Soil N_2O emissions in national greenhouse gas inventories: potential for improvement

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Overview

The current method used for national inventories of nitrous oxide emissions from soils (IPCC, 2006) provides results which, despite of large uncertainty, seem to reflect released quantities reasonably well (Corazza et al., 2010). However, changes in the emissions as a consequence of introducing emission abatement cannot be addressed properly. Since nitrous oxide soil emissions are described purely as a function of total nitrogen application, its decrease is the only possibility to formally achieve emission reduction. NitroEurope results are able to scientifically point towards further differentiation, with release rates depending on agricultural practice. Fertilizer type, fertilizer timing or soil type all may be seen as parameters contributing to the extent of emissions, and thus providing further options for abatement strategies. Regression models, literature studies on specific emission factors, and modelling approaches (in part based upon NitroEurope measurement campaigns) are applied to devise a methodology that could be used as a future "Tier 2" methodology according to IPCC nomenclature.

Methods/Approach

Within NitroEurope, several methods have been employed to describe the relationship between soil processes, specifically those triggered by anthropogenic activities, and the emission of compounds like nitrous oxide. Field measurements add to the already previously large body of evidence (Stehfest and Bouwman, 2006), allowing to identify specific parameters as the driving elements of trace gas release. Regionally applied soil models (Yeluripati et al., 2011) as well as statistical approaches (Lesschen et al., 2011) have been employed to isolate the individual effects. At the same time, also European scale models attempt to describe the detailed causes of N_2O emissions (Leip et al., 2011).

The aim of this paper is to contrast these individual approaches and to identify which areas of similarity exist, such that results may be singled out that can be considered reliable. At this time fully quantitative results are not yet available, thus we focus on a qualitative comparison of the respective approaches.

Results

An overview of the parameters tested in the respective approaches is presented in Table 1. This table also provides information, how a change in the respective parameter affects the emissions of N_2O.

Some of the approaches (specifically, Lesschen et al., 2011) extend over many more parameters that cannot be shown in detail here.

Table 1. Response of N_2O emissions to the parameters tested. Direction of arrow indicates whether N_2O emissions increase (➚) or decrease (➘) with change of the respective parameter, or remain stable (➔). Empty fields indicate that a parameter has not been tested

	Statistical approach (Lesschen et al., 2011)	**Regional modelling based on flux data** (Yeluripati et al., 2011)	**European scale modelling** (Leip et al., 2011)
Application of fertilizer N	➚	➚	➚
Soil organic carbon	➚	➚	➚
Share of manure in fertilizer	➚ ➘ (arable land vs. grassland)	➘	➚ ➘ (low vs. high summer temperatures)
Low ammonia application of manure	➚	*	**
Share of ammonia based fertilizer	➘	*	**
Precipitation	➚	➚	➚ ➘ (min. fertilizer vs. manure; precip here is summer precipitation)

*) No field data available to derive EF
**) Model is not able to differentiate

Results presented clearly indicate that a wealth of information is available already, but at the same time demonstrate more specific and more coherent evaluation will be required before new recommendations to IPCC can be issued.

References

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