

Reply to the comments of Anonymous Referee #3

We greatly appreciated the reviewer for providing many insight comments and considerable suggestions. We would like to modify our manuscript and clarify the discussions according to the specific comments. The detailed replies are as follows.

1. P30914, L4: Please state the dates of the field campaign in the abstract (month/year/duration).

Reply: Observation period of field campaign will be added in the abstract.

P30914, L11: State the averaging period of the 100 ppbv (hourly?)

Reply: Averaging period is 60 minutes, and we will replace the sentence with “hourly averaged O₃ concentration at site frequently exceed 100 ppbv”

P30914, L20: Later in the paper we learn that 15 NMHCs were measured. Somewhere in the paper please compare your work to other studies of biomass burning to give a sense of what fraction of important ozone precursors were measured, and which were missing. Even in campaigns where 100+ NMHCs are measured from biomass burning, there are still dozens of unidentified compounds that can contribute to ozone formation. For this paper, which compounds were measured impacts how the '35 and 23%' are interpreted; the more NMHCs are measured probably the lower the solvent fraction becomes as the aromatic fraction becomes relatively less.

Reply: As suggested by referee, only limited NMHCs species were measured during our field campaign. To avoid misleading readers, we will make clear in the revised manuscript that there is dozens of NMHCs compounds was not measured during observation, and some of them also contributed to *in-situ* O₃ photochemical formation. Considering this point, the contribution of different sources to O₃ production will be reanalyzed. Another important point, the photochemical processes of more reactive VOC species during transport will affects the interpretation of PMF analysis, and the anthropogenic factor at different photochemical ages may mistakenly be attributed to independent sources. In the revised manuscript, we will reduce the PMF factor number from 6 to 3, and the previous explicit classification (such as vehicle, fuel evaporation etc.) is not used any more.

P30914, L11-13 and 21-22. L11-13 states that O3 production was large when there was substantial NOx, but L21-22 states the opposite, that large NOx in the morning inhibited O3 production. Please clarify.

Reply: the sentence in L12-13 will be replaced with “in particular when the site was characterized by a prevailing southerly wind that brought substantial amounts of NMHCs and NO_x emitted from urban area”

P30915, L25: On the other hand, ozone production can be suppressed on short timescales due to titration with NO when NOx levels are high. Following from the above comment, perhaps present a brief discussion of impacts of high NOx on O3.

Reply: we will add brief discussion about the titration reaction between NO and O₃ when NO_x concentrations are high in the introduction section. In the revised manuscript we will present a typical O₃ pollution case (on June 19, 2010) to demonstrate such effect, and the mixing ratio of O₃ was only 4 ppbv when ambient NO_x concentration as high as 57 ppbv.

P30916, L15: State which year the measurements were made.

Reply: the sentence will be replaced with “from middle of May to the end of June 2010”

P30916, L24: Minor point but it's 'CO' on L24 but 'carbon monoxide' on P30917 L6. Define carbon monoxide as CO the first time it's mentioned then use CO thereafter. Make sure everything is defined (e.g., NOy on P30917, L13).

Reply: “carbon monoxide” on P30917 L6 will be replaced with “CO”, and definition of NO_y (NO_x, HNO₃, N₂O₅, PAN etc.) will be added.

P30917, L18: Somewhere early on in the manuscripts please state which specific NMHCs were measured (or refer the reader to Table 1). Which major O3 major precursors are included and which were not measured? How might this affect your analysis?

Reply: we will specify the NMHCs species which measured by GC-FID-MS at P30917, L18, and tell the reader that the unidentified NMHCs compounds (e.g. HC3: dimethylbutane; HC5: methyl-pentane, dimethyl-pentane, trimethyl-pentane; OLI: trans/cis-2-pentene, trans/cis-2-hexene) have some impact on the O₃ production calculation by RACM2 model, though their influence was limited.

P30917, L25: So presumably the 58-VOC mixture encompasses the 23 NMHCs/OVOCs presented here?

Reply: Yes.

P30917, L26: Please state how many oxygenated VOCs were measured (or refer the reader to Table 1). Change 'MCAR' to 'MACR'. Define all acronyms.

Reply: we will refer to Table 1 here and the misspelled acronyms "MCAR" will be replaced by "MACR".

P30917, L29: As well as the reference to Kudo et al., basic analytical information (precision, accuracy, etc.) still needs to be given here for the 15 NMHCs and 7 OVOCs.

Reply: The detection limit NMHCs by GC/MS was 0.002 – 0.005 ppbv at Signal/Noise ratio = 3, and detection limit of PTR-MS was estimated to be 0.01 – 0.08 ppbv. The uncertainty of measurements was estimated to be less than 15% in this study. We will mention basic analytical information in the revised manuscript.

P30918, L16: 'The missing data were linearly interpolated.' Please discuss what error/uncertainty this might introduce.

Reply: The NMHC species were measured at time resolution of less than 2 hours, however the time step of input of RACM2 model was at time resolution of 5 minutes. For the convenience of model run, the data gap was linearly interpolated, and such treatment did not influence our results. During the observation period, the VOC data between June 13 and June 17 were missing because of instrumental maintenance. For the other high- O₃ pollution days, all the instruments were working well and the dataset was available for the RACM calculation.

P30919, L5: Define RO2 and phi separately rather than together.

Reply: we will define RO₂ and phi separately in the revised manuscript.

P30920, L9: I believe this is the first time some specific NMHCs are being named (please name them sooner).

Reply: we will give brief introduction of observed NMHCs species earlier in the context.

P30920, L13: What is the 'G-space'? What is 'F-peak'? Try to ensure that the text is accessible to readers who are less familiar with PMF.

Reply: The G-Space shows scatter plots of one factor versus another factor, which can be used to assess rotational ambiguity as well as the relationship between source contributions. A more stable solution will have many samples with zero contributions on both axes, which provide greater stability in the PMF solution to less rotational ambiguity. A solution or combination of sources may also have no points on or near the axes, which results in greater rotational ambiguity (PMF v5.0 User guide). To avoid confusing readers who are less familiar with PMF, we would like to concise our analysis and remove the sentence in P30920, L13.

P30920, L20: Define 'sigma units'.

Reply: Hysplit model uses terrain following sigma coordinate, and 0.01 sigma unit is about 250 m.

P30920, L23: 'To better review the impact of emissions on the surface layer, only the footprint region of the air mass in units of residence time was demonstrated in the following analysis.' This sentence is a bit confusing because for me footprints and residence times do not intuitively go together, and the next sentence seems to define the footprint in terms of distance.

Reply: In the revised manuscript, we will use the number fractions of trajectories in the grids to represent their potential influence of anthropogenic emission.

P30921, L7: The reader still doesn't know which year the measurements were made.

Reply: The year "2010" will be added in the sentence.

P30921, L9-11: Is the 147 ppb O₃ max also an hourly value? On L13 CO is presented as a daily average. On L16 it's not clear if the NO_x and NO_y means are hourly or daily. P30917 L20 says that the time resolution of the NMHC measurements is ~2 hrs . . . is the average value of 200 ppbC on P30921 L19 a 2-hour average? Is the 451 ppbC maximum 'at 05:00' actually a 2-hour average? Because many different averages are presented in this paragraph, please state the time period (hourly, daily, etc.) each time an average is cited.

Reply: Sorry for our confusing discussion in this paragraph. We will state the averaging period when averaged values are used. We will replace the discussion in section 4.1 with the followings:

Temporal variations in the O₃, NMHCs, NO_x, NO_y, and CO mixing ratios are shown in Fig. 2, and statistics on the NMHC species are listed in Table 1. During observation periods, five pollution episodes (10–12 June, 14–17 June, 18–20 June, 22 June, and 23 June in 2010) were clearly observed on the basis of NO_x variations, and on 4 days (15 June, 19 June, 22 June, and 23 June), the hourly averaged O₃ mixing ratio exceed 100 ppbv (dashed line as shown in the Fig. 2). The highest O₃ concentration (hourly mean: 140 ± 3.3 ppbv) occurred at 17:00 LST on 15 June. We found that observation site was affected by the intensive open burning of crop residues in the south because of sharp increase of ambient CO level, and the hourly CO mixing ratio at 21:00 LST on 14 June and at 12:00 LST on 15 June was even as high as 1993 ± 155 ppbv and 1309 ± 91 ppbv, respectively. It was worthy to note that, the O₃ precursors transported from the megacity cluster to the south also contributed to the build-up of ambient O₃ at site, because obvious enhancements of NO_x mixing ratio (hourly mean: 22 ± 13 ppbv) were observed with the prevailing southerly wind (SE-SW sector), and the ambient O₃ mixing ratio decreased to almost zero due to titration reactions when the nitrogenous species were present in the early morning of pollution days. The maximum concentration of NMHCs (hourly value: 443 ppbC) occurred at 07:00 LST on 19 June when the hourly averaged NO_x and NO_y mixing ratio were 42 ± 2 ppbv and 60 ± 1 ppbv respectively, and hourly O₃ mixing ratio was found to be 124 ± 5 ppbv at 12:00 LST due to strongly photochemical processes in the daytime.

P30921, L11, 16, 19, etc.: Add an error bar to this average (and all others).

Reply: Standard deviation will be added for each averaging calculation.

P30921, L12: What direction was the burning coming from?

Reply: Observation site was prevailing southerly wind, indicated that OBB to the south of site impact our observation.

P30921, L15-17: It may help to refer the reader to the wind roses in Figure 4 here; with- out wind direction plotted in Figure 2 it's difficult for the reader to connect the 'obvious enhancement' to southerly wind.

Reply: We will add wind information in the Figure 1.

P30921, L15: High O₃ when air is transported from the megacity seems to contradict the previous sentence (highest O₃ during intensive open burning).

Reply: We will revise the discussion as I replied in the answer to the previous question.

P30921, L25: This is the first time we're learning that the field campaign was in 2010. Please state the exact dates of the Expo so the reader can see the extent of the overlap.

Reply: We will mention the year that our field campaign was performed in the previous section in the context.

P30921, L25: This sentence states that traffic increased, but the next sentence mentions emission controls and P30927 L11 suggests that NO_x and NMHC emissions were actually reduced during the Expo. So did traffic actually decrease?

Reply: As mentioned, strict emission control policy was implemented in Shanghai and Southern Jiangsu province during Shanghai Expo 2010 period; however we have no direct evidence that how much NO_x and NMHCs were reduced. To avoid misleading, we do not discuss the effects of emission controls in the revised manuscript in P30921 L24-P30922 L4.

P30922, L10: What does 'daily increment' mean? Do you mean amplitude? Same comment on L13-14.

Reply: We will replace the sentence with "... a predominant single peak distribution with a amplitude of 94 ppbv." on L10 and also on L13-14.

P30922, L14: Is '07:00' the average from '07:00-08:00'? Same question on L18-19. How the data are plotted can also be included in the Figure 3 caption. For NMHCs (Fig. 3g), if the time resolution is 2 hrs (P30917 L20) why are hourly data plotted?

Reply: The time label 07:00 LST means the average from 07:00 to 08:00 LST. We are sorry for misleading of the sentence on P30917 L20. Before 13 June 2010 the NMHCs species were measured at a time resolution of 2 hours, and the measurement interval was changed to 1 hour from 16 June 2010 to the end of the field campaign, that is why we could plot its hourly diurnal variation. We will clarify this point in the revised manuscript.

P30922, L17: '38.6' seems to have too many significant figures given the very large error bar shown in Fig. 3c. Please add the error here and adjust the sig figs accordingly. Also this peak appears to be for 4 a.m., not the broader peak from 0:00-8:00 a.m.; please revise the text. Likewise on L22 state that 57 ppbv is the hourly peak of the broader range.

Reply: We will revise this part according to suggestions as followings:

Diurnal variation in NO₂ at the site showed evident increase at night with a predominant peak (39 ± 18 ppbv) at 04:00 LST, evidently different from the features (two peaks at 09:00 and 18:00 LST during rush hour) observed at the urban site of the Shanghai megacity. The similar pattern was found for the diurnal variation of NO_y (Fig. 3d) on high- O₃ pollution days, which had a broader peak (57 ppbv) from 04:00-09:00 LST and gradually decreased due to photochemical consumption in the daytime.

P30922, L16-19: Please state that you have shifted from discussing the red line in the first half of the sentence to the gray line in the second half of the sentence; currently it is confusing because the reader does not know that the two peaks are no longer about the red line.

Reply: the second half of the sentence will be changed to "distinct from that (two peaks at 09:00 and 18:00 LST during rush hour, as shown by the gray line in Fig. 3c) observed at the urban site of the Shanghai megacity."

P30922, L20: Why do these different peaks suggest transport rather than in situ production? Also what is the typical transport time from Shanghai to the site?

Reply: We will clarify this point. As mentioned by referee, the titration reaction between NO and O₃ might contribute part of NO₂; however it was far from enough to explain such dramatic increase of NO₂ at night. As shown in Figure 1, during high-NO_x pollution period NO_x/NO_y ratio was normally larger than 0.5, it indicated that the air mass was just slightly aged, and the NO_x emission sources seemed not far away from the observation site. We found that there are numbers of small county towns (e.g. Qidong, Latitude: 31.808°, Longitude:121.658°) and mega-cities (e.g. Nantong, Latitude: 31.977°, Longitude:120.900°) to the south of observation site, which may contributed to the high NO_x level at site. The transport time from the larger city was about less than 4 hours providing a moderate wind speed (3 m/s) . To avoid misleading, we discuss the source region case by case on the basis of footprint analysis, rather than the just transport from Shanghai city.

P30922, L21-25: In order for the general reader to follow these arguments you will need to define NO_y and NO_z earlier in the text (e.g. P30917 L13). Also add an error bar to 32.6 and reduce the number of significant figures as appropriate.

Reply: We will define NO_y and NO_z earlier in the text. The sentence in L25 will be replaced with "... with a maximum value of 33 ± 10 ppb at 12:00 LST"

P30922, L24: Fig. 3e shows NO_x/NO_y, not NO_z. Similar comment for P30923, L1.

Reply: We will correct the mistakes.

P30923, L7: Add an error bar to the mean of 0.34 so the reader can see that it didn't vary.

Reply: The standard deviation (± 0.1) will be added.

P30923, L10: The morning error bars are large so 176.4 has too many significant figures. Please adjust and add its error bar. Also add an error bar to 48.6 and 62.8.

Reply: The standard deviation will be added. The sentence in L10 will be changed with "..., on the high- O₃ pollution days, total hourly averaged NMHCs concentration varied significantly (186 ± 200 ppbC) in the early morning (from 00:00 LST to 08:00 LST), and it gradually decreased to 65 ± 55 ppbC in the afternoon (from 12:00 LST to 18:00 LST). On low- O₃ pollution days, the NMHCs concentration was constantly low with a mean of 58 ± 46 ppbC, implying that contribution from the transport of urban emissions was limited."

P30924, L6-7: Please add error bars to each mean that is reported. Same comment on L20, 25. Same comment on P30926 L5-6.

Reply: The standard deviation will be added.

P30926, L7: The text makes it seem like the stagnant air mass persisted for 4 days (June 19-23) but Figure 2 indicates two separate pollution events on June 19 and 23. Should 'air mass was' be 'air masses were'?

Reply: We will change the sentence to "air masses were..."

P30926, L15: The runs are constrained by June 19 data but calculations are also presented for June 23 (L18). Were constraints from June 23 also used?

Reply: The sensitivity runs were constrained by data on June 19, because the site was prevailing southerly wind all the daytime. The footprint analysis indicated that the anthropogenic emission from urban area in the YRDR has great impact; On June 23, observation site was prevailing southerly wind in the morning. It changed to easterly wind in the afternoon, and the buildup of O₃ at site mostly resulted from direct transport of O₃ from marine area. Considering the representativeness of polluted air masses, we just use the data on June 19. To avoid misleading, we will remove the case on June 23 from the Figure 7.

P30926, L25: This sentence is confusing because 'which' should be about NO_x but is actually about NMHC/NO_x. Please rework. Also 30-50 compared to 5 seems much larger than 'slightly' up.

Reply: The sentence in L25 will be replaced with "... a substantial amount of NO_x, and NMHCs/NO_x ratio increased evidently up to 30-50 ppbC ppbv⁻¹ due to rapid NO_x photochemical loss."

P30927, L2-3: In both lines change 'radial' to 'radical'.

Reply: The mistake will be corrected.

P30927, L23: Is 1.4 similar to 2.0-2.2 (within the expected range) or is it actually statistically lower? An error bar on 1.4 would help (and on the values of 2.0 and 2.2 if they're available). P30927, L27: '74.4' and '55.4' are too precise. Also on P30928 L1 a 20% difference is not 'slightly' higher.

P30927, L27+: These arguments don't seem to be adding up. The fraction of isoprene explained by OBB (74%) is surprisingly high to me, and it is also is high compared to the YRDR inventory (54%; P30928 L2). Then on P30928 L3-4 the furan/isoprene ratio is too high, which is explained by isoprene being oxidized (so depleted). Please try to reconcile these arguments.

P30928, L6-7: How are you calculating the value of 3.5 from the Akagi paper? In their Table 1 column for crop residue they give an EF (g/kg) of 0.11 for furan and 0.38 for isoprene. So a furan/isoprene ratio would be 0.11/0.38 = 0.29 g/g. The mass ratio of 3.5 would be for isoprene/furan (0.38/0.11 = 3.5). I haven't checked the Christian paper; is it also isoprene/furan? Is the 16.5 presented here isoprene/furan or furan/isoprene? Anyway it seems that the differences could be even larger than what was presented.

P30928, L7: 'photo-oxidation of isoprene in the summer season' seems speculative. Akagi et al. state the sources of the crop residue data; were these measurements also performed in summer? If so then this argument may not hold. Please investigate.

P30928, L7-9: 'and the furan/isoprene ratio would be approximately equal to that of previous studies if MVK/MACR were taken into consideration'. Taken into account how? If you believe this to be the case please provide evidence.

P30928, L15: You could further this argument by checking if the i-butane/n-butane ratio is consistent with LPG or NG.

P30928, L24: What was the benzene loading on Factor 1? Were you surprised to see benzene load onto a different

factor than TEX? Section 5.4.1: For each factor, each time a compound is associated with a specific source (acetoneitrile for biomass burning, i-pentane for gas evaporation, NO₂ for fossil fuel combustion, etc.) please provide a

reference.

Replies to the comments from P30927 L23 – P30928 L24 together: We are very for unclear discussions in section 5.4.1. We will rework section 5.4.1 completely in the revised manuscript according to reviewer's insight comment. Firstly, since the identification of individual VOCs by PTR-MS is based on the mass number of protonated species, PTR-MS cannot distinguish isomers and is subject to fragments [de Gouw and Warneke, 2007]. PTR-MS signals at m/z 69 could be a mixture of isoprene and furan. Objectively distinguish them has always been a tricky issue. In this study, concentration of furan was calculated empirically as follows:

$$\text{Furan (ppbv)} = \frac{\text{m/z 69 (measured by PTR-MS)} - \text{Isoprene (measured by GC/MS)}}{\text{Furan sensitivity (PTR-MS)}} \times \text{Isoprene sensitivity (PTR-MS)} / \rightarrow [\text{Kudo et al., 2014}]$$

Therefore, furan/isoprene ratio here actually includes large uncertainty. In the revised manuscript, we will delete the discussion of this part. To response to the comments of referee, mass ratio of furan to isoprene was $0.11/0.38 = 0.29$ (Akagi et al., 2011) and $0.72/0.82 = 0.88$ (Christian et al., 2012), and the sentence "The higher ratio in the present study was probably due to the photo-oxidation of isoprene in the summer season, and the furan/isoprene ratio would be approximately equal to that of previous studies if MVK/MACR were taken into consideration" will be deleted.

Another important point, as suggested by other referees and literature [Yuan et al., 2012], the photochemical processes of more reactive VOC species during transport will affects the interpretation of PMF analysis, and the anthropogenic factor at different photochemical ages may mistakenly be attributed to independent sources. In the revised manuscript, we will reduce the PMF factor number from 6 to 3, and the previous explicit classification (such as vehicle, fuel evaporation etc.) is not used any more. The first factor contributed to large fraction of high-reactive species (e.g. C₈-C₉ aromatics, 1-butene) and NO₂, and we also found an obvious diurnal variation. Considering that NO₂ and C₈-C₉ aromatics have been much more abundant near the source, here factor 1 was termed as local primary factor. Factor 2 had abundance of low-weight alkanes and fewer fractions of high-reactive species and NO₂, and it did not show distinct diurnal variability. This factor correlated well with CO with a correlation coefficient of 0.63, we regarded the factor 2 as transport factor. The third factor was regarded as OBB-related sources due to the pronounced contribution of furan and acetonitrile to this factor with mass fractions of 64% and 50%, respectively. This factor also explained 72% of total isoprene, 51% of MVK + MACR (oxidation production of isoprene) and 52% of acetic acid.

Accordingly, The discussion in this section will be modified in accordance to the new PMF classification. The increment of O₃ production rate due to 10% increase of each factor was calculated. In the revised manuscript, we will focus a typical heavy O₃ pollution case at June 19 (hourly-averaged ozone concentration: 124 ppbv and one minute value: 168 ppbv at 1400 CST) and discuss the relative importance of each factor on the in-situ photochemical formation of O₃. As shown in the following figure, the transport factor was responsible for 60% (43 ppb) of the in-situ photochemical production of O₃ in the morning, followed by that of local primary factor (23%, 17 ppb), and the OBB-related factor only counted for 17% of total O₃ production. In the afternoon, relative importance of OBB-related factor weighted and it explained 34% (12 ppb) of photochemical produced O₃. We will clarify the point in the manuscript that, transport factor took the major responsibility of the high ambient O₃ level at the observation site, because the reactive VOCs species might have been processed in the upstream area, which could result in direct transport of O₃.

Reference: Yuan, B. et al. (2012), Volatile organic compounds (VOCs) in urban air: how chemistry affects the interpretation of positive matrix factorization (PMF) analysis, J. Geophys. Res.-Atmos., 117, D24302, doi:10.1029/2012JD018236.

P30929, L1-20: The verb tense changes from present to past in this paragraph. Also sometimes using words like 'could' and 'may' makes it unclear if the statement is a result or a speculation (e.g. L10-13; L19-20). Please rework.

Reply: We will use past tenses in this paragraph.

P30929, L22: While you mean MVK+MACR (not MVK/MACR), earlier furan/isoprene was a fraction, so for clarity I suggest avoiding MVK/MACR if you don't mean a fraction and also to be consistent with L24-28. Same comment elsewhere in the paper and for other compound pairs.

Reply: We will use MVK+MACR in the manuscript.

P30930, L4: Are these mass-based ratios (like before with furan/isoprene)? If so please state this.

Reply: They are mass-based ratios, we will clarify this point.

P30930, L5-6: 'oxygenated VOCs (including MVK and MACR) might also be preferentially present in the OBB plumes'. This statement seems speculative. What evidence is there for this?

Reply: This sentence will be deleted.

P30930, L7: How were the numbers of 1.8 and 4.2 calculated? For example Akagi et al. don't provide MVK and MACR EFs for crop residue burning in their Table 1.

Reply: The discussion about MVK and MACR EFs in Akagi et al.,'s paper will be deleted. We will rework with this part as follows "... In the present study, the [MVK + MACR]/isoprene mass ratio was the highest, ranging from 3 to 25, suggesting that the impact of biogenic sources was not significant. Kudo et al., [2014] reported that observed normalized excess mixing ratios (NEMRs) of OVOCs enhanced with air mass age, implying that the isoprene might undergo further oxidization after being emitted."

P30931, L9: There are too many significant figures on these numbers from the literature (they can't be known that accurately). Are these annual averages? If so for what year?

Reply: We will reduce the significant figures and add the year (2007).

P30931, L13-14: Verb tense is changing again and the sentence is hard to follow. The paragraph is also a bit hard to follow . . . increased aerosols lead to decreased O3; O3 is assumed to increase if aerosols are reduced; aerosol reduction leads to decreased AOD but increased actinic flux; high aerosol leads to decreased JO(1D); etc. Just it seems to go back and forth between impacts of increasing and decreasing aerosols; perhaps there is a smoother way to present this.

Reply: We will use past tense in the sentence L14. We will rework with this paragraph as followings: "The incorporation effect of HO₂ loss into the RACM2 model calculation resulted in the O₃ production rate being reduced by 13 % on average. Huang et al. (2011) reported that primary anthropogenic emissions of PM_{2.5} and PM₁₀ in the YRDR were 1511Ggyr⁻¹ and 3116Ggyr⁻¹ in 2007, respectively, accounting for 11 and 17 % of the total emissions in China. It suggested that O₃ photochemical production has been depressed due to the presence of aerosol particles in the atmosphere. A study by (Gerasopoulos et al., 2013) found a 40 % reduction in JO¹D at a high solar zenith angle during high aerosol loading periods (AOD = 0.5– 0.7). Presumably, ambient O₃ concentrations could increase provided that particle emissions are significantly reduced while NO_x and NMHCs emission remain unchanged."

Table 1: Please also add max and min values and add units.

Reply: We will add max, min and units

Figure 4: The units for the mixing ratios of O3, NO etc. need to be given.

Reply: We will add the unit for the Figure 4.

Figure 6: The different lines also need to be defined in the legend (not just panel a).

Reply: We will add legend for a, c, e and g

Technical corrections:

P30914, L7: Suggest changing 'was observed' to 'was occurring'.

Reply: We will use "was occurring" as suggested.

P30914, L14: Change 'potential' to 'a potential'.

Reply: We will use "a potential"

P30915, L5: Change 'has' to 'have'.

Reply: We will use "have" here.

P30915, L7: Omit 'evident'.

Reply: The word “evident” will be removed

P30916, L1-4: The verb tense changes from present to past in this sentence.

Reply: We will use the same present tense.

P30916, L9: Change 'have' to 'has'.

Reply: We will use “has”

P30916, L13: Change 'Quantitive' to 'Quantitative'.

Reply: We will correct the misspell

P30916, L14: Change 'measurement' to 'measurement campaign'.

Reply: We will adopt “measurement campaign”

P30916, L22: Change 'area' to 'areas'.

Reply: We will use “areas” here

P30917, L18: Change 'NMHCs' to 'NMHC'. Same comment on P30920, L7 and L11.

Reply: We will change NMHCs to NMHC.

P30917, L18: Remove 'an' for this sentence to work.

Reply: We will delete “an”.

P30918, L24: 'since NO₂ is known to exist at high concentrations comparable to O₃ at the observation site'. The wording in this sentence is a bit confusing.

Reply: This sentence will be deleted in the revised manuscript.

P30920, L1: Do not capitalize 'Where'. P30920, L6: Change 'numbers of NMHCs sources' to 'number of NMHC sources'? P30920, L12: Change 'alkane' to 'alkanes'.

Reply: We will use lower case “Where”; “alkane” will be changed to “alkanes”; P30920,L5-L8 will be deleted.

P30920, L13: Change 'seed' to 'seeds'. P30920, L18: Capitalize all of 'HYSPLIT'. P30921, L1: Define FLEXPART. P30921, L10: Change 'dash' to 'dashed'. P30921, L10: Change 'the Fig.' to 'Fig.' P30921, L12: Change 'agriculture' to 'agricultural'. P30922, L22: Change 'boarder' to 'broader'. P30922, L23: Use a subscript in 'NO_z'.

Reply: We will change “seed” to “seeds”; “Hysplit” will be capitalized; We will provide hyperlinks for FLEXPART model; “dash” will be changed to “dashed”; article “the” will be deleted; the word “agriculture” will be changed to “agricultural”; The word “boarder” will be changed to “broader”; NO_z will be changed to NO_z

P30923, L25: Change 'e.g.' to 'i.e.'

Reply: We will remove “(e.g. shanghai)” because this information is not very necessary.

P30924, L12: Could change 'Discussions' to 'Discussion'.

Reply: We will change “Discussions” to “Discussion”

P30925, L2: Change 'productions' to 'production'.

Reply: We will change “productions” to “production”

P30925, L3: Omit 'the'.

Reply: The article “the” will be deleted.

P30925, L15-16: To avoid repetition change 'observed at the observation site' to 'observed at the site'.

Reply: The word “observation” will be omitted.

P30926, L26: Change 'the observation in' to 'previous observations in the'. P30927, L9: Change 'from' to 'from the'. P30927, L20: 'Alkane' and 'alkene' should be plural. P30929, L4: Change 'as' to 'to be'.

Reply: We will add “previous” in L26; article “the” will be added in L9; The discussion in section 5.4.1 will be changed, and we will use plural form of Alkane and alkene.

P30929, L15: Change 'air mass was' to 'air masses were'. P30930, L10: Change 'observation' to 'the observation'. P30930, L11-12: Change 'little amount' to 'small amounts'.

Reply: “air mass was” will be changed to “air masses were”; “observation” will be changed to “the observation”; “little amount” will be changed to “small amounts”

P30930, L10-14: This is a run-on sentence. Please fix. P30930, L14-16: Please fix the grammar. P30930, L25: Omit 'refers to the paper,'. P30931, L19: Change 'will more' to 'will be more'. Figure 5: Caption needs a period.

Reply: We will rework with the L10-16; “refers to the paper” will be deleted; “will more” will be changed to “will be more”; a period will be added at the end.