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Towards the dynamic prediction of wildfire danger. Modeling temporal scenarios of fire-occurrence in Northeast Spain

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Up to date models of human-caused ignition probability have commonly been developed from a static or structural point of view, regardless of the time cycles that drive human behavior or environmental conditions. However, human drivers mostly have a temporal dimension, and fuel conditions are subjected to temporal changes as well, which is why a historical/temporal perspective is often required. Previous studies in the region suggest that human driving factors of wildfires have undergone significant shifts in inter-annual occurrence probability models, thus varying over time. On the other hand, an increasing role of environmental conditions has also been reported.

This research comprehensively analyzes the intra-annual dimension of fire occurrence and fire-triggering factors using NW Spain as a test area, moving one-step forward towards achieving more accurate predictions, to ultimately develop dynamic predictive models. To this end, several intra-annual presence-only models have been calibrated, exploring seasonal variations of environmental conditions and short-term cycles of human activity (working- vs non-working days). Models were developed from accurately geolocated fire data in the 2008-2012 period, and GIS and remote sensing (MOD1A2 and MOD16) information . Specifically, 8 occurrence data subsets (scenarios) were constructed by splitting fire records into 4 seasons (winter, spring, summer and autumn) then separating each season into 2 new categories (working and non-working days). This allows analyzing the temporal variation of socioeconomic (urban- and agricultural-interfaces, transport and road networks, and human settlements) and environmental (fuel conditions) factors associated with occurrence.

Models were calibrated applying the Maximum Entropy algorithm (MaxEnt). The MaxEnt algorithm was selected as it is the most widespread approach to deal with presence-only data, as may be the case of fire occurrence. The dependent variable for each scenario was created on a conceptual framework which assumed that there were no true cases of fire absence. Model accuracy was assessed using a cross-validation k-fold procedure, whereas variable importance was addressed using a jacknife approach combined with AUC estimation. Results reported model performances around 0.8 AUC in all temporal scenarios. In addition, large variability was observed in the contribution of explanatory factors, with accessibility variables and fuel conditions as key factors along models. Overall, we believe our approach is reliable enough to derive dynamic predictions of human-caused fire occurrence probability. To our knowledge, this is the first attempt to combine presence-only models based on XY located fire data, with remote sensing information and intra-annual scenarios also including cycles of human activity.