Geophysical Research Abstracts
Vol. 17, EGU2015-12137, 2015
EGU General Assembly 2015
© Author(s) 2015. CC Attribution 3.0 License.

Temperature versus plant effects on diel dynamics of soil CO_2 production and efflux: a controlled environment study

David Reinthaler (1), Jacques Roy (2), Damien Landais (2), Clement Piel (2), Victor Resco de Dios (3), and Michael Bahn (1)

(1) Institute od ecology, Universiy Innsbruck, Austria (david.reinthaler@student.uibk.ac.at), (2) CNRS, Ecotron, Montferrier sur Lez, France, (3) Department of crop and forest sciences - AGROTECNIO Center, Universitad de Lleida, Spain

Soil respiration (Rs) is the biggest source of CO_2 emitted from terrestrial ecosystems to the atmosphere. Therefore the understanding of its drivers is of major importance for models of carbon cycling. Next to temperature as a major abiotic factor, photosynthesis has been suggested as an important driver influencing diel patterns in Rs. Under natural conditions it is difficult to disentangle abiotic and biotic effects on soil CO_2 production, as fluctuating light intensity affects both photosynthetic activity and soil temperature. To analyse individual and combined effects of soil temperature and light on the dynamics of soil CO_2 production and efflux, we performed a controlled environment study at the ECOTRON facility in Montpellier. The study manipulated temperature and photosynthetically active radiation independently and was carried out in large macrocosms, hosting canopies of either a woody (cotton) or a herbaceous (bean) crop. In each macrocosm membrane tubes had been installed across the soil profile for continuous measurement of soil CO_2 concentrations. In addition, an automated soil respiration system was installed in each macrocosm, whose data were also used for validating a model of soil CO_2 production and transport based on the concentration profiles.

Both for cotton and for bean canopies, under conditions of naturally fluctuating temperature and light conditions, soil CO_2 production and efflux followed a clear diel pattern. Under constantly dark conditions (excluding immediate effects of photosynthesis) and constant temperature, no significant diel changes in Rs could be observed. Furthermore, soil CO_2 production and efflux did not increase significantly upon exposure of previously darkened macrocosms to light. Under constant temperature and fluctuating light conditions, we observed a dampened diel pattern of Rs, which did not match diurnal solar cycles. A detailed residual analysis accounting for temporal trends in soil moisture suggested a significant effect of photosynthetically active radiation on Rs in 15 out of 35 cases, but no such effect in 20 cases. Thus, our study suggests that while effects of photosynthetic plant activity on diel patterns of soil CO_2 production and efflux may occur, they are not consistent and play a comparatively minor role relative to those of soil temperature.