Atmospheric Conditions Aloft and Their Potential Impact on Fire Weather and Fire Behavior Prediction

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Abstract

Windy, dry weather conditions at the ground are well-known contributors to extreme fire behavior. From a meteorological perspective, the driest and windiest conditions in the lower atmosphere tend to occur not at the ground, but above the surface-based mixed layer. While dry air aloft is routinely used as an ingredient in weather forecasting, few fire weather indices and the operational forecasts that employ these indices address conditions aloft.

There have been a number of recent publications and conference presentations that highlight the importance of atmospheric conditions aloft for fire weather and fire behavior prediction. Analyses of the Haines Index and the role of released moisture from a fire in plume dynamics have illuminated the role of vertical fire-atmosphere interactions. Case studies that explore the generation of dry air aloft and the mechanisms by which that dry air can be mixed to the ground indicate the manner in which vertical fire dynamics and dry, windy air aloft can interact to alter fire weather and fire behavior characteristics. There is even evidence that upper atmospheric dry air with stratospheric origins might be a contributor to many of the anecdotal examples of "instability driven fire-atmosphere interactions."

Atmospheric conditions aloft are becoming recognized as increasingly important factors in producing more accurate fire weather and fire behaviour predictions, particularly for periods of extreme and erratic fire behavior. The atmospheric structures that contribute to these conditions are, in many cases, predictable hours or even days in advance of the event. The task is to develop and implement indices and diagnostics into the operational fire weather and fire behavior forecasting that sense these conditions and communicate to the forecasters and the operational users of fire weather prediction when and where the potential exists for extreme fire behavior.

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