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# Response of soil carbon dynamics to storm and bark beetle disturbance in boreal Norway spruce stands

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Abiotic and biotic disturbances can have significant effects on forest soil carbon (C) processes and balance. For example, tree mortality caused by storms and bark beetle outbreaks affects forest litter quality and quantity, light, water and nutrient availability as well as vegetation composition, all of which then may lead to changes in soil C dynamics. Amounts and proportions of autotrophic soil respiration (root and rhizosphere $CO_2$ effluxes) and heterotrophic respiration (microbial $CO_2$ efflux) can be altered due to the tree mortality and changes in the decomposition process. Storm and bark beetle disturbances are predicted to become more common in the future, and thus their effects on forest soil C dynamics may become even a more considerable and complex issue. We studied the influence of a large-scale storm in 2010 followed by an outbreak of a tree-killing bark beetle (*Ips typographus* L.) on soil respiration and soil C and N fractions in two Norway spruce (*Picea abies* L.) dominated forests, Paajasensalo (PS) and Viitalampi (VL), in southeastern Finland. In summers of 2015 (6 plots) and 2016 (6 plots), 2 sets of 3 types of plots – living trees (LT), standing dead trees killed by *I. typographus* (ID), and storm-felled trees (SF) – were established in PS and VL. Soil respiration, temperature and moisture were measured in the plots during summer-autumn 2015 - 2017. Measurements at SF plots were divided into open vegetated ($SF_o$) and dead tree detritus ($SF_d$) covered surfaces. Soil humus layer samples were collected from each plot to determine total C and N, microbial biomass C and N, and labile ($K_2SO_4$ extracted) C and N. Disturbance by storm and bark beetles decreased soil respiration in PS, but had no clear effect in soil respiration in VL. Soil temperature predicted soil respiration well at each plot type and at both forests, but correlations with soil moisture were either not significant or inconsistent. Humus layer total C and N contents and C/N ratios did not differ between plot types, but microbial biomass C and N and labile C contents were lower at the disturbed plots compared to those with living trees. Our results showed soil C dynamics responded similarly to storm and bark beetle disturbance and the response was detectable 5-7 years after such events.