Testing Ion Exchange Resin for quantifying bulk and throughfall deposition of macro and micro-elements on forests

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Overview

This work provides insights into using ion exchange resins for precipitation sampling, both in a controlled laboratory setting and field studies. This is interesting and relevant work, as IER are under used and could provide a cheaper more robust alternative for precipitation sampling in a wide variety of environments. The introduction emphasizes the importance of this work well.

The laboratory studies highlight the feasibility of this approach for a wide variety of analytes under several conditions that mimic the environment, as well as determine an efficient method for extracting analytes from the resin. The field studies show the application of this technique in practice. However, the field studies do have a limited sample size, which could impact their reliability.

I recommend this manuscript for publication in Atmospheric Measurement Techniques, following major revisions. Overall, the statistical analysis of the data is unclear and requires clarity so that readers can be confident in the use of IER for sampling. While the statistical analysis is the major point of concern, please refer to my specific comments below.

Specific Comments

Lines 138-142: I think this info regarding stock solutions and concentrations tested for each nutrient would be easier to read as table. Furthermore, ensure that all chemicals have numbers subscripted.

2.2 Laboratory Tests: were blanks (water with no nutrients in solution) analyzed for both the adsorption capacity and recovery efficiency test? These should be described somewhere within this section.

Line 237: Going back to my previous comment, you mention field and lab blanks here. Be sure to include information on how both were prepared in section 2.2.

Line 265: I am assuming you highlighting data in the "leachate" row of Fig.3, however I think it would be useful to explicitly direct the reader to that portion of the figure.

Figure 3: Do these represent average values across several trails? Finding a way to include standard deviations for this data, if so. This might help support your claim that certain nutrients had decreased capacity when loading was increased. Were t-tests done (or any statistical analysis) to support that these values are indeed different from each other?

Lines 289-290: This sentence is really confusing and I was having a difficult time connecting it to the data presented in Table 3.

Line 292: What does 4-2-1M indicate? This needs more description.

Table 3: Is there a way to incorporate the statistics presented in Table S3 into this main table?

Table 3: What does the column labeled "Mol" represent? I'm seeing here the dashed values again (ex: 1-2). This needs some clarity. In addition, is the Avg column necessary? This accounts for some poor recoveries for some species and artificially makes the method look reasonable. I think this will allow readers to justify using a less than optimal extraction technique.

Figure 4: Do the percentages indicate canopy cover? Please provide that detail in the figure caption.

Table 5: Either ensure that the variations in the intercept and slope are on the same line or create a separate row title for these values. It's challenging to read.

Line 324: Why was an ANOVA done of the comparison of IER method to water-method if there were only two categories? If I'm missing additional categories, then this needs emphasized.

Line 325: What were the treatments analyzed using the Tukey's test? The lines surrounding this sentence could use additional clarification so the reader understands what is being compared.

Line 326: I'm not sure how Figure S1 is displaying statistical data.

Line 326: Sometimes the authors refer to canopy openness in terms of percentages and other times using words like "clear cut". Using consistent terminology would be useful if these are supposed to represent the same samples.

Line 328: Is these supposed to refer the reader to Figure S4? If not, I'm missing how Fig. 4 connects to your statement.

Line 335: How was the loading capacity for the resin determined? If obtained from the supplier this might be pertinent information to include in the methods section (either directly in the text or as a supplemental table).

Line 339: How did you determine this 70% if you didn't test below 100%? This statement is confusing.

Section 4.1 Adsorption capacity: In general, how can there still be 100% adsorption if the resin is loaded above its capacity? Is this trying to emphasize that the determined capacity is an underestimation?

Line 390: Is the highest recovery for each element bolded in Table 3. If may be useful to indicate that and provide an explanation for why values over 100 were not considered.

Line 395: I am not sure how this statement related to the data provided in Table S3. Provide some clarity here.