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The interaction between wildland fire and their surroundings through fluid dynamics

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Wildfires pose a threat to life, property and critical infrastructure, but wildland fire is an unavoidable part of the natural environment. In order to improve our ability to cope with wildfires and anticipate their impacts on the earth system it is important to understand the processes that drive them and the mechanisms through which they are influenced by their surrounding environment. The motion of the atmosphere surrounding a fire and the two-way interactions between fires and the atmosphere play critical roles in fire behavior. These motions are influenced by the vegetation structure and nearby topography as well as ambient wind conditions as well as the fire itself. The influences of topography on fire behavior are dominated by terrain-induced changes in entrainment patterns that control the patterns of heat transfer to unburned fuel. Multi-scale two-way fire/atmosphere feedbacks determine heterogenous fireline dynamics and thus fire spread, the effects of fires on ecology and the near-field lofting and transport of the smoke and fire brands (lofted burning material, which can be transported downwind and start new fires). The fluid motions surrounding a fire influence the effectiveness and consequences of fuels management activities. For example, forest thinning not only removes combustible fuel, but also changes the vegetation drag and thus the ventilation of the fire, which can potentially increase fire spread. The importance of the coupled fire/atmosphere fluid motion surrounding fire is especially important in the context of prescribed fires. Safe use of prescribed fires to reduce fire risk while accomplishing ecologic objectives typically depends on fire practitioner's ability to anticipate the interaction of multiple fires. This interaction is tied to the interaction between the fires through their fire-induced indrafts. Recent advancements in computing power have created new opportunity for the complimentary use of numerical models to provide additional perspectives concerning fire/atmosphere feedbacks that have previously been challenging to explore. A better understanding of the way fluid motions of the local atmosphere influence fire will improve our ability to anticipate fire behaviour and develop effective fire and fuels management strategies.