Comments :

The paper demonstrates the application of an atmospheric inversion method to estimate China's methane emissions from 2019 to 2024, identifying key sectors such as livestock, waste, rice cultivation, and oil and gas as major drivers of the observed emission increase. The manuscript is well written, and the results are clearly presented. I have a few questions and suggestions.

1. The manuscript states that lognormal priors produced less stable posterior scaling factors than Gaussian priors, particularly in weakly constrained regions. However, no supporting diagnostics or sensitivity analyses are provided. Please provide quantitative evidence (e.g., posterior spread, convergence behavior, or ensemble stability metrics) to justify this choice.
2. In addition, the use of a minimum scaling factor of 0.001 to avoid negative emissions requires further clarification. The choice of this threshold appears arbitrary, and no sensitivity analysis is presented. Since truncating the Gaussian prior alters the probability density function and introduces a positive bias, please quantify: How often were negative samples generated? How sensitive are posterior emissions to the different lower-bound thresholds (e.g., 0, 0.0001, 0.01) ?
3. In Figure 1, please add markers indicating the locations of the ground-based stations, which would help illustrate the observation density at these sites. Additionally, how does the mean bias change during periods with higher observation density, such as specific months, weeks, or years? Compared to the ground-based stations, TAP shows a decrease in mean bias, while other stations show an increasing trend. What about RMSE and mean absolute error, do these metrics also show improvement? Furthermore, when comparing posterior simulations for the 2019 data, do you observe improvements across all locations, as reported in Chen et al. (2022)?
4. How does the posterior simulation compare with GOSAT observations? Do the mean bias, RMSE, and mean absolute error also show improvements.
5. Line 361: Is this comparison with UNFCCC for the year 2020? If not, please compare with the corresponding year. The anthropogenic emissions also differ from FAO and EDGAR v8 , what could be the reason for these discrepancies? Does FAO use different emission factors or activity data compared to EDGAR v8? What methodology is used in EDGAR v8 to estimate emissions? Including such context would help readers better understand the differences.
6. Line 371: The uncertainty and the rate of emission increase are both reported as 0.7 Tg yr^{-1}, could you clarify what might explain this similarity? What could be the possible reasons for the post-COVID increase in emissions? What could be the reasons for the observed decrease in coal mining emissions over Guizhou? Was there any policy changes in the state or province government?
7. Sectoral prior and posterior emission values for 2019 and 2024 are missing, which makes it difficult to assess relative changes. Additionally, Figure S3 does not include the relative change in dairy cow population, which would be helpful for interpretation.

8. In particular, the larger changes in waste-related emissions are reported in Henan and Heilongjiang. Where are these changes primarily occurring in urban areas or more remote regions? what have been the population changes in these regions from 2019 to 2024, and has per-capita waste generation also changed? Clarifying these aspects would help better identify locations where mitigation efforts may need to be prioritized.
9. How has OH changed over the six-year period? If this variation is not accounted for in the inversion, could it introduce additional uncertainty in the emission estimates?
10. As TROPOMI retrievals are influenced by haze, did you filter out such days over China? What impact does haze have on the estimated emissions over China?
11. In the waste sector, some countries show significantly higher emissions in hotspot regions in EDGAR v8 compared to EDGAR v7. Do you observe similar differences for China as well? If so, could you please explain them?

Others:

- The statement that the domain contains 8,290 grids, with each grid treated as a separate state vector element, is not entirely clear and would benefit from further clarification.