



Supplement of

Quantifying errors in surface ozone predictions associated with clouds over the CONUS: a WRF-Chem modeling study using satellite cloud retrievals

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Supplementary



Fig. S1. Scatter plots of O_3 and NO_y . The thick black line indicates the linear regression coefficient. The modeled O_3 and NO_y concentrations at 15–16 local time under clear sky conditions (hourly COD < 1) in the CNTR simulation are used for analysis. On the title heading, the first and second words indicate the name of state and the name of county of the site. The third one indicates the local setting of the site defined by EPA.



Fig. S2. Spatial distribution of sum of contingency category B and C between the WRFgenerated clouds (CNTR simulation) and SatCORPS GOES retrievals averaged over the whole study period.



Fig. S3. Similar to Fig. 7 but for several bins with different peak MDA8 O₃ ranges.



Fig. S4. Same as Fig. 7, but for the southeast US where the latitude is between $25^{\circ}N$ and $40^{\circ}N$ and the longitude is between $100^{\circ}W$ and $70^{\circ}W$.



Fig. S5. Box modeling results. Sensitivity of various chemical species to the cloud attenuation of photolysis rates. For NO_X (dashed lines) in the upper right subfigure, read the right *y*-axis.



Fig. S6. Histogram of hourly cloud optical depth (COD) during the daytime (16–23 UTC) over CONUS (land only) for the period of 3–12 July 2013 from (a) WRF-Chem simulations with the Thompson microphysics, (b) GOES retrievals, and (c) WRF-Chem simulations with the Morrison microphysics for the same 10-day period.



Fig. S7. (Left column) The results of 3–12 July 2013 WRF-Chem simulations with Thompson microphysics scheme. (a/c) Probability density function of MDA8 O_3 bias (model value minus observation value) for VOC/NO_X-limited regime under cloudy sky conditions defined with COD threshold of 20 in the simulations with the Thompson microphysics scheme. (b/d) Same as (a/c), but for the simulations with the Morrison microphysics scheme. (e and f) Difference in median values of MDA8 O_3 bias between the two simulations with respect to COD threshold (i.e., CNTR

minus GOES) for the simulations with the Thompson and with the Morrison microphysics schemes, respectively.



Fig. S8. Histogram of hourly cloud optical depth (COD) during the daytime (16–23 UTC) over CONUS (land only) for the period of 3–12 July 2013 from WRF-Chem simulations with (a) Grell-Freitas nad (b) Grell-3D cumulus parameterization schemes.



Fig. S9. (Left column) The results of 3–12 July 2013 WRF-Chem simulations with Grell-Freitas scheme. (a/c) Probability density function of MDA8 O_3 bias (model value minus observation value) for VOC/NO_X-limited regime under cloudy sky conditions defined with COD threshold of 20 in the simulations with the Grell-Freitas scheme. (b/d) Same as (a/c), but for the simulations with the Grell-3D scheme. (e and f) Difference in median values of MDA8 O_3 bias between the

two simulations with respect to COD threshold (i.e., CNTR minus GOES) for the simulations with the Grell-Freitas and with the Grell-3D schemes, respectively.