

Atmos. Chem. Phys. Discuss., referee comment RC1
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Comment on acp-2022-166

Anonymous Referee #1

Referee comment on "Sulfuric acid in the Amazon basin: measurements and evaluation of existing sulfuric acid proxies" by Deanna C. Myers et al., Atmos. Chem. Phys. Discuss., <https://doi.org/10.5194/acp-2022-166-RC1>, 2022

In this work, the authors examined different parameterization schemes for sulfuric acid (H_2SO_4) concentrations in the Amazon Basin. H_2SO_4 is the key species for new particle formation, and since it is not easily measured, models often need to use proxies based on other measurements that are more readily available. In this work, H_2SO_4 measurements were made in the Amazon Basin, and the authors examined how well each parameterization proxy describe H_2SO_4 concentrations. The main finding is that a proxy that incorporates a secondary non-photochemical source of OH is needed to explain H_2SO_4 concentrations in the Amazon forest. Also, reaction of SO_2 with Criegee Intermediates is also needed.

The manuscript is very well written and easy to follow, so I do not have any line-by-line comments. I only have some high-level questions mostly for my own curiosity. I leave it up to the authors to decide whether my comments/suggestions should be considered. In my opinion, the manuscript in its current form is a valuable contribution to the literature.

Main comments:

I am curious why from Dada et al. (2020) that the Criegee term does not include a sink for Criegee intermediates. The fate of Criegee Intermediates would depend on RH and perhaps concentrations of organic acids.

Similar to that comment: I expect that the Criegee + SO_2 rate to be quite dependent on alkene type, which may be significantly different between boreal and tropical forests. How much does changing the coefficients in Proxy 4 improve the estimations?

Since the authors believe that secondary OH production (especially under low-light or nighttime conditions) is likely underestimated, why can't the OH concentrations measured directly be used in Proxy 4 to see if how much that improves estimation?

Related to my previous comment: if OH itself cannot explain the discrepancy, I wonder if there are other SO₂ oxidation pathways that need to be taken into account. There is a recent boom in SO₂ oxidation literature and proposed mechanisms. Some of these mechanisms (will need to be homogeneous) may be applicable. This is speculative and depends on what the authors may find from my previous suggestion.

Minor comments:

In Figure 2, the R² for both Proxy 1 and Proxy 2 are 0.46. Is this a coincidence or is there a mistake? It may be useful to show the slopes of the regression too.

I prefer the × symbol over the letter x in scientific notation.