Data assimilation for landscape-scale wildland fire behavior

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Abstract

The recent occurrence of extreme wildfire events highlights the urgent need of designing accurate modeling systems to provide insights into the wildland fire dynamics and its driving factors at the scale of an event. Predicting landscape-scale wildfire behavior remains a challenge due to the strong atmosphere/fire interactions and to the uncertainties associated with environmental factors (e.g. biomass fuel properties and moisture content). In this context, data assimilation offers a promising mathematical framework to take advantage of the recent advances in infrared remote sensing technology to improve model predictions of the landscape-scale wildfire behavior [1].

We will discuss how to reconstruct a complete time history of a given wildland fire event using joint state-parameter estimation combined with infrared sensor observations of active burning areas [2]. A front shape similarity measure derived from image processing and based on the Chan-Vese contour fitting functional was introduced to handle position and topological errors in the propagating fire front [3]. We will also discuss the challenges to extend the data assimilation approach from controlled burns to actual wildfires, with the ultimate objective to produce reanalysis of extreme wildfire events. One cornerstone lies in its extension to a coupled atmosphere-fire model to have a better representation of the fire-induced flows near the wildland fire.

Rochoux et al. (2022) Book Chapter in Inversion and Data Assimilation, SCIENCES, in press.

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Keywords: Wildfires, Fire modeling, Data assimilation, Ensemble methods, Position errors, Parameter estimation

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