

# The evolution of cloud microphysics upon aerosol interaction at the summit of Mt. Tai, China

Jiarong Li<sup>1</sup>, Chao Zhu<sup>1</sup>, Hui Chen<sup>1,\*</sup>, Defeng Zhao<sup>1</sup>, Likun Xue<sup>2</sup>, Xinfeng Wang<sup>2</sup>, Hongyong Li<sup>2</sup>, Pengfei Liu<sup>3,4,5</sup>, Junfeng Liu<sup>3,4,5</sup>, Chenglong Zhang<sup>3,4,5</sup>, Yujing Mu<sup>3,4,5</sup>, Wenjin Zhang<sup>6</sup>, Luming Zhang<sup>7</sup>, Kai Li<sup>7</sup>, Min Liu<sup>7</sup>, Hartmut Herrmann<sup>1,2,8</sup>, Jianmin Chen<sup>1,4,9,\*</sup>

<sup>1</sup>Shanghai Key Laboratory of Atmospheric Particle Pollution and Prevention (LAP3), Department of Environmental Science and Engineering, Institute of Atmospheric Sciences, Fudan University, Shanghai 200438, China

<sup>2</sup>Environment Research Institute, School of Environmental Science and Engineering, Shandong University, Ji'nan 250100, China

<sup>3</sup>Research Center for Eco-Environmental Science, Chinese Academy of Sciences, Beijing 10085, China

<sup>4</sup>Center for Excellence in Urban Atmospheric Environment, Institute of Urban Environment, Chinese Academy of Science, Xiamen 361021, China

<sup>5</sup>University of Chinese Academy of Sciences, Beijing 100049, China

<sup>6</sup>State Environmental Protection Key Laboratory of Urban Ambient Air Particulate Matter Pollution Prevention and Control, College of Environmental Science and Engineering, Nankai University, Tianjin 300071, China

<sup>7</sup>Tai'an Municipal Ecological Environment Bureau, Shandong Tai'an Ecological Environment Monitoring Center, Tai'an 271000, China

<sup>8</sup>Leibniz Institute for Tropospheric Research, Leipzig, Germany

<sup>9</sup>Shanghai Institute of Eco-Chongming (SIEC), No.3663 Northern Zhongshan Road, Shanghai 200062, China

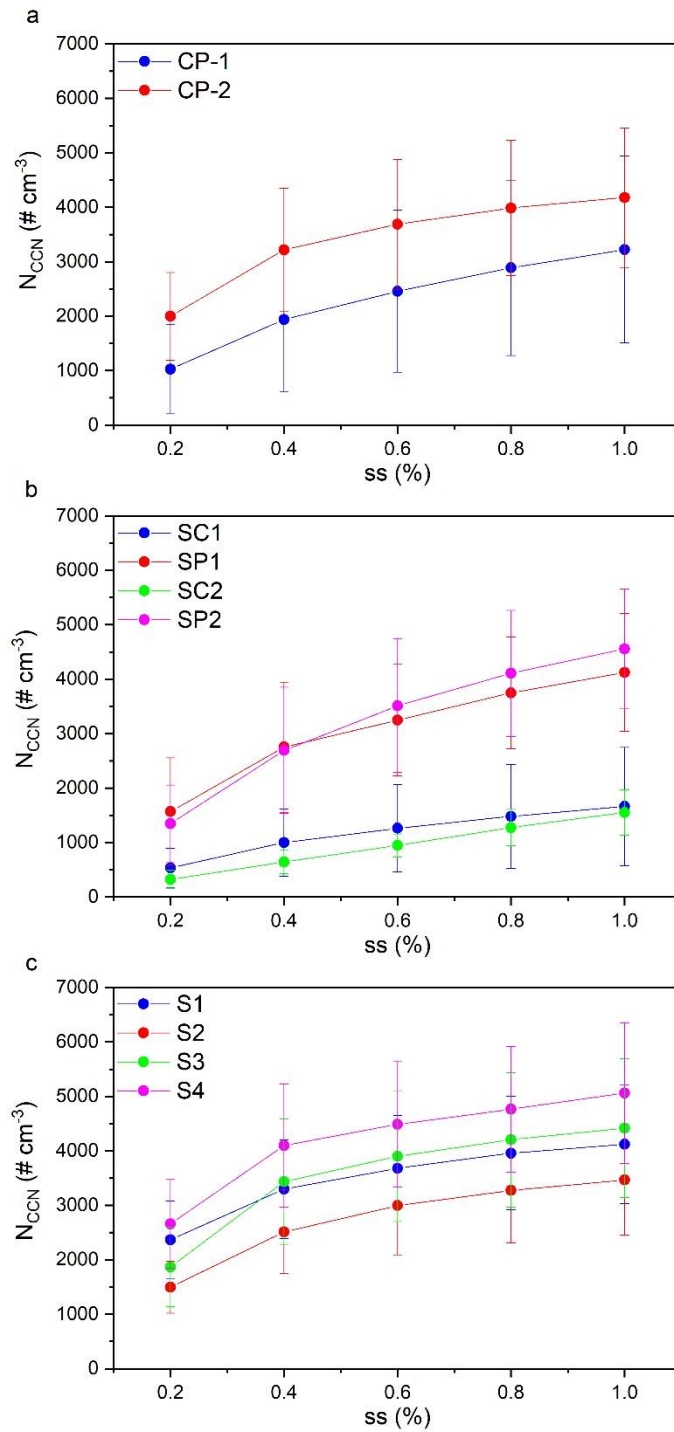
*Corresponding to:* Jianmin Chen (jmchen@fudan.edu.cn) and Hui Chen (hui\_chen@fudan.edu.cn)

## Supplement

**Table S1: Monitoring times of cloud events with averaged PM<sub>2.5</sub> mass concentration, cloud droplet number concentration (N<sub>c</sub>), mean liquid water content (LWC), effective radius (r<sub>eff</sub>), geometrical mean diameter (GMD), droplet surface area (PSA), pressure (P), temperature (T), relative humidity (RH), wind direction (WD), wind speed (WS) and the number of cloud samples at Mt. Tai.**

Event	Start	Stop	Duration	PM <sub>2.5</sub>	N <sub>c</sub>	LWC	r <sub>eff</sub>	GMDc	PSA	P	T	RH	WD	WS	No.of Sample
	(UTC/GMTC8)	(UTC/GMTC8)	(h)	(µg m <sup>-3</sup> )	(# cm <sup>-3</sup> )	(g m <sup>-3</sup> )	(µm)	(µm)	(cm <sup>2</sup> m <sup>-3</sup> )	(hPa)	(°C)	(%)	(°)	(m s <sup>-1</sup> )	(#)
1	2018/06/17 08:49	2018/06/17 09:08	0.3	34.48	156	0.03	3.9	6.8	234	84.4	14.9	90.8	203.6	1.3	0
2	2018/06/18 01:24	2018/06/18 03:02	1.6	23.23	202	0.02	3.3	5.7	268	84.2	13.3	98.8	241.1	4.1	0
3	2018/06/18 23:17	2018/06/19 00:05	0.8	44.18	300	0.06	4.1	6.4	469	84.0	14.7	97.3	233.3	3.1	0
4	2018/06/19 22:32	2018/06/19 23:26	0.9	87.65	385	0.05	3.7	5.6	478	84.3	16.0	97.8	95.0	1.9	0
5	2018/06/24 23:37	2018/06/25 22:14	22.6	7.92	558	0.35	6.8	9.4	1550	84.2	18.2	99.8	197.1	6.4	2
6	2018/06/27 23:31	2018/06/28 00:52	1.3	27.61	316	0.09	4.8	6.6	635	84.0	19.3	97.6	267.1	5.2	0
7	2018/07/01 22:40	2018/07/02 00:40	2.0	6.10	620	0.59	7.1	10.0	2481	84.2	16.6	99.2	93.4	4.2	1
8	2018/07/02 05:26	2018/07/02 08:15	2.8	31.00	402	0.06	3.6	5.9	484	84.2	16.2	98.9	58.8	3.3	0
9	2018/07/02 21:06	2018/07/02 22:02	0.9	66.02	240	0.02	3.0	4.9	230	84.1	16.4	98.5	90.7	3.0	0
10	2018/07/03 02:58	2018/07/03 06:31	3.6	41.65	380	0.07	4.0	5.9	719	83.9	15.8	97.6	34.2	4.6	0
11	2018/07/05 00:15	2018/07/05 06:25	6.2	46.44	730	0.11	3.8	5.6	1082	83.9	16.8	99.1	86.3	7.2	0
12	2018/07/05 21:35	2018/07/06 08:42	11.1	40.06	677	0.10	3.8	5.5	1137	84.2	17.4	98.8	73.2	8.6	1
13	2018/07/07 00:38	2018/07/07 02:00	1.4	28.18	462	0.06	3.6	5.4	606	84.4	16.1	98.7	98.6	4.8	0
14	2018/07/07 22:35	2018/07/08 03:00	4.4	14.68	193	0.06	5.1	6.8	456	84.4	15.9	99.8	203.6	4.8	1
15	2018/07/08 11:32	2018/07/08 22:30	11.0	20.01	440	0.14	4.9	7.2	963	84.5	16.0	97.4	89.9	5.7	2
16	2018/07/09 05:39	2018/07/09 12:18	6.6	2.99	59	0.14	9.8	12.4	525	84.5	16.0	99.6	72.6	5.8	0
17	2018/07/09 15:42	2018/07/09 22:14	6.5	11.14	166	0.07	5.3	6.6	625	84.5	15.8	93.5	92.9	2.4	0
18	2018/07/10 02:10	2018/07/10 04:55	2.7	8.17	121	0.10	6.9	8.1	627	84.5	15.5	95.6	207.1	3.4	0

19	2018/07/10 10:54	2018/07/13 12:51	74.0	8.71	633	0.32	6.0	8.4	1669	84.5	18.5	99.4	180.7	4.4	12
20	2018/07/13 21:17	2018/07/14 10:35	13.3	6.20	1519	0.54	5.2	7.5	3133	84.3	19.7	100.0	147.6	5.6	1
21	2018/07/14 15:58	2018/07/15 14:09	22.2	5.80	1081	0.39	5.2	7.6	2239	84.5	20.7	99.9	197.2	5.9	3
22	2018/07/15 20:42	2018/07/16 12:57	16.3	10.70	1346	0.40	4.9	7.1	2522	84.6	20.4	99.9	193.5	4.3	2
23	2018/07/16 20:43	2018/07/17 17:35	20.9	15.28	1147	0.33	4.9	6.8	2078	84.5	19.5	100.0	196.1	4.9	2
24	2018/07/17 22:07	2018/07/18 11:47	13.7	8.44	1250	0.41	4.9	7.5	2534	84.5	20.0	100.0	199.0	6.4	1
25	2018/07/18 21:36	2018/07/19 11:06	13.5	10.37	1161	0.31	4.6	6.9	2070	84.6	19.4	99.9	200.8	6.8	1
26	2018/07/19 22:51	2018/07/20 12:59	14.1	9.16	1157	0.41	5.2	7.5	2382	84.5	19.7	100.0	192.9	5.2	2
27	2018/07/20 22:27	2018/07/21 03:02	4.6	12.48	938	0.15	3.8	6.0	1237	84.5	18.7	99.8	210.9	6.4	1
28	2018/07/21 23:03	2018/07/21 23:36	0.6	21.02	607	0.06	3.2	5.5	622	84.6	18.4	98.9	199.4	7.1	0
29	2018/07/22 22:49	2018/07/22 23:34	0.8	7.22	1437	0.19	3.5	5.7	1658	84.4	18.6	99.2	81.3	9.7	0
30	2018/07/23 03:46	2018/07/23 18:29	14.7	1.87	630	0.37	6.0	9.8	1859	83.9	18.4	99.9	64.4	13.7	2
31	2018/07/24 09:03	2018/07/24 10:09	1.1	2.30	148	0.07	5.7	7.9	381	84.1	18.8	100.0	272.0	8.3	0
32	2018/07/24 11:34	2018/07/24 12:03	0.5	5.42	130	0.03	4.3	7.1	244	84.1	19.5	100.0	257.6	5.9	0
33	2018/07/24 18:20	2018/07/25 08:52	14.5	8.18	1441	0.23	3.7	6.1	1846	84.1	20.2	99.9	220.1	11.9	1
34	2018/07/25 19:29	2018/07/25 20:44	1.3	21.54	166	0.01	2.7	5.0	220	84.3	21.6	99.0	223.7	9.0	0
35	2018/07/26 01:38	2018/07/26 05:25	3.8	9.86	770	0.11	3.6	6.0	939	84.4	20.7	99.8	219.0	3.6	0
36	2018/07/26 19:32	2018/07/27 01:04	5.5	23.67	326	0.06	3.8	5.5	775	84.5	19.3	98.4	149.4	6.6	0
37	2018/07/27 12:17	2018/07/27 14:44	2.4	24.69	455	0.13	4.7	6.1	1185	84.5	20.0	94.5	89.9	4.5	0
38	2018/07/27 16:45	2018/07/30 00:05	55.3	10.68	445	0.17	5.1	7.3	1187	84.4	18.7	99.1	160.8	4.3	5
39	2018/07/30 03:55	2018/07/30 04:25	0.5	10.83	279	0.09	4.9	7.4	563	84.3	18.5	99.1	268.2	1.1	0
40	2018/07/30 06:29	2018/07/30 12:41	6.2	27.45	209	0.06	4.8	6.4	477	84.4	20.3	95.2	83.9	2.7	0



**Figure S1: The  $N_{CCN}$  measured at  $ss = 0.2\%$ ,  $0.4\%$ ,  $0.6\%$ ,  $0.8\%$  and  $1.0\%$  during (a) CP-1 and CP-2 (b) SC1, SP1, SC2 and SP2 (c) S1, S2, S3 and S4.**

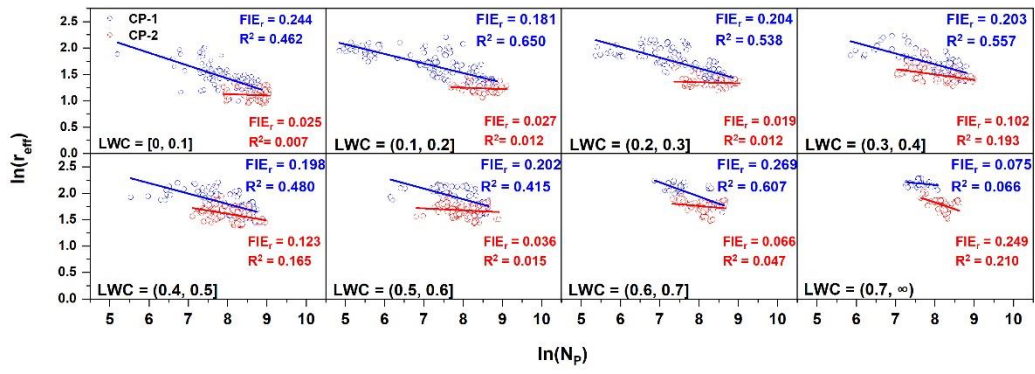


Figure S2: The calculation of  $FIE_r$  based on the plot of  $r_{\text{eff}}$  versus  $N_p$  in narrow LWC size bins with increase of  $0.1 \text{ g m}^{-3}$ .