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Soil moisture sensitivity of autotrophic and heterotrophic forest floor respiration in boreal xeric pine and mesic spruce forests

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Litter decomposition rates of the most process based soil carbon models affected by environmental conditions are linked with soil heterotrophic CO_2 emissions and serve for estimating soil carbon sequestration; thus due to the mass balance equation the variation in measured litter inputs and measured heterotrophic soil CO_2 effluxes should indicate soil carbon stock changes, needed by soil carbon management for mitigation of anthropogenic CO_2 emissions, if sensitivity functions of the applied model suit to the environmental conditions e.g. soil temperature and moisture.
We evaluated the response forms of autotrophic and heterotrophic forest floor respiration to soil temperature and moisture in four boreal forest sites of the International Cooperative Programme on Assessment and Monitoring of Air Pollution Effects on Forests (ICP Forests) by a soil trenching experiment during year 2015 in southern Finland. As expected both autotrophic and heterotrophic forest floor respiration components were primarily controlled by soil temperature and exponential regression models generally explained more than 90% of the variance. Soil moisture regression models on average explained less than 10% of the variance and the response forms varied between Gaussian for the autotrophic forest floor respiration component and linear for the heterotrophic forest floor respiration component.
Although the percentage of explained variance of soil heterotrophic respiration by the soil moisture was small, the observed reduction of CO_2 emissions with higher moisture levels suggested that soil moisture response of soil carbon models not accounting for the reduction due to excessive moisture should be re-evaluated in order to estimate right levels of soil carbon stock changes. Our further study will include evaluation of process based soil carbon models by the annual heterotrophic respiration and soil carbon stocks.