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δ^{13}C-variations of leaves in forests as an indication of reassimilated CO_2 from the soil

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Summary

An attempt has been made to evaluate the contribution of soil respired CO_2 to the total assimilation of a forest tree, by heeding the ^{13}C-concentrations of CO_2 from the free atmosphere and from mineralization processes within the soil respectively. An expression has been derived, according to which the assimilated fraction of CO_2 from the soil at a particular height of a tree is given by the $\delta^{13}C$-value of the corresponding leaves, $\delta^{13}C$ of atmospheric CO_2, $\delta^{13}C$ of soil respired CO_2 and the physiological state of the leaves expressed as the ratio of total respiration over gross photosynthesis and internal over external CO_2-concentration. In the particular case investigated, a $\delta^{13}C$-difference of 5‰ has been determined from bottom to top of a beech tree which results in a CO_2 contribution from the soil of about 22% for the lower forest strata, while the total contribution of soil respired CO_2 accounts for about 5% of the overall assimilation.