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Small scale CO₂ fluxes in a rainfed maize field under N fertilization

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Carbon-dioxide (CO₂) fluxes in the soil-plant-atmosphere system contain bidirectional material transport with organic and inorganic sources and sinks, and various pathways. Proportion of irrigated fields in the total area of Hungarian arable lands is low, and in case of a rainfed field water and CO₂ fluxes are only driven by meteorological factors. In this study we focused on maize under different fertilization treatments to see the plot scale variability of CO₂ fluxes and connected parameters.

The site is a multifactorial sowing time-fertilizer-maize variety field experiment near Martonvásár. Two treatment plots were selected for the measurements with contrasting 60 kg N ha⁻¹ and 180 kg N ha⁻¹ fertilizer treatments and no other factors were considered in the present study. We performed synchronized observations of (i) CO₂ fluxes: soil respiration (Rs; EGM-5 gas analyser + SRC-1 chamber, PPSystems); leaf scale photosynthesis (A; CIRAS-3 portable photosynthesis system, PPSystems)), (ii) soil temperature and soil water content, (iii) plant parameters: root growth (CI-600, CID-Bioscience), plant height, leaf area index (Accupar LP-80 ceptometer, Li-Cor). Data on the above parameters comprise several spatial replicates to explore spatial heterogeneity in case of a maize field managed in accordance with the typical Hungarian practice. The average applied N amount in the country is around 100-105 kg ha⁻¹.

Field measurements for CO₂ fluxes and biotic and abiotic drivers were performed six times in the vegetation period to establish relationship among them. Data were analyzed to optimize the labour intensive protocol for this experimental setup. Photosynthesis varied within the vertical canopy as reflected by measurements on five leaves per plant. Soil respiration was more dependent temporally on soil water availability than on temperature.