General comments:

This study introduces assimilating $PM_{2.5}$ observations from AirNow and PurpleAir networks within JEDI for AQMv7, and analysized the assimilation benefits by conducting several experiments. The work is important and within the scope of GMD, and the manuscript is well-structured overall. However, there are still some concerns require to be addressed to further improve the quality of the manuscript before its publication.

We thank the reviewer for the thorough evaluation of our manuscript!

In response to your comments, we have revised the manuscript accordingly and addressed the issues raised to strengthen the clarity and robustness of the study. Below, we provide point-by-point responses to the reviewer's comments, with **our replies shown in blue font. The changes in the revised manuscript are also shown in the blue font.**

Major comments:

(1) Data assimilation of PM2.5 observations has been extensively studied. This study demonstrates the value of assimilating novel observations from PurpleAir for improving numerical air quality predictions. But the unique features or advantages of the PurpleAir network have not been fully demonstrated. It is suggested that the authors further strengthen the explanation of the novelty of this study.

Thank you for the constructive comments and suggestions.

A paragraph has been revised and expanded to summarize the novelty of this work. It is provided below (see also the second-to-last paragraph in the Introduction):

"This study aims to develop and evaluate an initial aerosol analysis capability for the AQMv7 system by assimilating $PM_{2.5}$ observations using the JEDI 3D-Var framework. Compared to previous $PM_{2.5}$ data assimilation studies, this research adopts the NOAA's regional operational AQMv7 system and incorporates a new $PM_{2.5}$ transform in JEDI for assimilating $PM_{2.5}$ observations. In addition to evaluating the impact of assimilating AirNow $PM_{2.5}$ measurements on air quality prediction, this study also examines the impact of assimilating low-cost PurpleAir observations. Although PurpleAir data are valuable for real-time air quality monitoring, their impact on numerical air quality prediction has not been thoroughly investigated. To the authors' best knowledge, this is the first study to demonstrate the value of PurpleAir observations for air quality prediction during a major fire event using the AQMv7 system."

Minor comments:

(1) The authors cited several webpages such as in Lines 58, 106, and 394 of the manuscript. It should be noted that web-based references have stability risks due to periodic or irregular maintenance of websites. If a cited page becomes inaccessible, for example the EPA webpage in L394, readers would be unable to verify the definition of "Regions 1–10", leading to confusion in subsequent region-based statistical analyses in the manuscript. Therefore, it is recommended that essential contextual information be incorporated in the manuscript to enhance completeness and readability. If the authors deem webpage citations necessary, the citation format should be revised to align with the requirement of the journal.

We agree with the reviewer's comments. We have minimized the use of webpage references where possible and incorporated essential contextual information directly into the manuscript to improve completeness and readability. Specifically, EPA regions are now defined in the main text where they are used, or the statements have been rephrased into more general statements when appropriate. For cases where webpage citations remain necessary, the citation format has been revised to comply with the journal's requirements.

(2) Figure8 (middle row, right panel) shows an increase in MAE over the eastern U.S. Does it indicate limitations of the PA data or its assimilation in these regions during the study period, and why.

Both initial condition errors and model errors can lead to the increased MAE in 24h forecast in the PurpleAir data assimilation experiment over the eastern U.S. However, the current results indicate that this increase may be related to lower PurpleAir data quality in this region. This is supported by the presence of elevated MAE at several stations at the 1-h forecast time, which is close to the analysis time. In contrast, the MAE increase at the 24-h forecast lead time is much less pronounced in the experiment in which only AirNow $PM_{2.5}$ observations were assimilated, further suggesting that the issue is associated with PurpleAir data rather than model forecast error growth. A brief discussion on this was added in the revised manuscript in Section 4.

(3) Figure8: The colorbar ranges in the top and bottom row of the left panel looks truncated. It is suggested to expand the colorbar range to fully capture the extent of MAE reduction. Meanwhile, it is recommended that each panel within multi-panel figures be labeled with letters (a, b, c, etc.) to facilitate clear referencing in the manuscript text.

The color bar is chosen to clearly show the impact of PurpleAir data at 1h forecast time.

As described in the reply to the previous comments, as part of this revision, the figures were removed, but a table of statistics over different areas were added to clearly show the data impact.

(4) In Lines 88, 129, 211, 217: The "2.5" in "PM2.5" should be formatted as subscript to follow the convention and keep consistent with the others in the manuscript.

Fixed.