**Atmospheric
Chemistry
and Physics
Discussions**

Interactive
Comment

Interactive comment on "Investigation of downscaling techniques for the linkage of global and regional air quality modeling" *by* Y. F. Lam and J. S. Fu

Anonymous Referee #2

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The authors investigate 3 different methods to describe ozone boundary conditions in the CMAQ air quality model. They take 3 cases a) fixed profiles b) interpolated output from a global model c) filtered output from a global model and give arguments that option c) is the preferred option.

While the work is of a practical importance, and the analysis makes a sufficiently rigourous impression, there are a number of issues that need to be explained and described better.

1) it is not clear to me whether for case 1 the profile bc's were only prescribed at the model's boundaries, or also at the top of the model (at which level?)

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2) I think it is plausible that ozone concentrations associated with stratospheric intrusion from the GEOS-CHEM are not necessarily very accurate, and also inconcistent with MM5/CMAQ meteorologie. Nevertheless the phenomenon of stratospheric intrusion into the troposphere is a well documented feature that can sometimes even influence surface ozone. If the filtering out all stratospheric data is the only way to achieve good results- it may actually point to problems elsewhere in the model; and as a consequence the wrong sensitivities in scenario studies. I would like to see a thorough discussion on this.

3) I understand that the upper boundary of the CMAQ model is 100 hPa; did the authors try to use upper boundary conditions by prescribing concentrations only at this level? 100 hPa is -over the US- almost always in the stratosphere, and given the inertness of the UTLS layer, one won't need a special chemistry description, and it would take only a correct model transport to get the correct influx into the troposphere. If they tried, and it didn't work, can the authors describe what were the problems encountered? In the answer I would like to see a better description of the ability of CMAQ to the represent middle and upper tropospheric/lower stratospheric conditions.

4) the current way of filtering troposheric data may lead to rather low ozone columns-that are return input to the photolysis, what is the magnitude of this potential error?

5) Another serious problem with this paper is the very poor use of the English language (almost random use of the articles; numerous other grammar mistakes) which render the paper difficult to read, and some sections rather incomprehensible. In addition there are many signs of sloppy and hastely work- incomplete words and sentences. I will not try to make an extensive overview of linguistic issues- but would advise to have a native speaker to rigorously correct the manuscript- or seek professional help offered by Copernicus.

Further detailed comments below:

p. 16012 Abstract: very poor English. What is the 'tropopause' effect? I think the au-

thors want to say something like: "to determine upper boundary conditions for ozone,by separating tropospheric and stratospheric air"

p. 16012 l. 23-26 language

p. 16013 l. 16-16 Incomprehensible

p. 16013 l. 24 what is meant with abnormality?

p. 16014 l. 2 quick downward mixing: is this something artificial; if so it would also too quickly mix down any BC.

p. 16014 l.10 give typical summer/winter levels over the US.

p. 16014 l. 29 I thought that especially at midlatitudes the PV relationship was quite successfully describing downward transport of ozone

p. 16015 I guess you're talking about a 'chemical' tropopause.

p. 16015 the citation to Collins is probably not very appropriate- there are a number of other models that have a more realistic strat-trop exchange -including GEOSCHEM

p. 16017 what is meant with 1 hPa (upper stratopshere) in this context.

p. 16017 figure 1 is good to see, but the annual average is masking a lot of issues; I think it would be more illustrative to show for instance a seasonal cycle at 700 300 and 100 hPa, and give the statistics for e.g. winter,spring,summer,autumn seasons

p. 16019 If understand it correctly there are a number of GEOSCHEM hydrocarbons that do not end up into the CBM4 mechanims. Discuss whether this is a problem.

p. 16020 I think we need here to know how many layers are in GEOCHEM and in CMAQ in this region. I could as well imagine to define the first layer with o3>150 (or 100 ppbv) as 'stratosphere. I miss an overview what is the final result of this tropopause definition (e.g. for 4 segments in the US)

p. 16021 what is CONUS?

p. 16022 tempo is temporal thermo is thermal

p. 16027-16030 I didn't read these sections in great detail, improve the English, I trust the statistical analysis was done well.

p. 16032 I would suggest to improve the description of the motivation and the validity of the approach. I think the inconsistency of GEOSCHEM and CMAQ needs to be mentioned; as well as (I think) insufficient vertical resolution in the UT to realistic simulate cross-tropopause transport. Discuss whether there may be a compensation of errors.

p. 16032 I suggest to delete the 252 K sentence, the tropopause temperature is quite variable, this relation ship is very shaky.

p. 16403 what is the 19th layer (pressure, height?) In general check the English of figure captions.

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