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# Wind and fire propagation experiments conducted in the field: examples from the Alpes-Maritimes department, France.

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In Mediterranean regions, wild fires constitute one of the main natural risks for people, especially at the semi-urban - forest interface. Weather parameters influence fire rate of spread (R.O.S.). It is well known, for example, that hot dry air provokes a more efficient combustion, but wind is an even more important parameter. The impact of wind characteristics on R.O.S. is poorly understood and previous studies by the authors have shown that wind variability has a greater impact on R.O.S. than mean velocity. The objective of this work was to refine the spatial and temporal scales of analysis to characterise the impact of wind characteristics on fire R.O.S..

Heavy experiments with powerful instrumentation are expensive and often disappointing because wind and fire spread directions are rarely identical to expectation, so locating sensors and interpretating data can be difficult. In this series of experiments, lighter protocole, which requires about only 1 hour of preparation before fire ignition, was used. Before ignition, initial conditions are measured (vegetal fuel characteristics, topography, etc). With the help of the French National Forest Office, homogeneous areas on South oriented slopes covered with Genista cinerea, Buxus sempervirens, Spartum junceum, Juniperus oxycedrus for the bush stratum, and with Quercus pubescens and Pinus sylvestris for the tree stratum were selected. The experiments are conducted in winter, during sunny periods, and with a slope thermal wind breeze regime, where wind tends to ascend along the slope (during the day). Markers are installed every 5m to 10 m upslope to follow fire propagation.

The meteorological instrumentation consists of an automatic weather station, a hand thermo-hygrometer, a hand anemometer to follow the fire front, and especially two 3D anemometers (Young) with highly sensitive propellers to measure wind speed in orthogonal U, V, and W (vertical) directions every second. Thus, direction is computed from U and V speed components, and this avoids problems of inertia and non-accordance encountered with separated systems (anemometer and vane).

The main results show that spatial and temporal wind speed and direction variability can be important in complex topography. The behaviour of wind not influenced by the fire and of wind near the fire can be very different. Beyond some flame height threshold, the wind speed increases, the direction changes, and the positive vertical speed is higher. These characteristics are related to heat convection, which is also able to generate vorticies. In addition, only wind measurements carried out at the 1 to 2 second time step (no more) are able to characterize correctly air flow and turbulence, especially their temporal variability. This last point is very important because we have shown in various previous experiments that the R.O.S. is more correlated to the inverse of wind speed coefficient of variation near the fire than to its average speed. In fact, even in highly windy conditions, a very turbulent wind creates a lower fire R.O.S..

The results indicate that efficient modelling of fire propagation cannot be based on mean wind velocity alone, and that variability in wind speed and direction must also be taken into account. For the moment, wind velocity and direction are generally considered constant and this oversimplifies actual conditions.