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Modelling the impact of atmospheric parameters on nitrous oxide emissions from soil

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The trace gas N2O is a very stable and thus potent greenhouse gas and is the main contributor for the recent depletion of ozone in the atmosphere. In order reduce N2O emissions, underlying processes have been investigated intensively. Important drivers for the formation of N2O in soils are known since decades, but how the atmospheric conditions affect N2O-fluxes is widely unknown. The aim of this study is to observe and discuss interactions between N2O-fluxes and relevant atmospheric parameters, i.e. the friction velocity, Obhukov-Length and canopy height.

To analyze this we implemented an Eddy Covariance Station in combination with a Quantum-Cascade-Dual-Laser produced by Aerodyne Research Inc. (Billerca, Mass., USA) at an intensively managed agricultural field site at the TERENO research farm Scheyern (Germany), which is part of the TERENO preAlps-observatory. The measurement device allows in-situ flux measurements without disturbance of the atmosphere. Continuous flux-measurements started on 2014-11-01. Preliminary measurement results support the importance to consider atmospheric parameters to explain the strength of N2O-fluxes. The measurements indicate a positive relationship between N2O-fluxes and friction velocity in agreement with a models proposed by Garland (1977) or Owen and Thompson (1966).

Based on these measurements we propose a new model following Garland (1977) to simulate N2O fluxes on the field scale. The new model will be implemented in the modular ecosystem software framework Expert-N 5.0, which is already able to simulate the formation and transport within the soil. However, until now, a simple empiric gradient between the atmospheric and soil N2O concentrations was used to compute the N2O fluxes in terrestrial ecosystems. The new resistance model accounts for the effects of atmospheric parameters (such as the friction velocity) on that gradient and is thus more physical.