

## ***Interactive comment on “Evaluation of UTLS carbon monoxide simulations in GMI and GEOS-Chem chemical transport models using Aura MLS observations” by Lei Huang et al.***

**Anonymous Referee #1**

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This manuscript has two objectives: 1) introduce the new version 4.2 MLS CO data and 2) use these data to evaluate the convective transport and emissions in two global chemical transport models (GMI and GEOS-Chem). The manuscript is well written and well organized and achieves these objectives. Numerous analyses on the global scale to examine the zonal, meridional, and vertical distributions of CO in the MLS data and in the two models are conducted. In addition, the CO “tape recorder” is examined to illustrate the lag in the CO maximum with altitude in the UTLS. Regional analyses are also conducted for the major CO emission regions, and a bi-variate analysis is examined to determine the roles of convection and emissions in leading to the observed CO and to determine the source of errors in the model CO distributions. The manuscript

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should be published after the authors address the following issues.

Specific Comments: Line 42: CO has been used in transport studies in global models much farther back in time than indicated by the references used here. The Allen et al. (1996, JGR) should be included here.

Section 2.2: The two models are driven by the same meteorology and have a number of similarities. The authors need to highlight the major differences between the two models, as this is sort of lost in the text. Perhaps highlight the model differences in a table. This is important because one of the major aspects of the paper is illustrating the difference in the CO results between models.

Line 164: NCAR convection scheme. Is this correct? If so, what scheme is this? Is there a reference? Rain, cloud, land-water-ice all come from MERRA. They are not calculated in GMI as implied by this sentence.

Line 167: Need another sentence here: ...hindcast spinup period. Therefore, the GMI simulation used in this analysis is for 2004 through 2012.

Lines 218-219: Is it the monthly means that are archived?

Line 241: The headings in Table 2 are incorrect. “Minimum” should be “Maximum” and vice versa. What is meant by “peak” here? Is it the maximum of the grid cell values of monthly means?

Line 254: Need to point out that this maximum is not as broad as in the MLS data.

Line 270 ...local maxima and minima...

Line 271: ...underestimation of CO extremes from GMI...

Line 294: The underestimate over and downwind of North America should also be mentioned.

Line 323: At 147 hPa (not shown)...

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Line 347: 20 hPa

Line 378: It is unclear as to whether the underestimates listed here are for a particular month or an average over the years.

Lines 392-393: The peak in both models is a month later than MLS in East Asia also.

Line 404: Note that the seasonal cycle is not correct in North Africa and South Asia.

Line 419: "largest at 215 hPa" This is not true for four regions in DJF and MAM where the difference maximizes at 100 hPa.

Line 466: "...which is also captured in the GMI simulation, but not in the GEOS-Chem simulation."

Lines 474-475: I would say it is more pronounced at 215 than at 147 hPa.

Lines 514-516: Is there any explanation for this poor behavior by the models?

Lines 534-537: I don't think this conclusion is mentioned anywhere else in the paper.

Lines 591-593: This conclusion supports the need to have a table that clearly shows the differences between the two models, especially with respect to these topics.

Line 627: V4 CO is slightly more realistic

Table 2: There needs to be an overall heading over the nine columns to the right of the correlations. It should say "Model Biases (%)".

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