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Identification of key variables and thresholds concerning fire occurrence using CART

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Fire occurrence is usually a complex variable affected by many others. Relationships among them are site-depending and configure a system. A proper knowledge both about the variables involved in the process and their behavior is a powerful tool for managers, that can be used for a better design of measures against fire before and after those events occur. Relationships among environmental factors affecting fire occurrence are often non-parametric and involve complex interactions. CART is a statistical method with ability to capture hierarchical and nonlinear relationships and expose interactions among predictor variables. Those capabilities seem to be valuable when dealing with fire behavior.

Study zone is comprised by a natural park in North West Spain. High fire recurrence in the area has created a fire-driven landscape, characterized by high heterogeneity and fragmentation. It is a mountainous area covered with oak forest in the lowlands and mostly heathlands on the highlands, sometimes mixed with grasslands. Locals make fire on purpose, mostly for vegetation management.

Based on a fire cartography previously derived from Landsat imagery, we created a database to feed a CART model. With that aim, 20000 random sampling points were located throughout the study site, half of them were burned and the other half were not. To account for differences among years we used a multi-temporal sampling method so that points are equally distributed in scars burned during the period 1995-1999. For model validation 2500 independent points were defined following the same methodology. Values of the predictor variables were extracted for each sampling point and stored in the database. Predictor variables were altitude, slope, aspect, several

vegetation indices for the four previous years to the fire events, vegetation type, past fire regime and distances to the shortest path and village. Those variables try to account both for the natural and social components affecting the studied variable. In order to test the importance of each variables and the stability of the tree structure, we produce several trees with different predictor variables and a final one which uses all of them.

60 to 80% of the validation points were included in the classes with higher burning probability, depending on the used predictors. Some stable patterns were identified in most of the resulting trees. Vegetation indices values in the previous year to the fire event were found to be the most explaining variable. Slope, distance to the nearest building and altitude also appeared in the first tree splits. For each of these variables regular split limits were found suggesting the possibility of key thresholds existence in the system. Although the validation results are not outstanding, results are highly coherent with the previous knowledge about fire in the study site about the most important variables to take into account as well as about the found threshold for them. Models derived from CART seem to be appropriate when studying fire behavior.