

# Considerations about wind gust thresholds related to social impact: study of different regions in Catalonia

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## 1. INTRODUCTION

Severe weather can cause several damages on a territory and its population (Munich Re, 2016)  
**WIND** is one of the most important meteorological phenomena which cause remarkable economic losses (Consorcio de Compensación de Seguros, 2015)

### PREVIOUS STUDIES

**Drawback:**  
vulnerability due to population was not taken into account

- Fixed wind thresholds: MEDEX (Jansa et al, 2014), Catalan Meteorological Warning Alarms (Vilaclara et al, 2010)
- Different wind thresholds for different regions: 98<sup>th</sup> percentile of daily maximum gust speed (Hewston et al, 2011), return periods (Stepak et al, 2012)

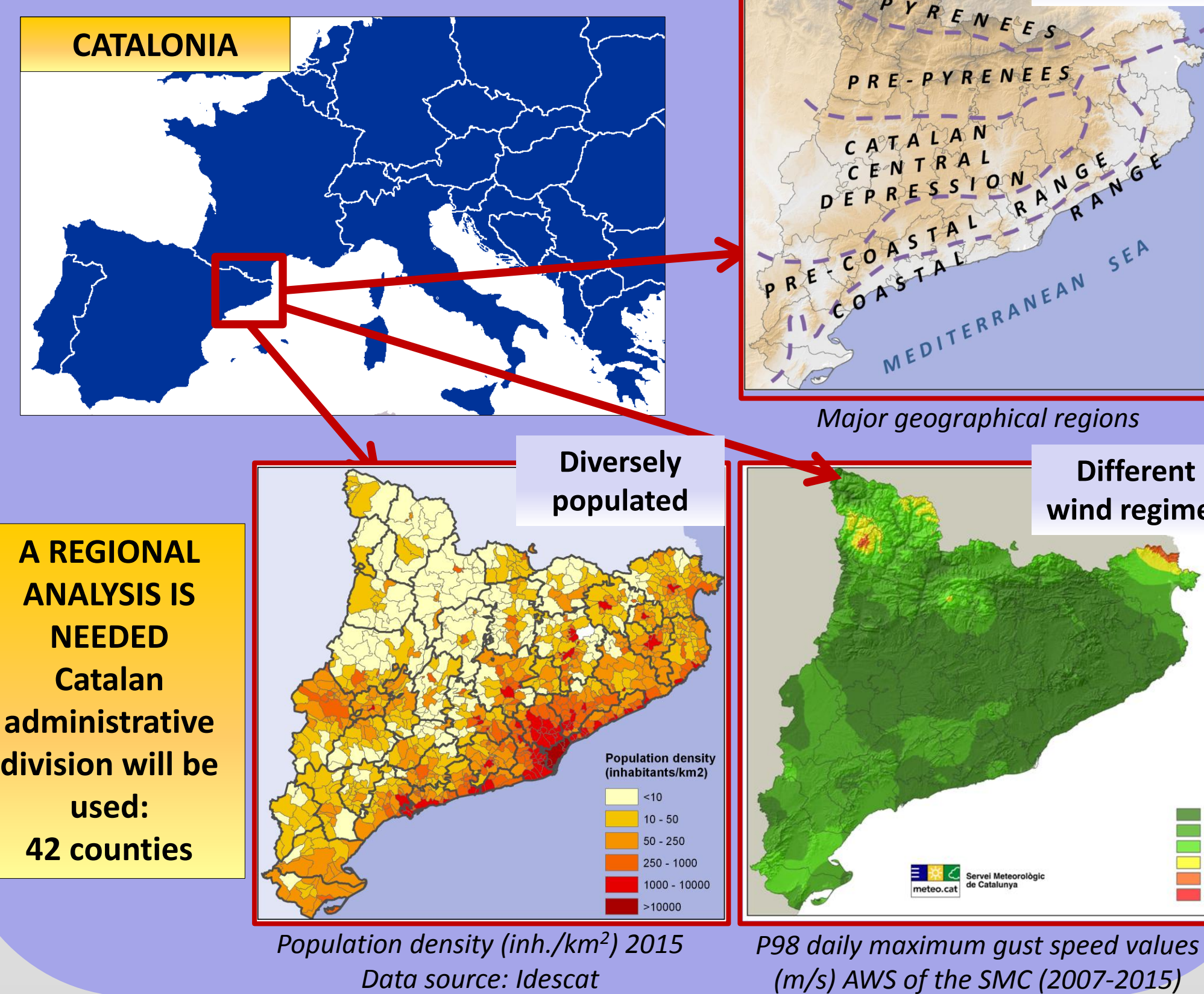
### CURRENT STUDY

The vulnerability factor is included

**AIM:** To obtain, for each county in Catalonia, thresholds of gust speed from which a remarkable social impact is observed.

**APPLICATIONS:** Better knowledge of the gust speed values that cause damage in different areas in Catalonia. In the future it could be used to consider new thresholds for Civil Protection alarms. Therefore, a higher accuracy by region will be reached.

## 2. AREA OF STUDY



## 3. DATA AND METHODOLOGY

Studies conducted by the Social Impact Research Group, in the frame of MEDEX, stated that **requests related to damage claims** received in Meteorological Services are a **good proxy indicator of social impact** (Amaro et al, 2010)

➤ **Source:** Database of requests received in the Meteorological Service of Catalonia (SMC) 2011-2015

SMC GENERAL PROCEDURE

**REQUESTS**  
Citizens, companies or organizations ask for data for a period in a certain location

**EVENT ANALYSIS**  
Association of the most representative weather station of the SMC network for each event. Individual treatment of each request: **HIGHER ACCURACY**

**METEOROLOGICAL REPORT**  
Report with the most representative data for the location requested

**TOTAL NUMBER OF REQUESTS (2011-2015): 17.674**

**Criteria for the study database:**

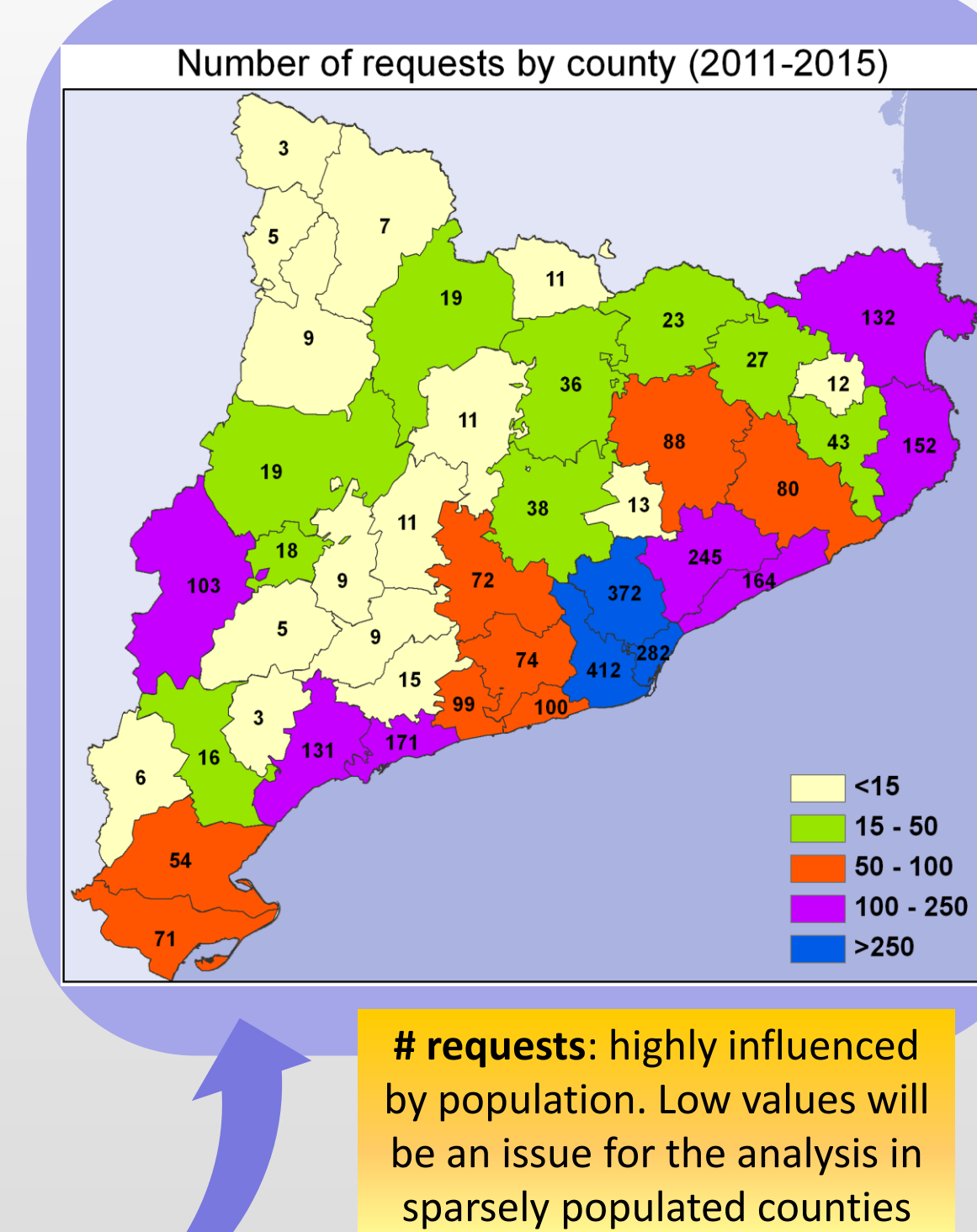
- Requests received between 2011 and 2015, related to events of any year
- Requests which only demand gust speed data
- Period requested: less than a month
- Not included if it was not related to a damage claim

CRITERIA

**NUMBER OF REQUESTS CONSIDERED: 3.170**

**NEW DATABASE: REQUESTS vs GUST SPEED by county**

Statistical analysis



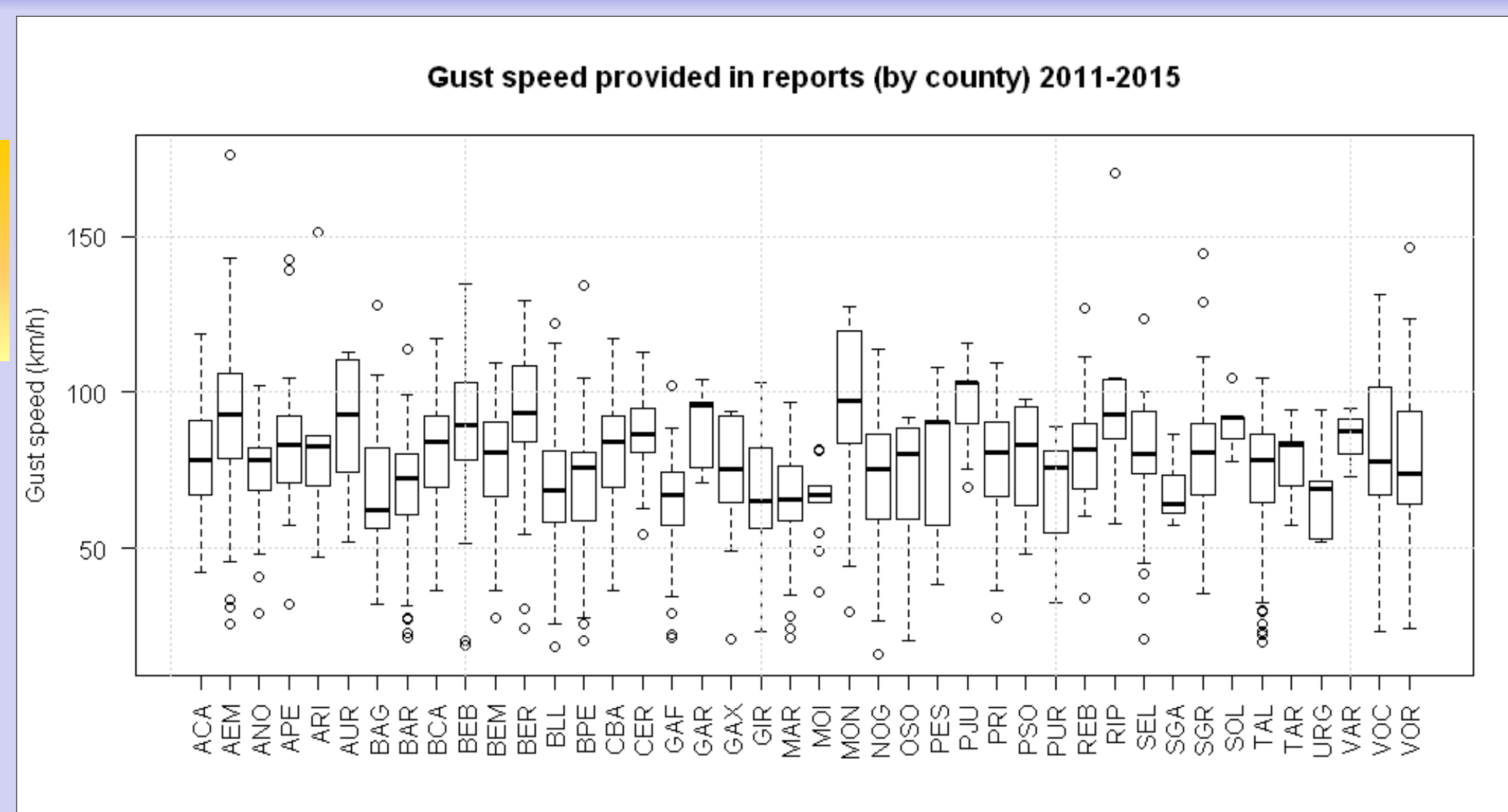
## 4. RESULTS: REQUESTS VS GUST SPEED

### a) RANGE OF GUST SPEED VALUES

#### SUMMARY

- Median: 76.1 km/h
- Mean: 77.2 km/h
- Standard deviation: 21.7 km/h

- Most of the gusts: 60-100 km/h (68% of the requests)



#### Remarkable differences between counties

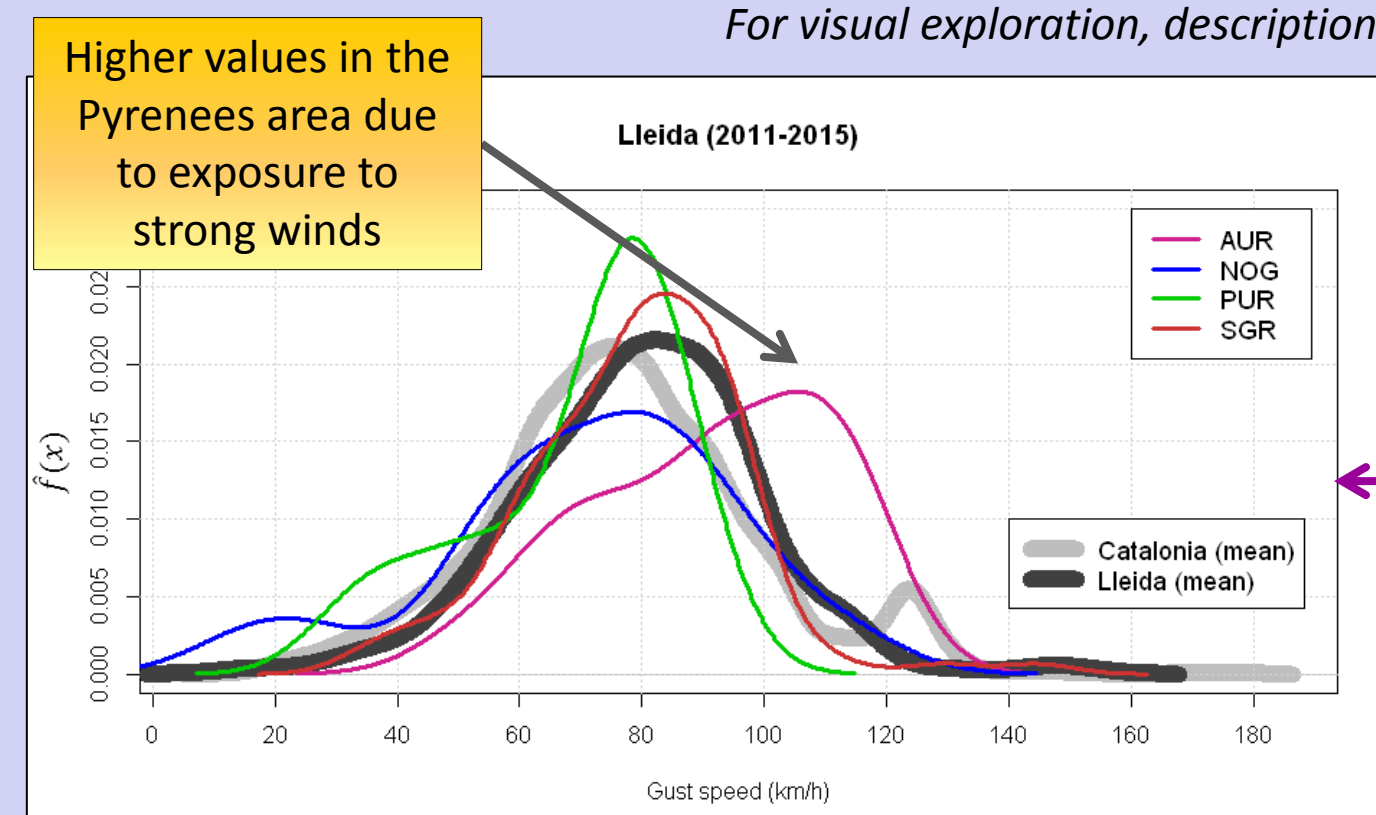
Confirm that a regional analysis is needed  
Different thresholds should be defined

#### Example

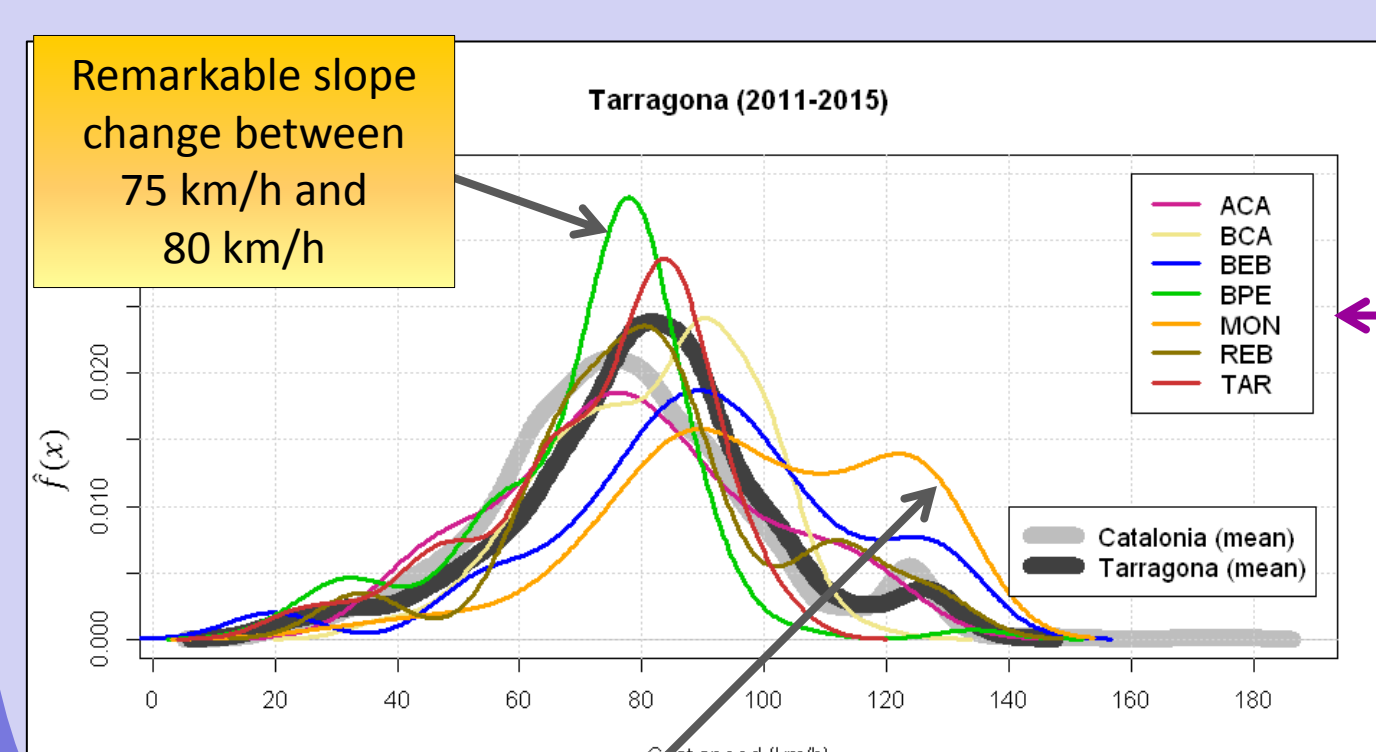
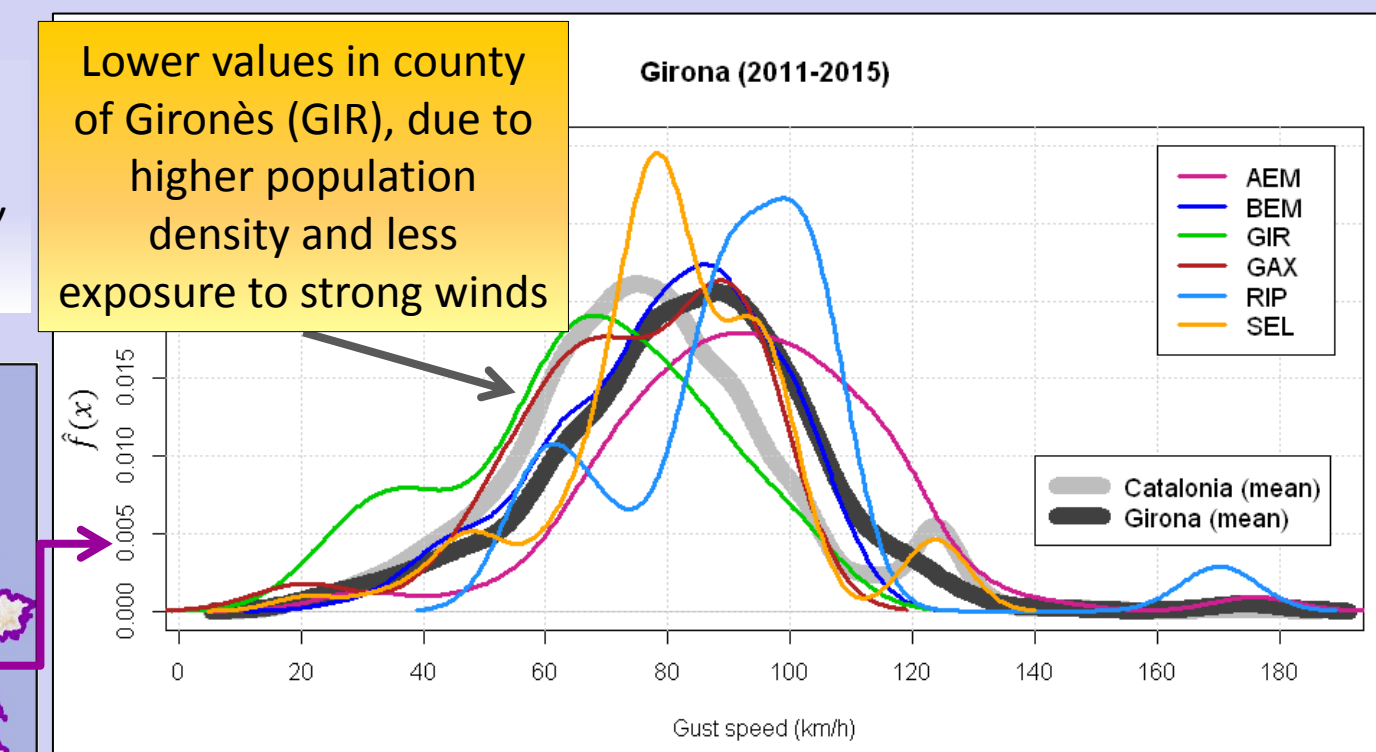
Median in Montsià (MON) county: 97.4 km/h

### b) KERNEL DENSITY ESTIMATION BY COUNTY (GROUPED BY PROVINCE)

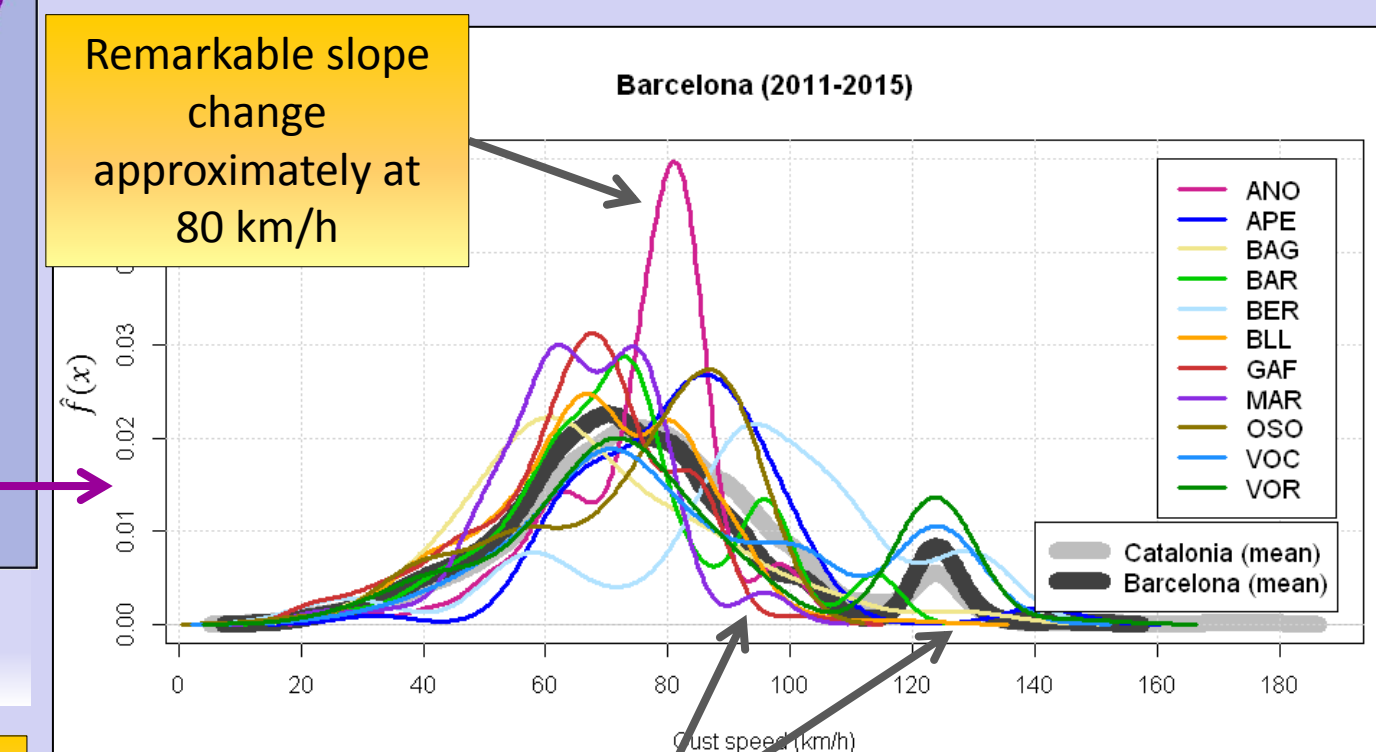
For visual exploration, description and comparison of the data (Gaussian Kernel smoothing, default bandwidth using R package)



Only calculated for counties with 15 or more requests  
Comparison with mean values for Catalonia (grey lines) and for each province (black lines)



In violet, province administrative division: Lleida, Tarragona, Girona and Barcelona



High values in the extreme southern counties, highly exposed to strong winds

In general, a remarkable rise is observed in the interval 60-70 km/h

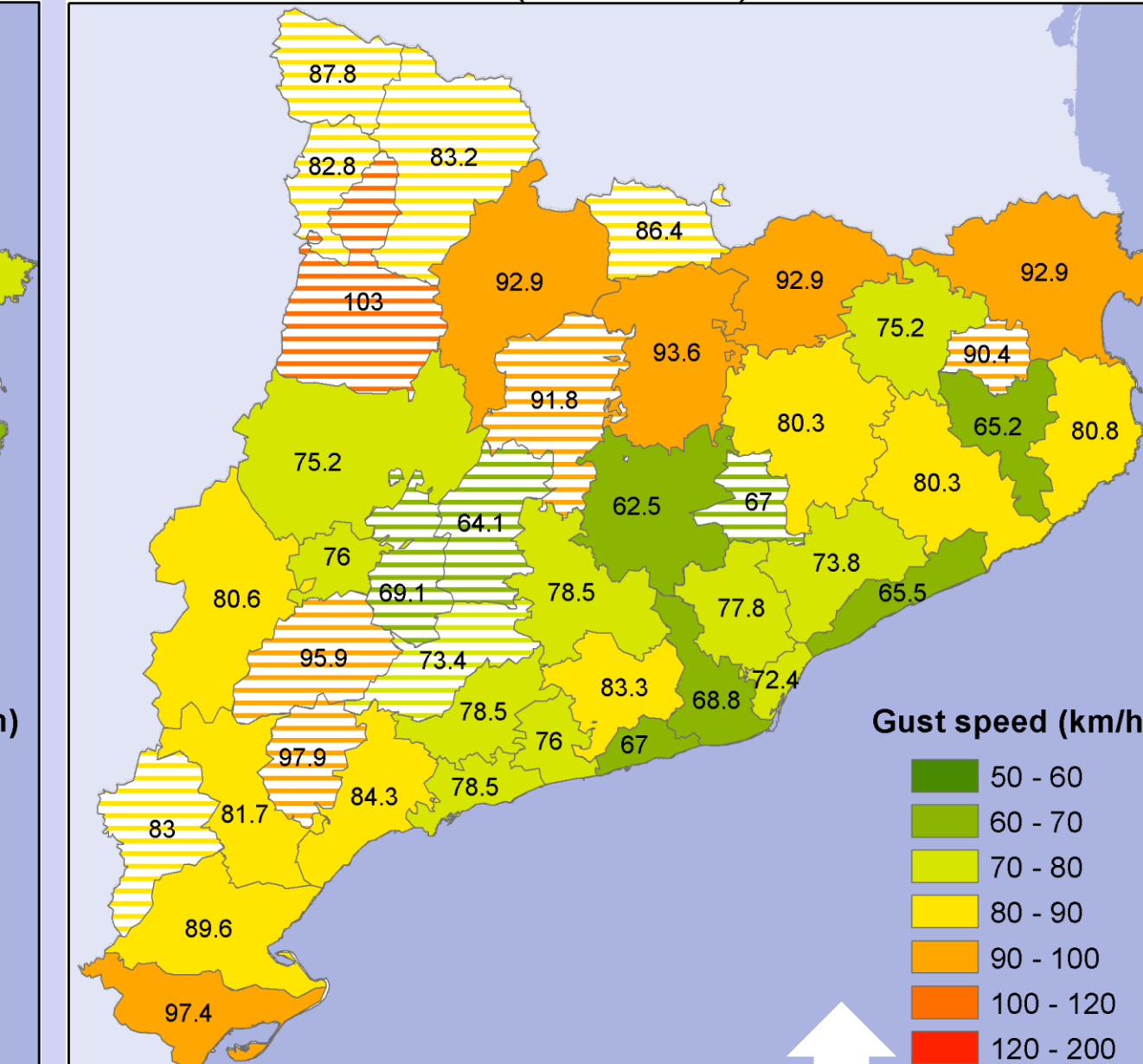
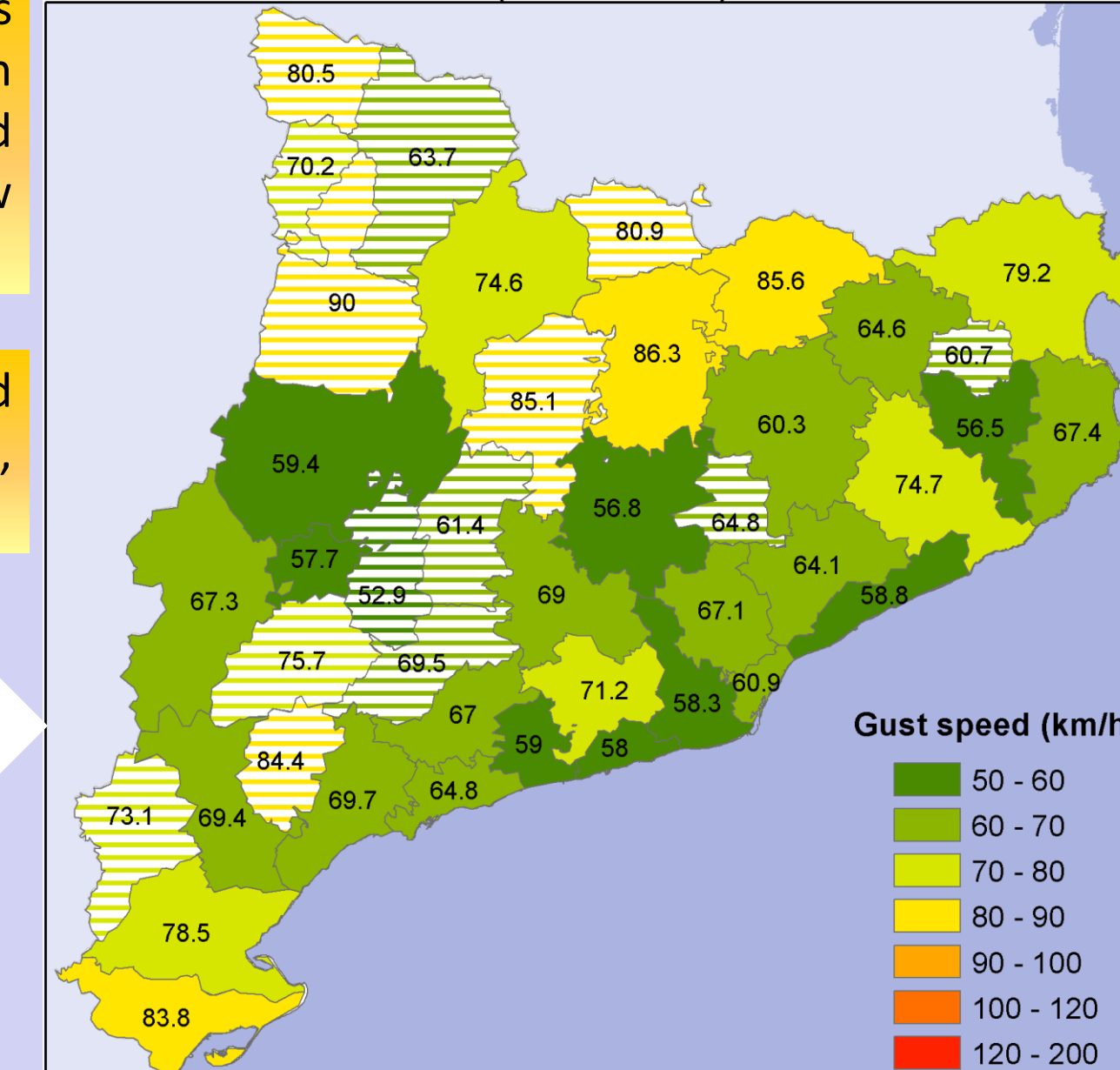
Most of the counties of Barcelona province show lower values than the rest of counties in Catalonia

Secondary peaks due to certain extreme events (especially in highly populated areas) and to different response inside a county

### c) QUARTILE MAPS BY COUNTY

P25 Gust speed provided in reports (2011-2015)

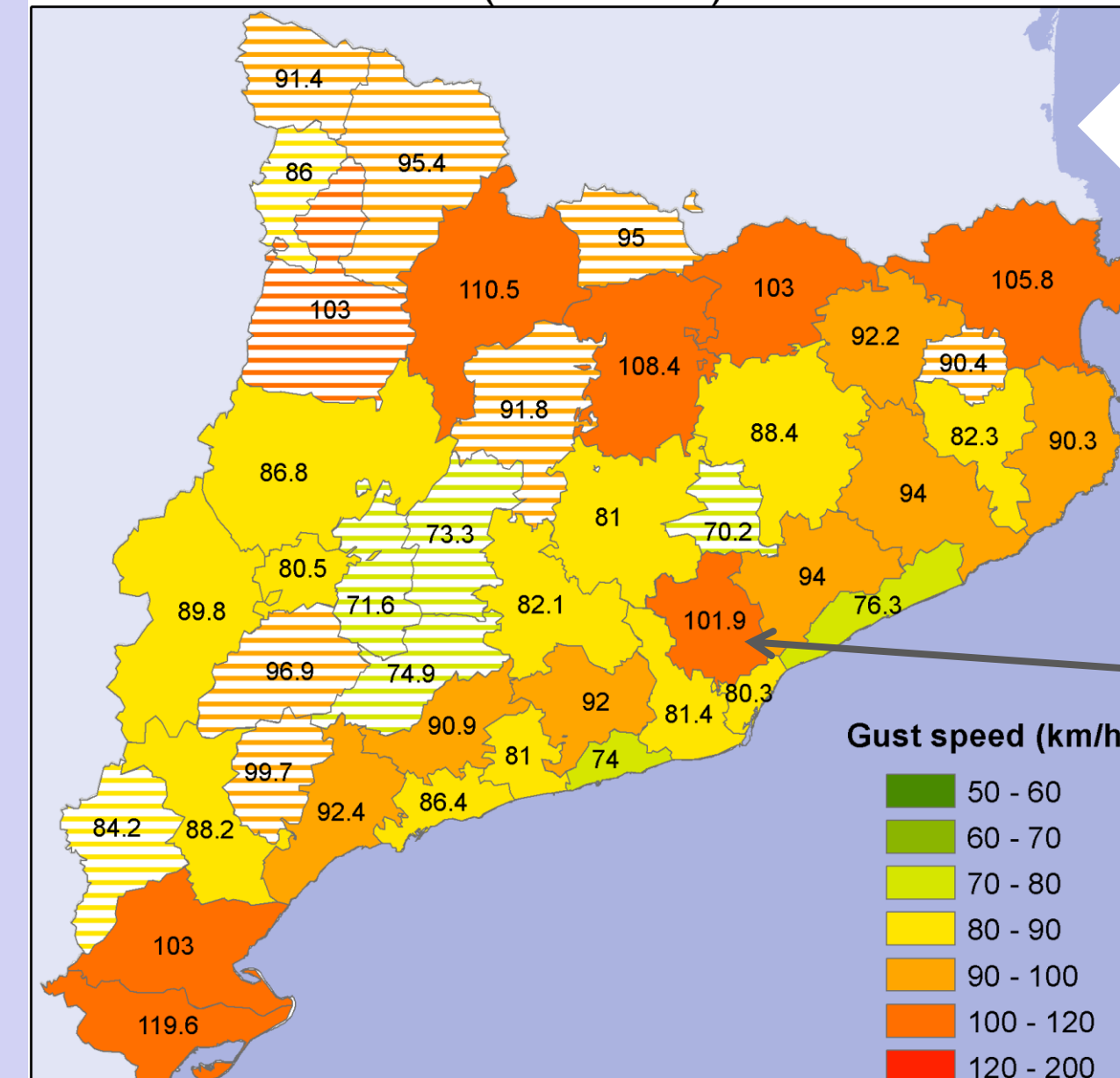
P50 Gust speed provided in reports (2011-2015)



### SUMMARY OF APPROXIMATE VALUES

Area	P25 (km/h)	P50 (km/h)	P75 (km/h)
Pyrenees area and extreme northern and southern coastal counties	75-85	85-100	100-120
Central coastal area, county of Gironès and some counties in the Catalan Central Depression	55-65	65-75	75-85
Other areas	65-75	75-85	85-95

P75 Gust speed provided in reports (2011-2015)



Stripe pattern in counties with less than 15 reports

## 5. CONCLUSIONS

- Gust speed values related to social impact have been analysed by county using damage related requests received in the SMC (2011-2015).
- Remarkable differences between counties have been observed both in number of requests and in the gust speed values associated to these requests. Also internal differences in some counties have been detected.
- For all Catalonia, most of the gusts related to requests are between 60 km/h and 100 km/h.
- In general, a remarkable rise of requests is observed at gust speed values between 60 km/h and 70 km/h.
- Quartiles of gust speed values have been calculated to determine which thresholds cause an important percentage of the requests received.
- Densely populated areas like the metropolitan area of Barcelona have 50<sup>th</sup> percentile values between 65 km/h and 75 km/h.
- In less populated counties and more exposed to strong winds the 50<sup>th</sup> percentile values are approximately between 85 km/h and 100 km/h.
- Future work will be aimed, firstly, at widening the period of study in order to have a total of 10 years of data (2006-2015). Afterwards, the results could be compared with other thresholds like the 98<sup>th</sup> percentile of daily maximum gust speed. Moreover, different areas with similar response to strong winds could be defined.
- In order to define useful thresholds for Civil Protection, it would be necessary to complement this study with their assistance interventions database. Then, damages that are not considered in this study, like the ones occurred in forest areas, would also be included.

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## 6. REFERENCES

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