



Supplement of

Evaluation of UTLS carbon monoxide simulations in GMI and GEOS-Chem chemical transport models using Aura MLS observations

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Fig. S1. (top row) Seasonal mean (DJF, MAM, JJA, and SON) distribution of CO mixing ratio at 215 hPa for December 2004 – November 2012 from MLS V4 data; (middle row) GMI model relative biases; (bottom row) GEOS-Chem model relative biases.



Fig. S2. As in Fig. S1, but for CO mixing ratio at 147 hPa.



Fig. S3. As in Fig. S1, but for CO mixing ratio at 100 hPa.



60S 40S 20S 0 20N 40N 60N 60S

Fig. S4. (top row) Vertical/latitudinal distribution of zonal mean CO mixing ratio during different seasons (DJF, MAM, JJA, and SON) from MLS V4 data; (middle row) GMI model relative biases; (bottom row) GEOS-Chem model relative biases.



Fig. S5. (top row) Monthly variation of zonal mean CO mixing ratio at 215 hPa for August 2004
– December 2012 from MLS V4 data; (middle row) GMI model relative biases; (bottom row)
GEOS-Chem model relative biases.



Fig. S6. As in Fig. S5, but for CO mixing ratio at 100 hPa.



Meridional mean CO at 215 hPa (ppbv)

Fig. S7. (left) Monthly variation of meridional mean (15 S–15 N) CO mixing ratio at 215 hPa for August 2004 – December 2012 from MLS V4 data; (middle) GMI model relative biases; (right) GEOS-Chem model relative biases.



Meridional mean CO at 100 hPa (ppbv)

Fig. S8. As in Fig. S7, but for CO mixing ratio at 100 hPa.



Fig. S9. (top row) Temporal variation of monthly mean CO deviations, zonally averaged over the tropics (15 S–15 N), vertically from 200 hPa to 50 hPa for August 2004 – December 2012 from MLS V4 data; (middle row) GMI model absolute biases; (bottom row) GEOS-Chem model absolute biases.



Fig. S10. As in Fig. S9, but over the northern subtropics $(10^{\circ}-30^{\circ}N)$.



Fig. S11. As in Fig. S9, but over the southern subtropics $(10^{\circ}-30^{\circ}S)$.



Fig. S12. (left) Scatter plot of MLS IWC versus GMI model convective mass flux (cmf); (right) Scatter plot of MLS IWC versus GEOS-Chem model convective mass flux. Each dot represents a $2^{\circ} \times 2.5^{\circ}$ grid box value of climatological monthly average of July over the tropics (30 S-30 N). The correlation coefficient between MLS IWC and model cmf is indicated at the top of each panel.