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Interactive comment on "Implications of model bias in carbon monoxide for methane lifetime" *by* S. A. Strode et al.

Anonymous Referee #2

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Reviewer Comments for 'Implications of model bias in carbon monoxide for methane lifetime by Strode et al.'

It is a well-know problem that current chemistry models are unable to represent the magnitude of carbon monoxide (CO) in the northern hemisphere, particularly in winter and spring. This paper addresses this problem and highlights the sensitivity of modeled CO to emissions and hydroxyl radical (OH) concentrations. They then go on to provide a valuable insight into the importance of model biases in ozone, water vapor and nitrogen oxide emissions in driving possible biases in simulated OH concentrations. The paper is well presented and scientifically relevant and is well suited for publication in ACP after the relatively minor corrections that are listed below.

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Main comments:

One of my main questions is why you use a chemistry climate model with free-running meteorology instead of a model with specified dynamics as your primary model. You show that when you use specified dynamics in the CO-only runs you reduce the model bias so I wonder what results you would get in section 3.4 if you also try a run with SD? It would be useful to give a brief description of why you employed each model version under section 2.2, as you have done for the CO-OH option on page 20312, L17.

Under section 2 give a brief description of how you change emissions, transport and OH prior to describing results. (Just simply by saying you apply scaling factors to emissions/OH and by switching between free-running and SD meteorology).

Table 2: Add CO-only option for the OH information. It is useful to see what the OH looks like in the CO-only run and whether it differs from the CO-OH model. Consider also adding zonal mean plot of OH for CO-only simulation to figure 1.

Figure 3: Can you show bias instead of absolute concentrations – may be easier to see differences between the runs?

Pg20314 L9-11 – How different are the NOx, NMHC and CH4 archived fields used for the CO-OH runs compared to those calculated within the RefGMI run? Does this explain the OH differences or is it something else?

Pg 20316, L8: Why exclude COnaa and CObio? Move this sentence to L13, after you've highlighted problems in increasing these regional emissions.

Pg 20319, Section 3.3: How do you sample the model for comparison to the MLS/OMI total column ozone. Does the instrument see the full total atmospheric column of ozone? Do you remove any model data when there is missing observations? Are there any limitations that will have an impact on your results?

Minor Corrections:

Pg 20306, L14 – Add reference for CO as primary sink for OH. Methane is also important, please change sentence to reflect this.

Pg 20313, L22-24: In figure 2 are the surface obs averaged over 1999-2009 also? Please indicate years used for each site.

Pg 20315, L17: Define IHG. Currently defined lower down in paragraph.

Pg20315, L23: global mean. -> global mean concentration? Or global mean bias?

Pg 20317, L16: Remove first sentence as repetitive and seems out of order. You state this lower in the paragraph.

Technical corrections:

Pg 20311, L20: The simulation in pulled -> The simulation is pulled

Pg 20312, L15: COonly -> CO-only

Interactive comment on Atmos. Chem. Phys. Discuss., 15, 20305, 2015.

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