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Which decomposition rate for pyrogenic carbon in the soil? First results from a long term field study based on ^{13}C, ^{15}N tracing approach under actual and increased N deposition condition

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It is widely accepted that pyrogenic carbon (PyC) is playing an important role in the global carbon cycle as a C-sink. PyC has for many years been considered a very recalcitrant matter (Goldberg, 1980). Since the studies of the last decade has rejected the hypothesis of the negligibility of BC decomposition (Schmidt and Noak, 2000), turnover, fluxes and actors of degradation have become the new borders for the research on BC in the soil. Radiocarbon soil dating (Skjemstadt et al. 1996) and secondary fluxes of BC (Rumpel et al.2006) have been the most used techniques to investigate BC dynamics in the soil on a millennia time scale. At least two recent studies are confirming the loss of PyC in the soil during the first decades after the deposition: Hammes et al. (2009) using an archived Russian steppe soil (0-80 cm profile depth) found a BC loss of 25% over 100 years. Nguyen et al. (2008) comparing topsoil (0,1 m depth) samples coming from tropical agricultural soil underwent to the slash and burn practice at different time (max 100 years ago) found a depletion of BC corresponding to the 16% after 5 years and to the 30% after 30 years.

According to IPCC, 2007 N deposition will increase in thirty years by between 50 to 100% relative to year 2000. While no specific studies have been carried out on the effect of N addition on PyC decomposition, the effect on SOM decomposition is a very well studied topic. However a-side to the fertilizing effect of N on plants and the consequent positive effect on soil respiration no positive, neutral or negative effect have been proved on SOM decomposition itself , either on N saturated and N limited soils (Bowden et al. 2004, Titiema, 1996, Micks et al. 2004).

Up to date no field manipulation studies have been published on PyC carbon decomposition, and few study on PyC are carried out in temperate forests.

Our study is aimed to investigate the decomposition rate and the relative mobilization processes of PyC over ten years according to two scenarios: 1) actual N deposition 2)increasing N deposition. The experimental design of the Swiss Char Study Initiative (Swiss CSI) corresponds to a field manipulation experiment: the equivalent of 255 g m^{-2} of ^{13}C (842‰), ^{15}N (4,2 atom %) labelled PyC has been added to 18 mesocosms installed in the soil in a clearence of a mixed temperate mountain forest in Laegeren (Switzerland) to simulate the post-fire event ecological conditions. The flux and delta^{13}C of the CO_2 evolving from the mesocosm is being measured to quantify the decomposition rate of labelled BC over ten years. We then estimate the delta^{13}C-CO_2 in the soil through the "Keeling plot": a method to determine the carbon isotope composition of ecosystem respiration (Pataki et al. 2003). It consist in the linear regression of the d^{13}C-CO_2 built up in a chamber at different [CO_2] on the corresponding 1/[CO_2]. Suction plates have been installed below the mesocosms in order to collect the leaching DOM, d^{13}C is being measured to know the quantity of PyC leaching from the soil. In half of the mesocosm the equivalent of 60 Kg/ha/year of mineral N is being added to simulate the increased N deposition scenario. The very first results from the experiment are showing a shift in delta^{13}C-CO_2 evolving from the mesocosm confirming the hypothesis of BC

degradation also on a short-term time scale even if in small quantity (<1% of applied PyC in the first week after application).

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