

This manuscript combines ground-based NH_3 observations, FY-4B satellite retrievals, and GCHP simulations to optimize agricultural and non-agricultural NH_3 emissions in Guangdong. The integration of these observations and the focus on regional and seasonal emission differences are valuable. However, further evaluation is needed to establish whether the inferred adjustments reflect errors in local emissions and whether the posterior inventory improves simulations consistently across seasons. The finding of overestimated agricultural emissions also deserves a more detailed explanation in relation to previous studies.

Major comments

1. The stretched-grid GCHP configuration simulates Guangdong within a global domain, rather than prescribing lateral boundary conditions for a separate Guangdong model. Nevertheless, concentrations within the province still depend on emissions and transport outside Guangdong. Avoiding prescribed lateral boundary conditions does not eliminate uncertainty in this external contribution. Because the inversion adjusts NH_3 emissions within Guangdong while holding external emissions fixed, errors in transported NH_3 may be compensated for by changes in provincial emissions. The current evaluation does not sufficiently establish how much of the model–observation discrepancy can be attributed to local emission errors.

I suggest evaluating the prior simulation in grid cells along and near the provincial boundary, separating inflow and outflow conditions where possible and reporting results by season. Boundary-grid discrepancies alone cannot uniquely identify transport errors, because local emissions also affect these cells. They would nevertheless provide a useful diagnostic when interpreted together with the prevailing winds. A sensitivity experiment perturbing NH_3 emissions outside Guangdong while keeping provincial emissions unchanged would provide stronger evidence. Please quantify the resulting concentration changes within Guangdong and assess whether accounting for this uncertainty alters the inferred agricultural and non-agricultural emission adjustments.

2. The agricultural scaling factors indicate that the prior inventory is overestimated in some seasons or months and underestimated in others. However, the reported prior–posterior evaluations pool observations rather than showing whether the posterior improves performance separately across seasons. Aggregate statistics can conceal compensating seasonal biases and do not adequately test the inferred seasonal redistribution of emissions.

Please compare prior and posterior NH_3 simulations with observations for each season, separately for the PRD and non-PRD regions. Seasonal scatterplots or monthly time series, accompanied by NMB, NRMSE, correlation coefficients, and sample counts,

would make the results much clearer. Where measurements permit, include NH_4^+ and deposition to help assess whether the seasonal NH_3 adjustments are consistent with other reduced-nitrogen observations. Please discuss any seasons in which the posterior provides little improvement or worsens agreement, rather than relying only on the aggregate improvement.

3. The inversion reduces Guangdong agricultural NH_3 emissions from 437.2 to 362.5 kt yr⁻¹, whereas the introduction describes a general tendency toward underestimated NH_3 emissions in previous Chinese inversion studies. The contrast with relevant studies in eastern China is potentially important.

The manuscript already discusses a sharper summer peak in GD-EI, compares inventories in Figure S19, and cites earlier PRD evidence of wet-season agricultural overestimation. These provide a useful starting point, but the reasons for the differences remain largely qualitative. I suggest a more focused comparison with relevant published studies, identifying the study year and region, prior inventory, source coverage, observational constraints, and whether the reported correction applies to agricultural or total emissions. Please examine whether Guangdong's climate and emission conditions, or the specific emission factors and temporal allocation in GD-EI, or the specific top-down estimation method could explain the different result. This discussion would help establish whether the result reflects a Guangdong-specific feature, a characteristic of the chosen prior inventory, or methodological differences, thereby clarifying the broader significance of the study.

Minor comments

4. The abstract refers to $0.2^\circ \times 0.2^\circ$ GCHP simulations, whereas Section 2.4 and Text S1 describe an effective resolution of approximately $0.1^\circ \times 0.1^\circ$. Please distinguish the native stretched-grid model resolution from the $0.2^\circ \times 0.2^\circ$ grid used for regridding and inversion analysis, and use these terms consistently.

5. Lines 236–239 state that GD-EI for 2022 was used as the prior for the 2023 inversion, while Figure S5 describes the original GD-EI emissions as being for 2023. Please reconcile these descriptions and specify whether any interannual adjustments were applied to activity data or emission profiles.

6. Line 255 directs readers to Figure S4 for the sectoral prior NH_3 emission distributions, but these appear in Figure S5 of the supplied supplement. Please correct the cross-reference and check the remaining figure citations.

7. Specify whether the emission error bars in Figure 4 represent one standard deviation or another confidence level.