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Interactive comment on “Use of a mobile laboratory to evaluate changes in on-road air pollutants during the Beijing 2008 Summer Olympics” by M. Wang et al.

M. Wang et al.

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We would like to thank the referee#3 for the comments and suggestions, which contribute to improve the quality of our paper. We have implemented all the comments and suggestions in the revised manuscript. Below please find a detailed point-by-point response to each comment.

Specific comments: Comment 1: I do not understand the discussion about the ratio of benzene to toluene. Both, traffic and the use of solvents were restricted; the findings indicate that the use of solvents was entirely stopped? In addition, the measurements are done within the dense plume of pollutants above a freeway. Is the PTR-MS specific

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enough under these conditions to identify benzene and toluene unambiguously.

Response: (1) As mentioned in our manuscript on page 12872, section 3.5, the benzene to toluene ratio(B/T) is a indicator for sources due to the differences of durations of benzene and toluene. This ratio is normally from 0.25 to 0.5 in urban area and usually around 0.5 when vehicle exhausts dominated. While for painting solvents, this ratio should be lower because of the painting solvent composition with more toluene but rare benzene. Given to the frequent usage of painting solvents for Olympics where we observed during our measurement, the low ratio before 4 August actually indicated some incoming sources such as painting solvents as well as fugitive gasoline emissions containing more toluene in addition to vehicle exhausts. After 4 August, the ratio increased to around 0.5, indicating vehicle exhausts as dominant source and the usage of painting solvents were restricted. To further support our conclusion, we analyzed the correlations between toluene and NO_x to prove the importance of painting in comparison to vehicle emissions. This could be another supporting evidence for our conclusion. We added sentences to make the results more conclusive, please see page 19, line 12 to 18: "To further demonstrate this suppose, a daily correlation between Toluene (solvent indicator) and NO_x (traffic emission indicator) has been calculated (SPSS 15.0) and shown in Fig. 8. Apparently, correlations(*r*) from 19 July to 4 August were low($r < 0.22$), while after August 4, the correlations jumped to higher than 4 most of time. This significant difference was tested by two-tailed t-test(SPSS 15.0), showing $p < 0.01$. This provides evidence that contribution from painting was reduced after August 5."

(2) We agree with the referee that in a heavily polluted environment the specification of VOCs by the PTR-MS was challenging. However, Rogers et al. (2006) have reported on-road PTR-MS measurements of aromatic compounds including benzene and toluene in Mexico City, a heavily polluted metropolitan area similar to Beijing. de Gouw and Warneke (2007) also found these aromatic compounds did not suffer severe interferences from other VOCs. Thus we trust our mass assignments.

Comment 2: Beijing has detailed network of atmospheric measurements at various

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locations. Are the measurements presented here before and after the Olympics representatives for Beijing?

Response: Yes, Beijing has a network of atmospheric stations. But one of the advantages of mobile laboratory is that it can easily move to capture the variances of pollutants with fast response instruments while monitoring. That's obviously that the atmospheric fixed-site can not obtain. A well-designed network of stations with similar instruments as mobile laboratory is also capable for temporal and spatial measurement . But most of the fixed-sites in the network of Beijing only focus on gases pollutants such as NO_x, CO, SO₂, O₃ and PM_{2.5} mass concentration which do not meet our requirements. Given to the huge funding requirement for such a network, the mobile laboratory is an economical alternative to accomplish such work. Second, we focused on on-road air pollutants concentration rather than ambient background concentration in Beijing. We emphasized more on the changes of the air pollutants due to control strategies and it can directly reflect the effectiveness of those measures, especially traffic control measure. Otherwise, the ambient concentration in Beijing may confuse different sources.

Comment 3:From the current material it is difficult to identify the different periods of the measurements: Table A1 has 7 periods, Fig 3 has three, the figures 7a to 7c has 6, and Figure 8 has one only. I suggest organizing these figures in a way that they share the same time axis and that the same sampling periods are used throughout the manuscript.

Response: Accepted. We added more descriptions and revised some sentences, figures and tables to make the temporal nature of our measurements more clear.

On page 10, line 5 to 14, we stated “Generally, these measures were classified into before(before 19 Jul 2008), during(20 Jul 2008-19 Sep 2008) and post(after 20 Sep 2008) full-scale control periods, according to magnitudes and scales of control measures. The full-scale control period included comprehensive control on industrial and

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construction activities, traffic emission as well as gas evaporation. To better clarify the effectiveness of different control measures especially during the Olympics and Paralympics, we further divided the full-scale control period into four stages, full scale control: before Olympics(20 Jul 2008-7 Aug 2008), during Olympics(8-23 Aug 2008), between Olympics and Paralympics(24 Aug 2008-6 Sep 2008), during Paralympics (7-19 Sep 2008).”

To further highlight the temporal variation, we revised table 2 by merging table 2 and table A1 as well as adding two columns showing corresponding periods of different control measures based on the statements above.

Comment 4: The 4th ring road is a heavily used freeway with frequent traffic congestions. Is it true that only data are presented when a minimum speed (60 km/h ?) is reached. Were the meteo measurements aboard the vehicle used? The relative wind speed could be used to identify possible contaminations by the vehicle. What is the interpretation of Table 3?

Response: (1) As shown in 2.2 inlet system in our revised manuscript, during our measurement, the driving speed was maintained at 60km/h. We maintained this speed for several reasons. First, it is the requirement of our sampling system, which had the minimal loss at a constant of 60 km/h. Second, it is also the optimal speed on road, because if the driving speed were low, the exhausts from mobile lab could interference the observation; if the driving were high, directed emissions from vehicles in front of the mobile lab could interference the observation. Due to the four lanes of the Fourth Ring Road at each direction and relatively small number of vehicles during our measurement period with respect to rush hours, it is not difficult to maintain a constant speed of 60km/h.

(2) Meteorological instrument on the mobile lab was not used for measurements in this study, but to exam whether the self-contamination exists. The referee’s suggestion is correct. We use wind speed on mobile lab to identify the tail winds and exclude

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abnormal data, which were caused by self contamination and other factors.

(3) From table 3, we tried to use the correlations between RH, T, WS and air pollutants concentrations of each sixteen segments of 31 days to estimate the influences by meteorological conditions. The low correlation coefficients generally indicated the meteorological condition during our measurement periods were not the major impact on the variations of air pollutants.

Minor comments technical corrections: Comment 1: For PM1 surface area S(PM1) use instead of SPM1 for readability.

Response: Accepted. We have changed the words accordingly.

Comment 2: Use Euro 4 instead of Euro IV. The stages are typically referred to as Euro 1, Euro 2, . . . and Euro 5 for Light Duty Vehicle standards. The corresponding series of standards for Heavy Duty Vehicles use Roman, rather than Arabic numerals (Euro I, Euro II, etc.).

Response: Accepted.

Comment 3: Table 1: Met One is a company not an instrument, please specify.

Response: Accepted.

Comment 4: Fig. 8: use x axis ticks for days and reduce the number of labels.

Response: Corrected.

Comment 5: Fig. 6: centigrade is not a unit, use °C

Response: Accepted.

de Gouw, J., and Warneke, C.: Measurements of volatile organic compounds in the earth's atmosphere using proton-transfer-reaction mass spectrometry, *Mass Spectrom. Rev.*, 26, 223-257, 2007.

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