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Atmospheric
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Discussions

Interactive comment on "A statistical proxy for sulphuric acid concentration" *by* S. Mikkonen et al.

Anonymous Referee #2

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In this manuscript, the authors seek to derive a proxy for sulfuric acid vapor concentration ([H2SO4]) from measurements taken at six sites. A number of different proxy functions (both linear and non-linear) have been tested. The best formulation of the [H2SO4] proxy uses global solar radiation, SO2 concentration, condensation sink (CS) and relative humidity (RH) as predictor variables. Nevertheless, the role of the CS (and RH) in the proxy was found to be only minor, since similarly accurate proxies could be constructed with global solar radiation and SO2 concentration alone. The derived power dependence of [H2SO4] on key parameters has been shown to be far different from those of theoretical values. While [H2SO4] proxy functions have been derived in previous studies, this study extends such studies by using data from more sites. The content of the manuscript is within the scope of ACP. Below I give my comments and suggestions for improvement.

1. It is hard to understand that [H2SO4] is determined by global solar radiation and SO2 concentration alone. The authors state that this could be attributed to SO2 being an indicator for anthropogenic pollution which represent sinks for the OH radical. Please provide some chemical mechanisms connecting anthropogenic pollution with OH concentrations. Can the Proxy L3 be applied to power plant plumes where SO2 concentration is very high and remote and marine air where SO2 concentration is very low? What about under the conditions that CS is dominated by sea salt, dust, and biomass burning emissions?

2. CS and RH. Theoretically there is no doubt that CS is a key parameter determining [H2SO4]. The dependence of CS on RH is nonlinear, especially when RH>$\sim$70-80%. Also the effect of RH on CS depends on the composition of particles. To use CSdry*RH to approximate wet (i.e., total) CS is questionable. What is the justification to use CSdry*RH as the total CS? Could the errors associated with this approximation affect the results?

3. As the authors mentioned, [H2SO4] proxy functions have been derived in previous studies with the limited data. It is necessary to discuss the difference between the present proxy functions and previous ones. How much is the improvement?

4. I would be useful if the authors can estimate the uncertainty of predicted [H2SO4] based on their derived proxy functions. The limitation of recommended proxy formulation should be discussed.

5. p20148, L5-6. Also Table 2. Are the values given in Table 2 for whole period of measurements (day and night)? Since [H2SO4] is generally very small at night. It is more relevant to consider the daytime data only for the statistical analysis presented in Table 2.

6. p20151, second paragraph and Figure 3. Figure 3 is exactly the same as Figure 2. Need to provide the right Figure 3.

7. p 20152, L25-27. Why? In the same paragraph, the authors cited several references to show that steady-state assumption should hold. Could the authors give some theoretical arguments under what conditions that the steady state assumption is unrealistic and why?

8. p 20153, L10-14. Please provide some details of the nonlinear fitting procedures. Why this method can take account the non-equilibrium conditions?

9. p 20153, L24-25. Could this an indication of the problem in the fitting method? I think this should be reflected in the abstract.

10. Equation N5c. What are the values of Ii used in this study?

11. If possible, the authors should publish the data they used in their analysis as supplementary materials so that interested readers can independently look into the issues and assess the derivations.

Interactive comment on Atmos. Chem. Phys. Discuss., 11, 20141, 2011.