

Interactive comment on “Assimilation of OMI NO₂ retrievals into the limited-area chemical transport model DEHM (V2007.0) with a 2-D OI algorithm” by J. D. Silver et al.

Anonymous Referee #1

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This paper reports a study of assimilation of OMI NO₂ retrieval into an off-line regional chemical transport model (CTM) using the optimal interpolation method. Based on the year-long analysis, the paper concludes that the model with data assimilation (DA) displays a marginal improvement of surface NO₂ simulation, and to a less extent, O₃ simulation. Though it has widely been used in weather forecast, DA is relative new to and rarely used in air quality forecast partially because the initial condition is not very crucial to accurate chemical concentration prediction. In this sense, more exploration of DA in CTM application should be encouraged.

However, this reviewer finds that the current version of paper lacks several key as-

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pects in exploration of the topic. The major driving force of DA is to improve the model forecast capability. Seeing the short memory of chemical initial conditions in CTM, it will be more interesting to show how DA will change chemical simulation in a short time period, e.g., 3 days, instead of an annual simulation. More seriously, the authors did not report how the vertical profile used in the OMI retrieval compared to the modeled NO₂ profile. The total amount of gas retrieved from satellites is very sensitive to the assumed vertical profile in the retrieval algorithm. One cannot simply compare the modeled total column values to the satellite retrieval without regard to its vertical structure. The paper is not particularly well organized, making it unnecessarily long. For example, all the figures and tables were mentioned in section 3 without detailed explanations. Then they were presented again in section 4. This is not a good flow. Please consider re-organize these two sections to reduce the redundancy and improve the readability.

Other comments follow: 1. Section 3.3, Figure 4 is not necessary and can be removed. In addition, the authors replicated the missing data to calculate the annual/seasonal average. Suggest only including the model results when observation is available to calculate the modeled average. 2. Section 4.1, line 15, suggest changing from “..is not so simple..” to “..is not so straightforward..”. 3. Section 4.1, line 25, Figure 3 hardly leads to the conclusion that “Without DA, the model underestimates ... and does not capture ...”. A probability density function plot may be a better option. 4. It should be clearer to show the NO₂ difference (model – OMI) maps in Figures 5 and 6. 5. Sections 3.5 and 4.4, it appears less related to the presentation but emphasizes the importance to compare short term DA results. 6. Figure 7 is not very clearly presented. Consider modifying.

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