Atmospheric Chemistry and Physics Discussions

Atmos. Chem. Phys. Discuss., referee comment RC1
https://doi.org/10.5194/acp-2022-392-RC1, 2022

Comment on acp-2022-392

Santtu Mikkonen (Referee)

Referee comment on "Measurement report: Increasing trend of atmospheric ion concentrations in the boreal forest" by Juha Sulo et al., Atmos. Chem. Phys. Discuss., https://doi.org/10.5194/acp-2022-392-RC1, 2022

Review of Sulo et al "*Measurement Report: Increasing trend of atmospheric ion concentrations in the boreal forest*"

The manuscript introduces an interesting result on increasing atmospheric ion concentration, especially as it has been shown that the aerosol particle concentrations are at the same time decreasing. The authors state that the manuscript gives the first proper assessment to atmospheric ions, which increases the value of this work if true. As other measurement sites are also starting to have long ion time series, this would be a nice reference point for comparing trends in different environments. The topic fits well to scope of ACP and I could recommend publishing it if the concerns below will be properly addressed.

Major comment:

My main concern is that the statistical methods are inadequately described and confusion in terminology raises concern that were the methods used properly and thus are the results valid. See my specific comments for details.

Specific comments:

Page 2 lines 63-64: Equations are rarely seen in Introduction section, as it is meant to give more general background information. Consider restructuring the text.

Page 3, lines 89-90: Does the change of instrument location affect the radiation measurements?

Page 7, lines 161-164: It is invariably true that the presence of autocorrelation needs to be accounted for but prewhitening is not necessary the best method for that. PW loses information on the time series and thus sometimes it may cause a significant trend not to be detected (see e.g. Razavi&Vogel, 2018). If the trend can be assumed monotonic, then Sen's slope is a proper choice and the significance for that can be tested without MK-test, and thus without prewhitening. This has been done e.g. in Leinonen et al. (2022) with bootstrap-based confidence intervals. Sen's slope can be correct for autocorrelation with method by Kunsch (1989), if needed. If the trend cannot be assumed monotonic, then more proper methods should be used, like dynamic linear models (DLM, Laine 2020). With DLM, also seasonal variation and other cyclic structures or sources of measurement error can be accounted for.

Page 7, lines 165-166: How were the validity of assumptions for n-ANOVA tested?

Table 3: Write in caption what does the interval within brackets indicate (same thing with Figures 4 and 5)

Section 3.2.3: Here is a slight confusion: Are you conducting here analysis of variance (ANOVA) or linear regression? From your results I would say the latter. Specify the model you are applying here and give the coefficients for the parameters at least in the appendix. Are the associations between variables assumed linear? Did you check how the residuals of your models look like? What is the time resolution of the data you are using in these analyses?

Figure 8: On what do you refer with R2? How were the individual R2 values derived? Are these sub-values from multivariable model (what is then the total R2?) or from separate bivariate models? If the model was multivariable, how was it constructed? Did you have all the predictors in the model at the same time, even if no significant? Did you check it for multicollinearity?

Line 295: please elaborate what you mean about this. Do you mean seasonal variation or really variance (see definition for that)? how do you estimate that with monthly medians? How does your model for this look like? With properly selected models, you can take the seasonal variation and the long term trend account at the same time.

References

Kunsch, H. R.: The Jackknife and the Bootstrap for General Stationary Observations, Ann. Stat., 17(3), 1217–1241, doi:10.1214/aos/1176347265, 1989.

Laine, M. : Introduction to Dynamic Linear Models for Time Series Analysis. in book: Geodetic Time Series Analysis in Earth Sciences, pp 139-156, doi: 10.1007/978-3-030-21718-1_4, 2020

Leinonen, V., Kokkola, H., Yli-Juuti, T., Mielonen, T., Kühn, T., Nieminen, T., Heikkinen, S., Miinalainen, T., Bergman, T., Carslaw, K., Decesari, S., Fiebig, M., Hussein, T., Kivekäs, N., Kulmala, M., Leskinen, A., Massling, A., Mihalopoulos, N., Mulcahy, J. P., Noe, S. M., van Noije, T., O'Connor, F. M., O'Dowd, C., Olivie, D., Pernov, J. B., Petäjä, T., Seland, Ø., Schulz, M., Scott, C. E., Skov, H., Swietlicki, E., Tuch, T., Wiedensohler, A., Virtanen, A., and Mikkonen, S.: Comparison of particle number size distribution trends in ground measurements and climate models, Atmos. Chem. Phys. Discuss. [preprint], https://doi.org/10.5194/acp-2022-225, in review, 2022.

Razavi S., R. Vogel: Prewhitening of hydroclimatic time series? Implications for inferred change and variability across time scales, Journal of Hydrology, Volume 557, 2018, Pages 109-115, https://doi.org/10.1016/j.jhydrol.2017.11.053.