Response to Referee #1

This is an excellent paper about the ozone concentrations in East and Southeast Asia. Key features are the quantity of surface stations in eight countries with different air quality standards, together with ozonesonde data from 10 sites. Another noticeable feature is the period investigated, which extended above 10 years in some sites. The authors presented the annual cycle of mean values, the 95th percentile, the number of threshold exceedances and trends. Tropospheric ozone profiles are presented and their trends. Finally, a relationship with nitrogen oxides and temperature is considered. Since the paper is quite complete, only some minor comments should be required before its final acceptance.

Thank you very much for your very helpful comments. We have addressed them carefully and please find our point-by-point response in blue.

Since the number of surface stations included in this study is noticeable, the authors could comment if noticeable outliers have been recorded, i.e. if there are stations that provide anomalous values.

Thanks for your comments.

For surface ozone, we have clarified that noticeable outliers are not detected in our dataset after data quality control. We show the observed maximum daily MDA8 ozone during 2017-2021 in different seasons in Figure R1, and find their ratios to seasonal median ozone are almost within 3~4, which suggests unnoticeable outliers for surface ozone.

For ozonesonde and IAGOS dataset, noticeable outliers are also not clearly detected. Instead, the data sampling shows large annual difference, which can be associated with the interpretation of our results. Thus, in this revision process, we have added the number of all ozonesonde and IAGOS data used in this study in Figure S1.

We have also added this information in Lines 179-180:

“Noticeable outliers are not detected in our dataset for both surface ozone and ozonesonde and IAGOS datasets.”

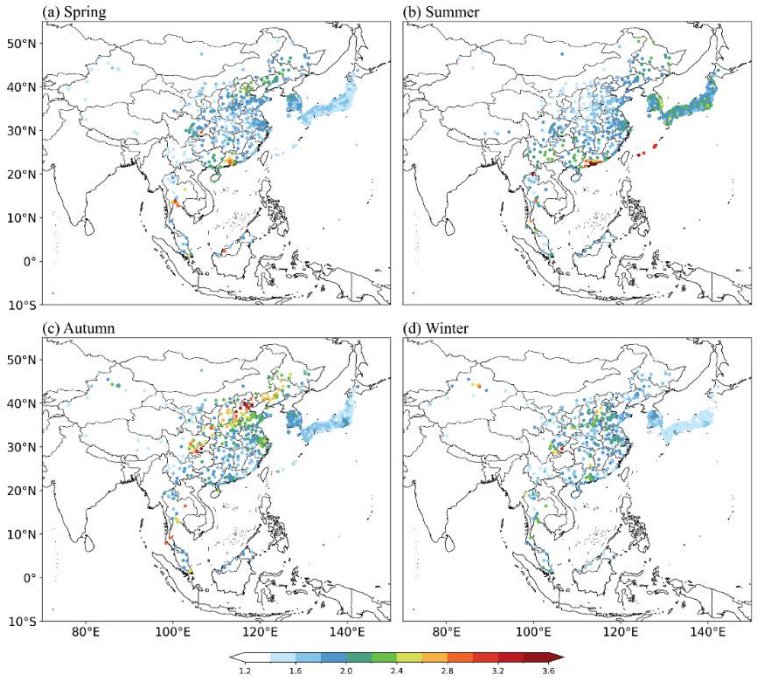

Figure R1. The ratios of the observed maximum daily MDA8 ozone during 2017-2021 to seasonal median ozone in (a) DJF, (b) MAM, (c) JJA, and (d) SON over East Asia and Southeast Asia.

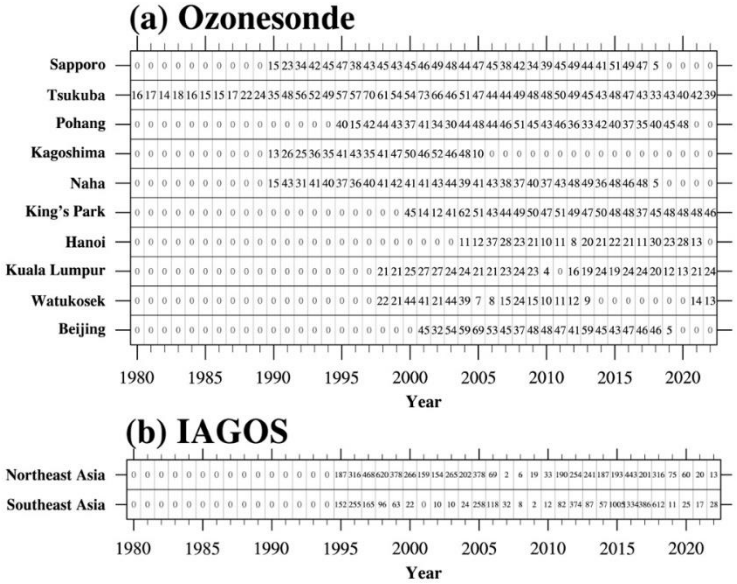

Figure S1. The number of all (a) ozonesonde and (b) IAGOS data used in this study.

The paper focus is on the high values. However, low values could be highlighted. The authors should indicate if such values belong to remote sites or if are linked to high concentrations of other substances.

Thanks for the suggestion! We have added some description about the low ozone values.

For surface ozone, in Lines 199-201: “In many Chinese cities, ozone concentration is even decreased to 20-30 nmol mol^{-1}, and this is because the high NO_x emissions in urban environment (e.g., North China Plain) make ozone strongly titrated”,

Lines 231-233: “However, Borneo Malaysia and Indonesia still record the 95th percentile ozone lower than 50 nmol mol^{-1}, suggesting the important role of fresh marine air inflow.”

Lines 283-286: “In contrast, low ozone-temperature slope of less than 1 nmol mol^{-1} $°C^{-1}$ across different seasons can be also found in some sites over Japan and Tibetan Plateau of China, suggesting a minimal role of local ozone photochemical formation in these remote sites.”

For tropospheric ozone, in Lines 413-416: “However, ozone in winter (DJF) is not the lowest but ozone in summer (JJA) is the lowest in Southeast Asia, probably due to the relatively stronger precipitation in summer, and warmer temperature in winter, compared to the atmospheric condition in Northeast Asia.”

The authors could indicate if it is possible to classify the stations following the ozone origin by transport or by precursors or if site classifications have been discarded.

This is a very important point classifying the stations by their ozone sources, although it is beyond of the scope this paper.

We have added in Lines 303-305: “It also deserves further study of cluster analysis about the ozone origin by transport or by precursors by taking advantage of this considerable ozone data records”.

Since the number of stations depends on the country. Some means presented in Figure 8 may be more robust against others. The authors could consider this fact.

Thanks！ Following your suggestion, we have added country-level ozone means in Figure 8 and Figure 6.

Finally, the temperature is considered. However, meteorological features are varied in different latitudes. The synoptic pattern evolution may be quite different in the analysed region. The authors could comment the possible influence of such features on ozone concentrations.

Following the referee’s suggestion, we have conducted additional analysis on the relationship between ozone and other meteorological features. The added Figure Sx-Sx are the calculated correlations between ozone and other key meteorological variables. Some related description has been also added in Lines 295-303:

“Considering the meteorological features may be quite different in different latitudes, we conducted additional analysis on the relationship between ozone and other meteorological features (Figure S3-S7). The widespread positive (negative) correlation between ozone and temperature (relative humidity), reflecting the known conductive condition for ozone photochemistry. However, the synoptic patterns that are important for ozone transport varied greatly at a regional scale. For example, in Figure S6, summertime southerly winds are conducive for ozone pollution over North China by transporting ozone precursors and warmer

air, but would decrease ozone over Southern China by carrying with cleaner marine inflow. As such, identifying the key synoptic pattern will be also necessary for understanding local ozone variations under climate change."

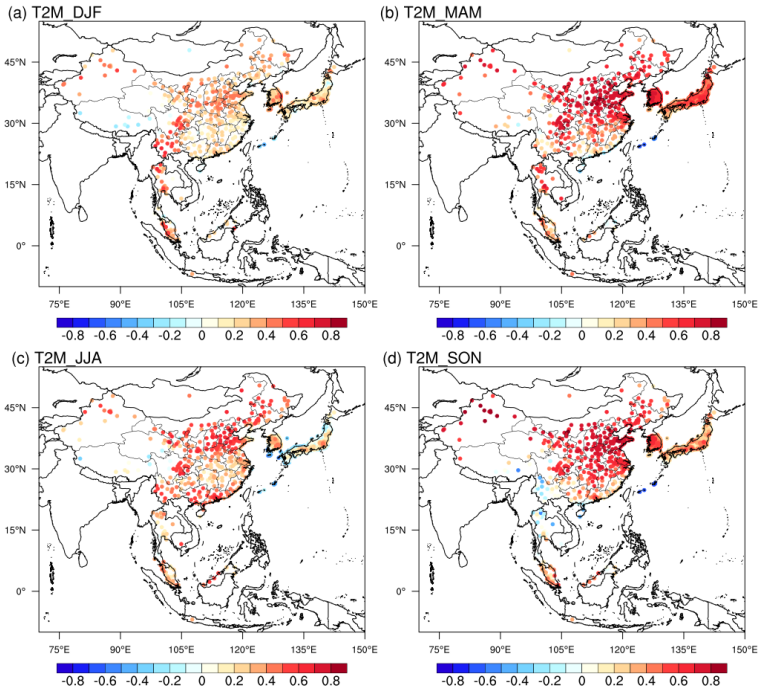

Figure S3. The correlation coefficients between observed daily surface MDA8 ozone and daily maximum 2-m air temperature in (a) DJF, (b) MAM, (c) JJA, and (d) SON averaged over 2017-2021.

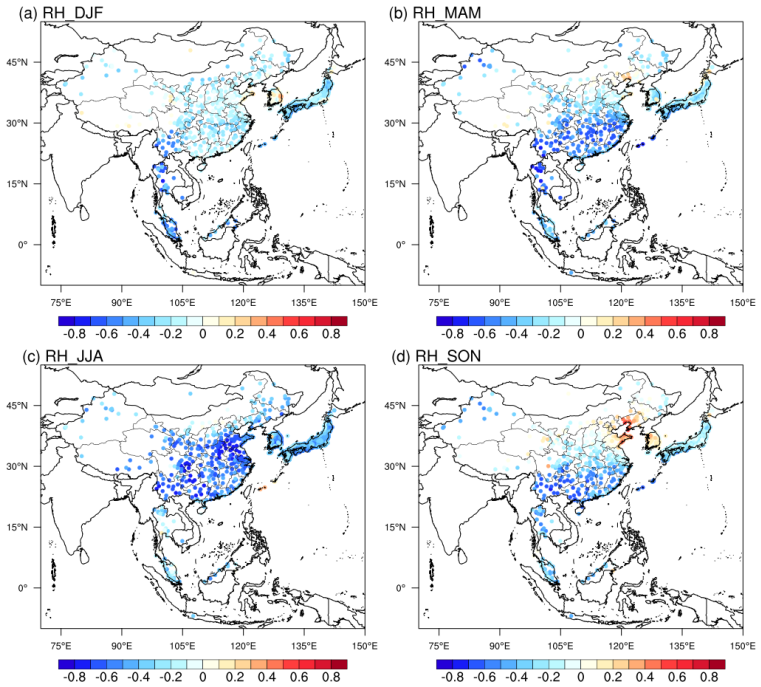

Figure S4. Same with Figure S3, but for relative humidity (RH)

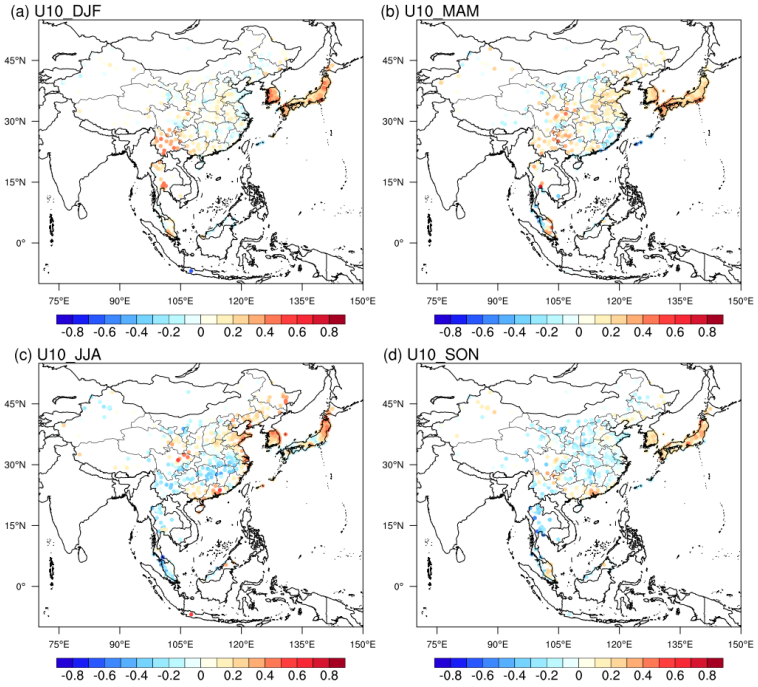

Figure S5. Same with Figure S3, but for 10-m zonal wind (U10).

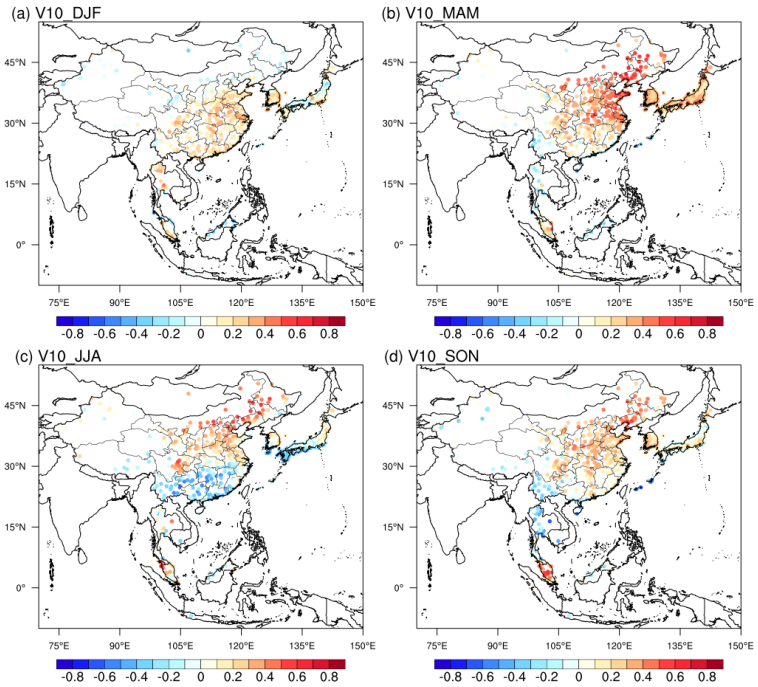

Figure S6. Same with Figure Ss, but for 10-m meridional wind (V10).

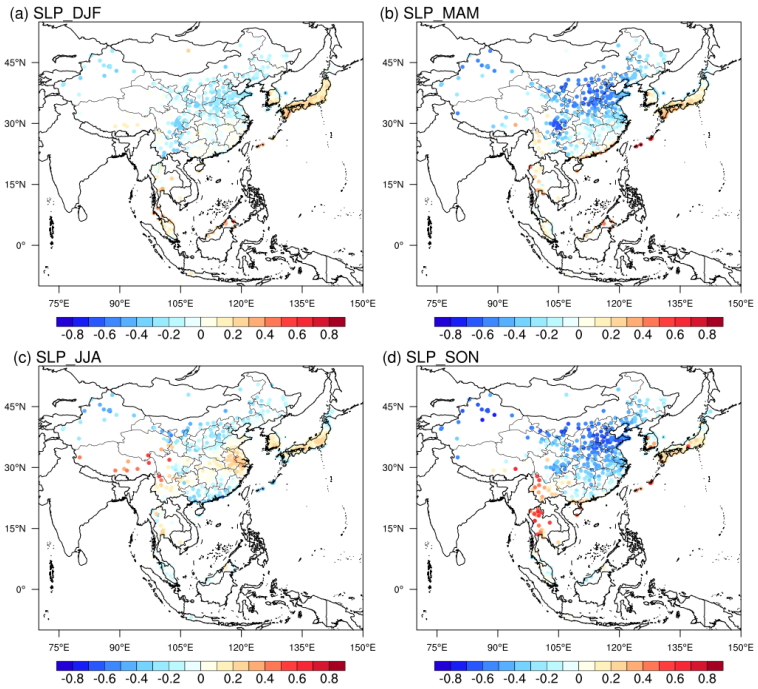

Figure S7. Same with Figure S3, but for sea level pressure (SLP)

Minor remarks.

L. 403. Dot instead of semicolon.

Corrected.

L. 580. Introduce one space in “forthe”.

Done.

L. 583. Introduce subscript in NO_2.

Done.