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Microbial carbon use efficiency – are current concepts and techniques adequate?

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Microbial carbon use efficiency (CUE) is microbial growth expressed as a proportion of the uptake of organic carbon. This simple definition is widely accepted, but ambiguous. Although there have been attempts to provide more comprehensive frameworks for microbial CUE, many important questions remain unresolved.

In our talk, we will look at microbial CUE from a conceptional perspective and discuss methodological challenges associated with it. Specifically, we will address the following points:
(1) How can growth be defined and how does this definition affect CUE estimates?
(2) Microbial carbon uptake is usually estimated as the sum of growth and respiration. What are we missing when we use this approximation and under which environmental conditions can this lead to an overestimation of CUE? Moreover, is it possible to directly quantify uptake for CUE estimation?
(3) We now know that microbes can take up organic molecules (e.g., lipids, amino acids and nucleotides) that are directly built into biomolecules and are not, or at least are not completely, metabolized (i.e. not channeled through glycolysis, the pentose phosphate pathway or the tricarboxylic acid cycle). Do we capture these pathways with the methods used to estimate CUE?
(4) Is CUE overestimated if organic carbon taken up by microbes is intermittently stored rather than allocated to growth?
(5) Inorganic carbon fixed by heterotrophic microorganisms can contribute substantially to microbial biomass build-up, but is not accounted for by current CUE estimates. Do we need to re-define CUE to include the uptake of such inorganic C?

Finally, we will argue that the growth and turnover of microbial communities, alongside CUE itself, are central to soil organic matter dynamics and the carbon storage potential of soils.