The authors appreciate the reviewers for reviewing our manuscript and providing constructive comments. As suggested, we carefully revised the manuscript thoroughly according to the valuable advices, as well as the typographical, grammatical, and bibliographical errors. Listed below are our point-by-point responses in blue to the review's comments (in italic). The figures added in the reply is represented by 'Figure', which is distinguished from 'Fig.' in the manuscript.

Anonymous Referee #1

This paper reports multimethod determination of the below-cloud wet scavenging coefficients of aerosols in Beijing, China. The analysis and interpretation of the results are overall fair. The paper presents very useful information regarding the wet deposition of aerosol. However, some additional information is still necessary for the readers to better understand this work.

[Response]: Thanks for your suggestions and we have added the necessary information marked in the blue in the manuscript, such as section 2.2.3 (the description of modeling calculation), section 3.1 (the detailed introduction of this rain event) and section 3.2 (the detailed introduction of Fig. 3).

Specific comments:

1.The modeling analysis presented in this study is subject to some uncertainties. For example, the washout was only parameterized for precipitation intensity, the aerosol species and so on. The coagulation kernel (E) was assumed to be a constant. What is the effect of this assumption on the modeling results? The authors should estimate the uncertainties of their modeling analysis, or at least state clearly the model configuration and limitation so that the readers can judge by themselves.

[Response]: In the NAQPMS model, the below-cloud scavenging module from Comprehensive Air Quality Model with Extensions (CAMx) v4.42 was employed to calculate the below-cloud wet scavenging process and the wet scavenging coefficient was briefly described as follows:

$$K = \frac{4.2\times10^{-7}\times E\times P}{d_p} \tag{11}$$

where d_p is the mean rain drop size and related to precipitation intensity. The collision efficiency E is a function of aerosol particle size and mainly considers Brownian diffusion, interception and inertial impaction as shown in Figure. 1. According to Figure 1, E depends on the particle size, i.e. decreasing sharply as the diameter smaller than 400 nm, and slightly increasing from 10^{-4} to 10^{-3} when the particle size between 400 nm-2 μm, after that it increasing very quickly. Thus, choose the E for different particle size will cause uncertainties in BWSC of one to two orders of magnitude for particle size in range of 0.01-2.5 μm. NAQPMS used in this study assumed SNA resides in fine mode size range (0.1-2.5 μm) and the geometric mean diameter of 0.5 μm was used in the calculation of E.

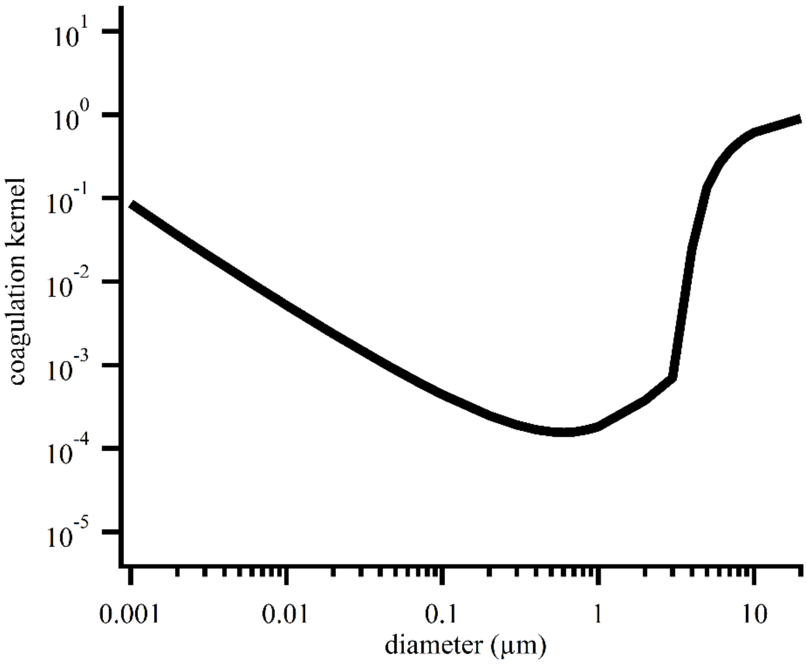

Figure 1. Size-resolved coagulation kernel based on the Brownian diffusion, interception and inertial impaction

We revised the model configure as "*The below-cloud scavenging module from Comprehensive Air Quality Model with Extensions (CAMx) v4.42 was employed to calculate the below-cloud wet scavenging process and the wet scavenging coefficient was briefly described as follows (Environ, 2005):*

$$K = \frac{4.2 \times 10^{-7} \times E \times P}{d_p} \qquad (11)$$

where d_p *is the mean rain drop size and related to precipitation intensity. The collision efficiency* E *is a function of aerosol particle size and mainly considers Brownian diffusion, interception and inertial impaction. NAQPMS used in this study assumed SNA resides in fine mode size range (0.1-2.5 μm) and the geometric mean diameter of 0.5 μm was used in the calculation of* E*.”*

And we also added the more description of NAQPMS in section 2.2.3 as “*In this study, a three-dimensional regional model, the Nested Air Quality Prediction Modeling System (NAQPMS) was adopted to calculate the aerosol scavenging coefficient. The NAQPMS, developed by IAP, is a fully modularized chemical transport model describing regional and urban-scale air pollution (Wang et al., 2001). The meteorological condition is driven by Weather Research and Forecasting (WRF) model. The NAQPMS consists of modules used for horizontal and vertical advection (Walcek and Aleksic, 1998), diffusion (Byun and Dennis, 1995), dry and wet deposition (Zhang et al., 2003; Stockwell et al., 1990), gaseous phase, aqueous phase, and heterogeneous atmospheric chemical reactions (Zaveri and Peters, 1999; Stockwell et al., 1990; Li et al., 2012). Carbon-Bond Mechanism Z (CBM-Z) and aerosol thermodynamic equilibrium partition model (ISORROPIAI1.7) have been used to calculated the gas and inorganic aerosol process. The cloud-process and aqueous chemistry module from Community Multi-scale Air Quality (CMAQ) modeling system v4.7 have been coupled in model by Ge et al. (2014). More details can be found in Li et al. (2016, 2017a). The NAQPMS has been widely used in prediction of acid rain, dust and secondary pollutions and can also reproduce well the physical and chemical evolution of reactive pollutants by solving the mass balance equations in terrain-following coordinates (Chen et al.,2019; Yang et al., 2019). It has been applied in Ministry of Ecology and Environment and local Environmental Protection Bureau such as Beijing, Shanghai, Guangzhou and Nanjing, etc. The NAQPMS also made great contribution to air quality assurance during the major activities (Wang et al., 2001; Wang et al., 2014d; Wu et al., 2010).*”

2. A brief introduction to Fig.3 should be provided, which should be much helpful for *the readers to better understand this study.*

[Response]: We added more introductions of the symbols in the caption to Fig. 3 as "*The top and bottom of the boxes represent the 75th and 25th percentiles, and central lines mean the median BWSCs. The whiskers represent maximum and minimum BWSCs, respectively.*"

Besides, for better understanding of multimethod, we have revised the symbols for multimethod and unified the expressions in the manuscript as: "*The theoretical estimated scavenging coefficients are labeled T. The field observations estimated by Eq (3) and (9) are labeled O1 and O2, respectively. The updated estimated method by Eq (10) is labeled as O2'. The modeling results are labeled M. And in following comments, we use the updated symbols instead. It will not be repeated later.*"

We also added the detailed description for Fig. 3 in section 3.2 as *"The observed O1 by SMPS, which mostly covers the range of Aitken and accumulation mode aerosols (0.014-0.74 μm), are much lower than the other two measurements. The observed BWSCs by original O2 are larger than the updated O2' method. However, O2' (5.7×10^{-5}, 8.9×10^{-5} and 5.4×10^{-5} s^{-1} for NO_3^-, SO_4^{2-} and NH_4^+) is much closer to the results of O1 (~10^{-5} s^{-1} for particle size in the range of 0.014-10.35 μm).*

3. There are only two cases in the paper, more field measurement estimation could decrease the influence produced by accidental elements, and give more convincing results.

[Response]: We agree with the reviewer's comment as well. In order to make up the bias from the limited rain events, we added the nine rain events at the same sampling site in IAP in summer of 2014 to compare the estimation methods of BWSCs of different precipitation with the same method O2'. Our results found that there is a strong exponential power relationship between the BWSCs and precipitation intensity both in the summer of 2014 and the rainfall event in winter of APHH-Beijing campaign with the coefficients of determination for SNA are over than 0.68. It indicated that rainfall event in winter of APHH-Beijing campaign also obeys the general wet scavenging rule in Beijing.

Although we cannot obtain the SMPS, SPAMS and POPC data in the summer of

2014 to compare the BWSCs under the multimethod, the same method the O2' has been employed to estimate the BWSCs in multi-event. Still, the multimethod to determinate the BWSCs of one rain event and even for multimethod of different rainfall events are needed for the future research.

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