Project Database of ICP Forests
PROJECT DESCRIPTION

PROJECT INFORMATION

Project title: Nitrate leaching risk mapping (NitLeach)

Project ID: 79

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Introduction

Water percolating from forest soils into groundwater is an important resource for drinking water production. Forest floors and soils are generally regarded to efficiently filter the infiltrating water and forests are often the preferred land cover for the hydrological basin of drinking water source or ground water withdrawals.

However, the atmospheric deposition of nitrogen has massively increased since the 1960ties due to human emission of nitrogen oxides (NO_x) and ammonia (NH_3). Despite reduction measures, critical loads are still exceeded in parts of Europe and this may lead to N saturation, to an increase in nitrate leaching from forest soils in future (Waldner et al., 2014). Clear cut, storm damage and calamities are known to lead to elevated nitrate leaching in the first 2 to 5 years in parts of the sites (Dahlgren; Dahlgren & Driscoll; Valigura & Messina, 1994; Johnson et al., 1997; Lewis & Likens, 2007; Futter et al., 2010).

Several authors have elaborated concepts to estimate the nitrate leaching risk based on indicators such as the C/N ratio of the forest floor (e.g. Gundersen et al., 1998; Rothwell et al., 2008; Dise et al., 2009; Futter et al., 2010; Lovett & Goodale, 2011). Jost et al. (2011) pointed out the importance of nitrification below snow cover (c.f. Williams et al., 2001) and of peak events for annual flux. Brumme et al. (2008) found a relation between N accumulation and acidity and explained it with the differing influence of leaf and needle litter on the organic matter formation in soil.

This current project will investigate the relationship between nitrate leaching and indicators based on the Swiss IAP (non-ICP Forests) plots and from/on? selected ICP Forests Level II plots in Central Europe. In a second step, relations between indicators and mapped data will be investigated in order to elaborate recommendations for nitrate leaching risk estimations and mapping.

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Aims and objectives

The aim of the project is to gain knowledge on the relation between nitrate leaching and explanatory variables in order to assess and map the nitrate leaching risk for forests in Central Europe with a special focus on Swiss forests

- determine nitrate leaching based on concentration in soil solution and modeled water fluxes
- investigate the relation between nitrate leaching and explanatory variables
- develop recommendations for nitrate leaching risk mapping

The objectives of the study are

- Complete the water budget modelling for selected ICP Forests Level II plots with soil solution data and calculate nitrate leaching fluxes
- Investigate the relationship between nitrate leaching, atmospheric deposition, tree growth, and indicators of N saturation such as foliar nutrition status and soil C/N ratio.

Methods

The proposed research activity can be divided into three phases:

I. Water budget modelling for selected ICP Forests level II plots based on daily meteorological data, physical soil characteristics, tree density and basal area per tree species, as well as LAI and soil water content or matrix potential measurements if available. If available and adequate, existent results of water budget modelling carried out by national experts/bodies are used. If not, water budget modelling will be carried out at the institute of the chair of the EP Meteorology, LWF Bavaria, Germany.

II. The relationships between nitrate leaching fluxes and the saturation indicators mentioned above will be investigated in a second step. The investigation will be done regarding to the long-term means as well as to the year to year variations of nitrate leaching on a plot. These investigations will mainly be carried out at the WSL, Switzerland. The used databases will include soil solution, soil analyses, foliar analyses, deposition, critical loads estimates and Ellenberger indices derived from ground vegetation surveys.

III. Elaboration of recommendations to map the nitrate leaching risk will have to consider the availability of adequate mapped indicator parameter. The WSL will carry out this step focussing on the situation in Switzerland only. However, other countries are welcome to carry out this step for their country as well - with or without collaboration with WSL and/or LWF Bavaria.