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Developing a physical-based crop model for N managements of crop rotations in North Rhine-Westphalia, Germany

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Developing a Physical-based Crop Model for N Managements of Crop Rotations in North Rhine-Westphalia, Germany

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Abstract: To protect the water bodies from agricultural nitrogen (N) emissions, the Fertilizer Application Ordinance (FO) of Germany has been revised in 2017 based on the requirements of the Nitrates Directive of the European Union. However, there is little scientific knowledge on the effects of the new FO on the N emissions for specific farm types. Furthermore, due to the different soil and climate regions and crop rotations, traditional methods such as regional survey and field experiments are too costly and impractical. Therefore, a model-based assessment could be a cost-effective option. Within the modeling framework SIMLPACE (www.simplace.net), two specific modules were developed in our study to overcome the shortcomings. The first one is used to consider different crop rotations and it has sufficient flexibility to consider all combinations of crop rotations in Germany. The second one could simulate different N management scenarios. Following all management rules of the FO. Importantly, the N module could also consider catch crop effects and crop residue management, which obviously affect farmers' N applications. The modules were integrated into SIMPLACE to form a dynamic, process-based simulation model. Statistical data including crop yields of six different crops and N uptake in the storage organs over 4 crop rotations and 5 soil-climate regions in Germany from 2000 to 2008 were used to evaluate the newly developed model. The results indicated that our model could obtain accurate simulations for both yield and N uptake in all evaluation scenarios. Meanwhile, comprehensive validation including the whole N cycle is still necessary.

Keywords: SIMPLACE; Crop rotations; Nitrogen; Fertilizer Ordinance; Management