

Supplement of Atmos. Chem. Phys., 19, 15569–15581, 2019
<https://doi.org/10.5194/acp-19-15569-2019-supplement>
© Author(s) 2019. This work is distributed under
the Creative Commons Attribution 4.0 License.



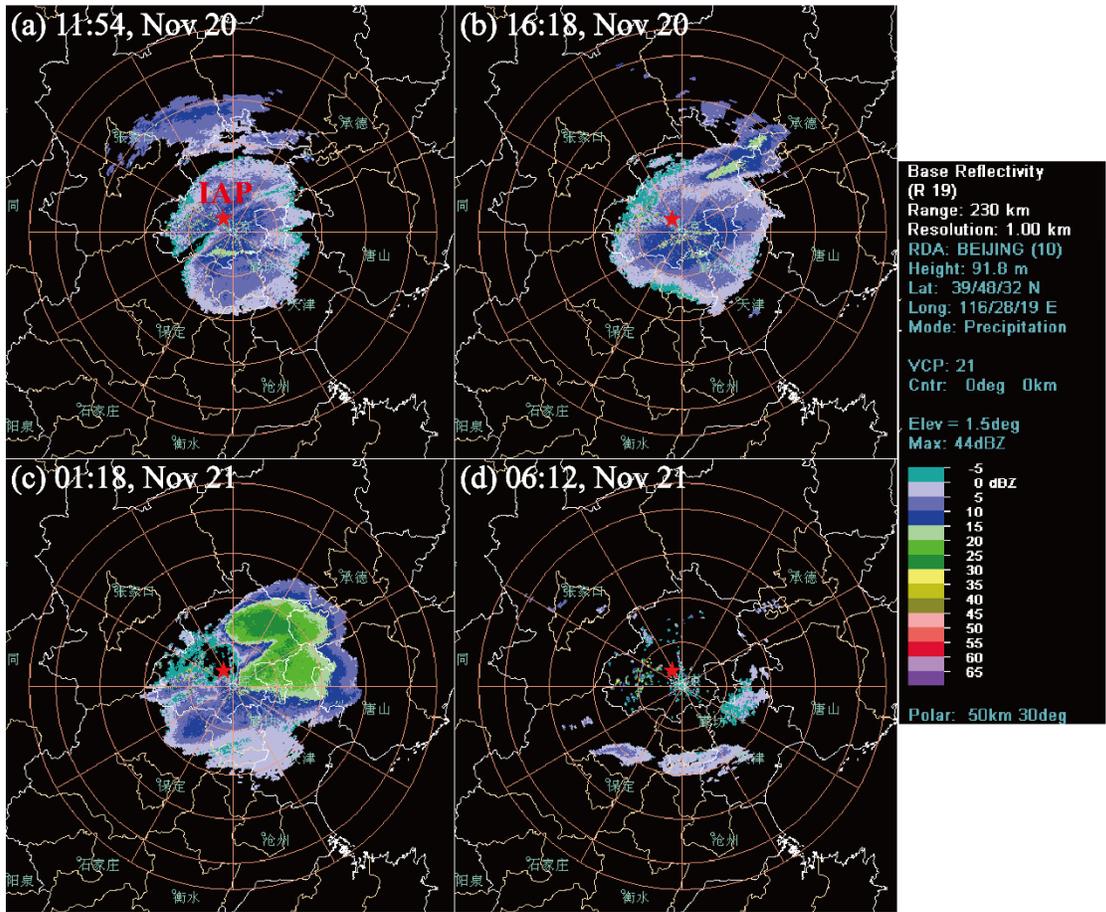
Supplement of

Multi-method determination of the below-cloud wet scavenging coefficients of aerosols in Beijing, China

Danhui Xu et al.

Correspondence to: Baozhu Ge (gebz@mail.iap.ac.cn)

The copyright of individual parts of the supplement might differ from the CC BY 4.0 License.



1

2 **Figure s1. The radar base reflectivity during the rainfall event (the sampling site at the IAP is**
 3 **indicated by the red star).**

4

5

6

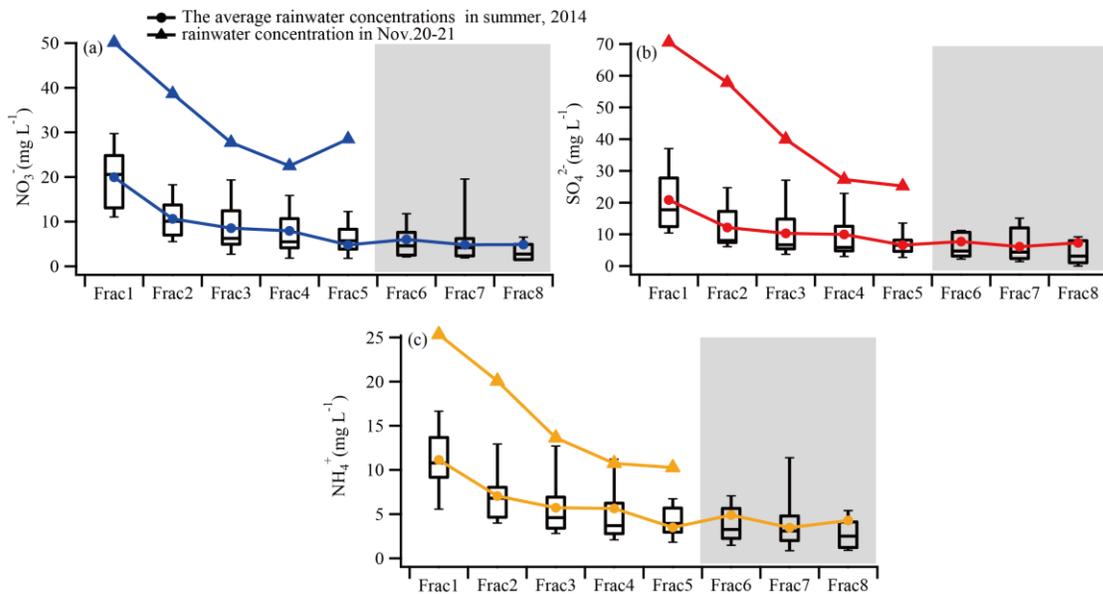
7

8

9

10

11 The Figure. s2 shows the average concentrations of SNA in summer of 2014 (Box and whisker plot) and
 12 this rain event in winter of APHH-Beijing campaign. The VWA concentrations are no more than 30, 40 and
 13 15 mg L⁻¹ for NO₃⁻, SO₄²⁻ and NH₄⁺, respectively, and decreased sharply during the beginning of rainfall
 14 and remained at low levels during the event. The in-cloud scavenging process is considered as the median
 15 value of the concentrations after accumulated precipitation exceeds 5 mm. These values were 2.75, 3.33,
 16 and 2.51 mg L⁻¹ for NO₃⁻, SO₄²⁻ and NH₄⁺, respectively, in summer of 2014 (as shown in Figure. s2 marked
 17 in grey shadow) (Xu et al., 2017).



18
 19 **Figure s2. Evolution of the (a) NO₃⁻ (blue), (b) SO₄²⁻ (red) and (c) NH₄⁺ (orange) of precipitation**
 20 **during summer 2014 and November 20th to 21st within different precipitation fractions of several**
 21 **sampled precipitation events (The data show the lowest, lowest 25 percentiles, median highest**
 22 **quartile, highest 75 percentiles, and highest value, respectively).**

23

24

25

26 **Table s1. The observation dataset list**

Observation instrument	Abbreviation	Introduction
		(time resolution and mainly measured material)
Ion Chromatography	IC	anions (SO_4^{2-} , NO_3^- , Cl^- and F^-) and cations (NH_4^+ , Na^+ , K^+ , Ca^{2+} and Mg^{2+}) in the rainfall samples
Ambient Ion Monitor-Ion Chromatograph	AIM-IC	60 min resolution, $\text{PM}_{2.5}$ concentrations
Scanning Mobility Particle Sizer	SMPS	5 min resolution, 14-740 nm particle number concentration
Single-particle Aerosol Mass Spectrometer	SPAMS	60 min resolution, 0.2-2.5 μm particle number concentration, mainly focus on NO_3^- , SO_4^{2-} and NH_4^+
Polarization Optical Particle Counter	POPC	5 min resolution, 0.4-10.35 μm particle number concentration

27

28

29

30

31

32

33

34

35

36

37

38

Nomenclature			
d_p	aerosol particle diameter	F	aerosol flux
D_p	raindrop diameter	D_{ep}	wet deposition
$N(d_p)$	aerosol particle number concentration	C_p	concentration in the precipitation
$N(D_p)$	concentration of raindrops	C_{a0}	original aerosol concentration before the rainfall
$K(d_p)$	size-resolved below-cloud scavenging coefficient	$C_a(0)$	aerosol concentration at the surface
K	below-cloud scavenging coefficient	$C_a(z)$	aerosol concentration at height z
$U_i(D_p)$	falling velocity of raindrops	$C_{p,below}$	washout concentration
$E(D_p, d_p)$	collision efficiency	P	precipitation intensity
A	horizontal area of the given box	$h'(z)$	depth of the layers in the vertical direction
h	vertical height of the given box or cloud-base height	f	vertical distribution of aerosols
M	aerosol mass of the given box	$C'_a(0)$	aerosol concentration at the surface and eliminates effects of north and north-west wind
C_a	average aerosol concentration	BWSC	below-cloud wet scavenging coefficient
APHH-Beijing	Atmospheric Pollution and	CTMs	Chemical Transport Models

	Human Health-Beijing		
MICS-Asia	Model Inter-Comparison Study for Asia	TF-HTAP	Hemispheric Transport of Atmospheric Pollutants
VWA	volume weighted averaged	NCP	North China Plain
IAP	Institute of Atmospheric Physics	IC	Ion Chromatography
AIM-IC	Ambient Ion Monitor-Ion Chromatograph	SMPS	Scanning Mobility Particle Sizer
SPAMS	Single-particle Aerosol Mass Spectrometer	POPC	Polarization Optical Particle Counter
SNA	NO_3^- , SO_4^{2-} and NH_4^+	NAQPMS	the Nested Air Quality Prediction Modeling System
NAAQS	the National Ambient Air Quality Standard	CAMx	Comprehensive Air Quality Model with Extensions
CMAQ	Community Multi-scale Air Quality modeling system	CNEMC	China National Environmental Monitoring Centre