Geoscientific
Model Development
Discussions

Interactive comment on "The description and validation of a computationally-Efficient CH$_4$-CO-OH (ECCOHv1.01) chemistry module for 3-D model applications" *by* Y. F. Elshorbany et al.

Anonymous Referee #2

Received and published: 4 December 2015

An efficient representation of tropospheric OH as described here can facilitate multi-decadal simulations that need to represent the long lifetime of methane and its inter-actions with OH, and might be useful for future studies of paleo or future atmospheres. Below I suggest some additional information to help guide future adopters of this approach, as well as some additional evidence, if available, to strengthen the paper.

General comments.

If possible, it would be stronger to show in the main text the differences in results using archived, annually-varying OH fields versus the parameterized approach as a demonstration of the utility of the parameterization relative to the currently favored compu-

tationally efficient approach. For example, is there a scenario with archived OH that could be compared with Base? Comparison with a full chemistry model would also be useful.

Does the parameterization require having a companion full chemistry simulation to provide the driving parameters? If so, then the value here must be that the parameterized version allows for cheaper sensitivity simulations relative to that single full chemistry simulation. If this is correct, it would help to state this more clearly. Is the factor of 500 a result from this work or is that number based on the 2000 paper (P 9455 L9-11)? It would be useful to provide a brief description of what the parameterization involves, including that it is tailored to regional chemical and meteorological conditions.

Consider reducing the number of figures in the supplemental material and possibly in the main text.

Specific comments follow.

P9453 L23. How large is this bias from using archived OH?

P9454 L19-22. Does the parameterization avoid this uncertainty somehow? Is it updated to include more recent isoprene-NOx-OH relationships?

P9455-9456 Is this the only update from the parameterization described in the 2000 paper? Are total ozone columns and stratospheric OH, Cl, and O1D varying inter-annually? Are photolysis rates calculated explicitly in ECCOH (P9456 L4)?

P9457 L18. Where does Table 2 describe the input variables?

P9458 L11-13 seems to require the reader to know what these distributions look like. L18-19 consider showing this comparison.

P9459 L3-15 Are these values all for lifetimes with respect to tropospheric OH loss only? L26. Are these models for the same period as the ECCOH simulations? P9460 L3 Table 3 should be Table 4 ? L4 "reasonably well" would be stronger if supported by

a more objective measure like a correlation coefficient or bias estimate. L20. What is the evidence for regional high biases in natural emissions; are there isotopic measurements?

P9466 L26. How large is the vertical gradient in CH4?

P9467 L12-16. Consider adding a statement to explain why this can't be equally well studied with sensitivity simulations using archived offline OH fields.

P9468 L25-26. Are overhead ozone columns and lightning NOx varying in ECCOH online?

P9469 L11. Are these numbers for the Base or AllVary or both? L21. How important is this compared to uncertainty in emissions?

P9470 L4-6. It would help to point to the evidence supporting this statement.

Table 1. The methane tracer is inactive in radiation, but surely there is a methane abundance set in the radiation code? It would be good to clarify that the emissions used here are bottom-up estimates if that is the case. Are the anthropogenic emissions based on EDGAR or have they been optimized through prior inversions?

Table 4. Is there an explanation for why AllVary often performs worse than Base?

Figure 2. Consider replacing AllVary with a difference plot.

Figure 4. Please describe how the growth rate is calculated and how to interpret the gray shaded area.

Figure 7. Why is ECH4_vary closer to observations than AllVary? Does this imply a problem with the parameterization, emissions, or both?

Figure 12. Not sure what the vertical line sentence in the caption refers to.

Figure 14. Caption needs fixing.

Figure 15. Is there an explanation for why the model is frequently the wrong sign?

Figure 16. Consider adding correlation coefficients.

Figrue 22. What are the deviations relative to? Is this the standard deviation?