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Modelling the fate of pesticides in paddy rice-fish pond farming system in Northern Vietnam

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During the last decade rice production in Vietnam has tremendously increased due to the introduction of new high yield, short duration rice varieties and an increased application of pesticides. Since pesticides are toxic by design, there is a natural concern on the possible impacts of their presence in the environment on human health and environment quality. In North Vietnam, lowland and upland rice fields were identified to be a major non-point source of agrochemical pollution to surface and ground water, which are often directly used for domestic purposes. Field measurements, however, are time consuming, costly and logistical demanding. Hence, quantification, forecast and risk assessment studies are hampered by a limited amount of field data. One potential way to cope with this shortcoming is the use of process-based models.

In the present study we developed a model for simulating short-term pesticide dynamics in combined paddy rice field - fish pond farming systems under the specific environmental conditions of south-east Asia. Basic approaches and algorithms to describe the key underlying biogeochemical processes were mainly adopted from the literature to assure that the model reflects the current standard of scientific knowledge and commonly accepted theoretical background.

The model was calibrated by means of the Gauss-Marquardt-Levenberg algorithm and validated against measured pesticide concentrations (dimethoate and fenitrothion) during spring and summer rice crop season 2008, respectively, of a paddy field – fish pond system typical for northern Vietnam. First simulation results indicate that our model is capable to simulate the fate of pesticides in such paddy – fish pond farming systems. The model efficiency for the period of calibration, for example, was 0.97 and 0.95 for dimethoate and fenitrothion, respectively. For the period of validation, however, the modeling efficiency slightly decreased to 0.96 and 0.81 for dimethoate and fenitrothion, respectively.

In our presentation we will picture key model features and algorithms and demonstrate that our model provides a useful and appropriate tool for analyzing and quantifying the transport and behavior of pesticides in paddy rice farming systems.