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Combining a root exclusion technique with continuous measurements of CO_2 by chambers and inside soil for a pin-point separation of ecosystem respiration in croplands

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To better assess ecosystem C budgets of croplands and understand their potential response to climate and management changes, detailed information on the mechanisms and environmental controls driving the individual C flux components are needed. This accounts in particular for the ecosystem respiration (R_{eco}) and its components, the autotrophic (R_a) and heterotrophic respiration (R_h) which vary tremendously in time and space. Therefore, we developed and tested a method to separate R_{eco} into R_a (as the sum of $R_{a(shoot)}$ and $R_{a(root)}$) and R_h in order to detect temporal and small-scale spatial dynamics within their relative contribution to overall R_{eco}. Investigations were carried out for winter wheat (*Triticum aestivum*) during the crop season 2015 at an experimental plot (CarboZALF-D) located in the hummocky ground moraine landscape of NE Germany.

R_{eco} was derived from CO_2 flux measurements from plant stand and soil during nighttime using automatic chambers. R_h was derived from CO_2 efflux measurements from fallow next to the automatic chambers using CO_2 sampling tubes in 10 cm soil depth. $R_{a(root)}$ was calculated as the difference between CO_2 efflux measurements in planted soil and R_h. $R_{a(shoot)}$ was calculated as R_{eco} - $R_{a(root)}$ - $R_{h.}$ R_{eco} varied seasonally from <1 to 9.5 g C m^{-2} d^{-1}, and was higher in adult (a) and reproductive (r) than juvenile (j) stands (g C m^{-2} d^{-1}: j 1.2, a 4.6, r 5.3). Observed R_a and R_h were in general smaller compared to the independently measured R_{eco}, contributing in average 56 % and 44 % to R_{eco}. However, both varied strongly regarding their environmental drivers and particular contribution throughout the study period, following the seasonal development of soil temperature and moisture (R_h) as well as crop development (R_a). Thus, our results consistently revealed temporal dynamics regarding the relative contribution of $R_{a(root)}$ and $R_{a(shoot)}$ to R_a, as well as of R_a and R_h to R_{eco}. Based on the observed results, implications for partitioning of R_{eco} in croplands are given, which requires a spatial and temporal pin-point approach to increase reliability.