Rebuttal for NHESS Discussion Manuscript

Towards predictive data-driven simulations of wildfire spread – Part II: Ensemble Kalman Filter for the state estimation of a front-tracking simulator of wildfire spread by M.C. Rochoux et al.

We appreciate the positive and constructive comments made by the Reviewer. Detailed answers are given below.

"The only remark is related to the exclusion of terrain topography effects on the model: what is the level of complexity related to the introduction of this parameter?"

► The extension of the FIREFLY front-tracking simulator to complex terrain topography was performed very recently.[☆] The idea underlying this extension is to project the simulated fire fronts on a given terrain topography onto the two-dimensional horizontal plane. In this context, the outputs of FIREFLY are still the two-dimensional front marker locations at regular time-intervals as for no-slope fire propagation cases. Thus, the data assimilation algorithm remains the same for no-slope and slope-aided fire propagation. That is why the discussion on these aspects was not introduced so far. Future plans include to evaluate the parameter and state estimation strategies in fire propagation cases over complex terrain topography; currently, the main issue is to find observation data sets for slope-aided fire propagation to assimilate using the data-driven FIREFLY capability.

Beyond the complexity of FIREFLY, one may ask if it is necessary to control the terrain elevation in the data assimilation framework. It is known that a fire spread model is very sensitive to the terrain elevation since the fire significantly accelerates in the upslope direction such as in canyon configurations. Thus, in the perspective of data assimilation, the main question relates to the uncertainty of the terrain topography database(s) that is (are) commonly used and/or available in current front-tracking simulators such as FOREFIRE, FARSITE, PROMETHEUS or PHOENIX RapidFire. If this uncertainty significantly affects the location of the simulated fire front, then it is required to include the terrain elevation in the control vector. However, this question needs to be put in perspective with the objective of applying data assimilation to coupled fire-atmosphere simulators such as FOREFIRE-MESONH. In this context, the errors on the terrain topography are not of primary importance relatively to the surface wind conditions, the properties of the biomass fuel or the (heat, mass and momentum) surface fluxes. These errors could therefore be assumed negligible.

The authors propose to add a discussion on these aspects in the Conclusion section.

[⋆]Charlotte Emery, Mélanie Rochoux, Sophie Ricci and A. Trouvé: State estimation using data assimilation for simulation of regional-scale wildfire spread with complex topography. *Technical Report*, TR-CMGC-13-63**,** CERFACS/CNRS SUC URA No1875, Toulouse, France.