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PhyFire & HDWind: from the initial ideas to the current tool

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We present a historical review of PhyFire and HDWind, both models developed by the research group on Numerical Simulation and Scientific Computation founded by L. Ferragut at the University of Salamanca.

The PhyFire is a simplified physical wildfire spread model that has it origin in a simple 2-D one-phase physical model, based on the energy and mass conservation equations, and takes into account convection and diffusion. As radiation is one of the dominant thermal transfer mechanism in wildfires, it was incorporated to the initial model with a local radiation term [1]. The influence of moisture content and heat absorption by pyrolysis were introduced in the model by means of a multivalued operator representing the enthalpy [2]. The non-local radiation from the flame above the fuel layer was included in the model enabling to cope with the effect of wind and slope over the flame tilt [3]. Efforts have also been made to improve the feasibility of the PhyFire model with simulations of real fires [4] and experimental fires [5], and it has been adapted to data assimilation techniques [6].

The HDWind provide a 3D wind velocity field in the air layer over the surface of study, solving only 2D linear equations. The origin of this model lies in an asymptotic approximation of the primitive Navier–Stokes equations considering that the horizontal dimensions are much larger than the vertical ones [7, 8]. In [9], the wind velocity field obtained by the model is adjusted to several wind velocity measurements at different points in the 3D domain by solving an optimal control problem. Work is currently under way to couple the HDWind model and the mesoscale WRF forecasting model.

At present, both, the PhyFire and the HDWind models, are integrated into a GIS [10] and are available on a web site `http://sinumcc.usal.es`.

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