



## **Heterogeneity of gaseous emissions in soils-spatial vs temporal variability**

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Nitrous oxide (N<sub>2</sub>O) plays a dual role in the atmosphere as a greenhouse gas and via its influence on stratospheric ozone chemistry. The main source of N<sub>2</sub>O is agricultural soil, with an estimated 96 kt emitted from this source in the UK in 2012 (ca. 83% of the total UK N<sub>2</sub>O emissions). Microbial transformations such as nitrification, denitrification and chemodenitrification are responsible for these emissions. Soil texture and structure and land management practices (including presence of livestock) – soil wetness, aeration, temperature and mineral N content – influence the magnitude of the emissions. Heterogeneity in nutrient distribution and moisture, i.e. hot spots, create spatial variations in the main drivers of these transformations. Studies at laboratory scale are aimed to minimize the variability encountered in the field but although they provide important information on the controlling factors of the soil processes, they are not useful for real quantification. Daily and seasonal variation (temporal) in soil conditions (chemistry, physics and biology) and thus in emissions also occurs. This variability makes it a difficult challenge to quantify emissions and currently makes the soil source the largest contributor to the overall uncertainty of the UK greenhouse gas inventory. Here we present results of a statistical study on the variability of N<sub>2</sub>O emissions from measurements using the static chamber technique for a variety of N sources. Results from measurements using automated chambers are also presented. Part of the work was funded by the UK government to improve the quantification of this source by measuring emissions from sites with contrasting soil, climate and land management combinations. We also include results from measurements carried out with automated chambers on the UK National Capability Farm Platform in the South West of England. The results show that spatial variability largely contributes to the uncertainty of emissions but temporal variations also impact the observed fluxes. Reaching a compromise between sampling frequency and spatial coverage is the challenge we face in order to estimate accurate fluxes.