Geophysical Research Abstracts
Vol. 19, EGU2017-3817, 2017
EGU General Assembly 2017
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Microbial carbon pump and its significance for carbon sequestration in soils

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Abstract:
Studies of the decomposition, transformation and stabilization of soil organic carbon have dramatically increased in recent years due to growing interest in studying the global carbon cycle as it pertains to climate change. While it is readily accepted that the magnitude of the organic carbon reservoir in soils depends upon microbial involvement because soil carbon dynamics are ultimately the consequence of microbial growth and activity, it remains largely unknown how these microbe-mediated processes lead to soil carbon stabilization. Here, two pathways, ex vivo modification and in vivo turnover, were defined to jointly explain soil carbon dynamics driven by microbial catabolism and/or anabolism. Accordingly, a conceptual framework consisting of the raised concept of the soil "microbial carbon pump" (MCP) was demonstrated to describe how microbes act as an active player in soil carbon storage. The hypothesis is that the long-term microbial assimilation process may facilitate the formation of a set of organic compounds that are stabilized (whether via protection by physical interactions or a reduction in activation energy due to chemical composition), ultimately leading to the sequestration of microbial-derived carbon in soils. The need for increased efforts was proposed to seek to inspire new studies that utilize the soil MCP as a conceptual guideline for improving mechanistic understandings of the contributions of soil carbon dynamics to the responses of the terrestrial carbon cycle under global change.