

Interactive comment on “Assimilation of MODIS Dark Target and Deep Blue observations in the dust aerosol component of NMMB/BSC-CTM version 1.0” by Enza Di Tomaso et al.

Anonymous Referee #2

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Review of Assimilation of MODIS Dark Target and Deep Blue Observations in the dust aerosol component of NMMB/BSC-CTM version 1.0 by Tomaso et al.

The authors applied the LETKF technique to the chemical transport forecast model (NMMB/BSC-CTM), and performed an assimilation and forecasting experiment for mineral dust with MODIS AOD observations. I found that the manuscript describes the framework of the system and validation results of the experiment very well and is suitable for publication in GMD with minor revision.

General comments:

1:

C1

The abstract is quite prolixity. Abstracts should include only important information.

2:

I cannot read some figures due to poor resolution and small labels. The authors should re-draw the figures.

Specific comments:

Page 6, line 187: The authors use 100 km as the cut-off (localization) length. How do you estimate this values? For example, Rubin et al. (2016) and Yumimoto and Takemura (2011) used more longer length (1000 and about 600 km).

Rubin et al., Atmos. Chem. Phys., 16, 3927-3951, 2016, doi:10.5194/acp-16-3927-2016

Yumimoto and Takemura, Geophys Res. Lett., 38, L21802, doi:10.1029/2011GL049258

Page 7, line 212:

"h" is already used in line 209. Use another character to represent horizontal localization factor.

Section 3.0:

Ensemble-based methods usually use inflation methods. Does this system use any inflation method?

Figure 1:

Can you add ensemble mean of the vertical flux in the figure?

Page 8, line 237-239:

You use AOT (optical column amount) as the observational constraint. How does the system adjust 3D mass concentration fields of dust bins from the 2D observational

C2

constraint?

Page 9, line 274:

Do you consider error in AE? AE over the land may have much larger uncertainty than ocean. Can you separate the dust-dominant condition correctly over the land?

Page 9, line 276:

Coverage and observation time of MODIS do not correspond to those of OMI (particularly for AOTs from Terra satellite). How do you derive the AOTs under dust-dominant condition when there is no OMI observation corresponding to? You do not use MODIS measurements from Terra satellite?

Page 11, Line 344:

The authors extend the system to 4D-LETKF. What are the merits of the extension instead of sequential assimilation? You assimilate AOD with 6-hour interval. I read literature suggests that 4-dimensional methods (smoothers) have advantages in assimilating observation with fine temporal resolution comparing with 3-dimensional methods (filters). However, the 6-hour interval is not so short (actually longer for 4D-LETKF). Addition to this, the main purpose of this study is improving of forecasting with assimilation. Why do you choose smoother for this purpose rather than filter? Did you try the 3D-LETKF? Did you find that the 4D-LETKF is superior to the 3D-LETKF in forecast performance?

Page 11, Line 344:

Do you introduce temporal localization? The assimilation window (24 hours) is too long to examine assimilation without the temporal localization.

Page 11, line 365:

The authors use the vertical localization. What are the merit of that for assimilating vertically integrated observations?

C3

Figure 6:

I think this figure shows ensemble spread of dust AOD. Why the spread exhibits much larger value all over the Southern hemisphere?

Figure 10:

Could you adjust the vertical axis of panels? For example, AOD values at Lecce_University are too small to plot with vertical axis of 0.0-4.0. Could you add MODIS-measured AOD on the panels? It would be good to see difference (error) in MODIS AOD.

Page 14, line 456:

'Top' should be left. 'bottom' should be right.

Page 14, line 460:

The higher spread does not mean the better spread (background error covariance). If you used the larger perturbation, you'd obtain the higher spread.

Figure 11:

Do you compare model result with AERONET observation in daily average? hourly average? or monthly value?

Figure 9:

There are some regions where the DA-NRL-DB shows opposite increment from the DA-NRL. For example, the DA-NRL-DB obtains negative increment around Somalia Peninsula. However the DA-NRL shows positive one. Does this mean there is biases between the Dark-target and the Deep Blue AODs?

Interactive comment on Geosci. Model Dev. Discuss., doi:10.5194/gmd-2016-206, 2016.

C4