

Wang et al. presents their results of hygroscopicity and volatility measurements during and after the Victory Day parade period in China. Aerosol hygroscopicity describes the interaction of aerosols and water vapor, and Aerosol volatility reflect the mixing state of nonvolatile aerosol particles. In addition to their importance of climate effects, the variation of them indicates the change in primary emissions, particle aging process, and regional transport. This dataset provide us new insights into the haze formation mechanisms in Beijing. The paper is well written and organized. Overall, the manuscript is within the scope of ACP. The reviewer would recommend the manuscript for publication in ACP after some minor revisions.

Specific Comments:

Line 61-64: The authors highlight the uncertainty of aerosol on climate. However, the author discuss the aerosol chemistry indicated from hygroscopicity and volatility throughout the paper. In fact, the pollution formation mechanism remain unclear in Beijing.

Re: Revised, Thanks! This has been addressed as "the pollution formation mechanism and the climate effect of aerosols remain highly uncertain due to the highly variable physical and chemical properties of aerosols, as well as complex mechanisms that govern aerosol-climate interactions" in the revised version of the paper (see L61-63).

Line 250-251: The authors define the 40 nm and 150 nm particles as fresh and pre-existing particles, respectively. The authors should address the validity of the definition. In fact, freshly emitted refractory particles (like BC) are primarily within the 150 nm to 240 nm diameter range (Levy et al., 2013). In contrast, it takes several hours for the growth of 40 nm even during NPF events. The reviewer suggests that the 40 nm particles are from local sources whereas the 150 nm particles are influenced by long-range transport and vertical mixing.

Re: Revised, Thanks! This has been addressed as "Particles with D_p equal to 40 nm represent local-impacted particles and particles with D_p equal to 150 nm represent regional-transported particles" in the revised version of the paper (see L251-253).

Line 314-320: The reviewer highly suspects that the nitrate is responsible for the appearance of more hygroscopic mode in the 40 nm particles in the early morning. How can form H_2O_2 during the night? The presence of nitrate in Aitken mode particles is very difficult and the addition of nitrate was initially promoted by sulfate condensation (Ye et al., 2010).

Re: The heterogeneous reactions in the atmosphere are complex, the reactive material includes H_2O_2 , HO_2 , N_2O_5 , O_3 and so on. At night the formation of NO_3 and N_2O_5 becomes important, NO_x can be oxidized to NO_3 by through heterogeneous reactions. NO_3 and NO_2 can be further combined to N_2O_5 . Then nitrate can be formed rapidly through NO_3 and N_2O_5 . This rapid conversion enhances the available nitrate and may add significantly to the nitrate available for condensation, enhancing night-time concentrations compared to those observed in the day (Dall'Osto et al., 2009). In addition, nitrate in locally produced aerosol was present mainly in particles smaller than 300 nm. In our study, ACSM data also suggested nitrate mass concentration increased sharply at night, especially during the non-control period (Zhao et al., 2016, Figure 8.). This has been addressed as "During the Clean2 period, there is

another obvious peak at about 0300 LT in the early morning, likely related to the increase in nitrate. Because there was a large amount of NO_x emitted from traffic sources in the evening during the non-control period, with the PBL height reduction and ambient temperature decrease, NO_x could be transformed into hydrophilic nitrate rapidly through NO₃ and N₂O₅ (Dall'Osto et al., 2009).” in the revised version of the paper (see L316-322).

Line 372: The vehicles emit both gas and particle pollutants, regardless of emission control conditions. However, the NPF is favored when the concentration of pre-existing particles is lower due to emission control.

Re: Revised, thanks! This has been addressed as “As stated previously, during the Clean1 period VOCs has a weaker decrease than SO₂ and NO_x, this would lead to more VOC-formed organic particles formed, which are normally highly volatile.” in the revised version of the paper (see L372-374).

Line 400-402: Do the authors think the emission of refractory particles at night is larger than at daytime? The increase of number fraction may be caused by the slower particle aging and weaker vertical mixing.

Re: Yes, the sampling site is located in the downtown of the city. A number of diesel vehicles and heavy trucks only can be allowed to enter the downtown at night, this made the increase of refractory particles at night. It can be reflected from the diurnal cycle of BC (Zhao et al., 2016, Section 3.5). Then the slower particle aging and weaker vertical mixing made the external-mixed BC accumulated. This has been addressed as “...and then the slower particle aging and weaker vertical mixing made the external-mixed BC accumulated” in the revised version of the paper (see L405-406).

Line 426-430: The authors should pay attention to the contradictory statements of σ_{κ} -PDF “always” exceeds 0.08, ... , the mean σ_{κ} -PDF of 40-nm particles during the Clean1 period “is equal to” 0.08.

Re: Revised, thanks! This has been addressed as “ σ_{κ} -PDF always exceeds 0.08 but the 40-nm particles during the Clean1 period” in the revised version of the paper (see L429-430).

Technical comments:

Line 325: The term of hydrophilic should be replaced by “hygroscopic”, because hygroscopic growth do not take place at a high RH for many hydrophilic substance.

Re: Revised, thanks! This has been addressed in the revised version of the paper (see L326).

Line 336: The condensation species are sulfate, nitrate, OA other than SO₂, NO_x, and VOCs.

Re: Revised, Thanks! This has been addressed in the revised version of the paper (see L337).

Ye, X.N., Ma, Z., Hu, D.W., Yang, X., Chen, J.M., 2010. Size-resolved hygroscopicity of submicrometer urban aerosols in Shanghai during wintertime. Atmospheric Research 99, 353-364.

References:

Dall'Osto M., Harrison R.M., Coe H., Williams P.I. and Allan J.D.: Real time chemical characterization of local and regional nitrate aerosols, *Atmos. Chem. Phys.*, 9, 3709-3720, 2009.

Zhao J., Du W., Zhang Y., Wang Q., Chen C., Xu W., Han T., Wang Y., Fu P., Wang Z., Li Z. and Sun Y.: Insights into aerosol chemistry during the 2015 China victory day parade: results from simultaneous measurements at ground level and 260 m in Beijing, *Atmos. Chem. Phys. Discuss.*, 2016, 1-29, 10.5194/acp-2016-695, 2016.