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Integrating spatial technologies and fire modelling for studying fire behaviour and designing landscape management strategies in fire-prone Mediterranean areas.

B. Duguy (1), J.A. Alloza (1), A. Röder (2) and R. Vallejo (1)

(1) Fundación Centro de Estudios Ambientales del Mediterráneo, Parc Tecnològic, Paterna, Valencia, (2) University of Trier, Remote Sensing Department, Trier, Germany (bduguy@ub.edu / Fax: 00 34 934112842)

The number of large wildfires raised in the 1970's in the Valencia Region (eastern Spain), as in many northern Mediterranean areas, as a consequence of the increasing fuel load due to extensive land abandonment. Recently, spatial technologies, such as Remote Sensing and Geographical Information Systems, combined with fire modelling have contributed to improve our understanding about landscape structure and fire patterns interactions. The simulation of fire processes is becoming a powerful tool for carrying spatial studies of fire behaviour and for testing the effectiveness of silvicultural and fuel treatments in relation to fire control.

The main objectives of this study were: 1) to parameterise the fire growth model FARSITE for a real fire, 2) to explore the effect of fuel spatial distribution on fire propagation and behaviour and 3) to test the effectiveness of different firebreak alternatives for controlling fire spread.

The study site of Ayora (Valencia province) was affected by a large fire (31.700 ha) in 1979. We parameterised the FARSITE model for the fuel and weather conditions of this fire, that is for high fire hazard conditions. The topographical layers were obtained in ArcView after the Digital Elevation Model. The fuel model map prior to fire was also generated in ArcView after reclassification of the Remote Sensing-derived 1979 vegetation structure map. We used the Rothermel's (1972) behaviour fuel models.

We simulated different fuel scenarios derived from the 1990's reference landscape

(Spanish Forest Map, 1993), maintaining the same topographical and weather conditions as in 1979. We finally tested firebreak networks of different densities and firebreak widths, all generated in ArcView after the current firebreak network existing in the area. Simulations were compared through the area burned (ha), the fire rate of spread (m/mn) and the fireline intensity (kW/m).

The obtained results showed that fire propagation and behaviour are greatly influenced by the fuel spatial distribution, and by heavy surface fuels, such as fuel model 4, in particular. The fragmentation of large areas of dense shrublands through the introduction of dense wooded patches was the most effective way to reduce fire size, generally slowing fire spread and limiting fireline intensity. Both the introduction of narrow forest corridors connecting woodlands and the promotion of high perimeter-area relationships (complex shapes) for wooded patches decreased the area burned.

The introduction of a firebreak network always reduced fire size, sometimes enhancing the effectiveness of the fuel distribution alterations. Dense networks with medium-width firebreaks were more effective than less dense networks with wider firebreaks.

The integration of FARSITE-derived indications with common recommendations found in the literature (landscape ecology, forest management) resulted in a “target fuel scenario” and a set of landscape-specific fuel management guidelines.

The proposed methodology could be a powerful tool for land managers in the design of dynamic sustainable fire management strategies.