Responses to the Reviewer

General Comments:
The revised manuscript 'A comprehensive study of two-way and offline coupled WRF v3.4 and CMAQ v5.0.2 over the contiguous U.S.: Performance evaluation and impacts of chemistry-meteorology feedbacks on air quality' presented the comprehensive comparison of offline (i.e., traditional) CMAQ and two-way coupled CMAQ over the CONUS. I appreciate the authors' work to address my concerns, especially by adding the trend analysis. As commented by other reviewer, seasonal analysis has been added and figures are replaced appropriately in the supplemental material. The presentation quality has been significantly improved from original version. Here I have two further comments on the revised manuscript. Please clarify these issues.

Reply: We thank the reviewer for carefully reviewing our revision. We have further revised our paper to address the reviewer's additional comments. Please see our point-by-point responses below.

1. Long-term trends of meteorology and pollutants: I appreciate to include 5-yr trends analysis in the revised manuscript. The additional discussion in Fig. 3 is important to consider the modeling performances. In the discussion of trends in PM2.5, the authors stated that "Overall, the model performs well for PM2.5 for most of years and better over CSN than IMPROVE sites with general underpredictions in most years. The observations for both CSN and IMPROVE show a general decreasing trend (except for 2010 over CSN) especially over IMPROVE sites.". I impressed different understanding in this trend found over CSN. I guess CSN also showed gradual decreasing trend from 2008 to 2012 but the year of 2009 posed strong drop. This lower value found in 2009 is consistently seen both by model and observation, but interestingly, IMPROVE sites did not the drop on 2009. If there is specific reason to cause this drop, it is useful to include the short statement on this feature.
Reply: The reviewer is right that CSN indeed shows gradual decreasing trend except for 2009 instead of 2010 as we initially thought in the paper. According to EPA (2012), the strong drop of $PM_{2.5}$ in 2009 is due to a few reasons including many national and local regulations that are imposed, the contribution of economic slowdown to cleaner air conditions and also favorable meteorological conditions to lower air pollution levels in 2009. The impacts are more apparent over CSN sites mainly composed of urban/suburban areas than IMPROVE sites mainly composed of remote areas and national parks. The above points have been added in the revision lines 498-504 (in the track-mode file).

2. Satellite data comparison for column abundant: I understood that AK is not considered and only the valid pixels by satellite observations are considered when paring model results. However, for example as shown in Fig. 12, satellite observed NO2 and HCHO showed deficit at northern border of domain (over Canada) whereas model calculated values over this area. If the deficit is treated as same in model analysis, the deficit (marked by white color in this figure) grid should be consistent (this concern is also noticed on AOD presented in Fig. 4 and CDNC presented in Figs. 6 and 7). It is highly recommended to confirm the analysis procedure again. Regarding this figure, winter time HCHO posed inhomogeneous signals. In the revised manuscript, "except for column HCHO in winter" is stated in line 553 (track-mode), but is the satellite measurement itself reliable?

Reply: To further address the reviewer's concern on the satellite and simulation data pairing and comparison, we have updated all the plots that containing missing satellite data (considered as deficit data) by excluding those data from simulation plots as well. The domain mean values on the plots have been updated as well. The updated plots include AOD in Fig. 4, CDNC in Figs. 6 and 7, and NO_2 and HCHO in Fig. 12. Now both updated satellite and simulation plots contain the consistent data for comparison.

As also indicated by the reviewer, the satellite measurements on HCHO may indeed have higher uncertainties in winter than summer. According to Stavrakou et al. (2009), the air mass factors used for HCHO column calculation may bear ~18% error under clear sky conditions to ~50% error for very cloudy conditions. The winter typically has higher cloud cover than summer (See Figs. 6 and 7) and thus higher uncertainties for HCHO column. This point has been added in the revision lines 567-570 (in the track-mode file).

Technical points:
Fig. 2: It is better to add DJF and JJA for the legend of TMPA and PRISM.
Reply: The DJF and JJA have been added.

Fig. 3: The title of y-axis shown as "RH" should be "RH2" to be consistent in the discussion in main text.
Reply: It's been fixed.

References:

Stavrakou, T., Müller, J.-F., De Smedt, I., Van Roozendael, M., van der Werf, G. R., Giglio, L., and Guenther, A.: Global emissions of non-methane hydrocarbons deduced from SCIAMACHY formaldehyde columns through 2003–2006, Atmos. Chem. Phys., 9, 3663–3679, doi:10.5194/acp-9-3663-2009, 2009.

U.S. EPA: Our nation's air status and trends through 2010, EPA-454/R-12-001, February 2012, https://www.epa.gov/sites/default/files/2017-11/documents/trends_brochure_2010.pdf, 2012.