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Estimating agricultural N2O emissions in France: comparison of a spatialized agro-ecosytem model (CERES-EGC) and a terrestrial biosphere model (O-CN)

R. S. Massad (1), V. Prieur (2), E. Boukari (1), S. Lehuger (1), F. Chaumartin (1), M. Schultz (3), and B. Gabrielle (1)

(1) INRA, AgroParisTech, UMR1091 EGC, 78850 Thiverval Grignon, France, (2) CEA, CNRS, UVSQ, Laboratoire des Sciences du climat et de l'Environnement, Saclay, France, (3) Norwegian Meteorological Institute, Oslo, Norway

Nitrous oxide (N2O) is a major greenhouse gas and air pollutant. Considered over a 100 year period, it has 298 times more impact 'per unit weight' (Global warming potential) than carbon dioxide. The parties to the United Nations Framework Convention on Climate Change (UNFCCC), including France, are committed to estimate their national nitrous oxide (N2O) budgets and to establish regional programmes of N2O emissions reductions. Agricultural activities are gradually coming into focus as a major GHG emission sector; precise regional estimates of current N2O emissions from arable land are being needed, along with possible means for mitigating emissions. The use of biogeochemical simulation models to estimate N2O fluxes from agricultural soils has obvious benefits. These models provide a unique potential to mechanistically predict N2O emissions from arable soils on both the plot-scale and the regional/national scale on daily time resolutions. In this study we apply two biogeochemical simulation models: CERES-EGC and O-CN all over France for the year 2007 in the perspective of producing an inventory of N2O emissions from croplands. Simulated total N2O emissions from agricultural soils sum up to 20.4 Gg N-N2O/yr with the CERES-EGC model and to 95.1 Gg N-N2O/yr with the O-CN model. Even though the total emissions are largely different between the two models, the temporal and spatial distributions are comparable. When compared to the EDGAR 4.2 emission database we note that O-CN overestimates the annual emissions by approximately a factor of two, whereas CERES-EGC underestimates those emissions. These differences can be explained to a certain extent by the difference in land-use types considered in each of the models and the inventories.