Dear Dr. Sayer,

We appreciate your kind remarks and the reviewer's comments. We have addressed the concerns through revisions in the main text and the Supplementary Materials.

1. In line 321, I'd recommend phrasing as something like "Since both *satellite-based* models" since the previous paragraph mentions three models and "both" implies two.

- I concur with this suggestion and believe it refers to line 302 of the revised manuscript.

Author's response: Thank you for your valuable suggestion. We agree that the phrasing could be articulated better. We meant to highlight that both OMI- and TROPOMI-based models heavily rely on satellite-derived parameters. Therefore, we use MERRA2-based model outputs to fill gaps in the other two models when satellite retrievals are unavailable.

Lines 312–315:

"*Since OMI and TROPOMI models rely heavily on satellite-derived observations, occasional cloud cover and instrument-specific limitations, including row anomalies in OMI (Torres et al., 2018) and retrieval uncertainties in TROPOMI (Veefkind et al., 2012), can result in missing or invalid satellite retrievals, preventing $PM_{2.5}$ estimates from both models for certain regions and time periods.*"

2. In lines 519ff, why do the authors only give a summary of the MLP algorithm rather than LASSO, RF, and others?

- I believe this is around line 427 in the revised manuscript (saying that MLP is a neural network). I think it is ok as-is, but consider adding a sentence describing the others if you feel appropriate.

Author's response: We agree that briefly describing the different machine learning approaches would improve clarity. We have added the sentence below to distinguish algorithms based on underlying approaches.

Lines 438–441:

"*These algorithms represent different modeling approaches, including linear and kernel-based regression (LASSO and SVM), tree-based ensemble methods (RF and XGBoost), and neural networks (MLP). The MLP is a fully connected neural network, and its architecture used in this study is illustrated in Fig. S9 in the Supplementary Materials.*"

3. Lines 551-54: I recommend not putting quantitative results and interpretation in a figure caption

- I do not have strong feelings on this although agree with the referee that interpretive information (e.g. talking about seasonality) could be removed and should ideally be in body text only.

Author's response: Thank you. We have revised the captions for Figures 2 and 3 to remove any quantitative results or interpretations.

4. Line 714: is q a test statistic that's unique to FDR? Otherwise, should it state "($p < 0.05$)"?

- My understanding is that q is correct (and refers to the FDR threshold) but this should be made explicit at first use in the manuscript to avoid potential confusion.

Author's response: Thank you for the clarification. We have revised the first mention of the Benjamini–Hochberg false discovery rate (FDR) procedure in Section 2.7 in Materials and Methods to explicitly clarify that q-values are FDR-adjusted p-values and that $q < 0.05$ indicates statistical significance.

Lines 412–414:

"*For the pixel-wise trend analysis, the Benjamini–Hochberg false discovery rate (FDR) procedure was applied to the SMK p-values across all valid grid cells. The resulting FDR-adjusted p-values (q-values) were used to identify statistically significant trends, with $q < 0.05$ considered statistically significant*"

5. Production office comment – Figure S7: If the map originates from Esri, please add the required attribution text "Powered by Esri".

Author's response: Thank you for pointing this out. The map already included the required attribution ("Sources: Esri, TomTom, FAO, USGS | Powered by Esri"). We have increased the font size of the attribution in Figure S7 to improve its legibility in the final Supplementary Materials.