UNCERTAINTY QUANTIFICATION OF WILDLAND FIRE PROPAGATION

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ABSTRACT

The present work focuses on the application of non-intrusive stochastic project methods for the uncertainty quantification of wildland fire propagation. For the stochastic characterization we use the Polynomial Chaos decomposition of a stochastic variable, where the Galerkin projection of the stochastic variable in the stochastic space is done through a numerical projection instead of an algebraic one. The goal of using such approach is to avoid the inherent complexity in dealing with strong non linearities of the equations. The choice of the polynomial chaos decompositions is due to the lack of efficiency or stochastic variables description of other methods such as Monte Carlo or variance reduction for example.

For the present case we study the propagation of parametric uncertainty through a semi-physical model of wildfire spread, namely the Rothermel model. This model provides outputs such as the rate of spread, the spread direction, the effective wind speed, and the Byram's fire line intensity, which are all dependent of uncertain inputs concerning the properties of the fuel bed, the orography and the meteorology conditions.

In a early stage we analyze the sensitivity of the input variables in both senses, the numerical and the physical one, in order to verificate and validate the presented methodology as well as getting a prior estimate of the individual relevance of each input variable in the overall fire spread process. A further aim of this phase is to compare the results obtained (in particular the error bars) with the existing literature.

A fire spread model with uncertainty is then applied to the prediction of a fire front under real terrain and realistic inputs, resulting in important elements concerned to the interest and applicability of this approach to fire line prediction.