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A probabilistic model of the influence of weather, geography and humans on wildfire occurrences in the Mediterranean

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Wildfires in southern Europe cause fatalities, property losses, damage to cropping areas and land degradation. The prediction of wildfire occurrence, together with community hazard maps, supports forest fire mitigation measures (including prescribed fires to reduce fuel buildups, construction of fire breaks, reduction of accumulated vegetation close to endangered properties, evacuation preparedness). Wildfires in the Mediterranean mostly occur during long drought periods combined with high temperatures and strong winds and are partly triggered by humans. For prediction purposes, it is therefore necessary to model the influence of weather condition and human intervention on wildfire occurrence. Because of randomness and uncertainty involved in wildfire events, such prediction models should be probabilistic [1],[2].

Previous work of the authors on the effect of weather conditions, geography and humans on wildfire occurrences with a Bayesian Network model showed a dependence between human population density and wildfire occurrence [3]. However, the Fine Fuel Moisture Code of the Canadian Fire Weather Index (FWI)[4], which was selected as an indicator for weather conditions in [3], was found to be ill-suited for predicting wildfire occurrence in the investigated Mediterranean region, possibly due to the specifics of the local climate. In the present study, we statistically investigate the effect of various weather factors (e.g. temperature, relative humidity) on wildfire occurrence and the suitability of the FWI and its components (fuel moisture codes and fire behavior indexes) for prediction in the Mediterranean. In addition, the effect of human presence on wildfire occurrence is examined.

A regression model is formulated to describe the relationship between wildfire occurrence and explanatory variables representing meteorological conditions, geography and human presence. The model is based on both temporal and spatial data. Daily values of dry-bulb temperature, precipitation, wind speed and relative humidity are considered as explanatory meteorological variables. In addition, we also investigate the suitability of FWI and its components as explanatory variables. The presence of humans and their possible intervention is represented by the density of human population and livestock as well as land use type (e.g. to account for clearing activities in agricultural sites).

The parameters of the model are estimated from data obtained for the Greek Mediterranean island of Rhodes for the years 2000-2009. This study area is chosen as it represents quite adequately the climate and the mixed land uses of fire-prone Mediterranean regions. Weather data are obtained from the German Weather Service. Historical data of wildfire occurrences are obtained from the Greek Fire Service. The spatial reference of the model is the municipality level, at which data is available. The temporal reference is one day. Therefore, the resulting regression model enables daily predictions of wildfire occurrence for a municipality.

The results of the study should improve the prediction of wildfire occurrence in the Mediterranean. In addition, it should support the understanding of the influence of weather, geography and human factors on wildfire occurrence.

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