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# Soil copper contamination effect on carbon mineralisation: evidence of a soil CO2 emission decrease from literature review

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Among all pollutants, copper (Cu) is of major environmental and toxicological concern with contamination from various origins. Moreover as a cation, Cu is easily complexed by the negatively charged soil organic matter (OM) inducing high concentrations in upper layers of soils where OM dominates. Due to its biotic and abiotic interactions with soil constituents Cu is expected to affect several soil processes among them the soil respiration, but studies provided contrasting results as soil respiration have been shown to decrease or increase with soil contamination depending on the studies.

In this study, we aimed at assessing how soil respiration is affected by Cu contamination in order to quantifying as a first approach the GHG emissions for a contaminated soil. We performed a quantitative review of literature focusing on soil heterotrophic respiration (thus excluding autotrophic respiration from plants) which aimed at 1) assessing the impact of a copper contamination on soil carbon (C) mineralisation and thus $CO_2$ emissions, and 2) hierarchizing the determinants of such an impact on C mineralisation compare to the influence of pedo-climatic soil parameters such as pH, clay percentage or the type of climate.

On the basis of a selection of roughly 390 literature data, global main results showed a decrease in soil $CO_2$ emission with an increase in soil Cu contamination. Data from ex situ spiking experiments could be easily differentiated from the ones originated from in situ natural contamination due to their sharper decrease in soil organic carbon mineralisation. Interestingly, ex situ spikes data on the short term provided a threshold: an increase in soil $CO_2$ emissions was noticed for data below total soil Cu content of 180 mg $kg^{-1}$ while a decrease was observed above this concentration. On the contrary, long-term in situ contamination due to anthropogenic activities (urbanisation, agriculture …) did not significantly impact soil carbon mineralisation except when we focused on the high inputs of industrial contamination (smelter, composted plant…). Soil pH was found as a variable of interest as acidic soils were more sensitive to Cu contamination for C mineralisation than neutral or alkaline soils, while the % of clay and the type of climate did not add explanation to the variation in C mineralisation. These results are discussed and the collected data allowed us to propose a general equation quantifying how soil respiration can be affected by a Cu contamination.