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Effects of crop management, soil type, and climate on N2O emissions from Austrian Soils

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Within the project FarmClim ("Farming for a better climate") we assessed recent N2O emissions from two selected regions in Austria. Our aim was to deepen the understanding of Austrian N2O fluxes regarding region specific properties. Currently, N2O emissions are estimated with the IPCC default emission factor which only considers the amount of N-input as an influencing factor for N2O emissions. We evaluated the IPCC default emission factor for its validity under spatially distinct environmental conditions.
For this two regions for modeling with LandscapeDNDC have been identified in this project. The benefit of using LandscapeDNDC is the detailed illustration of microbial processes in the soil. Required input data to run the model included daily climate data, vegetation properties, soil characteristics and land management. The analysis of present agricultural practices was basis for assessing the hot spots and hot moments of nitrogen emissions on a regional scale.
During our work with LandscapeDNDC we were able to adapt specific model algorithms to Austrian agricultural conditions. The model revealed a strong dependency of N2O emissions on soil type. We could estimate how strongly soil texture affects N2O emissions. Based on detailed soil maps with high spatial resolution we calculated region specific contribution to N2O emissions. Accordingly we differentiated regions with deviating gas fluxes compared to the predictions by the IPCC inventory methodology.
Taking region specific management practices into account (tillage, irrigation, residuals) calculation of crop rotation (fallow, catch crop, winter wheat, barley, winter barley, sugar beet, corn, potato, onion and rapeseed) resulted in N2O emissions differing by a factor of 30 depending on preceding crop and climate. A maximum of 2% of N fertilizer input was emitted as N2O. Residual N in the soil was a major factor stimulating N2O emissions.
Interannual variability was affected by varying N-deposition even in case of constant management practices. High temporal resolution of model outputs enabled us to identify hot moments of N-turnover and total N2O emissions according to extreme weather events. We analysed how strongly these event based emissions, which are not accounted for by classical inventories, affect emission factors.
The evaluation of the IPCC default emission factor for its validity under spatially distinct environmental conditions revealed which environmental conditions are responsible for major deviations of actual emissions from the theoretical values. Scrutinizing these conditions can help to improve climate reporting and greenhouse gas mitigation measures.