

Interactive comment on “Long-term trends of water chemistry in mountain streams in Sweden – slow recovery from acidification” by H. Borg and M. Sundbom

Anonymous Referee #1

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General comments:

This study highlights the value of long-term monitoring in assessing the biogeochemical processes and changes in stream water chemistry in remote areas in Sweden, in response to a period of thirty years of continuous sulphur dioxide emission reduction in Europe, against a background of climate change. In the 1970s, the transboundary character of air pollutants was first robustly established, and anthropogenic SO₂ emissions have been decreasing since then in response to legislative controls. The present study is particularly interesting because it covers the whole period of SO₂ reduction. A recovery of the investigated mountain streams from acidification impacts is clearly shown, and also beneficial effects of remediation measures in the catchment

C4974

area (liming of wetlands) on stream water chemistry. However, the recovery of soils and water bodies in this especially vulnerable area is obviously moderated by complex interactions between climate, hydrology, geology and vegetation.

This paper is based on a careful and original analysis and interpretation of a wealth of monitoring data. The structure of the manuscript is straightforward, and figures and tables are explanatory. In my opinion, this is an interesting article and merits publication.

Specific comments:

1.) Page 12856, line 7: “Acid episodes with pH values less than 5.0 still occurred during the most recent years.” pH=5 could be normal in a peat-bog influenced stream. What is the baseline scenario for pH in these streams when they were, in the past, unforced by anthropogenic environmental impacts?

2.) Page 12858, line 17: “Trace elements such as cadmium also showed lower concentrations and less seasonal variations after liming.” While there are many positive effects of liming, the authors should also mention that liming may affect the peatland ecosystems through significant changes in mosses, lichens, and microbial food webs which constitute a key element in the functioning of peatland ecosystems. Moreover, a long-term lime treatment of soils could result in accumulation of heavy metals. The re-acidification after termination of liming could mobilize the metals from the peat soils and these toxic metals would then be washed away during rainfall periods and snow melt and give rise to stream water contamination.

3.) Page 12864, line 25: “When the acidic deposition on the catchment increased, the groundwater pH also successively decreased, and the Mn(II), Fe(II), and Fe(III) in complexes with FeOOH were dissolved, transported to the streams and then oxidized.” What do you mean by “in complexes with FeOOH”? Particle-bound transport? Please clarify.

C4975

4.) Page 12865, line 14: "In a reference stream (5111), even an increase of sulphate by approximately 1 $\mu\text{eq L}^{-1}\text{yr}^{-1}$ was measured." What are the factors that may have played a role for that increase in sulphate concentrations? Formerly deposited anthropogenic sulphate, stored in the peatlands of the catchment? Or internal sources of sulphate like mineralization of peat (which contains organically bound sulphur) due to droughts or artificial drainage?

Technical corrections:

1.) Abstract: Please explain what the meaning of abbreviations is, e.g. ANC (acid neutralizing capacity?), TOC (total organic carbon?), and please define what is meant by "base cations" (Na^+ , K^+ , Ca^{2+} , Mg^{2+} ...?), BC^* ?

2.) Page 12854, line 16: Concentrations of SO_4^{2-} and Cl^- in meqL^{-1} ?

3) Figure 1: In this map of the study area, one of the snow sampling sites (at 400 m.a.s.l.) is missing.

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