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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Global Atmospheric Chemistry – Which Air Matters" *by* Michael J. Prather et al.

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The authors thank referee #1 for the prompt, thoughtful, and constructive comments (RC1). Many of these are technical and will be corrected in the revision after all review comments are in (with fully traceable responses). Here, we think it is important to discuss some of the larger issues where our miswriting or omissions may have caused some misinterpretation.

C1) Alternative methods for model-measurement analysis using historical/nudged/specified dynamics in the models – Discussed already? We believe that lines 100-114 directly address this issue. Nudged CCMs or CCMs running with 'specified dynamics' are truly different models than the free-running climate versions. The nudging is an acceleration term that creates different residual tracer circulations

and even water cycles. If this 15-line explanation with references needs expanding, then we can.

C2) Methodology vs science paper – Both. Yes, there is a fair amount of nuts-and-bolts in this paper, and it needs to be documented, which might make it an AMT-like paper (GMD would be more for documenting specific models). Figures 1 and 2 are certainly motivation/methodology figures but beginning with Figure 3 we present new diagnostics that clearly identify how models differ. This paper presents a 6-model comparison of tropospheric reactivity using 2D and weighted probability distributions. The RC1 point is well made: we failed in the current manuscript to highlight the scientific conclusions from this comparison; thanks for catching this; we will fix it. In addition to the Conclusions, the Introduction (lines 146 & 167?) needs revision to point to what we found with the multi-model comparison.

C3) Other unbiased data sets – Yes, need to add. While we use some results from the incredibly valuable MOZAIC/IAGOS aircraft measurements and reference these papers, we failed to emphasize their importance in already providing an unbiased climatology for O3 and CO at cruise levels and for profiles over airports. Starting at line 136 we need to add this discussion. The major extension with ATom is the near-complete chemical package and the regular near global profiling. If the referee knows of other objective sampling chemical climatologies, please let us know and we will include in the revised discussion.

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