Geophysical Research Abstracts
Vol. 14, EGU2012-3568-1, 2012
EGU General Assembly 2012

Quantification of soil, root and litter respiration using natural variation in 13-C composition of CO_2 fluxes and modelling

S. Blagodatsky, F. Albanito, D. Robinson, and P. Smith
University of Aberdeen, School of Biological Sciences, Aberdeen, United Kingdom (sblag@mail.ru)

Heterotrophic and autotrophic components of soil respiration react differently to projected changes in environmental conditions. In addition, individual heterotrophic components, such as litter and soil organic matter in underlying mineral soil layers might contribute differently to the respiration flux.Therefore, partitioning of surface soil CO_2 flux in multiple source components is necessary for the understanding of underlying mechanisms, and precise modelling of the carbon turnover in soil. Isotopic methods based on natural variation in carbon isotope composition (δ^{13}C) of soil respiration have frequently been applied for partitioning of soil respiration. However, the partitioning of three CO_2 fluxes based on differences in the abundance of one isotope (^{13}C) in source members is not possible with a simple balance approach (two end-member model). Recently, Albanito et al. (2012) reported a three end-member mixing model for the estimation of root, soil and litter contributions to the total CO_2 flux from forest soil. This approach combines results of two different methods: CO_2 flux component integration and C budget calculation based on the isotopic composition of components and the resulting flux. The estimation of component fluxes by two methods helps to overcome the uncertainties linked with either method: i.e. to account for the increase in respiration rate caused by disturbances due to physical separation of components. Full consideration of possible influences and corresponding calculations can be better completed with a help of modeling.

Here, we report the application of simple data-driven model describing the decomposition rate of the three components in order to quantify the disturbance effect in the component integration CO_2 flux method, and to improve the partitioning of soil, litter and root respiration. The total surface CO_2 flux and C isotope composition was measured using a dual-chamber and cavity ring-down spectrometer (Albanito et al., 2012) for the sandy calcareous regosol under a pine forest. Respiration rates and ^{13}C signatures of the components were estimated under field conditions similar to those for total flux measured by the chamber method. The model gives estimates of the final CO_2 flux from soil and its isotopic composition using the input data for separated components: i.e. respiration rates of litter, soil and roots. Mismatch between model prediction and field chamber measurements can be taken into account by optimization of the "disturbance factor" values, the combination of which is unique for each case. Finally, the corrected contribution of each flux component can be obtained and linked with environmental and soil conditions. The most susceptible to the disturbance component was SOM in mineral horizons, while the root respiration was less sensitive. Litter contribution to the total flux was the largest for the site under study. The results confirm the perspectives of the proposed model approach in combination with the new method of Albanito et al. (2012) for the quantification of ecosystem respiration response under the changing climatic conditions.

Reference:

Albanito F., McAllister J.L., Cescatti A., Smith P., and Robinson D. 2012. Dual-chamber measurements of δ^{13}C of soil-respired CO_2 partitioned using a field-based three end-member model. Soil Biology and Biochemistry. In press