



Space-time dynamics of soil respiration link to the C pool distribution at the hillslope scale

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A crucial issue in soil C dynamics modelling is to develop models suitable for regional scale, but based on local and short-time scale observations. Recent research has illustrated the strong linkage between SOC dynamics and landscape processes. There is increasing evidence that lateral fluxes of SOC, sediment and water will further enhance the variability of SOC dynamics, especially on agricultural land. Hence, in this study, we aim to improve our understanding of soil C dynamics by quantifying the soil respiration response of carbon pools at different positions along a slope catena, characterized by different soil moisture and temperature conditions and by different SOC stock and C pool distributions.

The study was performed on a hillslope in the Belgian loamy belt. Time series of soil moisture, temperature and surface CO₂ fluxes were monitored on a regular basis (at least once a week, during spring and autumn 2011) along the hillslope, at the soil surface. At the same positions, soil cores (1 to 1.5 m depth) were collected and analyzed for SOC, C distribution (using a chemical fractionation), mineral oxides (oxalate extractions), pH, and texture.

Our results show that substantial lateral transport of soil materials takes place along this hillslope, with a continuous burying of surface C and minerals at the bottom of the slope. This results in the development of a colluvial soil with an increasing SOC stock. This colluvial C stock mainly consists of labile C (66%), and this labile C stock in the colluvium is 3.5 higher than the labile C stock at the other slope positions. This stock is thus poorly stabilized and has a higher potential for mineralization. The other part of this C stock is stabilized by organo-mineral associations (19%) or is recalcitrant C (15%). Compared to the other slope positions, this colluvial stable C stock is significant, as it is 1.5 to 2 times higher.

The spatial gradient of the measured soil respiration is consistent with the previous C pool distribution observations along the hillslope, since there is a significant higher respiration at the bottom of the slope (colluvial area) than at the other slope positions. The measured temporal dynamics of the soil respiration is explained by moisture and temperature variations. This measured space-time dynamics, completed with further additional field measurement campaigns, will be the basis for calibrating and validating hillslope scale soil C turn-over models.