Manuscript number: egusphere-2025-697
Full title: Satellite-based estimation of contrail cirrus cloud radiative forcing derived through a Rapid Contrail-RF Estimation Approach
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The authors developed a rapid system for evaluating contrail radiative forcing using geostationary satellite observations, a contrail cirrus detection algorithm, and look-up tables constructed from a radiative transfer model. The authors analyzed several days of datasets that include detected contrail cirrus clouds to estimate the shortwave, longwave, and net radiative effects of contrail cirrus and validate the resultant estimations with those from CERES products, showing the accuracy of the estimated "contrail" radiative forcing to be about 15%. The present paper shows novel results regarding the contrail radiative forcing estimation with careful uncertainty evaluations and quantification. The topic in the present paper is suitable for *Atmospheric Measurement Techniques (AMT)*. However, the present contrail RF estimation relies on the accuracy of the contrail detection algorithm, and the authors do not describe the performance evaluation of the detection algorithm. This manuscript requires major revisions before reconsideration of publication. Please find the specific comments below.

Major comments

1. **Uncertainty of the contrail cirrus detection and separation methods:** The algorithms for the contrail detection and separation from natural cirrus clouds would be among the key factors that impact the contrail RF estimations. However, I do not see any description regarding the accuracy of the present contrail detection/separation method (e.g., Page 5, Lines 124-127). In addition, the descriptions in Lines 305-307 let me suspect the possibility of misdetection of natural cirrus clouds as contrail cirrus because the authors applied a very simple CTP filter to detect contrails. Finally, this suspicion became more confident with the scatter plot of COTs in Fig. 17 that shows COTs of contrail cirrus clouds to be optically thicker than ~3 for most of the cases and thicker than 20 for some cases. I do not think that these are all from contrail cirrus clouds. Although the authors show a contrail cirrus case in Figs. 7-8, it is not sufficient to inform of the accuracy of the contrail detection method. Without a solid validation of the contrail detection/separation method, the representativeness of the quantitative estimation of the "contrail" RF is questionable. The authors should at least provide quantitative discussions of the contrail detection/separation methods or cite the reference that describes a comprehensive validation of the method.
2. **Discussion of contrail RF does not contrast with previous studies.** Previous studies have also evaluated contrail RF, but the present study did not compare their estimations with those estimated through the previous studies. The authors should discuss the results with the previous studies in terms of contrail RF [1-3] and optical properties [4-5]. I suspect that the estimated contrail RF in the present study is too large compared to these previous studies, even if cloud fractions are taken into account.

Minor comments

1. Page 1, Line 17 "Wielicki et al. (1995)": This should be "(Wielicki et al., 1995)". This type of error is seen throughout the manuscript, and I suggest the authors double-check the reference format.

2. Page 2, Line 29: Use parentheses for the references.
3. Page 2, Lines 33: “later properties of the persistent contrail cirrus clouds” sounds a bit odd. Probably, rephrase it with “the properties of the resultant persistent contrail cirrus clouds.”
4. Page 5, Line 133 “DEKOUTSIDIS and FEIDAS”: Use lower cases for the reference.
5. Page 5, Lines 136-138: Ill-posed problem is the condition that the measurements do not have sufficient information to unambiguously estimate the state vector. I suggest the authors improve the descriptions.
6. Page 12, Lines 281-282: What is the lower detection limit of contrails (in terms of COT)?
7. Page 153 Line 307: “note” should be “noted”
8. Page 14, Line 317: Please check the required format for the subsection. Should the subsection start from 0?
9. Page 16, Line 345 “likely due to the still nighttime conditions in this region”: This will become unambiguous if the authors co-plot SZA along UTC in Fig. 10.
10. Figure 13: I suggest the authors take off the legends in (a-b) as they overlap with plots and are redundant. Also, the caption needs to describe what the symbols (i.e., circles and stars) indicate.
11. Page 26, Line 499 “some”: This should be deleted.
12. Page 28, Lines 533-534: I think that the statement should be restricted to the region of interest (i.e., Europe) and suggest the authors revise the corresponding description to be “…provides promising results over the region of interest.”

Reference

[1] Kärcher, B. (2018). Formation and radiative forcing of contrail cirrus. *Nature communications*, *9*(1), 1824.

[2] Burkhardt, U., & Kärcher, B. (2011). Global radiative forcing from contrail cirrus. *Nature climate change*, *1*(1), 54-58.

[3] Chen, C. C., & Gettelman, A. (2013). Simulated radiative forcing from contrails and contrail cirrus. *Atmospheric Chemistry and Physics*, *13*(24), 12525-12536.

[4] Iwabuchi, H., Yang, P., Liou, K. N., & Minnis, P. (2012). Physical and optical properties of persistent contrails: Climatology and interpretation. *Journal of Geophysical Research: Atmospheres*, *117*(D6).

[5] Schumann, U., Baumann, R., Baumgardner, D., Bedka, S. T., Duda, D. P., Freudenthaler, V., ... & Wang, Z. (2017). Properties of individual contrails: a compilation of observations and some comparisons. *Atmospheric Chemistry and Physics*, *17*(1), 403-438.