

## Review of amt-2021-58

The authors have addressed most of my initial concerns, however I still take issue with the implemented “arch effect” correction which I believe needs to be considered before the manuscript can be published.

### General Comments

In my opinion the correction is not really necessary for the analysis that follows, but if it is to be included then statements made about it need to be justified which in many places they are not. To be clear, the authors use the correction to attempt to improve the resulting extinction profiles in two, somewhat coupled, ways: first to get a better sense of the locality of the Raikoke plume, and second to get a better extinction estimates from OMPS-LP. The first point is fine, I take no issue with, and might be important for the discussion for the CCC. The second point is the one that I have a problem with. There is no evidence presented that the correction is improving the extinction, and in fact I believe it is making it worse. As I stated previously my intuition is that a 1D retrieval is smoothing the true field into the shape of an arch, not simply introducing unphysical arches. This means that the overall extinction loading is relatively unaffected by the biases in a 1D retrieval, and yet the correction is significantly reducing the loading. Now, I fully admit that I might be wrong, but there is no justification at all in the manuscript for the efficacy of the correction and there are figures in the manuscript that suggest the correction is not working (see specific comments).

If justification for the correction cannot be provided then my preference would be to remove it, or at least use it only to assess the locality of the plume and not the overall loading. As I previously stated, I would also be fine if the correction was presented as a potential source of error instead of an actual correction. This is still okay, but it would mean that the correction is not applied and the differences are only used as uncertainty estimates. The authors additional statement that “We consider this procedure of correction only as an estimate” does not go far enough since they then continue to use the corrected extinction as gospel.

I have a few specific comments below, all related to the arch effect.

### Specific Comments

**p.5 l.153:** The statement “If we believe that these lower altitude values do not represent a true aerosol signal, we need to apply a correction in order to accurately determine overall aerosol loading.” neglects the fact that a 1D retrieval is probably smoothing the true field, reducing the extinction inside the plume in addition to creating arches. Performing the correction will do more harm than good if the 1d effect is more of a smoothing effect.

**p.8 l.210:** The statement “The arch effect characteristic of the limb observations should be taken into account when calculating the optical thickness of aerosol clouds” simply is not justified with any of the information presented in the manuscript. If the effect is to be included there needs to be some evidence provided that it is improving the result.

**Figure 5:** I have the same comment I had last time since I do not believe it was sufficiently answered. Why is the correction reducing the extinction by ~50% before the eruption even happens? To me this is evidence that the correction is not working as it should. Essentially this is saying that every limb sounder is overestimating aerosol extinction by upwards of 30-50% in clear conditions?

**Figure 10:** This is maybe more of a comment. SAGE III is affected by the same 1D retrieval bias, the authors are suggesting that it could be biased by 30-40%, so why is it usable here? I realize the same correction cannot be applied to the sparse sampling of SAGE III, but the fact that the manuscript does not mention this issue seems odd if it is as important as the authors claim.

**p.22 1.469:** “We have shown that this effect is significant” the only way to show this effect is significant is to simulate 2D radiances and then retrieve in 1D. You have shown that a very specific correction technique, which may or may not work, introduces significant differences.