

Atmos. Meas. Tech. Discuss., referee comment RC2
<https://doi.org/10.5194/amt-2022-305-RC2>, 2022
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Comment on amt-2022-305

Anonymous Referee #2

Referee comment on "Diurnal carbon monoxide observed from a geostationary infrared hyperspectral sounder: First result from GIIRS onboard FengYun-4B" by Zhao-Cheng Zeng et al., Atmos. Meas. Tech. Discuss., <https://doi.org/10.5194/amt-2022-305-RC2>, 2022

This study describes the CO retrieval algorithm for the geostationary GIIRS sounders on board FY-4B satellite. The paper is in general well explained and clear, particularly for the algorithm, however some information or clarification are missing.

Comments:

Ln 9: The year of when the sounder was launched should be indicated in the abstract to inform the reader.

Ln 10: how having hyperspectral measurements of CO provide diurnal observation of CO? I would think that having geostationary CO data allow observation of diurnal CO variability. Could you reformulate your sentence or give more precision?

Ln 34. I would maybe say "(GEO) orbit can provide contiguous coverage with similar or higher spatial resolution than LEO and a revisit time of 1-2 hours [...]" or a similar sentence. Because, GIIRS has the same spatial resolution than IASI (12km diameter at nadir).

Ln. 89: Figure A1. b and c, are these figures for the same day as Fig. A1.a?

Fig. 1b. The values on Fig. 1B are a too small.

Fig. 1c. It would be interesting to have, as well, the Jacobian by pressure (the ones used for the radiative transfer model). This would inform on the variability that GIIRS channels sensitivity have depending on atmospheric pressure. Additionally, there is no comment on this figure. What do you conclude with this figure in term of sensitivity for CO and H₂O with GIIRS?

Ln. 171. You computed 3-hourly CO profile climatology for each month, which month are you talking about? The period of study has not been introduced yet, except result for July 2022 introduced in the abstract.

Ln. 174. Should be "2080 cm⁻¹ to 2120 cm⁻¹".

Ln. 194. "The number of pressure grids in the forward RT model should be large enough to reduce the error [...]". A reference is missing here regarding this remark.

Ln 262: To be consistent, I would write the title as "Averaging kernel (AK) matrix and Degree of Freedom for Signal (DOFS)"

Ln. 276. How much data are removed after the quality filter? Similarly, how much data are removed before and after labeled clear sky for the period of your study, before the post-screening is done?

Ln. 289. Could you precise why you added a Gaussian white noise? Is the added noise mentioned Ln 291 referring to the Gaussian white noise. If yes, then Ln 291 should appear just after the white noise is mentioned Ln. 289.

Ln. 293. You could introduce a map to visualize the regions of interest.

Ln. 304. How can you conclude that from Figure 2?

Ln. 314.: The results of Figure 3 are only for North China Plain, but have you done it also for the two other regions? Mongolia has a more complex diurnal TC change than North China Plain but the surface pressure/topography is also different between the two regions. Would the results of Figure 3 be the same for Mongolia region or not?

Ln. 315. It is confusing, the "truth" is based on the ECMWF EAC4 results but it is also used

as CO a priori profile in your retrieval algorithm, so what is the difference between the comparison of (1) and (2)? How can you compare the retrievals to ECMWF EAC4, if you already used this CO profile as a priori profile in your retrieval algorithm (see Ln. 291)?

Ln. 470-479: Talking about wildfires, during the month of July 2022, several wildfires occurred in Siberia. The transport and mixing of CO in the Northern Hemisphere might have bring CO concentrations from the Siberian fires to the regions of your study. Have you looked at that? The ECMWF EAC4 and ER5 simulation/reanalysis used in your algorithm do not include 2022 and so might not be representative of CO concentrations for the month of July 2022. It is difficult to determine if your retrievals are well representative of July 2022 consequently. It could be then interesting to have evaluation of your L2 retrievals to in situ data.

Appendix A: Figure A1.a is not used in the study. Considering the wildfires in July 2022, was there fire CO emissions included in CAMS model?

This study was only done for a summer month, but have you look at other season? The diurnal cycle might be associated to meteorological conditions and emissions patterns different by season. Additionally, having hourly data and comparing North China with Mongolia and East China Sea, I was wondering if you looked at the difference in CO concentration between these regions during the daytime. I would expect to observe highest concentration for North China than Mongolia during the morning time corresponding to rush hours, however this would depend on synoptic disturbances.