Reply to comments raised by Referee #1.

The original comments are in plain texts, and our replies are in **bold texts**.

This study investigates the C3H8 retrieval from ground-based FTIR spectra at Xianghe, and discuss the C3H8 column variation in North China, based on these new FTIR measurements. The technical details and uncertainty discussion are generally well provided in current form, but the result part, such as data comparison and trend explanation, are somewhat less satisfactory. Overall, I suggest the publication on AMT after presenting more information for data interpretation. Specific suggestions are listed below.

First of all, we would like to thank you for the comments and suggestions.

1. Method 2.3: Line 20-25: It is still not clear why perform a profile retrieval for H2O column concentration. Because each species could have large variability in vertical scale. Moreover, suggest providing more technical details about the how to perform a profile retrieval.

More information are added now.

Original text: "To reduce the impact of uncertainties about the abundances of these species, these column abundances are retrieved along with the target gas mole fractions; only for H_2O we perform a profile retrieval, because of its large variability."

Revised text:" To reduce the impact of uncertainties about the abundances of these species, CH4, O3 and HDO columns are retrieved along with the target gas mole fractions. For these three species, their profile shapes are fixed and only scaling factors are retrieved simultaneously. As H2O absorption lines are relatively strong (Table 1) and H2O variability is large in the atmosphere, we perform a profile retrieval for H2O. Therefore, the state vector includes CH4, O3 and HDO columns, as well as 47-layers' C3H8 and H2O mole fractions."

2. Section 3.2: Since the large difference exists for seasonal variation of C3H8 column concentration between model and FTIR measurements, it would be better not present this comparison in the main text, unless the authors could provide more evidence or information to explain these differences. For example, the authors could collect some surface observation of C3H8 concentration in Xianghe or surrounding regions that used for comparison to FTIR retrieval near the surface.

Thanks for the suggestion. Unfortunately, there is no surface observation of C3H8 in Xianghe or surrounding regions. Currently we do not have solid conclusion to fully understand the discrepency between the FTIR measurements and the model simulations. In the revised version, this part has been removed.

3. Section 3.3 Line 20-25: What is the significance by providing the ratio of ΔC2H6 to ΔC3H8? What does the trend of this ratio mean?

Since C2H6 and C3H8 are co-emitted by oil gas sources (Li et al., 2017; Bourtsoukidis et al., 2019) and C2H6 and C3H8 have similar lifetimes with about 2-8 weeks, the ratio of ΔC2H6 to ΔC3H8 can represent the emission ratios of C2H6 to C3H8 in this region.

The trend of this ratio reprents the trend of the emission ratio in this region. As our FTIR measurements do not show a clear trend in ΔC2H6/ΔC3H8, it is inferred that the emission ratios of C2H6 to C3H8 in this region remain unchanged between 2018 and 2022.

4. Section 3.4: The authors compare FTIR measurement to MkIV data here, but the basic information about MkIV measurement were not well described. Readers might be very interested about the principle of technique used for C3H8 measurement in MkIV and the accuracy of these data. Based on these information, we can rule out the systematic difference deviation between FTIR and MkIV.

Thanks for the suggestion. More information about the MKIV C3H8 data are added in the revised version.
"MKIV C3H8 data uses the GFIT inverse retrieval code to derive the C3H8 columns from the MKIV observed spectra between 2964.5 and 2970 cm^{-1} with a specral resolution of 0.5 cm^{-1}. The mean uncertainties of the MKIV retrieved C3H8 and C2H6 column are estimated to be around 8×10^{15} molecules/cm2 and 7×10^{14} molecules/cm2, respectively, which are also provided by Toon et al., (2021)."

References:

Bourtsoukidis, E., Ernle, L., Crowley, J. N., Lelieveld, J., Paris, J.-D., Pozzer, A., Walter, D., and Williams, J.: Non-methane hydrocarbon (C_2–C_8) sources and sinks around the Arabian Peninsula, Atmos. Chem. Phys., 19, 7209–7232, https://doi.org/10.5194/acp-19-7209- 2019, 2019.

Li, M., Liu, H., Geng, G., Hong, C., Liu, F., Song, Y., Tong, D., Zheng, B., Cui, H., Man, H., Zhang, Q., and He, K.: Anthropogenic emission inventories in China: a review, Natl. Sci. Rev., 4, 834–866, https://doi.org/10.1093/nsr/nwx150, 2017.

Toon, G. C., Blavier, J.-F. L., Sung, K., and Yu, K.: Spectrometric measurements of atmospheric propane (C3H8), Atmos. Chem. Phys., 21, 10727–10743, https://doi.org/10.5194/acp-21-10727-2021, 2021.