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Linking grassland soil respiratory fluxes and assimilate supply: evidence and open questions

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There is increasing evidence that the supply of photosynthates or other forms of fresh organic carbon may alter processes underlying soil CO_2 efflux. However, no study has so far addressed this topic *in situ* in temperate grasslands. Diurnal temperature-independent patterns of soil CO_2 efflux and CO_2 concentrations indicate a possible link between assimilate supply and soil respiratory processes, but the interpretation is complicated a.o. by uncertainties in the definition of a reference depth for soil temperature, and by a vertically heterogeneous distribution of respiratory activities and their sensitivity to environmental changes. We combined soil CO_2 profiles, experiments manipulating the supply of fresh organic carbon, and ^{13}C pulse-chase labelling experiments to assess the importance of photosynthates for soil respiratory fluxes in a mountain grassland in the Austrian Central Alps. Our results indicate that 1) production, transport, and emission of CO_2 are closely coupled, CO_2 production being partly independent of temperature, 2) components of soil respiration are differentially affected by the supply of fresh organic C, microbial respiration exhibiting a more pronounced response than root respiration, 3) freshly assimilated C is rapidly transferred belowground and largely respired within few days. It is concluded that assimilate supply may play an important role in modulating grassland soil respiration and its component processes. Implications of these findings for modelling the production and emission of CO_2 from soils will be discussed.