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Forest disturbances and soil organic carbon dynamics in the Austrian Alps

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Disturbances are important drivers of the forest carbon (C) cycle. Our knowledge on how changing windthrow disturbance regimes will affect forest C cycling is, however, far from complete. Here, we investigated the impact of windthrow on soil respiration (Rs) at mountainous forest sites in the Austrian Alps. Additionally, the effects of tree regeneration on Rs and decomposition were explored by artificial gap disturbance. Rs did not respond to windthrow in the initial years after disturbance, but increased above pre-disturbance levels roughly a decade after windthrow. A temperature related increase in microbial respiration (Rm) offset a decrease in autotrophic soil respiration (Ra) after windthrow when vegetation re-establishment was scarce. A later increase in Rs was related to the establishment of a dense grass layer and a consequent increase in Ra. A C loss from increased rates in Rm was assumed to be the main driver of an observed decline in the soil organic C stocks during the post-windthrow period. Advance tree regeneration could be shown to slow decomposition and mitigate soil C losses mainly via a modulation of the soil microclimate. An increasing frequency and severity of windthrow events in mountainous forest ecosystems could positively feedback on atmospheric CO_2 concentrations. However, a pro-active forest management, which facilitates tree regeneration, could reduce post disturbance soil C losses.