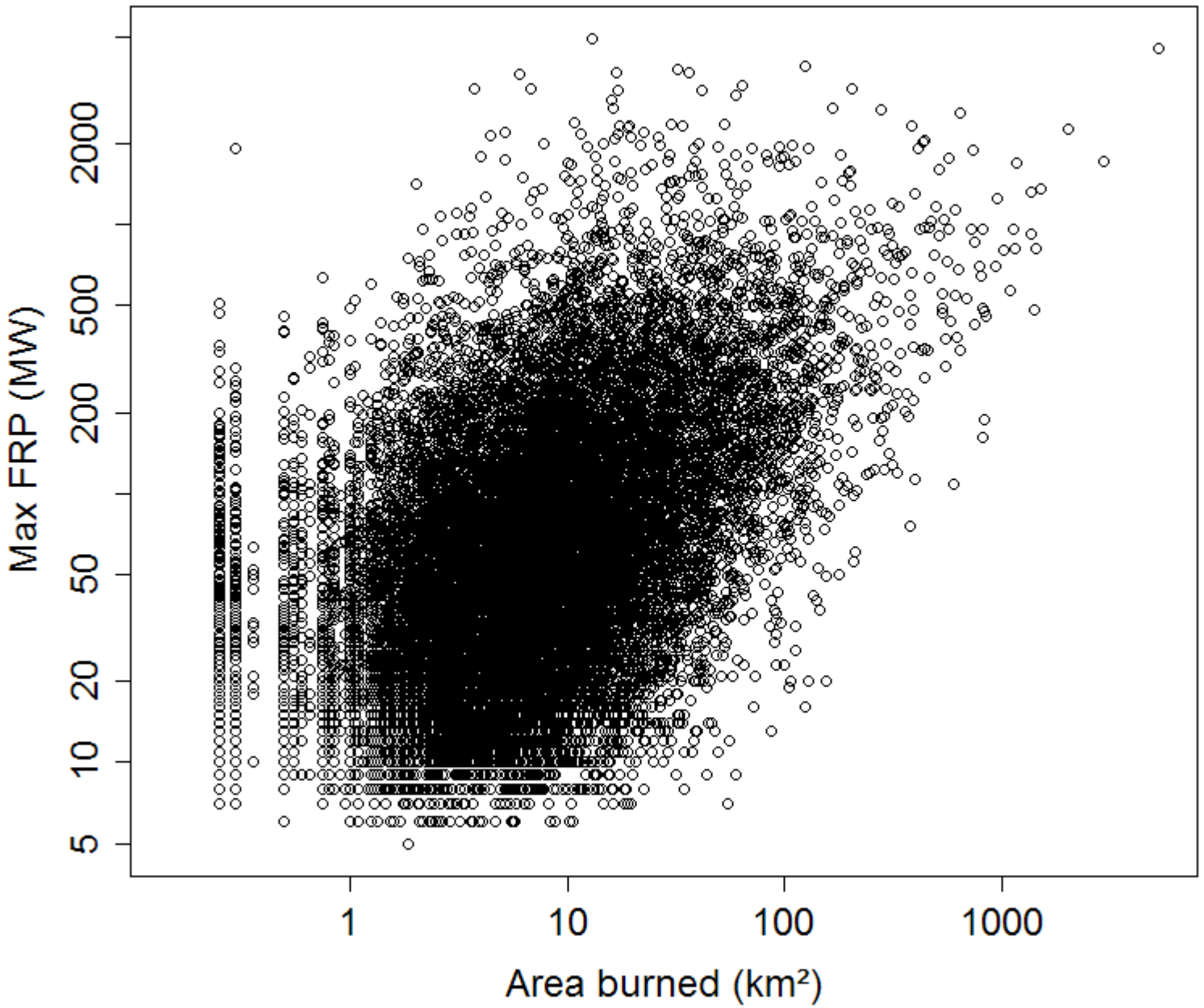
One starting on day 99 with a mean burn date on day 100.

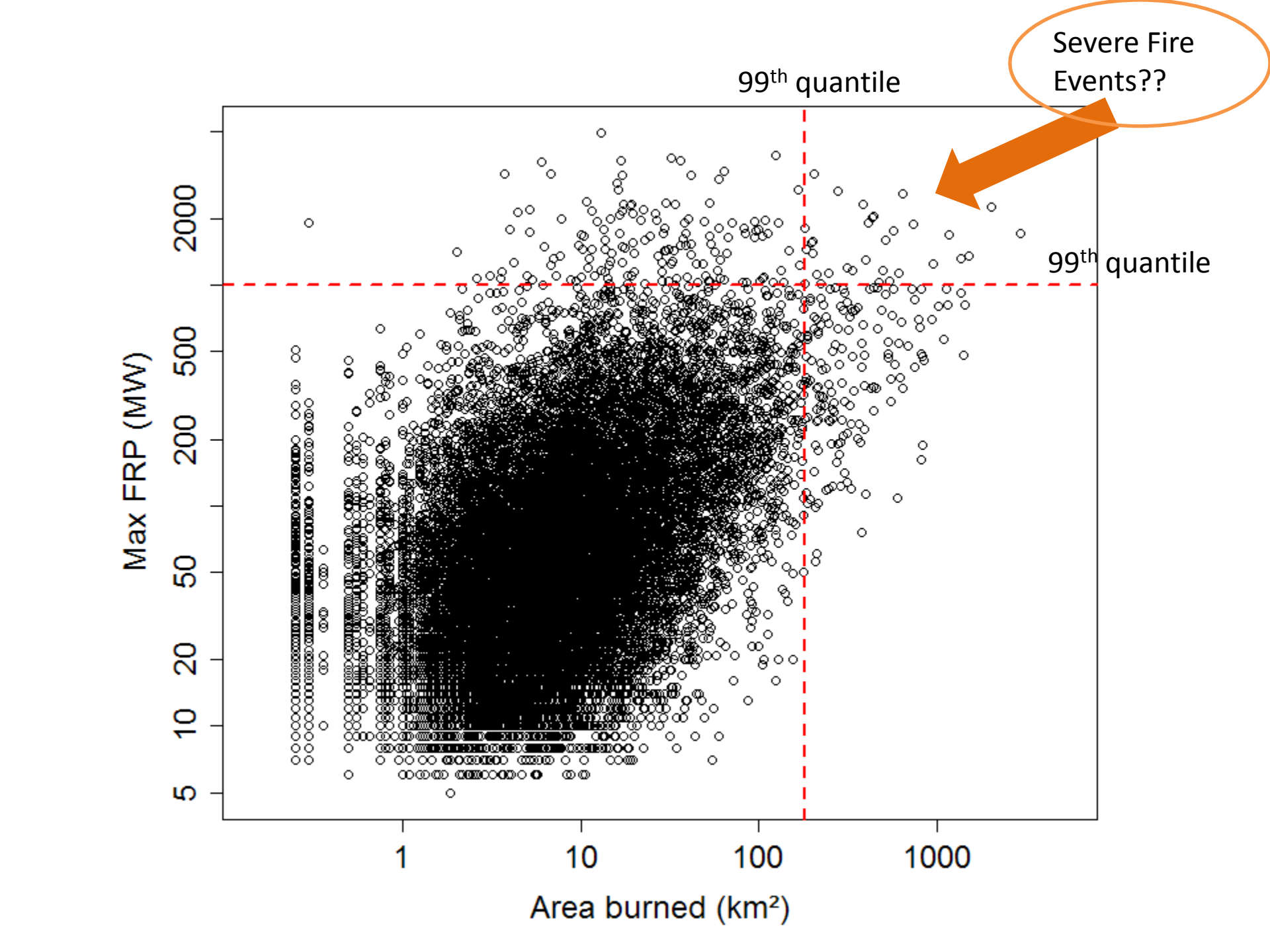
Identifying individual fires

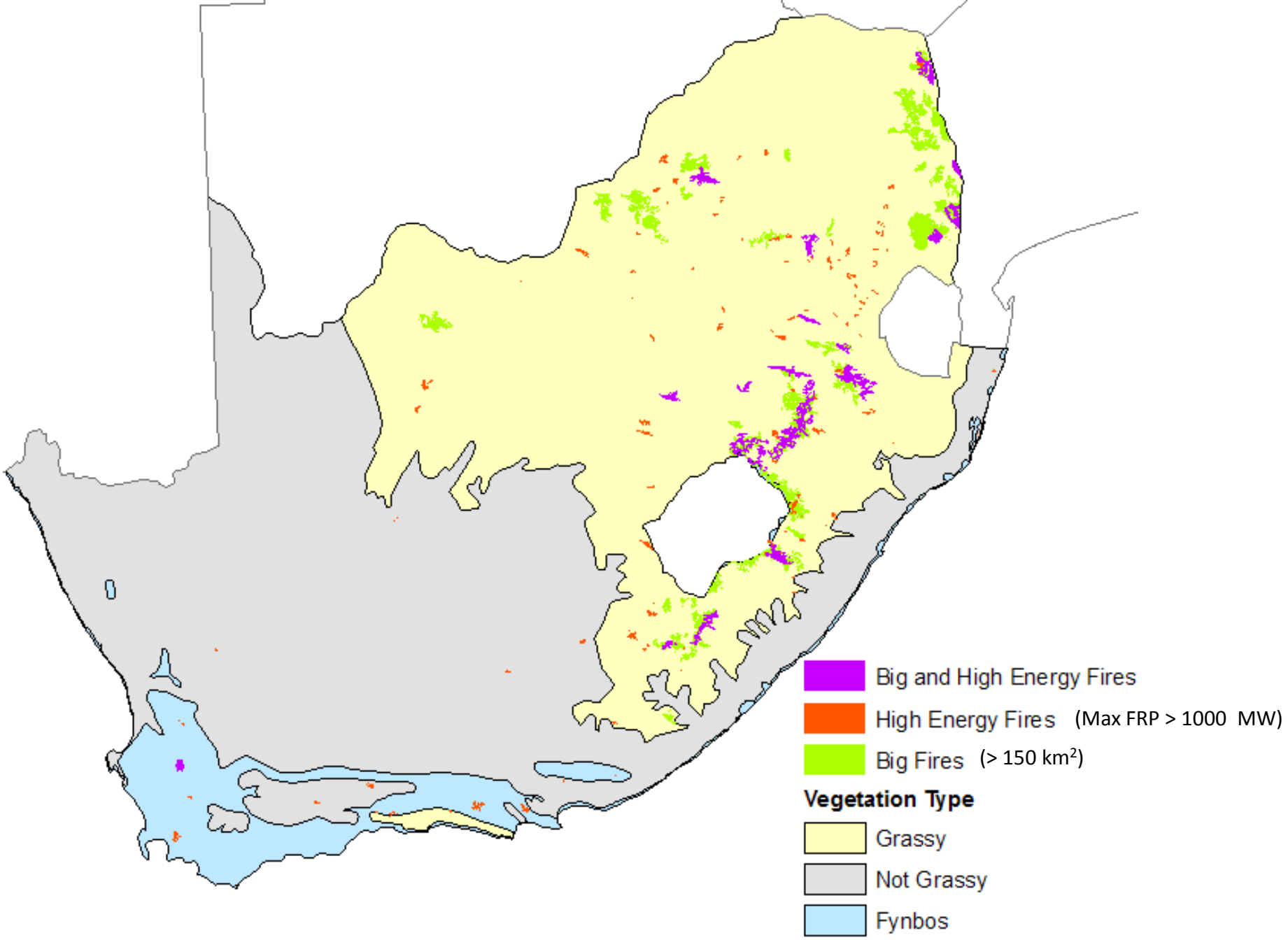



Burned Area Raster Datasets
Reproject using gdalwarp [1]
Burned Area Raster Datasets
Vectorise using GRASS [2]
Burned Area Vector Datasets
GRASS Export to PostGIS [3]
Active Fires Vector Dataset
PostGIS Spatial Database
Import Shapefiles to PostGIS [4]
MODIS LandCover Vector Datasets
MOD12Q1 2005/06 IGBP
Merge, Clean, Thin datasets;
Ensure geometries projected identically
Analysis Ready PostGIS Spatial Database
Albers Conical Equal Area
1. Data Preparation

- From these algorithms extract:
  - Individual fire size
  - Date of burning (start, mid, end)
  - Energy Released (average, max, min, FRP measured within the fire extent)


Max FRP (MW)
5
10
20
50
200
500
2000
1
10
100
1000
Area burned (km²)


Severe Fire Events??
99th quantile
99th quantile
Max FRP (MW)
5
10
20
50
200
500
2000
1
10
100
1000
Area burned (km²)


Big and High Energy Fires
High Energy Fires (Max FRP > 1000 MW)
Big Fires (> 150 km²)
Vegetation Type
Grassy
Not Grassy
Fynbos

Characterising severe fires

- Definition of a “severe fire” might depend on vegetation type. Fire size is not always a good predictor.
- Severe fire events appear to be clustered:
  - Of the 24 large, high-energy fires, 8 occurred within one week of each other.
- The media reports support the idea of “associations of fires” related to particular synoptic conditions.
- Subject of future research

Severe fires in South Africa

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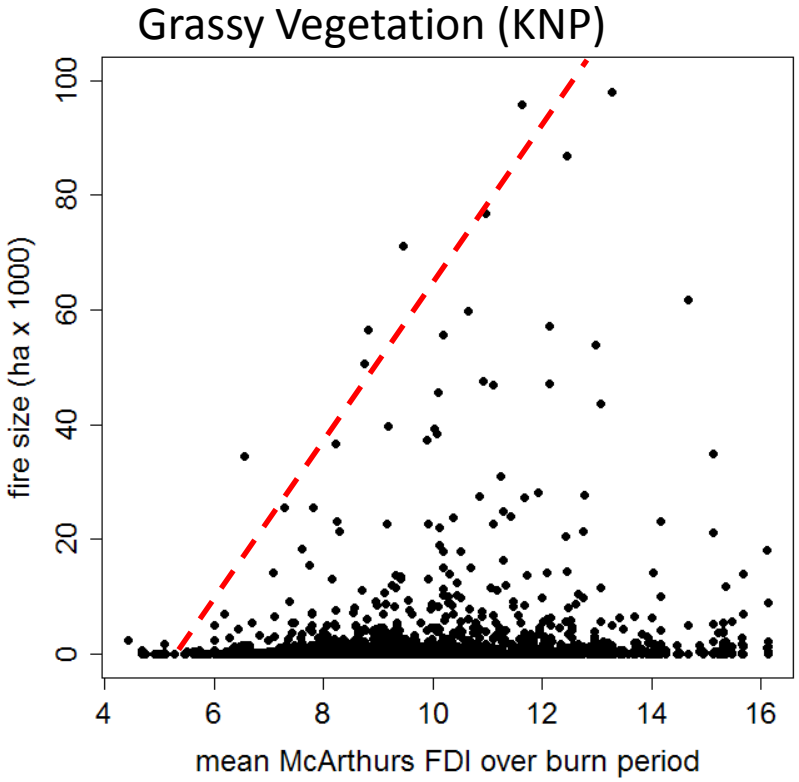
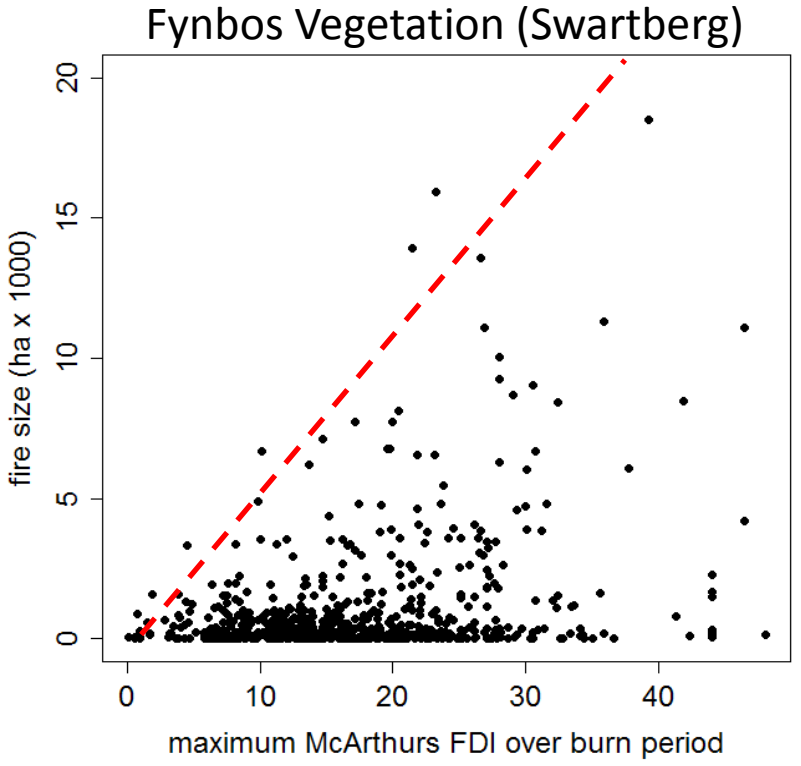
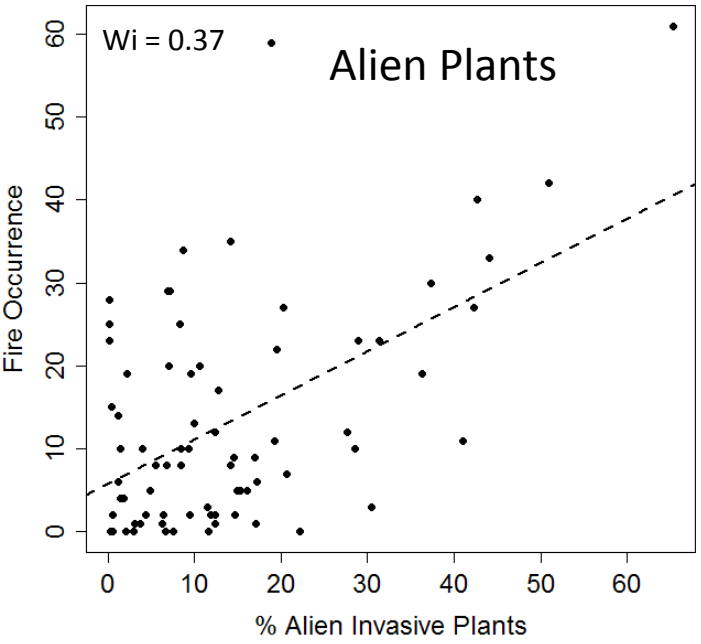
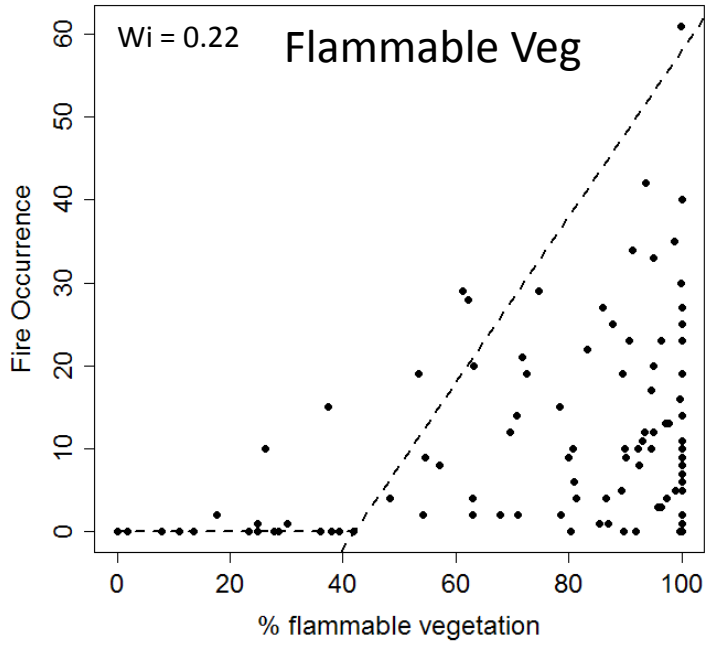
Conditions causing severe fires





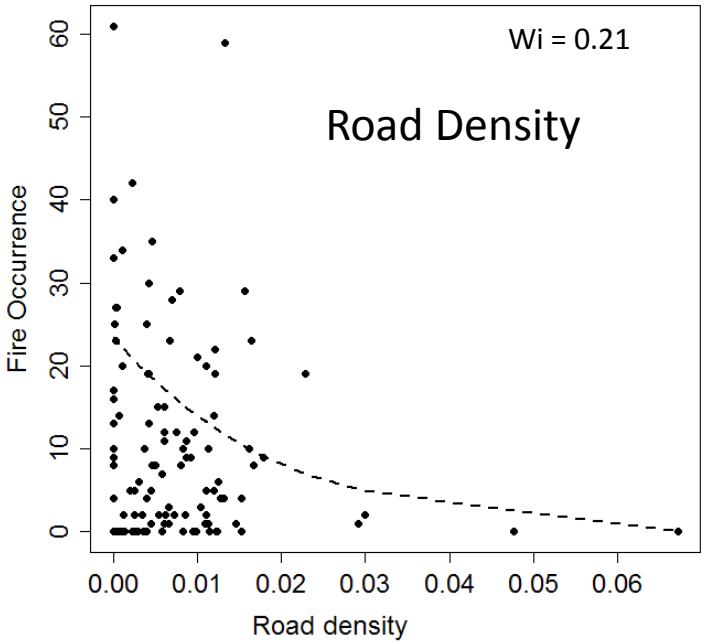


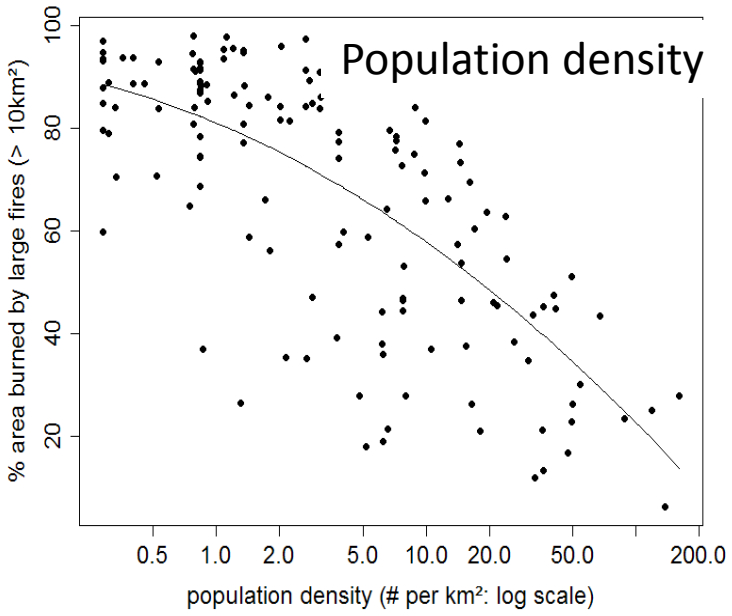


Co-limitation

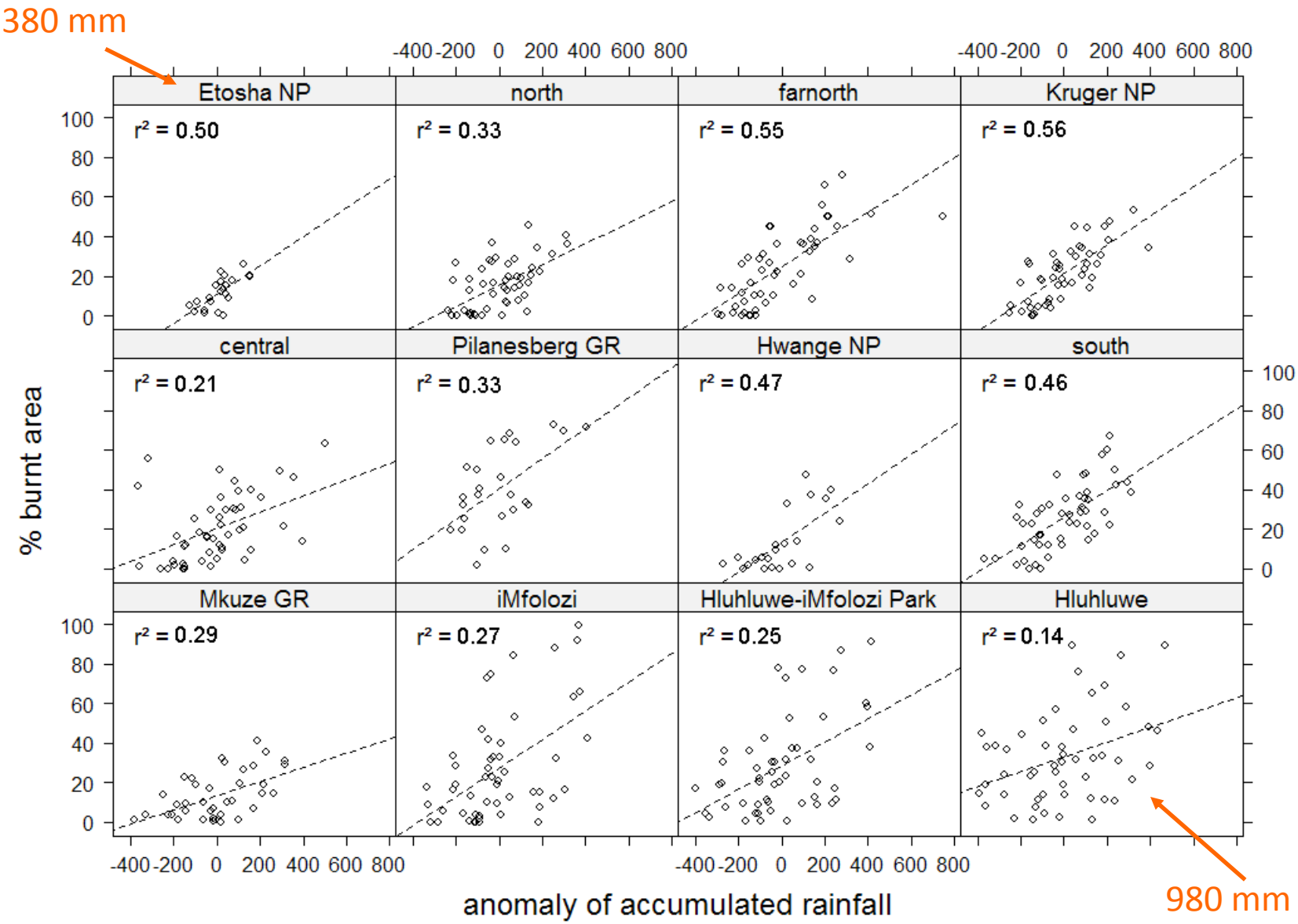
"Switches" (Bradstock 2009)

Extreme fire weather alone does not cause extreme fire events.

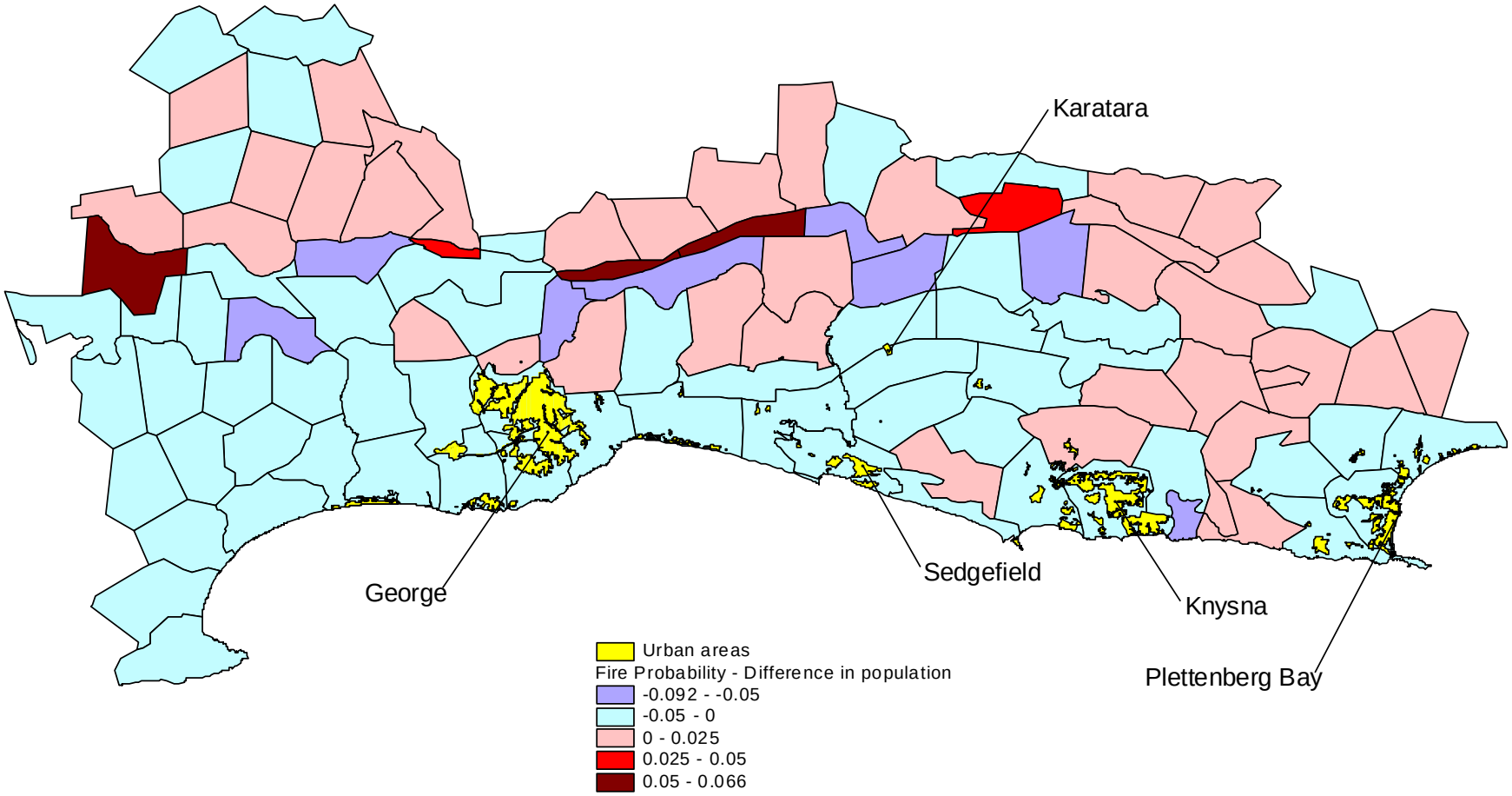




Drought doesn't always mean more fire

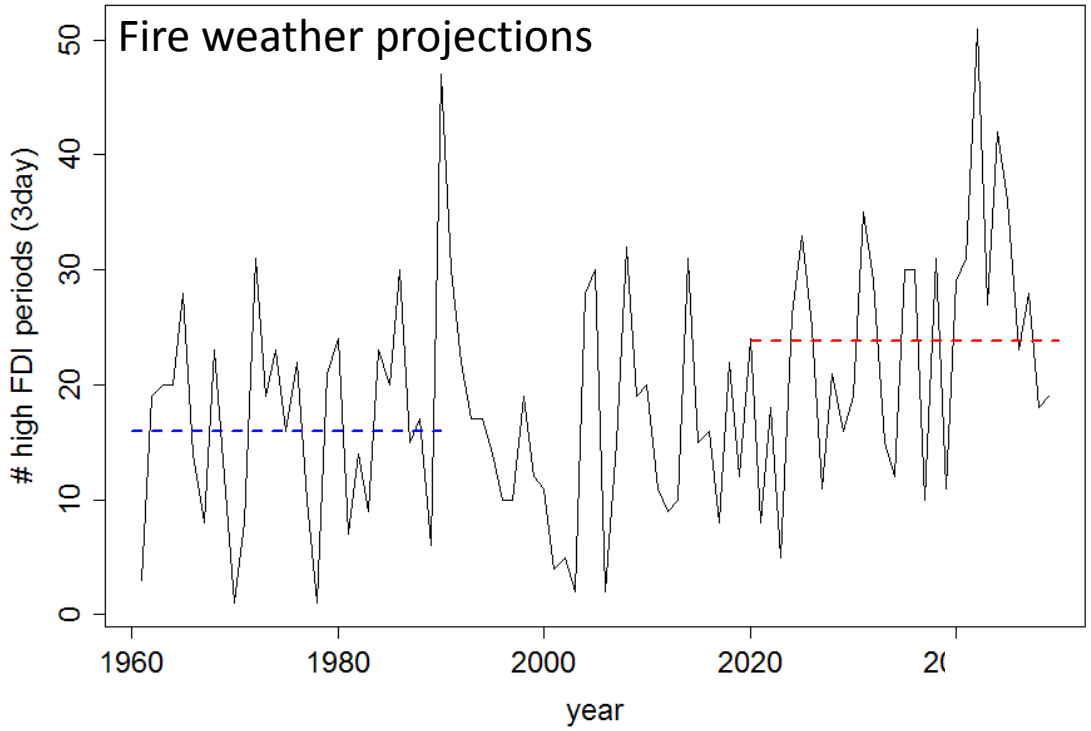


Change in fire risk with predicted future population changes in the southern Cape (South Africa)



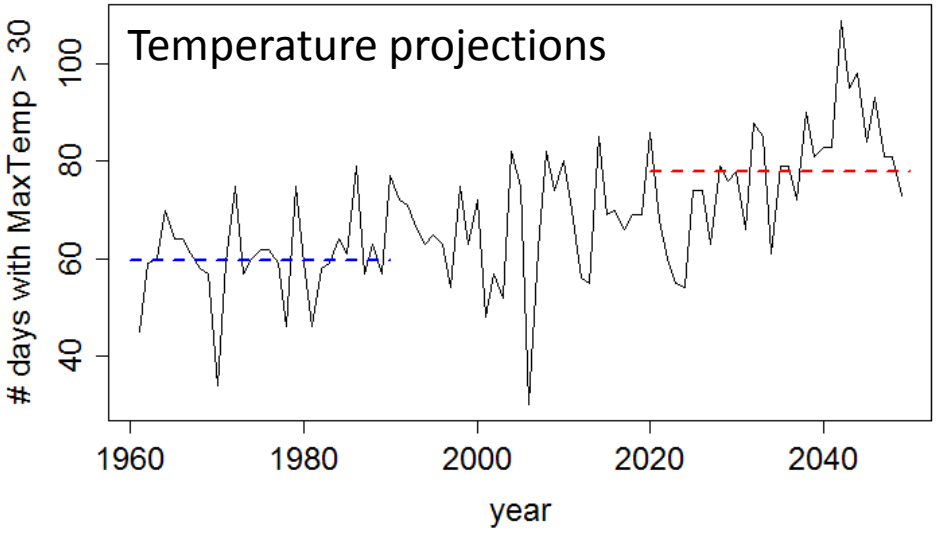
SANTAM CASE STUDY March 2011

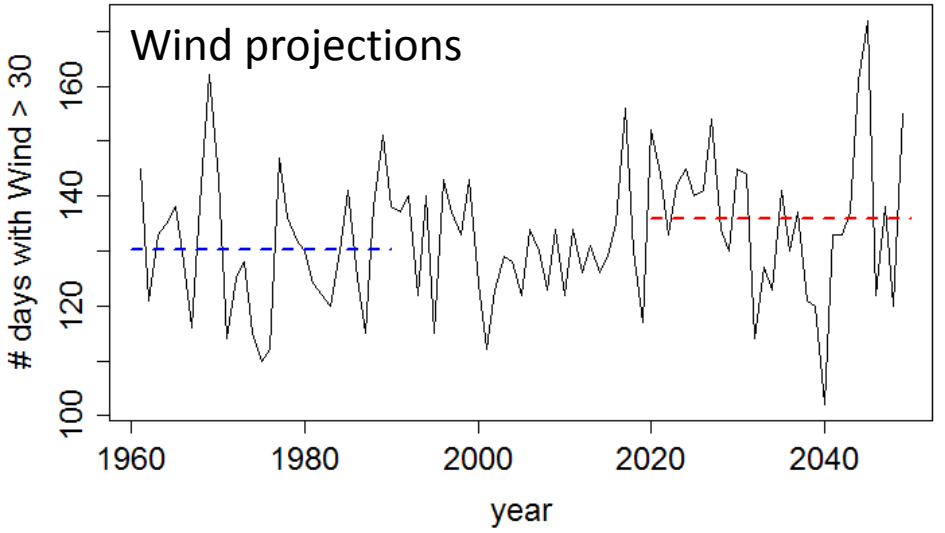
Fire Risk: Climatic projections



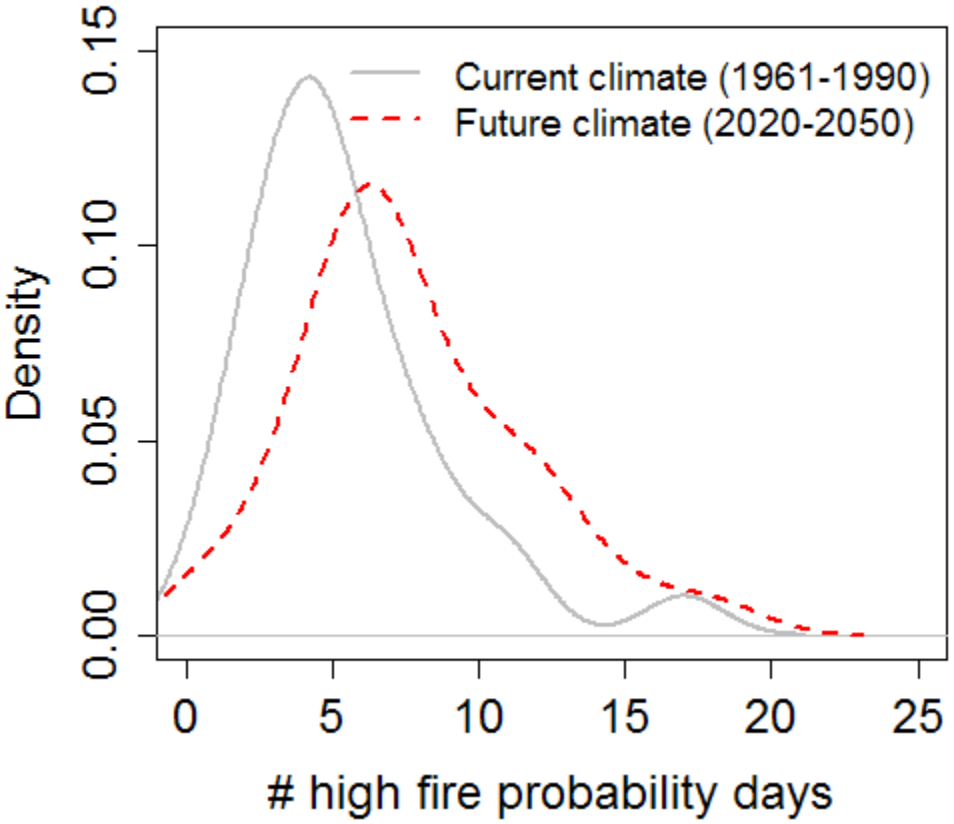
Number of extreme fire weather periods (3 days high FDI) increases by ~ 50%

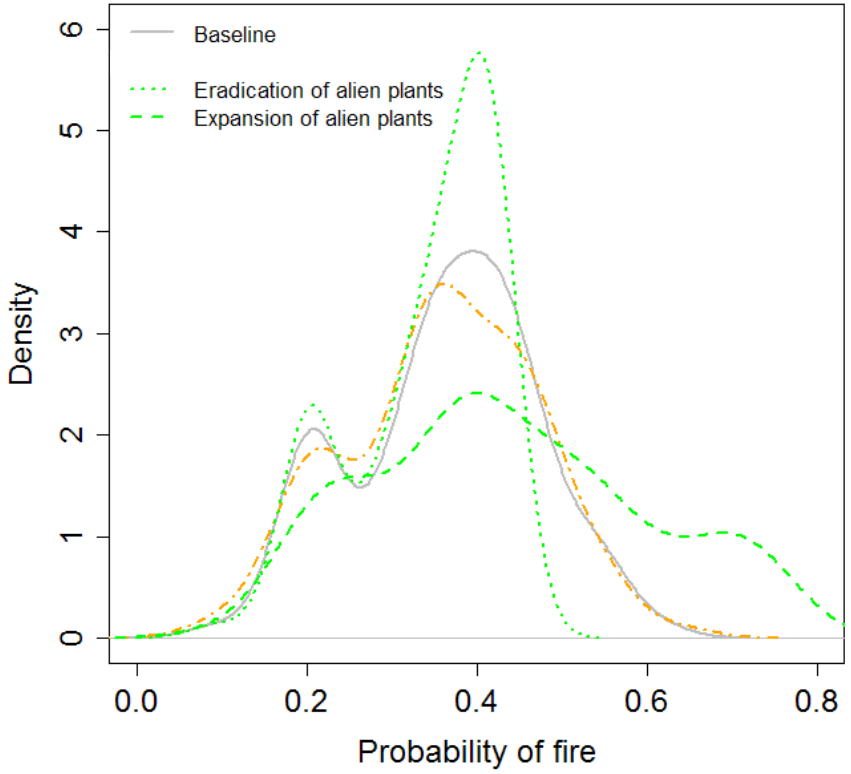
Driven largely by maximum temperature, but also by wind.



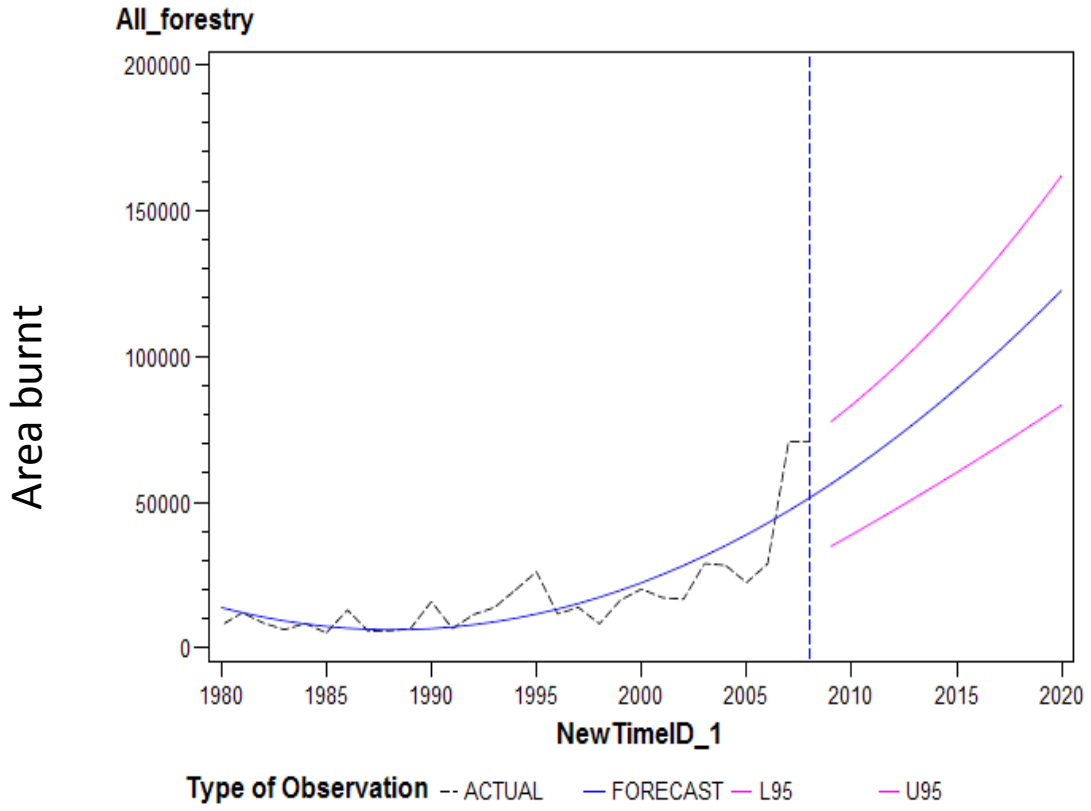


Fire Risk: Statistical modelling results





Evidence of trends in severe fire activity?

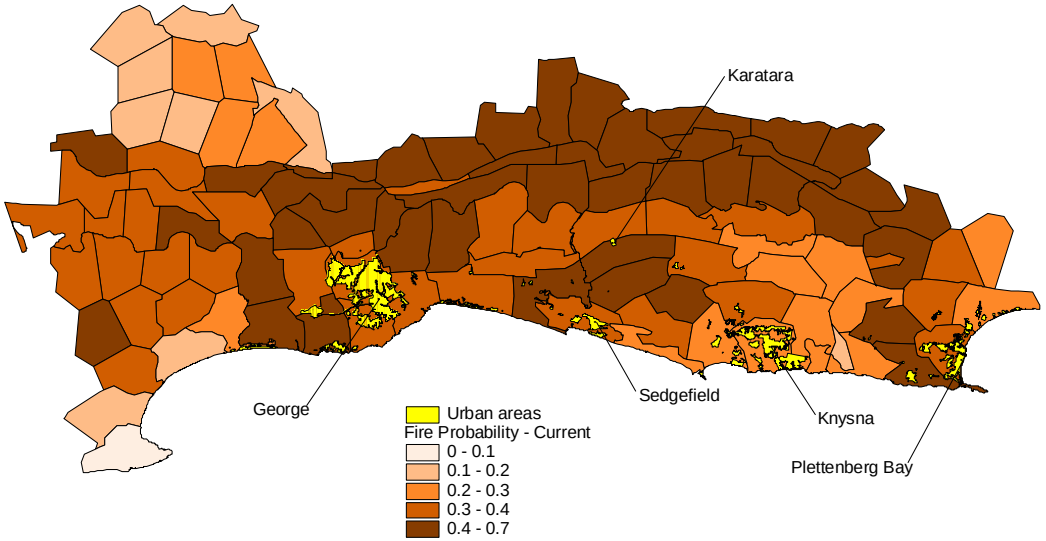


This trend could be due to:

- Climatic Change
- Increases in Alien Invasive Plant Cover
- Increases in area covered by plantation forestry

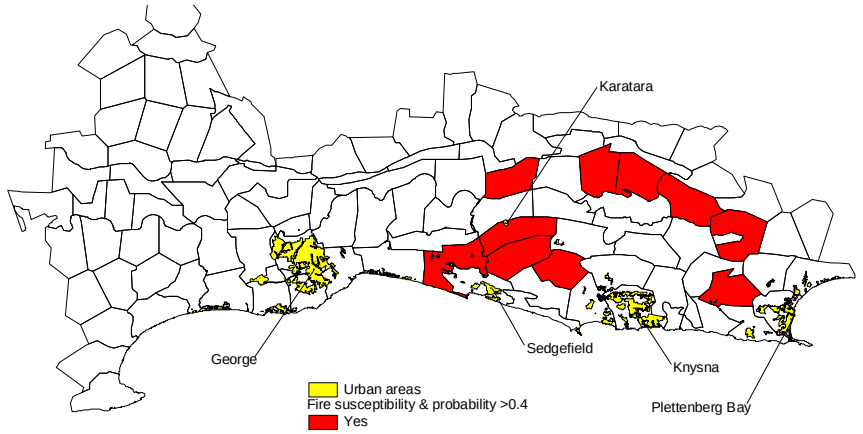
Annual area of forest plantations burnt in South Africa between 1980 and 2007, and forecasted trends based on a stepwise autoregressive method.

Level of fire probability

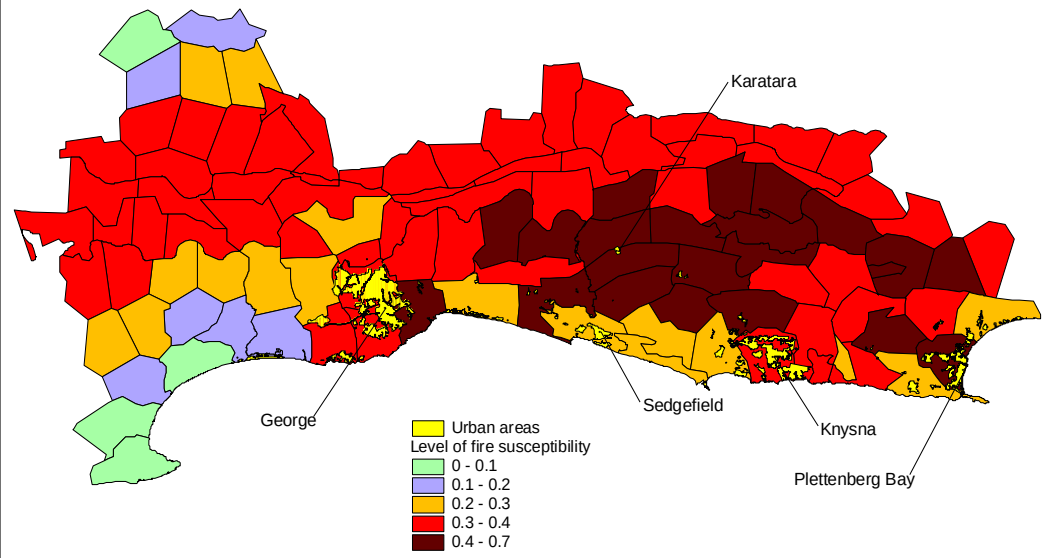


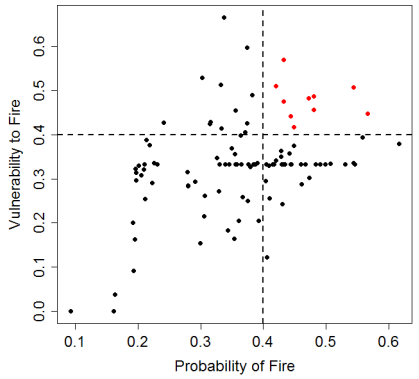
There are 10 regions with high probability and vulnerability

Both fire vulnerability and fire probability > 0.4



Level of fire vulnerability



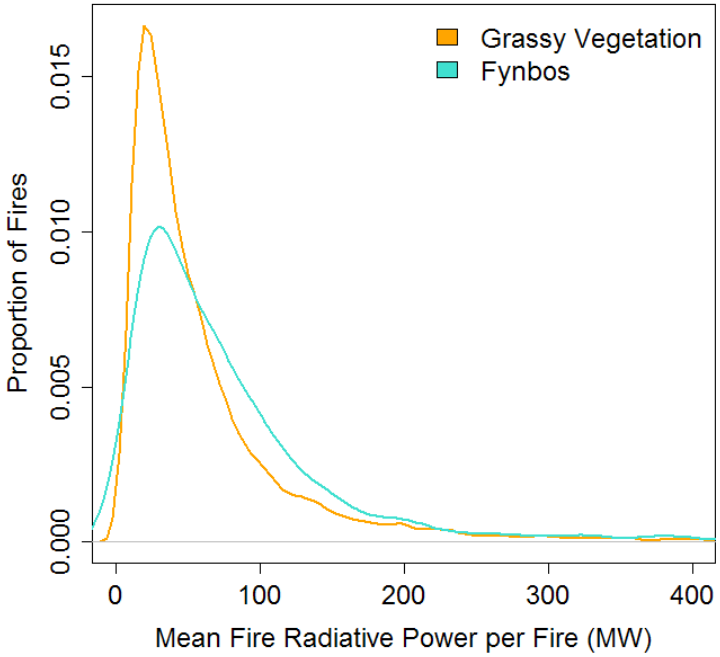


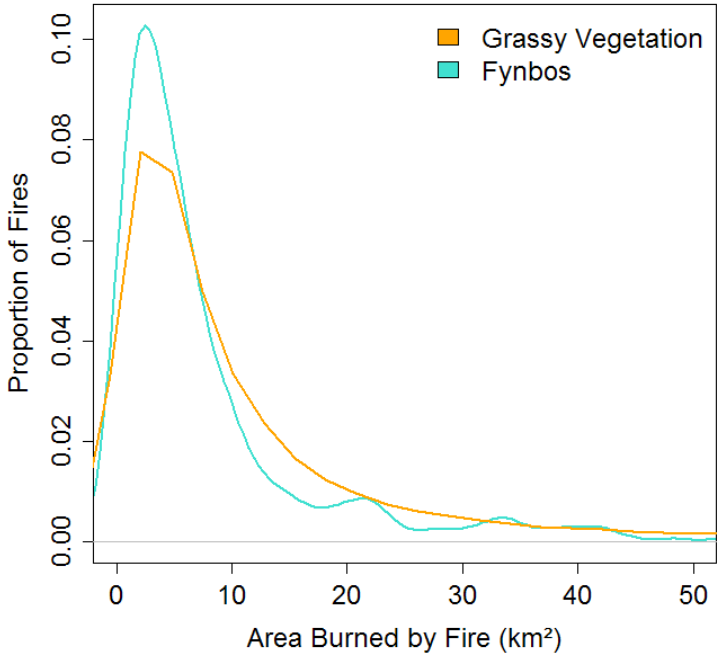
Understanding severe fires:

- Move from assessing individual fires, to looking at associations of fires and exploring synoptic patterns
- Must assess climatic drivers in the context of land cover, and human land use changes
- Human response strategies also affect fire risk: Work with FPA's and the Insurance Industry

Thank you:

- Co-authors
- CSIR Strategic Research Funding
- EU CarboAfrica Funding





Fynbos systems have more high-energy fires, grassy systems have more large fires

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