Review: "The enhanced capabilities of mid-infrared limb emission sounding to observe stratospheric aerosol injection geoengineering interventions"

The authors analyse the capabilities of a potential future high-spectral-resolution mid-infrared limb emission sounding instrument for detecting and monitoring potential SAI deployments.
Overall, I find this an interesting study, however, in its current form, the manuscript requires revisions before it can be considered for publication. I recommend another round of reviews.

Below are some general and specific comments intended to improve the manuscript.

General comments

1. Throughout the manuscript, the authors repeatedly refer to 'weak' or 'very weak' SAI scenarios without specifying the corresponding injection rates or aerosol loadings. I strongly recommend that all SAI scenarios be clearly defined in terms of injection rate. The manuscript gains greater depth and clearer statements when it refers to more quantitative measures rather than qualitative and ambiguous expressions.

2. The manuscript uses the terms 'geoengineering', 'SAI', and 'SAI geoengineering' interchangeably and without a clear definitional framework. Since the study focuses specifically on stratospheric aerosol injection, I recommend adopting SAI as the primary term. Consistent terminology is not merely a stylistic concern, it is essential for clarity, precision, and to avoid ambiguity, particularly given the broad and sometimes contested use of the term 'geoengineering' in the literature.

Specific comments

1. Title: "... stratospheric aerosol injection geoengineering interventions". Unfortunately, the list of terms overlaps and is redundant. Stratospheric aerosol injections (SAI) are a form of (solar) geoengineering and already involve deliberate intervention. I recommend using only the term 'stratospheric aerosol injections' in the title. If there is a valid reason for this combination of terms, please explain.

2. l. 19: "...of a high-spectral-resolution limb-emission sounding technique..." or "...of high-spectral-resolution limb-emission sounding techniques...".

3. l. 19: "very weak", please provide quantitative information rather than ambiguous qualitative descriptions. Please make this change here and throughout the manuscript.

4. l. 20: "stratospheric aerosol injections geoengineering interventions", please see my comments above. Please make this change here and throughout the manuscript.

5. l. 24: "unilaterally/illegally": But only with regard to the injection rates examined here. Illegal

injections are very unlikely to occur evenly between 30° N/S and 15° N/S. Please rephrase this here and throughout the manuscript.

6. l. 106: "We assess the capabilities of CAIRT to detect extremely small amounts of SO_2". Please be more precise (here and throughout the manuscript).

7. l. 141: "The solar geoengineering scenario" or "The stratospheric aerosol injection scenario".

8. l. 157: "In this geoengineering simulation..." - see my comments above. Please make this change here and throughout the manuscript.

9. l. 160: Please add the injection height.

10. l. 168: The difference between volcanic eruptions and potential SAI is not clearly pointed out here. Continuously injected sulphur amounts lead to much lower injection amounts per time compared to a volcanic eruption with the same amount injected. Please rephrase it here and throughout the manuscript.

11. l. 205: through?

12. Fig. 3: Maybe a different colour combination instead of orange and green? Or use different line styles.

13. l. 235: "The weaker SO_2 injection...", please be more precise. Change it here and throughout the manuscript.

14. l. 248: What is the corresponding radiative forcing?

15. Fig. 8: Some panels have y-ticks and some don't?

16. l. 308: "... CAIRT's extensive spatiotemporal coverage...". Please be more specific and provide us with the quantitative information here. So far, this is purely a qualitative and ambiguous statement.

17. l. 323: Where is the 5 - 10 % error range coming from?

18. l. 326: Unfortunately, that statement is not correct. The statement in Lange et al. is not that SAI deployments of less than 1 Tg S/y cannot be detected, but rather that 1 Tg S/y can definitely be detected. Furthermore, the study also examines the first month of the initial phase – at that point, only 1/12 of the injected amount had been released, which could not be distinguished from natural variability. Please rephrase.

19. l. 328: OK, but you can't compare continuous injections to volcanic eruptions, even if they involve the same amount of injection. Continuous injections result in much smaller injected amounts per time compared to a volcanic eruptions with the same amount injected.

20. l. 378: "... our results stress the importance of increasing our global observational capabilities...". As the manuscript currently is, I do not agree with this statement. Please elaborate on this point and revise the manuscript accordingly.