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Using ^{15}N isotope analysis to understand N_2O production and consumption processes.

***MASTA**, Mohit*; E-mail: mohit.masta@ut.ee, ORCID: 0000-0003-0656-3288
***ESPENBERG**, Mikk*; mikk.espenberg@ut.ee, ORCID: 0000-0003-0469-6394
***PÄRN**, Jaan*; jaan.parn@ut.ee, ORCID: 000-0001-6507-8894
***MANDER**, Ülo*; E-mail: ulo.mander@ut.ee, ORCID: 0000-0003-2340-6989

University of Tartu, Institute of Ecology and Earth Sciences, Tartu, Estonia

Nitrous oxide is a potent greenhouse gas which is involved in stratospheric ozone depletion. Even though nitrogen cycle has been studied for a long time, it is still challenging to understand specific N_2O production and consumption processes. This is due to the complexity and heterogeneity of soil, wherein multiple processes can take place simultaneously. Isotopic composition of N_2O can help us solve this and provide useful information on evaluating N_2O sources and calculate global budgets. N_2O is a linear molecule and its understanding at molecular scale can provide major insights into partition of its source processes. The N_2O site preference (SP), which is the difference in $\delta^{15}N$ between N_2O molecules substituted with ^{15}N at the central and the peripheral position, has proved to be a major tool to tackle this problem. The objective of this study is to use isotopic research for N_2O sources and process partitioning. We will bring some examples from our recent studies in the lab and in a drained peatland forest.

During our lab study based on peat soil from a floodplain fen, we observed bacterial denitrification was a major source of N_2O emissions under flooded conditions. We observed this using ^{15}N isotopic mapping technique, which helped separate multiple active processes. We applied a similar method in-situ on a drained peatland in southeastern Estonia and described hybrid N_2O formation, where one N atom of the N_2O molecule was taken from NH_4 and the other N molecule from another source such as organic N, was the dominant source of N_2O emissions. The isotopic mapping and molecular enrichment of ^{15}N during our experiment showed that. The isotopic mapping initially suggested nitrification as a major source, but on further investigation of ^{15}N enrichment, we found the presence of hybrid processes (^{15}N nitrogen from two pools or processes). Furthermore, we studied the genetic potential for major N_2O processes (denitrification, nitrification, dissimilatory nitrate reduction to ammonium (DNRA)) and combined these with the isotope results, and this integrated approach is an important tool to partition N_2O processes. When using ^{15}N tracers, the isotopic technique can partition the sources (nitrate or ammonia) of N_2O. Hence, using the isotopic mapping of natural abundances and ^{15}N tracers to partition the source, we can get initial insights into N_2O sources and processes together. Isotopic mapping is still under development and further research is required as it also has a problem of overlapping of processes.