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Modelling climate change impact on N_2O emissions from agricultural soils based on long-term observations

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Intensive agricultural land use is considered to be the major source of the anthropogenic contribution to the increase in atmospheric N_2O concentration during the last decades. A reduction of anthropogenic N_2O emissions therefore requires a change in agricultural management practices. Mathematical models help to understand the interaction between the determining processes of N_2O production and the dynamics of state variables affecting N_2O emissions. In particular the impact of climate change on N_2O emissions can be better analyzed.

The aim of this study was to test the modeling approaches for their ability to describe and quantify the long-term development of N_2O emissions from agricultural fields observed at the Research farm Scheyern situated 40 km north of Munich, Bavaria. Data for model evaluation were obtained during 25 years (1992-2017) mainly by the closed chamber method. We applied two different modeling approaches, where one model assumes a fixed N_2O/N_2 ratio for N_2O production and neglects the transport of N_2O in the soil profile; whereas the other model explicitly considers N_2O transport and assumes a dynamic reduction of N_2O to N_2.

Generally, both modeling approaches were able to describe the observed long-term and seasonal dynamics of N_2O emissions and events of high N_2O emissions due to increased denitrification activity after heavy precipitation and during thawing after soil freezing. It is concluded that the decrease of frost thaw-events due to higher temperatures during the cold season is the main reason for the decrease of N_2O from the agricultural fields at the research farm Scheyern.