Land use and agricultural management effects on deep drainage and solute leaching

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We present tested a simplified method for the quantification of water and solute leaching and present some results of in-situ measurements.
Some techniques of monitoring the quantity and quality of soil water flow below the root zone are capable. Commonly, lysimeters are applied for measuring drainage fluxes and solute leaching. Costs are high and results may be biased due to typical “lysimeter errors”. Hydrological field measurements may provide an alternative. The aim of the paper was to test this under lysimeter and field conditions.
Soil water content and tension below the rootzone are important hydrologic variables that control leaching processes. Soil water content and tension measurements down to 3 m depth and soil water sampling were used to determine deep drainage dynamics and loss of nitrogen by leaching. The method of quantifying deep drainage rates based on soil hydrological measurements was tested in comparison with lysimeter discharge measurements from 2001 till 2008. Deep drainage rates and nitrate losses of forest, grass fallow and arable land managed under various farming regimes (integrated, integrated with irrigation, ecologic and low input) and tillage systems (plough and no till) were quantified in the Pleistocene region of Northeast Germany from 1994 to 2007.
Results confirmed the reliablity of the simplified method on sandy soils of a deep water table. Willmott’s index of agreement was d = 0.97 revealing the validity of this approach. Results underline the hypothesis of the well-balanced, slow and continuous progression of the soil water content below the root zone.
The field study revealed lowest annual leaching rates were measured at forest sites (0.9 kg ha^{-1}) and under grass fallow (1.7 kg ha^{-1}). They were higher under cropping. In dependence on annual deep drainage rates between 100 mm and 200 mm during the study period, nitrogen loss varied between 14 and 41 kg ha^{-1}. Nitrate concentration varied between 40 and 150 mg l^{-1}. This could be explained by different crop yields of management systems and irrigation effects. No-till treatment resulted in reduced nitrate leaching (18 kg ha^{-1}) as compared with the tillage system with plough and tooth cultivator (27 kg ha^{-1}).
It may be concluded, that in-situ measurement of deep drainage dynamics and solute leaching for quantifying arable management effects on ecological processes may be a proper method on many sites.