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Interactive comment

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.

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For certain experiments in this study, the authors use a compilation of methane emissions that is based on bottom-up estimates (inventories and process-models) and not constrained by atmospheric observations (lines 263-266). The resulting increase in emissions between 2000 and 2016 is 70 Tg/yr. This is a large difference, compared to emission scenarios constrained by methane mole fractions [CH4], which place the increase in the order of 20-40 Tg/yr (depending on start and end period). For examples, see Saunois et al. (2017, doi.org/10.5194/acp-17-11135-2017) with best estimates of around 24 Tg/yr between the two periods 2002-2006 and 2008-2012 or Nisbet et

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al. (2019, doi.org/10.1029/2018GB006009), who estimate a ∼44 Tg/yr difference between 2000-2005 and 2015-2018. Bottom up emissions have been repeatedly shown to overestimate the increase in methane after 2007, as reviewed by Saunois et al. (2017). Consequently, the increase of [CH4] in the atmosphere is strongly overestimated in the present study as seen in Fig. 8, where the modelled difference in [CH4] between 2000 and 2010 is >70 ppb, while the observation is ∼25 ppb.

The modelling presented here is outside my area of expertise, yet it would be interesting how the overestimate in methane emissions will influence the simulated CH4-OH dynamics. E.g., is the offline LMDz model subject to CH4-feedback on OH? Would a lower rate of emissions increase produce a significantly different result?

The unrealistic CH4 evolution makes it difficult to assess the importance of the findings for the recent methane budget. For example, the authors state that varying OH from 2000 to 2010 suppressed [CH4] by 5-15 ppb (line 538). Would that value hold for a slower [CH4] increase? Does the stated OH effect as equivalent to 7-20% of the emissions change (line 540) represent a fixed percentage of any emissions increase or would it scale with the emissions scenario (in which case the OH effect could be equivalent to 16-45% of the emissions change of Saunois et al., 2017)?

In my opinion, the relevance of the presented findings for the wider community could be strongly enhanced by a more realistic emission scenario.

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