This manuscript investigates 2015−2023 trends of major air pollutants in South Korea using the AirKorea surface network and satellite observations. The results indicate that further NO_x emission decreases in Korea will reap benefits for both O_3 and $PM_{2.5}$ pollution. The figures are well prepared, and the analyses are relatively sound based on the results. This research's quality and scope are suitable for publication in ACP. However, the manuscript still requires revision to ensure a high-quality analysis that meets ACP standards, subject to the following concerns.

Major Comments:

1. The manuscript analyses trends in major air pollution in Korea using multi-source data, including satellites, ground-based observations, and emission inventories…, but there are significant differences in trends between the multi-source data that need to be clarified. (a) Authors claim CO trend observed by MOPITT decreased slower than surface concentrations because of the background contribution to the CO VCD (Line155-156), why there is a consistent downward trend in MOPITT and surface concentrations in the period 2015-2018 and a huge difference in their downward trends in 2019-2023, it is clear that there is more than just the effect of background concentrations here. (b) Surface SO_2 concentrations and OMI VCDs have decreased at similar rates but there are differences (Line173), For example, SO_2 observed by OMI rises significantly in 2019-2020, and SO_2 observed by both OMI and GEMS rises in 2022-2023, whereas CAPSS and AirKorea only show a downward trend, and these details should be clarified. (c) I really don't understand why the diurnal variation of NO_2 VCD observed by GEMS in warm season (8-11:00 local time) and cold season (10-13:00 local time) is opposite to that of surface NO_2 (Figure 4e). The authors try to explain this phenomenon by using the variation of the mixed layer height, it is insufficient. Besides, the high NO_2 concentration in the morning and evening is affected by meteorological conditions. Vehicle emissions during the morning and evening rush hours are also an important factor. NO_2 is mainly concentrated near the surface and rapidly photolysis after sunrise, and the satellite and the surface observations should show similar diurnal trends, which can be confirmed by previous observations in some mega-cities (Tian et al., 2018) and background stations (Cheng et al., 2019). What's more, an observation from the GEMS also showed that NO_2 column concentrations began to decline at 10:00 (local time) (Xu et al., 2023). I recommend first comparing the GEMS and surface NO_2 concentrations on an hour-by-hour basis, and then carefully analysing the reasons for the opposite trend.
2. Line288-289 "Based on the criteria from Duncan et al. (2010) the positive trend in RFN implies that Korea is now mostly in the NOx-sensitive regime (RFN > 2)." In order to avoid the misjudgment of O_3 formation sensitivity caused by arbitrary selection of FNR thresholds, I strongly suggest using a third–order polynomial model to investigate the empirical relationship between FNR and surface O_3 concentrations, which has been widely used in other studies (Ren et al., 2022; Jin et al., 2020). The criteria presented in Duncan et al. (2010) may not be applicable to the current diagnosis of O_3 formation sensitivity, the threshold is usually small (1 and 2), which causes the contribution of the NOx limit regime to be overestimated.

Minor Comments:

1. Line 57-58 "Synoptic meteorology and transport from China also contribute to seasonal and long-term variations of pollutants over Korea." Missing relevant references.

2. Line 204-205 “Both surface and column NO_2 are higher by a factor of two during the cold season, which can be explained by the longer NO_x lifetime (Shah et al., 2020).” Differences in warm- and cold-season emission patterns should have a greater impact.
3. Line 242-243 “but CHOCHO shows hotspots for manufacturing industries while HCHO shows hotspots for petrochemical facilities.” Unclear HCHO shows hotspots for petrochemical facilities, since HCHO observations are also more distributed, HCHO didn't just indicate petrochemical facilities.
4. Line 262-263 “has been previously reported as systematic low biases in satellite observations of CHOCHO and HCHO.” Please specify it.
5. GEMS is observed every hour during the day and the time should be clarified. For example, in Fig. 3d, does GEMS use all the observations during the day or just a certain hour of the mid-day.
6. Figure 5g “OMI CHOCHO×20”, Does it mean 20 times magnification? This should be clarified in the legend.

Suggestion:

Although well known, some instrument name abbreviations should indicate the full name when they first appear, i.e. OMI, TROPOMI, MOPITT…

Reference:

Cheng S, Ma J, Cheng W, et al. Tropospheric NO2 vertical column densities retrieved from ground-based MAX-DOAS measurements at Shangdianzi regional atmospheric background station in China[J]. Journal of Environmental Sciences, 2019, 80: 186-196.

Tian X, Xie P, Xu J, et al. Long-term observations of tropospheric NO2, SO2 and HCHO by MAX-DOAS in Yangtze River Delta area, China[J]. Journal of Environmental Sciences, 2018, 71: 207-221.

Xu T, Zhang C, Xue J, et al. Estimating hourly nitrogen oxide emissions over East Asia from geostationary satellite measurements[J]. Environmental Science & Technology Letters, 2023, 11(2): 122-129.

Ren J, Guo F, Xie S. Diagnosing ozone–NO x–VOC sensitivity and revealing causes of ozone increases in China based on 2013–2021 satellite retrievals[J]. Atmospheric Chemistry and Physics, 2022, 22(22): 15035-15047.

Jin X, Fiore A, Boersma K F, et al. Inferring changes in summertime surface Ozone–NO x–VOC chemistry over US urban areas from two decades of satellite and ground-based observations[J]. Environmental science & technology, 2020, 54(11): 6518-6529.