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Atmospheric Chemistry and Physics Discussions

Interactive comment on "The levels, variation characteristics and sources of atmospheric non-methane hydrocarbon compounds during wintertime in Beijing, China" *by* Chengtang Liu et al.

Anonymous Referee #1

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General comments:

This paper presents measurements of ambient non-methane hydrocarbons (NMHCs) from an urban site in Beijing. Although the observation was conducted only for one month (from 15 December 2015 to 14 January 2016), more than 700 samples were taken and analyzed using a custom-built online gas chromatograph so that good, quasi-continuous time series of NMHCs were obtained. There were some haze periods during the observation, which makes possible to discuss the NMHCs measurements for different pollution conditions. In addition to the characterization of concentrations

and diurnal variations of NMHCs, the authors show the estimation of wintertime OH and NO3 concentrations, discuss the species vs species ratios and the implication to sources, and present the results of source apportionment from the PMF analysis. It is shown that coal combustion is the most important NMHCs source during haze days in winter. The data presented in this paper are of high quality and valuable for atmospheric environmental studies. The results, in particular, the importance of coal combustion to NMHCs and the concentrations of OH and NO3 in winter in Beijing, are not previously reported. In general, the paper is well structured and written. The paper can be improved by appropriately addressing the following major and minor issues. I recommend publication of this paper in ACP after revisions

Specific comments:

(1) Given the inhomogeneous sources distributions and the combination with the winter meteorological conditions, particularly wind direction (e.g., Lin et al., 2011, Zhang et al., 2014), not only wind speed but also wind direction should be used for the interpretation of the NMHCs measurements. Source apportionment suggests that the most important source in haze conditions is coal combustion emission. And it is mentioned that coal combustion is prevailing for heating and cooking by farmers in rural areas. Then the question is: does the dependence of the concentrations of NMHCs and other pollutants on wind direction agrees with the source apportionment and directional distributions of major sources?

(2) The observation period is grouped into clear, light haze and heavy haze days, which are normally closely related with wind speed and direction. Therefore, there might be significant differences in sources impacting the NMHCs at the receptor site. To be able to find the differences, it is suggested to make the PMF analysis separately for the groups of days. However, it seems to me that the PMF analysis was only performed for the entire dataset (section 3.3.2) though the portions of each source are given for different pollution conditions (Fig. 7).

(3) It is suggested to treat the data from 19-22 Dec. 2015 differently since the odd-even plate number rule might have substantially changed the absolute and relative contributions of vehicle emission during this period, which may cause different source apportionment and species ratios.

(4) The interpretation on the different diurnal variations is vague (page 6 lines 20-25). The authors do not show any data of PBL height. The cited references (Quan et al, 2013; Liu et al., 2013) are all about September and the situation may be different in winter months. In addition, the PBL height alone cannot explain the different diurnal patterns. The author states "The boundary layer in clear day is relatively high, which favors for diffusion of pollutants (Gao et al., 2015), and hence, the distinct NMHCs peak values appeared during the two rush hours". If the high PBL in clear day favors the diffusion, emissions from vehicle as well as other sources should be better diluted. Why should the rush hours peaks so protruding? I think the key is the lowest nighttime level of pollution during clear days. It is the lowered nighttime level of pollution that makes the daytime rush hours peaks more evident. If the nighttime PBL were the highest during clear days, the lowest nighttime level of pollution would have been at least partly explained. Unfortunately, the paper presents no PBL height data. However, wind speed data are shown in Table 1 for different pollution conditions. The average wind speed during clear days was nearly twice as high as those during haze days, which could have resulted in the differences. To obtain more robust conclusion, the authors are suggested to calculate the daytime and nighttime wind speed for different pollution conditions. It would be better if they can show data of the PBL height, too.

(5) Species ratios are presented, discussed in terms of emission sources, and used for estimating the OH and NO3 concentrations. While these are good attempts, the authors did not pay attention to uncertainties in use of the ratios. Good correlations can be caused by chemical reactions of NMHCs with OH, NO3 or O3, or simply by atmospheric mixing or dilution (e.g., Parrish et al., 1992; McKeen and Liu, 1993). It seems to me that atmospheric mixing is not considered at all in this paper. The re-

sults might have been biased by such omission. I suggest that the authors discuss all the assumptions that are needed to make for the use of this ratio technique and the uncertainties associated with their results.

Minor points:

Page 3 line 11: I think the coordinate is that of RCEES not Beijing city so it should be placed directly after RCEES.

Page 3 lines 24-25: change "ramp" to "ramped"

Page 3 line 30-page 4 line 1: how was the detection limit determined? Either give the determination method here or cite the reference, which in it is described.

Page 4 line 3: a citation for US PMF 5.0 is necessary.

Page 4 lines 23-24: "based on both a good fit to the data and the most reasonable results". Please be more detail about this.

Page 5 line 3 and page 21 Table 1: It is better to change the unit of wind speed to m/s.

Page 6 line 10: delete "of the".

Page 7 line 11: did you measure O3? If yes, the data should be shown in Figure 1.

Page 8 line 2: are the results from daily estimation?

Page 8 line 3: it is meaningless to compare the short-term values for ground level with the global average.

References

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