Research project uses real-time data assimilation to predict path of wildfires

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Using real-time data to more quickly predict the movement of wildfires is the objective of a National Science Foundation-funded research project at the University of Colorado Denver.

The data assimilation for tracking wildfires would offer many benefits, including helping to ensure that people are cleared from harm's way and guiding firefighters to more quickly contain and extinguish wildfires. Other implications are improved forest and prairie management.

Jan Mandel, PhD, professor and chairman of the Mathematical & Statistical Sciences Department, is the principal investigator (PI), and Loren Cobb, PhD, research associate professor, Mathematical & Statistical Sciences, is co-PI. Collaborators are Jonathan Beezley, PhD, who assisted Mandel and Cobb in their research on modeling epidemics of infectious diseases and is now a researcher at Meteo France and CERFACS; Adam Kochanski, research associate, Atmospheric Sciences, University of Utah; and Craig Clements, PhD, associate professor, Meteorology and Climate Science, San Jose State University.

Wildfires are unpredictable and difficult to track, said Cobb, whose specialty is high-dimensional statistics. When a plane flies over a fire zone, it can take hours, if not days, to analyze the picture and predict the fire's direction. "The trick nowadays is to somehow incorporate all the data as it arrives in real time and adjust the model to conform to the latest information," he said. "Then we predict from there the next movement—that's what the firefighters need."

Numerical weather forecasting has made great advances in the last 15 years, Cobb said, and the hope is that similar mathematical methods can have the same predictive effect for wildfires.

Similar to how East Coast residents were warned days ahead of Hurricane Sandy, "we would like to do the same with wildfires, even within minutes," Cobb said. "Every year we hear about somebody getting caught (in a wildfire), so there are lots of reasons for doing this and lots of beautiful math inside."

Mandel said the research explores new methodology for data assimilation. "There is a scientific standard for making the models closer to reality—we keep on improving things," he said. "Over time you keep gently pushing the model toward reality so you don't break the model. At the same time you run the model ahead of time so you can predict what's going to happen."

Mandel said the research is building off work started on wildfire modeling years ago at the National Center for Atmospheric Research. Numerical weather forecasting and wildfire tracking have overlaps, the researchers say, as weather, humidity and winds are important to wildfire behavior. Also, the research builds off Mandel and Cobb's research into epidemics of infectious diseases.

"There's some similarity between epidemics of infectious diseases and wildfires," Cobb said. "They both need fuel. In the cases of an epidemic the fuel is people who are susceptible to a disease. .. The spatial pattern as it moves across a continent is similar. Where they depart is the phenomenon of a firestorm. A firestorm is a wildfire gone crazy and it has its own special dynamics that a wildfire doesn't have."

He added, "nobody is looking forward to the kinds of firestorms that global warming may bring. If we have hotter weather and a drier climate

and trees being killed by beetles—that's a bad combination."

Provided by University of Colorado Denver