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Predicting the global warming potential of agro-ecosystems in Europe

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Nitrous oxide, carbon dioxide and methane are the main biogenic greenhouse gases contributing to the global warming potential (GWP) of agro-ecosystems. Evaluating the impact of agriculture on climate requires a capacity to predict the net exchanges of these gases in an integrated manner, as related to pedo-climatic conditions and crop management. The biophysical crop model CERES-EGC is designed to predict the productivity and GWP of agro-ecosystems at the plot-scale. Here we applied a Bayesian calibration to its both sub-models of N2O emissions and CO2 fluxes to deal with parameterization and uncertainty analysis. The N2O emission module of CERES-EGC was calibrated against chamber measurements from 7 arable sites in France and the CO2 flux module was calibrated against eddy-covariance measurements from 3 sites in Europe. Measurements from the various sites were assimilated in the posterior probability density functions for the different parameters, using a Bayesian calibration method based on the Metropolis-Hastings algorithm. The model was subsequently extrapolated to predict CO2 and N2O fluxes over entire crop rotations of 3 European experimental sites of the NitroEurope-IP network. Indirect GHG emissions arising from the production of agricultural inputs and from cropping operations were also added to the final GWP. Such modelling approach makes it possible to test various agronomic management scenarios, in order to design productive agro-ecosystems with low global warming potential. The model would be extrapolated from plot- to regional-scale, with the ultimate goal of generating spatialized GHG inventories. Differentiating the emissions in space would thus make it possible to target critical zones in mitigation scenarios at regional scale.