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Open-N: An open source code for modeling nitrous oxide emission from upland and water-logged soils of a spruce forest ecosystem

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Besides water (H_2O), carbon dioxide (CO_2), and methane (CH_4), nitrous oxide (N_2O) is regarded as one of the most important greenhouse gases. Total global N_2O emission from temperate forest soils are estimated to be in the range of 0.1-2.0 Tg N yr^{-1}, thus contributing about 7% to the global atmospheric N_2O budget. However, particular at larger scale estimates of N_2O emission have still a high degree of uncertainty due to the huge temporal, spatial and inter-annual variability of N_2O fluxes. Since field measurement are time consuming and costly, a precise inventory of N_2O emission is hampered by a limited number of available field measurements. One potential way to overcome this shortcoming is the use of process-based models. However, although highest N_2O emission with up to 10 kg N ha^{-1} yr^{-1} were mainly reported for forest soils affected by stagnant water, the current available N_2O emission models are restricted to upland soils, except *Wetland-DNDC*. However, since *Wetland-DNDC* is not an open-source model, that is, the user has no access to the source code, the application is limited.

Against this background we developed the open-source model *open-N*. The new model simulates long-term carbon and nitrogen dynamics of organic and mineral spruce forest soils with special emphasis placed on the formation and emission of N_2O. State-of-the-art approaches and algorithms to describe the fundamental biogeochemical processes (e.g. mineralization, denitrification, nitrification) and the driving soil environ-

mental factors (e.g. soil moisture and temperature) were combined and numerically solved using the ordinary differential equation (ODE) solver *Berkeley Madonna* (Version 8.0.1).

The model will be calibrated by means of the Levenberg-Marquardt algorithm and validated against measured data (200-2004) from various water-logged (e.g. Histic Gleysol, Humic Gleysol) and upland (e.g. Endoskeletic Cambisol) soils of a spruce forest ecosystem in South-west Germany.

In our presentation we will focus on first simulation results indicating that *open-N* is a powerful tool for simulating N_2O emission from upland and water-logged forest soils.