ACP's continued efforts on this paper are greatly appreciated. Please see below the author responses (in blue) to Editor's suggestions (in black). Quoted text from the revised manuscript is *in italic*.

Editor's suggestion (based on Referee #3's earlier comment on L425-430 and Figure 11): the explanation of the above query is insufficient. The authors should add lines on the below point: "In Figure 11, the high FNR in the region where the correlation between ozone and NOx is high indicates NOx-sensitive regime."

Changed to: "*Fig. 11 indicates the connection between early afternoon (19 UTC) NO_2 columns and daytime surface O_3 as well as the dependency of this connection on column HCHO/NO_2 ratios. Larger-than-two HCHO/NO_2 values dominate the study region where the overall surface O_3-NO_2 column spatial correlation is high (r=0.54). Daytime surface O_3 concentrations exhibit the most robust spatial correlation with early afternoon NO_2 columns in 2020 (r=0.62, versus 0.47–0.56 for other years), when the domain-wide median and mean HCHO/NO_2 ratios are larger than the other years' by at least 0.5. These model results suggest that NO_x-sensitive or transitional regimes dominate this region during 2018–2023 and point to a potential of inferring surface O_3 variability across this area from high-quality remote sensing NO_2 and HCHO column data*".

Editor's suggestion (based on Referee #1's earlier comment on Lines 181-182): Please add discussions and references of previous papers on SM-DA case studies where other met parameters are evaluated.

Referee #1 questioned about NARR's data quality and its impact on WRF's met performance. To address this, two references have been added to this paragraph: "*Daily reinitialized atmospheric initial conditions (ICs) and boundary conditions (BCs) were downscaled from the 3-hourly, 32 km North American Regional Reanalysis (NARR) dataset, which overall well represents the observed daily variability in apparent temperature for the eastern US (e.g., Ibebuchi et al., 2024). Huang et al. (2017b) showed that, initializing WRF with the North American Mesoscale Forecast System (6-hourly, 12 km)'s atmospheric fields instead of NARR's did not result in significant changes in WRF-simulated surface air temperature fields over the southeastern US*". Ibebuchi et al. (2024) also found that NARR's apparent temperature performance is not as good as that of ERA5 (at 0.25°×0.25° horizontal resolution). In this paper, Fig. S19 shows overall consistent year-by-year variability in WRF and ERA5 surface air temperature.

The impacts of SM DA on non-temperature 2D/3D met fields (e.g., humidity, winds, precipitation) can be found in Huang et al. (2021, 2022, over the southeastern US, WRF initialized with NARR) and Huang et al. (2018, over Asia, WRF initialized with FNL). Results in Huang et al. (2022) indicate that % improvements in near-surface and free tropospheric air temperature due to SM DA are greater than those in humidity for Noah-MP based cases. A sentence has been added to Fig. S18 caption: "*The improvements in other key meteorological* *fields due to the DA, which may be relatively smaller than that in air temperature according to previous studies (e.g., Huang et al., 2021, 2022), also impacted the model's O_3 performance.*".

Huang, M., Crawford, J. H., Diskin, G. S., Santanello, J. A., Kumar, S. V., Pusede, S. E., Parrington, M., and Carmichael, G. R.: Modeling regional pollution transport events during KORUS-AQ: Progress and challenges in improving representation of land-atmosphere feedbacks, J. Geophys. Res.-Atmos., 123, 10732–10756, https://doi.org/10.1029/2018JD028554, 2018.

Ibebuchi, C. C., Lee, C. C., Silva, A., and Sheridan, S. C.: Evaluating apparent temperature in the contiguous United States from four reanalysis products using Artificial Neural Networks, J. Geophys. Res.-Machine Learning and Computation, 1, e2023JH000102, https://doi.org/10.1029/2023JH000102, 2024.

Editor's suggestion (based on Referee #1's earlier comment on Lines 488-509): As suggested by the referee a line should be added in the manuscript on, 'Meteorology can also contribute partially to the observed enhancement in the surface ozone'.
This point is now more clearly written at the beginning of Section 3.3.1 "*Satellite (i.e., GPM, SMAP, and TROPOMI) and in situ observations collected at/round Harvard Forest and the CRN-Millbrook site during the SMAPVEX22 campaign were analyzed along with WRF-Chem results during a precipitating event associated with a frontal passage that occurred from late 13 July to early 14 July 2022. This event caused sharp increases in SSM around 14 July in Massachusetts (by >0.06 m^3 m^{-3}) and parts of the eastern New York (by ~0.02 m^3 m^{-3}), as well as drastic changes in air temperature (by up to ~5 K decreases at the surface) and other meteorological fields. These changes in SSM and meteorological conditions contributed to the abrupt O_3 reductions of up to 30 ppbv (Figs. 13a and S17)*".

Please note that SM DA has feedback on frontal passage characteristics, which impact both local and upwind O_3 (not always clean as this referee suggested). For example: "*The enhancements in soil wetness resulted in altered precipitation characteristics, a bit cooler surface soil/air, thinner atmospheric boundary layer, suppressed biogenic VOC and soil NO_y emissions as well as O_3 formation while deposition accelerated….*".