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Integration of Geographic Information Systems with a Diagnostic Wind Field Model for Fire Management

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ABSTRACT. The past 10 years have seen an increased interest in diagnostic wind modeling efforts in the fields of air pollution research and wind energy engineering. Applications relating wind to forest fire behavior are also beginning to capitalize on computer-generated outputs from wind models. Most wind model outputs have been considered useful only as intermediate data files loaded into specialized software packages for further processing. Output data are used to generate various output products without being passed into sophisticated mathematical models. With the developed technology of geographic information systems (GIS), new map products can be created. If designed properly, these maps can pass information more efficiently to both the decision maker and the GIS for further analysis. The methods used to create and edit topographic and meteorological databases, display the results of the KRISSY diagnostic wind field model, and perform analyses on the topography and estimated wind field are described. FOR. SCI. 37(2):560–573.
ADDITIONAL KEY WORDS. Wind modeling, geographic information systems, wildfire, chaparral.

SINCE WIND IS THE PRIMARY MODE of heat transfer in a forest fire (Countryman 1964), knowledge of local winds is indispensable to the forest fire manager. Successful forest fire management strategies rely on fire behavior models which in turn rely on several environmental models including fuels, terrain, and weather. Wind is more difficult to model than other factors in fire spread because of the extreme variability of the air motion in time and space. Moreover, wind fields contain vector information which leads to more complex analysis than for scalar information.

Development of diagnostic models for local-scale wind flow may lead to more accurate prediction of wind fields using sparse data. These wind fields can be linked to a geographic information system (GIS) whose purpose is to store, manage, display, and analyze spatial data and their interrelationships. Using four case study days in the San Jacinto Mountains, 150 km east of Los Angeles, this study describes how the vector-based ARC INFO[1] GIS was used to create and edit topographic and meteorological databases, display the results of the KRISSY diagnostic wind field model, and perform analyses on the combined effects of slope and the estimated surface wind field with a slope-wind interaction model.

[1] ARC INFO is a registered trademark of Environmental Systems Research Institute, Inc., Redlands, CA.