

Interactive comment on “Current, steady-state and historical weathering rates of base cations at two forest sites in northern and southern Sweden: A comparison of three methods” by Sophie Casetou-Gustafson et al.

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Received and published: 4 April 2019

Response to reviewer 1

Reviewer 1 gave very negative opinions of the paper. We have identified three major points that we respond to below.

Lack of any originality / 10 previous papers has shown the same thing It is true that a number of papers have previously compared weathering estimates from the PROFILE model, the depletion method (sometimes named pedon mass balance) and the mass

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balance methods (sometimes referred to as the catchment budget method). In this respect our study contributes incremental knowledge to some aspects of this research area. However, most previous studies synthesize estimates from different investigations that, although they are sometimes from the same site, have not been carried out in a harmonized way as regards exact sampling location, input data, method assumptions and scale (pedon/catchment).

The rationale of our study was to perform a detailed harmonized comparative study at two ecosystem experimental sites with particularly good data on three growth and soil nutrients and where the Norway spruce stands were in the phase where growth and nutrient demand is at its highest level. In several other studies, base cation accumulation in biomass and soil change has been assumed to be negligible or zero to facilitate calculations. In situations where base cation uptake in biomass is high, it dominates the flux of the elements included in the balance (here K, Mg, Ca, not Na), and good estimates of the BC uptake are of particular importance. An additional strength of our data is the high quality in the determination of quantitative mineralogy (XRPD data) and stoichiometry (electron microprobe analysis) which is used in the application of the PROFILE model. Furthermore, in our study the mass balance study was performed at the stand/pedon scale with a system boundary in the soil defined at 50 cm depth. This definition of the soil system reflects the root zone and is more relevant for the forest nutrient sustainability estimates than the catchment scale.

We do not therefore concur that similarity of findings with previous studies is an argument for not publishing the study. The inherent difficulties in studying soil weathering means there are still many uncertainties and knowledge gaps. Also findings that corroborates some general features of the methods compared are of great value (see also manuscript by Akselsson et al. in review of this special issue). We look forward to the opportunity to revise the manuscript with a stronger emphasis on a demonstration of the novelty in our study.

Limited sampling We disagree with the critique that the study is based on too limited

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sampling data. The Asa and Flakaliden experimental sites are random designs with 4 blocks. The statistical design for this type of experiment dictates that it is the plot mean values that are used in the statistical analyses, not the within-plot variation (it would be pseudo-replication). This means that each plot value is based on a number of subsamples. For example, 25 soil cores were taken from each plot, and soil water was sampled from 3 tension lysimeters per plot. Base cation accumulation in tree biomass was based on site- and stand-specific allometric functions were in total 93 trees at Asa and 180 trees were destructively sampled at different occasions during the period of measurements. In the plots, the incremental growth of each tree was measured repeatedly.

Except for the study by Simonsson et al. (2015) who only estimated weathering rate with the mass balance method at one site in Sweden (and focussed on examination of the uncertainty), we have are not aware of any other similar study on this issue with the same high precision in estimating base cation uptake.

In order to avoid any misunderstandings, we propose to update and clarify the description of the sampling carried out .

Incomplete consideration of uncertainties We agree that this comment is relevant. It was also put forward by reviewer 2. As we have described above, the data available means that the manuscript can be improved in relation to this point.

Interactive comment on Biogeosciences Discuss., <https://doi.org/10.5194/bg-2019-47>, 2019.

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