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Long term consequences of a prescribed burn and slash mastication to soil moisture and CO_2

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Thinning of forest stands is frequently used to reduce the risk of catastrophic fire. But thinning requires that the refuse (or slash) be removed from the site, which can be done either by burning it or by mastication and dispersal. Either method has long term consequences to the soil and to soil moisture and soil CO_2 levels. This study presents 2+ years (2004-2006) of continuous soil moisture and CO_2 measurements at two experimental slash treatment sites within Manitou Experimental Forest in the Rocky Mountains of southern Colorado: (i) a prescribed burn site and (ii) a site at which the slash was masticated and dispersed. Each experimental site has a separate control plot (with no treatment). The instrumentation was installed before each treatment (either burning or mastication). In the case of the prescribed burn the soil moisture sensors had to (and did) survive temperatures exceeding 200 C. The results suggest that:

(1) The burn area tends to have higher soil moisture and lower concentrations of CO_2 than the control site. This result is consistent with the loss of plant cover, roots, and microbial biomass at the burn site, which would reduce transpiration and root and microbial respiration. This difference between treatments reaches its maximum during the late summer of 2005, approximately a year and a half after the burn, when the volumetric soil moisture at the control site is only about half of that at the burn site. As a consequence of this depletion of soil moisture at the control site, the normal gradient of CO_2 (for which CO_2increases with depth) is virtually eliminated yielding similar and relatively low concentrations at 0.05 and 0.15 m. But the burn site appears to have sufficient moisture at the lower depth for microbial respiration to continue at

levels sufficient to maintain the soil CO_2 gradient and relatively greater amounts of CO_2.

(2) Relative to the control area, the areas covered by the masticated wood chips tend to have higher soil moisture at 0.15 m depth and relatively less soil moisture at 0.05 m, and considerably higher CO_2 concentrations at both depths. This is consistent with the expectation that a layer of wood chips act as a barrier to precipitation (reducing the soil moisture at the upper level) and to the diffusional loss of water vapor (at the lower level) and the loss of CO_2 (at all levels). In addition, the chips can apparently have unusual effects on the production of soil CO_2. During mid through late March 2005 the amount of CO_2 at 0.05 m soil depth at the chip-covered areas increased from a relatively constant 2500 ppm to about 10,000 ppm. The amounts of CO_2 increased at lower depths as well, but by lesser amounts. However, the increase at 0.05 m was enough to reverse the usual soil CO_2gradient. Although the control area had higher soil moisture at this time than the chip site, it showed no significant change in the amount of CO_2 or the CO_2 gradient.