Geophysical Research Abstracts
Vol. 16, EGU2014-13456, 2014
EGU General Assembly 2014

The synergetic effect of moisture protection, substrate quality and biotic acclimation on soil organic carbon persistence along a cultivated loamy hillslope

François Wiaux (1), Marnik Vanclooster (1), Jean-Thomas Cornelis (1), and Kristof Van Oost (2)

(1) Université Catholique de Louvain, Earth and Life, Environmental sciences, Louvain-la-Neuve, Belgium (francois.wiaux@uclouvain.be), (2) George Lemaître Centre for Earth and Climate Research, Earth & Life Institute, Université catholique de Louvain, Place Louis Pasteur 3, 1348 Louvain-la-Neuve, Belgium

The combination of hydrologic, geomorphic and biogeochemical approaches is required to determine organic carbon (OC) persistence and dynamics within landscapes. Here, we used soil in-situ surface heterotrophic respiration measurement as an indicator of OC persistence along a hillslope (crop field on the loess belt under temperate climate), characterized by an important erosion-induced OC stock colluvium downslope. Along this topographical gradient, we quantified the space-time structure of soil water and temperature, and soil OC amount and quality (from a chemical point of view based on NaOCl oxidation) in relation to CO_2 fluxes. We used a Generalized Least Square (GLS) regression model to identify the role of each abiotic factor as well as their interactions on observed soil respiration rates, and to calculate time-average values of these CO_2 fluxes at each studied slope positions.

We observed significant differences between the observed respiration rates along the topographical gradient (up to 30% more CO_2 emissions downslope and 50% backslope, relative to un-eroded summit position). Despite mean CO_2 fluxes (standardized at 15°C) at the bottom of the slope are significantly higher ($p<0.05$) than at the top of the hillslope, this difference is lower than expected given the high OC stock found downslope (c.2 times higher than at the summit position). In the cultivated loamy hillslope, the soil OC persistence is mainly controlled by the stabilizing effect of the high moisture content, implying large amount of OC. This provides evidence that soil OC dynamic (sink or source) can be mainly governed by site-specific abiotic conditions (e.g. soil moisture). On the other hand, OC found downslope was showed to be especially vulnerable for OC mineralization (it would emit 26% to c.40% more CO_2 in case of temperature increase), due to both (i) improved efficiency of soil-micro-organisms in stabilizing conditions, and (ii) high quality of OC stock (easy to decompose for soil micro-organisms). This leads to consider erosion-induced OC stocks in downslope colluviums as "delayed bombs", which may be reconnected to the atmosphere if the current stabilizing conditions of this specific pedo-climatic ecosystem would be changed.