

RC1: '[Comment on gmd-2021-74](#)', Anonymous Referee #1, 27 Jul 2021 [reply](#)

Thank you for the review of this manuscript. Based on your comments, Figure 8 is now replotted and all the corrections were made as suggested. My point-by-point responses are found below.

*Reviewer's comments are italicized.

The present work of Ha demonstrates an interface between the WRF-Chem model and the WRFDA system. Said interface is used for surface assimilation of PM2.5, PM10 and four gas species (SO2, NO2, O3 and CO). A comparison against independent surface observations recorded over the Korean Peninsula indicates that 3DVAR PM2.5 forecasts produced by the WRFDA system have a lower RMSE than that of a non-DA baseline, although this does not appear to be true for all chemical species under consideration. 3DVAR increases the overall accuracy of PM2.5 forecasts (for both time series and categorized events, see figures 12 and 13). However, the experiments do not appear to show a statistical significant improvement in the "false alarm" rates over those of the non-DA baseline in either of the two model domains (cf. right panels in Figure 13). Nevertheless, the manuscript is well written and the work of Ha should facilitate further developments on top of the existing WRFDA implementation (as described in the "Conclusions" section). I believe it warrants publication in GMD after minor revisions, as follows:

1/ Abstract: "co" -> "CO".

=> "co" is now changed to "CO".

"And the effects" -> "The effects".

=> "And the effects" is also changed to "The effects".

Also I feel like the abstract is too "optimistic" re. the improvements in forecast skill over the non-DA baseline (particularly the final sentence). This should be qualified to be consistent with the actual results presented in sections 3 - 4.

=> Based on the results from Table 3, the final sentence is now modified as below.

“, reducing systematic bias errors in surface PM2.5 (PM10) concentrations to 0.0 (-1.9) $\mu\text{g}/\text{m}^3$ over South Korea in 24-h forecasts.”

2/ l. 60 (p. 3): "readers refer to" -> "readers are referred to"

=> Changed.

3/ l. 139 (p.5): "so2, no3, o3 and co" -> should be all capitalized (there are other instances of inconsistent capitalization throughout the manuscript)

=> The four gas species are now capitalized everywhere in the text: L6, L149, L191, L218-220, L256, L260, L275, L291-292, L405-406. Also, they are now capitalized in Table 2.

4/l. 231 (p. 8): define "(o-f)'s" as "observations-minus-forecasts". this should be consistent with the labels in e.g. Figure 6 ("omb", "oma", ...)

=> The paragraph is now removed in the process of polishing the manuscript. But the caption of Figure 6 is now modified from (o-a)'s and (o-b)'s to observation-minus-background (omb; dotted gray line) and observation-minus-analysis (oma; solid black line).

5/ Figure 8: The differences between the averaged analysis ("Mean") and the May 26 analysis is difficult to interpret, I suggest using a different layout to display the information (_not_ a pie chart).

=> Figure 8 is now replotted to show the differences in a bar plot in b). The caption is also edited accordingly.

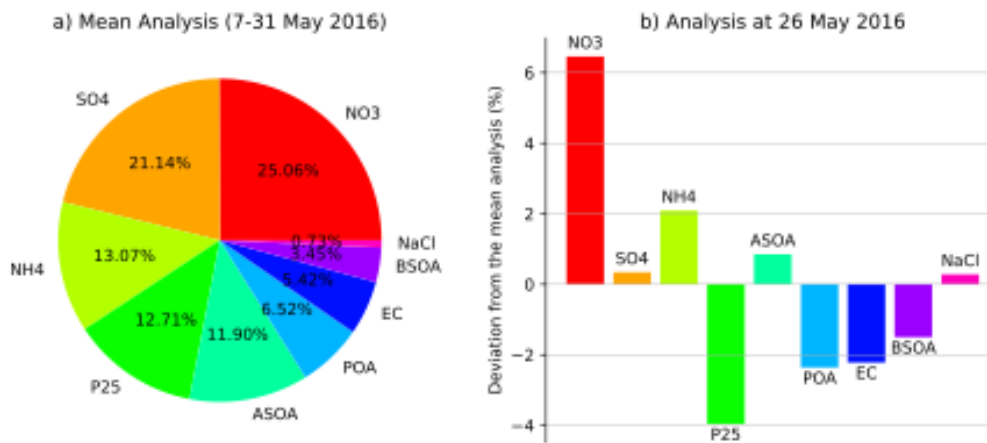


Figure 8. a) A pie chart showing the percentage contribution by aerosol species in Seoul, South Korea, in the analysis averaged for 97 cycles from 00 UTC 7 May to 00 UTC 31 May 2016 and b) deviations from the mean analysis in the analysis at 00 UTC 26 May 2016 over domain 2 in the DA experiment. Surface PM_{2.5} consists of aerosol sulfate (SO₄; so4ai and so4aj), ammonium (NH₄; nh4ai and nh4aj), nitrate (NO₃; no3ai and no3aj), primary organic matter (POA; orgpai and orgpaj), elemental carbon (EC; eci and ecj), unspciated PM_{2.5} (P25; p25ai and p25aj), sodium chloride (NaCl; naai, naaj, clai, and claj), 4-bin anthropogenic and biogenic secondary organic aerosols (ASOA and BSOA, respectively) at the lowest model level.

6/l. 379 - 380: The "significant reduction" in false alarm rates is not evident to this reviewer from the results presented, particularly for domain D1 (Fig. 13).

=> Just for clarification, it was stated as "clearly reduced", not "significantly reduced". Respecting the reviewer's concern on the impression of being too optimistic, however, "clearly" is now removed. Also, the 9-km simulations (as mentioned in the sentence) correspond to domain 2, not domain 1. Now, "(in D2)" is added at the end, for clarification.