PYROGEOGRAPHY OF THE IBERIAN PENINSULA

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INTRODUCTION

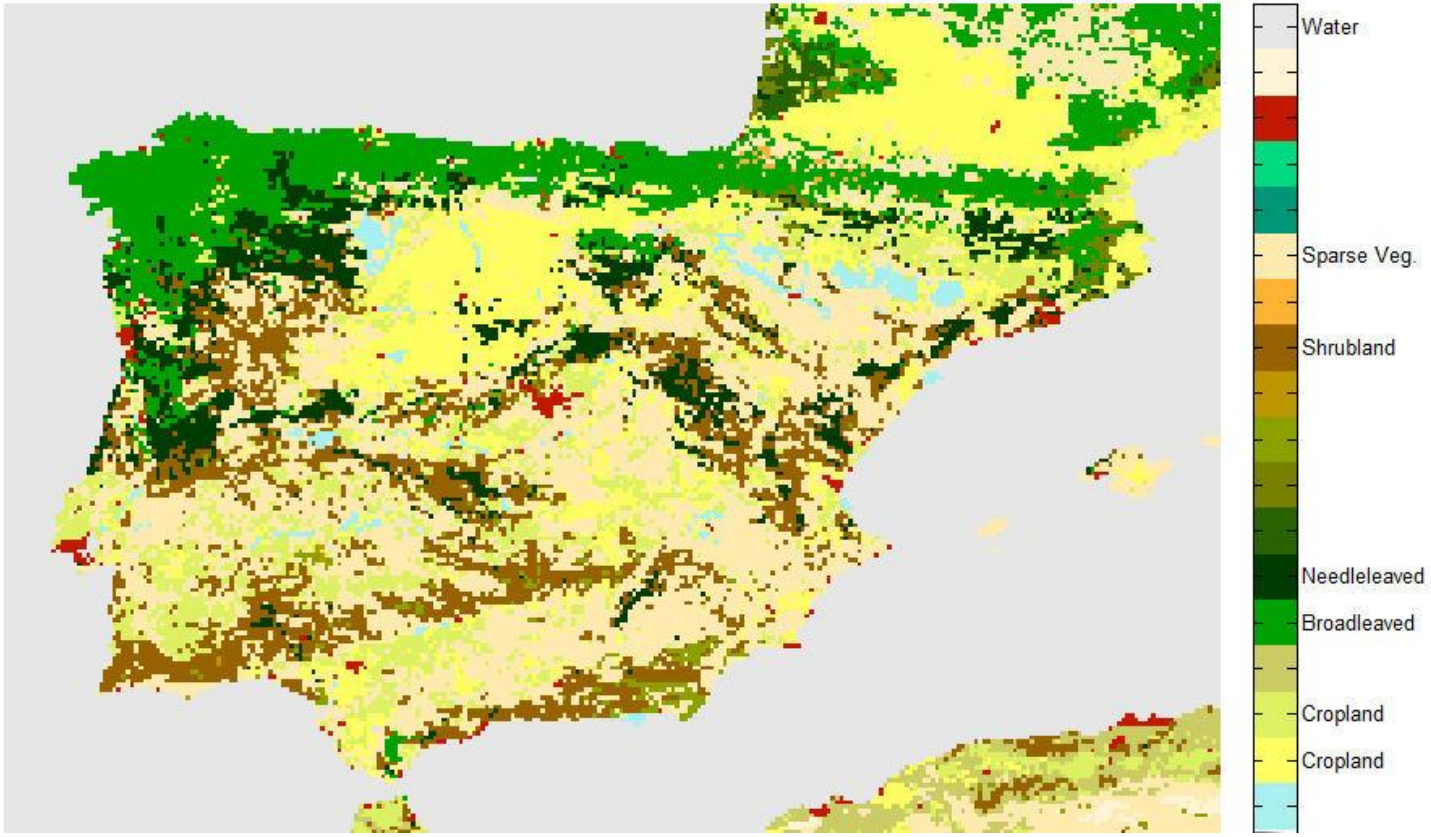
- Between **1980-2010**, the **Iberian Peninsula** has contributed to **60% of the total** burned area that was recorded in six Southern Mediterranean Countries: Portugal, Spain, Italy, France and Greece.
- The aim is to **assess fire activity over the Iberian Peninsula** based on time series of hot spots extracted from MODIS, an instrument on-board TERRA/AQUA.

DATA

- **Daily values of hot spots** were obtained from MODIS Fire and Thermal Anomalies Product (MOD14A1/MYD14A1), for the **Iberian Peninsula**;
- The data cover the period from **July 2002 to August 2012**;
- For each day, hot spots were aggregated on a 0.05° latitude by 0.05° longitude grid and **fire density** was defined as the **number of hot spots detected per grid cell on a given day**;
- Land cover data were obtained from Globcover, an ESA initiative relying on observations from the 300m MERIS on-board ENVISAT;
- Vegetation data were degraded to the 0.05° latitude by 0.05° longitude grid **by assigning to each cell the respective modal class**.

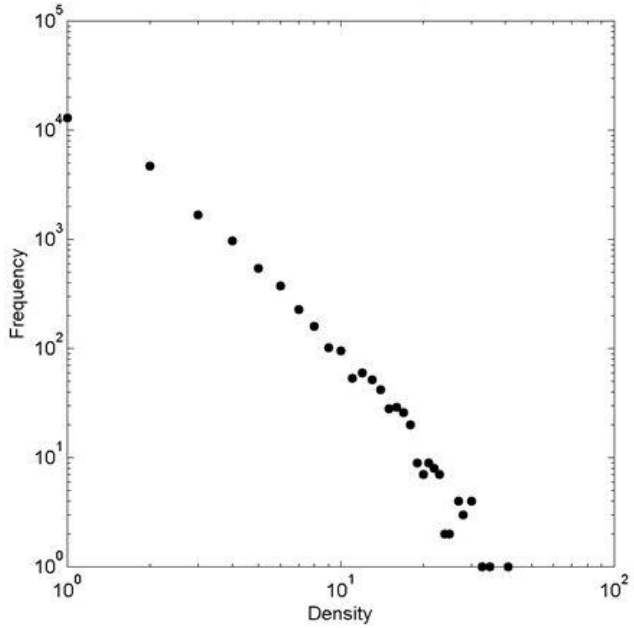
DATA

- Globcover map for the Iberian Peninsula



SPATIAL AND TEMPORAL VARIABILITY

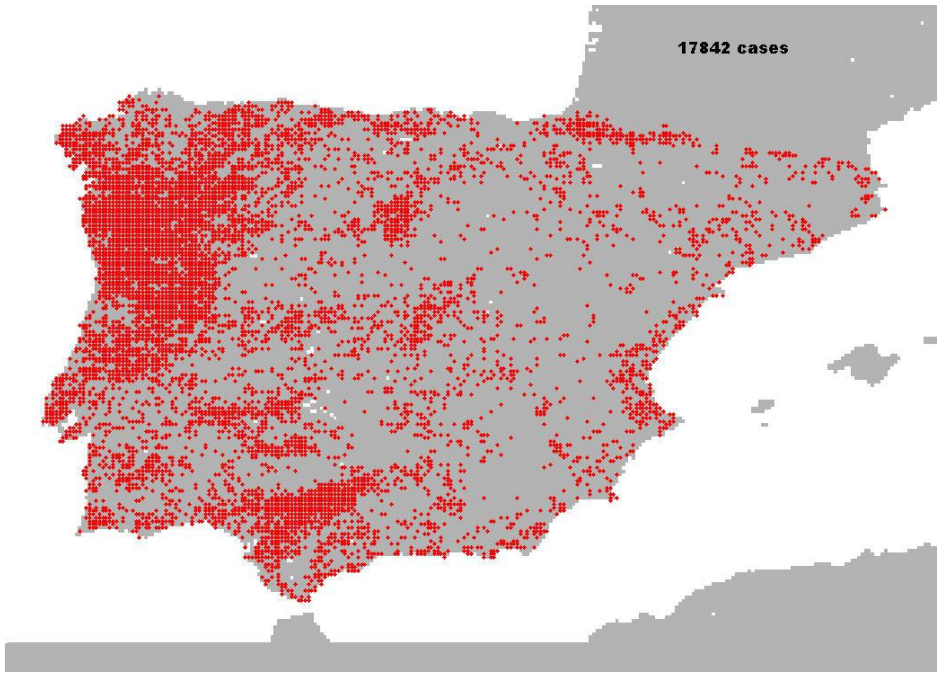
- Fire density exhibits a power law behaviour, which suggests to investigate:
  - The geographical distribution of extreme events;
  - The annual cycle of fire activity;
  - The relationship of spatial and temporal variability with land cover types and human activity.



SPATIAL AND TEMPORAL VARIABILITY

- Spatial distribution of fire events

  Events [1, 2]

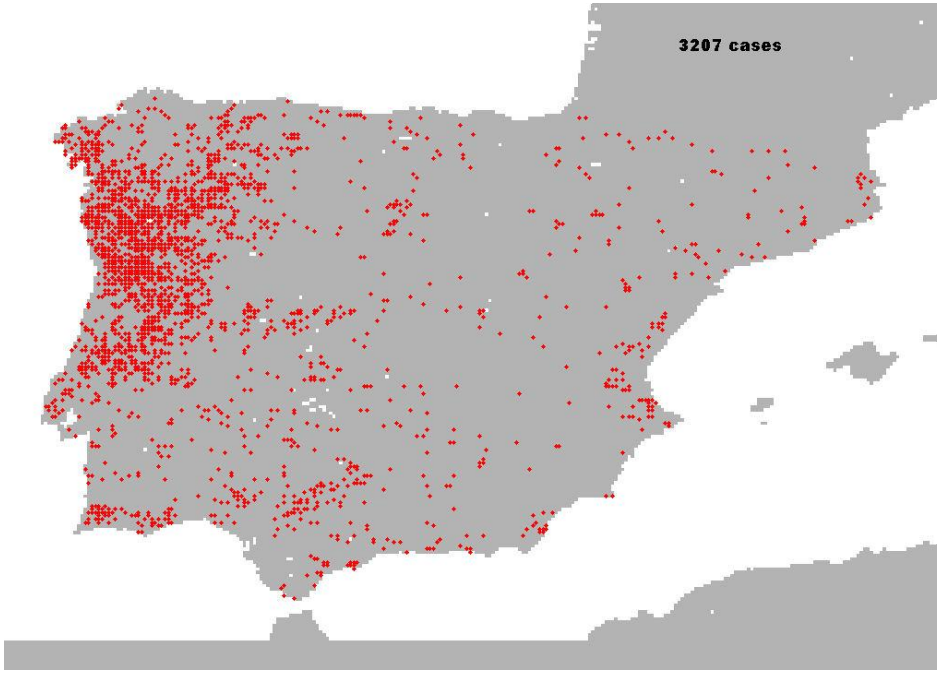


The higher the density, the more concentrated the events in the Northern half and in the South coast of Portugal, and in the region of Valencia (Spain).

SPATIAL AND TEMPORAL VARIABILITY

- Spatial distribution of fire events

  Events [3, 5]



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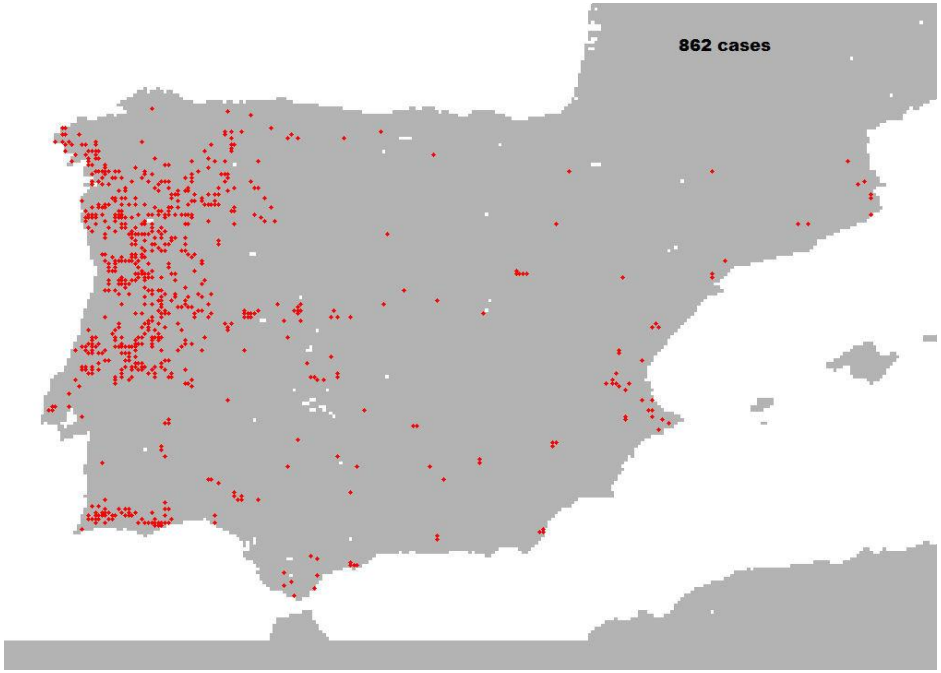
SPATIAL AND TEMPORAL VARIABILITY

- Spatial distribution of fire events

  Events [6, 9]



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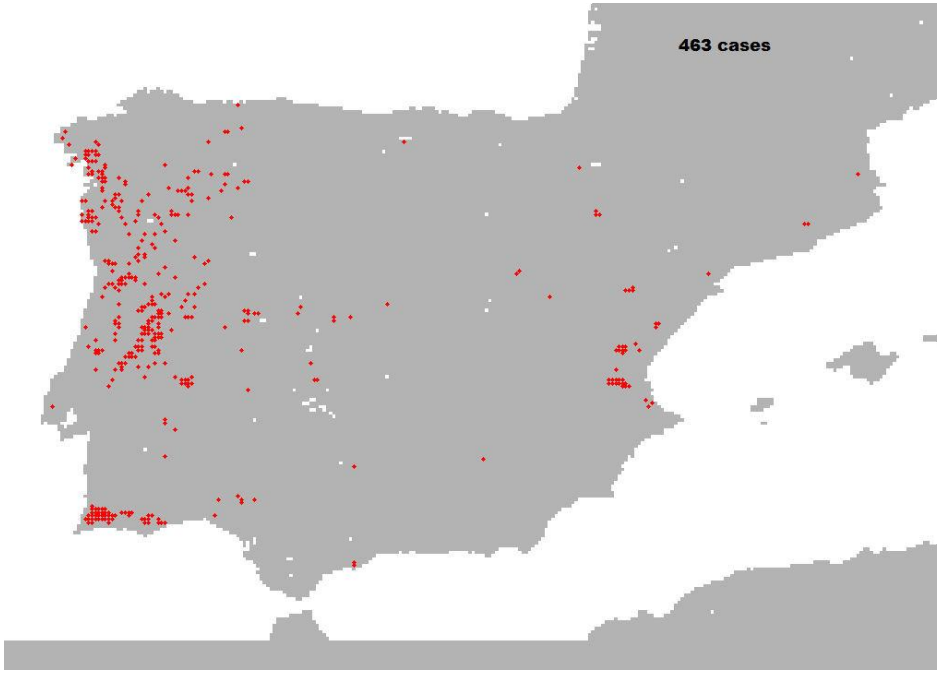
SPATIAL AND TEMPORAL VARIABILITY

- Spatial distribution of fire events

  Events >10



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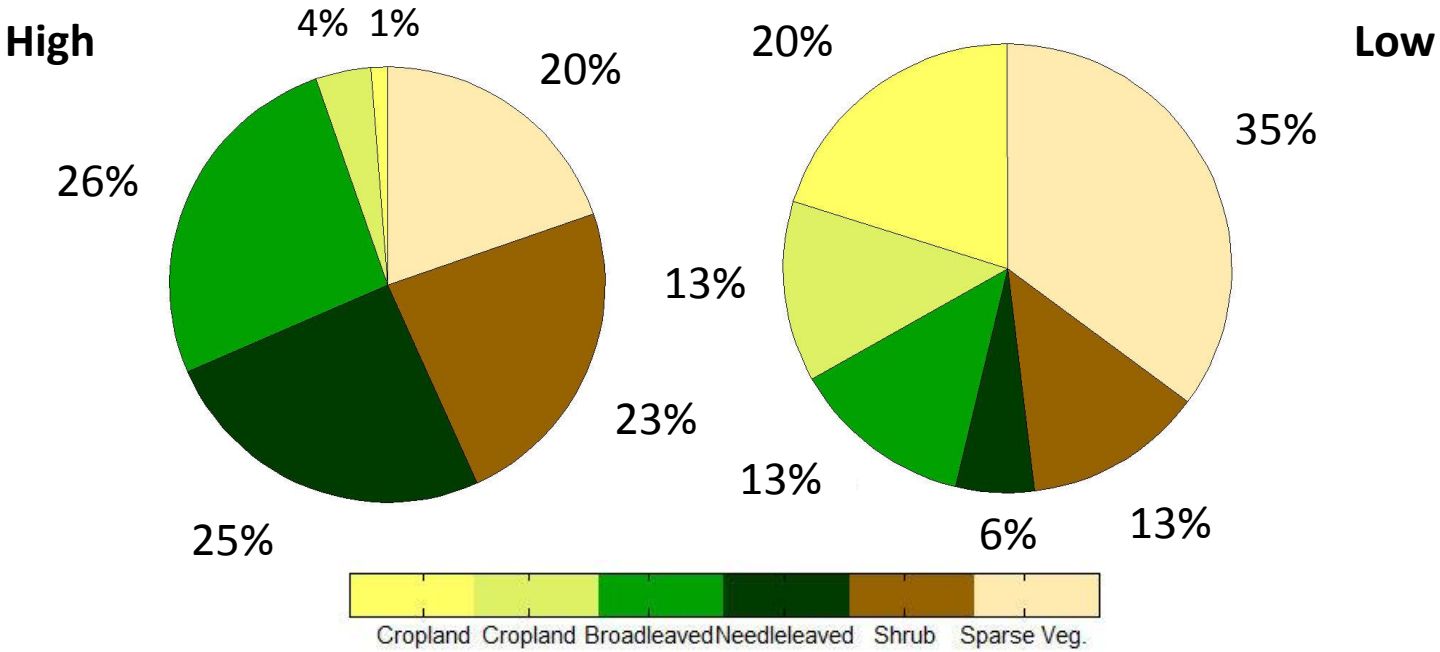
SPATIAL AND TEMPORAL VARIABILITY

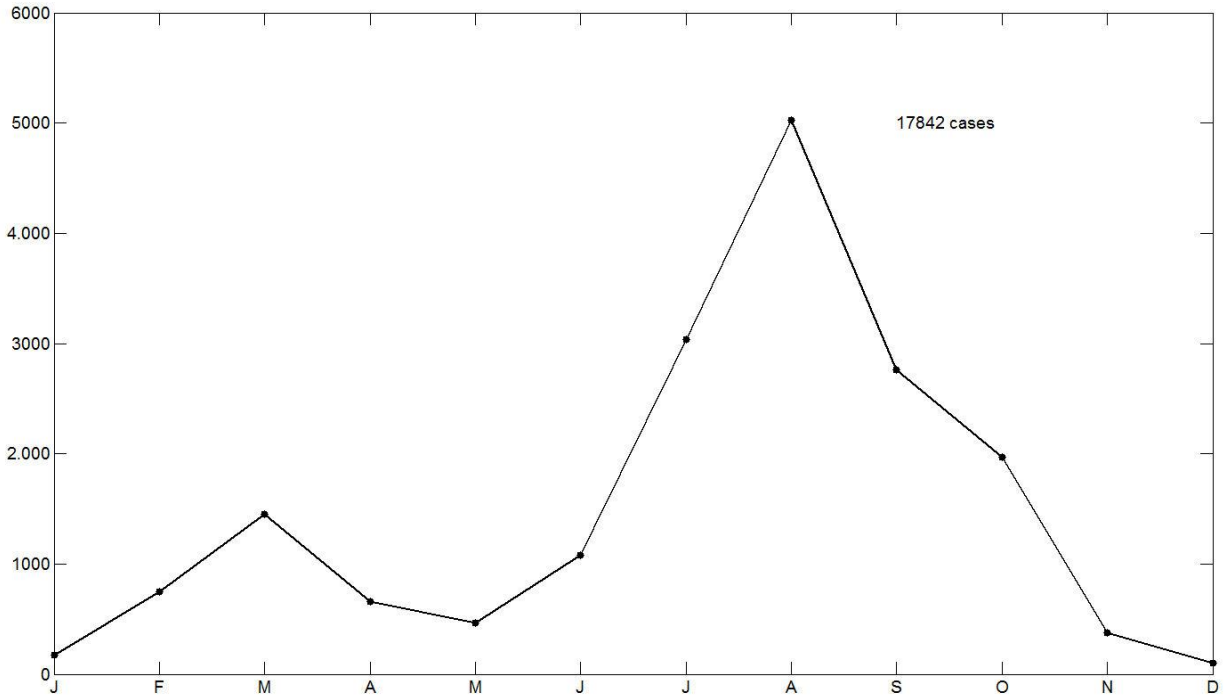
- Pies represent the distribution of land cover types associated to **high** (left panel)and **low** (right panel) density events
  - High density events (>6) predominate in forests (51%) and shrubland (23%), contrasting with low density events that tend to occur in cropland (33%) and sparse vegetation (35%).



SPATIAL AND TEMPORAL VARIABILITY

- Temporal distribution of fire events

  Events [1, 2]

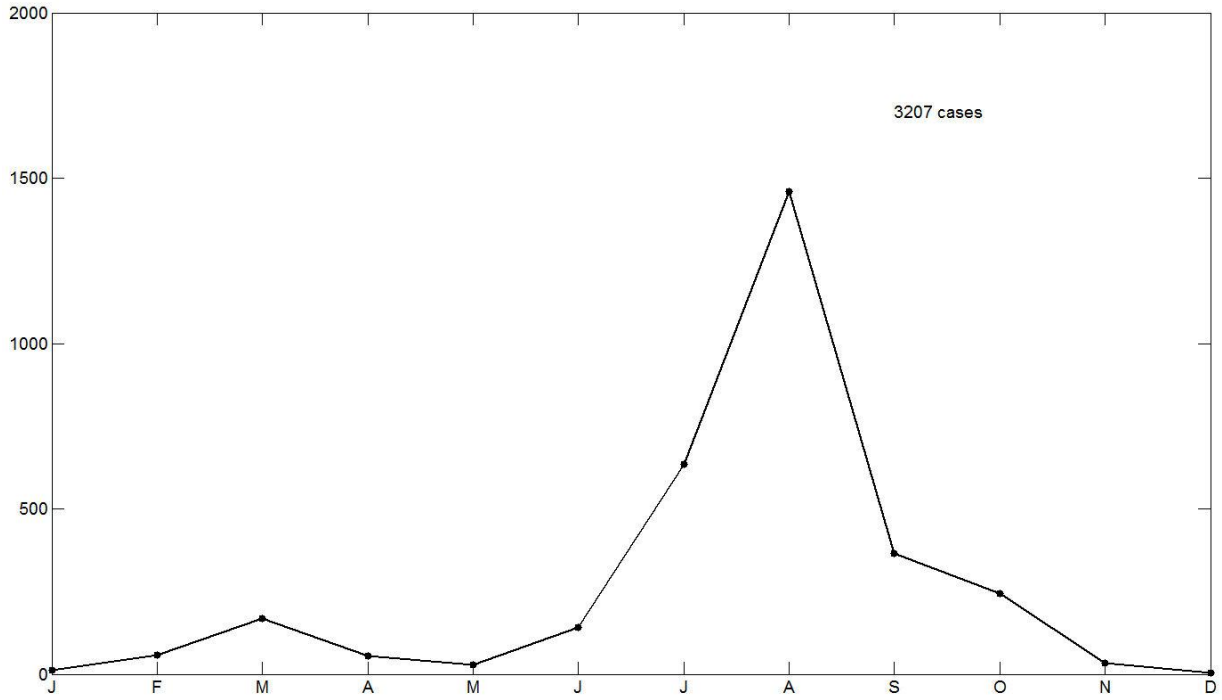


➢ The annual cycle of fire activity presents a bi-modal distribution with a main peak in August and a secondary one in March.

SPATIAL AND TEMPORAL VARIABILITY

- Temporal distribution of fire events

  Events [3, 5]



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SPATIAL AND TEMPORAL VARIABILITY

- Temporal distribution of fire events

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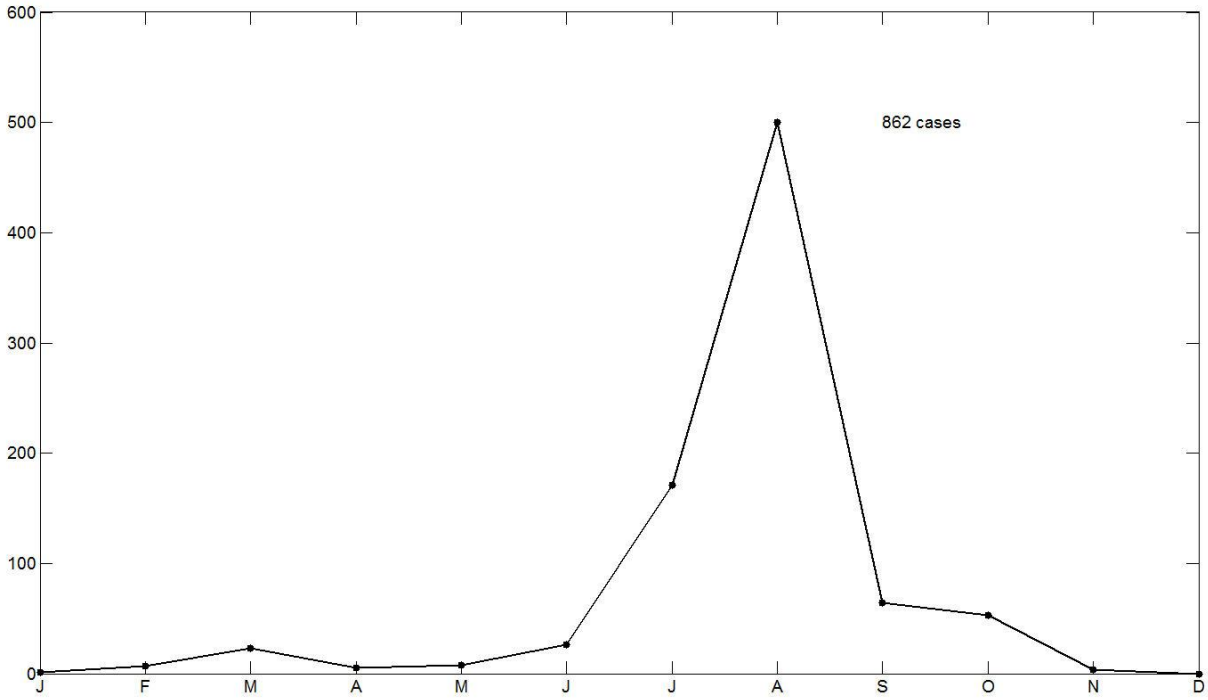

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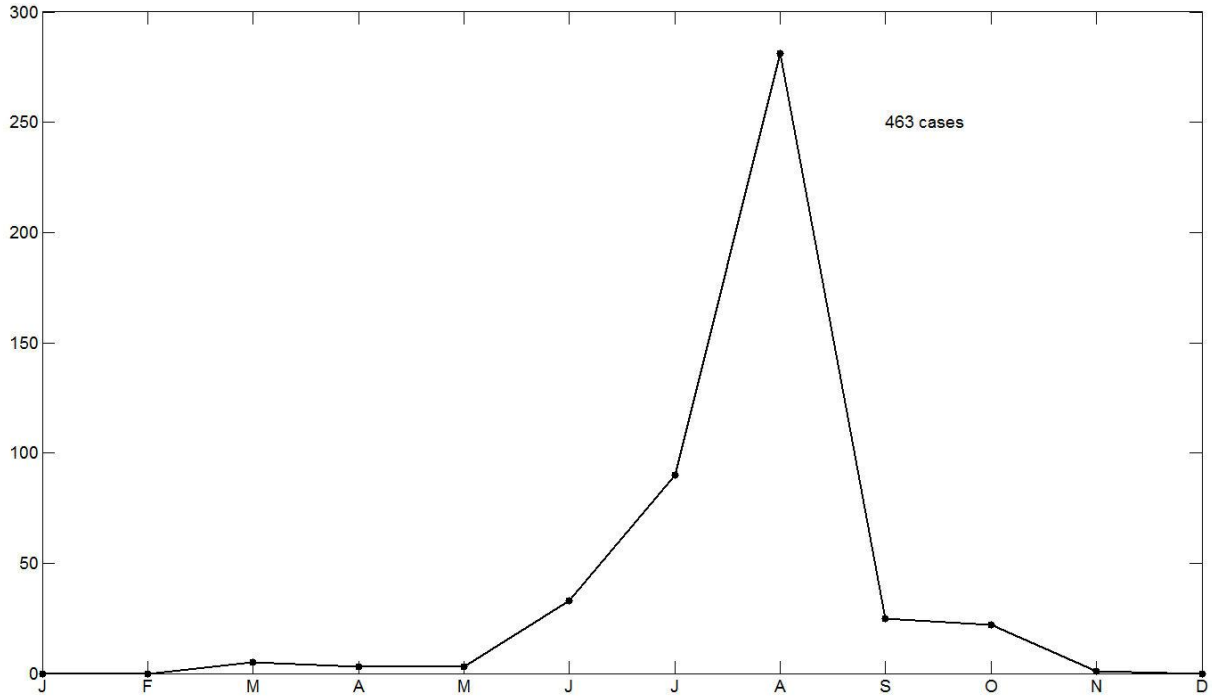
SPATIAL AND TEMPORAL VARIABILITY

- Temporal distribution of fire events

  Events >10



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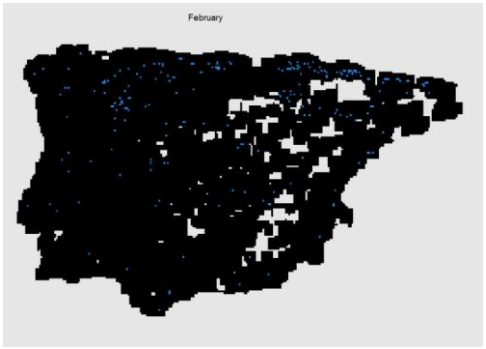
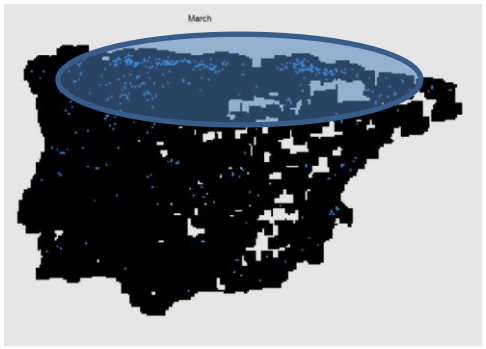
SPATIAL AND TEMPORAL VARIABILITY

- The season of predominant activity also shows typical geographical distributions:
  - The peak in **March** predominates in the **Northern regions of Spain** and is mostly related to agricultural activities

Feb

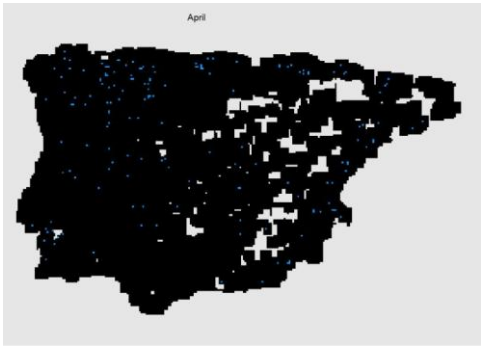


Percentile 66



Mar

Apr

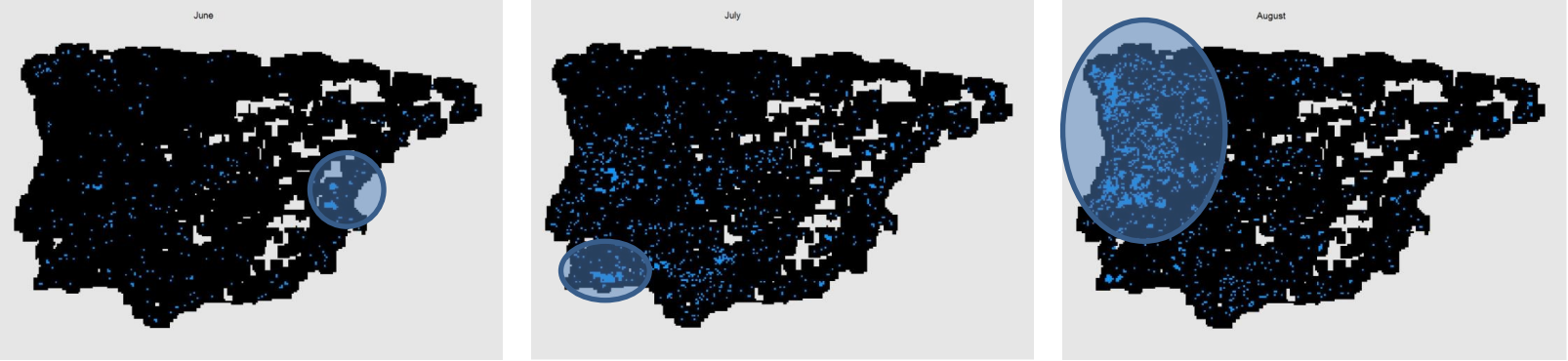


May

SPATIAL AND TEMPORAL VARIABILITY

- The peak in **August** presents a core of hot spots in the Northern half of Portugal and Galicia, and is dominated by events of high density;
- Two other nucleus may be observed in June in the region of Valencia and in July in the Southeast of Portugal

Percentile 66

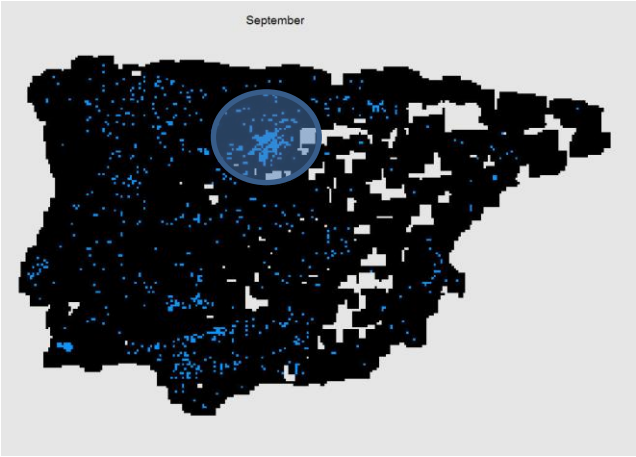


Jun Jul Aug

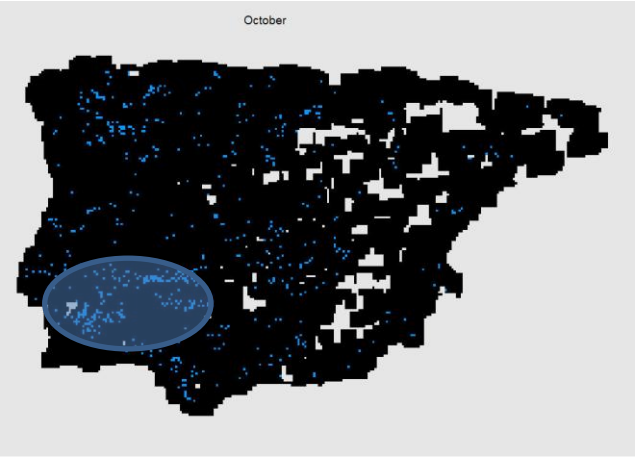
SPATIAL AND TEMPORAL VARIABILITY

- Occurrences in September and in October are mainly concentrated in the regions of Valladolid/Segovia and in Andalusia;

Percentile 66



Sep

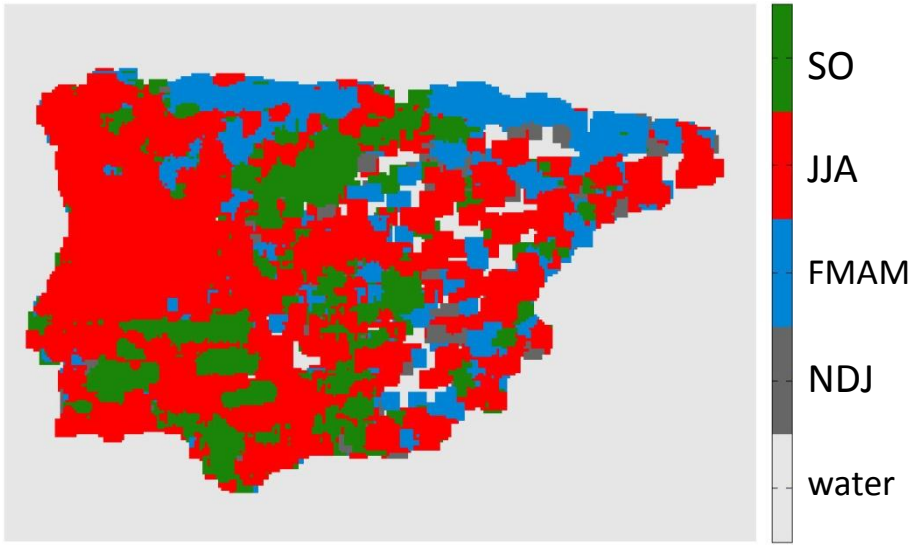


Oct

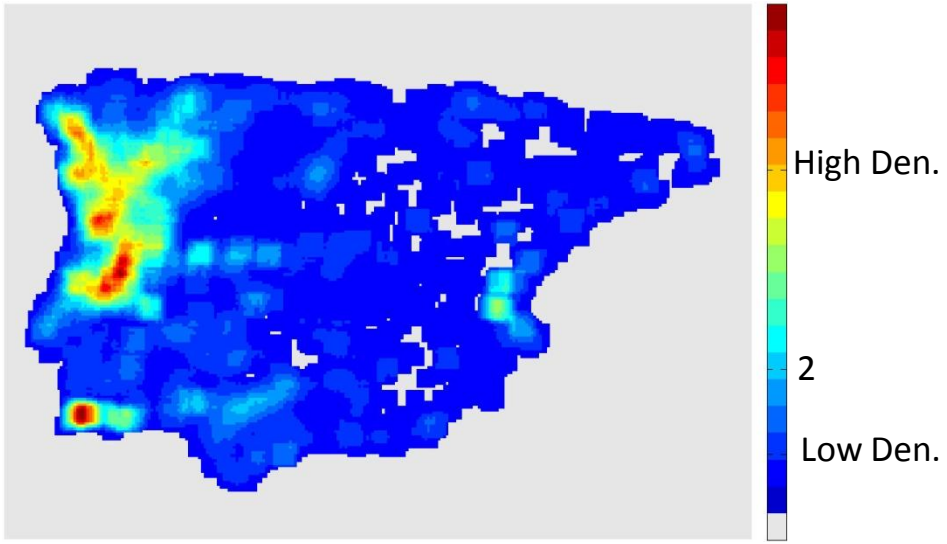
SPATIAL AND TEMPORAL VARIABILITY

- A regional classification of fire activity in the Iberian Peninsula may be achieved by applying spatial filters to predominant season of activity and/or to fire density

Distribution according to season

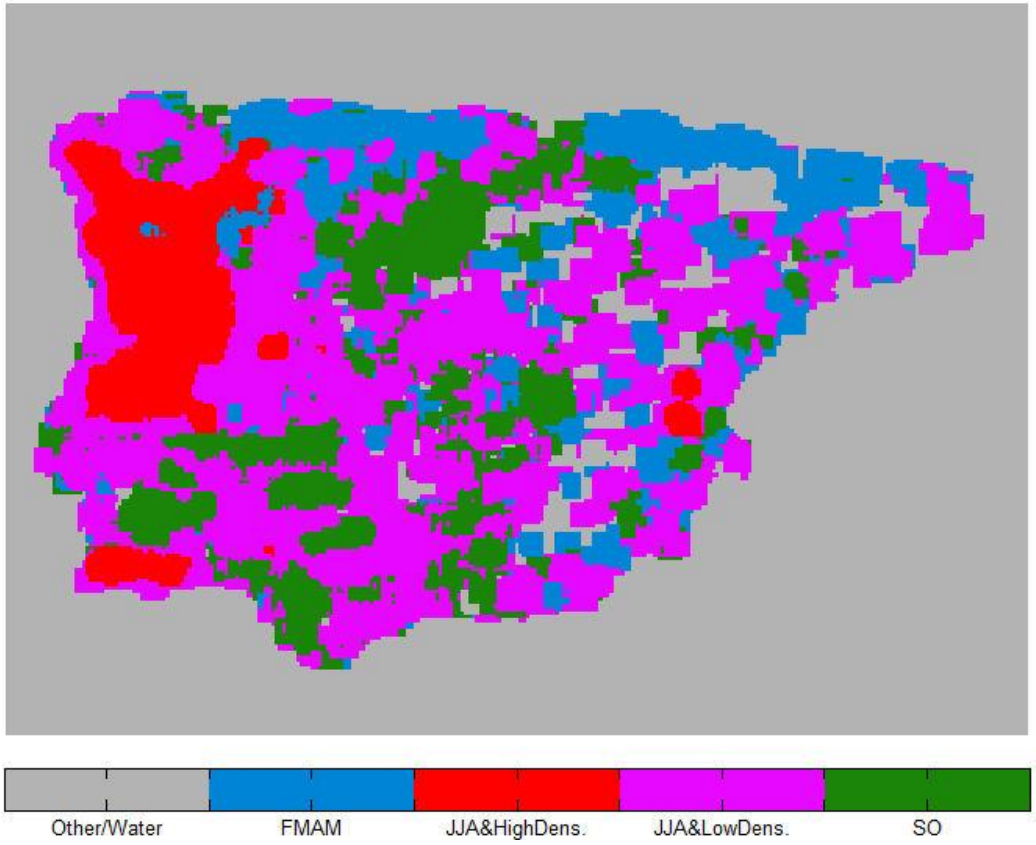


Distribution according to density

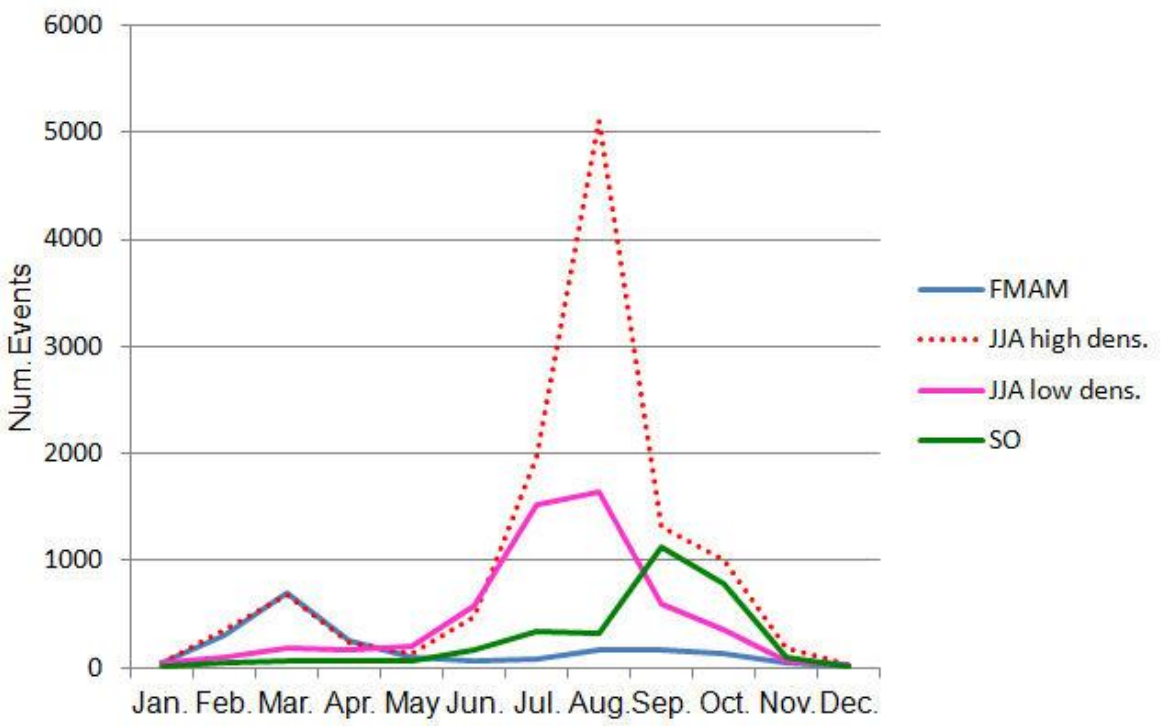


SPATIAL AND TEMPORAL VARIABILITY

- Four regions were defined according to the months of predominant fire activity and to levels of fire density – **4 pyroregions**.



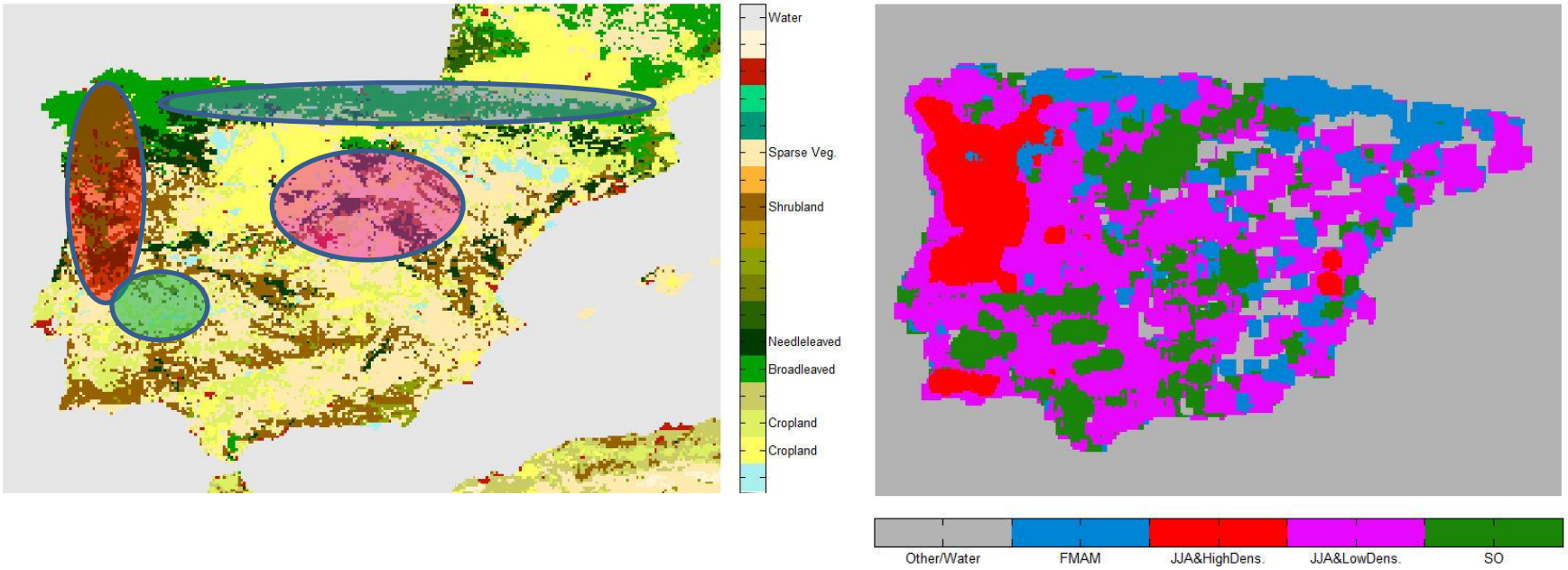
SPATIAL AND TEMPORAL VARIABILITY



- Each pyroregion has a typical annual cycle of fire activity.
- We will now investigate the land cover type and human activity associated to each region, as well as the distribution of extreme events.

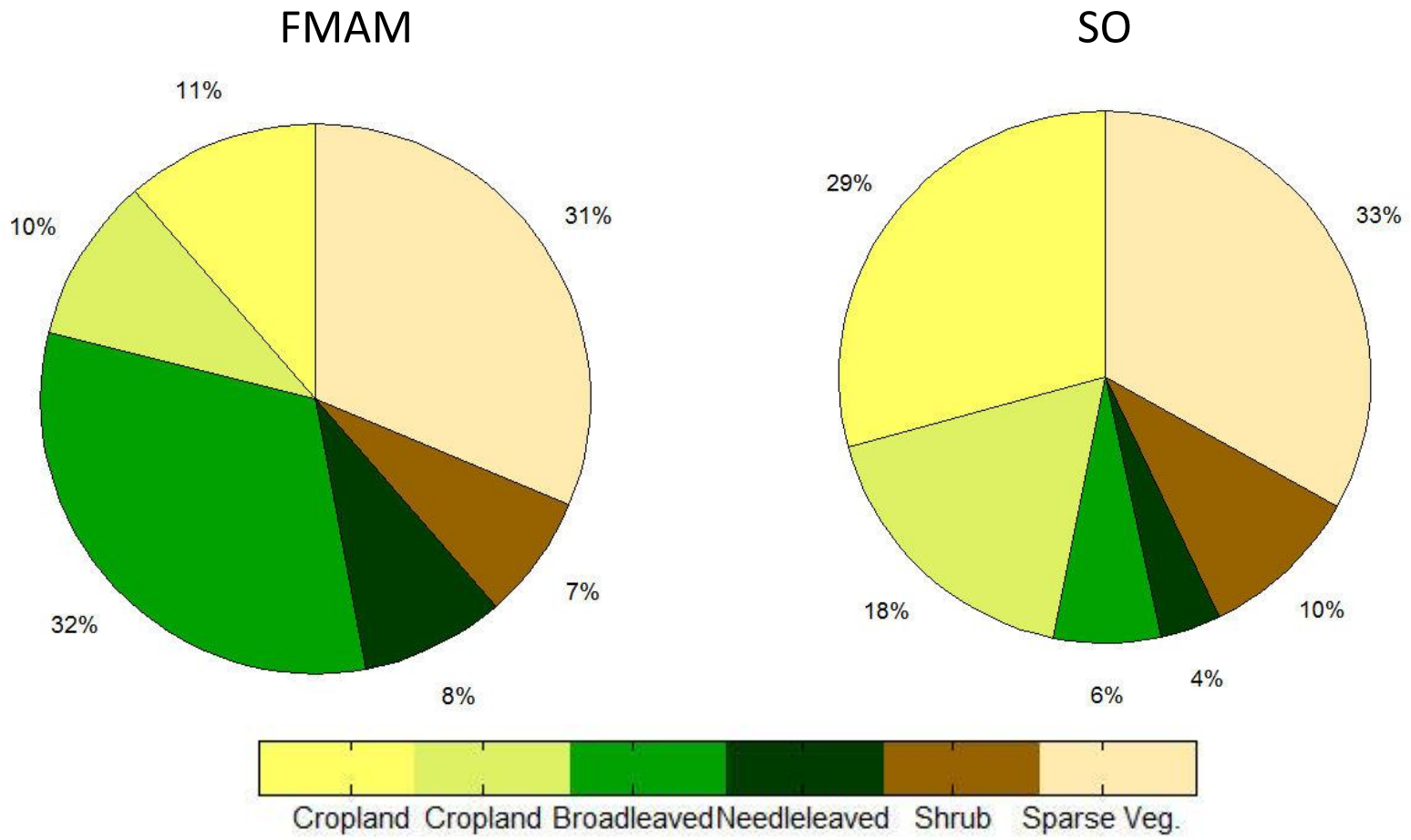
SPATIAL AND TEMPORAL VARIABILITY

- Comparison of maps of land cover with defined pyroregions shows that each of the four regions is characterized by predominant types of land cover;



SPATIAL AND TEMPORAL VARIABILITY

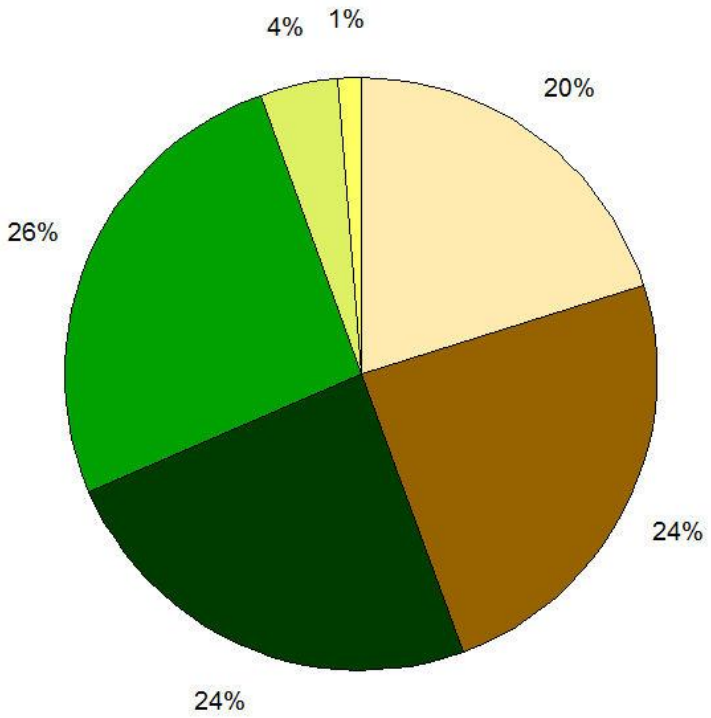
- Types of vegetation predominant in each of the pyroregions



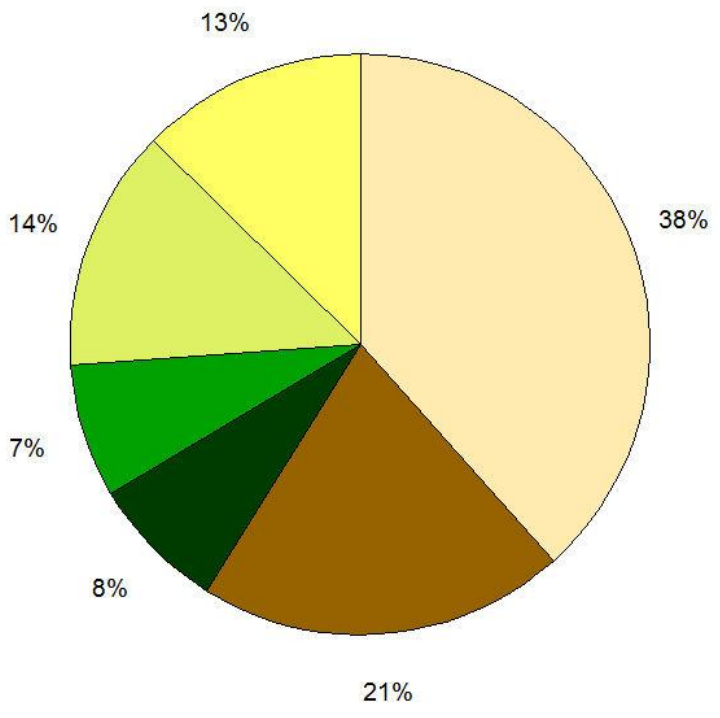
SPATIAL AND TEMPORAL VARIABILITY

- Types of vegetation predominant in each of the pyroregions

JJA & high fire events density

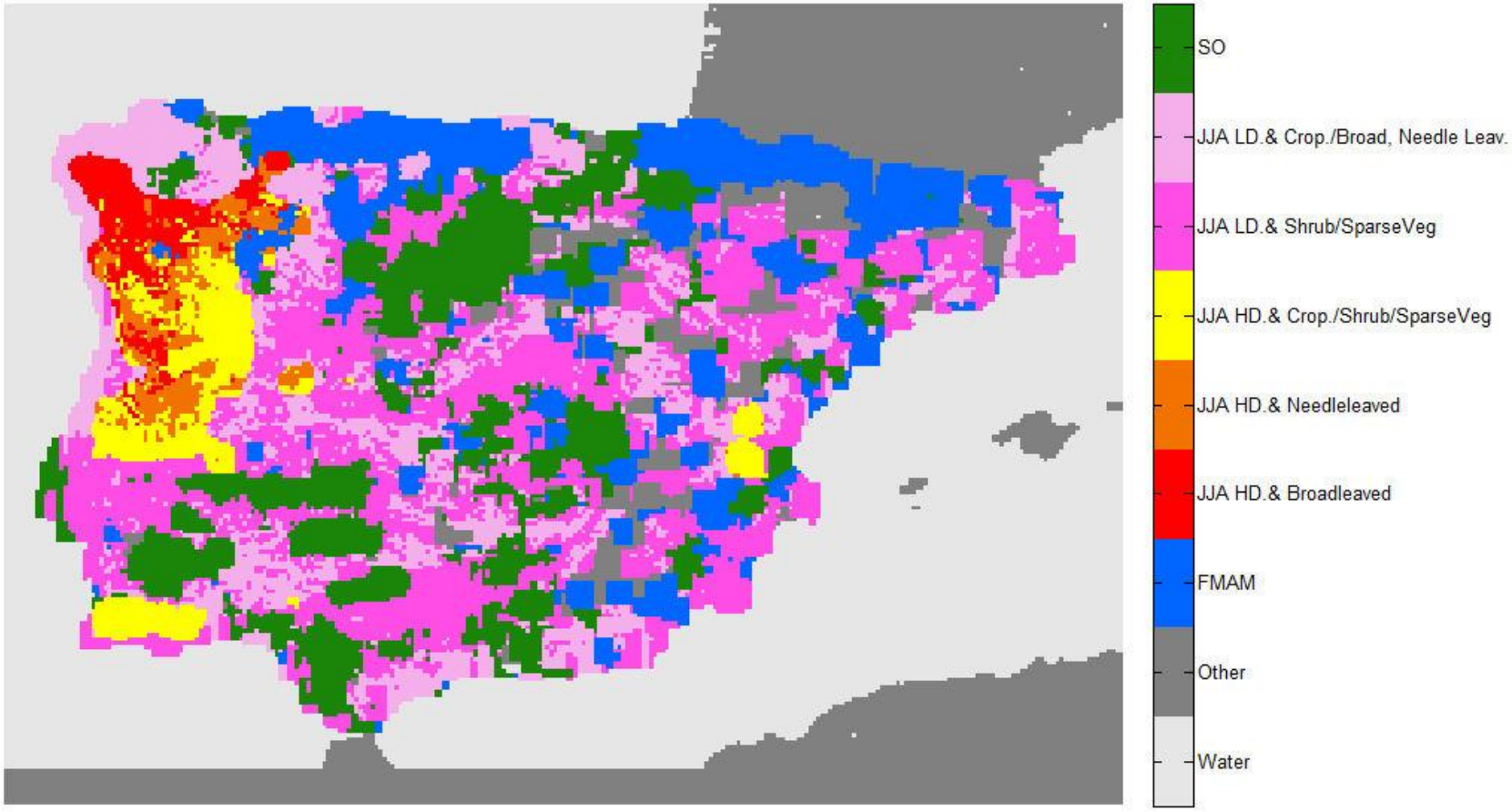


JJA & low fire events density



SPATIAL AND TEMPORAL VARIABILITY

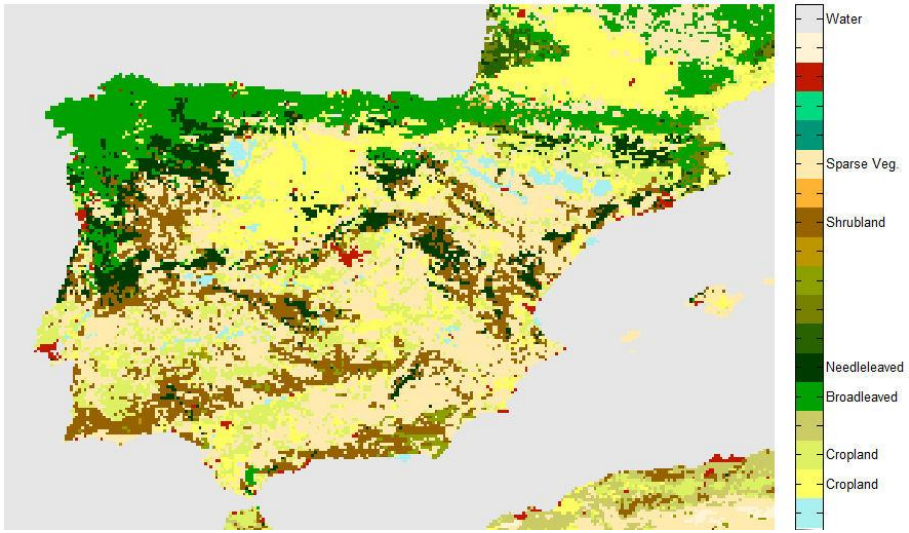
- Regions of high and low density in June, July and August were further divided, taking into account the type of land cover.



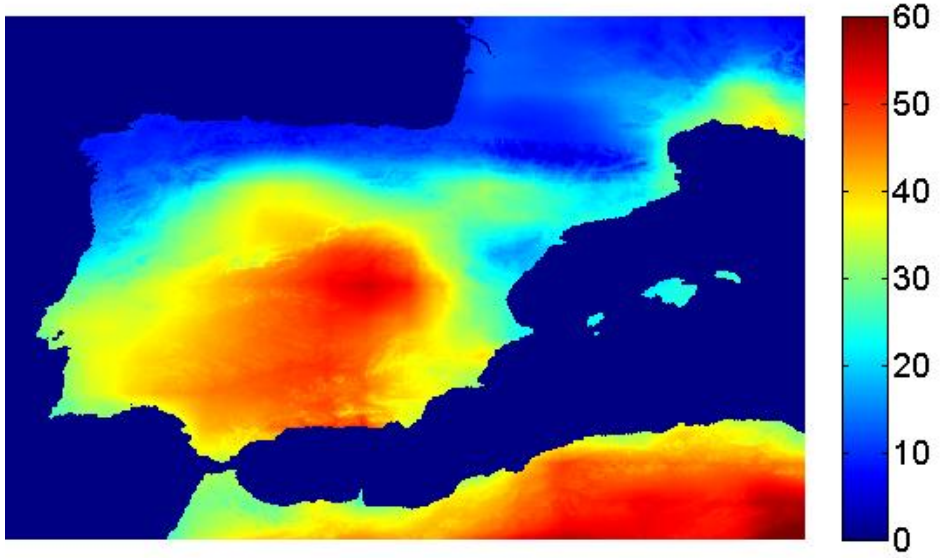
CLIMATE AND FIRE

- Fire activity in Mediterranean Europe is linked to several atmospheric mechanisms **working at different temporal and spatial scales**, namely the climatological background and associated weather conditions **(see Trigo et al. 2006).**
- At the **regional scale** and at t**he seasonal or inter-annual time scales**, rainy and mild winters, followed by warm and dry summers, lead to high levels of vegetation stress that make the region particularly prone to the occurrence of fire events **(see Pereira et al. 2005)**.
- At the **local and daily scales**, extreme weather conditions (e.g. temperature, wind speed, atmospheric stability, fuel moisture and relative humidity) play in turn a key role in the setting and spreading of wildfires **(see Pereira et al. 2005)**.

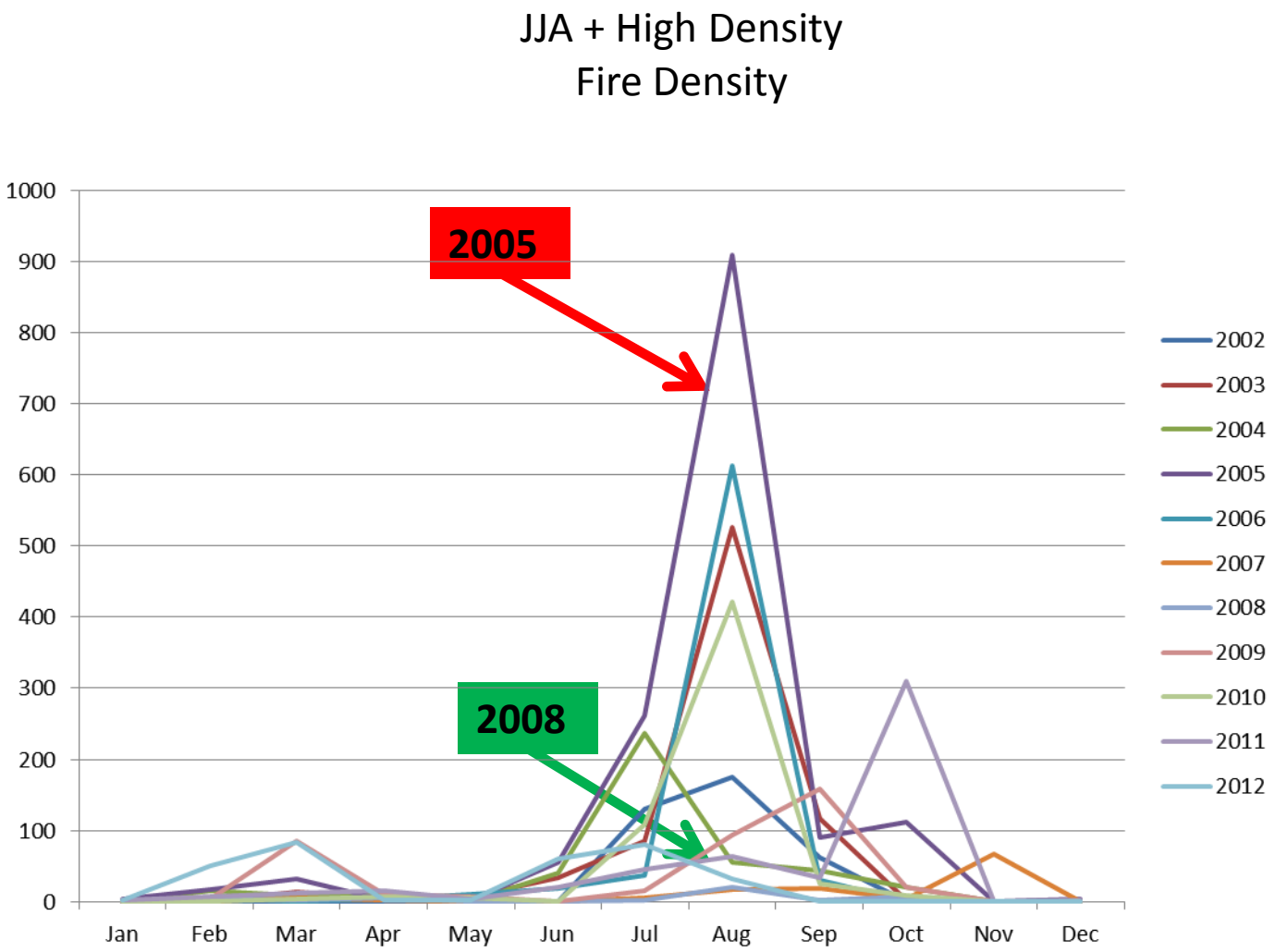
CLIMATE AND FIRE



FWI (1979-2009 July-August)



FIRE ACTIVITY AND DSR



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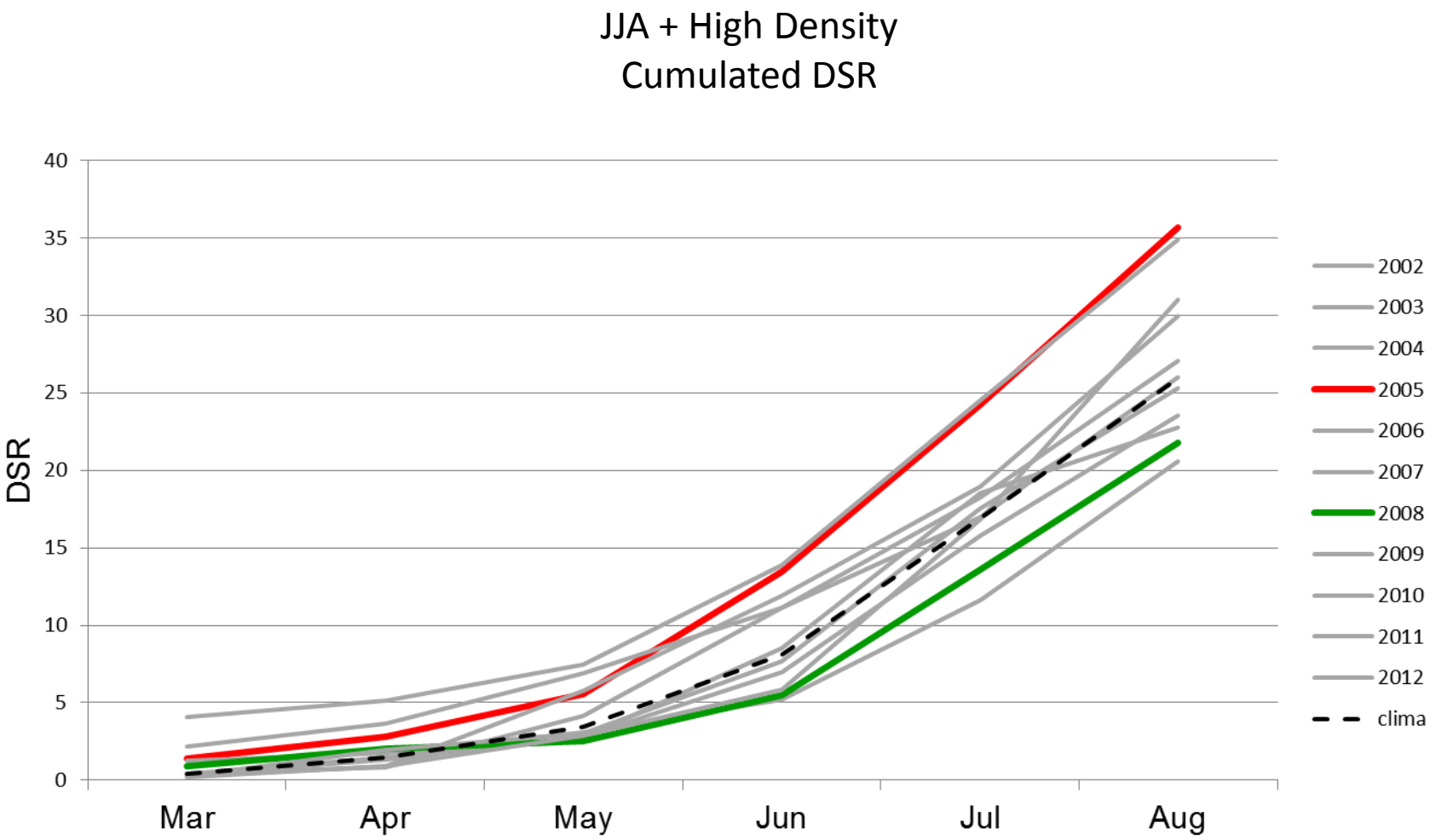
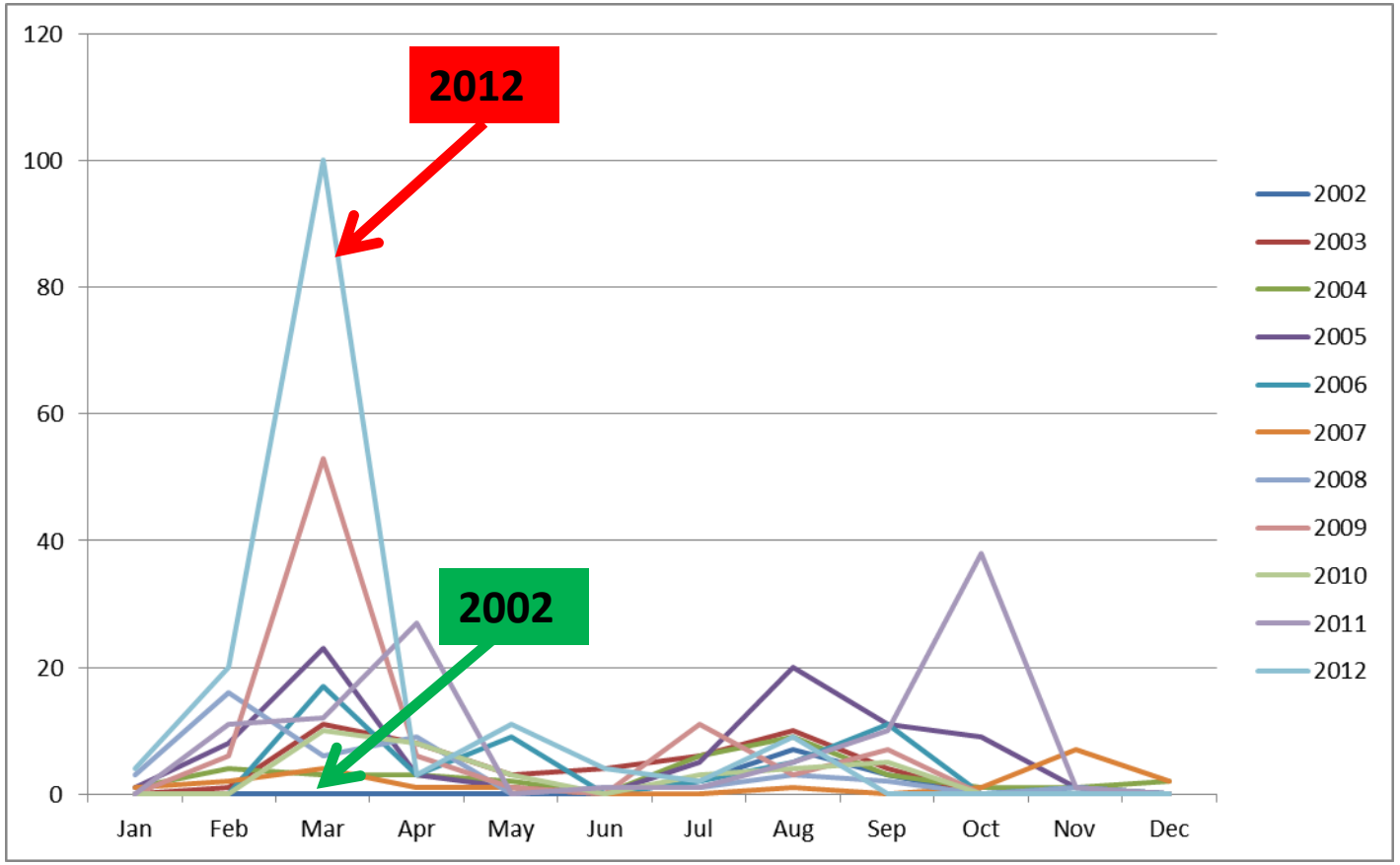


FIRE ACTIVITY AND DSR

FMAM
Fire Density



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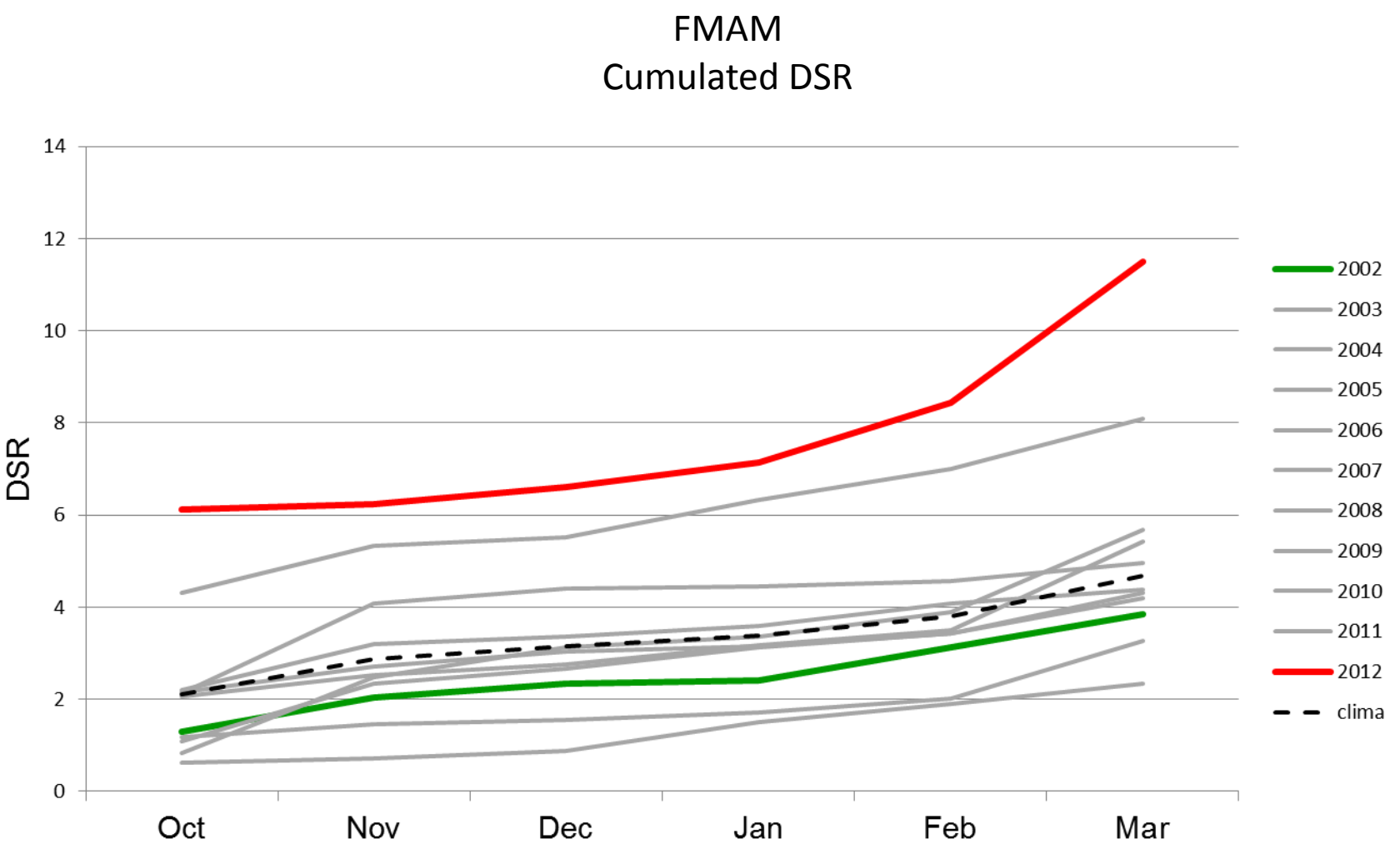

CONCLUSIONS

- A **regional classification** of fire activity in **Iberian Peninsula** was developed based on **hot spots** as derived from a long time series of **MODIS** observations ;
- This classification takes into account the different characteristics of **density of fire activity** in what respects both to the predominant **season of fire activity** and the different **levels of fire density**;
- Regions associated to different types of land cover and of human activity were accordingly defined – **pyroregions**;
- **Seasonal and inter-annual variability** of fire activity in pyroregions is closely linked to **precipitation and temperature regimes** that drive levels of **vegetation stress**;
- The effect of temperature and precipitation on vegetation stress may be assessed by means of **cumulated values of DSR** that present large differences between years of extreme high and low fire levels of fire activities;
- This study is on the basis of a procedure to generate **maps of fire risk** in the Iberian Peninsula.