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The flowing of nitrogen in a soligenous sloping mire in the German national park *Hochharz Mountains*

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The objective of the research was a quantification of water and nitrogen fluxes in the soligenous sloping *Ilsemoor* located in the spring area of the Ilse stream, German *Hochharz Mountains*, under the hypothesis of increased nitrogen inputs. N-fluxes were analyzed in order to determine the N retention in the mire and thus to come to conclusions about the effects of atmospheric N inputs on the moor ecosystem. N balancing based on the sampling of N inputs with consideration of different paths of surface water input, field and forest deposition as well as the quantification of the N output into flowing water. Field depositions were determined using two different methods: the bulk deposition method and the ^{15}N-isotope-dilution method (ITNI: Integral Total Nitrogen Input). The ITNI system registers the whole N input in a soil-plant system. Compared with the bulk deposition method, also the gaseous N input is considered and the direct N uptake by the plants (Böhme and Russow 2002). Inputs into forest stands were handled as bulk deposition. The N input with slope surface water was determined by measuring the discharge rate in situ and calculating the N concentration by sampling the surface water input points. N output from the moor catchment region into flowing water was continuously monitored by measurements of the discharge rate at a sampling weir with subsequent determination of the N concentration at the sampling point. In addition to this hydrochemical parameters of the moor water, soil physical and chemical parameters of the peat and the nutrient content of the above-ground biomass were determined. The sampling period extended over the hydrological years 2002 and 2003 and for the ITNI measuring system from 05.07.01 to 23.10.02.

In the hydrological year 2002, open field deposition with the recorded precipitation of 2106 mm was of 31 kg N ha^{-1} a^{-1}. In the hydrological year 2003, precipitation reached 1373 mm and thus was markedly lower. In that year, open field depositions amounted to 29 kg N ha^{-1} a^{-1}.
The atmogenous net-N input into the vessels determined by the ITNI measuring system has been demonstrated in Table 1.

Table 1: Results obtained by the ITNI-System AN: atmogenous N input

Pot	Dry matter g	N-content /Pot mg	AN_{netto} mg	AN_{netto} Plants (%)	AN_{netto} mg Pot^{-1} d^{-1}	AN_{netto} g ha^{-1} d^{-1}	AN_{netto} kg ha^{-1} a^{-1}
1	8.57	373.1	167.2	11.5	0.4	92.6	**33.8**
2	4.21	294.0	124.6	9.3	0.3	69.0	**25.2**
3	4.33	368.6	146.3	10.2	0.3	81.0	**29.6**

Since one pot (No. 4) has developed a very poor and thus neglectible plant growth, only the remaining three vessels were evaluated. It becomes clear that biomass production was generally poor due to the difficulties in plant cultivation and growth as a result of extreme weather conditions. For the period of one year, deposition rates of about 34, 25 and 30 kg N ha^{-1} were obtained. They yielded an average value (arithmetical mean) of about 30 kg N ha^{-1}

a^{-1}. The bulk deposition analysis showed an input of 27 kg N ha^{-1} a^{-1} for the same period. The small differences between both methods can be explained by a minimum biomass development in the ITNI test, which involved only a slight uptake of gaseous N by the plants from the atmosphere. The dependence of atmogenous N input on biomass production as observed in the measurements suggests, however, that stronger plant growth involves also increased N uptake and thus increased net N input to the system. More investigations are required to come to significant findings.

Compared with field deposition, forest deposition at the sampled site was clearly increased. In the hydrological year 2002 with a forest precipitation of 1814 mm, the N input into the stand amounted to 53 kg N ha^{-1} a^{-1}. In the hydrological year 2003, precipitation in the forest reached 960 mm carrying a deposition of 63 kg N ha^{-1} a^{-1}. The N levels in fog exceeded those in rain by the manifold and explain the much higher N inputs in the forest due to interception of fog by the stand.

The nitrogen output in runoff water was 17 kg N ha^{-1} a^{-1} in the hydrological year 2002 and 21 kg N ha^{-1} a^{-1} in the following year. Runoff quantities of 1676 mm (2002) and 1218 mm (2003) were recorded. Runoff rate and N loading in the water showed a highly significant relationship to the quantity of surface water input and its N loading on the slope at comparable N dynamics and composition of the N load. The reason are particularities in the hydrological regime of the *Ilsemoor* which is characterized by pronounced erosion gullies allowing surface water and precipitation flow off very fast.
The N retention of the mire in the sampling period has been demonstrated in Table 2.

Table 2: N retention of the mire in the hydrological years 2002 and 2003

	Hydrological years	
	2002	**2003**
N retention (%)		
NO_3-N	60,9	69,6
NH_4-N	97,9	95,5
N_{org}	52,9	-10,0
$\sum N_t$	**68,8**	**64,9**

High N retention rates of 69 % and 65 % were established in the *Ilsemoor* in 2002 and 2003 resp. in regard of the fact that N_2 outputs were not subject of balancing. Thus, the moor represents an N sink. Sorption of N in peat and uptake of nitrogen by plants are reasons for the high N retention in the mire. This shows also ascertained high N concentrations and close C/N ratios in peat and above-ground biomass. The highest retentions, i. e. 98 % in 2002 and 96 % in 2003, were recorded for ammonium, the lowest for organic N compounds (53 % in 2002 and –10 % in 2003).

The recorded N input in the sampling period is critical for the long term development of mires. Changes in the composition of plant populations in favour of N tolerant species are suspected.

Literature

Böhme, F. und Russow, R. (2002). Formen der atmogenen N-Deposition und deren Bestimmung in Agrarökosystemen unter besonderer Berücksichtigung der ^{15}N-Isotopenverdünnungsmethode (ITNI). UFZ-Bericht 16: 6 –17.