

## ***Interactive comment on “Preindustrial to present day changes in tropospheric hydroxyl radical and methane lifetime from the Atmospheric Chemistry and Climate Model Intercomparison Project (ACCMIP)” by V. Naik et al.***

**Anonymous Referee #1**

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The authors present an analysis of multi-model simulations to gain insight into the drivers of OH and methane. Overall, I believe that this manuscript has significant deficiencies. Therefore I do not recommend that it be published without major additional analysis. My comments, which are in no particular order, are:

1) The title and abstract are not clear in that I was led to believe that the entire 1850-2000 period was simulated. I recommend that it be explicitly stated in the abstract that the simulations are time slices. For the same reason, the first sentence of Section 2.1 is misleading – “investigate the historical evolution (1850-2000) . . .”.

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2) Major Concern: Unfortunately, I did not learn anything new about the drivers of OH and methane from this manuscript. I recommend that the authors explicitly say what new results are presented and how the analysis contributes to the scientific understanding of methane and OH.

3) Major Concern: Most methane is lost in the tropical/subtropical troposphere (so is methylchloroform), so why not focus the analysis of the model output in this region. There are a number of factors not discussed that drive OH, which do have observational constraints. a) The overhead ozone column is a major driver of OH. Why didn't the authors compare the model output to the three decades of observations of the overhead ozone column? b) Water vapor is another important driver, but there is no comparison of the model output to AIRS or MLS water vapor. c) Clouds are another important driver and there are several datasets available for model evaluation. d) There is now nearly a decade of observations of the tropospheric NO<sub>x</sub> column, another important driver of OH. e) Why not compare model tropospheric ozone with MOZAIC aircraft data? Possibly Young et al. (2012) discusses this, so please summarize their findings.

4) Section 3: The authors state that the “Models can be categorized into two groups . . .” Why these two groups? In the context of individual model uncertainty, what model trends in OH are statistically significant?

5) Section 3.1: Why not discuss the findings of Lawrence et al. (2001) here concerning the limitations of constraining tropospheric OH? In the last sentence of this subsection, the last word “observations” is not appropriate as there are very few direct observations of OH.

6) Why aren't the model distributions of methane compared to GMD and SCIAMACHY data?

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