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Modeling of nitrogen dynamics in sandy soils under grassland in northern Germany

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Nitrogen leaching can be of serious environmental concern in areas with highly permeable soils and shallow groundwater. Sandy soils can show high rates of leached nitrate especially in combination with an elevated fertilizer input and wet climate conditions. Intensive management of grassland for forage production on dairy farms dominates in regions with sandy soils in northern Germany. This farm specialization posses an unfavorable nitrogen efficiency because of relevant amounts of excreted manure leading to higher nitrogen losses.

Soil conditions and detailed farm management were achieved for an experimental site, called Karkendamm, located on a sandy area in northern Germany. Over a period of five years nitrate concentrations in soil water were measured. Additionally soil water contents, inorganic nitrogen in soil and above ground biomass were documented at fixed dates. Modeling of nitrogen dynamics in this soil-plant-atmosphere continuum can improve the nitrogen management to reduce nitrate leaching from dairy farms. Soil water flows like drainage or deep percolation were not measured so that nitrate nitrogen loads could not be calculated for this site.

The process-based model CoupModel (Jansson & Karlberg 2004) was applied to assess water and nitrogen flows in the soil column under different grassland systems. Different management types like grassland cutting or grazing had to be parameterized in the model to correctly simulate the nitrate nitrogen flows.

First simulation runs show plausible results for the soil water content in different

depths. The simulated groundwater level was calibrated against measurements with spatial variations to consider temporarily saturated conditions in this lowland area. Nitrate concentrations show higher variations between the treatments and depths. Factors like initial inorganic and organic nitrogen content and the dynamic growth of biomass were found to be most sensitive for the nitrogen dynamics for this site beside daily precipitation.