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comment

Interactive comment on "Evaluation of a multi-model, multi-constituent assimilation framework for tropospheric chemical reanalysis" *by* Kazuyuki Miyazaki et al.

Anonymous Referee #1

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Major comments:

This study presents an unprecedented work consisting in applying the same data assimilation framework to different Chemical Transport Models. This allows to treat the different flavor of model error terms such as chemistry, transport and deposition schemes in a consistent manner. The study is well written and presents a comprehensive work. The evaluation against independent measurements is greatly appreciated.

The discussion on the model error is quite interesting, this could be further compared to the observations error, which has been effectively used in the analysis procedure. It is stated that the analysis error can be overestimated, which is not common in EnKFs

where the spread in the ensemble is usually too small. The ensemble spread and the analysis error of the model mean against TES can be as low as 1 ppb (Fig. 6). One can expect that the use of a multi-model estimate (inter-model differences in the spread) of the model error fits nicely the observation error. In general, throughout the paper, error bars can be added to the observations.

P9L25: "The state vector includes the chemical concentrations of various species as well as the surface sources of NOx and CO and LNOx sources". And P10L6: "We also applied covariance localization for different variables in the state vector (Kang et al., 2011), by setting the covariance among non- or weakly related variables to be zero." Could you be more specific and describe which observations are used to estimate which state variable? In particular in the case of the Ozone responses to NOx perturbation, it would be interesting to know which state variables are optimized while assimilating ozone.

Minor comments: For future work, you could look at the impact of assimilation on the O3-CO correlations and dO3/dCO enhancement ratios (Zhang et al. 2006).

P5L4: the family name of the author is "Olivier" not "Oliver" according to https://themasites.pbl.nl/tridion/en/themasites/edgar/publications/index-2.html

P9L24: The data assimilation settings were almost same among the systems as follows. Should it be a "the" before same? this sentence can be improved.

P12L26 "lowover", is there a space missing ?

P15L12: "the large multi-model spreads (25–55%) suggest that individual models have large uncertainty in representing strong ozone productions, for instance, associated with VOCs emissions and chemistry." Is it really an uncertainty or is it just because the chemical regime is not in favor of a clear and linear relationship between Ozone and NOx emissions.

P15L16: "the mean of the individual model estimates (solid while lines)". I guess you

mean 'white line' instead of 'while line'.

P21 L34: "Fig.13 compares the global distributions of annual and tropospheric mean OH concentrations." How do you define tropospheric? – also in legend of Fig. 13.

Figure 3: You should define what the dashed lines are in legend.

Figure 5: you could replace 'model' by 'control'

Figure 6: "(a) Standard Deveation among the models"

References: Zhang, L., et al. (2006), Ozone-CO correlations determined by the TES satellite instrument in continental outflow regions, Geophys. Res. Lett., 33, L18804, doi:10.1029/2006GL026399.

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