Compound effects of soil moisture extremes, forest fires, and aspects on soil respiration from Post-fire and Undisturbed Pinus nigra Forests

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Abstract

Hydrological extremes and wildfires are increasing in magnitude and frequency due to climate change impacts; hence, it is essential to understand the compound effects of these disturbances on the different components of the global carbon cycle, particularly soil respiration (Rs). We conducted an experiment in a randomized complete block design with four replicate blocks to determine the compound effects of soil moisture extremes, types of forest fires, and aspects on Rs in postfire and undisturbed black pine (Pinus nigra Arnold) forest ecosystem. We measured Rs using an automated soil respiration machinery (LI-8100A, LiCor BioSciences), which also measures soil temperature, air temperature, and soil moisture simultaneously. The Rs exhibited significant differences among treatment combinations ($p < .0001$), time ($p < .0001$), and moisture regimes ($p < 0.0001$) but not with the interaction effects of treatment x time ($p = 0.0058$), aspects ($p = 0.95410$), and types of forest fires ($p = 0.0059$). The compound effects of soil moisture drought x crown fire x exposed aspect revealed a significantly lowest Rs (1.21 µmol m-2 s-1) among treatment combinations. In contrast, the compound effects of water-saturated soil x types of forest x aspect showed no significant differences compared to the control. The Rs ranged from 1.21 to 1.81 µmol m-2 s-1 for the soil moisture drought x forest fires x aspects, 1.90 to 2.55 µmol m-2 s-1 for the water-saturated soil x forest fires x aspects, and 1.83 to 2.38 µmol m-2 s-1 for the control. The Rs exhibited a positive relationship with the soil temperature ($r = 0.59$) and the air temperature ($r = 0.63$) but negatively correlated with the soil moisture ($r = -0.33$). The soil and air temperatures showed a strongly positive correlation ($r = 0.87$), suggesting that a near-surface air temperature provides a good approximation of the soil temperature.

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