Impact of selected agricultural management options on the reduction of nitrogen loads in three representative meso scale catchments in Central Germany

Michael Rode[1], Enrico Thiel[2], Uwe Frank[2], Gerald Wenk[1] and Fred Hesser[1]
Helmholtz Centre for Environmental Research – UFZ, [1]Department of Ecosystem Analysis and Management, Brückstrasse 3a, 39114 Magdeburg, [2]Department of Soil Physics, Theodor-Lieser-Str. 4, 06120 Halle

Abstract

Nitrogen inputs into surface waters from diffuse sources are still unduly high and the assessment of mitigation measures is associated with large uncertainties. The objective of this paper is to investigate selected agricultural management measures on nitrogen loads and to asses the impact of differing catchment characteristics in central Germany. A new modelling approach which simulates spatially highly distributed N-transport and transformation processes in soil and groundwater was applied to three meso-scale catchments with strongly deviating climate, soil and topography conditions. The approach consists of the integrated object oriented modelling framework JAMS linking an agro-ecosystem, a rainfall-runoff and a groundwater nitrogen transport and transformation model. Different agricultural management measures with deviating levels of acceptance were analysed in the three study catchments.

N- leaching rates in all three catchments varied with soil type, the lowest leaching rates being obtained for loess soil catchment (18.5 kg nitrate N ha^{-1} yr^{-1}) and highest for the sandy soils catchment (41.2 kg nitrate N ha^{-1} yr^{-1}). The simulated baseflow nitrogen concentrations varied between the catchments form 1 to 6 mgN l^{-1}. These concentrations reflected the nitrogen reduction capacity of the subsurfaces. Nitrate reduction capacities of the subsurface were only important for calculated nitrogen concentrations during baseflow conditions. The management scenarios showed that highest N leaching reduction could be achieved by well site-adapted agricultural management options. Nitrogen retention in the subsurface did not alter the ranking of the management scenarios calculated as losses from the soil zone. The reduction effect depended strongly on site specific conditions, especially climate, soil variety and the regional formation of the crop rotations.