

## Supplementary Information for –

### Observations of nanoparticle shrinkage phenomena

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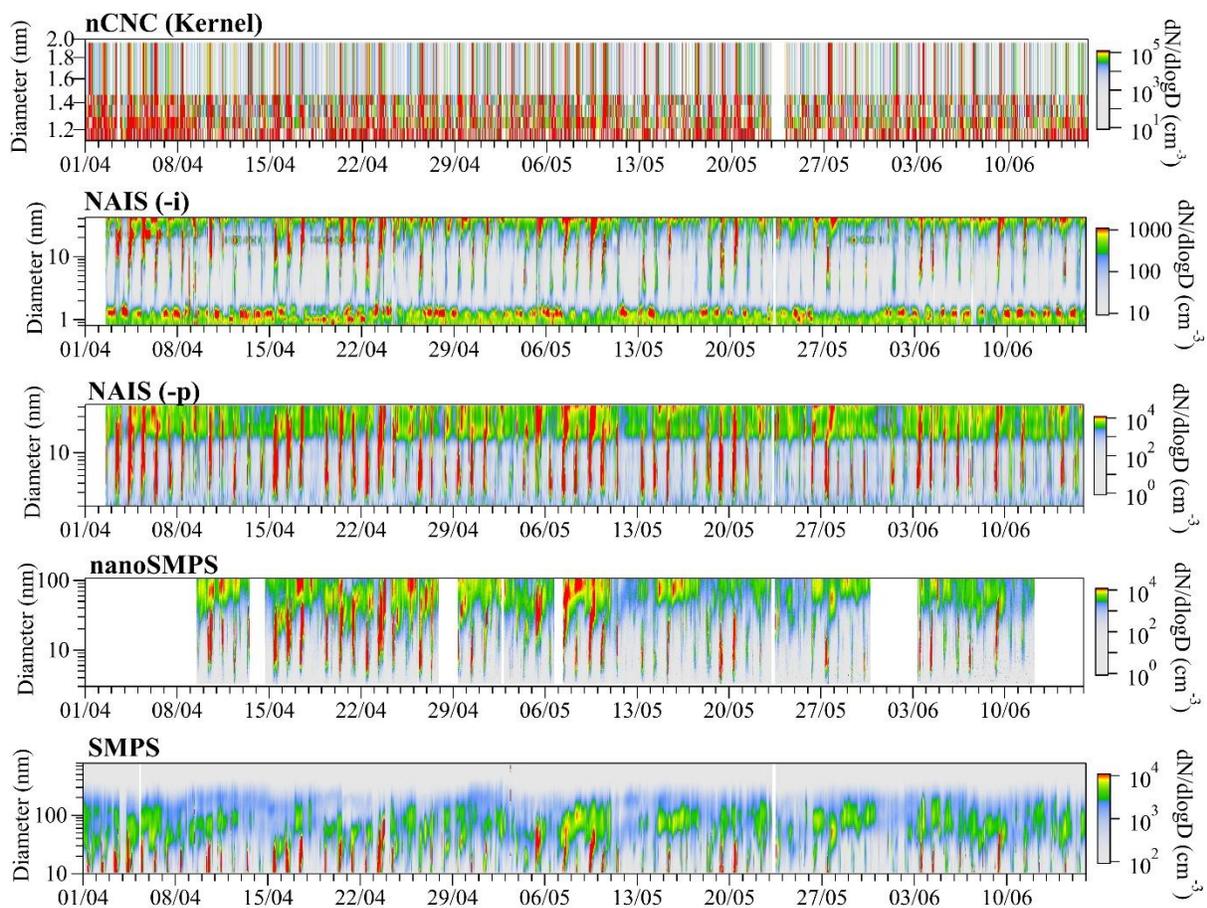
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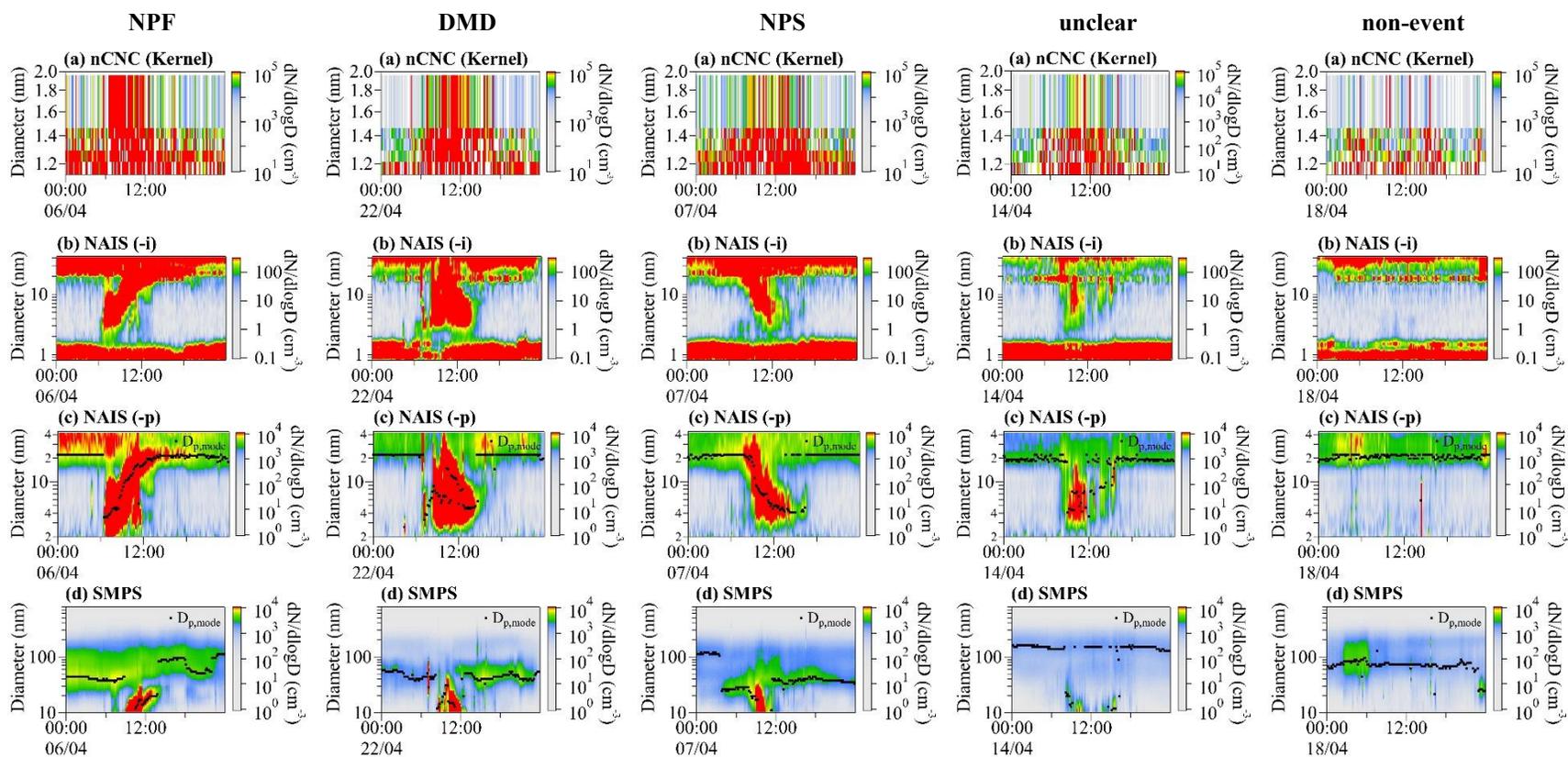
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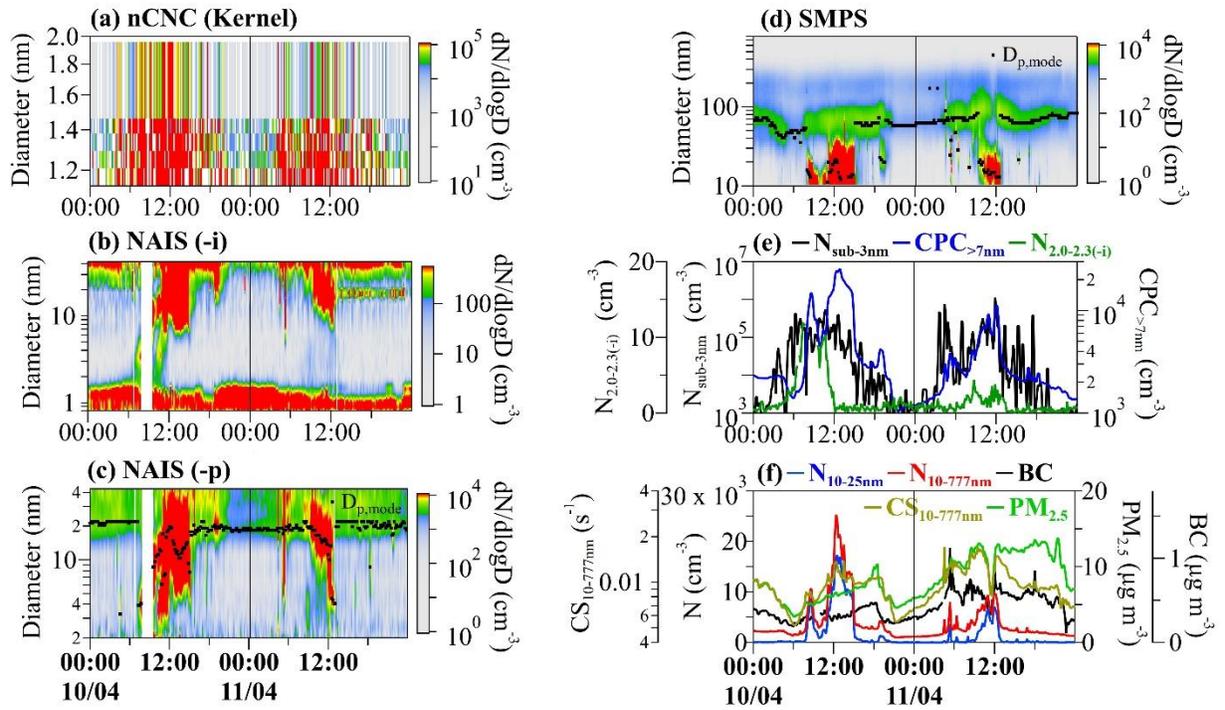
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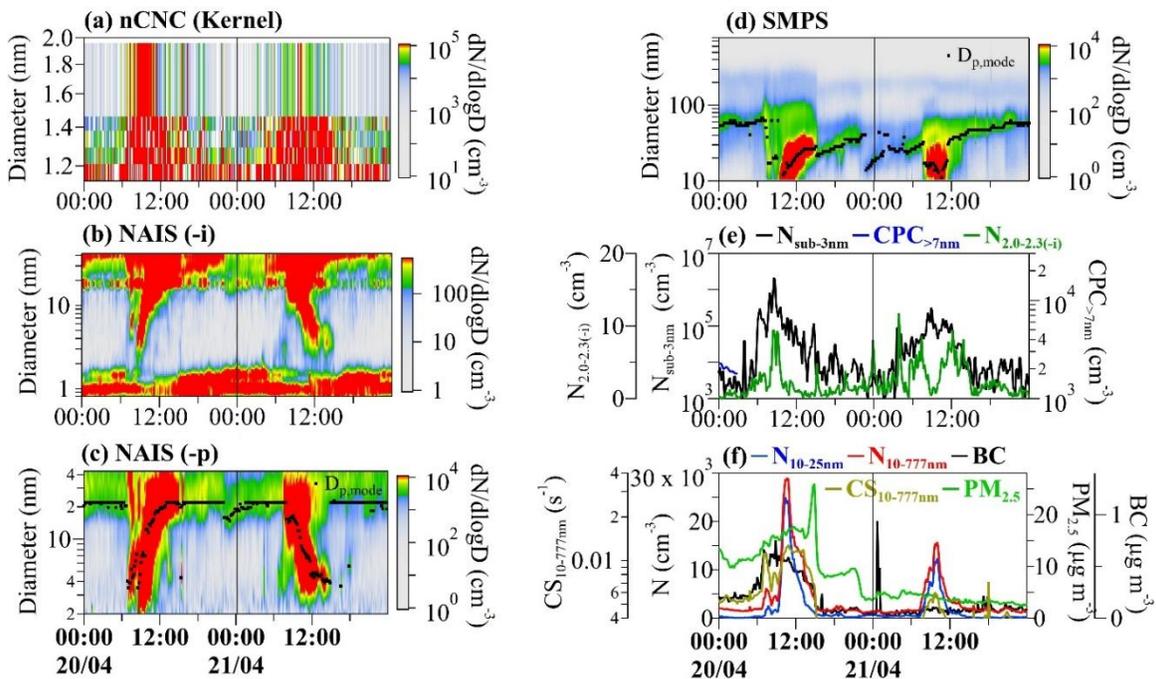
**Figure S1.** Time evolution of 10-minute median particle size distributions during the SPICY campaign, 1 April – 15 June 2024, based on nCNC, NAIS (negative polarity ions and particles), nano-DMA SMPS, and SMPS measurements.



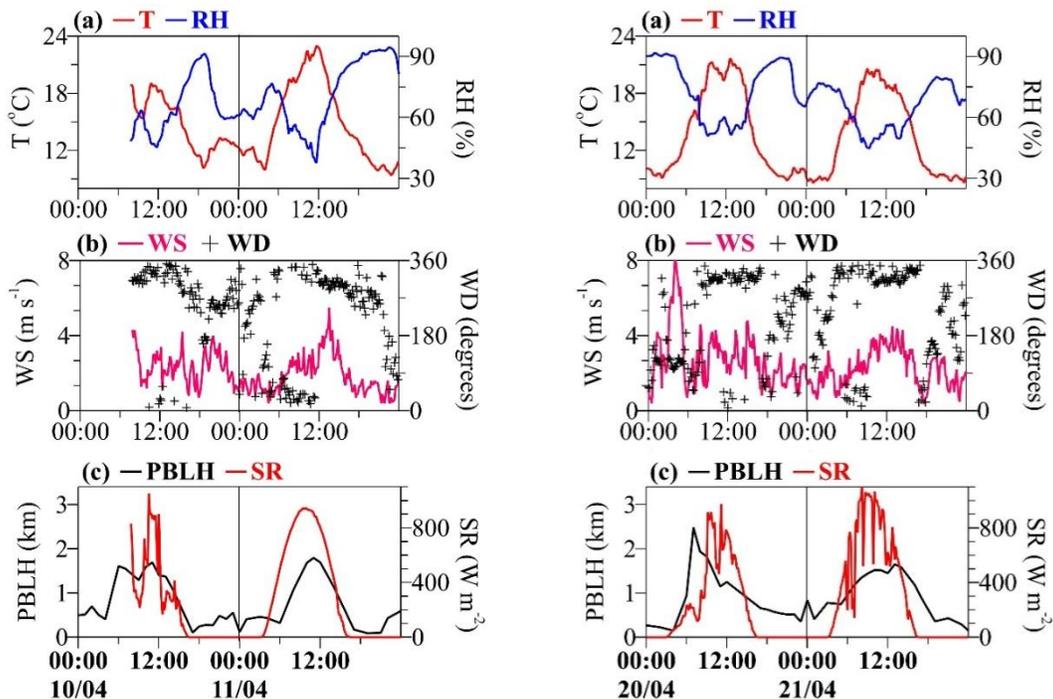
**Figure S2.** Median diurnal variation of particle size distributions measured by (a) nCNC, NAIS negative polarity (b) ions and (c) particles, and (d) SMPS for observed typical NPF, DMD, NPS, unclear and non-event days. Black dots indicate the particle mode diameter.



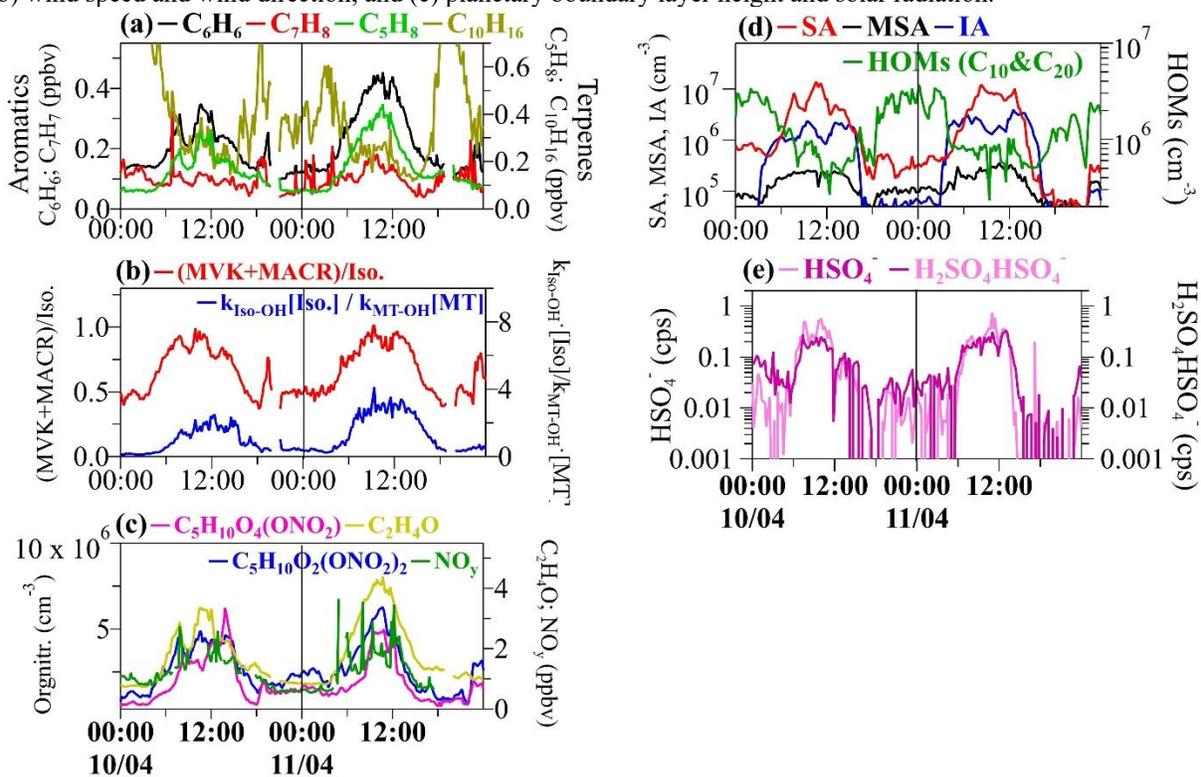
**Figure S3.** Median diurnal variation of aerosol properties during the consecutive NPF-NPS events observed during 10-11 April. Particle size distributions measured by (a) nCNC, (b-c) NAIS negative polarity ions and particles, and (d) SMPS. Panel (e) shows concentrations of negative polarity ions in the 2.0-2.3 nm size range measured by NAIS ( $N_{2.0-2.3(-i)}$ ), sub-3nm particles measured by nCNC ( $N_{\text{sub-3nm}}$ ), and >7nm particles measured by CPC ( $N_{>7\text{nm}}$ ). Panel (f) shows nucleation mode ( $N_{10-25\text{nm}}$ ) and total particle ( $N_{10-777\text{nm}}$ ) number concentrations from SMPS, total condensation sink ( $CS_{10-777\text{nm}}$ ), and particulate matter of aerodynamic diameter less than 2.5  $\mu\text{m}$  ( $PM_{2.5}$ ) and black carbon (BC) mass concentrations.



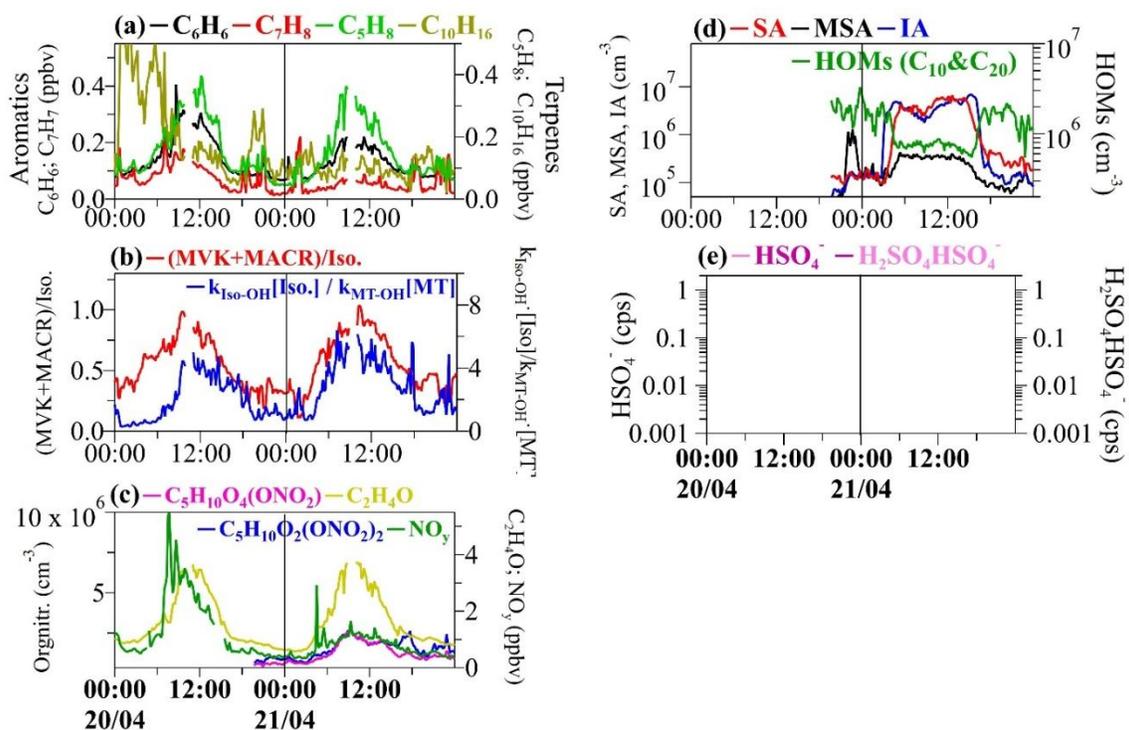
**Figure S4.** Same as Fig. S3, but for the consecutive NPF-NPS events observed during 20-21 April.



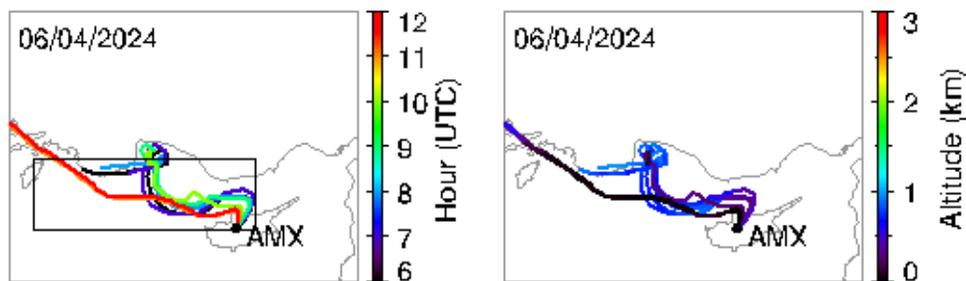
**Figure S5.** Median diurnal variation of meteorological parameters during the consecutive NPF-NPS events, shown for the 10-11 April case (left panel) and the 20-21 April case (right panel). (a) air temperature and relative humidity, (b) wind speed and wind direction, and (c) planetary boundary layer height and solar radiation.

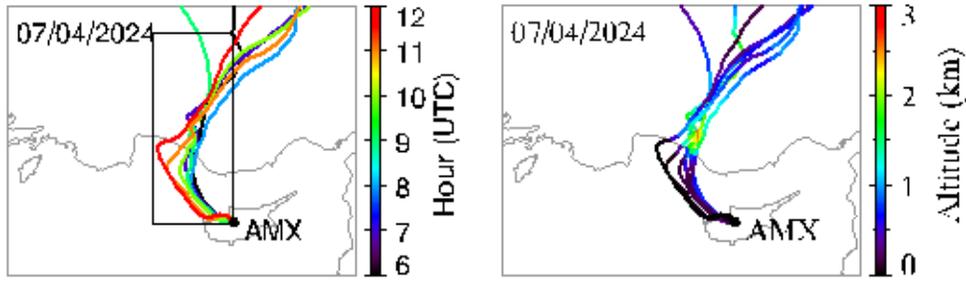


**Figure S6.** Median diurnal variation of aerosol precursors and condensing vapours during the consecutive NPF-NPS events observed during 10-11 April. (a) mixing ratios of benzene ( $C_6H_6$ ), toluene ( $C_7H_8$ ), isoprene ( $C_5H_8$ ), and monoterpenes ( $C_{10}H_{16}$ ); (b) the ratio of sum of methyl vinyl ketone (MVK) and maethacrolein (MACR) to the isoprene [(MVK+MACR)/Iso.] and the relative OH reaction rates of isoprene and MTs ( $k_{Iso-OH} \cdot [Iso] / k_{MT-OH} \cdot [MT]$ ); (c) organonitrates ( $C_5H_{10}O_4(ONO_2)$  and  $C_5H_{10}O_2(ONO_2)_2$ ), acetaldehyde ( $C_2H_4O$ ) and reaction nitrogen compounds ( $NO_y$ ); (d) concentrations of sulfuric acid (SA), methyl sulfonic acid (MSA), iodic acid (IA), and highly oxygenated organic molecules (HOMs,  $C_{10}$  &  $C_{20}$ ); (e) ambient ion mode signals of bisulfate monomer ( $HSO_4^-$ ) and dimer ( $H_2SO_4HSO_4^-$ ) in counts per second (cps); (f) the percentage difference in organic vapour concentrations (molecules  $cm^{-3}$ ) between the NPF and NPS events as a function of volatility bin, expressed as  $\log_{10}$  of the effective saturation concentration,  $\log_{10}(C^*)$ . Negative percentage differences indicate higher organic vapour concentrations during the NPS event. ULVOC, ELVOC, LVOC and SVOC denote ultra-low volatile organic carbon, extremely low volatile organic carbon, low volatile organic carbon and semi-volatile organic carbon, respectively.

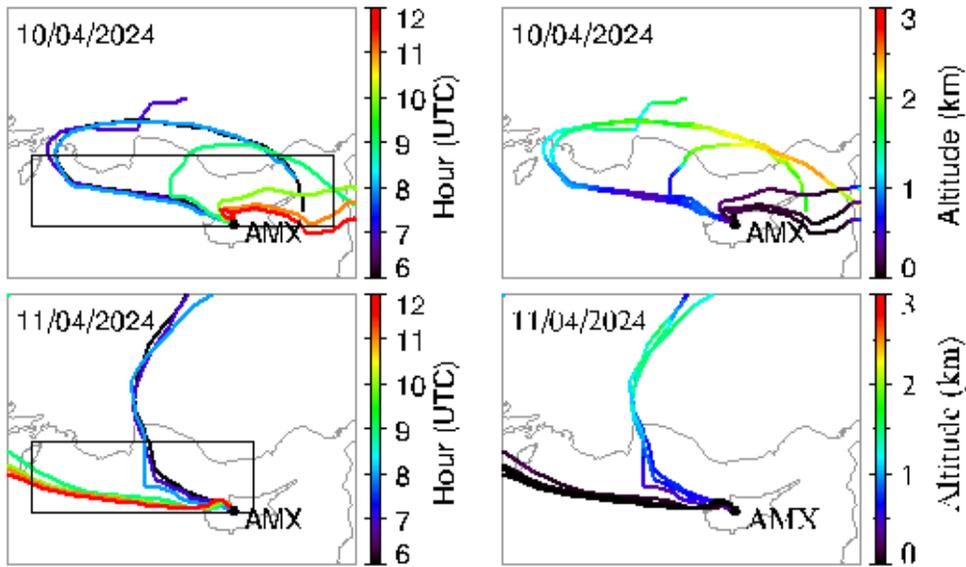


**Figure S7.** Same as Fig. S6, but for the consecutive NPF-NPS events observed during 20-21 April. MION-APi-TOF measurements are not available on 20 April.

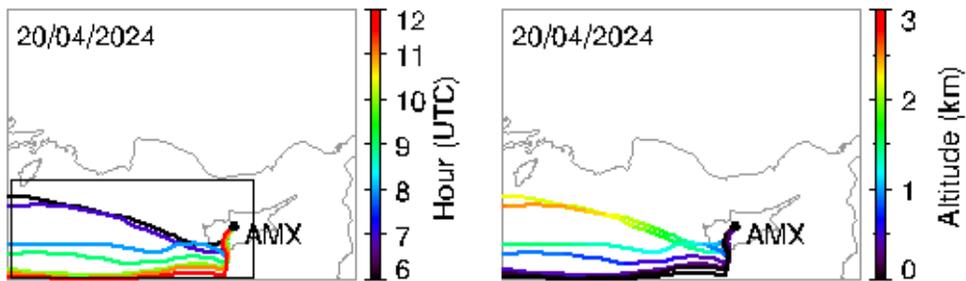




**Figure S8.** 48-hour air mass backward trajectories (6-12 UTC) as a function of hour of the day, and altitude, initialized at 500 meters above ground level at the AMX site during the NPF event (6 April, top row) and the NPS event (7 April, bottom row). The region shown by the rectangular box was used for further analysis, presented in Fig. S11.



**Figure S9.** Same as Fig. S5, but for NPF event (10 April, top row) and the NPS event (11 April, bottom row).



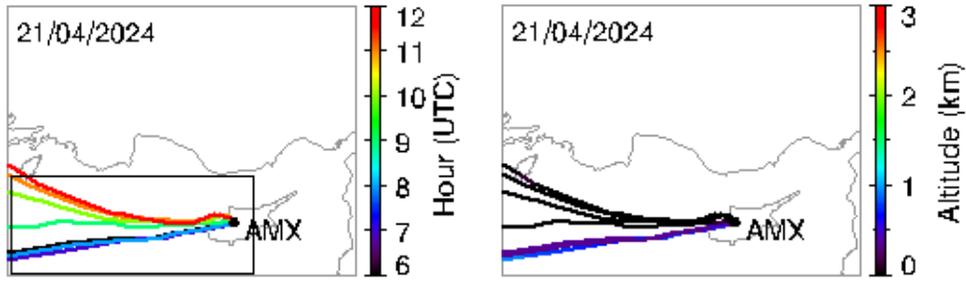


Figure S10. Same as Fig. S5, but for NPF event (20 April, top row) and the NPS event (21 April, bottom row).

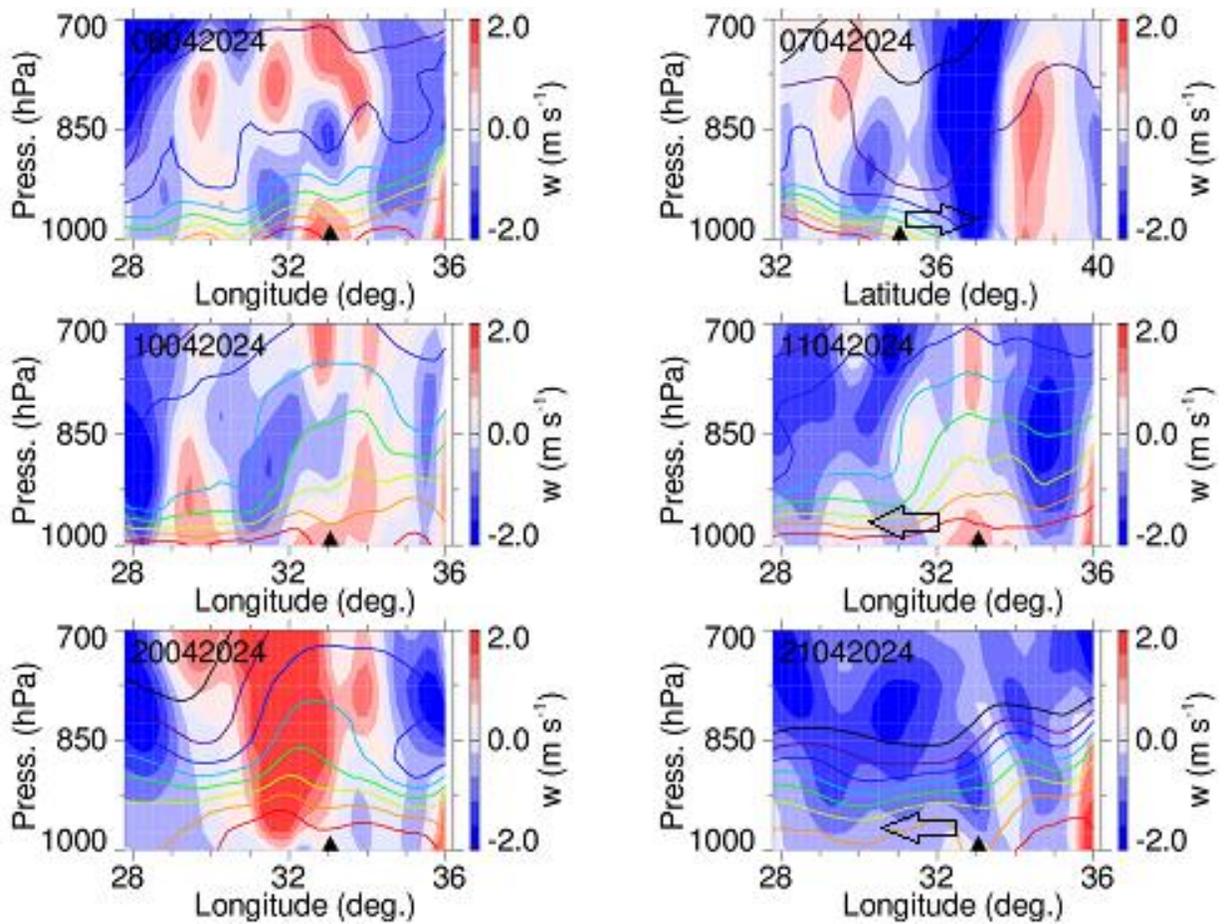
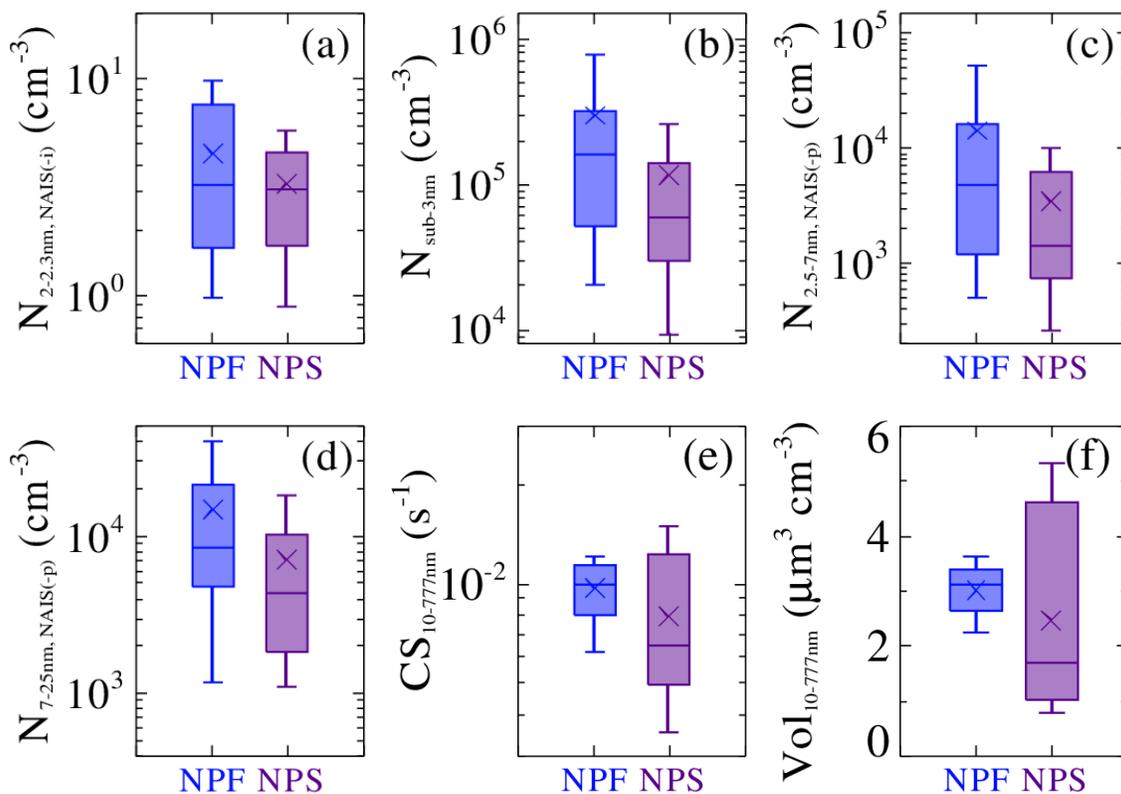


Figure S11. Longitude (latitude)-altitude cross-sections of averaged vertical velocity ( $w$ , filled contours) along air-mass trajectories over 6-12 UTC, indicated by the boxes in Figs. S9-S11, for consecutive NPF and NPS event days observed on 6-7 April, 10-11 April, and 20-21 April, respectively. Contour lines represent specific humidity at 2, 3, 4, 5, 6, 7, 8, and 10  $\text{g kg}^{-1}$ , shown in black, violet, blue, cyan, green, yellow, orange, and red, respectively. The negative value of  $w$  indicates subsidence, while the positive values indicate the updraft. The open arrows indicate the upwind region of the measurement site.



**Fig. S12.** Box-whisker plots show number concentrations of (a) negative ions in the 2.0–2.3 nm size range, (b) sub-3nm particles, (c) negative polarity particles in the 2.5–7.0 nm and (d) 7.0–25 nm size range. (e) total condensation sink ( $CS_{10-777\text{nm}}$ ) and (f) total particle volume concentration for observed NPF (6, 10, and 20 April) and NPS (7, 11, and 21 April) event days. Data correspond to the 06–12 UTC period. The cross symbol indicates the mean, the horizontal line indicates the median, the bottom and top of the box indicate the 25<sup>th</sup> and 75<sup>th</sup> percentiles, and the bottom and top of the whisker indicate the 10<sup>th</sup> and 90<sup>th</sup> percentiles.