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Spatially explicit groundwater vulnerability assessment to support the implementation of the Water Framework Directive – a practical approach with stakeholders

K. Berkhoff
[1]Institute of Environmental Systems Research, University of Osnabrück, Germany
[*]now at: Institute of Physical Geography, University of Frankfurt, Frankfurt (Main), Germany

Abstract. The main objective of the study presented in this paper was to develop an evaluation scheme which is suitable for spatially explicit groundwater vulnerability assessment according to the Water Framework Directive (WFD). Study area was the Hase river catchment, an area of about 3 000 km^2 in north-west Germany which is dominated by livestock farming, in particular pig and poultry production. For the Hase river catchment, the first inventory of the WFD led to the conclusion that 98% of the catchment area is "unclear/unlikely" to reach a good groundwater status due to diffuse nitrogen emissions from agriculture.

The groundwater vulnerability assessment was embedded in the PartizipA project ("Participative modelling, Actor and Ecosystem Analysis in Regions with Intensive Agriculture", www.partizipa.net), within which a so-called actors' platform was established in the study area. The objective of the participatory process was to investigate the effects of the WFD on agriculture as well as to discuss groundwater protection measures which are suitable for an integration in the programme of measures.

The study was conducted according to the vulnerability assessment concept of the Intergovernmental Panel on Climate Change, considering sensitivity, exposure and adaptive capacity. Sensitivity was computed using the DRASTIC index of natural groundwater pollution potential. Exposure (for a reference scenario) was computed using the STOFFBILANZ nutrient model. Several regional studies were analysed to evaluate the adaptive capacity. From these studies it was concluded that the adaptive capacity in the Hase river catchment is very low due to the economic importance of the agricultural sector which will be significantly affected by groundwater protection measures. As a consequence, the adaptive capacity was not considered any more in the vulnerability assessment.

A groundwater vulnerability evaluation scheme is presented which enjoys the advantage that both exposure and sensitivity can be operationalized in a spatially resolved manner (500 × 500 m grid) by the two models mentioned above. The evaluation scheme was applied in the Hase river catchment. 21% of the catchment was classified as highly vulnerable, another 73% as medium vulnerable. Only 6% of the Hase river catchment has low vulnerability. Grid cells of the high vulnerability class are

considered as priority areas for groundwater protection measures in the programme of measures of the WFD. Measures will be particularly effective in the north-eastern part of the catchment where groundwater vulnerability is mainly due to high nitrogen emissions.

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