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Dry deposition to bulk samplers underneath a roof in a spruce (picea abies Karst.) forest

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Abstract
Standard bulk precipitation samplers of the funnel+bottle type were exposed underneath a roof facility in a spruce forest at Solling, Germany. They contained 200 ml of distilled water adjusted to a series of pH steps and were placed for 1, 2, and 4 weeks, respectively. Considerable enrichment rates of chemical elements, particularly nitrate-N, ammonium-N and sulfate-S were observed, which must be attributed to dry deposition.

1. The experiment

In the Solling mountain area of central Germany a roof manipulation study is conducted in a 60 y old norway spruce (picea abies [L.] KARST.) stand. One of the three roofs of 300 m^2 area each is currently used for drought experiments.
During an extensive experimental drought phase in the summer of 1992 bulk samplers with polyethylene funnels and bottles, of the same type as regularly used for throughfall sampling, were exposed underneath that roof. Time periods of exposure were 1, 2, and 4 weeks, respectively. The bottles contained 200 ml of standard solution with pH 3, 4, 5, ($H_2O_{dest.}$), 8 and 9. Each pH step was in 3 replicates.
During the drought phase the sprinkler systems underneath the roof do not operate. The roof cover prevents rain or canopy drip from entering the bulk samplers. Therefore, any enrichment of chemical constituents in the samplers after exposure can be attributed to either dry deposition or organic contamination (by insects, bird droppings, etc.). The pH steps were employed in the experiment to test the dependence of dry deposition on the pH of the exposed sample solution.

2. Results

The results show appreciable enrichment rates of chemical constituents, particularly of nitrate-N and ammonium-N, in the exposed bulk samplers (figs. 1, 2). There is no indication that this input is due to an organic contamination by insects or birds. The enrichment is independent of the pH of the exposed sample. In the case of NH_4-N it seems to be related to the time of exposure (fig. 2), but not in the case of NO_3-N, where the highest concentrations gained were found in the second exposure period lasting only two weeks (fig. 1). The enrichment is most probably caused by high deposition rates of particles and gaseous compounds.

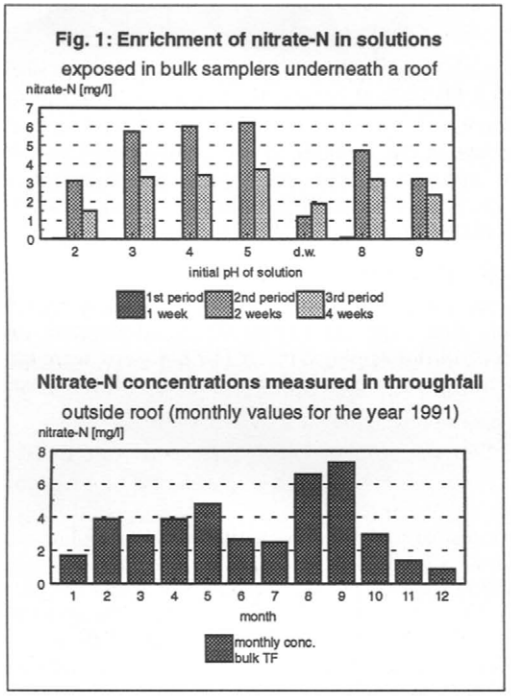
3. Discussion

It is quite surprising how high the final element concentrations in the samplers exposed *underneath* the roof were. They were actually in the same range as those normally observed in monthly samples from the same type of bulk samplers exposed *outside* the roofs (figs. 1, 2, lower parts).
The enrichment of elements seems to be independent from the pH of the exposed solution. This provides evidence that the nature of the dry deposited material is particulate. The depo-

sition velocities calculated on the basis of the observed enrichment (table 1) are much higher, however, than particle deposition velocities for these constituents reported in the literature.

4. Conclusions

- dry deposition can make up a considerable part of the element input to bulk samplers
- no pH-dependence of the enrichment of NO_3-N, NH_4-N and SO_4-S in the exposed samples was observed
- calculation of deposition velocities for NO_3-N and NH_4-N from their observed enrichment in this experiment leads to very (unrealistically?) high values.



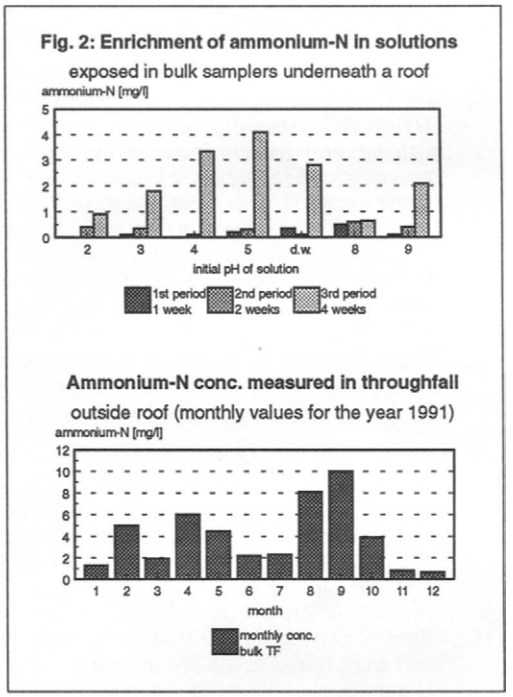


Table 1: Calculated deposition velocities [cm/s]
for nitrate and ammonium at varying pH

	nitrate-N 2nd sampling period	ammonium-N 3rd sampling period
pH 2	10.1	1.7
pH 3	20.6	7.6
pH 4	19.0	5.3
pH 5	19.5	7.6
d.w.	3.8	3.9
pH 8	14.6	1.1
pH 9	10.1	6.1