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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Quantifying errors in surface ozone predictions associated with clouds over CONUS: A WRF-Chem modeling study using satellite cloud retrievals" *by* Young-Hee Ryu et al.

Anonymous Referee #1

Received and published: 22 November 2017

This is a very good manuscript that demonstrates how the inclusion of satellite derived cloud properties can be used to improve atmospheric chemistry model simulations. I concur with Prasad Kasibhatla's comment that vertical profiles of O3, as well as NOx and NOz, should be evaluated with the field campaign observations. In addition, I wonder if the conclusions from the analyses involving NOx limited regimes are biased toward rural sites and therefore don't accurately represent NOx limited urban and sub-urban sites. A further analysis as discussed below could answer this question.

Major comments:

1) Evaluate vertical profiles of O3, NOx, NOz from field campaigns.

2) I have some reservations concerning the analyses involving NOx and VOC limited regimes in Sections 5.4 and 5.5 (although I like the last paragraph in Section 5.5). This manuscript has specific conclusions for VOC and NOx limited regimes. There are urban areas that are NOx limited. I suspect the NOx limited conclusions are heavily weighted toward rural areas and don't accurately represent polluted urban and suburban areas. I suggest binning sites based on ozone concentrations and then performing the analyses described in Sections 5.4 and 5.5 so the reader can compare VOC and NOx limited sites with similar ozone concentrations as well as VOC limited sites over a range of ozone concentrations and NOx limited sites over a range of ozone concentrations. Perhaps this can be done by binning the sites based on the peak maximum 8 hour average ozone concentration throughout the year (i.e., bin 1: peak MDA8>75, bin 2: peak MDAO3 between 70-75, . . .). It may be interesting to include the sites that fall into the transitional zone in your analysis. Include a figure showing delta O3 / delta NOy to identify NOx and VOC limited regimes.

Minor comments:

Abstract, line26: Remove mention of "robust with respect to the choice of the microphysics scheme." Only 2 microphysics schemes were tested.

Page 5, lines 89-91: Why skip pixels to create an 8km product? Why not leave the product at 4 km?

Page 9, line 181: Change "and with fire" to "and fire"

Page 10, line 189: Change "(Sillman and He (2002)" to "Sillman and He (2002)"

Page 11, lines 203-204: Change "wrong clouds (that are not present in reality)" to "clouds that are not present in reality"

Page 11, lines 204-205: Re-word this sentence.

Page 11, line 207: change “except for the mountain regions and northwestern US” to “except for parts of the Rocky Mountains and the Pacific Northwest.”

Page 11, line 208: Change “in the central” to “in central”

Page 13, lines 252-253: Change “This is” to “These reductions are”. Provide a further explanation of this claim.

Page 13, lines 254-260: This text states that NOMADSS has a larger mean model-to-observation ratio than SEAC4RS. This is not the case based on Figure 3.

Section 5.2: Calculate and discuss model-observations comparison statistics. Use maximum daily 8 hour average O3 (MDAO3) instead of 8hr average ozone between 10-17 LST.

Section 5.3: If you have a simulation with “photolysis with WRF clouds and PAR with GOES clouds”, this would be interesting to include in this section.

Page 16, lines 316-318 and Figure 6: Difficult to see the relative differences between Figure 6c and 6d. A figure of the absolute value of 6d divided by the absolute value of 6c may be helpful.

Page 16, lines 318-320: Ozone difference of a simulation with photolysis with WRF clouds and PAR with GOES clouds minus GOES may or may not be 80% of CNTR-GOES. I suggest rewording this sentence to “The contribution of changes in BVOC emissions is $\sim$20% compared to changes of BVOC emissions and photolysis rates using GOES observations.”

Figure 4: Use EST or CST, not LST. Map shows areas in the eastern and central time zone.

Figure 5: Show 3 panels with a CNTR, GOES, and difference plot (CNTR-GOES). Include observations overlayed on-top of the CNTR and GOES plots.

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