4.5 Wildfire pyroconvection and CAPE: buoyancy's drying and atmospheric intensification.

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Accurate prediction of wildfire behavior and spread is only possible when the fire and atmosphere simulations are coupled. This includes fire related fluxes at the surface and its plume. We use WRF-FIRE to capture fire line propagation as the result of interactions between heat and moisture fluxes, pressure perturbations, wind sheer development and dry air downdraft. The wind patterns and dynamics examined in the simulation of the first 24 hours of Fort Mc Murray wildfire (Horse River ignited on late afternoon of May 1st, 2016). The simulation of first day of wildfire has not taken the suppression activities into consideration. By the late morning of May 2nd, the combination of unstable environment due to daily heating, advection moistening, and wildfire pyroconvection caused the strong updraft that reached above troposphere in less than 12 hours from ignitions. The updrafts slowed down above the freezing level and the ascending speed reached as high as 12 m/s in the simulation. The entrainment mixed the mid and upper level dry air and lowered atmosphere moisture. The mid-level and upper-level dew point temperature change between 5-10° C in two hours on the morning of May 2nd, probably the result of the strong mixing caused by fire buoyancy forces. The buoyant air strengthened the ascent as soon as the strong nighttime inversion was eliminated by daytime heating. The strong updraft from wildfire fluxes coupled with unstable atmosphere on the early afternoon (May 2nd) was a result of south west low level moisture advection. The combination of day-time elimination of capping inversion, wildfire pyroconvection (increasing heat and moisture at surface) and advection moistening increased the Convective Available Potential Energy (CAPE). And it was the onset of a Convective Mesoscale System (CMS). The 887J/kg total increases of CAPE in less than 6 hours and the high Bulk Richardson Number of 93 (BRN) was an indicator of the growing Pyrocumulus cell. The simulation is fast enough to be consider for a real-time operational model.