Christopher Jones

Chris.Jones@slu.se

Supervisors: Laurent Philippot (INRA), Sara Hallin (SLU)

Soil Functioning and Ecosystem services (WP2)

Denitrification is a facultative anaerobic respiratory pathway in which nitrate (NO^{3-}) or nitrite (NO^{2-}) is stepwise reduced to nitrous oxide (N_2O) or nitrogen gas (N_2) under oxygen-limited conditions, and is found amongst a diverse range of soil microoganisms. In agricultural soil ecosystems, denitrification is a significant cause of N-loss after fertilization and accounts for the majority of global annual emissions of N_2O, a potent greenhouse gas and stratospheric ozone depleting substance. The ratio of denitrification end products (N_2O/N_2) emitted from soils depends on a large number of environmental variables, including oxygen and carbon availability, pH, NO^{3-} concentration, and temperature. However, the abundance and community composition of soil microorganisms capable of reducing N_2O may also have a significant role in determining end product molar ratios. This adds a new level of complexity to sustainable soil management programs that seek to predict N_2O emissions solely through the monitoring of environmental factors.

The aim of this project is to determine the relative contribution of environmental factors and the diversity of N_2O reducing communities in determining denitrification end products in managed soil ecosystems. Potential denitrification activity and N_2O emissions were measured in combination with the abundance and diversity of N_2O reducing microorganisms, as determined by pyrosequencing of marker genes specific to N_2O reducers. Additionally, new molecular tools have been developed to detect previously unexplored lineages of N_2O reducing microorganisms, which may play a significant role in determining whether a given soil acts as a source or a sink of N_2O under changing environmental conditions. Network analysis and structural equation modeling will be used to compare the diversity of N_2O reducing communities with climate data as well as soil chemical and physical properties to identify key N_2O reducing lineages and environmental parameters that may be used to predict if a soil acts as a source or a sink for N_2O under varying conditions.