

To Referee #1

We are grateful to you for your interest and comments on this manuscript.

Please find the point-by-point answers to your comments in green.

Please note that the present version of this manuscript reports mixing ratios in ppt and no longer in ppb to show the significant decimal digits.

Please note that, following the referee's comments, we have reformulated/refined the statistical analysis described in Section 2.3, updated the results and discussion accordingly, and have finally merged Section 3.1 with Section 3.2 (now Section 3.1).

The manuscript "Long-term analysis of atmospheric propane over Southern Europe based on observations conducted at the WMO-GAW station of Monte Cimone" presents a 13-year time series of propane, measured at Monte Cimone, Italy. Notably, all the data are available and can be immediately accessed, and I applaud the authors for keeping the monitoring station active and making the data openly accessible.

I really enjoyed reading this manuscript and consider it a nice piece of work. While some readers might find the detailed analysis tedious, I believe this work is essential for detailed investigations of our atmosphere.

Nevertheless, I have a few minor comments for the authors to consider.

Major comment:

This preprint is under review for Atmospheric Chemistry and Physics (ACP). According to the journal's scope, "Articles should have important and clearly argued implications for our understanding of the state and behavior of the atmosphere [...]". I consider this work valuable and important, as it confirms much of the previous work on C<sub>3</sub>H<sub>8</sub>. However, not all readers may share this view. Please, consider presenting this manuscript as a "Measurement Report".

We agree about this point with the reviewer#1 since the paper mostly focuses on discussing new observations rather than delving into understanding the behaviour of the atmosphere. We will reconsider the manuscript as "Measurement Report".

Minor comments:

Line 6): JFJ is used but has not been defined. Please check the consistency with the following sentence.

Thank you for pointing this out. We revised the sentence as follows: "...Jungfraujoeh (JFJ, Switzerland).."

Line 132): I suggest removing "slight" as the trend is anyhow statistically significant.

Following your suggestion, the sentence was rephrased as follows:

“Between 2011 and 2023, C<sub>3</sub>H<sub>8</sub> mixing ratios exhibited a significant decrease of ..”

Line 290): It would be beneficial to briefly compare other emissions databases (e.g., CAMS or CEDS) for the three countries investigated. Similarly, it would be helpful to again cite a few articles mentioned in the introduction that show the underestimation of emissions has been known since 2018 (Dalsoren et al., 2018).

Following your suggestions, we added the following to Section 3.6 Inversion estimates:

“Comparisons of our estimates of propane emissions with the estimates from the Copernicus Atmosphere Monitoring Service (CAMS) confirm increases of 141 and 113% over the CAMS global anthropogenic emissions inventory (Soulie et al. 2024) for Italy and France, respectively.”

“Previous studies related the observed low estimations of propane emissions at the global (Etiopie and Ciccioli, 2009) and regional (Bourtsoukidis et al., 2020) scales to missing geologic sources, and fossil fuel emissions in the USA (Tzompa-Sosa et al., 2019) or the northern hemisphere (Dalsøren et al. 2018). In this context, previous studies (Dalsøren et al., 2018; Tzompa-Sosa et al., 2019; Rowlinson et al., 2024; Ge et al., 2024) concluded that current emission inventories underestimate anthropogenic fossil fuel emissions of C<sub>3</sub>H<sub>8</sub>.”

Line 295): There is a missing period (.) before "Similar".

Thank you for pointing this out. We revised this typo accordingly.

Figure 10): I recommend using "CH" for Switzerland (instead of "CHE").

Figure 10 denotes the countries with the three-letter country codes (e.g., CHE for Switzerland, ITA for Italy, and FRA for France)) defined in ISO 3166-1 alpha-3 by the International Organization for Standardization (ISO). We preferred the three-letter country codes to the two-letter country codes (e.g., CH for Switzerland, IT for Italy, and FR for France) because the ISO 3166-1 alpha-3 allows an easier association between the codes and the country names than the two-letter country codes.

References

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