Characterization and mapping of wildland urban interfaces Assessing forest fire risk in South of France

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Forest fire risk concerns large territories and causes great damages with ecological, social and economical consequences but also with high costs of prevention and fire fighting. Every year more than 2,600 forest fires affect about some 26,000 hectares of vegetation in the French Mediterranean area (Promethée database 1973-2004). Some years have heavy consequences with human dead life and burned houses and more than 60,000 hectares of burned vegetation on different areas in the South of France. Forest fire risk increases because of dynamics of land cover: deep land transformations have been observed for some decades in the Mediterranean region. On the one hand agricultural fallows and orchards are slowly colonized by vegetation, on the other hand forest is not exploited enough; both conducting to the fuel load accumulation. Besides, especially in the South of France, the urbanization, joined to the forest extension phenomenon, generates new spatial configurations called wildland urban interfaces (WUI). WUI concerns integrate "natural" vegetation massifs connected to urban systems which bring out both components of forest fire risk: hazard (breaking out probability, distribution) and vulnerability. Assessing forest fire risk in the WUI is a need for wildfire prevention and land management. Considering that a level of fire risk can be affected to each type of wildland urban interface, how can we objectively characterize these WUI types? How can we set their boundaries to map them over wide areas and at a scale fit to regional development? How to establish relationships between fire risk level and WUI types?

The aim of this paper is to present a spatial analysis method to characterize and to map wildland urban interfaces types and a first approach of forest fire risk in WUI allowing to qualify interface typology in terms of fire risk levels.

METHODOLOGICAL PROCESS TO CHARACTERIZE WILDLAND URBAN INTERFACE

Wildland urban interfaces are modelled as two intermixed elements, residential houses according to their density and fuel vegetation according to its structure. The combination of those criteria enables to quantify the spatial configuration between vegetation patches (forest, scrubland), urbanization patches and other factors (agriculture, roads…) with landscape.
So to characterize wildland urban interfaces, the methodological process includes two steps. The first one uses remote sensing in order to produce a land cover map and specifically a vegetation map. The second one is to carry out analysis of the spatial organization of the two components that are vegetation and houses. The methodology is developed on a case study area in the South of France covering around 40,500 ha. In this area, WUI are very well represented and urbanization is spreading instead of agricultural fallows, near and inside woody zones.

Data used is SPOT 5 satellite imagery dated from July 2002 acquired within the program ISIS framework by CNES (National Centre of Spatial Studies). Other databases used in this study are BD TOPO® or aerial photos BD ORTHO® 2003 produced by the French National Geographic Institute (IGN).

Through remote sensing a supervised classification of the satellite imagery is elaborated with a view to obtain a map of vegetation. The layer of houses is extracted from the BD TOPO ® of the IGN and allows to produce a map of houses.
Then spatial analysis consists on the one hand in calculating ecological metrics and on the other hand in calculating house density, then combining criteria by GIS. Quantitative and objective indicators are so determined to characterize a typology of wildland urban interfaces. Then GIS allows to map wildland urban interfaces on wide areas and at a large scale.

RESULTS

A map of the aggregation values is produced according three classes of aggregation levels: null, low and high aggregation allowing to point out the horizontal structure of vegetation.
Low aggregated zones correspond to forest borders, skirts or to garden vegetation including urban area and infrastructures. Structure of the vegetation is discontinuous, interrupted by other land cover types. On the other hand, strongly aggregated zones correspond to forest massifs or scrubland. Structure of the vegetation is dense and continuous. An aggregation value equal to zero corresponds to zones covered by fields, bare ground, urban areas...
A map of houses density is produced according to three classes of density: low, middle and high density. Low density represents isolated dwellings, middle density represents scattered habitat and high density corresponds to urban area.
A typology of wildland urban interfaces (as illustrated by figure 1) has been built according to combination of the quantitative criteria described above: vegetation aggregation metric (no aggregation, low and high aggregation) and houses density (low, middle and high houses density). The combination between the three classes of vegetation aggregation and the three classes of houses density lead to nine interfaces types which are illustrated below:

***Figure 1*:** Wildland urban interface typology.

CONCLUSION

Relationships can be established between spatial repartition of fire ignition points and wildland urban interfaces. So around three quarters of fire ignition points are located in the interfaces and the majority of them are located in interface the type characterized by high aggregation of vegetation and high density of houses.
This method corresponds to a need of end-user and will constitute a valuable tool for land development but also for fire fighting. In this study, first results have shown a higher fire ignition in the interfaces. Other relationships have to be developed between interfaces types and the other elements of risk: vulnerability, fire fighting, hazard elements like topography, exposure, vegetation…

The method presented in this study enables to establish a descriptive wildland urban interface typology in the context of South of France. In the European integrated project FIREPARADOX, this method has to be generalized on the whole of European Mediterranean area with the contribution of partners from Spain, Greece and Italy.