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Assessing the mitigation potential of agricultural systems by optimizing agricultural management practices with the process based model LandscapeDNDC

Saul Molina Herrera, Edwin Haas, Steffen Klatt, David Kraus, Ralf Kiese, and Klaus Butterbach-Bahl
Karlsruhe Institute of Technology (KIT), Institute of Meteorology and Climate Research (IMK-IFU), Garmisch-Partenkirchen, Germany

The use of nitrogen based fertilizers in agriculture increased crop yields in recent decades. Even though the harmful effects to the environment (increased emissions of nitrous oxide-N2O, nitric oxide-NO and leaching of nitrate to the groundwater) did not follow this increase proportionally, the excess of nitrogen from agricultural soils is still a major source. The necessity to identify affordable strategies that improve crop production and minimize nitrogen losses are in continuous debate between policy decision makers and farmers. A good commitment from stakeholders to enforce laws might reduce environmental impacts. In this line, the adoption of modern precision climate smart agriculture tools applied to management practices will result in prominent step to mitigate N losses. In this study we present optimized strategies for 10 sites (agricultural and grassland ecosystems) with long term field observation across Europe. Here we show the mitigation potential to reduce nitrogen losses under the constrain of keeping yields at observed levels. Modeled crop yields and joint N losses (NO, N2O and NO_3 leaching) were evaluated against observations. The sites present particular management regimes including the main commodity crops (maize, wheat, etc.) and fertilization amendments (synthetic and organic fertilizers).
The mitigation potentials to reduce N losses for all sites were assessed by different optimization methods addressing the individual underlying agricultural management (sequences of crops, alternative crop varieties, use of cover crops, timings of planting and harvest, type of fertilization & manure applications and splitting application of N, residues management and irrigation). The sampled agricultural management alternatives had to integrate the environmental benefits and economical aspects. This will show options to enhance a sustainable intensification of cultivated lands in Europe.