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Keynote

Fire/atmosphere Modeling: Opportunities and Challenges

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Abstract

Wildland fires continue to pose risk to lives and property and thus practitioners and scientists continue to work to gain better understanding and ability to predict their behavior. Simultaneously, wildland fire decision makers are working towards more proactive approaches to managing the risk of wildfire , such as fuels treatments and prescribed fire. Executing such measures requires the ability to explore the ramification of such treatments as well as ensure that prescribed fires will meet their objectives. Experiments and observations have demonstrated that the two-way feedbacks between fires and atmosphere play critical roles in determining how fires spread or if they spread. Advancements in computing and numerical modeling have generated new opportunities for the use of models that couple process-based wildfire models to atmospheric hydrodynamics models. These process-based coupled fire/atmosphere models, which simulate critical processes such as heat transfer, buoyancy-induced flows and vegetation aerodynamic drag, are not practical for operational faster-than-real-time fire prediction due to their computational and data requirements. However, these process-based coupled fire-atmosphere models make it possible to represent many of the fire-atmosphere feedbacks and thus have the potential to complement experiments, add perspective to observations, bridge between idealized-fire scenarios and more complex and realistic landscape fire scenarios, allow for sensitivity analysis that is impractical through observations and pose new hypothesis that can be tested experimentally. Additionally, coupled wildfire/atmosphere modeling opens new possibilities for understanding the sometime counterintuitive impacts of fuel management and exploring the implications of various prescribed fire tactics. Certainly, 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. One of the critical aspects of using these sorts of models and learning from them for the development of new operational models is the challenge of visualizing them. Learning to find ways of digesting three-dimensional variation of the interaction between fire and atmosphere is critical. For this purpose, we have had to employ various strategies to visualize this highly transient and highly heterogeneous modeling results involving approximately 20 critical state variable.