Geophysical Research Abstracts
Vol. 18, EGU2016-15333, 2016
EGU General Assembly 2016

Greenhouse gas emissions from on-site wastewater treatment systems

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Nearly one third of the Irish population relies on decentralized domestic wastewater treatment systems which involve the discharge of effluent into the soil via a percolation area (drain field). In such systems, wastewater from single households is initially treated on-site either by a septic tank and an additional packaged secondary treatment unit, in which the influent organic matter is converted into carbon dioxide (CO_2) and methane (CH_4) by microbial mediated processes. The effluent from the tanks is released into the soil for further treatment in the unsaturated zone where additional CO_2 and CH_4 are emitted to the atmosphere as well as nitrous oxide (N_2O) from the partial denitrification of nitrate. Hence, considering the large number of on-site systems in Ireland and internationally, these are potential significant sources of greenhouse gas (GHG) emissions, and yet have received almost no direct field measurement.

Here we present the first attempt to quantify and qualify the production and emissions of GHGs from a septic tank system serving a single house in the County Westmeath, Ireland. We have sampled the water for dissolved CO_2, CH_4 and N_2O and measured the gas flux from the water surface in the septic tank. We have also carried out long-term flux measurements of CO_2 from the drain field, using an automated soil gas flux system (LI-8100A, Li-Cor®) covering a whole year semi-continuously. This has enabled the CO_2 emissions from the unsaturated zone to be correlated against different meteorological parameters over an annual cycle. In addition, we have integrated an ultraportable GHG analyser (UGGA, Los Gatos Research Inc.) into the automated soil gas flux system to measure CH_4 flux. Further, manual sampling has also provided a better understanding of N_2O emissions from the septic tank system.