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Using a semi distributed model to enhance communication with stakeholders and participation for designing nitrogen-efficient cropping systems in a catchment

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Context

Catchment scale fully distributed agro-hydrological models are often advocated to evaluate the effect of N mitigation plans on water quality. This type of model is well suited to predict nitrate concentration in rivers under different scenarios, thanks to the variety of processes considered (e.g. groundwater table fluctuations, retention by landscape structures). The role of stakeholders is often limited to providing input data for the modeling; participation only takes place when defining the scenarios to be tested (e.g. implementation of a regulation). In most cases, characterization of the cropping systems and their evolution is carried out by scientists alone based on data from surveys and external expert knowledge. For instance, crop succession on each field plot is determined using complex statistical methods or remote sensing data, generating a complex system description that is not always adapted to the stakeholder's issues. However, modeling with stakeholders at local scale enables increasing and sharing knowledge by collaborative learning. We assume that involving stakeholders in the characterization of the cropping systems to be modeled, and simplifying system description, helps performing modeling studies that answer their questions on design of N efficient cropping systems.

The model

Syst'N is a tool designed to increase knowledge on nitrogen losses in cropping systems, at the plot scale. This tool, beyond a mere simulation model, was developed in order to meet requirements and constraints of non scientific users such as local stakeholders involved in water quality actions. They are referred to as 'stakeholders' hereafter. In this simulation study, N losses at the outlet of the catchment result from an aggregation of losses simulated in 63 homogenous simulation units (HSU), representing cropping systems present in the catchment.

Learnings from field experience with stakeholders

The field experience described here is from a 80km^2 catchment located in Burgundy, France. Data from farm surveys was available for $\sim$300 field plots each year since 2003. We will present how characterization of the cropping systems to be simulated as HSU was done combining this data and local expert knowledge. In this study, the aim of experts' elicitation was beyond filling gaps in the farm survey database; the stakeholders are the experts here. Cropping system present in the catchment were distinguished based on crop succession and management practices that stakeholders and scientists considered as influencing N losses. Crop successions consist in seven crop rotations that were defined a priori by experts, either because they are frequent in the catchment or because experts considered them as innovative and wanted to test them. Utilization of the farm survey database comes after, in order to 'translate' expert narrative information into numerical model input. Simulation outputs are not only presented in an aggregated form (simulation of N concentration at the outlet), but also for each HSU and were structured in order to compare the effect of determining factors: soil, agricultural practices and crop successions.

Conclusion

Running HSU simulation instead of fully distributed model may results in poorer prediction of N concentrations, but it allows engaging local stakeholders in the process of cropping system description and design, which in turns facilitates outputs assimilation.