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Sensitivity of fire behaviour simulations to spatial accuracy of input data

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Wildland fire spread and behaviour are complex phenomena due to both the number of involved physicalchemical factors, and the nonlinear relationship between variables. Several models attempt to predict the propagation of fires under different fuel, weather and other environmental conditions. The different fire simulator systems developed and validated in the last two decades are characterized by semi-physical, statistical or probabilistic approaches. The semiphysical approach combines the physical theory of combustion and heat transfer with statistical relationship between the different factors involved in fire spread, parameterized by large databases of both experimental and prescribed fires. The most widespread fire prediction model is the semiempirical fire model developed by Rothermel and incorporated into the BEHAVE Fire Behaviour Prediction and Fuel Modelling System. Rothermel's model constituted the core of different spatial and temporal explicit fire spread and behaviour simulators, i.e. FARSITE (Fire Area Simulator) developed by Finney in 1994. Several works reported limitations of Rothermel's model due to the inaccuracies of both the model equations and the accuracy and quality of input data. The use of spatial simulators of fire behaviour as FARSITE requires the availability of high resolution environmental and fuel data; in absence of realistic data, errors on the simulated fire spread can be compounded to produce a decrease of the spatial and temporal accuracy of predicted data.

In this work, FARSITE was employed to simulate spread and behaviour of some real fires occurred in North Sardinia during the past summer seasons. The effect of fuel models and weather conditions on the accuracy of FARSITE simulations was evaluated to assess the capabilities of the simulator in accurately forecasting fire spread and behaviour in areas covered by Mediterranean maquis. A custom fuel model, designed and developed for North Sardinian maquis, provided realistic values of simulated fire spread and behaviour. Improvements on the accuracy of both fire spread and behaviour were also obtained using raster maps of wind speed and direction, rather than uniform wind fields. For this purpose, a computational fluid dynamic model was used to obtain numerical simulations of wind fields and to evaluate the effect of topography on wind regime. The results confirm that the use of both accurate wind field data and appropriate custom fuel models is crucial to obtain accurate simulations of fire behaviour occurring on Mediterranean vegetation during the drought season.