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Sea salt aerosols as a reactive surface for inorganic and organic acidic gases in the Arctic troposphere

J. W. Chi et al.

Correspondence to: W. J. Li (liweijun@sdu.edu.cn) and Y. M. Zhang (ymzhang@cams.cma.gov.cn)

Supporting information

A summary of the number of table, and figures:

Total number of tables: 1 (Table S1)

Total number of figures: 4 (Figure S1, Figure S2, Figure S3, and Figure S4)

Hygroscopic experiment analysis

Individual particle hygroscopic (IPH) system was built for observing hygroscopic properties of individual SSA at different relative humidity. The experimental apparatus is composed of three parts: (1) Introducing dry and wet (obtained by humidity generator (GenRH-A, UK)) N_2 gas with controlled flow by mass control flow meter into a chamber; (2) Mounting the TEM grid with aerosols on the bottom of a perspex environmental microscopic cell (GenRH Mcell, UK) with four holes on the side. Two holes are for controlling RH and others for temperature by low constant temp bath (DC-0506, China); (3) Images were observed in different relative humidities through an optical microscope (Olympus BX51M, Japan) with a camera (Canon 650D). The detail information of a similar experimental set-up is described elsewhere (Ahn et al., 2010). Similar IPH systems have successfully obtained aerosols' hygroscopic growth observations with the diameter larger than 0.5 μm in filed and laboratory experiments (Ahn et al., 2010;You et al., 2012;Peckhaus et al., 2012;Li et al., 2014a;Li et al., 2014b). Optical microscopic did not measure vertical particle changes and the particle hygroscopic growth curve for sizes was to some extent uncertain. The result can simply exhibit particle hygroscopic property, however, it is difficult to in comparison with the growth factors and other studies based on particle mass or volume (Ahn et al., 2010). Here fresh, partially aged, and fully aged SSA were chosen to observe particle hygroscopic growth at the RH range from 3% to 95% under one stable room temperature at 20 ^{o}C (Fig. S4).

Table S1. Sampling dates, sampling times, and meteorological conditions for 23 samples

No.	Sampling date	Sampling time	T (^{o}C)	RH (%)	Air pressure (hPa)	Wind direction	Wind speed (m/s)
1	Aug.4, 2012	9:06-9:36	4.7	82	1002.1	330	4.1
2	Aug.4, 2012	21:00-21:20	3.7	85	1001.9	309	5.3
3	Aug.5, 2012	14:53-15:14	5.6	75	1002.6	95	1.8
4	Aug.7, 2012	20:50-21:15	4.9	84	1009.0	296	4.1
5	Aug.8, 2012	8:23-8:48	4.9	81	1007.6	238	2.1
6	Aug.9, 2012	15:20-15:49	7.0	78	1003.5	120	7.3
7	Aug.10, 2012	0:15-0:40	7.3	80	998.6	135	8.9

8	Aug.11, 2012	9:10-9:35	6.2	94	997.0	303	3.3
9	Aug.12,2012	16:00-16:25	6.6	80	1006.8	129	5.9
10	Aug.13, 2012	9:25-9:50	5.1	82	1010.0	141	0.0
11	Aug.14, 2012	15:12-15:42	4.6	88	1020.5	117	2.6
12	Aug.14, 2012	21:17-21:47	4.8	84	1020.7	276	5.4
13	Aug.15, 2012	18:45-19:31	6.0	70	1018.9	88	3.3
14	Aug.17, 2012	9:00-10:00	3.8	86	1017.1	116	0.3
15	Aug.17, 2012	14:50-15:20	3.7	85	1015.7	109	2.2
16	Aug.18, 2012	15:30-16:15	5.7	83	1020.3	23	1.5
17	Aug.19, 2012	15:30-16:10	6.0	72	1010.0	212	4.9
18	Aug.19, 2012	21:10-21:45	6.1	74	1004.1	297	2.2
19	Aug.20, 2012	9:00-9:40	3.6	77	1008.5	334	2.6
20	Aug.20, 2012	15:10-15:50	4.3	72	1004.7	315	7.5
21	Aug.21, 2012	15:05-15:40	1.6	87	1003.7	314	6.8
22	Aug.22, 2012	8:55-9:30	2.8	78	999.2	331	2.8
23	Aug.23, 2012	15:10-16:10	4.7	56	1001.3	105	4.6

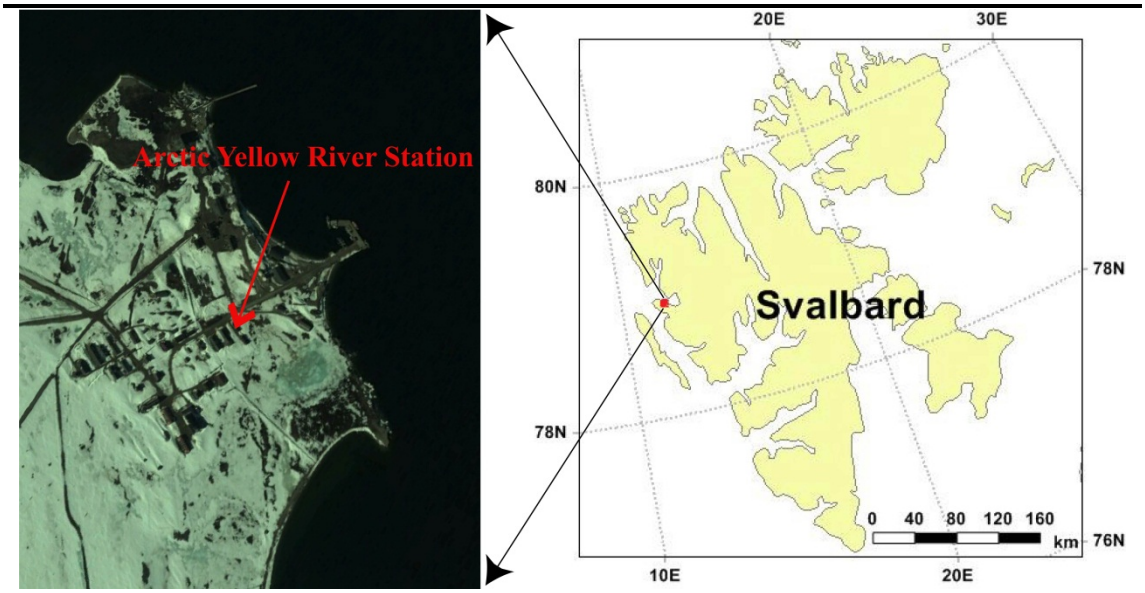

Figure S1. The location of sampling point-Chinese Arctic Yellow River Station, Svalbard.

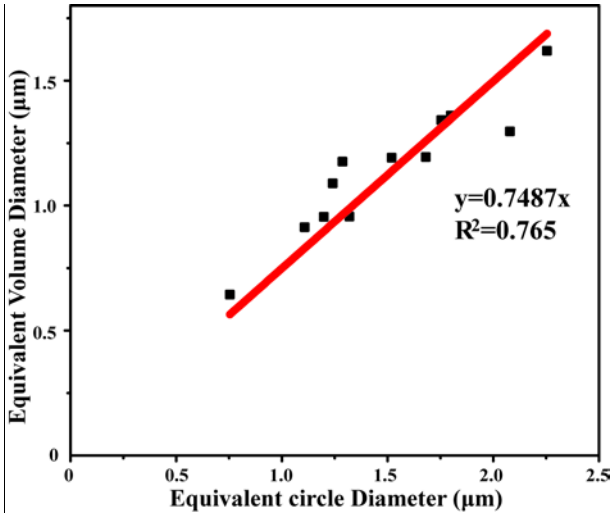

Figure S2. The correlation of equivalent circle diameter (d) and equivalent volume diameter (D) obtained by AFM.

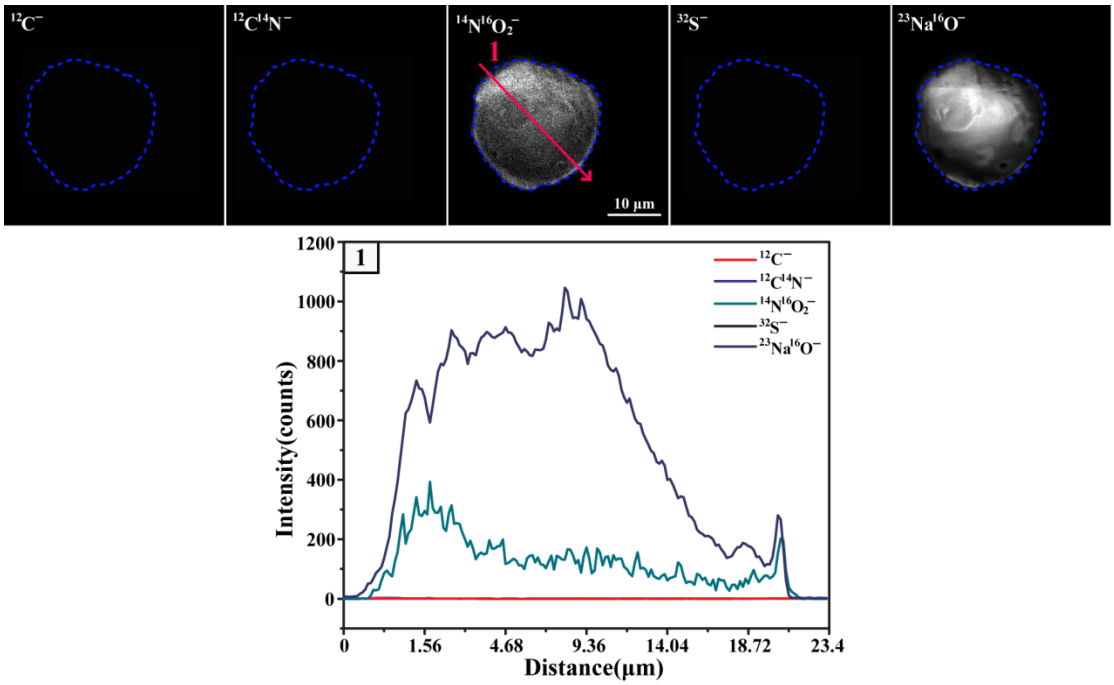

Figure S3. NanoSIMS-based ion intensity mappings. Mappings of $^{12}C^-$, $^{12}C^{14}N^-$, $^{14}N^{16}O_2^-$, $^{32}S^-$, and $^{23}Na^{16}O^-$ from laboratory generated $NaNO_3$ particle on silicon substrate. Line 1 represents the line scanning on the surface of individual particle.

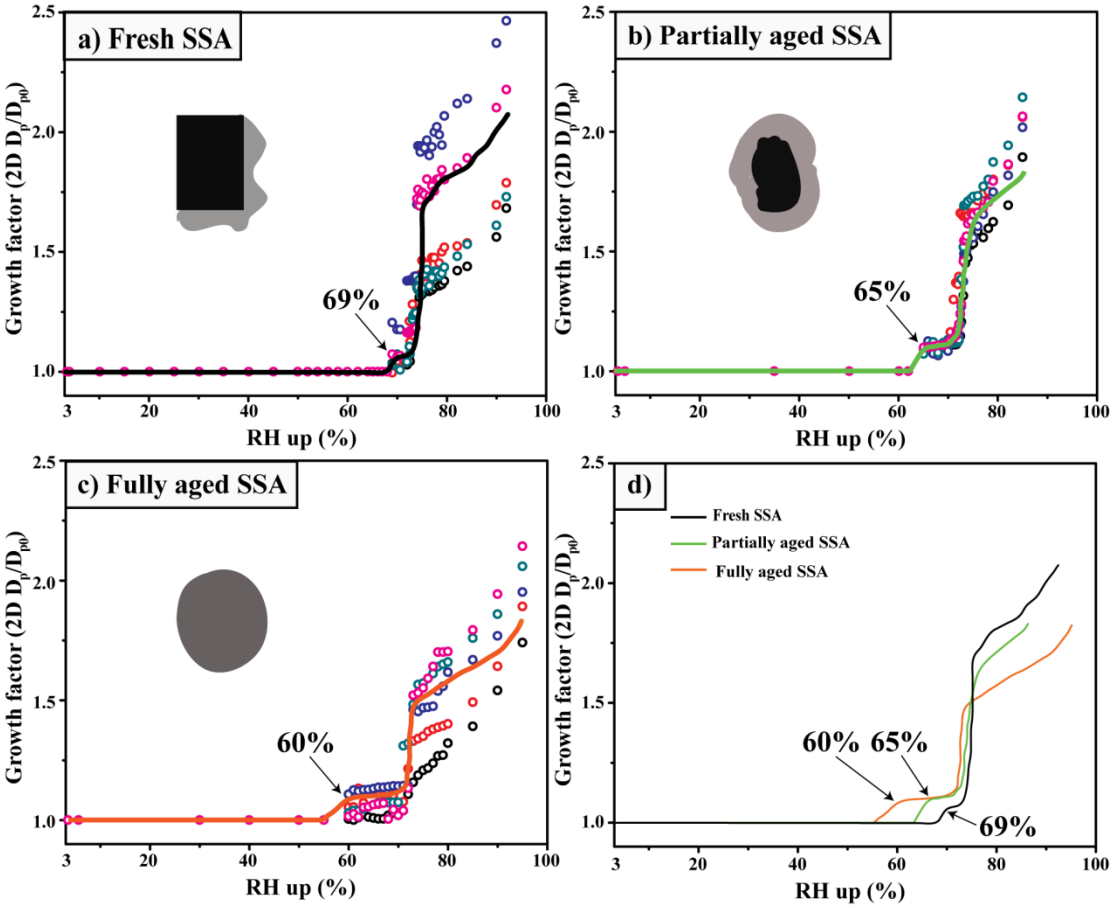

Figure S4. Deliquescence process of fresh SSA (a), partially aged SSA (b), and fully aged SSA (c) with different colors for different particles. The lines show the hygroscopic growth of individual SSA. The relative humidity for three typical SSA is 3-92%, 3-85%, and 3-95%, respectively.

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