Supplement of Aerosol Research, 3, 15–44, 2025
https://doi.org/10.5194/ar-3-15-2025-supplement

AEROSOL Research
Open Access

Supplement of

New particle formation dynamics in the central Andes: contrasting urban and mountaintop environments

Diego Aliaga et al.

Correspondence to: Victoria A. Sinclair (victoria.sinclair@helsinki.fi)

Supplementary Information

Supplementary Figures

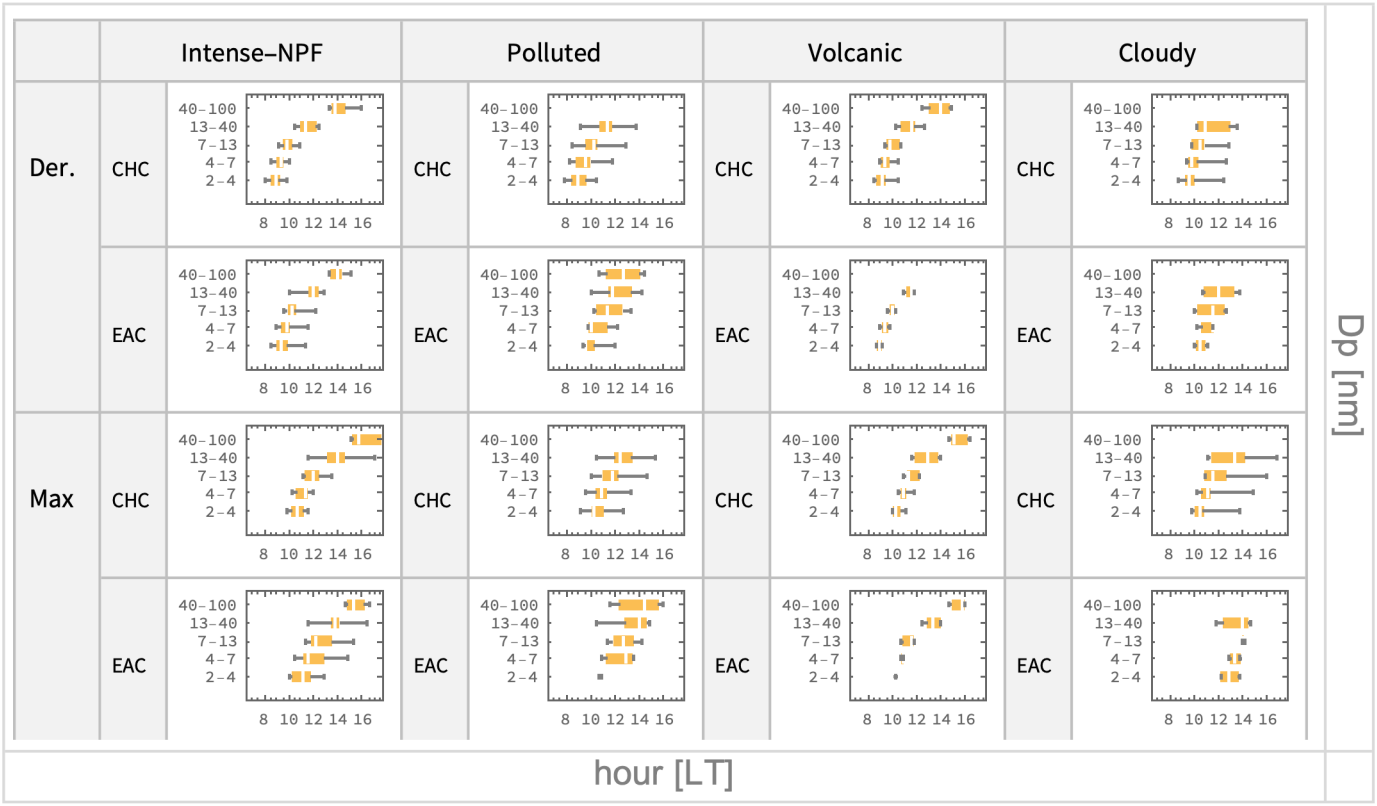


Figure S1. Histograms showing when the growing mode was detected. The dataset is separated by category and station at different size ranges (nm) using two methods: maximum concentration (Max) and maximum of the time derivative of the concentration (Der.). The median is denoted by a white line and the edges of the box are at the first and third quartiles.

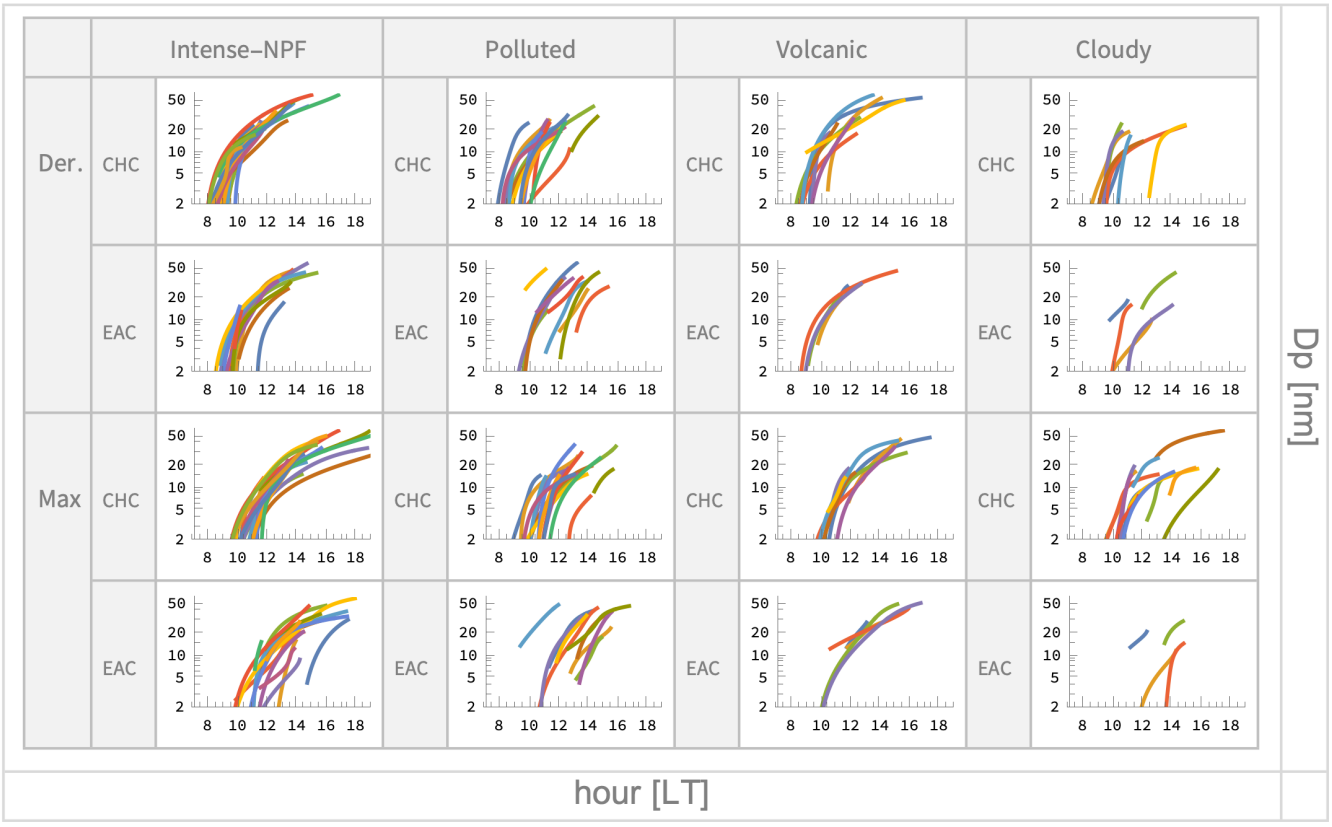


Figure S2. The plots show the estimated growing edge grouped by category and station at different size ranges (nm) using two methods: maximum concentration (Max) and maximum of the time derivative of the concentration (Der.). Areas in the PNSD where the edge was to be found by either method were selected manually after visual inspection. The PNSD was previously smoothed by using a gaussian filter with a standard deviation of 1 hour. The Der. method systematically and expectedly detects events earlier than the Max method.

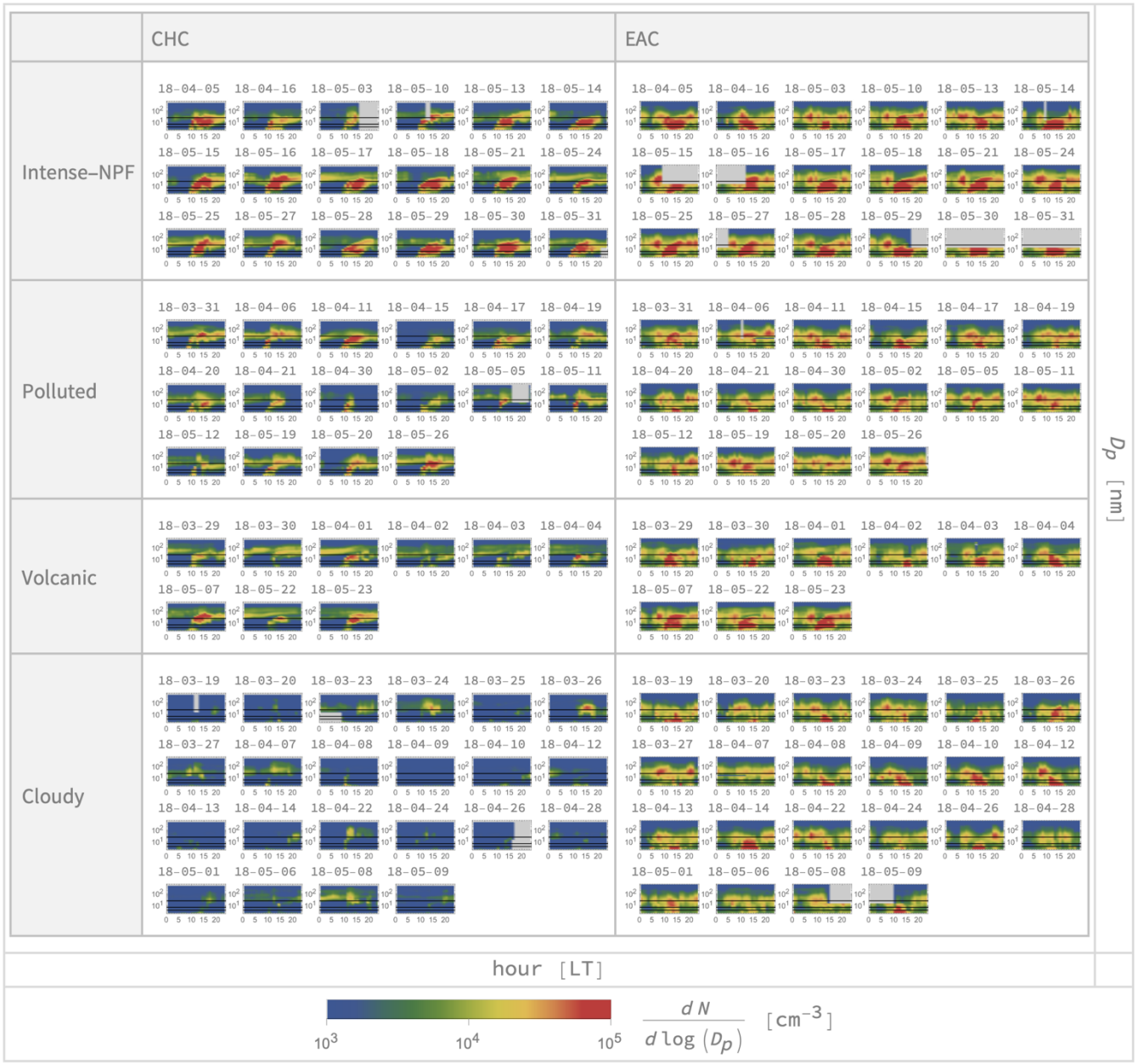
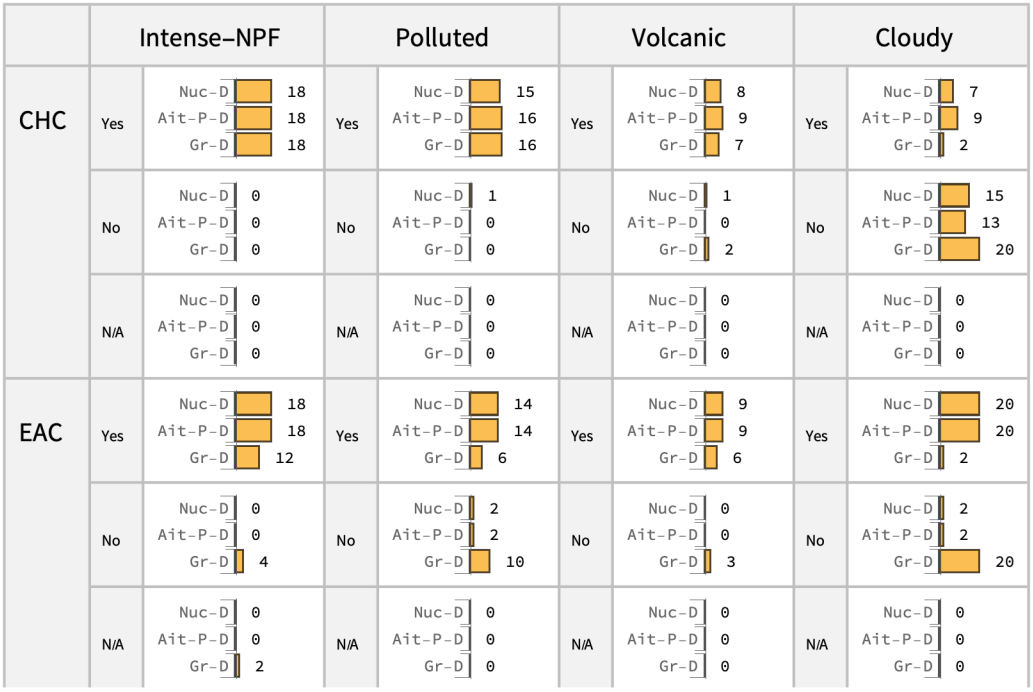


Figure S3. Surface plots of the PNSD for each of the 65-day used in this study separated by category and station. The black lines mark the 4, 7 and 25 nm. The 2-4 nm range was used to detect nucleation (Nuc-D) by visual inspection in the traditional categorization of events. Likewise, the range 7-25 nm was used to detect the appearance of larger modes (Ait-P-D). Also, if a clear growing edge was detected the day was marked as showing growth (Gr-D).



25

Figure S4. Bar charts showing the number of days where nucleation (Nuc-D), Aitken peaks (Ait-P-D) and a distinct growing edge (Gr-D) were detected. The labels "Yes", "No" and "N/A" indicate detection, no detection, and missing data, respectively.

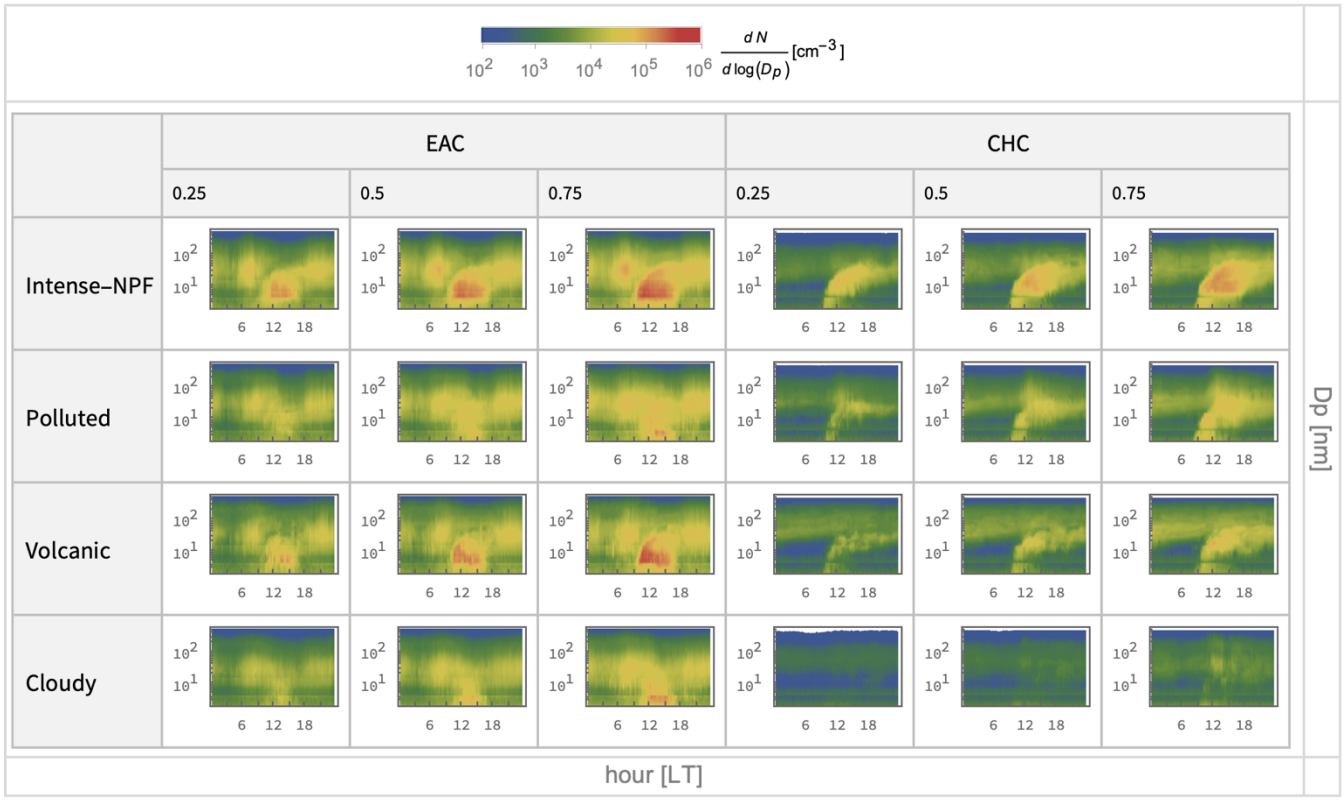


Figure S5. Quantiles 0.25, 0.50 and 0.75 of the PNSD grouped by category and location. The range from 2-4 nm correspond to the negative ion concentration from NAIS and is multiplied by 10 to aid in the visualization. The range 4-15 nm correspond to neutral particles from NAIS and the range 15-440 nm is obtained from MPSS.

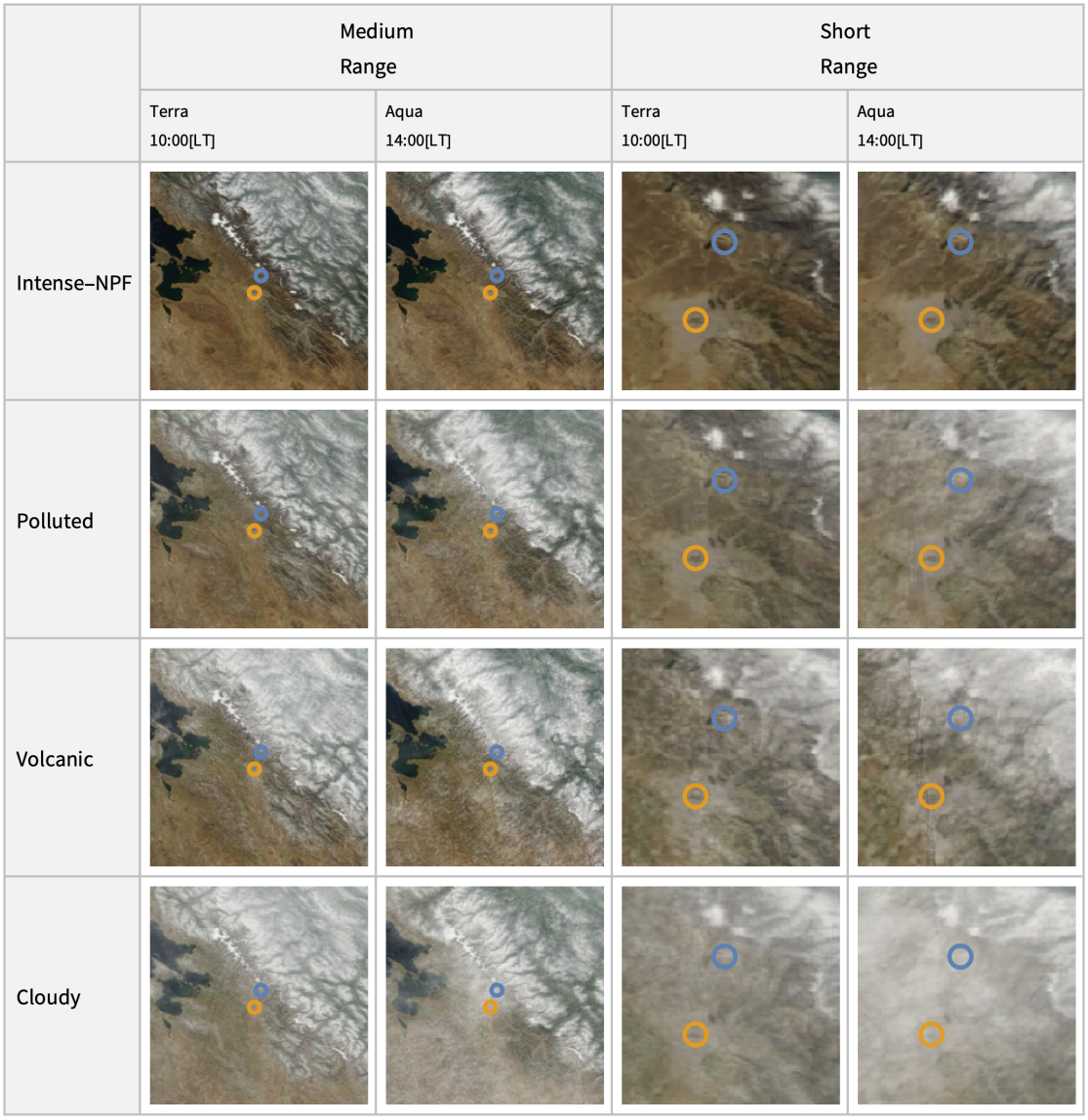


Figure S6. Median of images obtained from the MODIS instrument aboard the Aqua and Terra satellites grouped by category and hour. CHC and EAC are marked by sky blue and orange circles, respectively. In all cases except for Intense-NPF, the afternoon overpass presents more clouds than the morning overpass.

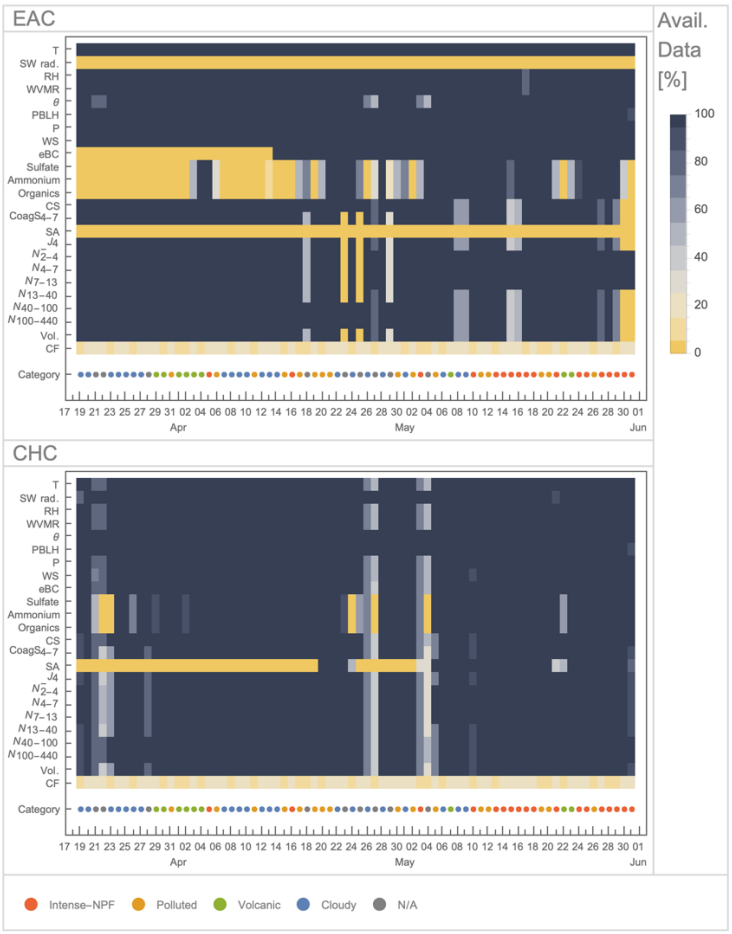


Figure S7: Percentage of available data per day and station.

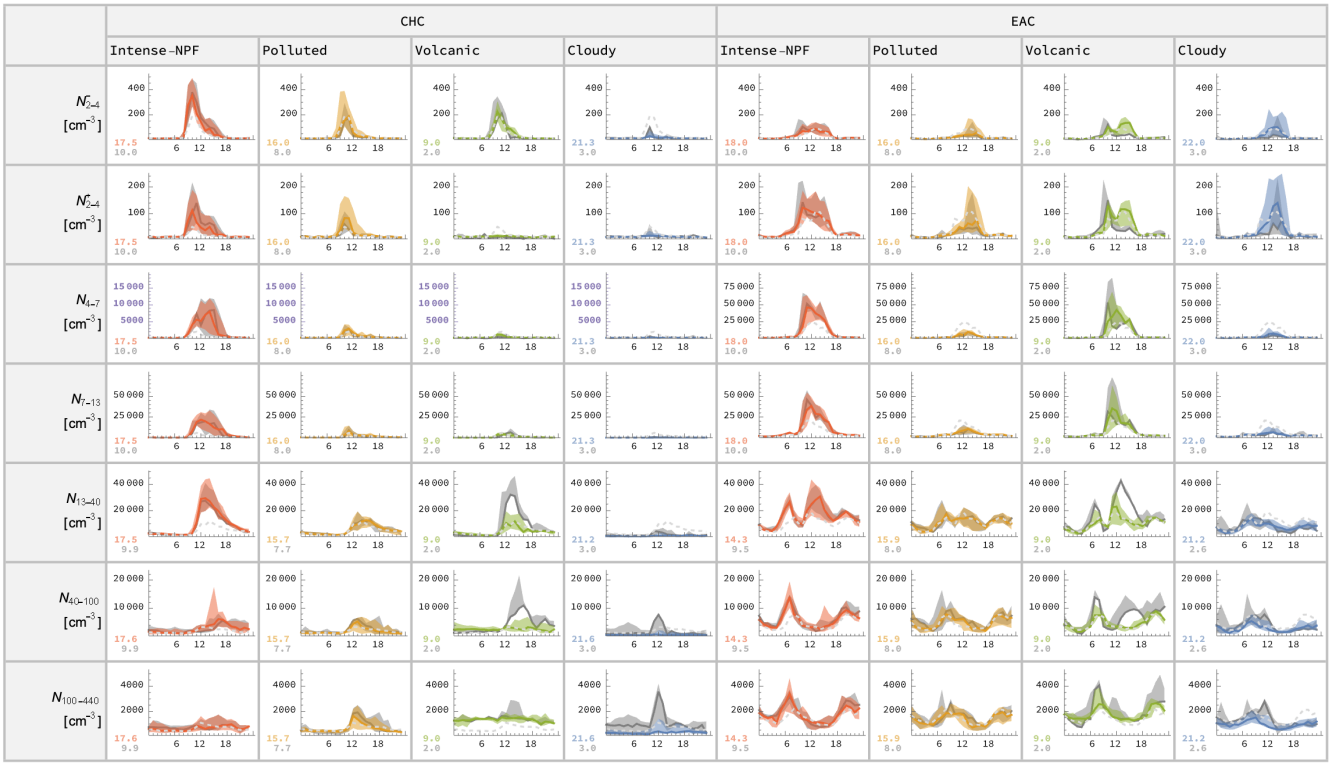


Figure S8: Concentrations of ions or particles at different size ranges grouped by category and station. The full lines are for hourly medians and the shaded areas denote the interquartile range. The dashed grey line is the median of all categories and is shown for comparison. Not all variable observations were available for everyday and therefore we select a subset of days when most relevant parameters (e.g. PNSD, SA, eBC, Sulphate) were sampled and show it in grey for comparison. For an overview of available observations see Figure S7. The coloured (grey) number in the lower left marks the number of available days for the given variable.

Figure S9: Relevant meteorological variables grouped by category and station. The full lines are for hourly medians and the shaded areas denote the interquartile range. The dashed grey line is the median of all categories and is shown for comparison. Not all variable observations were available for everyday and therefore we select a subset of days when most relevant parameters (e.g. PNSD, SA, eBC, Sulphate) were sampled and show it in grey for comparison. For an overview of available observations see Figure S7. The coloured (grey) number in the lower left marks the number of available days for the given variable.

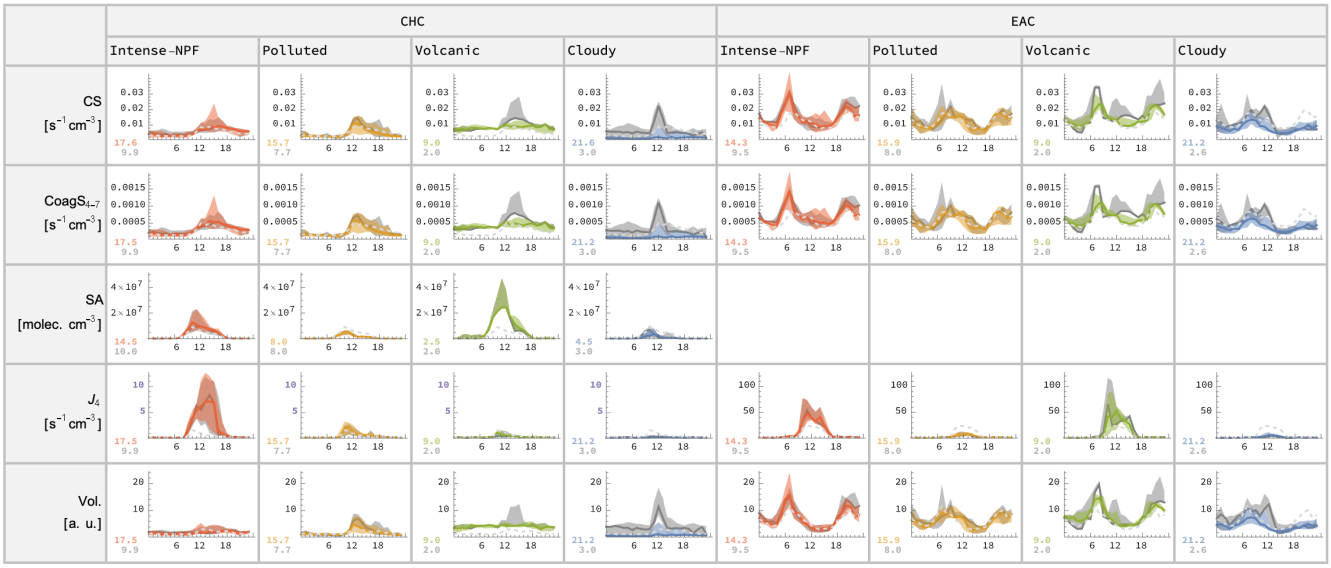


Figure S10: Relevant variables related to NPF grouped by category and station. The full lines are for hourly medians and the shaded areas denote the interquartile range. The dashed grey line is the median of all categories and is shown for comparison. Not all variable observations were available for everyday and therefore we select a subset of days when most relevant parameters (e.g. PNSD, SA, eBC, Sulphate) were sampled and show it in grey for comparison. For an overview of available observations see Figure S7. The coloured (grey) number in the lower left marks the number of available days for the given variable.

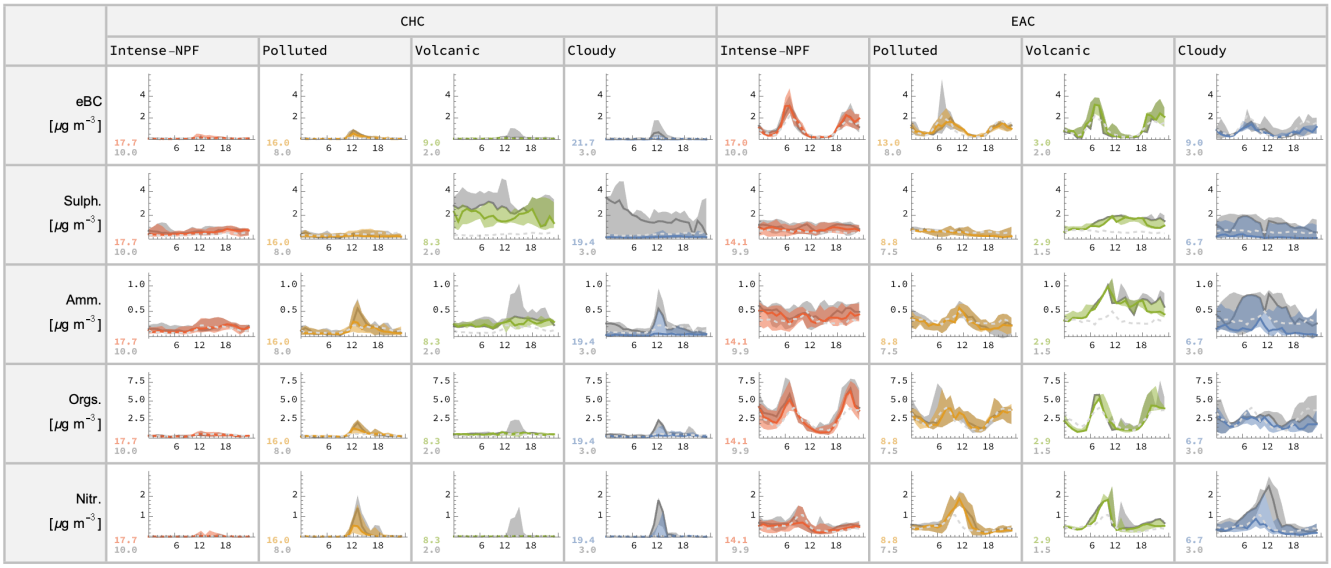


Figure S11: Concentration of aerosols species grouped by category and station. The full lines are for hourly medians and the shaded areas denote the interquartile range. The dashed grey line is the median of all categories and is shown for comparison. Not all variable observations were available for everyday and therefore we select a subset of days when most relevant parameters (e.g. PNSD, SA, eBC, Sulphate) were sampled and show it in grey for comparison. For an overview of available observations see Figure S7. The coloured (grey) number in the lower left marks the number of available days for the given variable.

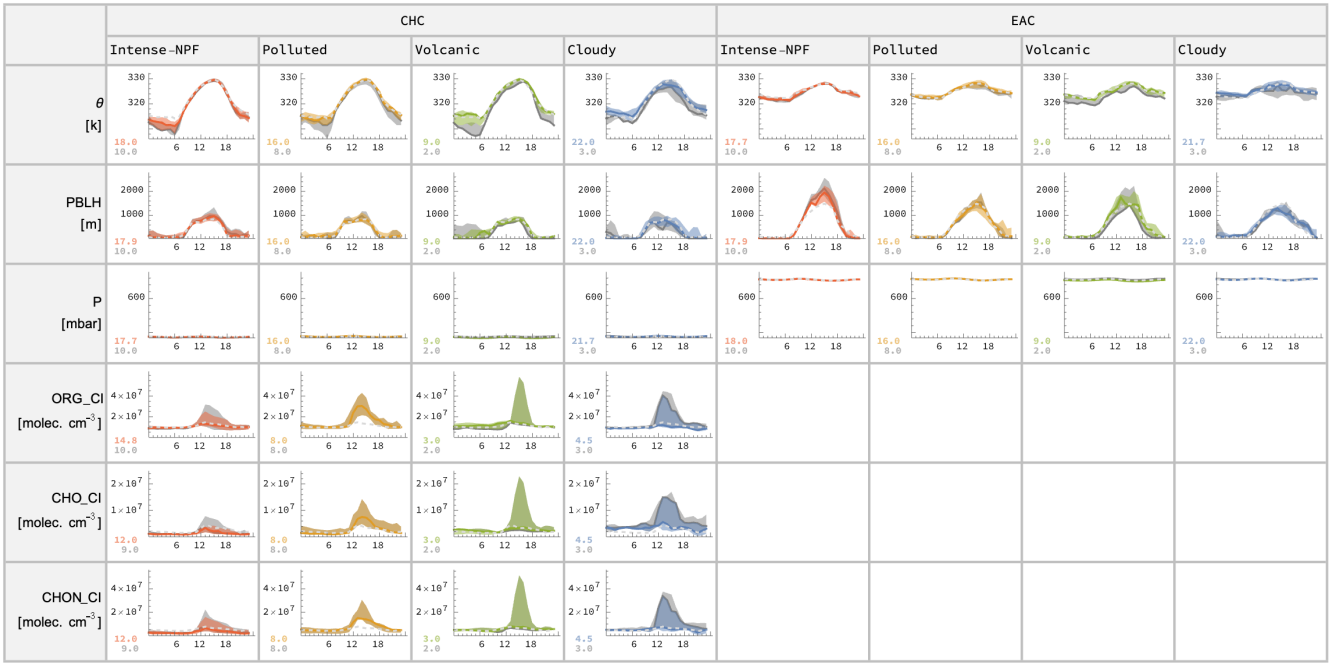
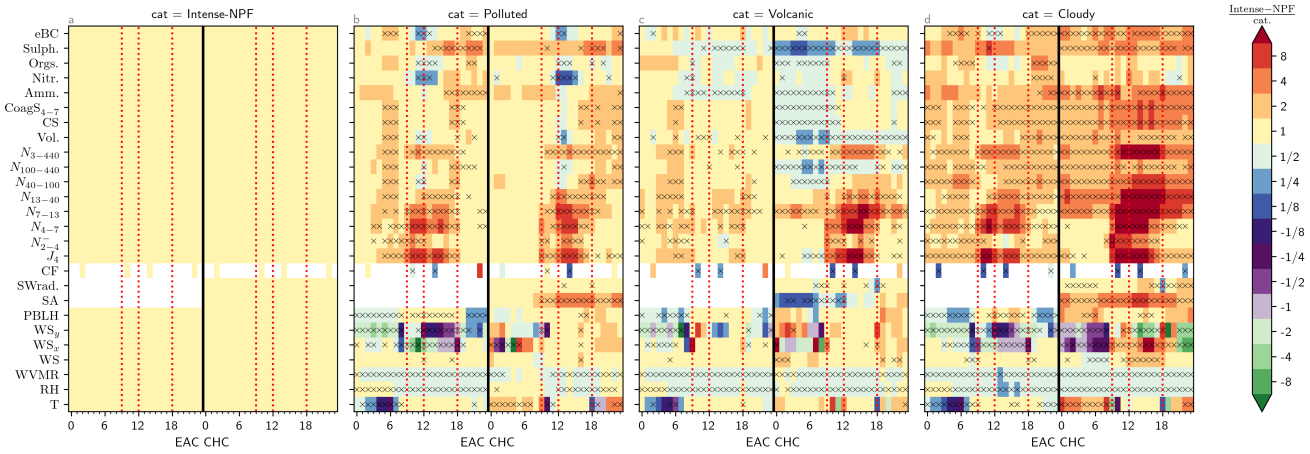
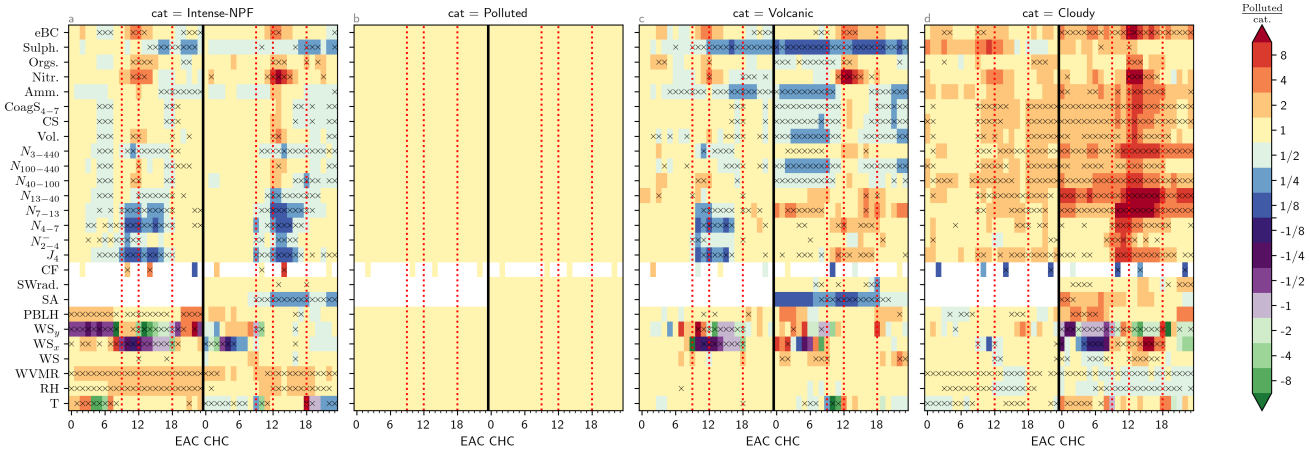


Figure S12: Ancillary variables. The full lines are for hourly medians and the shaded areas denote the interquartile range. The dashed grey line is the median of all categories and is shown for comparison. Not all variable observations were available for everyday and therefore we select a subset of days when most relevant parameters (e.g. PNSD, SA, eBC, Sulphate) were sampled and show it in grey for comparison. For an overview of available observations see Figure S7. The coloured (grey) number in the lower left marks the number of available days for the given variable.



90 **Figure S13: Ratio between median hourly values observed at Intense-NPF category and the other categories for selected variables. The marker "x" denotes that the observed distributions at that hour and variable are significantly different (Mann-Whitney U test, p-value<0.1).**



95

Figure S14: Ratio between median hourly values observed at Polluted category and the other categories for selected variables. The marker "x" denotes that the observed distributions at that hour and variable are significantly different (Mann-Whitney U test, p-value<0.1).

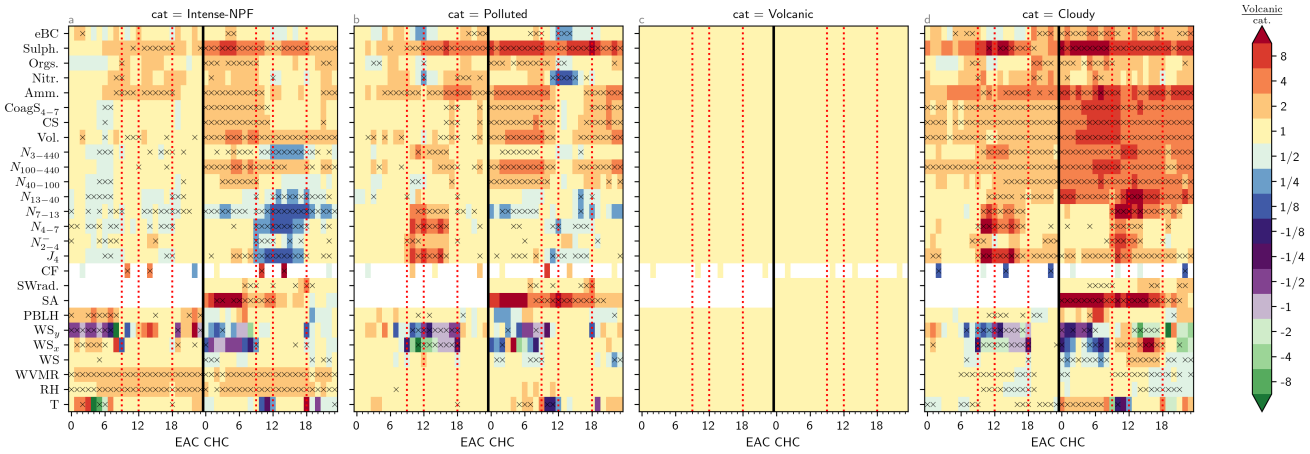


Figure S15: Ratio between median hourly values observed at Volcanic category and the other categories for selected variables. The marker "x" denotes that the observed distributions at that hour and variable are significantly different (Mann-Whitney U test, p-value<0.1).

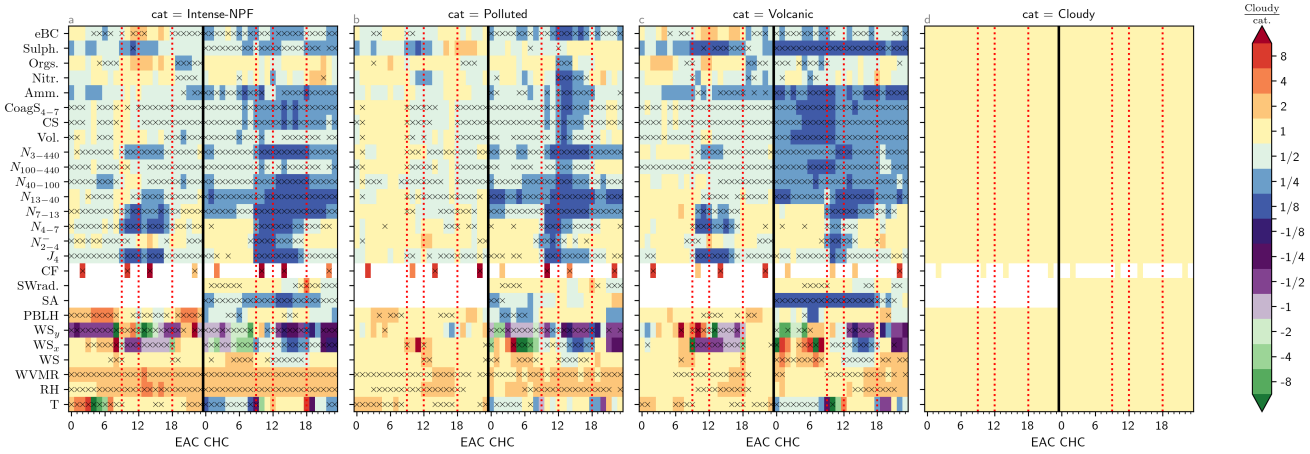


Figure S16: Ratio between median hourly values observed at Cloudy category and the other categories for selected variables. The marker "x" denotes that the observed distributions at that hour and variable are significantly different (Mann-Whitney U test, p-value<0.1).

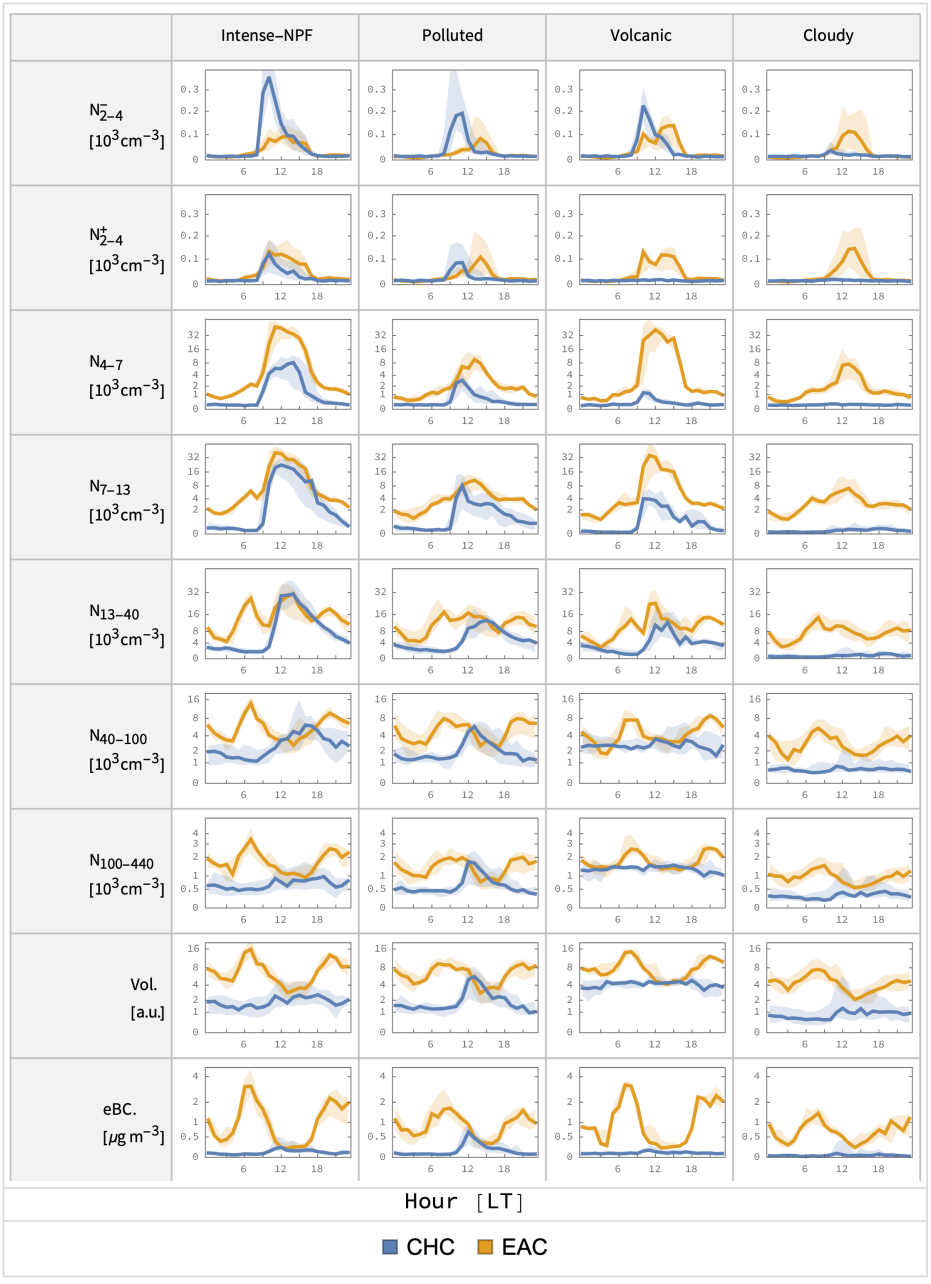


Figure S17: Side by side comparison of selected parameters between CHC and EAC. The solid line stands for the group median and the shaded are the interquartile range.

Supplementary Tables

Growth rates [nm]

		Der.				Max				
		Intense–NPF	Polluted	Volcanic	Cloudy		Intense–NPF	Polluted	Volcanic	Cloudy
CHC	2–4	$6.6^{15.2}_{3.6}$ 15	$7.3^{11.0}_{4.5}$ 15	$5.6^{16.6}_{5.0}$ 8	$10.7^{13.9}_{3.9}$ 8	2–4	$4.3^{9.7}_{3.7}$ 17	$6.4^{7.6}_{3.9}$ 15	$4.7^{6.7}_{4.2}$ 6	$3.9^{6.8}_{3.1}$ 8
	4–7	$7.0^{10.1}_{4.3}$ 16	$6.8^{9.5}_{4.8}$ 15	$6.2^{18.2}_{5.2}$ 8	$7.7^{16.7}_{6.1}$ 8	4–7	$5.0^{8.5}_{3.4}$ 17	$7.8^{9.6}_{4.1}$ 15	$6.2^{7.2}_{5.7}$ 9	$5.6^{7.4}_{5.0}$ 10
	7–13	$7.2^{9.9}_{5.4}$ 17	$7.9^{11.5}_{5.3}$ 16	$7.7^{16.5}_{5.8}$ 9	$11.2^{19.2}_{3.8}$ 8	7–13	$6.0^{7.5}_{5.0}$ 18	$7.8^{10.2}_{4.4}$ 16	$8.0^{8.8}_{6.7}$ 9	$8.9^{14.6}_{4.2}$ 12
	13–40	$7.5^{8.9}_{6.9}$ 16	$9.4^{11.3}_{6.2}$ 15	$9.2^{13.0}_{7.1}$ 9	$6.1^{17.1}_{3.2}$ 7	13–40	$6.8^{8.7}_{4.3}$ 16	$6.2^{10.8}_{3.7}$ 15	$9.3^{10.1}_{7.3}$ 9	$8.1^{11.1}_{3.4}$ 11
EAC	2–4	$6.5^{11.4}_{6.1}$ 11	$10.2^{10.6}_{7.9}$ 5	$7.2^{8.7}_{6.7}$ 3	$6.6^{9.4}_{1.8}$ 3	2–4	$4.9^{7.3}_{3.2}$ 9	$4.5^{12.2}_{4.5}$ 2	$4.1^{4.4}_{4.1}$ 2	$3.1^{13.7}_{3.1}$ 2
	4–7	$9.0^{10.3}_{6.5}$ 12	$7.0^{11.1}_{5.9}$ 6	$7.3^{8.4}_{6.8}$ 4	$5.1^{12.0}_{2.7}$ 3	4–7	$5.7^{9.1}_{2.8}$ 12	$7.2^{9.9}_{5.1}$ 5	$4.6^{5.0}_{4.6}$ 2	$3.4^{18.3}_{3.4}$ 2
	7–13	$7.6^{10.1}_{7.1}$ 12	$9.1^{12.1}_{6.6}$ 8	$7.9^{8.0}_{7.0}$ 4	$5.3^{6.4}_{3.8}$ 4	7–13	$7.8^{8.9}_{6.6}$ 14	$9.5^{12.1}_{6.8}$ 9	$5.6^{6.4}_{3.4}$ 3	$5.8^{10.6}_{5.8}$ 2
	13–40	$9.4^{12.3}_{7.3}$ 11	$13.8^{16.0}_{9.6}$ 11	$8.7^{11.8}_{8.2}$ 5	$7.4^{8.1}_{4.7}$ 4	13–40	$9.3^{9.8}_{5.7}$ 13	$11.8^{13.5}_{9.9}$ 10	$9.2^{11.3}_{6.3}$ 5	$7.3^{11.5}_{5.3}$ 3

Table S1. Growth rates grouped by category and station at different size ranges (nm) using two methods: maximum concentration (Max) and maximum of the time derivative of the concentration (Der.). Each entry shows the median value of the variable; first (Q1) and third (Q3) quartiles are denoted as subscripts and superscripts, respectively; the number on the right indicates the amounts of days when GR was detected at the specific size range.

125

Time of growing mode

		Der.					Max			
		Intense–NPF	Polluted	Volcanic	Cloudy		Intense–NPF	Polluted	Volcanic	Cloudy
CHC	2–4	09:18 / 08:51 (08:28) 15	09:39 / 09:01 (08:24) 15	09:22 / 08:55 (08:42) 8	09:44 / 09:27 (09:11) 8	2–4	11:12 / 10:40 (10:15) 17	11:03 / 10:17 (10:06) 15	10:37 / 10:19 (10:04) 6	10:45 / 10:24 (09:50) 8
	4–7	09:30 / 09:14 (08:58) 16	09:57 / 09:34 (08:46) 15	09:33 / 09:20 (08:59) 8	10:12 / 09:39 (09:29) 8	4–7	11:30 / 11:22 (10:35) 17	11:19 / 10:58 (10:22) 15	10:59 / 10:51 (10:40) 9	11:19 / 11:03 (10:36) 10
	7–13	10:13 / 09:52 (09:31) 17	10:31 / 10:14 (09:29) 16	10:34 / 09:46 (09:34) 9	10:45 / 10:32 (09:47) 8	7–13	12:26 / 11:52 (11:18) 18	12:06 / 11:38 (10:54) 16	12:12 / 11:26 (11:13) 9	12:17 / 11:30 (10:52) 12
	13–40	12:10 / 11:22 (10:45) 16	11:45 / 11:17 (10:43) 15	11:51 / 11:29 (10:41) 9	13:20 / 11:00 (10:14) 7	13–40	14:13 / 13:53 (13:07) 16	13:26 / 12:32 (11:52) 15	13:40 / 12:52 (11:57) 9	14:22 / 13:21 (11:12) 11
	40–100	14:35 / 13:32 (13:30) 6	1	14:34 / 13:29 (12:31) 4	0	40–100	18:10 / 15:14 (15:09) 6	0	16:27 / 15:09 (14:42) 3	1
EAC	2–4	09:56 / 09:27 (08:56) 11	09:45 / 09:38 (09:38) 5	09:09 / 09:01 (08:42) 3	11:04 / 10:29 (10:03) 3	2–4	11:36 / 11:02 (10:17) 9	10:50 / 10:48 (10:48) 2	10:20 / 10:12 (10:12) 2	13:38 / 12:11 (12:11) 2
	4–7	09:55 / 09:47 (09:20) 12	11:23 / 09:58 (09:52) 6	09:28 / 09:24 (08:59) 4	11:38 / 11:27 (10:20) 3	4–7	12:37 / 11:29 (11:06) 12	13:25 / 12:48 (11:21) 5	10:54 / 10:44 (10:44) 2	13:47 / 12:58 (12:58) 2
	7–13	10:31 / 10:08 (09:51) 12	12:33 / 10:39 (10:24) 8	10:04 / 10:03 (09:32) 4	12:24 / 10:34 (10:00) 4	7–13	13:29 / 12:07 (11:49) 14	13:21 / 12:37 (11:57) 9	11:48 / 11:31 (10:38) 3	14:04 / 13:56 (13:56) 2
	13–40	12:26 / 11:54 (11:34) 11	13:29 / 11:52 (11:26) 11	11:39 / 11:33 (11:16) 5	12:52 / 10:56 (10:40) 4	13–40	13:57 / 13:46 (13:27) 13	14:32 / 13:35 (12:47) 10	13:54 / 13:14 (12:56) 5	14:35 / 13:55 (11:50) 3
	40–100	14:05 / 13:58 (13:25) 5	14:27 / 12:41 (10:47) 3	1	1	40–100	16:28 / 15:13 (14:35) 3	15:57 / 14:23 (11:38) 3	15:53 / 15:45 (14:34) 3	0

Table S2. Time when the growing mode was observed grouped by category and station at different size ranges (nm) using two methods: maximum concentration (Max) and maximum of the time derivative of the concentration (Der.). Each entry shows the median value of the variable; first (Q1) and third (Q3) quartiles are denoted as subscripts and superscripts, respectively; the number on the right indicates the amounts of days when GR was detected at the specific size range. The Der. method systematically and expectedly detects the mode earlier in the day when compared to the Max method.

130