Second review of

Four-dimensional Variational Assimilation for SO$_2$ Emission and its Application around the COVID-19 lockdown in the spring 2020 over China

by

Yiwen Hu et al.

Overall comments

I appreciate the authors' revisions to the manuscript and believe it is stronger. In particular, the data assimilation system and experiments are more clearly described. I think the manuscript is nearly ready for publication and only have minor comments for the authors to further consider.

At this point, I think the biggest issue is the grammar. There are many errors and typos, and I encourage the authors to fix as many as they can prior to publication.

Minor comments

1. Line 28: Perhaps I missed it, but I didn't see this information about exactly 200% and 300% increases of correlation coefficient in the main text. This information should be noted in the main text if you want to state it in the abstract.
2. Line 30: 238.7% is inconsistent with lines 426 and 457. Line 426 says the increase of correlation was 238.7%, but line 457 says it was a 201.3% increase. The values in lines 30, 426, and 457 should be identical.
3. Line 107: Please point specifically to Fig. 1a.
4. Line 120: Please abbreviate Energy Golden Triangle in the caption.
5. Fig. 1 caption (line 124): Please remove "which belongs to China" (sounds too political).
6. Line 171: Please remove "large".
7. Lines 192-193: Please remove the sentence beginning with "The representative error…". It's out of place, and it's an also an inaccurate statement.
8. Line 195: Typo in the reference ("er al."), and I didn't catch this in the reference list (could have missed it).
9. Line 200: Did you mean Eq. (12) instead of Eq. (10)?
10. Lines 291-292: The statement "From the observed…" is not a proper sentence. Please revise.
11. Lines 300-302: Please make sure all these specific values in the text exactly match those annotated on the figure. For instance, in line 300, 2.8 should be 2.76 and 1.8 should be 1.79.
12. Fig. 5d: Instead of "control" and "DA" in the legend, please call it "background" and "analysis".
13. Lines 321-322: This sentence can be removed, as it's the same as lines 306-308.
14. Lines 330, 443, and elsewhere: Because you did not perform formal statistical significance testing, please don't use the word "significant". A better word is "substantial".
15. Fig. 7b: Are the units percent? If so, please state. Same comment for Fig. 9b.

16. Lines 364, 379, 400, and 449: Instead of writing "2019" and "2020", please write Emi_2019 and Emi_2020 for consistency with Table 2 and clarity.
17. Fig. 10: It might be helpful to change the black dotted lines to red dotted lines to more easily see the correspondence with 2020.
18. Lines 438-441: Please omit. These are not key findings that need to be recapped.