Process-based modelling of phosphorus losses from an agricultural dominated catchment in S-E Norway

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Agricultural practices and the consequent losses contribute to the transport of phosphorus to surface waters. Climate change can potentially increase the environmental pressure of agriculture on freshwater ecosystems. In the Nordic Region, climate change may lead to an increase in the number of freeze /thaw cycles and to an increase in precipitation amount after the growing season from September to April. These changes can cause increase in the amount of runoff and its intensity, with subsequent adverse effects on erosion and nutrient loss.

Mathematical models integrate the available knowledge on environmental responses to main driving forces and therefore they are essential tools for studying water and mass transport from soil profile to catchment scales. By successful adaptation of such models to study areas the combined effect of changes in driving forces (e.g. climate, land use) can be assessed and used for developing efficient mitigation measures to prevent unfavourable environmental impacts.

In this study we used the process-based INCA-P model (Wade et al., 2002) aiming to improve our understanding of runoff generation and P loss processes from various land use and soil management systems of an agricultural dominated catchment in South-East Norway. The Skuterud catchment is a small artificially drained agricultural catchment being part of the Agricultural Environmental Monitoring Program (JOVA) in Norway (Bechmann et al., 2007). The area of the catchment is 4.5 km^2 of which agriculture covers 2.7 km^2, forest 1.3 km^2 while the rest is occupied by urban areas. The main agricultural crops are wheat, barley and oat.

The INCA-P model was parameterized for four different land use groups (grass, forest, cereals and urban) and for two soil management systems (with and without autumn ploughing). Daily meteorological data and soil water content deficit were used as driving variables. The simulated values were compared with discharge and water quality data measured at the outlet of the catchment. The calibration and validation periods were from 1994 to 1999 and from 2000 to 2007, respectively.

In our study we present the results of model calibration and we discuss the possibilities of predicting the long term hydrological and environmental impacts of climate change for Norwegian conditions. Special attention is paid to the problem of the parameterisation of various mitigation measures in the modelling procedure in order to evaluate their effects on runoff and phosphorus losses.

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Wade A.J, P.G. Whitehead and D. Butterfield. 2002. The Integrated Catchments model of Phosphorus dynamics (INCA-P), a new approach for multiple source assessment in heterogeneous river systems: model structure and equations. Hydrology and Earth System Sciences, 6(3): 583-60.