Geoscientific
Model Development
Discussions

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Interactive
comment

Interactive comment on "3D-Var versus Optimal Interpolation for Aerosol Assimilation: a Case Study over the Contiguous United States" *by* Youhua Tang et al.

Anonymous Referee #3

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Aerosol data assimilation in Weather-Chemistry coupled models has been increasingly practiced to improve air quality forecast with satellite aerosol observations. This article compares the 3D-Var and OI data assimilation methods applied to PM2.5 and/or AOD observations in the CMAQ modeling system. This is an interesting work, but the quality of the paper still has room to be be improved.

Major comments:

First, the purpose of data assimilation is to improve forecast. However, this paper presents mainly the impact of data assimilation on the simulation at the assimilation time window. It does show impact on prediction, but it was a only one-hour forecast

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from 18 to 19 UTC on 07/01/2011 (Figure 8). Additionally, it is unclear to the reviewer if the time-series plot (Figure 9) showed forecast results or adjusted results from assimilating data on the same time window.

Second, the data used for verification is not clearly described. Are they the same PM data used in the assimilation? Please note that the data used for assimilation should not be used in the verification of data assimilation process. Otherwise, the verification is cheating by checking self-consistency.

Specific comments:

1.Treatments on observation and prior errors need a better justification. Error characterization on observation and background are essential to data assimilation. Observation error was simply assumed as constant (0.1) for both PM2.5 and AOD. This needs to be justified with error covariances.

2.The data assimilation system should be described in more detail. In particular, the OI system needs a detailed description, so that readers does not need to go to Tang et al 2015 for essential information about the method. Also, it is not clear how CMAQ and GSI 3D-Var get coupled.

3.A brief description and references of the PM2.5 data are needed. How many number of sites are used? Were all sites used for both data assimilation and model evaluation?

4.A brief description of MODIS AOD is also necessary with references. It shall include which MODIS product is used (e.g., level 2 or level 3, which collection, on which wavelength) and why 18Z data assimilation is applied, etc.

5.Page 6, line 34: Do those mass scaling factor vary with time and location? If they are constants, please provide here.

6.Figure 2: It is not clear to the reader which wavelength is for these AODs. I cloud only confirm that the Reconstruction AOD (panel b) is at 550 nm.

7.Figure 4: Arrangement of panels in Figure 4 is confusing and please make them clear and consistent. The figure caption says GSI is on the left and OI on the right, but OI is found in the middle row for both columns and GSI is found at the bottom row for both columns too. According to the text, I think those panels should be arranged like Figure 6: (a) GSI_PM, (b) OI_PM, (c) GSI_AOD, (d) OI_AOD, (e) GSI_All, (f) OI_All.

8.Figure 7: Again, please specify the used spectral wavelength for AODs.

9.Evaluation of model predictions needs further quantitative statistically analysis. For instance, bias, RMSE and R^2 for predictions of PM2.5 against observation should be reported.

10. Font size in almost every plot needs to be increased, especially for color-bar axes.

Interactive comment on Geosci. Model Dev. Discuss., https://doi.org/10.5194/gmd-2017-147, 2017.