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Greenhouse gas (CO₂, CH₄, N₂O) emissions from soil fauna – what have we learned over the past decade?

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Soils harbor a diverse fauna, ranging in size from <200 µm to several cm. These animals are direct producers of greenhouse gas (GHG) emissions via their respiratory and metabolic activities and can indirectly change soil carbon and nitrogen cycling by changing physical, chemical and biological soil properties, e.g. through bioturbation, defecation, herbivory, and litter fragmentation and redistribution. In addition, they can create microhabitats which offer more favorable conditions to microorganisms than bulk soil. Thus, soil fauna is able to substantially effect the spatial and temporal variability of GHG fluxes in ecosystems. However, emissions of carbon dioxide (CO₂), methane (CH₄) and nitrous oxide (N₂O) from and associated with soil fauna remain poorly quantified and have been limited to only a few regions and species. The literature review presented here gives an overview of GHG emission studies addressing soil fauna taken place since 2010. For each GHG (CO₂, CH₄ and N₂O) the keywords “emission* OR flux*” were combined with keywords querying different soil fauna groups. The initial search using the databases Web of Science Core Collection and Lens.org resulted in 282 and 531 journal articles, respectively, of which 165 studies were duplicates. This literature (*n* = 648) is being screened according to the following categories: i) location of study (geographical location, field, laboratory), ii) soil type, iii) ecosystem type, iv) species, v) GHG fluxes, and vi) methodologies (flux measurements, species monitoring). Based on this, the current state of knowledge, research gaps and methodological challenges will be identified to provide ideas and guidance for the design of future research projects trying to further our understanding of the quantitative role of soil fauna in the soil carbon and nitrogen cycle in natural and managed ecosystems.