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Using Coupled Wildfire/Atmosphere Models to Further to Expand our Understanding of Wildfire Behavior

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Advancements in computing power have created new opportunity for the use of numerical models in wildfire research. Models such as FIRETEC and the Wildland Fire Dynamics Simulator (WFDS) attempt to represent the interaction between dominant processes that determine wildfire behavior such as convective and radiative heat transfer, aerodynamic drag and buoyant response of the atmosphere to heat released by the fire. Such models are not practical for operational faster-than-real-time fire prediction due to their computational and data requirements. However, their process-based model-development approach creates an opportunity to provide additional perspectives concerning aspects of fire behavior that have been observed in the field and in the laboratory; allow for sensitivity analysis that is impractical through observations and pose new hypothesis that can be tested experimentally. Numerical studies support new conceptual models for dominant roles of multi-scale fluid dynamics in determining the nature and viability of fire spread. Results from these studies highlight critical roles coupled fire/atmosphere interaction, which is directly affected by the structure of the vegetation in the vicinity of the fire. There need to be continued efforts to validate the results from these numerical investigations, but, even so, they suggest relationships, interactions and phenomenology that should be considered in the context of the interpretation of observations, design of fire behavior experiments, development of new operational models and even risk management.