Geophysical Research Abstracts
Vol. 16, EGU2014-13838, 2014
EGU General Assembly 2014

Transpiration affects soil CO_2 production in a dry grassland

János Balogh (1,2), Szilvia Fóti (3,4), Krisztina Pintér (1), Susanne Burri (2), Werner Eugster (2), Marianna Papp (4), Zoltán Nagy (1,3)

(1) Institute of Botany and Ecophysiology, Szent István University, 2100 Gödöllő, Hungary (balogh.janos@mkk.szie.hu), (2) Grassland Sciences Group, Institute of Agricultural Sciences, ETH Zurich, 8092 Zurich, Switzerland, (3) MTA-SZIE Plant Ecology Research Group, 2100 Gödöllő, Hungary, (4) Institute of Ecology and Botany, MTA Centre for Ecological Research, 2163 Vácrátót, Hungary

Although soil CO_2 efflux can be highly variable on the diel time scale, it is often measured during daytime only. However, to get a full understanding of soil CO_2 efflux and its impact on carbon cycle processes, looking at diurnal processes is crucial. Therefore, our aim was to investigate how diel variation in soil CO_2 efflux from a dry, sandy grassland in Hungary depends on variations in potential drivers, such as gross primary production (GPP) and evapotranspiration (ET). In order to reach this goal, we combined measurements of CO_2 and H_2O fluxes by eddy covariance, soil chambers and soil CO_2 gradient system. Surface CO_2 fluxes were partitioned into the three CO_2 production components originating from the three soil layers to clarify the timing and the source of the CO_2 within the top 50 cm of the soil.

CO_2 production rates during the growing season were higher during nighttime than during daytime. This diel course was not only driven by soil temperature and soil moisture, but also by ET. This was shown by changes of ET causing a hysteresis loop in the diel response of CO_2 production to soil temperature. CO_2 production was coupled to soil temperature at night and during midday (12–14 h), when ET remained relatively constant. However, when ET was changing over time, CO_2 production was decoupled from soil temperature. In order to disentangle these effects, we carried out time-lag analyses between CO_2 production and efflux residuals after having subtracted the main effects of soil temperature and soil water content from measured CO_2 fluxes. The results showed a strong negative correlation between ET rates and residuals of soil CO_2 production, and a less strong, but still significantly time-lagged positive correlation between GPP and residuals of soil CO_2 production. Thus, we could show that there is a rapid negative response of soil CO_2 production rates to transpiration (suggesting CO_2 transport in the xylem stream) and a delayed positive response to GPP, indicating the importance of newly synthesized non-structural carbohydrates for soil respiration.

We conclude that the instant effect of soil temperature and transpiration in combination with the time-lagged effect of GPP governed the diel changes in soil CO_2 production at our site. If measurements are carried out at night or during daytime only, then this can lead to considerable misinterpretations of CO_2 production rates. Hence we recommend that estimates of respiration rates at a specific site should include both nocturnal and daytime processes.