Simulation of nitrous oxide effluxes, crop yields and soil physical properties using the LandscapeDNDC model in managed ecosystem

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Modeling of nitrous oxide emissions from soil is very complex. Many different biological and chemical processes take place in soils which determine the amount of emitted nitrous oxide. Additionaly, biogeochemical models contain many detailed factors which may determine fluxes and other simulated variables. We used the LandscapeDNDC model in order to simulate N2O emissions, crop yields and soil physical properties from mineral cultivated soils in Poland. Nitrous oxide emissions from soils were modeled for fields with winter wheat, winter rye, spring barley, triticale, potatoes and alfalfa crops. Simulations were carried out for the plots of the Brody arable experimental station of Poznan University of Life Science in western Poland and covered the period 2003 – 2012. The model accuracy and its efficiency was determined by comparing simulations result with measurements of nitrous oxide emissions (measured with static chambers) from about 40 field campaigns. N2O emissions are strongly dependent on temperature and soil water content, hence we compared also simulated soil temperature at 10cm depth and soil water content at the same depth with the daily measured values of these driving variables. We compared also simulated yield quantities for each individual experimental plots with yield quantities which were measured in the period 2003-2012.

We conclude that the LandscapeDNDC model is capable to simulate soil N2O emissions, crop yields and physical properties of soil with satisfactorily good accuracy and efficiency.