2nd International Congress on Fire in the Earth System:
Humans and Nature

Social vulnerability and wildfire risk in evacuation support: Methodological proposal applied to the municipalities of Lousã and Sertã (Central Portugal)

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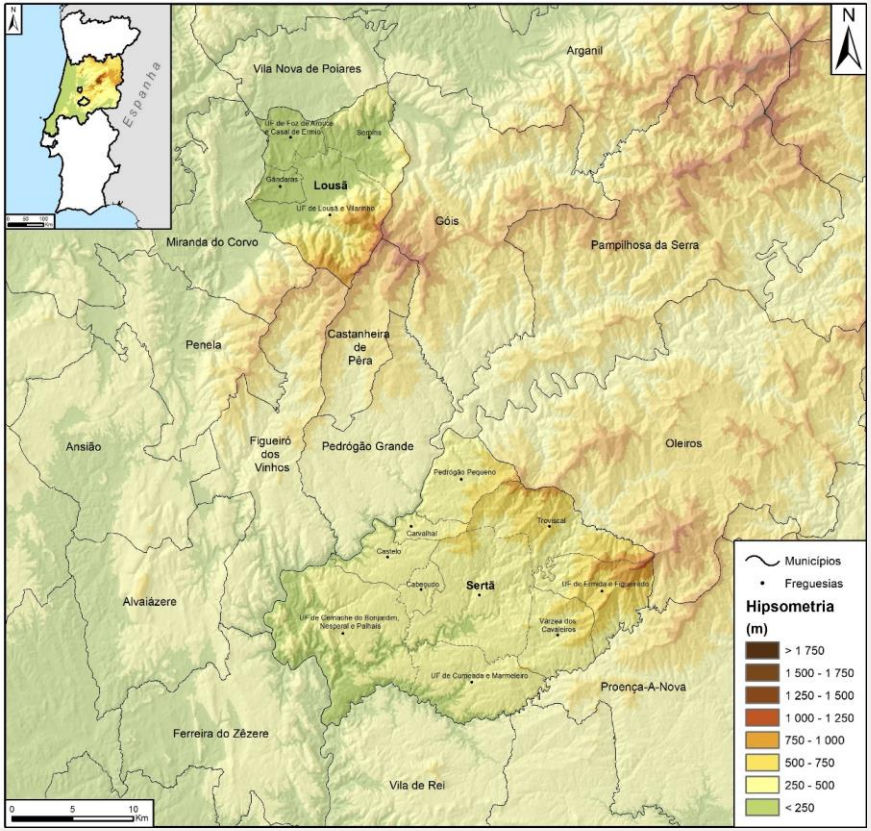
Objetives

- **Propose a methodology to support evacuation in a forest fire scenario,** applied to the municipalities of **Lousã** and **Sertã** (Central Portugal), based on:
- Assessment of **Social Vulnerability** (*adapted from Chakraborty et al. 2005*):
  - Population and structure;
  - Differentiated access to resources;
  - Population with special needs for evacuation;
- **Mapping Wildfire risk as a result**:
  - **Hazard**(Probability and Susceptibility) **× Social Vulnerability**

Study area

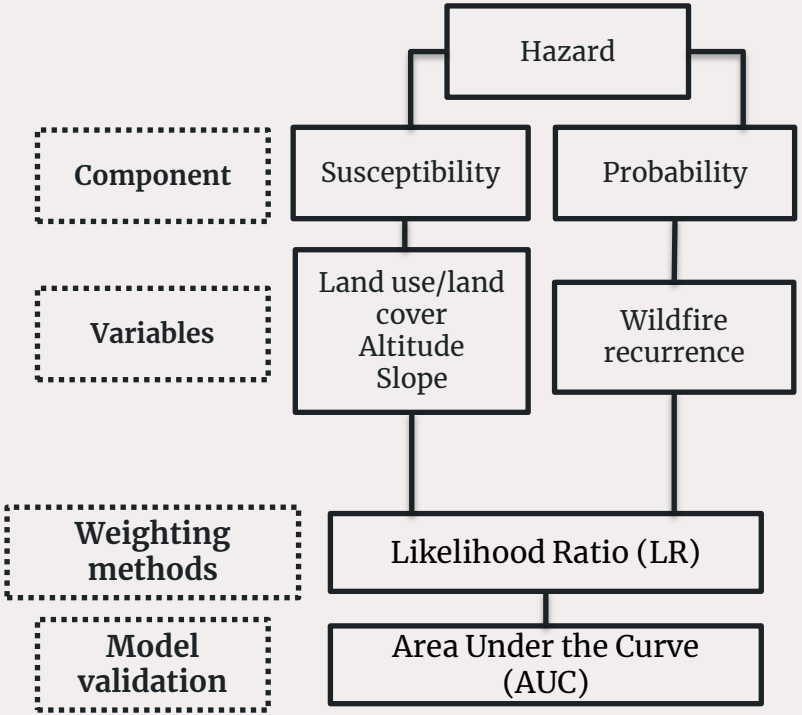


The municipalities of **Lousã** and **Sertã** are located in the Central Region of Portugal, and are characterized by:

- Rugged topography;
- Predominance of forest (mainly *Pinus Pinaster* and *Eucalyptus globulus*);
- High aging index (221.8 in Lousã and 363.6 in Sertã);
- Strong population variation;
- High recurrence of forest fires;
- Deaths, injuries and evacuations were recorded in some wildfires events.

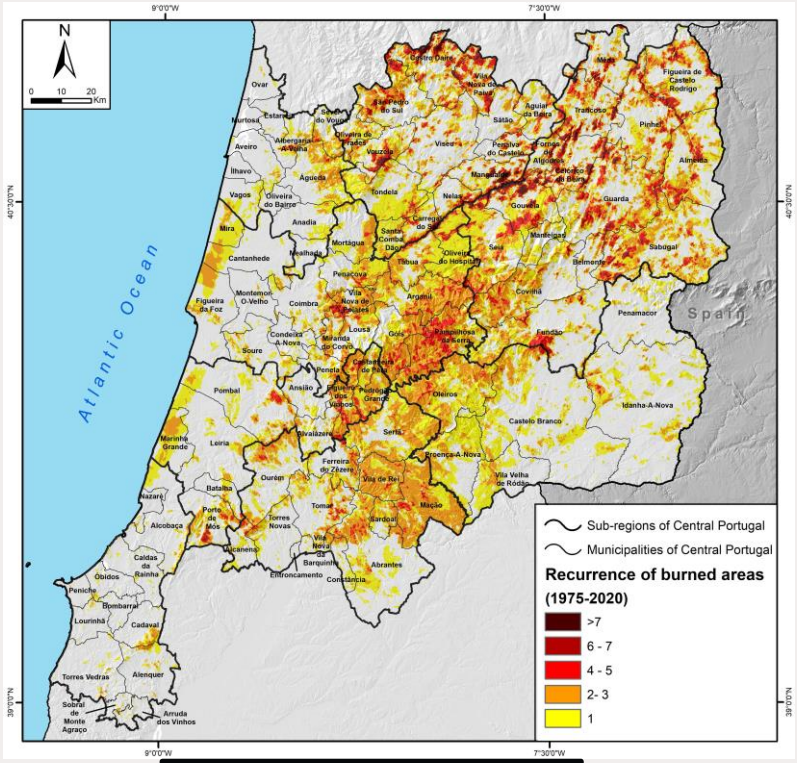
Methodology: Wildfire Hazard

Simplified Wildfire Hazard Assessment Framework

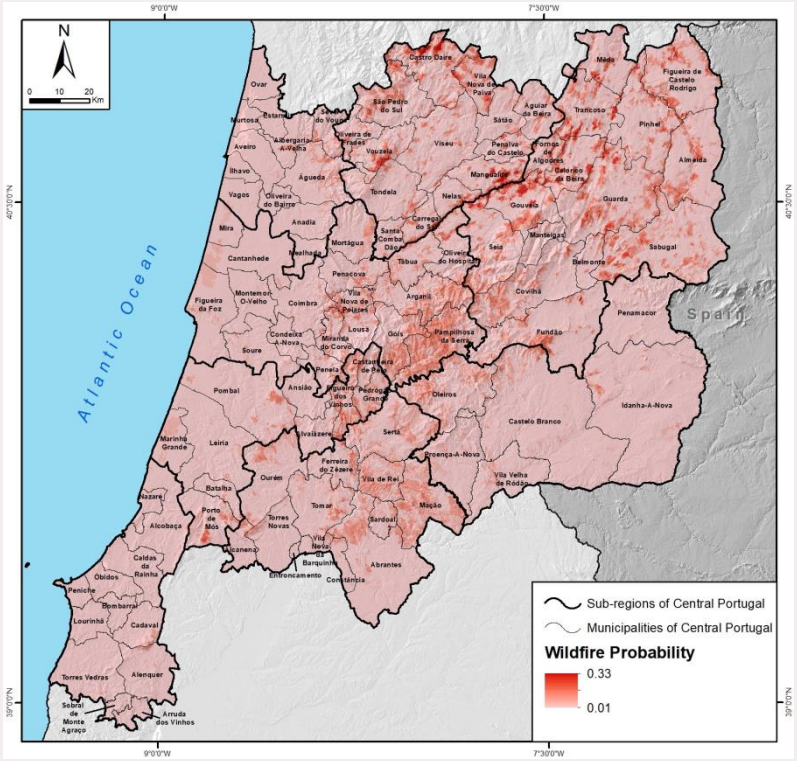


(adapted from Oliveira et al., 2020)

Methodology: Wildfire Probability



Recurrence of burned areas (1975-2020)



Wildfire Probability

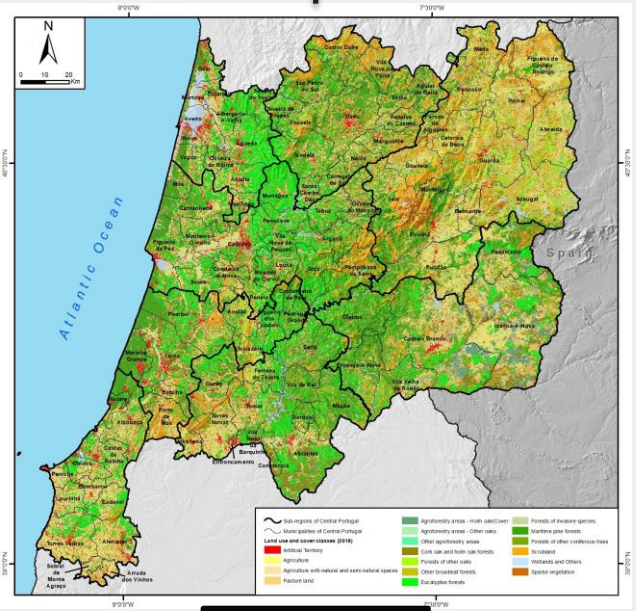
$$\text{Wildfire Probability} = \frac{f}{N}$$

f = Number of times a pixel burned

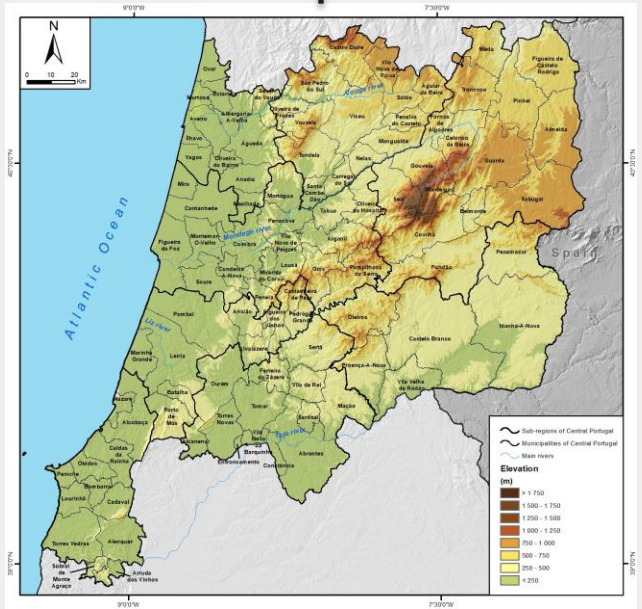
N = Number of years in the series

Methodology: Wildfire Susceptibility

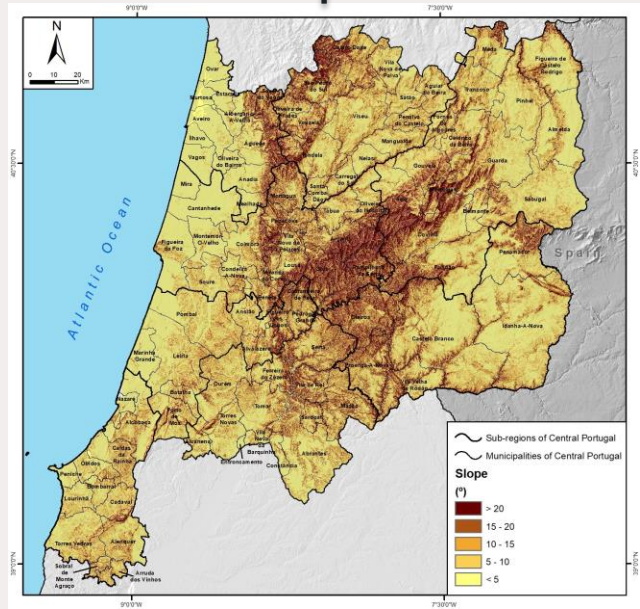
Burned Areas (1975-2019)



Land Use



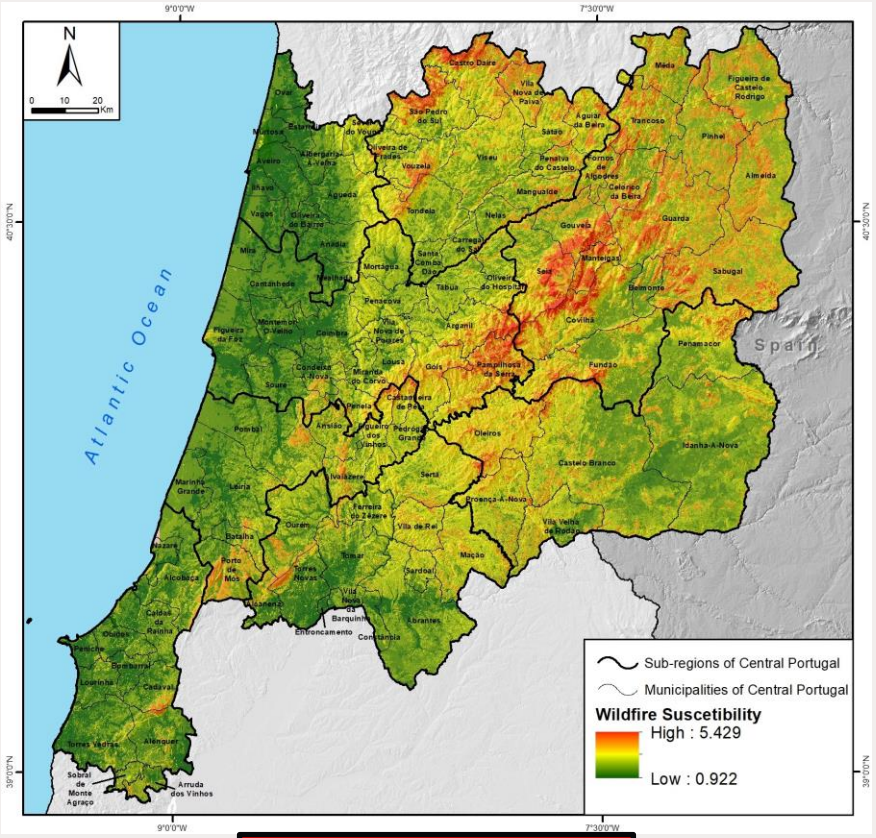
Elevation



Slope

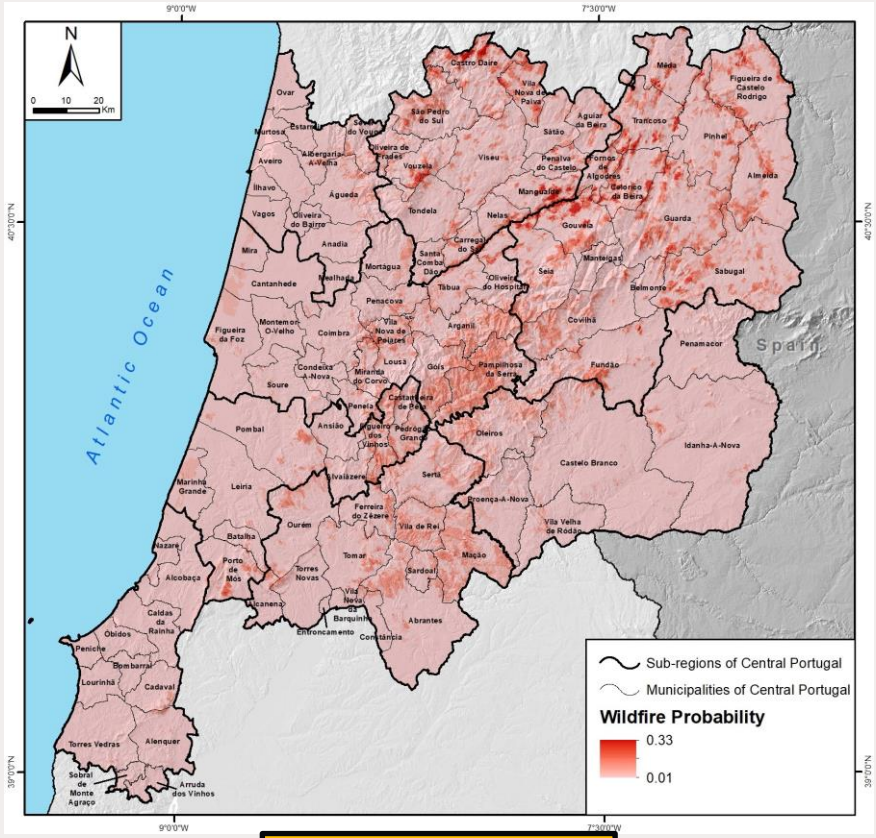
Wildfire Susceptibility

Methodology: Wildfire Hazard calculation



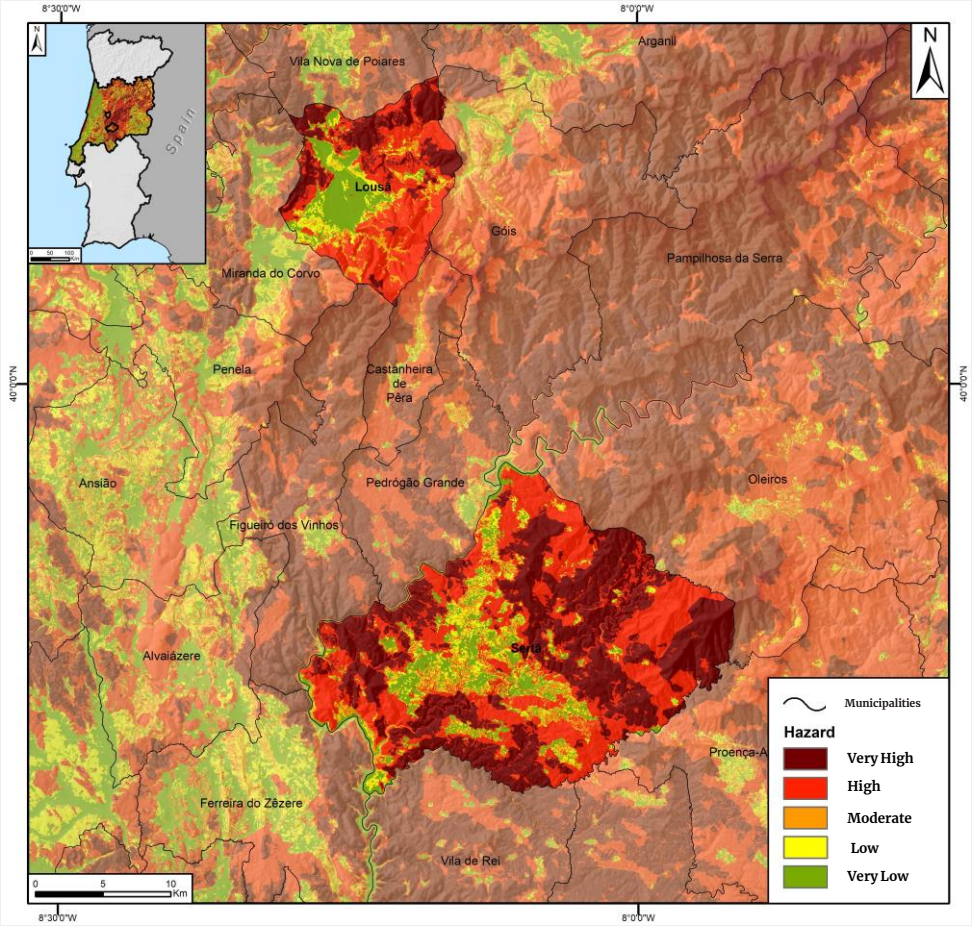
Wildfire Susceptibility

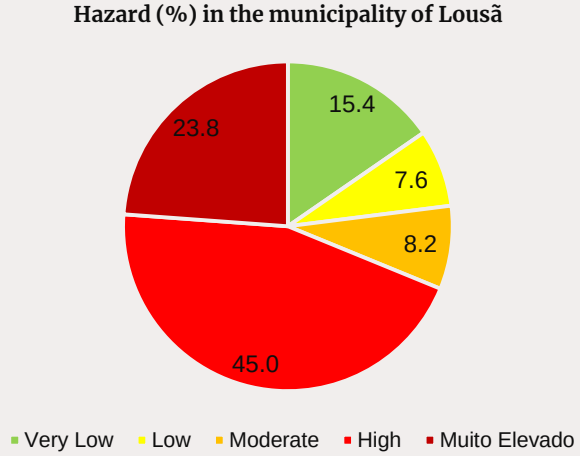
×

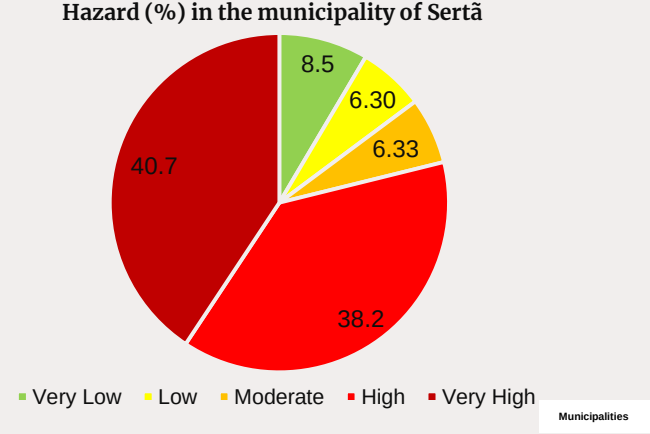


Wildfire Probability

Results: Wildfire Hazard







Methodology: Social vulnerability to support evacuation

Step 1: Calculate the ***Ri***.

For each variable i determine the ratio of variable i to the total number registered in the municipality.

Step 2: Standardization for each variable

$$\frac{Ri}{Rmax}$$

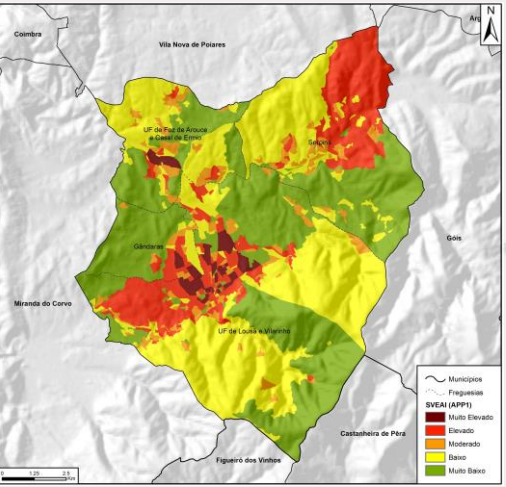
Rmax= Maximum value of the previously calculated ratio.
Social **V**ulnerability for **E**vacuation **A**ssistance **I**ndex

$$(\text{SVEAI}) = \frac{\sum SVEAIi}{n}$$

Characteristics	Statistical subsection
Population and structure	Total resident individuals
	Classic buildings
Differentiated access to resources	Classic families with more than 2 unemployed
	Individuals residing without knowing how to read or write
	Pensioners or retired resident individuals
	Resident individuals without economic activity
Population with special needs for evacuation	Resident individuals aged between 0 and 4 years
	Resident individuals over the age of 64
	Isolated classic buildings
	Total institutionalized families

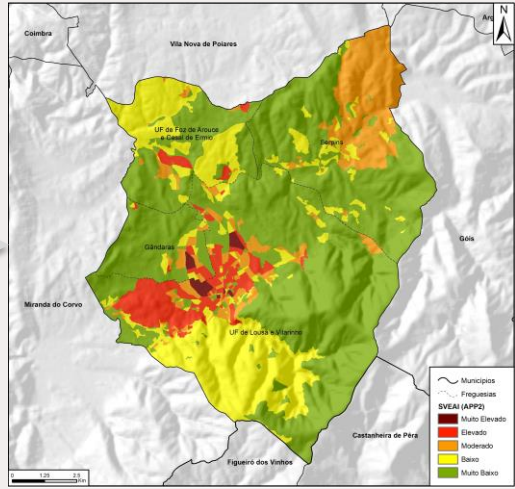
(adapted from Chakraborty et al. 2005)

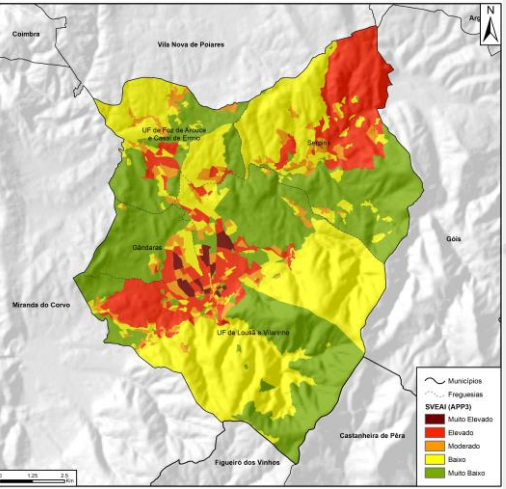
Results: Social vulnerability for evacuation assistance



APP1: Population and structure

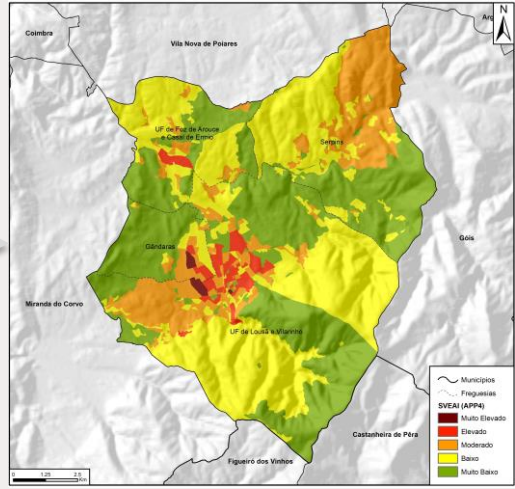
APP2: Differentiated access to resources





APP3: Population with special needs for evacuation

APP4: all components



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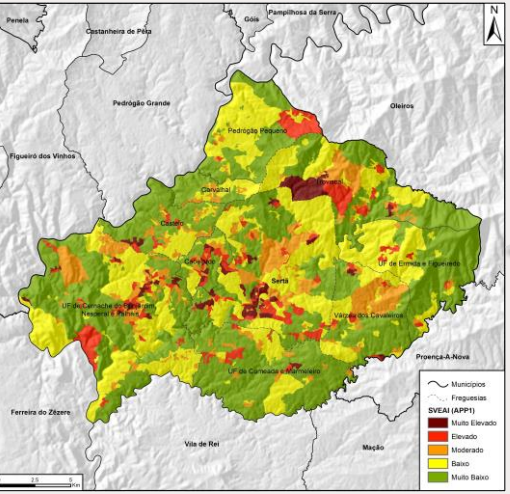

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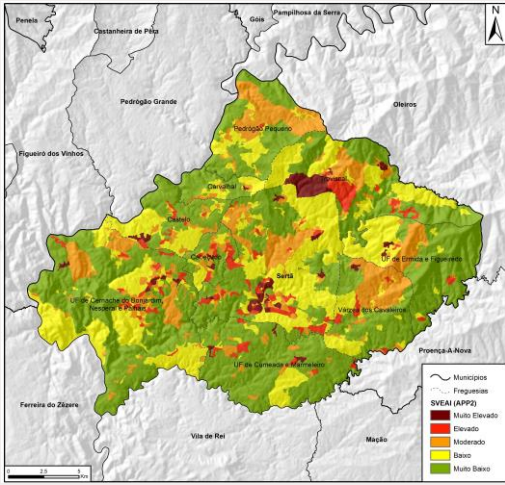

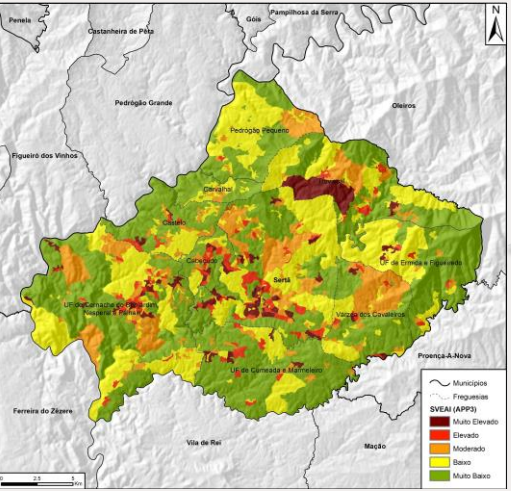

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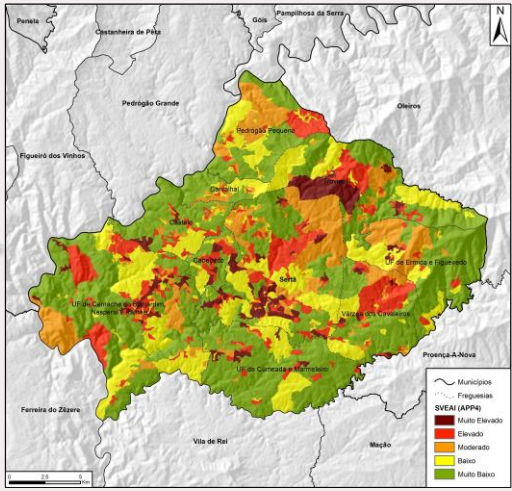
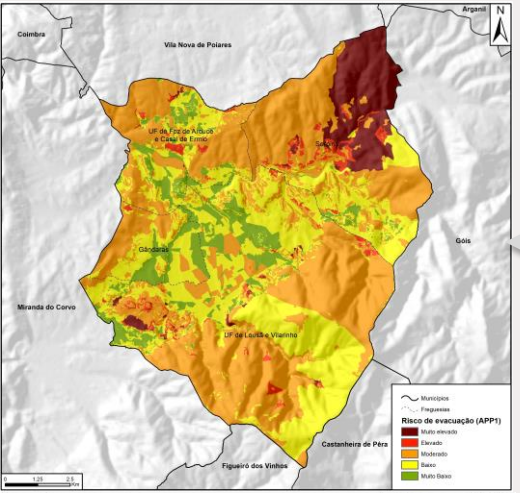


Results: Wildfire Risk in support of evacuation



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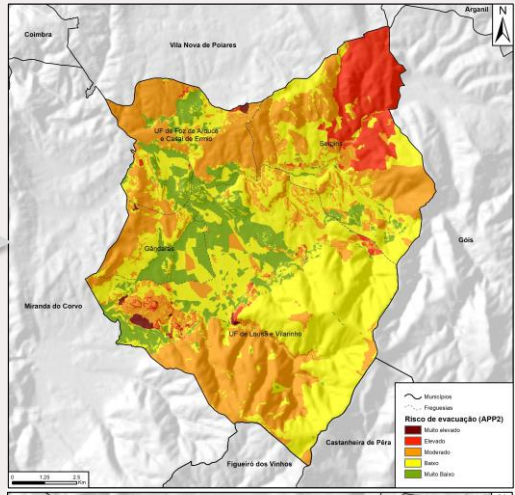

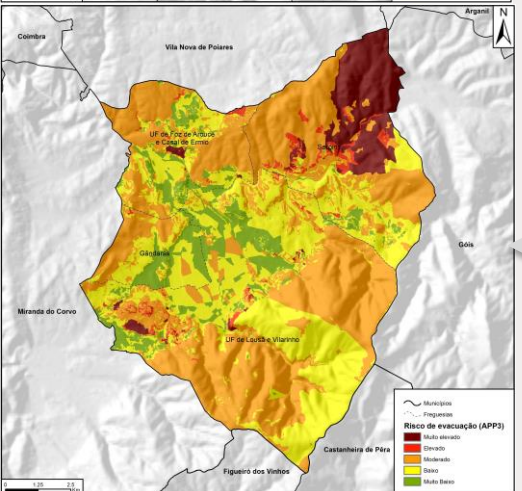

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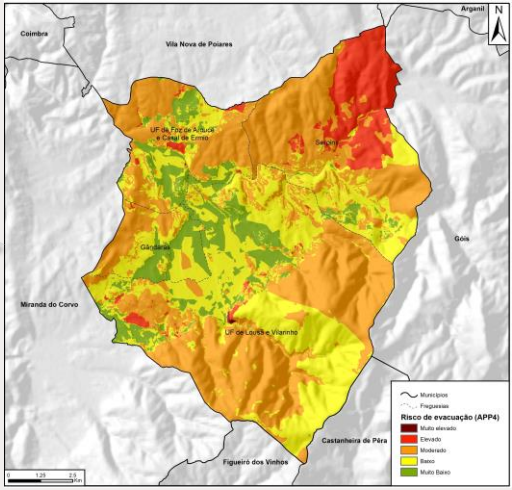

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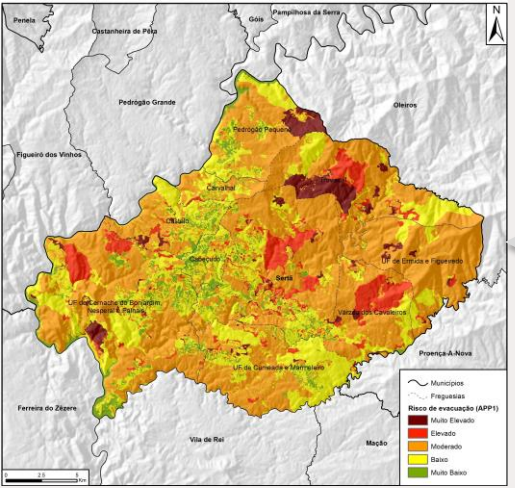

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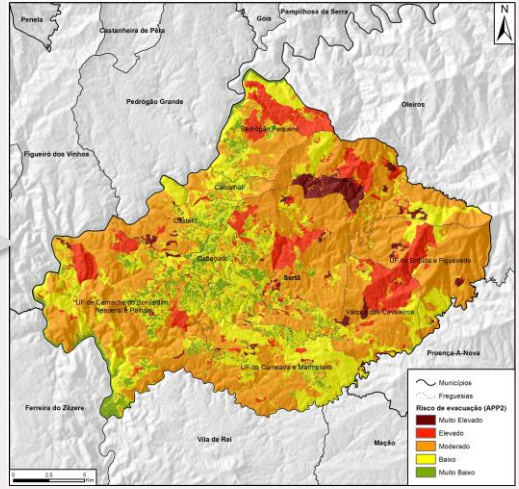

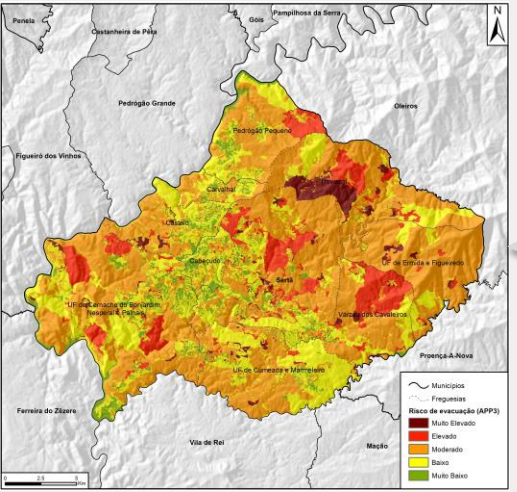

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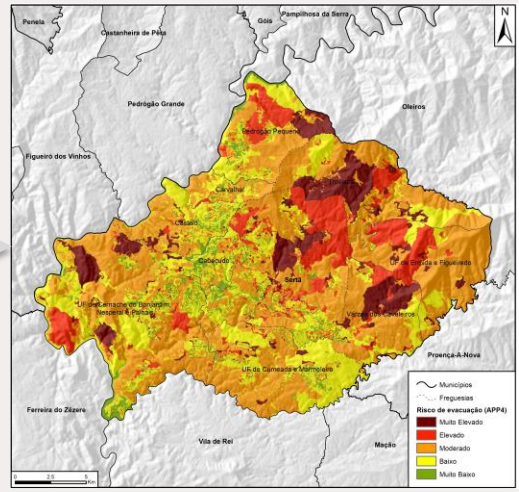

Conclusion

- **More than 50%** of the study areas were classified with **high** and **very high Wildfire Hazard**, showing high favourability for the occurrence and propagation of fires;

- The analysis of **Social Vulnerability to support evacuation** allows the construction of an important perspective of the territory in terms of vulnerability, however, the analysis only seems complete when integrated with the component of **wildfire hazard**. Indeed, the most vulnerable areas are not always the ones with greatest risk;

- The methodological proposal may constitute a support tool for evacuation planning, however **other variables need to be integrated**, such as the road network, the time required for the displacement of individuals, especially the elderly, among others.

Acknowledgments

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