FiBL

Master Thesis at the Research Institute of Organic Agriculture FiBL and ETH Zurich

Title	Soil nitrous oxide emission modelling – a model intercomparison
Description	Soil and biogeochemical models have been applied to assess nitrous oxide (N2O) emissions from agricultural soils and the effects of mitigation measures, as well as for the analysis of N cycling in agriculture in general. However, modelling soil N2O emissions is a complex and difficult task due to large variability and uncertainty. A general trade-off in such modelling approaches also exists between the level of complexity within the model and the availability and the costs to collect the accurate data needed for the model runs. At FiBL, a simplified model to estimate cumulative N2O emissions from soils has been developed. This model relies on readily available farm data only (e.g. synthetic fertilizer, compost and manure applications or production quantities) and is thus simpler than well-established process-based models, such as DNDC or DAYCENT, but includes more detailed parameters than the simplistic IPCC tier 1 approach. Considering changes in C and N pools in the soil, the model captures the emission patterns by the specific characteristics of organic fertilizers added, while still keeping data requirements at a reasonable level. The model developed at FiBL could for example be used in the context of C credits in response to reduced N applications and for generally improved assessments of farm-specific N-transformations and all related types of emission components (e.g. as part of LCA inventories). After having finalized the model coding, we plan to test the newly developed model with empirical emission data. Different measurement data on soil greenhouse gases from field trials will be used for model validation. Other well-established models, namely DNDC and/or DAYCENT, will be included with the very same data to see how they perform in comparison. The task of the master student would be to run the DAYCENT and/or the DNDC model and to discuss the model results in the wider context of calibration/validation tests and in comparison with the results from the new simplified model (which will be provided by FiBL). Of particular relevance will be the correlation of modelled and measured N2O emissions and the relative performance in modelling the data between the new simplified model and the DAYCENT and/or DNDC model.

Dr. Matthias Meier
Research Institute of Organic Agriculture FiBL | Ackerstrasse 113 | Postfach 219
5070 Frick | Switzerland | Phone +41 62 865 72 72 | info.suisse@fibl.org | www.fibl.org

Supervision	Main supervisors would be Dr. Matthias Meier at FiBL and Prof. Johan Six at ETH Zurich. The thesis would formally be affiliated at the chair of Prof. Johan Six. Interested students are kindly requested to contact Dr. Matthias Meier, matthias.meier@fibl.org. The work would mainly be conducted at FiBL, in Frick.
Start	As soon as possible
References	Abdalla, M., M. Jones, J. Yeluripati, P. Smith, J. Burke and M. Wiliams (2010). "Testing DayCent and DNDC model simulations of N2O fluxes and assessing the impacts of climate change on the gas flux and biomass production from a humid pasture." Atmospheric Environment 44: 2961-2970. Blagodatsky, S. and P. Smith (2012). "Soil physics meets soil biology: Towards better mechanistic prediction of greenhouse gas emissions from soil." Soil Biology & Biochemistry 47: 87-92. Chirinda, N., D. Kracher, M. Laegdsmand, J. R. Porter, J. E. Olesen, B. M. Petersen, J. Doltra, R. Kiese and K. Butterbach-Bahl (2011). "Simulating soil N2O emissions and heterotrophic CO2 respiration in arable systems using FASSET and MoBiLE-DNDC." Plant Soil. DNDC (2009). User's Guide for the DNDC Model (Version 9.3), Institute for the Study of Earth, Oceans and Space, University of New Hampshire. Giltrap, D. L., C. Li and S. Saggar (2010). "DNDC: A process-based model of greenhouse gas fluxes from agricultural soils." Agriculture, ecosystems & environment 136(3): 292-300. Parton, B., D. Ojima, S. Del Grosso and C. Keough (2001). CENTURY Tutorial, and the Daycent web page http://www.nrel.colostate.edu/projects/daycent/