

Reply to Editor

The manuscript repeatedly describes the product as a four-dimensional aviation emission inventory, and the Data Availability section states that the dataset is provided as GeoTIFF files at $0.1^\circ \times 0.1^\circ$ resolution for CO₂, NO_x, SO₂, PM, CO, and HC. However, based on my inspection of the files currently available on Zenodo, the GeoTIFF files appear to contain only two-dimensional spatial fields, rather than explicit temporal, vertical, or phase-resolved dimensions.

Could the authors please clarify whether this is intentional? If the full four-dimensional dataset is available through additional files, layers, metadata, or a separate data structure, these should be clearly described in the Data Availability section and accompanying documentation. If the public dataset only provides 2-D gridded outputs, the authors should revise the terminology throughout the manuscript to avoid overstating the dimensionality of the released dataset. Given that the "4-D" nature of the dataset is a central claim of the manuscript, this issue is important for assessing the dataset's completeness, reproducibility, and usability.

Response:

We fully agree that the originally provided two-dimensional GeoTIFF files did not adequately represent the full four-dimensional structure of the inventory described in the manuscript. To rectify this, we have comprehensively reorganized the data products and released the complete 4-D gridded emission dataset, incorporating longitude, latitude, altitude, and temporal dimensions, via a finalized Zenodo record. Furthermore, we expanded the methodological documentation to explicitly detail how the high-frequency QAR observations are mathematically aggregated into this four-dimensional spatiotemporal grid.

In Section 2.3.4, the aggregation methodology was expanded to transparently define the four-dimensional grid structure, reading as follows:

"The second-by-second emission records were subsequently aggregated into a four-dimensional spatiotemporal emission grid. The horizontal domain was discretized at a resolution of $0.1^\circ \times 0.1^\circ$,

while the vertical dimension was divided into 1000-m altitude layers. The temporal dimension was aggregated by calendar month. For each 1-Hz QAR observation, the calculated emission mass was assigned to the corresponding horizontal grid cell, altitude layer, and calendar month based on the actual aircraft longitude, latitude, and pressure altitude. Emissions from all trajectory observations falling within the same spatiotemporal grid cell were then summed.

The resulting dataset contains monthly four-dimensional emission fields for CO₂, SO₂, NO_x, PM, CO, and HC. This bottom-up aggregation retains the spatial and temporal distribution of individual flight trajectories while converting the high-frequency emission estimates into a standardized 4D emission inventory."

In Section 4, the Data Availability statement was updated to reflect the finalized 4-D dataset and the permanent repository link, reading as follows:

"The high-resolution 4D gridded aviation emission inventory dataset generated in this study is freely available at Zenodo via <https://doi.org/10.5281/zenodo.23334964> (Lu et al., 2026). The dataset is provided in NetCDF format with a horizontal spatial resolution of 0.1°×0.1° and a vertical resolution of 1000 m, including emission fields for CO₂, NO_x, SO₂, PM, CO, and HC."