

Interactive comment on “Errors and improvements in the use of archived meteorological data for chemical transport modeling” by Karen Yu et al.

Anonymous Referee #2

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This work addresses issues related to vertical transport in offline CTMs that are run at coarse resolutions. Because analysis or reanalysis meteorology is typically computed at much finer spatial and temporal scales, the use of these fields to drive offline fields can cause several problems. First, the use of 3D fields that are archived every 3 to 6 hours results in a loss of information about shorter time scale mixing processes, even when the CTM is run at the same resolution as the meteorological analysis. Second, averaging meteorological fields spatially to a much coarser grid reduces vertical mass flux because the role of subgrid transport processes differs substantially at fine and coarse resolutions and this difference is not accounted for in CTMs. These effects are examined using a combination of short-lived tracer experiments in the offline GEOS-Chem and an online version of the GEOS-5 GCM. This is an important but previously

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unaddressed issue that affects the use of CTMs for a number of scientific problems. The analysis is insightful, thorough, and well written. I recommend publication after the minor comments below are addressed.

General Comments:

The transport issues are well illustrated using the zonal mean plots of Rn, Be, and Pb. It would be interesting to see how large the horizontal variations were. For example, I would assume that the large mid- and upper troposphere differences seen in the left panel of Figure 6 are larger over land masses (where Rn is emitted) than over oceans. I don't think it's necessary to add more figures, but it would be nice to see a discussion of the horizontal and temporal variability of these errors discussed somewhere in the text.

These issues would appear to be problematic for a wide range of longer lived gases that GEOS-Chem and other CTMs are used to study (e.g. CO, CH₄). Could you comment on the implications for other species in the conclusions?

Technical Comments:

P2, line 8 – What version of the GEOS analyses are being used to drive GEOS-Chem?

P4, line 20 – This online capability is being used here as a comparison against the offline GEOS-Chem runs? Should mention this here.

P8, line 12 – Which way is GEOS-5's RAS transport done – short plume to tall or tall to short?

Figure 3 – Does the middle panel also include the difference in online vs offline PBL mixing? This is mentioned in the discussion of Figure 2 (p8, line 19) and appears to have a substantial impact in the left panel of that figure. However, it is not noted in figure 3 and its impact is not discussed.

P9, line 15 – Also worth noting that while the percentage change in the figure is large,

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the absolute mixing ratio at the poles are quite low because of the short lifetime of Rn and lack of emission over ice/snow covered land masses. So this should be interpreted as very large uncertainty about a very small number.

P10, line 21 – The use of the term ‘on-line archive’ is confusing since the archive isn’t used in the online simulation. Maybe this need to be made more explicit – e.g. ‘archiving of fields in support of offline simulations’.

P10, line 27 – Is omega saved every 3 hours as is standard in GEOS? Or more frequently for these experiments?

Interactive comment on Geosci. Model Dev. Discuss., <https://doi.org/10.5194/gmd-2017-125>, 2017.