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# Coupling agronomic and hydrological models to test the effect of agricultural activities and their spatio-temporal distribution on water quality

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Complex interactions between anthropogenic, hydrologic, biogeochemical and ecologic processes occur in agricultural landscapes. Hydrology and agronomy are generally studied independently, respectively at catchment and field scales. However, water quality and quantity is influenced by a combination of hydrologic (ranging from e.g., extreme events to trends in climate change) and agronomic (ranging from e.g. agricultural practices to change in farming system) processes. At meso scales, realistic spatio-temporal distribution of the activities and constraints are particularly crucial, because of the need to evaluate realistically the effects of activities on aquatic ecosystems and predict the effect of the required substantial changes in farming systems. A scientific community in landscape agronomy is emerging. We present here to two experiences in building and testing agro-hydrological models and explain how they are build and coupled, then, used to test realistic scenarios, including the farm and environmental constraints.

-SACADEAU model (Aurousseau et al., 2009, Gascuel-Odoux et al., 2009) couples a model that represents the weeding activities of the farmers with a model that represents the transfer and transformation of herbicides over a medium size catchment (5-50 km$^2$), to predict the transfer rate of the applied herbicides transferred up to the stream. This coupled model is used to test the sensitivity of realistic spatio-temporal distribution of activities on water quality. The results show that spatial strategies (Salmon-Monviola in press), forbidding herbicides to be applied on some areas of the catchment, can be efficient whatever the year, while temporal strategies, delaying or scattering the weeding activities in time, and therefore in space, are highly dependent of the weather year, indicating that the flexibility of the activities in space and time really depend the weather of the year.

- ACAMOD model is now developing. It couples MELODIE, a model that represents the activities of animal breeding farms, including the spatio-temporal distribution of activities on farm lands such as animal breeding and manure management, with TNT (Beaujouan et al., 2002), a transfer and transformation model of nitrogen in landscape, now intensively used in different projects. The two models are implemented in VLE computing environment, using the generic platform RECORD dedicated to distribute land uses and agricultural activities over a territory. We present how the models are coupled and the innovative scenarios which can be tested (See details in the poster session of this session).

Finally, models are becoming increasingly complex because they simulate an increasing number of interacting processes that are distributed over time and space. They allow us investigation of more scenarios combining constraints related to climate, physical environment or human activities and decisions. Modelling faces additional difficulties, however, when simulating large numbers of scenarios, in which the qualitative responses required for management, such as ranking risks according to various situations, which cannot be easily assessed. Moreover, the reverse approach which identifies temporal drivers or spatial origins of pollution would be useful in agro-environmental management. Two ways have been recently developed: firstly, the predictions can be used as a set of learning examples for symbolic learning techniques to induce rules based on qualitative and quantitative attributes. These techniques have been used to mine the critical source areas involved in herbicide pollution from simulation data provided by using SACADEAU MODEL (Trepos et al., submitted); friendly visualization tools have been developed; secondly, the predictions can be stored in a warehouse data to mine knowledge from current as well future questions of the stakeholders. More than uncertainty, these developments between computer sciences, agronomy and hydrology, intend to express the results in the language of the stakeholders to improve decision making. All these techniques can be used for integrated water management, in quantity as well quality.

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