Response to Anonymous Referee #1

We thank the reviewer for his/her thoughtful comments. The manuscript has been revised accordingly. Listed below are our point-by-point responses to the reviewer's comments, which are repeated in italic.

General

1. The discussion on size distributions in this manuscript is an important part in this manuscript as it is a sub-section by itself, and the major conclusion is based primarily on this discussion. Two different particle size measures, D_{va} and D_m, were used as from AMS and FMPS, respectively. A note on the difference between the two and possible conversion (DeCarlo et al., AS&T, 2004) would be beneficial. Even better is presenting volume-weight size distribution from FMPS, so that a rough estimation of density of aerosols could be possible. In doing that, the authors can also include difference in particle density to further support the difference in chemical composition during LT and MT periods.

[Response]: Following the reviewer's suggestions, we expanded the discussions on 1) the relationship between D_m and D_{va}, and 2) the comparison of the volume-weighted size distribution from the FMPS measurement to the mass-weighted size distribution form the HR-AMS measurement in Section 3.2. However, the two size distributions look quite different (Fig. S9). Similar differences in size distributions between SMPS and Q-AMS measurements were reported previously, e.g., in a study at Pittsburgh (Zhang et al., 2005). One possible reason for the differences is that D_{va} and D_m are significantly affected by particle shape in that a non-spherical particle would appear smaller in D_{va} but larger in D_m compared to a spherical particle of the same physical diameter. The differences appear to be larger when BC plays a more important role in particle composition. Given that BC contributes a considerable fraction (> 10%) of total PM_1 mass at the roadside site on 30 July, large size differences between FMPS and HR-AMS are expected.

We estimated the average particle density (Eq.1) assuming a density of 1.75 g cm^{-3} for inorganic species (Lide, 1992), 1.2 g cm^{-3} for organics (Turpin and Lim, 2001), and 1.77 g cm^{-3} for BC (Park et al., 2004; Bond and Bergstrom, 2006). The average density of aerosol particles during less traffic (LT) and more traffic (MT) periods is very close, which is 1.42 g cm^{-3} and 1.43 g cm^{-3}, respectively.

$$\rho = \frac{[Org] + [SO_4^{2-}] + [NO_3^-] + [NH_4^+] + [BC]}{\frac{[SO_4^{2-}] + [NO_3^-] + [NH_4^+]}{1.75} + \frac{[Org]}{1.2} + \frac{[BC]}{1.77}} \quad (1)$$

2. Line 27, page 30730: Was the wind from the north? By looking at Fig. 2, the wind direction was 120-240 deg. for the whole day of Jul. 28. And in a previous sentence (Line 22-23) on the same page, the authors just stated that the wind was persistently from QC campus, which is on the south.

[Response]: We thank the reviewer for spotting this error. The wind direction was indeed south, i.e., from the QC campus. We corrected it in the revised manuscript.

3. This is a nice work on primary aerosol near roadside environments. But the authors attempted to put it in too broad a context. For example, the last sentence in the abstract tends to infer health impact without any information on how specific toxic compounds (or group of compounds) are formed and change. The term "oxidation properties" (line 17, page 30725) is mentioned but the only hint on oxidation property is the regional characteristics of OOA factors, i.e., there is no result showing the oxidative chemistry per se in this typical roadside environment (see also minor comment c). Therefore, it is suggested that those general statements should be revised with a focus on the major conclusions about primary OA formation, which by themselves are very impressive already.

[Response]: Following the reviewer's suggestions, we have removed the sentence on exposure implications from the abstract.

The "oxidation properties" originally refers to the oxygen-to-carbon (O/C) ratio – a marker indicating the aging of organic aerosols. In order to avoid confusion, we clarified this point in the revised manuscript.

Specific comments:

a. Line 26, page 30733: a missing space in "to those".

b. Line 18, page 30736: delete redundant article "the" in "a the major fraction…".

[Response]: corrected

c. Line 16-18, page 30737: is this sentence a statement relevant to the current study? The results here do not imply any seasonal effects, nor do they show any direct evidence on photochemistry.

[Response]: The previous study by Zhang et al. (2004) showed a significant seasonal effect on particle number distributions. The aerosol composition and evolution processes might also be strongly seasonal dependent. The purpose of this statement was to point out that since our measurements took place in summer, it may be important to conduct the same measurements in different seasons for a better understanding the characteristics of near-highway submicron aerosols. However, after considering the reviewer's comments, this sentence was removed in the revised manuscript.

d. Table 1, page 30745: mismatch in columns.

[Response]: corrected

References:

Bond, T. C., and Bergstrom, R. W.: Light Absorption by Carbonaceous Particles: An Investigative Review, Aerosol Sci. Tech., 40, 27-67, 2006.

Lide, D. R.: CRC Handbook of Chemistry and Physics, 73rd ed., CRC Press, Boca Raton FL, 1992.

Park, K., Kittelson, D. B., Zachariah, M. R., and McMurry, P. H.: Measurement of inherent material density of nanoparticle agglomerates, Journal of Nanoparticle Research, 6, 267-272, 2004.

Turpin, B. J., and Lim, H. J.: Species contributions to $PM_{2.5}$ mass concentrations: Revisiting common assumptions for estimating organic mass, Aerosol Sci. Tech., 35, 602-610, 2001.

Zhang, K. M., Wexler, A. S., Zhu, Y. F., Hinds, W. C., and Sioutas, C.: Evolution of particle number distribution near roadways. Part II: the 'Road-to-Ambient' process, Atmos. Environ., 38, 6655-6665, 10.1016/j.atmosenv.2004.06.044, 2004.

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