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The influence of cockchafer larvae on net soil methane fluxes under different vegetation types – a mesocosm study

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The influence of land-use associated pest insects on net soil CH_4 fluxes has received little attention thus far, although e.g. soil-dwelling Scarabaeidae larvae are qualitatively known to emit CH_4. The project "CH4ScarabDetect" aims to provide the first quantitative estimate of the importance of soil-dwelling larvae of two important European agricultural and forest pest insect species – the common cockchafer (Melolontha melolontha) and the forest cockchafer (M. hippocastani) – for net soil CH_4 fluxes. Here we present a mesocosm study within "CH4ScarabDetect" which tests the influence of different abundances of common cockchafer larvae on net soil CH_4 fluxes under different vegetation types. In August 2016, 27 PVC boxes with a base area of 50 cm x 50 cm and a height of 40 cm were buried in planting beds previously used for cultivating vegetables. The bottom of each box was filled with a 10 cm thick layer of loam which was then covered with a 25 cm thick layer of loamy sand. The soil was hand-sieved prior to filling the boxes to remove any macrofauna. The mesocosms were planted with either turf, carrots or a combination of both. Of the resulting nine replicates per vegetation type, six were infested with one cockchafer larvae each in November 2016. In three of these infested mesocosms, the larvae abundance will be further increased to three in May 2017. This mesocosm study will continue until October 2017 during which measurements of net soil CH_4 fluxes will be conducted with the chamber flux method twice per month. For the in situ separation of gross CH_4 production and gross CH_4 oxidation, the chamber method will be combined with a $^{13}CH_4$ isotope pool dilution technique. Methane concentrations and their isotopic signatures in the collected gas samples will be analysed with a state-of-the-art CRDS analyzer (cavity ring-down spectroscopy, G2201-i) equipped with the Small Sample Isotope Module 2 - A0314 (Picarro Inc., USA). Different combinations of larvae abundance and depth distribution might yield the same net CH_4 flux rates. To account for this non-invasively, the chamber measurements are additionally combined with acoustic measurements of larvae activity in the soil. For this purpose, an acoustice sensor is installed in the middle of each mesocom. This is the first time that a $^{13}CH_4$ isotope pool dilution technique, the chamber method, and acoustic measurements are combined to study non-invasively the influence of soil-dwelling larve on net soil CH_4 fluxes in the field. This novel approach will not only further our understanding of the role of cockchafer larvae in the terrestrial CH_4 cycle and provide a new tool for soil CH_4 flux and soil insect studies, but promises to also improve our knowledge on cockchafer ecology as well as the monitoring of cockchafer infestations in agricultural and forest soils.

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