3. Atmospheric deposition

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3. 1 Introduction

Atmospheric deposition is an important input pathway for elements into ecosystems (Littmann 1994, Ihle 2001, Schaaf 2004). In initial ecosystems on quaternary material nutrient availability is a limiting factor for primary production. In this context, atmospheric input might be an important source for nutrient for the vegetation of the artificial watershed Chicken Creek. In Central and Northern Europe the high atmospheric nitrogen deposition can influence development of ecosystems. In nutrient-limited ecosystems, like dry grassland ecosystems, atmospheric nitrogen import have a large impact on primary productivity and can modify species composition, vegetation dynamics and the direction of succession (Bakker and Berendse 1999).

To provide information about the atmospheric deposition within the monitoring project, bulk deposition is sampled in a grid-design on the catchment. The gathered data will provide the annual element input into the ecosystem (Gast et al. 2001, Gast 2003, Schaaf 2004).

3. 2 Material and Methods

Sampling of bulk and dry deposition was carried out at the experimental site with 18 open bulk deposition samplers at 1 m above-ground (Fig. 3.1) located at the grid points C2, C4, C6, F2, F4, F6, I2, I4, I6, L2, L4, L6, N2, N4, N6, P2, P4, P6. Sampling started in July 2007. The samplers were made of two 2 liter receptors and collectors polyethylene bottles. The exposed area of the collector is 115 cm^2 and the collector aperture is covered by a plastic ball to prevent evaporation from the bulk sampler. The bottle is mounted in PVC pipe topped by a metal bird perch. The samples were collected at 2-weekly intervals. Samples are immediately analyzed for pH and electrical conductivity (WTW Inolab 740) and stored in a fridge at +4°C until further analysis. The samples are analyzed for concentrations of Ca^{2+}, Mg^{2+}, Na^{+}, K^{+}, Fe^{3+}, Al^{3+} (ICP-OES Unicam 701 and Thermo Scientific iCAP 6000), NO_3^{-}, SO_4^{2-}, Cl^{-} (IC Dionex 5000), NH_4^{+} (Rapid Flow Analyzer Alpkem), DOC and TOC (Shimadzu TOC-5000 and VCPH+TNM-1). Annual bulk deposition was derived from the ion concentrations and the corresponding rainfall amounts in the deposition samplers.

Fig. 3.1: Bulk deposition sampler.

3. 3 Results and discussion

The precipitation amount measured with the bulk deposition samples showed considerable differences to the rainfall amount recorded with the rainfall gauges at the weather stations (see Chapter 2). The mean precipitation in the bulk samplers during the measuring period July 10th, 2007 to December 16th, 2008 was 1145 mm, while 879 mm was recorded at weather station 1 with the automatic rain gauge. This variance can be explained by differences of the design of the used samplers, the windfield around the receptor and technical problems of the rain gauge during winter due to freezing. No distingued spatial rainfall pattern could be observed over the 18 samplers. The measured pH -values at Welzow varied between 4.1 and 6.9 and the electric conductivity between 14 and 118 μS cm^{-1} (Fig. 3.2). Major cations in the bulk deposition are K^+, Na^+, Mg^{2+} and Ca^{2+} (Fig. 3.3). The annual deposition of 2008 is shown in Tab. 3.1. The samples were analysed for Al^{3+} und Fe^{3+}, however, both elements were under the detection limits. Seasonal variations of concentration of anions (NH_4^+, NO^-, SO^{2-}, Cl^-) are shown in Fig. 3.4. Especially, the NO_3^--concentration and deposition showed a sesonal variation in 2008 and increased drasticly in summer 2008 (Fig. 3.4 C). Local agricultural sources and harvesting could be an explaination for the seasonal variation of the N-deposition (Littmann 1994). However, only a data analysis of long-term records can confirm such varitions. The caculated annual N-deposition in 2008 is 20.4 kg ha^{-1} a^{-1} (Tab. 3.1) and corresponds to other results from Brandenburg with 12 - 19 kg ha^{-1} a^{-1} (Gast 2003, Schaaf 2004) and 21 kg ha^{-1} a^{-1} (Volz 1995), respectively.

Matschullat et al. (2000) measured in the bulk deposition in the Erzgebirge at open fields NH_4^+ concentrations of 0.84 mg l^{-1} and for NO_3^- 2.67 mg l^{-1} at the end of the 1990s. The region south-east of Berlin is characterised by relative high sulphur and nitrogen deposition (Wellbrock et al. 2005). From the viewpoint of ecosystem development, the amont of nitrogen deposition is regarded as critical load for nutrient poor ecosystems like heathland ecosystems (Bakker and Berendse 1999, Ihlig 2001).

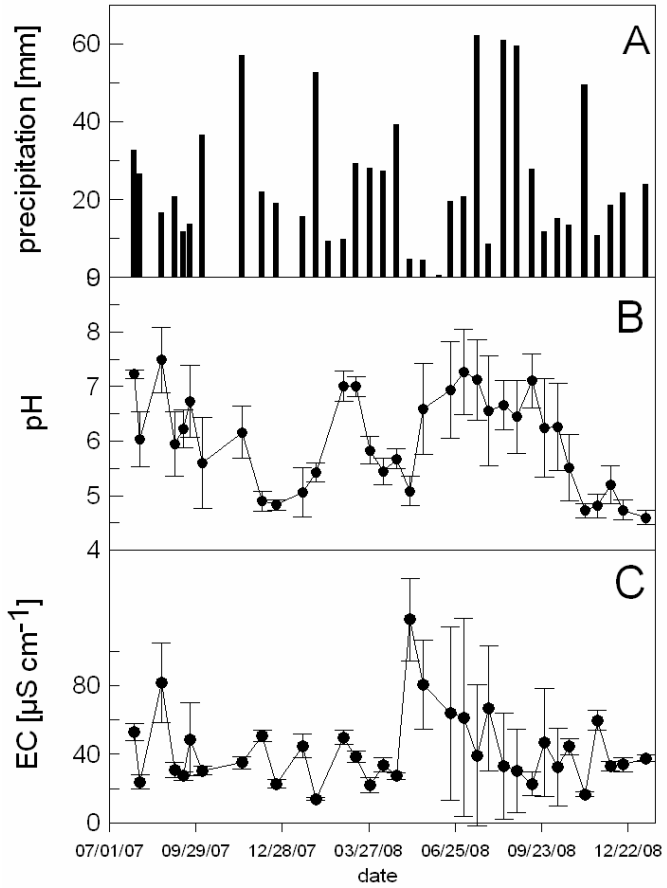

Fig. 3.2: Precipitation, pH and electric conductivity (EC) of the bulk depoition between July 10th, 2007 and December 16th, 2008.

Tab. 3.1: Median of element concentration and of annual bulk deposition at Chicken Creek in 2008.

ions	concentration [mg l^{-1}]		deposition [kg ha^{-1} a^{-1}]
Ca^{2+}	1,3	Ca	7,4
Mg^{2+}	0,2	Mg	1,2
Na^{+}	0,87	Na	5,6
K^{+}	0,18	K	2,4
Cl^{-}	1,59	Cl	7,6
NH_4^{+}	2,4	NH_4-N	11,8
NO_3^{-}	7,72	NO_3-N	8,6
SO_4^{2-}	5,6	SO_4-S	14,7
DOC	2,81	DOC	17,0
TOC	2,13	TOC	18,1

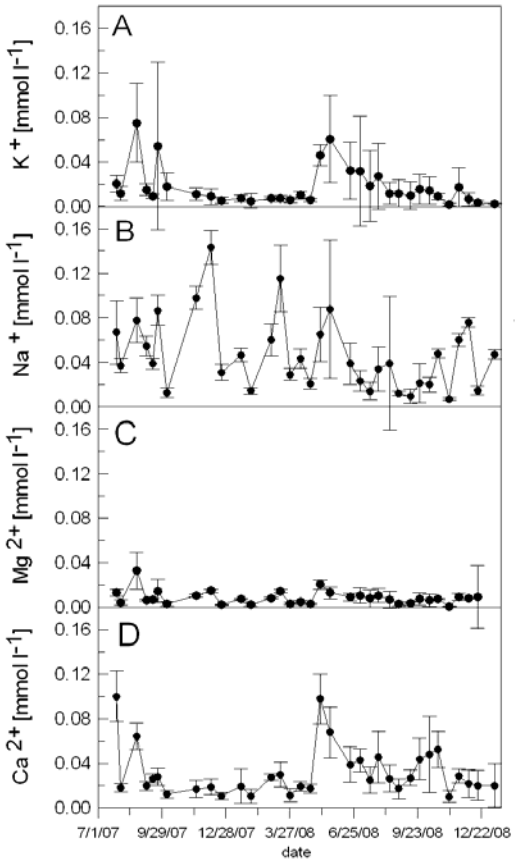

Fig 3.3: Cation concentrations in bulk deposition between July 10th, 2007 and December 16th, 2008.

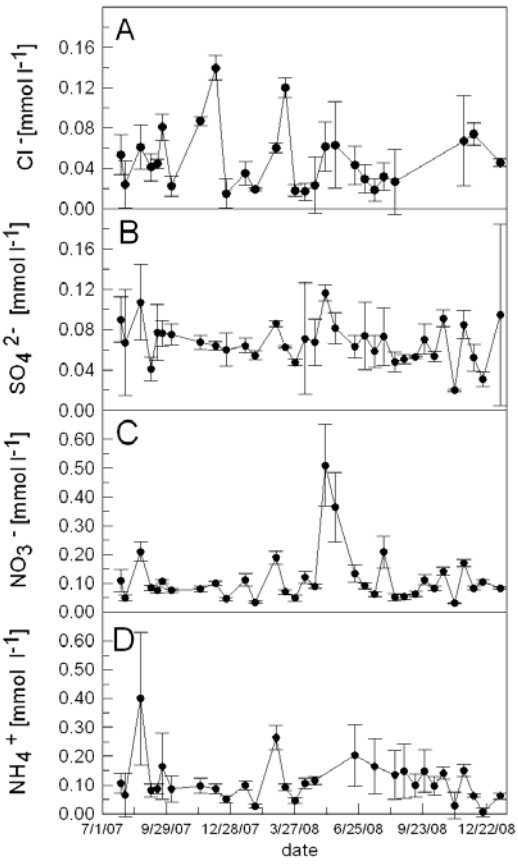

Fig.3.4: Anion concentrations in bulk deposition of between July 10th, 2007 and December 16th, 2008.

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Acknowledgements

We thank Ralph Dominik, Marin Dimitrov, Gunter Baumann and Silvio Vogt for their help with the field work. Thanks to Gabi Franke, Regina Müller, Helga Köller, Evi Müller and Anita Maletzki for the analysis of the samples together with Nonka Markova and Tzvetelina Dimitrova.

Citation:
Veste, M., Schaaf, W. (2010): Atmospheric deposition. In: Schaaf, W., Biemelt, D., Hüttl, R.F. (eds)
Initial development of the artificial catchment 'Chicken Creek' – monitoring program and survey 2005 - 2008.
Ecosystem Development 2, pp. 21-25