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Interactive comment on "Simulation of tropospheric chemistry and aerosols with the climate model EC-Earth" *by* T. P. C. van Noije et al.

Anonymous Referee #2

The authors do a nice job of documenting the tropospheric chemistry derived in TM5 and how it is coupled to an Earth System model framework. My main comment/concern is frequency of the coupling (i.e., 6-hours) between EC-Earth and TM5 and how this frequency affects the chemical results. See comments on advection and photolysis rates below.

This work is an appropriate paper for GMD. I have made some specific comments below for the authors to consider.

Specific Comments:

Abstract, Line 13. Please don't use "which likely reflects an". It either does or doesn't or should be mentioned.

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Abstract, Line 18. I would add the value of the CH4 lifetime for EC-Earth, and then discuss the % change. You should state that this is the total atmospheric lifetime (vs that with OH).

Page 1937, line 29. Another very good reference is Lamarque, J-F, L. K. Emmons, P. G. Hess, D. E. Kinnison, S. Tilmes, F. Vitt1, C. L. Heald, E. A. Holland, P. H. Lauritzen, J. Neu, J. J. Orlando, P. Rasch, and G. Tyndall, CAM-chem: description and evaluation of interactive atmospheric chemistry in CESM, Geosci. Model Dev., 5, 369-411, doi:10.5194/gmd-5-369-2012. (also in GMD).

Page 1938, line 15. "Decadal simulation. . . for present-day conditions". Is this a perpetual 2000 type of simulation, or do you run from 2000 through 2009?

Page 1939, line 4. "Version 2.3" The abstract denotes the EC-Earth version as "2.4"?

Page 1939, line 4. "IFS model cycle" What is a model cycle?

Page 1940, line 15. "3x2 degrees, 31 levels" Why such coarse resolution, especially since the EC model is run at 1.125 degrees? Also, is it really necessary to decrease the vertical levels to 31 (from 62 in the IFS)? If this were just about numerical cost, it would be nice to state this. If there is a technical reason why you've decided to have different horizontal and vertical resolutions that also would be important to state.

Page 1941, line 5. "data exchange between TM5 and IFS is set to 6-hours" In most CCMs, the chemistry is inline and the chemical constituents are modified at least every hour (most less than that). Does this mean you calculate photochemistry just 4x per day?

Page 1942, section 2.2.3 Transport. The TM5 advection routine can use two schemes and it is stated that model simulations presented in this work used the Russell and Lerner (1981) approach. What is not stated is what the advection routine is in EC-Earth. One can imagine when the EC-Earth / TM5 is fully coupled (not just one way as shown in the paper), that this could cause issues. In the future, do the authors plan to

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have the advection handle by the climate model in the fully coupled configuration?

Page 1947, line 25. "linear interpolation" I believe you mean you are doing a linear interpolation of the seasonal cycle for the emissions?

Page 1956, lines 5-12. It would also be nice to report the lifetime with respect to OH (see Prather et al., 2012). In addition, adding the observed OH distribution (based on Spivakovsky et al., 2000) to the figure 3 would be interesting.

Page 1958, line 21. "Table 6" You mean "Table 5"?

General comment on the ozone section: It is a bit on the long side, especially compared to the discussion of OH and CO. You may want to make this section more concise. Also, it would be nice to know why the STE is lower in both model versions (relative to other published studies). Is this a direct result of too little ozone in the lower stratosphere or a dynamics/transport issue?

Page 1972, lines 5-6. "photolysis rates" Please be specific in this work how often these rates are updated for the present version and future versions. I.e., are you really only updating photolysis rates every 6 to 3hours?

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Interactive comment on Geosci. Model Dev. Discuss., 7, 1933, 2014.

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