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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Inter-model comparison of global hydroxyl radical (OH) distributions and their impact on atmospheric methane over the 2000–2016 period" *by* Yuanhong Zhao et al.

Anonymous Referee #2

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General comments: The manuscript "Inter-model comparison of global hydroxyl radical (OH) distribution and their impact on atmospheric methane over the 2000-2016 period" written by Yuanhong Zhao describes the inter-model differences in spatial distribution and temporal evolution of OH concentrations, and elucidates the impacts of simulated OH concentration fields on CH4 using the LMDz chemical transport model. The manuscript contains novel investigation to reveal inter-annual variations in OH and its impact on CH4 over recent decades using multi-model approach. The topic of the manuscript is certainly within the scope of ACP. Overall, the manuscript is well written and easy to follow. I would like to consider the publication of the manuscript from ACP, while I have several comments below which should be addressed before publication.

Specific comments: 2.1. OH field Is the prescribed biogenic NMVOC emissions (p. 8, l. 187) climatology? Please clarify.

How did the authors prescribe the ECLIPSE and RCP85 emission inventories in the INCA simulations during the periods before 2004, between 2006-2009, and after 2011?

2.2.2. Model simulations Please clarify how the OH increasing and decreasing rates are determined in the Run$_O H_i n c and Run_O H_d ecsimulations. Why are the rates +1 and -1$

3.1. Spatial distributions of tropospheric OH The authors attributed possible causes of too large interhemispheric differences in OH in the CCMI models to model O3 and CO biases and unaccounted processes in some of the CCMI models, as reported by previous studies. Why is not the model performance on O3 and CO in the CCMI ensembles evaluated or referred? It might be better to cite Strode et al. (2016), Revell et al. (2018), and other papers.

3.3. Factors contributing to inter-model differences Why the authors did not assess inter-model differences in tropospheric O3 burden? The tropospheric O3 burden should also affect primary production of OH.

Do inter-model differences in vertical distribution of lighting NO production affect OH vertical distributions?

3.4. Inter-annual variations of OH What is possible cause of significant positive [OH] trends over the tropics (p. 19, l. 454)?

4.2.1. Spatial distributions of tropospheric CH4 mixing ratio Could you explain how inter-model differences in spatial and temporal OH variations affect the simulated global CH4 mixing ratio more in depth?

Technical corrections: p. 13, l. 317: publication year is missing.

p. 19, l. 461: "and" is typo?

p. 23, l. 545: typo for EMAC-L90MA?

Reference Revell, L. E., Stenke, A., Tummon, F., Feinberg, A., Rozanov, E., Peter, T., Abraham, N. L., Akiyoshi, H., Archibald, A. T., Butchart, N., Deushi, M., Jöckel, P., Kinnison, D., Michou, M., Morgenstern, O., O'Connor, F. M., Oman, L. D., Pitari, G., Plummer, D. A., Schofield, R., Stone, K., Tilmes, S., Visioni, D., Yamashita, Y., and Zeng, G.: Tropospheric ozone in CCMI models and Gaussian process emulation to understand biases in the SOCOLv3 chemistry–climate model, Atmos. Chem. Phys., 18, 16155-16172, https://doi.org/10.5194/acp-18-16155-2018, 2018.

Strode, S. A., Worden, H. M., Damon, M., Douglass, A. R., Duncan, B. N., Emmons, L. K., Lamarque, J.-F., Manyin, M., Oman, L. D., Rodriguez, J. M., Strahan, S. E., and Tilmes, S.: Interpreting space-based trends in carbon monoxide with multiple models, Atmos. Chem. Phys., 16, 7285-7294, https://doi.org/10.5194/acp-16-7285-2016, 2016.

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