Supplement of

Reconciling the bottom-up and top-down estimates of the methane chemical sink using multiple observations

Yuanhong Zhao et al.

Correspondence to: Yuanhong Zhao (zhaoyuanhong@ouc.edu.cn)

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Figure S1. Spatial distribution of the tropospheric mean OH precursors from observations (top) and the difference in the OH precursors between CESM1-CAM4chem (middle) and GEOSCCM (bottom) simulations and the observations (model – observation).

Figure S2. Left: The latitude means of total ozone column from TOMS/SBUV observations (black), and CESM1-CAM4chem (yellow) and GEOSCCM (blue) simulations. Right: the difference in observed total ozone column between CESM1-CAM4chem (yellow) and GEOSCCM (blue) simulations and the observations (Model – observation).
**Figure S3.** Latitude-height cross sections of specific humidity (top) and air temperature (bottom) from MERRA-2 reanalysis data (left) and the differences of CESM1-CAM4chem (middle) and GEOSCCM (right) simulations with the reanalysis data (model – MERRA-2).

**Figure S4.** Spatial distributions of air mass-weighted tropospheric mean [OH] ([OH]_{trop-M}) in 2010 from 3D model simulations (left) and chemical box model (DSMACC) simulations driven by the corresponding 3D model outputs (right). The global mean values are shown inset in molec cm$^{-3}$. 
Figure S5. Spatial distribution of tropospheric mean [OH] estimated by Spiavkovsky et al. (2000).

Figure S6. Spatial distribution of NO$_2$ given by Spiavkovsky et al. (2000) averaged over November to March (left) and July to October (right) at 900hPa (top) and 500hPa (bottom).
Figure S7. Sensitivity of $[\text{OH}]$ to individual factors (filled colors) as a function of HCHO+isoprene mixing ratio (y-axis) and O($^1\text{D}$) photolysis rate or NO$_2$ mixing ratio estimated by the DSMACC simulations using MOZART-4 chemical mechanism.

Figure S8. (a) Zonal averaged difference between modeled and observation-based $[\text{OH}]_{\text{trop-M}}$ estimated by the All _obs simulation ($[\text{OH}]_{\text{model}} - [\text{OH}]_{\text{obs}}$; yellow); The total contribution of the 8 individual factors to the difference in global $[\text{OH}]_{\text{trop-M}}$ estimated from the simulation $x_k \_\text{obs}$ simulations ($\sum [\delta [\text{OH}]_{xk}]$; blue). (b) The difference between the two estimates ($\sum [\delta [\text{OH}]_{xk}] - ([\text{OH}]_{\text{model}} - [\text{OH}]_{\text{obs}})$).