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Effects of different tree species on soil organic matter composition, decomposition rates and temperature sensitivities in boreal forest

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High-latitude ecosystems store a large proportion of the global soil organic matter (SOM) and its mineralization constitutes a major carbon flux to the atmosphere. It has been suggested that different tree species can significantly influence organo-chemical composition of SOM, and rate and temperature sensitivity of SOM decomposition.
In this study we used surface soil samples (top 5 cm) from a field experiment where five different tree species (Pinus silvestrys L, Picea abies (L.) H. Karst., Larix decidua Mill., Betula pendula Roth, and Pinus contorta Douglas) were planted on a grass meadow in a randomized block design (n=3) ca. 40 years ago. The samples were incubated at 4, 9, 14, and 19 °C at a soil water potential of -25 kPa (previously determined as optimal water content for decomposition). CO_2 production rates were measured hourly for 13 days.
CO_2 production rates were consequently lowest in the control plots and increased in the order Meadow< Contorta < Betula < Larix < Pinus < Picea. The values ranged between 0.03-0.1, 0.06-0.154, 0.1-0.24 and 0.13-0.36 mg CO_2 g-1 OM (dw) h-1 at 4, 9, 14 and 19°C respectively. The temperature response of CO_2 production corresponded to Q10s of 2.22 (±0.11), 2.22(±0.15), 2.66 (±0.18), 2.09 (±0.33), 2.38 (±0.31) and 2.31 (±0.09) for meadow, contorta, betula, larix, pinus and picea respectively. Only betula resulted in significantly higher Q10s as compared to the control plots, picea, contorta and larix treatments. These differences in tree species effects on SOM decomposition and its temperature sensitivity will be further discussed in relation to the organo-chemical composition of SOM as determined by pyrolysis gas chromatography-mass spectrometry (Py-GC-MS) and nuclear magnetic resonance spectroscopy (NMR) techniques.
We conclude that the temperature response of SOM decomposition rates is likely coupled to tree species composition and may have important implications for soil C dynamics. This finding can have important implications for both the understanding of forest ecosystem carbon balances in high latitude ecosystems and also the selection of different tree species in forest management schemes.