Denitrification in Agricultural Soils: Integrated control and Modelling at various scales (DASIM)

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The new research unit DASIM brings together the expertise of 11 working groups to study the process of denitrification at unprecedented spatial and temporal resolution. Based on state-of-the art analytical techniques our aim is to develop improved denitrification models ranging from the microscale to the field/plot scale. Denitrification, the process of nitrate reduction allowing microbes to sustain respiration under anaerobic conditions, is the key process returning reactive nitrogen as N_2 to the atmosphere. Actively denitrifying communities in soil show distinct regulatory phenotypes (DRP) with characteristic controls on the single reaction steps and end-products. It is unresolved whether DRPs are anchored in the taxonomic composition of denitrifier communities and how environmental conditions shape them. Despite being intensively studied for more than 100 years, denitrification rates and emissions of its gaseous products can still not be satisfactorily predicted. While the impact of single environmental parameters is well understood, the complexity of the process itself with its intricate cellular regulation in response to highly variable factors in the soil matrix prevents robust prediction of gaseous emissions. Key parameters in soil are pO_2, organic matter content and quality, pH and the microbial community structure, which in turn are affected by the soil structure, chemistry and soil-plant interactions. In the DASIM research unit, we aim at the quantitative prediction of denitrification rates as a function of microscale soil structure, organic matter quality, DRPs and atmospheric boundary conditions via a combination of state-of-the-art experimental and analytical tools (X-ray μCT, ^{15}N tracing, NanoSIMS, microsensors, advanced flux detection, NMR spectroscopy, and molecular methods including next generation sequencing of functional gene transcripts). We actively seek collaboration with researchers working in the field of denitrification.