Reply to Referee #1

General Comments

This study describes a new database of tropospheric ozone measurements over the oceans, coastal, and polar regions from buoys, ships, aircraft, ozonesondes, and surface sites. The creation of this database is important since measurements of tropospheric ozone are lacking over these sink regions, and this study is an important component of TOAR-II. The authors present a comprehensive description of data sources, flagging methods, and backward trajectory methods. They provide a preliminary assessment of the data statistics and diurnal patterns, in preparation for the TOAR-II assessment report on this topic. I recommend that this paper be accepted after minor revisions.

We are grateful to the referee for his/her comments. A point-by-point response is given below (in blue).

Specific Comments

- In the first paragraph of the Introduction, the authors state that "The overall budget of tropospheric ozone is dominated by the photochemical production and loss terms" and then important loss terms over the ocean and in remote regions are discussed, but none of the production terms are discussed. To better tie in this sentence and fully explain how global ozone is controlled, it could be helpful to add a sentence somewhere in this paragraph about the photochemical production of ozone and whether it's location dependent.

The estimated ranges of the photochemical production and loss, and those of the deposition and stratosphere-troposphere exchange were added. We have also added a sentence on photochemical production as recommended:
L 102 in the Track Changes version: *The net ozone production mainly occurs over regions with NOx pollution and depends on the abundance of volatile organic compounds (VOCs).*

- Lines 149-151 state that no data are assigned to the Mediterranean Sea and Black Sea region because of the predominant continental influences. Was there data available over those bodies of water? If data was available but then excluded because the air masses would've had a too-high influence from the land, this should be stated.

We did not collect data for the R6 region because continental influences were generally unavoidable. (L163)

- In the paragraph beginning on line 203, the authors should consider adding a statement describing why Radon is used as a tracer for land influence.

Radon, emitted from land and lost with a half-life of 3.8 days (Zhang et al., 2021), is suitable for testing the performance of 120 h trajectories and then removing the cases with fresh continental outflow. This was added from Line 219 in the revised manuscript.

- Why is IAGOS data not included in the aircraft data set?

IAGOS data are above the altitude range we are interested in, particularly over the oceans. In the future we plan to include them after developing appropriate filtering.

- When selecting a sonde data point every 200 m (line 240), did you ensure that the data point had high quality? For example, some sonde profiles are noisy, so you may select a data point that is erroneously low or high. This issue may be resolved by first smoothing the profiles.

We agree that smoothing will produce a better dataset. But the ozonesonde original data are often smooth enough, as the sampling rate is usually higher than the response time of the sonde, about 20–30 s (Vömel et al., 2020, Van Malderen et al., 2025), which usually corresponds to the vertical resolution of ~150 m.

- Line 290: Do you mean “longitudinal distribution”?

Corrected.

- Tables 1-5 are very detailed and long. Consider moving them to the SI.

Table 1 and 2 for ship/buoy-based and airborne observations are the main products from this study, and thus they are kept in the main text. On the other hand, Table 3–5 treating ozonesonde and surface observations have primary data sets elsewhere produced within the TOAR-II activity. Our data selection and addition of the trajectory information are original but regarded as secondary. Thus we moved the three tables to the SI (as Table S3 to S5 in the revised manuscript).

- Consider adding a reference to Chang et al. (2024, https://doi.org/10.5194/acp-24-6197-2024) in the last paragraph of the Conclusions when you mention the lack of dense/homogeneous data.

The reference was added to the revised manuscript.
Line 399:
Although the observational data have been collected as widely as possible, they are still not sufficiently dense or homogeneous across the defined regions, particularly for the purpose of small trend detection (Chang et al., 2024).

- This paper does not mention satellites which provide data over the oceans and coasts. The authors should mention that this data exists but is being managed by another TOAR working group and is

therefore not within the scope of this paper/database.

We added the following sentence in the revised manuscript, in the end of Introduction section:

L141:
Satellite data are not included in this study because they are discussed elsewhere in the TOAR-II special issue (Gaudel et al., 2024; Pope et al., 2023) and because it is still difficult to resolve the commonly low ozone levels in the boundary layer over the oceans from satellite observations.

Technical Corrections

- The legend and region labels (R1, R2, etc.) in Figure 1 should be larger.

We revised the figure accordingly.

- Line 170: “e.g.” should be “i.e.” if you list all cruises with 1-minute based data.

We revised the figure accordingly.

- Section 2.2 should reference Figure 1.

Figure 1 was mentioned in the sections 2.1 and 2.2 in the revised manuscript.

- To the Figure S2 caption, add a comment about why the top row is red and the bottom row is blue.

The sites from non-polar region are shown in red and those from polar region in blue. This was mentioned in the figure caption after revision.

- Many acronyms are undefined. Rather than defining them in-text, consider adding a table of acronyms to the SI.

We spelled out some acronyms in the text (e.g., TOAR in the abstract, DWD-MPI when it appears first). A table of acronyms was included in the Appendix.

- Please replace the in-text URLs with proper references:
  - Line 144
  - Line 190
  - Line 242 (can reference Van Malderen et al., 2025 instead)
  - Line 257
  - Line 263

References were properly given to the URLs in the revised manuscript.

We thank the referee again for the important comments and suggestions to improve the manuscript.

References

Van Malderen, R., Thompson, A. M., Kollonige, D. E., Stauffer, R. M., Smit, H. G. J., Maillard Barras, E., Vigouroux, C., Petropavlovskikh, I., Leblanc, T., Thouret, V., Wolff, P., Effertz, P., Tarasick, D. W., Poyraz, D., Ancellet, G., De Backer, M.-R., Evan, S., Flood, V., Frey, M. M., Hannigan, J. W., Hernandez, J. L., Iarlori, M., Johnson, B. J., Jones, N., Kivi, R., Mahieu, E., McConville, G., Müller, K., Nagahama, T., Notholt, J., Piters, A., Prats, N., Querel, R., Smale, D., Steinbrecht, W., Strong, K., and Sussmann, R.: Global Ground-based Tropospheric Ozone Measurements: Reference Data and Individual Site Trends (2000–2022) from the TOAR-II/HEGIFTOM Project, EGUsphere [preprint], https://doi.org/10.5194/egusphere-2024-3736, 2025.

Vömel, H., Smit, H. G. J., Tarasick, D., Johnson, B., Oltmans, S. J., Selkirk, H., Thompson, A. M., Stauffer, R. M., Witte, J. C., Davies, J., van Malderen, R., Morris, G. A., Nakano, T., and Stübi, R.: A new method to correct the electrochemical concentration cell (ECC) ozonesonde time response and its implications for “background current” and pump efficiency, Atmos. Meas. Tech., 13, 5667–5680, https://doi.org/10.5194/amt-13-5667-2020, 2020.