Geophysical Research Abstracts
Vol. 13, EGU2011-2084, 2011
EGU General Assembly 2011

Estimation of greenhouse gas emissions from Italian agricultural areas at high spatial resolution using DNDC biogeochemistry model

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In Italy, the overall agricultural sector emitted 37.2 Mt of CO2 eq. in 2009 (Romano et al., 2009), of which more than half (21.6 Mt of CO2 eq.) as N2O from soils. Although the national methodology is in accordance with Tier 1 and 2 approaches proposed by the IPCC, still empirical emission factors are used. However, these methods could not capture the interaction among biogeochemical cycles, climatic and environmental conditions and local agricultural practices. In order to improve the GHG balance assessment in cropland, higher order methods (Tier 3) are recommended such as, for example, model applications at spatial level. In the present study, a GIS-model integration was performed with the aim of improving the national GHG inventory in Italy. The de-nitrification decomposition (DNDC) model, chosen due to its ability to simulate carbon (C) and nitrogen (N) cycles, has been tested against measured data coming from eddy-covariance stations and soil flux chambers (for CO2 and N2O fluxes) belonging to Carbo-Italy network (Alberti et al., 2010). Despite the varying site specific parameters, the results confirmed the ability of the model to represent the real C balance in irrigated maize crop in north-eastern Italy (both on conventional and minimum tillage) and on a land use change from set-aside to conventional maize in central Italy. Modelled N2O emissions fitted the measured data well, but the corresponding emission factor from fertilizers was much lower than the IPCC default (0.008 vs 0.0125 kg N2O-N kg-1 N, respectively). A platform of simulation was then built to run DNDC for the entire national territory, linking the model with geographical databases (Giltrap et al., 2010). To implement the model, a high spatial resolution grid (1 x 1 km) was adopted and a tree management (e.g. a combination of different management and land use) was also built to simulate crops with a 'business as usual' (BaU) scenario and with alternative management practices (AMP). Although the total area under agriculture has not been simulated so far, this platform of simulation appears promising to improve the national GHG inventory and derive C credits with appropriate management practices. The adoption of minimum tillage to maize crop, for example, was estimate to potentially sequester more than 4 MtCO2 eq.

Reference

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