



Supplement of

Ion and particle size distribution measurements in the Indo-Gangetic Plain: seasonal insights and challenges in new particle formation event characterization

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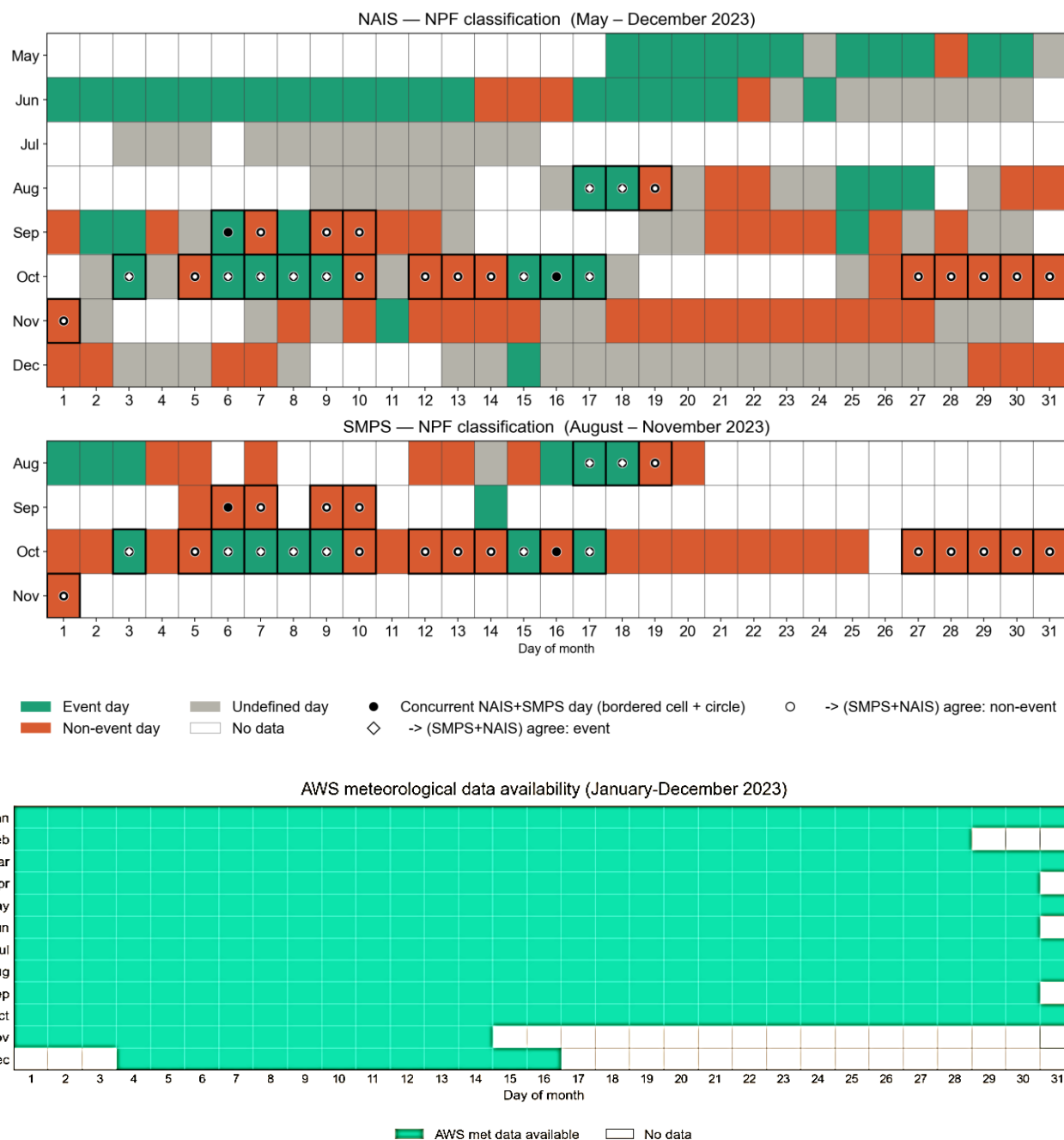


Figure S1: NAIS, SMPS and AWS data availability. For NAIS and SMPS, event and non-event days are marked for the whole study period.

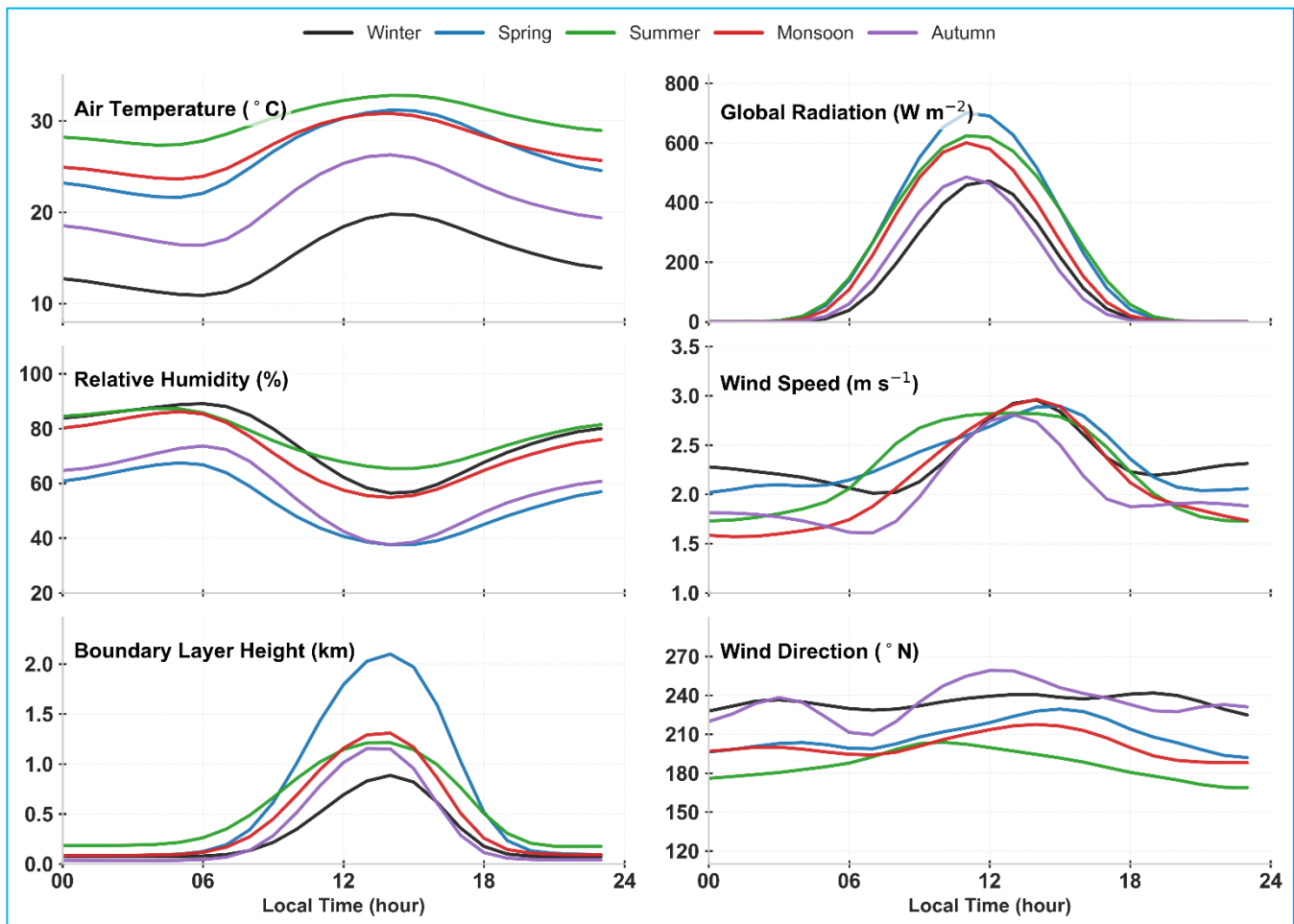


Figure S2: Diurnal profiles of meteorological parameters (temperature, relative humidity, Boundary layer height, global radiation, wind speed and wind direction) by season. Average values by season and hour of day are presented for all parameters except wind direction. The median value is presented for wind direction.

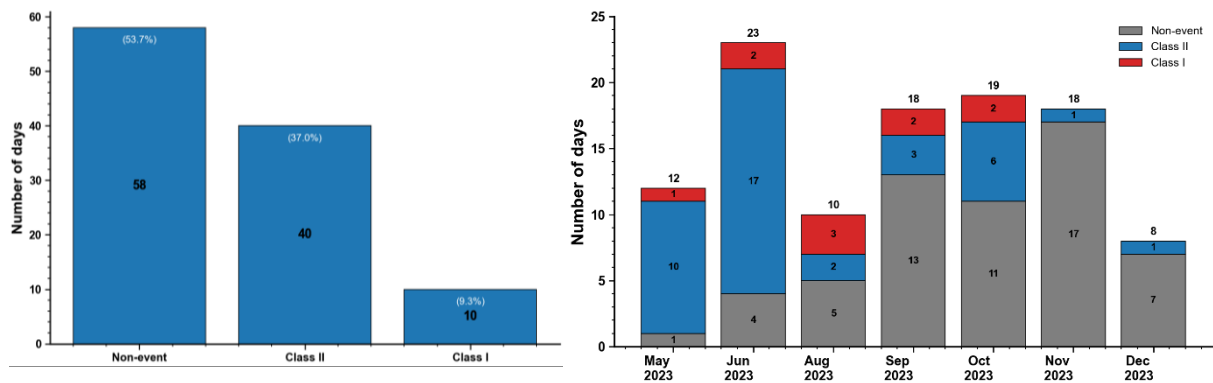


Figure S3: Dal Maso et. al, 2005 classification with absolute numbers.

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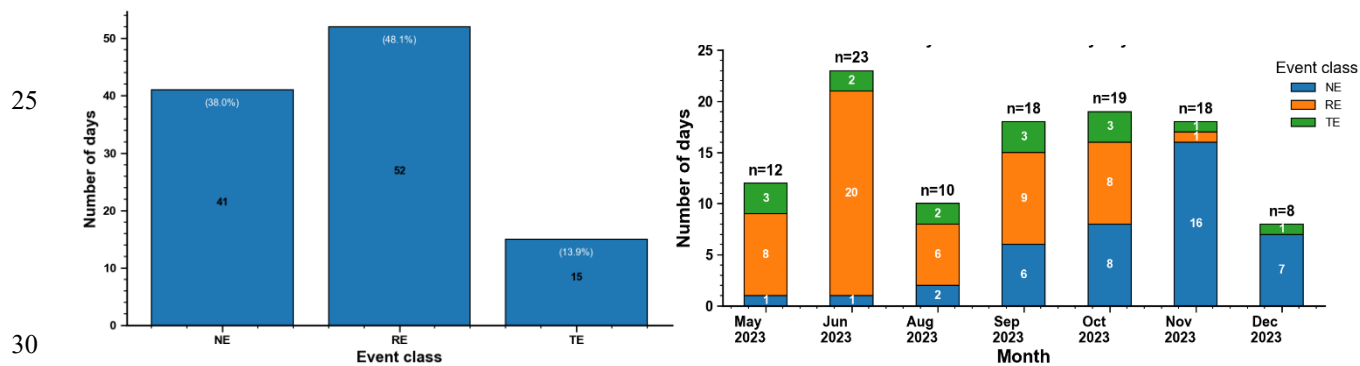


Figure S4: Dada et. al, 2018 classification with absolute numbers.

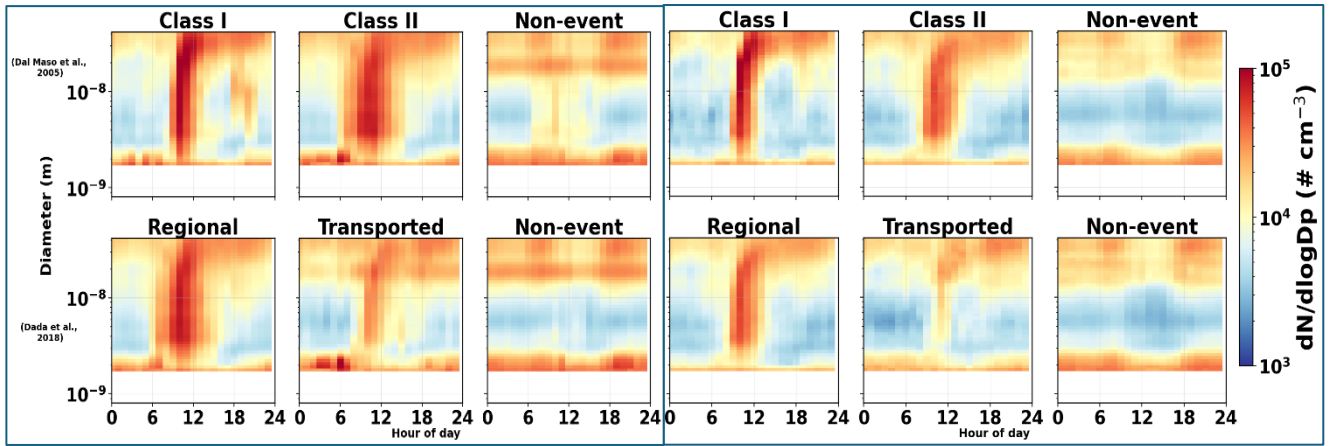


Figure S5: Mean (Left panel), Median (Right panel) particle size distributions (cm^{-3}) defined by two classification methods. Top panels (Dal Maso et al., 2005): Class I, Class II, and Non-event days. Below panels (Dada et al., 2018): Regional, Transported, and Non-event days. Data are aggregated over all days belonging to each class, showing the typical diurnal evolution of the aerosol size distribution for the different event types.

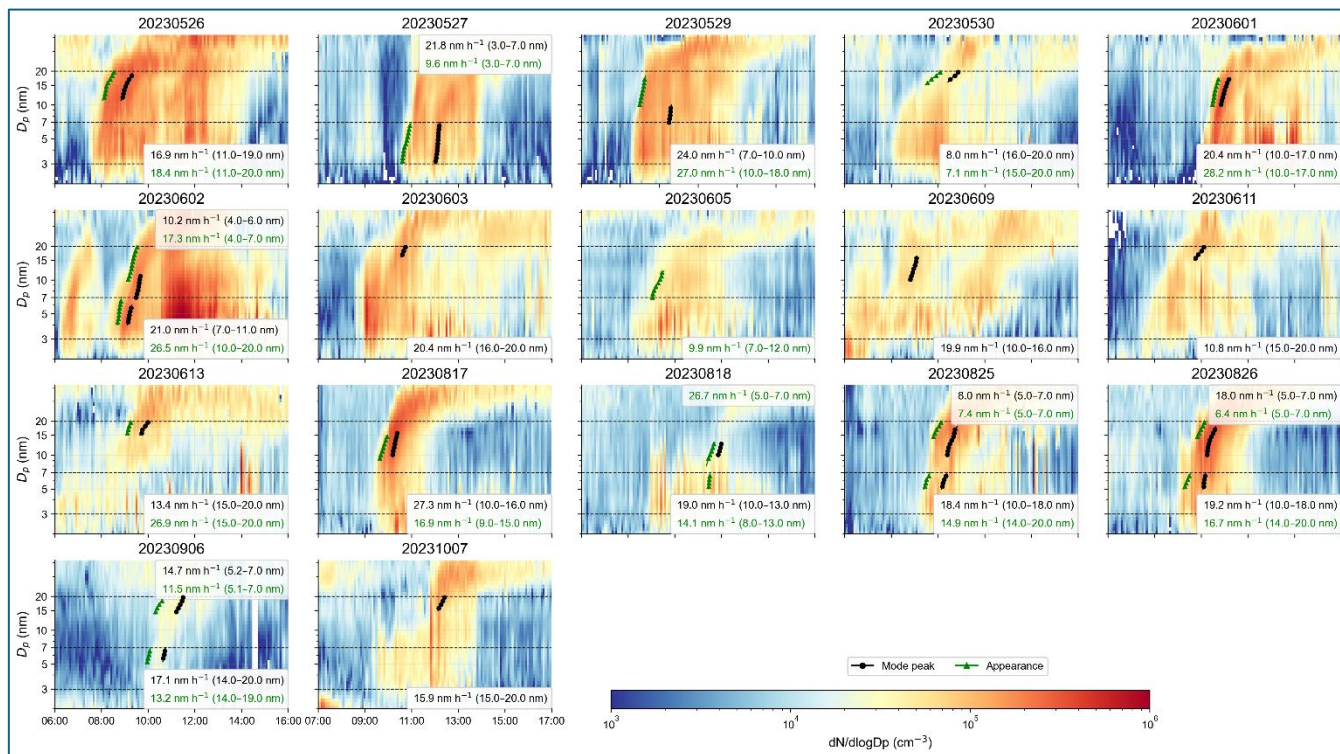
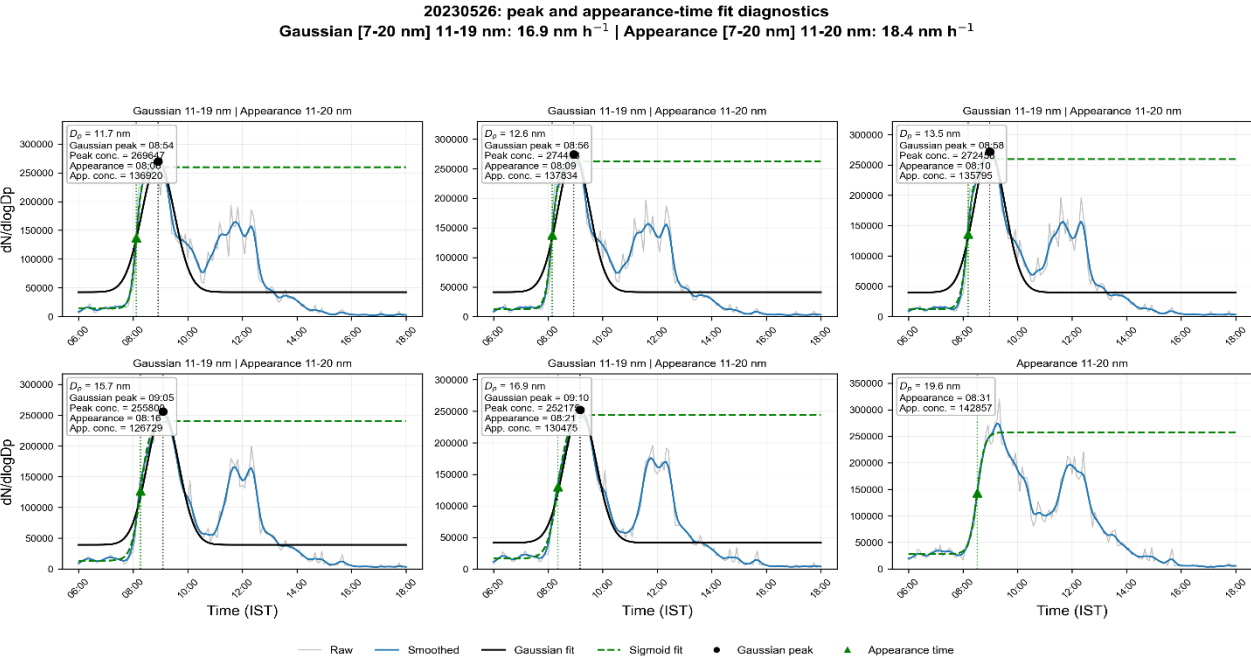
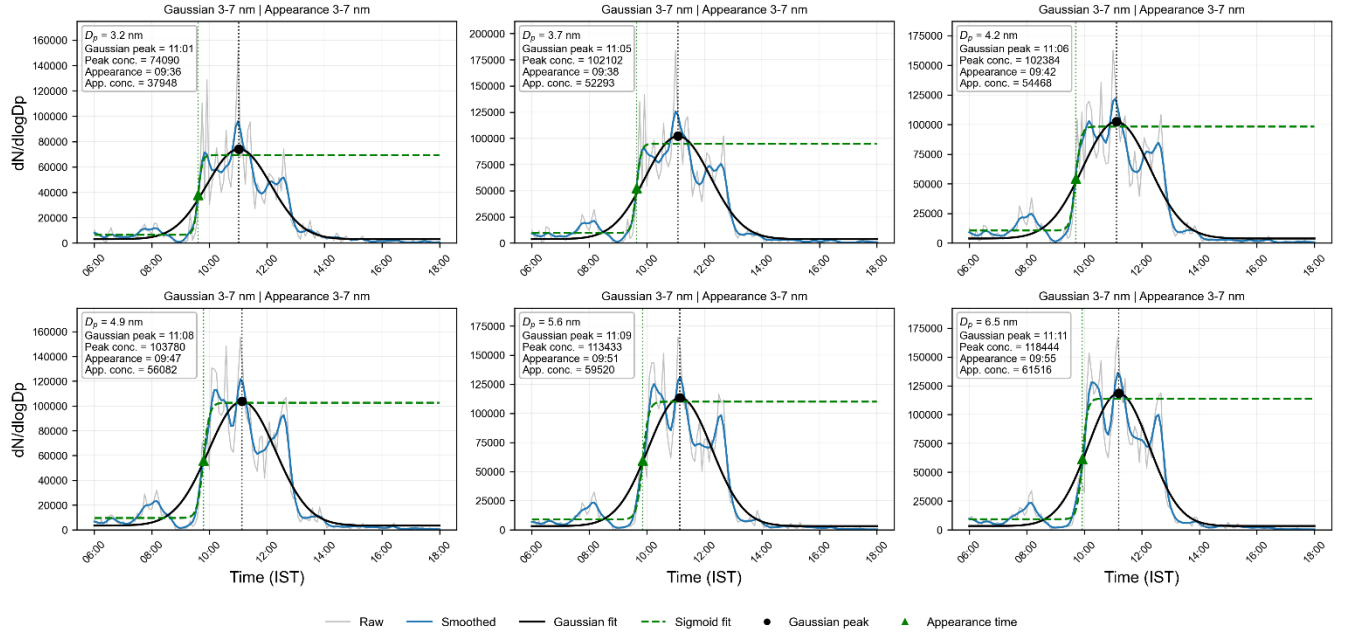


Figure S6. Individual day growth rate calculation for maximum concentration and appearance time method. Influence of different factors can be observed in addition to NPF signatures.

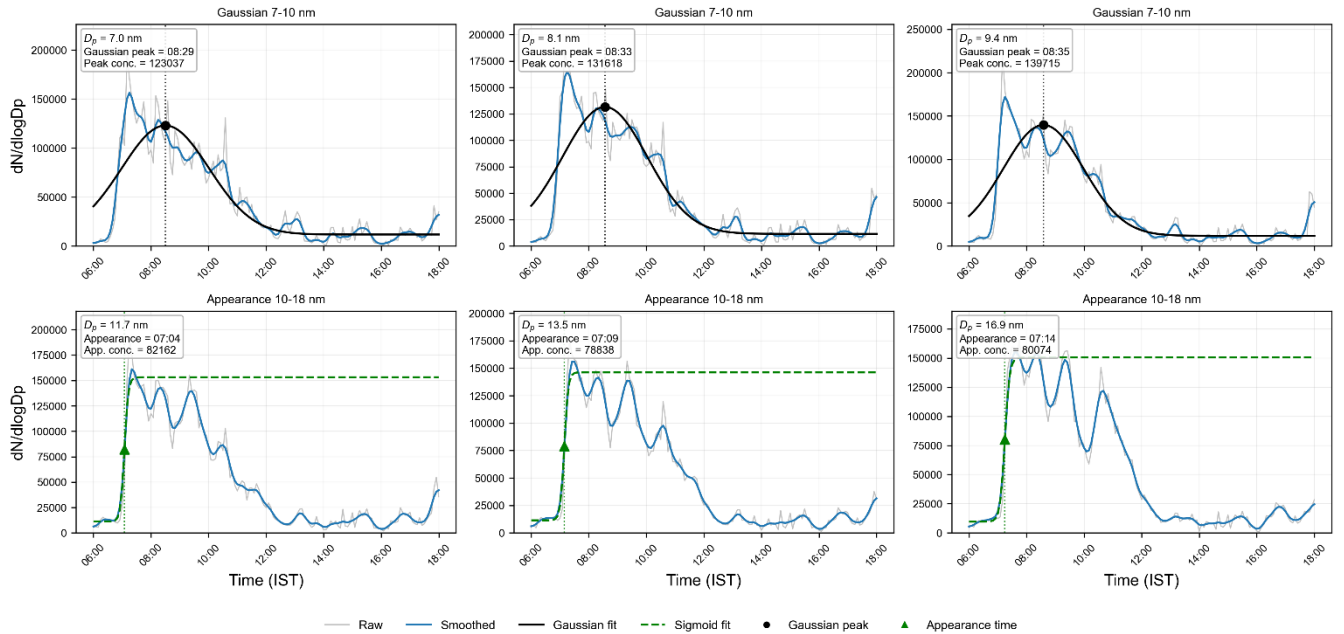
Figure S7: Event-wise GR fitting diagnostics for the 17 NAIS event days for which at least one reliable GR estimate was obtained. Panels show the particle number size distribution together with the fitted appearance-time and/or Gaussian mode-peak points used in the GR calculation. Annotated lines indicate the fitted diameter ranges and corresponding GR values, allowing visual assessment of whether the fitted feature represents coherent particle growth or plume-like variability.



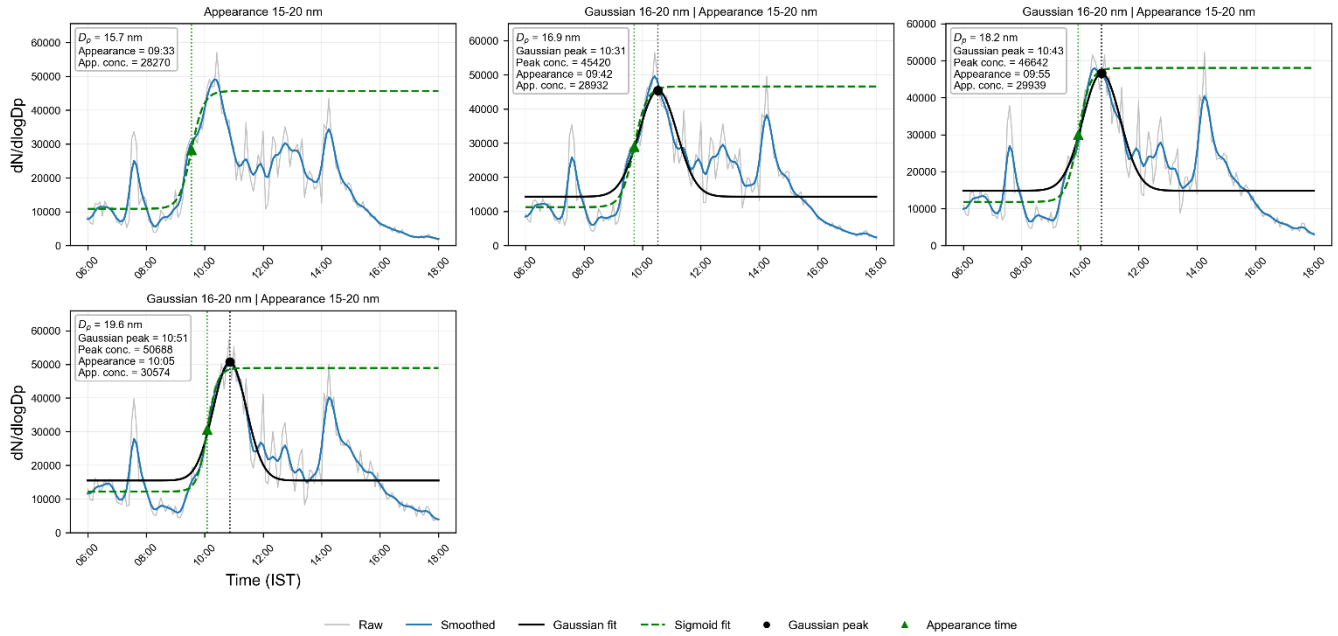
20230527: peak and appearance-time fit diagnostics
Gaussian [3-7 nm] 3-7 nm: 21.8 nm h⁻¹ | Appearance [3-7 nm] 3-7 nm: 9.6 nm h⁻¹



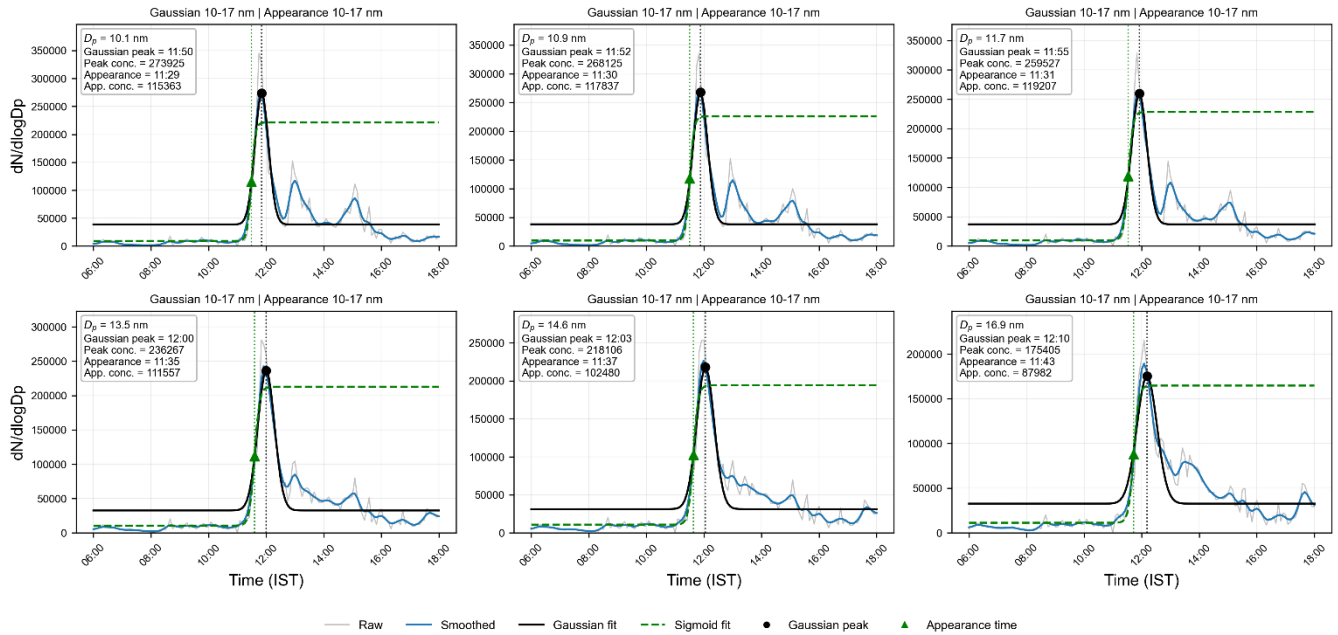
20230529: peak and appearance-time fit diagnostics
Gaussian [7-20 nm] 7-10 nm: 24.0 nm h⁻¹ | Appearance [7-20 nm] 10-18 nm: 27.0 nm h⁻¹



20230530: peak and appearance-time fit diagnostics
Gaussian [7-20 nm] 16-20 nm: 8.0 nm h⁻¹ | Appearance [7-20 nm] 15-20 nm: 7.1 nm h⁻¹

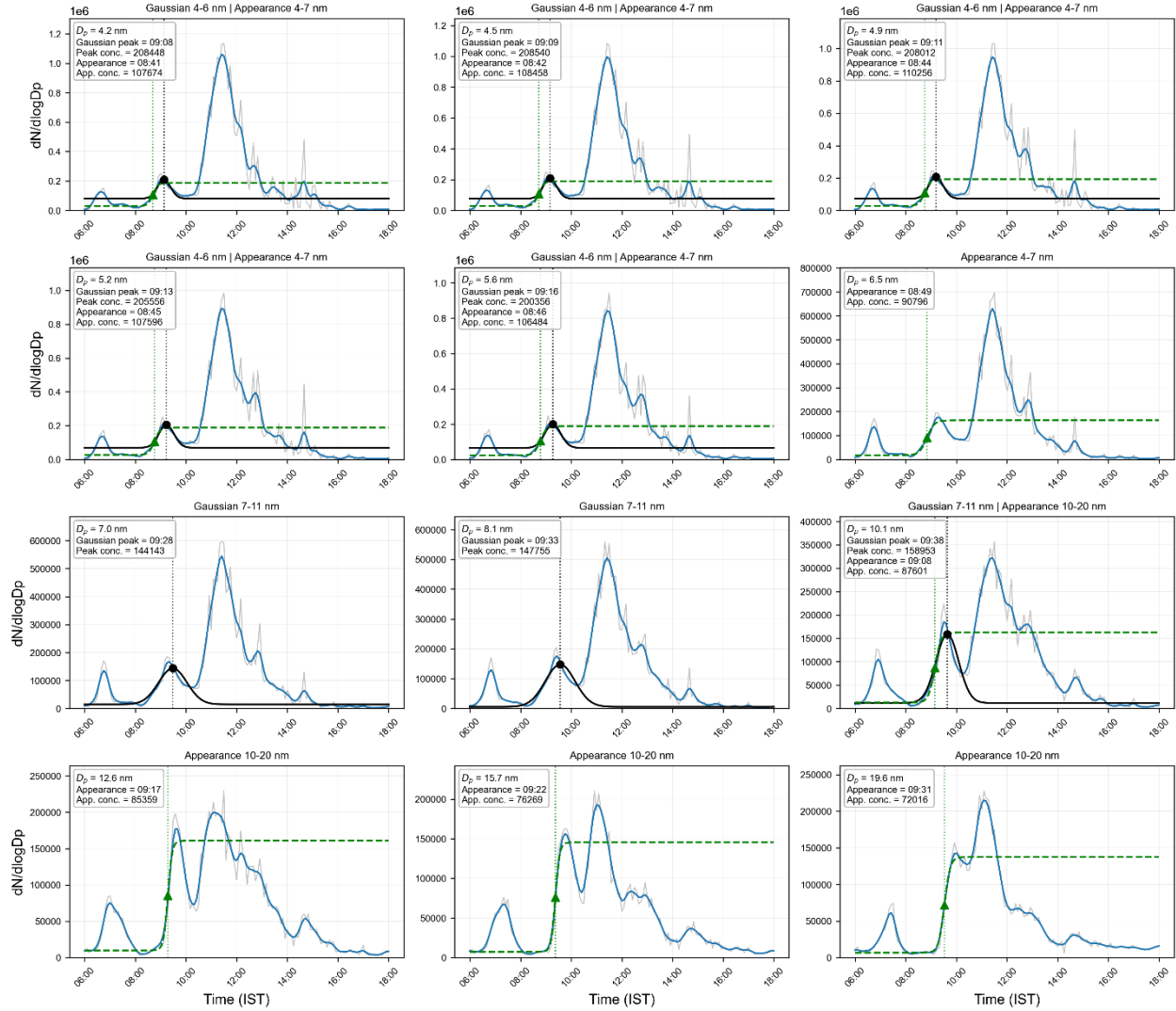


20230601: peak and appearance-time fit diagnostics
Gaussian [7-20 nm] 10-17 nm: 20.4 nm h⁻¹ | Appearance [7-20 nm] 10-17 nm: 28.2 nm h⁻¹



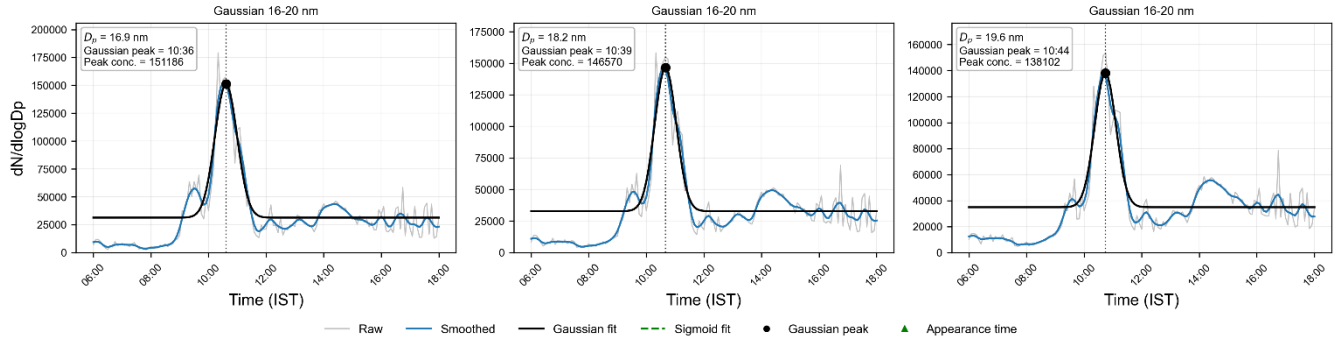
20230602: peak and appearance-time fit diagnostics

Gaussian [3-7 nm] 4-6 nm: 10.2 nm h⁻¹ | Appearance [3-7 nm] 4-7 nm: 17.3 nm h⁻¹ | Gaussian [7-20 nm] 7-11 nm: 21.0 nm h⁻¹ | Appearance [7-20 nm] 10-20 nm: 26.5 nm h⁻¹

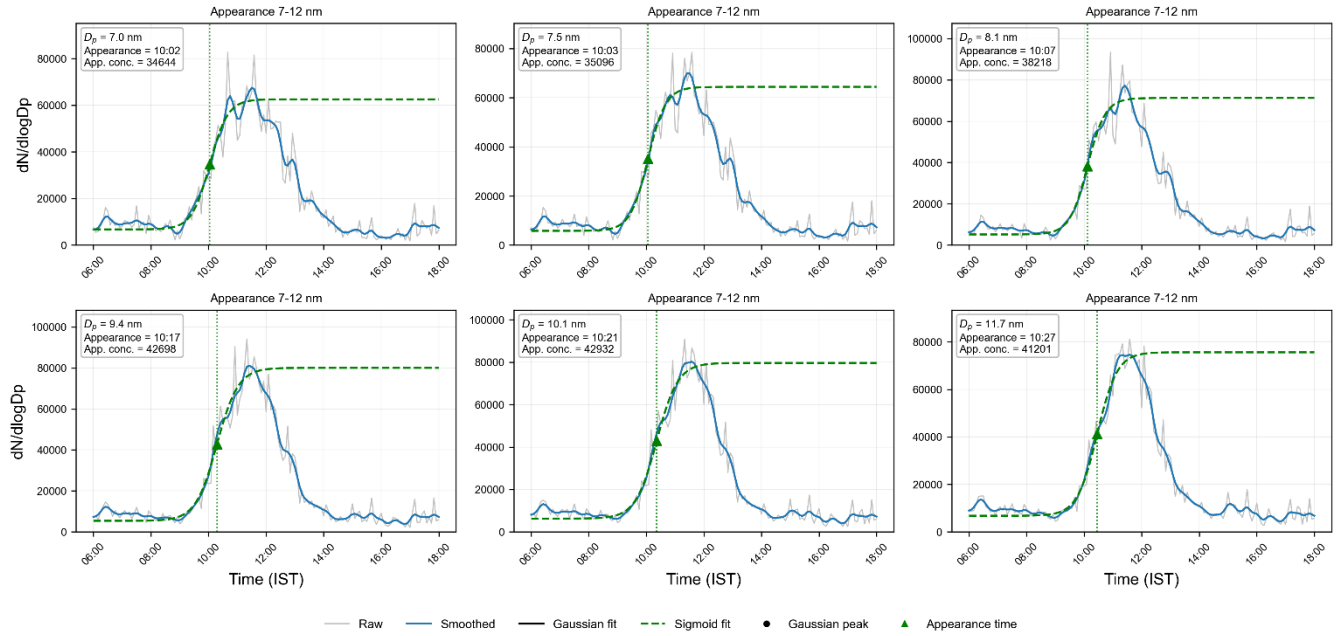


— Raw — Smoothed — Gaussian fit — Sigmoid fit • Gaussian peak ▲ Appearance time

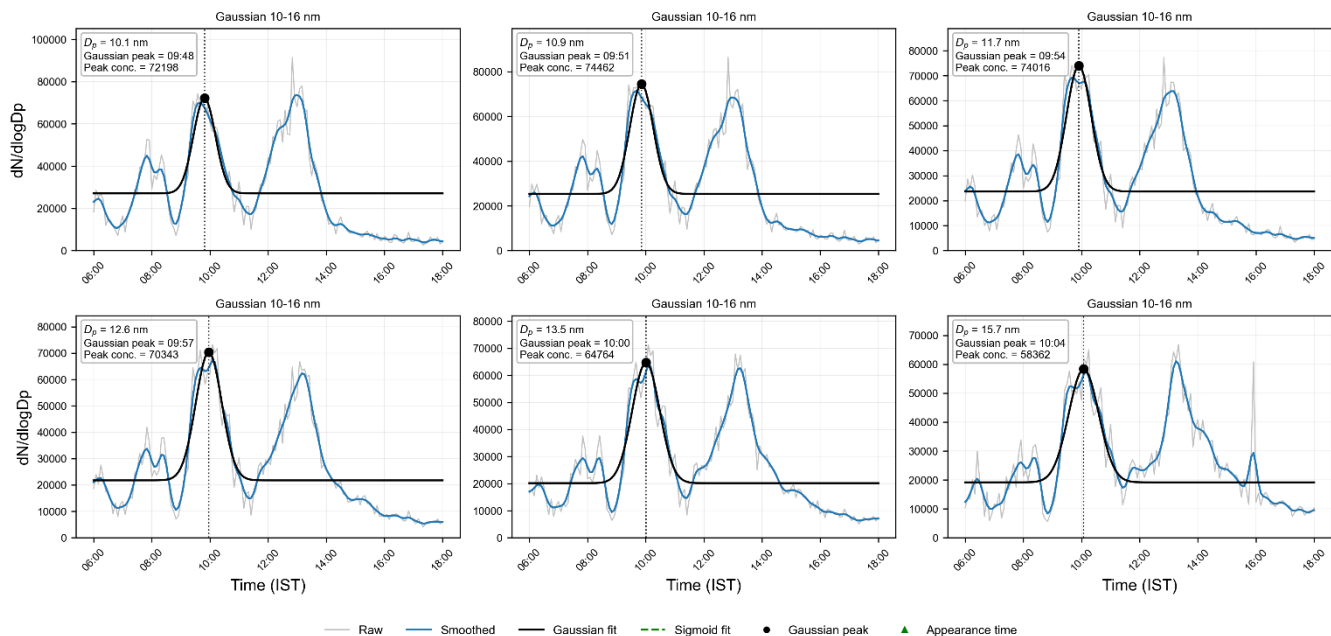
20230603: peak and appearance-time fit diagnostics
Gaussian [7-20 nm] 16-20 nm: 20.4 nm h⁻¹



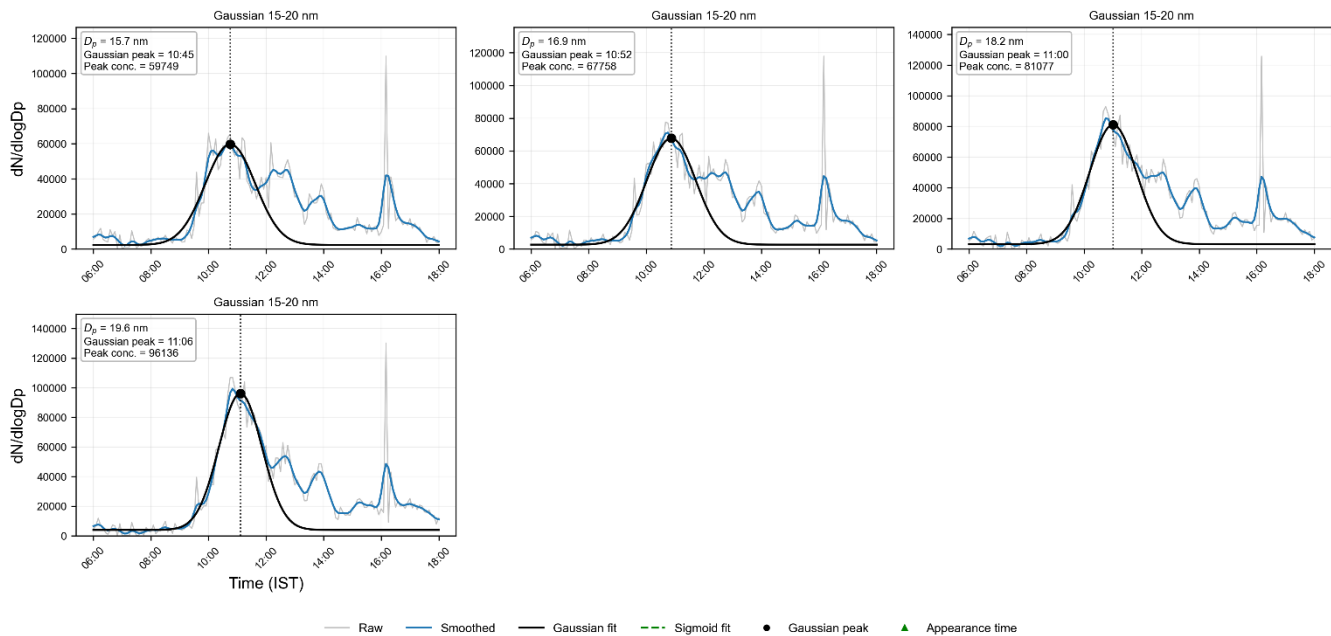
20230605: peak and appearance-time fit diagnostics
Appearance [7-20 nm] 7-12 nm: 9.9 nm h⁻¹



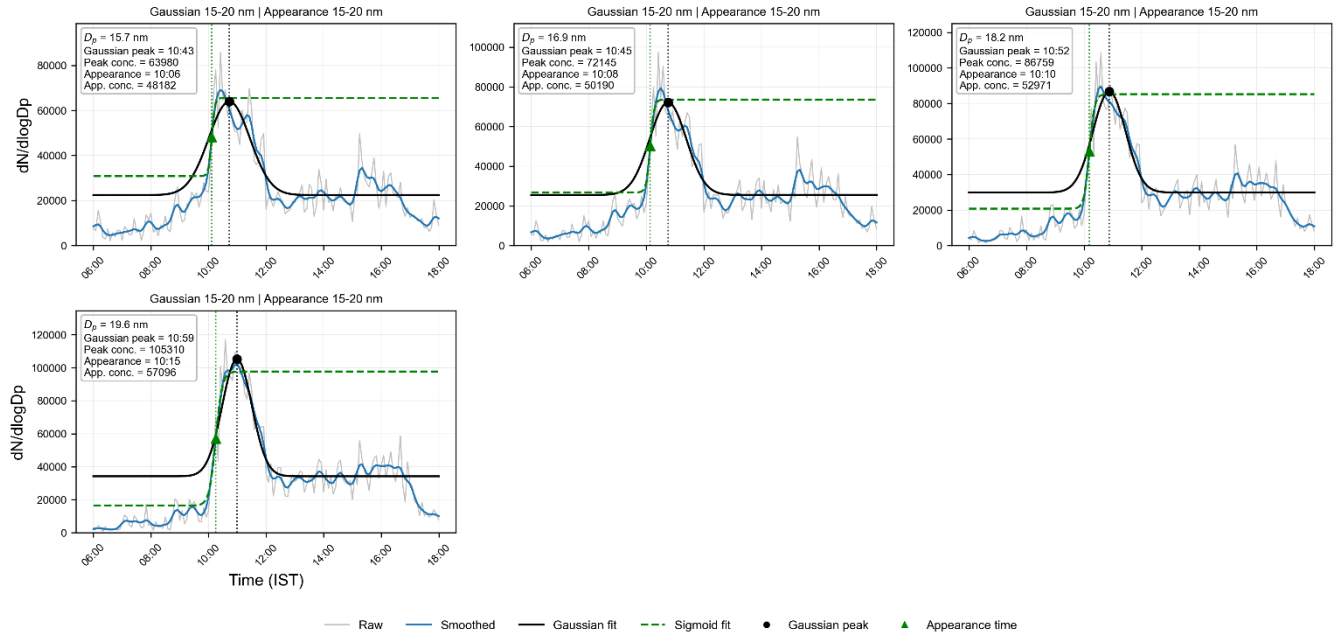
20230609: peak and appearance-time fit diagnostics
Gaussian [7-20 nm] 10-16 nm: 19.9 nm h⁻¹



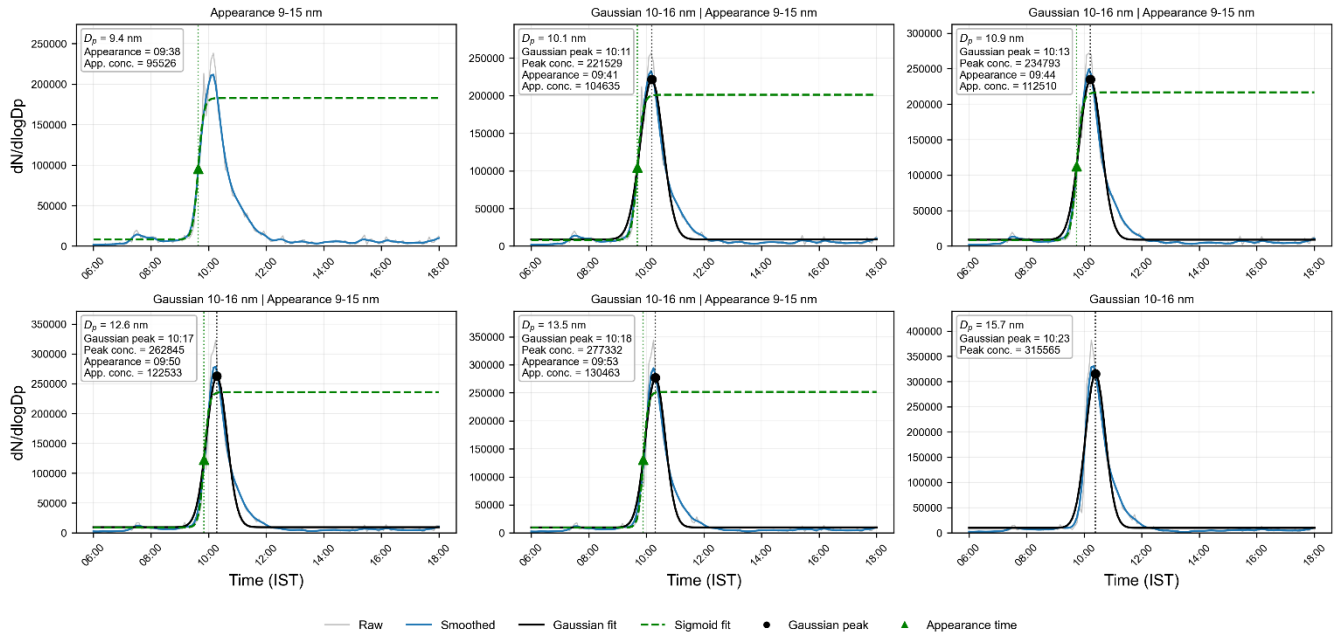
20230611: peak and appearance-time fit diagnostics
Gaussian [7-20 nm] 15-20 nm: 10.8 nm h⁻¹



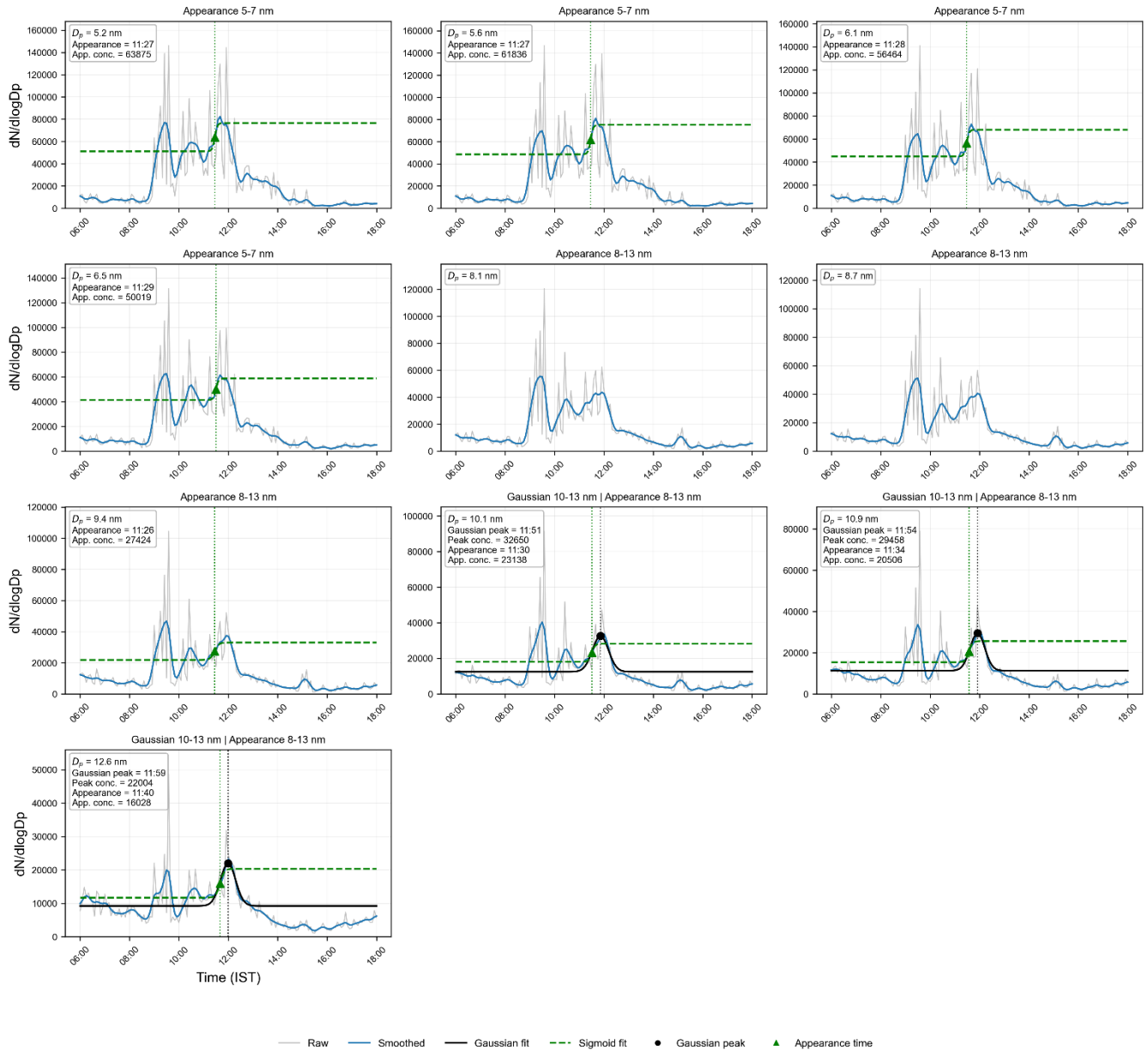
20230613: peak and appearance-time fit diagnostics
Gaussian [7-20 nm] 15-20 nm: 13.4 nm h⁻¹ | Appearance [7-20 nm] 15-20 nm: 26.9 nm h⁻¹



20230817: peak and appearance-time fit diagnostics
Gaussian [7-20 nm] 10-16 nm: 27.3 nm h⁻¹ | Appearance [7-20 nm] 9-15 nm: 16.9 nm h⁻¹

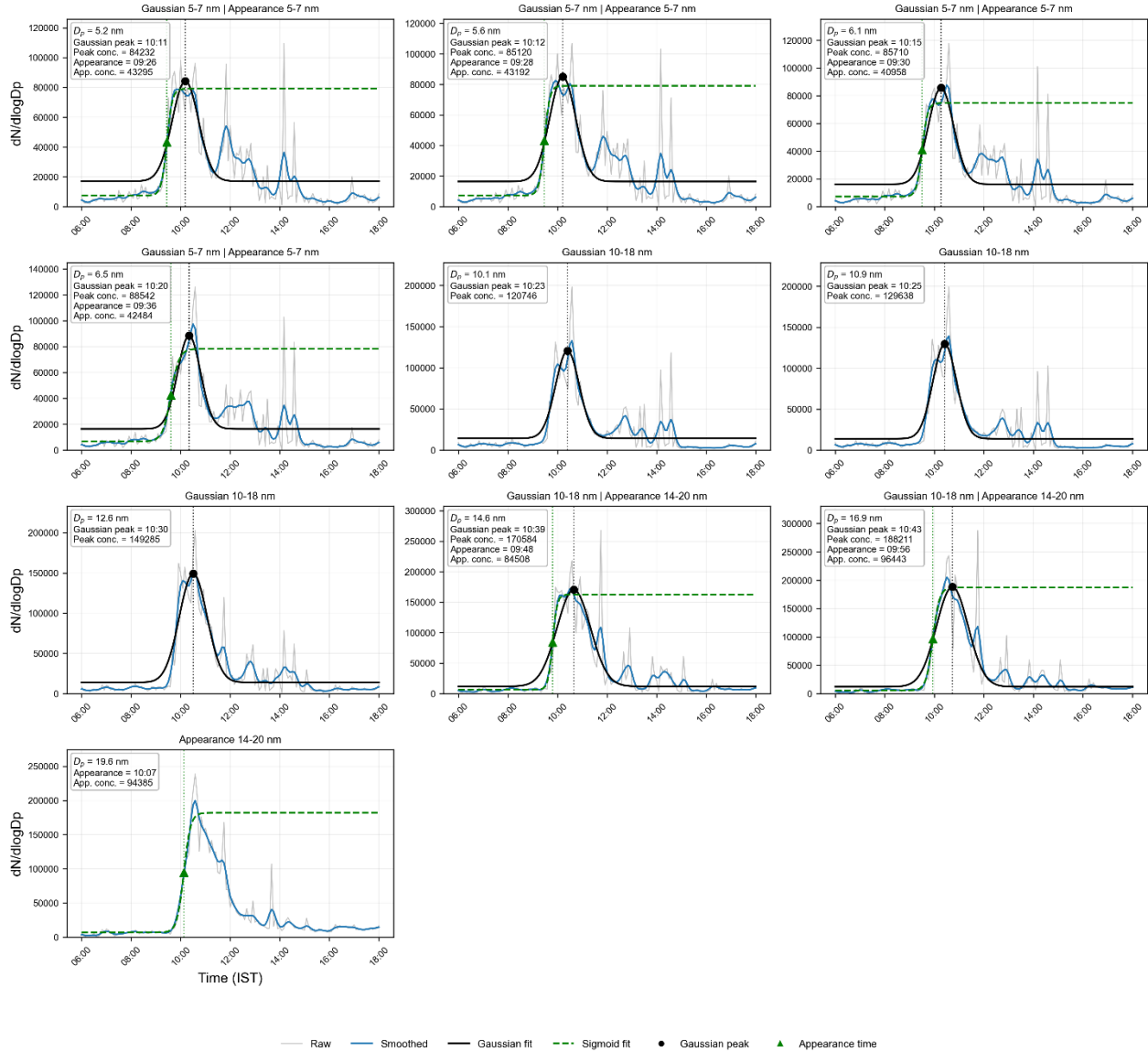


20230818: peak and appearance-time fit diagnostics
 Appearance [3-7 nm] 5-7 nm: 26.7 nm h⁻¹ | Gaussian [7-20 nm] 10-13 nm: 19.0 nm h⁻¹ | Appearance [7-20 nm] 8-13 nm: 14.1 nm h⁻¹



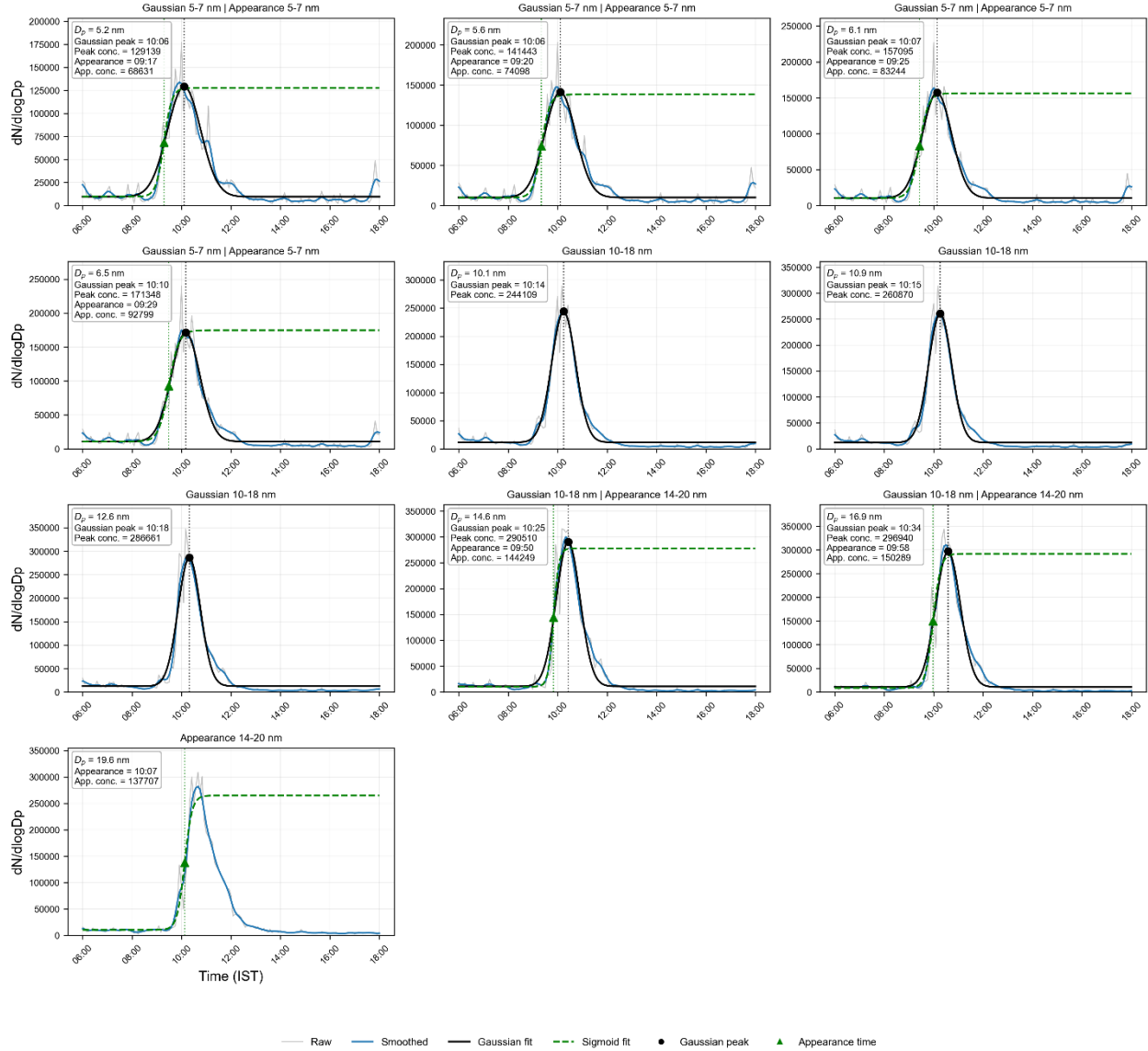
20230825: peak and appearance-time fit diagnostics

Gaussian [3-7 nm] 5-7 nm: 8.0 nm h⁻¹ | Appearance [3-7 nm] 5-7 nm: 7.4 nm h⁻¹ | Gaussian [7-20 nm] 10-18 nm: 18.4 nm h⁻¹ | Appearance [7-20 nm] 14-20 nm: 14.9 nm h⁻¹

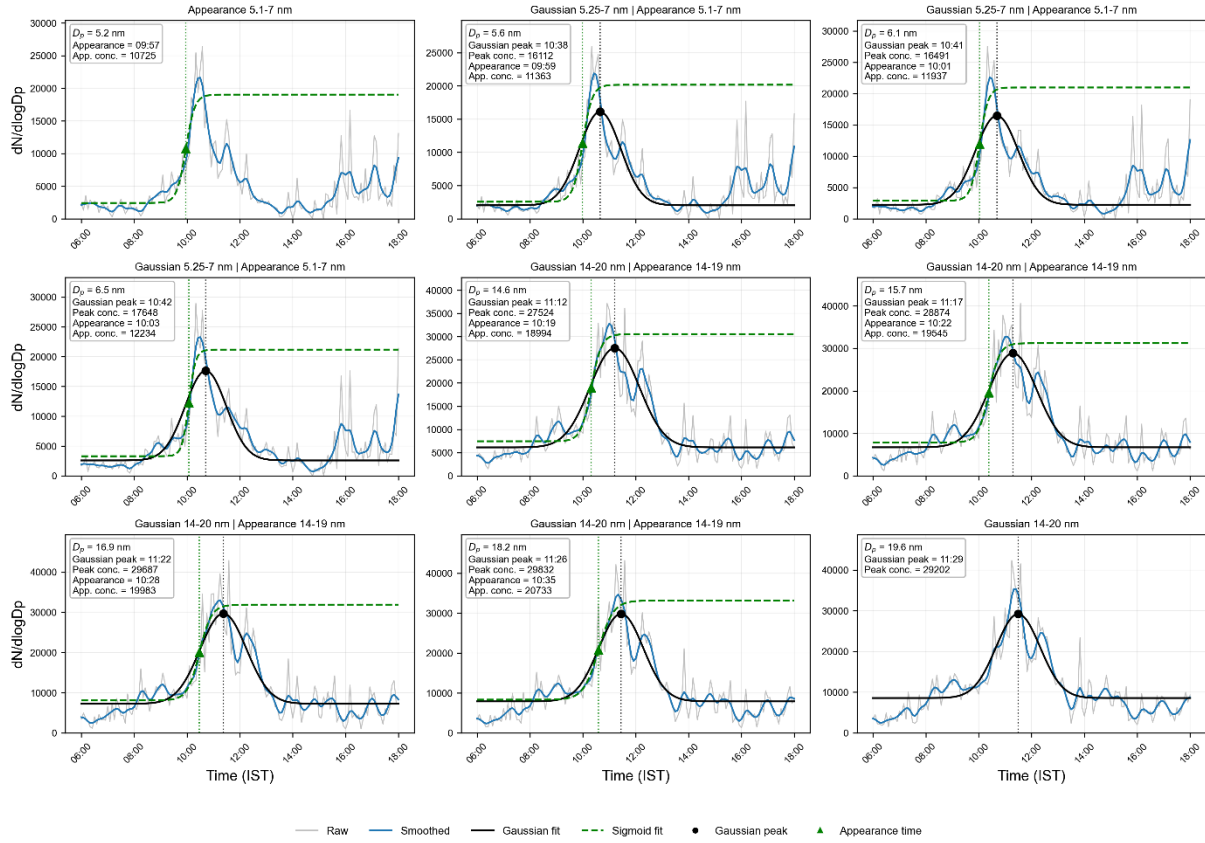


20230826: peak and appearance-time fit diagnostics

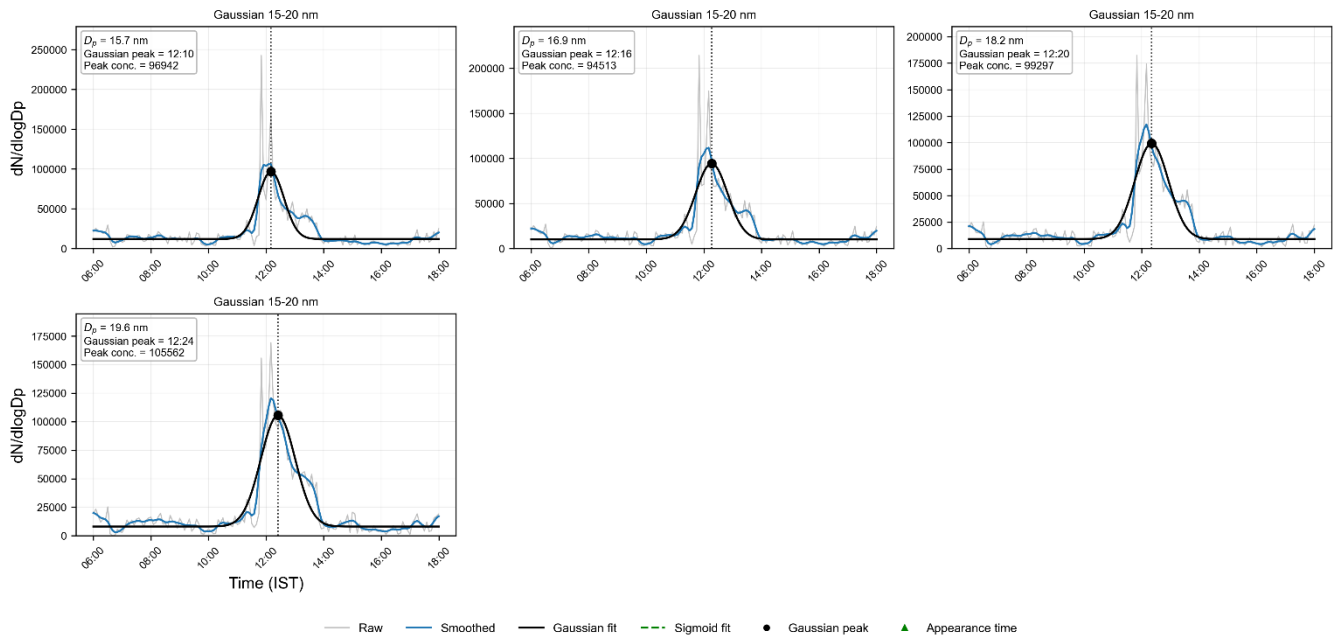
Gaussian [3-7 nm] 5-7 nm: 18.0 nm h⁻¹ | Appearance [3-7 nm] 5-7 nm: 6.4 nm h⁻¹ | Gaussian [7-20 nm] 10-18 nm: 19.2 nm h⁻¹ | Appearance [7-20 nm] 14-20 nm: 16.7 nm h⁻¹



Gaussian [3-7 nm] 5.25-7 nm: 14.7 nm h⁻¹ | Appearance [3-7 nm] 5.1-7 nm: 11.5 nm h⁻¹ | Gaussian [7-20 nm] 14-20 nm: 17.1 nm h⁻¹ | Appearance [7-20 nm] 14-19 nm: 13.2 nm h⁻¹



20231007: peak and appearance-time fit diagnostics
Gaussian [7-20 nm] 15-20 nm: 15.9 nm h⁻¹



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80 **Table S1:** Daily condensation sink (CS) statistics for the strict concurrent NAIS-SMPS event/non-event
 comparison. Values were calculated from the merged NAIS-SMPS particle number size distribution during the
 morning NPF-relevant window, 06:00–12:00 LT, using the corrected diameter-based CS formulation. For each day,
 85 mean, median, and interquartile range are reported in s^{-1} . Event and non-event classifications follow the final
 agreement-based NAIS-SMPS dataset used for the CS comparison.

	Date	group	mean_cs	median_cs	p25_cs	p75_cs
90	17-08-2023	Event	0.01401	0.011982	0.00939	0.01845
	18-08-2023	Event	0.00993	0.009533	0.0089	0.01024
	03-10-2023	Event	0.01448	0.014665	0.01235	0.01641
	06-10-2023	Event	0.01774	0.018011	0.01429	0.02185
	07-10-2023	Event	0.01209	0.009283	0.0056	0.01851
	08-10-2023	Event	0.00852	0.006137	0.00514	0.01143
95	09-10-2023	Event	0.00712	0.00526	0.00447	0.00817
	15-10-2023	Event	0.0144	0.007395	0.00621	0.02116
	17-10-2023	Event	0.08347	0.110752	0.00862	0.12729
	19-08-2023	Non-event	0.01346	0.014153	0.01072	0.01607
	07-09-2023	Non-event	0.01576	0.015562	0.01426	0.01631
	09-09-2023	Non-event	0.01143	0.010368	0.00947	0.01368
100	10-09-2023	Non-event	0.016	0.016183	0.01451	0.01714
	05-10-2023	Non-event	0.01934	0.018287	0.01522	0.02347
	10-10-2023	Non-event	0.02858	0.029715	0.02517	0.03164
	12-10-2023	Non-event	0.03022	0.029192	0.02096	0.04053
	13-10-2023	Non-event	0.04037	0.046067	0.02665	0.0522
	14-10-2023	Non-event	0.0302	0.026998	0.01824	0.0429
	27-10-2023	Non-event	0.03708	0.036565	0.03079	0.04396
105	28-10-2023	Non-event	0.03518	0.036524	0.02605	0.0422
	29-10-2023	Non-event	0.04877	0.057855	0.03411	0.0619
	30-10-2023	Non-event	0.01682	0.018095	0.0099	0.01972
	31-10-2023	Non-event	0.11927	0.129596	0.10578	0.13565
	01-11-2023	Non-event	0.08621	0.097474	0.05697	0.10707

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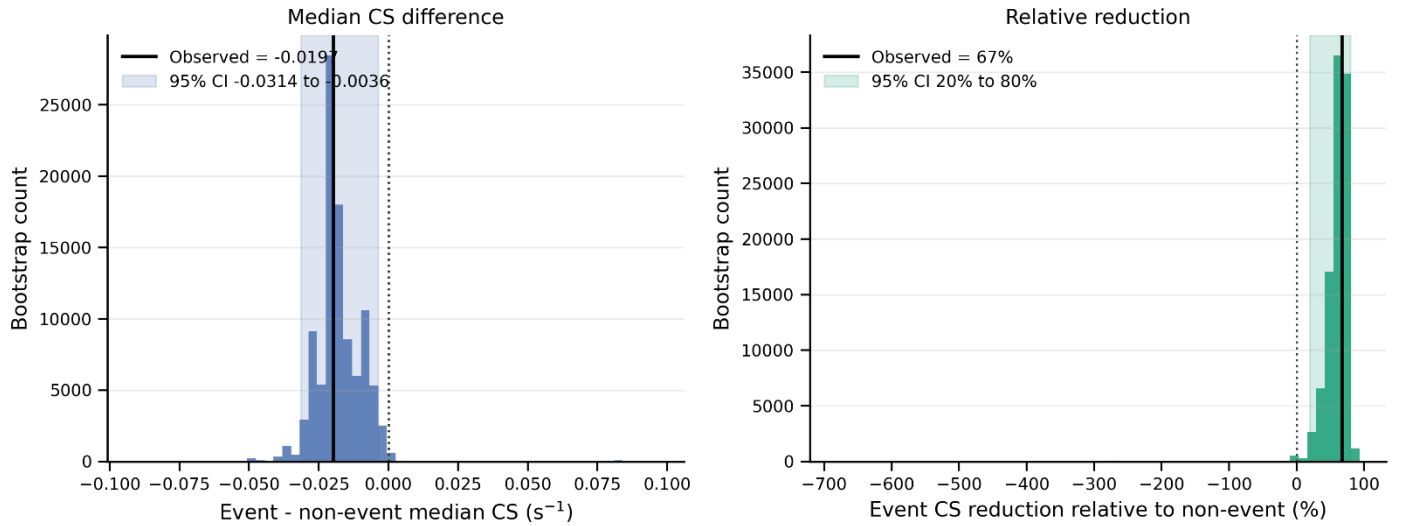


Figure S8. Bootstrap analysis of the event/non-event condensation sink (CS) contrast. Daily median CS values were first calculated for each strict concurrent NAIS-SMPS day during **06:00–12:00 LT**, using the corrected diameter-based CS formulation. Event and non-event days were then resampled separately with replacement. The left panel shows the bootstrap distribution of the difference in group medians, defined as event minus non-event CS. The right panel shows the corresponding percentage reduction in event-day CS relative to non-event days. Shaded regions indicate the 95% bootstrap confidence intervals, and vertical black lines show the observed values.