Geophysical Research Abstracts
Vol. 15, EGU2013-10787, 2013
EGU General Assembly 2013


# Modeling nitrous oxide emissions from tile-drained winter wheat fields in Central France

Jiangxin Gu (1), Denis Loustau (1), Catherine Hénault (2), Changsheng Li (3), Philippe Rochette (4), Pierre Cellier (5), Bernard Nicoullaud (2), Agnes Grossel (2), and Guy Richard (2)

(1) INRA, UR1263 EPHYSE, F-33140, 33883 Villenave d'Ornon, France (jiangxin.gu@bordeaux.inra.fr), (2) INRA, UR 0272 Science du sol, Centre de recherche d'Orléans, CS 40001 Ardon, 45075 Orléans cedex 2, France, (3) Institute for the Study of Earth, Oceans, and Space, University of New Hampshire, Durham, NH 03284, USA, (4) Agriculture and Agri-Food Canada, 2560 Hochelaga Blvd, Québec, QC, G1V 2J3, Canada, (5) INRA, UMR 1091 Environnement et Grandes Cultures, 78850 Thiverval-Grignon, France

The process-based DeNitrification-DeComposition (DNDC) model has been validated for nitrous oxide (N2O) emission and regulated variables in a broad range of agroecosystems but rarely under tile-drained condition. In this study, we tested DNDC (version 9.5) at seventeen sites cropped with winter wheat across a tile-drained landscape (around 30-km2) in Central France. To compare the ability of simulating N2O flux between models, we applied the outputs of DNDC such as soil temperature, water-filled pore space (WFPS) and inorganic nitrogen (NH4+ and $NO_3$-) content in topsoil (0-20 cm) to a simplified process model, Nitrous Oxide Emission (NOE), and a developed version of NOE by incorporating effects of soil WFPS and clay content on N2O reduction (NOEred). Sharing the same algorithm of nitrification and denitrification with NOE, NOEred accounts the N2O loss as a dynamic proportion to each process rather than fixed ratio as NOE does. With modification on soil field capacity and wilting point and crop growth parameters according to the field measurement, DNDC predicted the soil WFPS and crop yields with reasonable accuracy. As compared to the observation, the DNDC-predicted NH4+ and $NO_3$- content declined much slower during the post-fertilization period at all sites, indicating the underestimation of their consumption. As a result of the overestimation of NH4+, the NOE-predicted cumulative nitrification rate was averagely 4.9 (ranging from 3.9 to 6.6) times greater than the prediction of DNDC. Despite the overestimation of $NO_3$-, DNDC and NOE generated similar cumulative denitrification rate at most sites. All three models were capable of simulating the fertilizer-induced N2O emission peaks, in which NOEred captured 34% of the variations in daily N2O flux across space and time ($p<0.001$, $n=256$) with positive model efficiency (0.31) and moderate underestimation (5%). Only the prediction of NOEred yielded positive model efficiency (0.03) for cumulative N2O emissions, explaining 53% of the variations ($p<0.001$, $n=17$) with neutral bias (1%). Our validation indicates that the prediction of DNDC for nitrogen biogeochemistry (N2O flux and soil NH4+ and $NO_3$- content) was not optimal in the studied soils. We suggest dynamic proportions of N2O emitted through nitrification and denitrification replacing the fixed ratios in NOE in future simulation.