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An analytical approach to the separation of root respiration in forest soils

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A rough estimation of root respiration can be obtained analytically from soil-surface CO_2 efflux from a regression between total surface soil respiration and root density. In the present study, a development of this indirect methodology is presented by taking into consideration both the temporal variation and the spatial heterogeneity of heterotrophic respiration. For this purpose, soil CO_2 efflux, soil carbon content and main stand characteristics were estimated in seven evergreen forest ecosystems along an elevation gradient ranging from 250 to 1740 m. For each site and for each sampling date the measured soil CO_2 efflux (R_S) was predicted with the model $R_S = a \times S_C + b \times R_D \pm \varepsilon$, where S_C is soil carbon content per unit area to a depth of 30 cm and R_D is the root density of the 2-5 mm root class. Regressions with statistically significant a and b coefficients allowed the indirect separation of the two components of soil CO_2 efflux. Considering that the different sampling dates were characterized by different soil temperature, it was possible to investigate the temporal and thermal dependency of autotrophic and heterotrophic respiration. It was estimated that annual autotrophic respiration accounts for 16 to 58% of total soil CO_2 efflux in the seven different evergreen ecosystems.