

Predicting phosphorus losses with the model PLEASE on a local and regional scale in Denmark and the Netherlands

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The application of large amount of phosphorus in agriculture has led to the accumulation of phosphorus in soils in many intensively used agricultural areas, causing excessive losses of P to surface waters. In many countries the present policy is to reduce P application rates towards a situation where P input equals P exported with the crop. Due to the high P content in the soil such plans are mostly not sufficient to reach surface water quality standards and additional measures to reduce P loading to surface water are necessary. For a cost effective implementation of these measures an instrument to identify critical fields/areas for phosphorus leaching is indispensable.

In the Netherlands phosphorus losses to surface water are simulated with a comprehensive process oriented simulation model (STONE, Wolf et al., 2005). STONE distinguishes, for the Netherlands as a whole, 6405 spatially explicit calculation units (plots) with an average area of about 500 ha. The identification of critical fields requires a much higher spatial resolution. STONE is less suitable for this purpose, because of the large number of input parameters required for this model (Schoumans et al., 2009). For this reason, a simple model (PLEASE, Schoumans et al., in prep.) has been developed based on a simplification of the process description in STONE. With this model P leaching to surface waters can be calculated using field characteristics like depth of the groundwater table, precipitation surplus, P status and phosphorus adsorption capacity of the soil.

To evaluate the performance of the model, it was applied to 29 sites (fields) and a number of (mini)catchments in the Netherlands and Denmark. For 8 sites in the Netherlands the model could be validated on measured P leaching fluxes, for the other sites validation was limited to a comparison of measured and simulated concentrations in lysimeter cups, drainwater or piezometers. The validation showed that for most sites the model was able to rank sites from low to high concentrations and from low to high leaching fluxes. Deviations between measurements and simulations may be due to simplification of the model and the use of generic sorption characteristics. Large deviations were found for eutrophic peats soils and soils with shrinkage cracks. Eutrophic peats soils often release large amount of phosphorus from the subsoil. Shrinkage cracks may lead to transport of P through macropores to drains and surfacewater. In order to apply PLEASE to such soils these aspects need to be considered.

Wolf, J. et al., 2005. The integrated modeling system STONE for calculating nutrient emissions from agriculture in the Netherlands. *Environmental Modeling and Software* 18, 597-617.

Schoumans, O.F., P. Groenendijk and C. van der Salm (in prep.). PLEASE: A simple procedure to determine P losses by leaching.

Schoumans, O.F., M. Silgram, P. Groenendijk, a F. Bouraoui, H. E. Andersen, B. Kronvang, H. Behrendt, B. Arheimer, H. Johnsson, Y. Panagopoulos, M. Mimikou, A. Lo Porto, H. Reisser, G. Le Gall, A. Barrj and S. G. Anthony, 2009. Description of nine nutrient loss models: capabilities and suitability based on their characteristics. *J. Environ. Monit.*, 2009, 11,506–514.