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Simulations of N2O concentrations for France using ecosystem models, emission databases and an atmospheric transport model

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Soils are responsible for a major, although highly uncertain, share of the global emissions of nitrous oxide (N2O). N2O fluxes are strongly correlated to soil properties, soil management and local climatic conditions. These controlling factors interact at different temporal and spatial scales making it challenging to asses emissions at a regional level both with measurement and modeling. We used two biogeochemical simulation models CERES-EGC and O-CN to estimate N2O fluxes from agricultural soils over France, and compared them into the regional atmospheric chemistry-transport model CHIMERE (0.25°x0.25° for France). Comparisons between modelled and observed mixing ratios give insights on the quality of the emission scenarios used as input to the model, assuming small transport errors. The maps were tested by comparing CHIMERE simulations with time series of N2O atmospheric mixing ratios measured continuously in two locations over France during the year 2007. In an inverse mode, N2O emissions scenarios are used combination with N2O observed mixing ratios and an atmospheric transport model, to produce optimized emission scenarios. The model used is a global model (LMDZ-INCA, 3.75°x2.5° resolution with a 1°x1° zoom over Europe). For France the O-CN model which only accounts for crops and managed grassland emissions simulates total emissions of 95 Gg N-N2O/yr which are larger than total fluxes inferred from inversions (75 Gg N-N2O/yr). Inverted fluxes are 30% larger when compared to the prior emissions. Concerning CERES-EGC which only accounts for crops, the total emissions for 2007 sum-up to 20.4 Gg N-N2O/yr and are smaller than the total inverted flux.