Geosci. Model Dev. Discuss., 8, C3687–C3690, 2016
www.geosci-model-dev-discuss.net/8/C3687/2016/

Geoscientific Model Development Discussions

Interactive comment on "Background error covariance with balance constraints for aerosol species and applications in data assimilation" *by* Z. Zang et al.

Anonymous Referee #1

Received and published: 12 January 2016

This paper presents the treatment of aerosol background error covariance with balance constraints. Overall, the paper is well written. The presented results shows that the method would improve the chemical data assimilation performance.

One major concern is that the numerical experiments were only based on a 24-hour forecasting. Since the atmospheric chemistry and meteorological conditions vary day to day. It is highly suggested that the authors extend the experiments to a longer time period. The test period is coincident with CalNex field campaign. So it is not difficult to fnd more observations for such testing.

Cross-correlations can be between different species/bins or different grid points. The

authors often use "cross-correlation" without specifying what they mean. It is helpful to be unambiguous. For instance, in abstract (line 7 on Page 10054), "cross-correlation" probably refers to the correlation between different species.

The description of model configuration is lacking. Although readers are referred to Li et al.(2013) for details, some basic information should be provided directly. For instance, the mapping projection used for the horizontal coordinates and the extension of the vertical levels are better given in the paper.

The calculation of the cross-correlation of emission species is not clear. Is it based on 15 May-14 June, 2010 emissions over domain d03?

In addition, the observations deserve a little more explanation as well.

Specific:

10054, line 14, "are more coincident" -> have better agreement

10054, line 23, "meteorology-chemistry models" -> Chemical transport models

10055, line 4, "difficult dealt due to ...": Remove "dealt".

10056, line 26, "balance analysis fields": balanced analysis fields?

10056, line 16: PM2.5 is part of PM10 and PM1 is part of PM2.5. So they do not represent different size bins.

10056, line 19: The spread of observation impact is not necessarily "enhanced".

10057, line 4: It is not clear what "the species that are not ADJACENT" means here.

10057, line 12, ".. has been ESTIMATED ...": Developed or applied?

10058, Eq(1): It is better to have the LHS written as J(x) and x should be in bold font.

10059, line 2, "d = y - Hx ": d= y-H xˆb

10059, lines 6-7: This seems to neglect the fact that there are multiple variables at

each grid point.

10059, line 18, “which represent ...”: Separate the run-together sentence. They represent the correlation among pairs of grid points for one species.

10063, line 16, “cross-correlations between emissions”: Change to “cross-correlations of emission species”, to be consistent with the title of Section 3.2.

10063, line 19, “the cross-correlations of aerosol emissions from ...” -> the cross-correlations of aerosol emission species from ...

10064, line 3, “...that is coupled to aerosol and chemistry domains” -> ...that is coupled to aerosol and chemistry models

10064, lines 16-17, “Emission files are .... of the aerosol forecasts”: What does "a primary factor for the distribution of the aerosol forecasts” mean? In addition, it is a run-together sentence that needs to be rewritten.

10065, line 5: “With the exception of the auto-correlation in the diagonal line” is redundant.

10066, line 25: Please spell out “DA” as “data assimilation” since DA is not previously defined yet.

10067, line 3: Figure 2 -> Figure 4.

10067, line 4: Fig. 2a -> Fig. 4a.

10067, line 8: Fig. 2b -> Fig. 4b.

10067, line 8, “all standard deviations significantly decrease”: The decrease of NO3 is not significant.

10069, line 8: There are many other flights available. Why was this flight chosen over all the others? More description on the flight observations is needed as well.

10069, line 25: WRf/Chem -> WRF-Chem. Note that the WRF/Chem is better changed

to WRF-Chem in the entire paper.

10071, line 17: Figure 11 does NOT show “scatter plots”.

10071, line 19: Fig.1a -> Fig. 11a

10072, lines 9-10: It is not true that the data assimilation has the hypothesis of the independent control variables. The independence of control variables merely helps to simplify the background error covariance matrix.

10077, Table 1: Please add the name of the species to the table.

10079, Figure 2: Why aren’t the cells identical in shape? It applies to Figure 3 too.

10081, Figure 4, “Same as Fig. 3”: Figure 4 is quite different from Figure 3.

Interactive comment on Geosci. Model Dev. Discuss., 8, 10053, 2015.