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Field-Scale Validation of Data-Driven Wildland Fire Spread Simulations

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The objective of this project is to demonstrate the benefits of data-driven wildfire spread modeling using ensemble-based data assimilation methods combined with sensor observations of the position of the fireline in order to provide a wildfire spread forecasting capability. The present data-driven modeling approach is similar to that used for weather forecasting applications. Our wildfire spread simulation prototype called FIREFLY-EnKF features the following components: a front-tracking fireline solver that adopts a regional-scale viewpoint, treats wildfires as propagating fronts, and uses a description of the local rate of spread (ROS) of the fire as a function of biomass fuel, topographical and meteorological properties (based on the Rothermel model); a series of observations of the fire front position; and a data assimilation algorithm based on an ensemble Kalman filter (EnKF) that can correct ROS parameters in order to decrease the distance between simulated and observed fire front positions. In this work, FIREFLY-EnKF is extended to a spatially-distributed parameter estimation approach to cope with the spatial variations of environmental conditions (in particular near-surface wind conditions). The potential of FIREFLY-EnKF for dynamically estimating the interactions between the near-surface wind and the fire is evaluated in simulations of two field-scale prescribed-burn experiments: a 30-hectare fire experiment called FireFlux I (Clements *et al.* 2007), and a 2-hectare fire experiment called RxCADRE S5 (O'Brien *et al.* 2015). In both cases, data assimilation is shown to improve greatly the accuracy of the fire model and in particular its forecasting capability.

References

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Bio for the presenter: Cong Zhang is currently a PhD student in the Department of Fire Protection Engineering at University of Maryland, College Park. His research interests include wildfire spread, data assimilation, and fire-atmosphere interactions.