Cost Effective Off-Grid Automatic Precipitation Samplers for Pollutant and Biogeochemical Atmospheric Deposition

Overview:

The paper outlines the design of an automatic precipitation sampler for off-grid use. It is suitable for measuring pH, conductivity, and dissolved organic carbon. The new sampler was tested in the Newfoundland and Labrador Boreal Ecosystem Latitudinal Transect over a two-year period for open-fall and throughfall precipitation. A notable disadvantage to this sampler is the inability to collect snowfall, limiting year-round monitoring of precipitation.

This work is of great interest to atmospheric scientists and is within the scope of the journal. Overall, this work is appropriate for acceptance in AMT following the revisions outlined below. The revisions mostly focus on reformatting, reducing lengthy descriptions, and improving clarity (particularly in the introduction and results/discussion sections).

Specific Comments:

Introduction

Overall, the introduction is very lengthy. Finding ways to pare down this material would allow for clarity of the important topics related to this work.

Line 74-91: It seems like this paragraph is trying to introduce pH, conductivity, and DOC, however it is hard to separate the information of these three topics from each other. The discussion of pH, conductivity, and DOC are mixed together, making it hard for the reader to parse out the relevant information for each topic. This paragraph needs to be revised and simplified.

Line 119-132: This paragraph discusses persistent organic pollutants (POPs), which the authors do not monitor during the testing period presented in this work. This paragraph could be removed from the introduction and incorporated later as a future use for the sampler.

Line 152-165: This paragraph discusses monitoring reactive nitrogen in atmospheric deposition, however this was not a focus of the precipitation characteristics (pH, conductivity, and DOC) that was highlighted in the results. If this does in fact connect with those three characteristics, those connections need to be made clearer, or this paragraph can be removed.

Materials and Methods

Line 305-306: Is the conductivity that triggers the sensor typically for that of precipitation (both in your geographic region and others)? I wonder about the variability of precipitation globally and if this would cause differences in sampling. In addition, what is the time delay for the lid opening once triggered?

Results and Discussion

Overall, I think the results and discussion could be reformatted. It was confusing to read and keep track of the sampler's validation results and how you were actually applying the sampler to gain new information (like TF and OF comparisons). I appreciate the "General Design Advantages" section to highlight the ability to use this sampler in remote locations and to collect replicates.

Line 681: If there is a lot of data missing from the ECCC monitoring site, why would you choose this dataset for your comparisons?

Line 689-690: The R^2 values are presented in a confusing manner, especially the ones found in parentheses. Please make it more clear which value corresponds to which site.

Overall, Section 3.3 Comparison of Sample Collection Volumes is very long and feels repetitive. This section should be made more concise.

Line 815-819: Mentioning and comparing the pH of the TF samples to the pH of the soil in that area seems like extraneous information. Why are you making this comparison? If it's truly needed, provide some justification or explanation as to why this is important.

Line 893-894: p-values to support your statements that the conductivity of $HgCl_2$ in water is comparable to field blanks and less than your samples would strengthen this argument.

Section 3.4.2 – Most other sections have a comparison of OF and TF samples, but this one does not. Was that intentional? A brief statement comparing these two would be great.

Line 958-963: You mention wildfire plumes being a potential cause of increased DOC levels in precipitation. Was there a wildfire event near your sites during your sampling period to warrant mentioning this possibility? Or would the possibility of increased DOC still be observed some amount of time after a wildfire event? In order to justify including this argument, I would like to see if you could make a potential correlation to an actual event that may explain this.

The discussion on DOC seems less than a validation of instrument performance, but rather a capability of the sampler. Unless you have DOC data from your sampling locations to compare to, this seems like new information for remote sampling sites.

Line 1014: what evidence do you have that supports the same that the automated system better maintains the integrity of DOC in samples?

<u>Technical Corrections</u>

Starting with section 3.4.3 – it is mentioned that flux (with the units: mg C m^{-2} d^{-1}) is used. However, at several points in this discussion flux is given as mg C m^{-2} a^{-1}. I'm providing a list locations I've found this mistake, but please check throughout the manuscript for places I may have missed:

Lines 50, 921, 925, 944, 955, 966, 997, 998, 1001