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Analysis of weather condition influencing fire regime in Italy

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Fires have a crucial role within Mediterranean ecosystems, with both negative and positive impacts on all biosphere components and with reverberations on different scales. Fire determines the landscape structure and plant composition, but it is also the cause of enormous economic and ecological damages, beside the loss of human life. In addition, several authors are in agreement suggesting that, during the past decades, changes on fire patterns have occurred, especially in terms of fire-prone areas expansion and fire season lengthening.
Climate and weather are two of the main controlling agents, directly and indirectly, of fire regime influencing vegetation productivity, causing water stress, igniting fires through lightning, or modulating fire behavior through wind. On the other hand, these relationships could be not warranted in areas where most ignitions are caused by people (Moreno et al. 2009). Specific analyses of the driving forces of fire regime across countries and scales are thus still required in order to better anticipate fire seasons and also to advance our knowledge of future fire regimes.
The objective of this work was to improve our knowledge of the relative effects of several weather variables on forest fires in Italy for the period 1985-2008. Meteorological data were obtained through the MARS (Monitoring Agricultural Resources) database, interpolated at 25x25 km scale. Fire data were provided by the JRC (Join Research Center) and the CFVA (Corpo Forestale e di Vigilanza Ambientale, Sardinia). A hierarchical cluster analysis, based on fire and weather data, allowed the identification of six homogeneous areas in terms of fire occurrence and climate (pyro-climatic areas). Two statistical techniques (linear and non-parametric models) were applied in order to assess if inter-annual variability in weather pattern and fire events had a significant trend. Then, through correlation analysis and multi-linear regression modeling, we investigated the influence of weather variables on fire activity across a range of time- and spatial-scales.
The analysis revealed a general decrease of both number of fires and burned area, although not everywhere with the same magnitude. Overall, regression models where highly significant ($p<0.001$), and the explained variance ranged from 36% to 80% for fire number and from 37% to 76% for burned area, depending on pyro-climatic area. Moreover, our results contributed in determining the relative importance of climate variables acting at different timescales as control on intrinsic (i.e. flammability and moisture) and extrinsic (i.e. fuel amount and structure) characteristics of vegetation, thus strongly influencing fire occurrence. The good performance of our models, especially in the most fire affected pyro-climatic areas of Italy, and the better understanding of the main driver of fire variability gained through this work could be of great help for fire management among the different pyro-climatic areas.