

Annual evolution of ultrafine particles and new particle formation in León (NW Iberia)

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INTRODUCTION

Atmospheric aerosol particles present a high negative impact on human health, air quality and global climate change. Numerous studies have proposed that ultrafine particles (UFP; particle diameter <100 nm) are more toxic compared to larger particles of same composition. Furthermore, the adverse health effects caused by UFP number concentrations have been indicated to be stronger than those by the fine particle (Nel, 2005).

UFP fraction is divided into two size modes: nucleation (<30 nm) and Aitken (30-100 nm). Large particles are classified in accumulation mode (100 nm-1 µm) and coarse mode (>1 µm). New particle formation (NPF) events, along with traffic, are the main sources of UFP particles in urban backgrounds. The reverse process is the Shrinkage. It is defined as decreases in particle size caused by particle-to-gas conversion, with a sufficient duration to be observed (Alonso-Blanco et al., 2017).

Several studies have revealed that NPF is generally favoured under high insolation, low relative humidity, high wind speed, and low pre-existing particle surface area (Alonso-Blanco et al., 2017).

The main aim is the detection and characterization of NPF and shrinkage events in León during one year sampling.

STUDY AREA

UNIVERSITY OF LEÓN (NW SPAIN)

- Population: 200,000 people
- Mediterranean climate
- 838 m above sea level

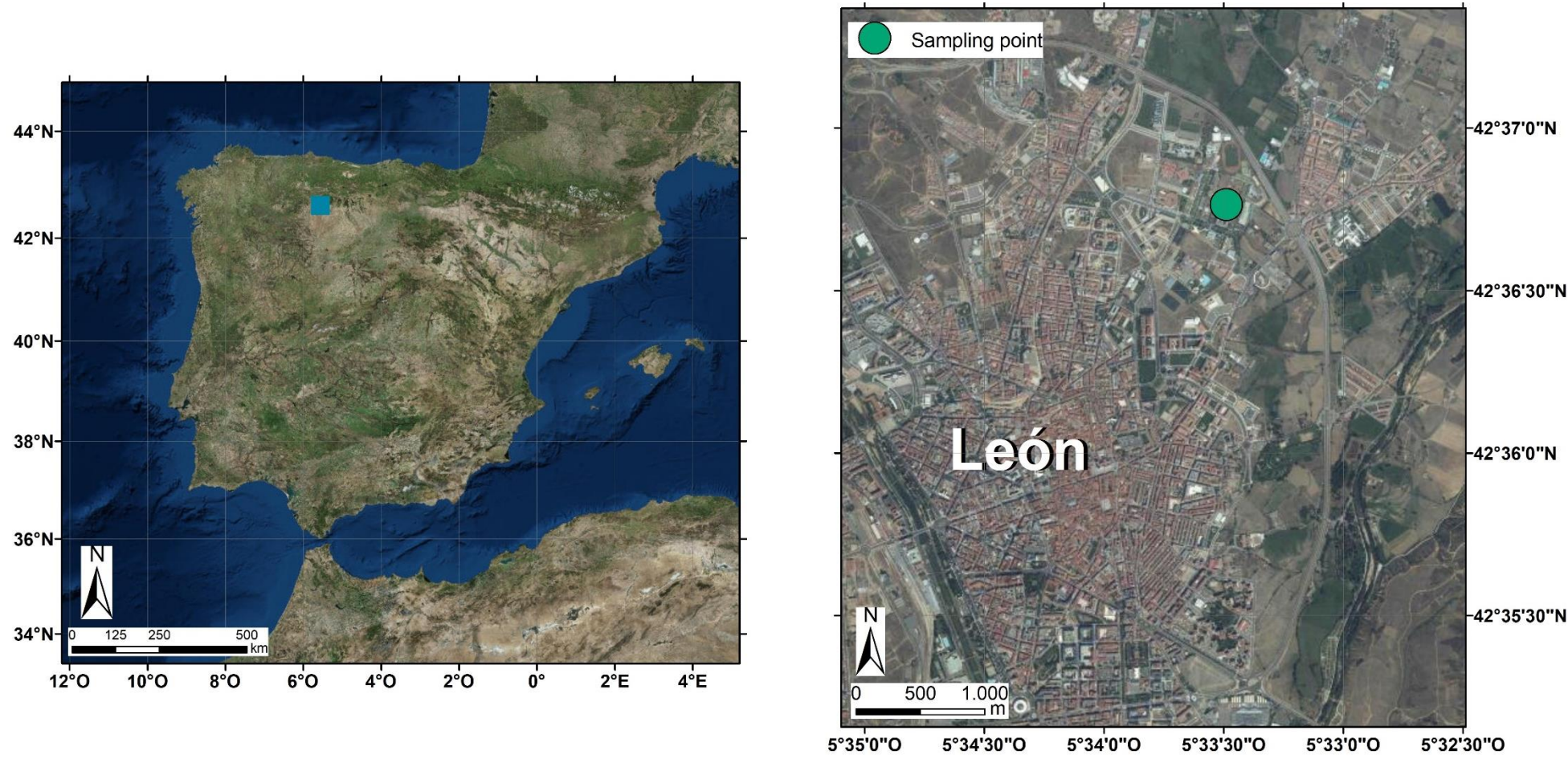


Fig. 1. León situation in Iberian Peninsula and sampling point in León .

SAMPLING CAMPAIGN

March 2016



February 2017

URBAN BACKGROUND STATION

MATERIAL

Scanning mobility particle sizer spectrometer (SMPS Model 3938)

UFP size distributions were measured continuously every six minutes using a high resolution nanoparticle sizer

Particle classifier (DMA 3081)

Condensation particle counter (CPC 3772)

Davis Weather Station (meteorological variables)



Fig. 2. SMPS Model 3938 and Davis Weather Station used during the sampling campaign at León between March 2016 and February 2017.

RESULTS

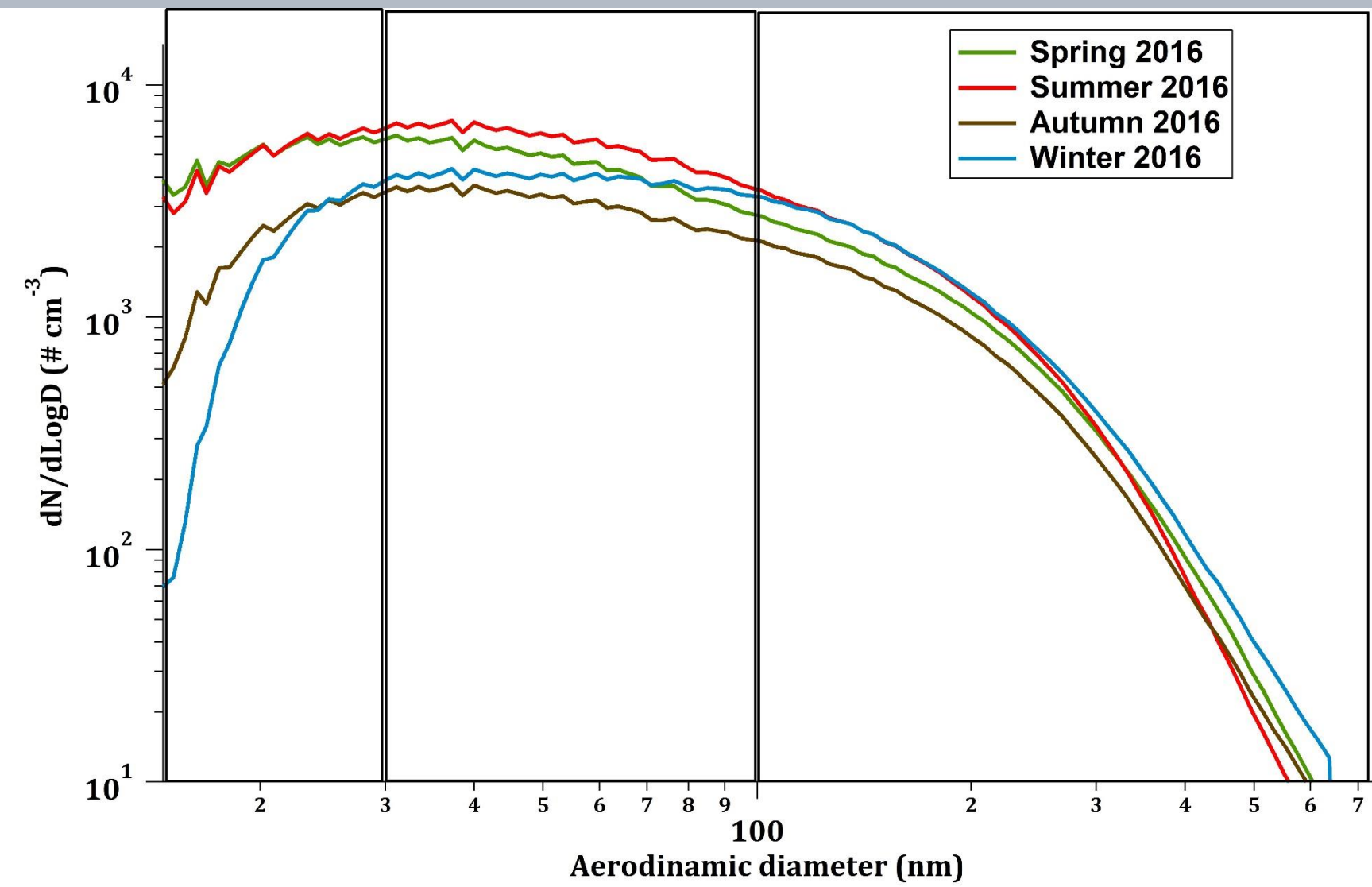


Fig. 4. Particle concentration by seasons along sampling at León.

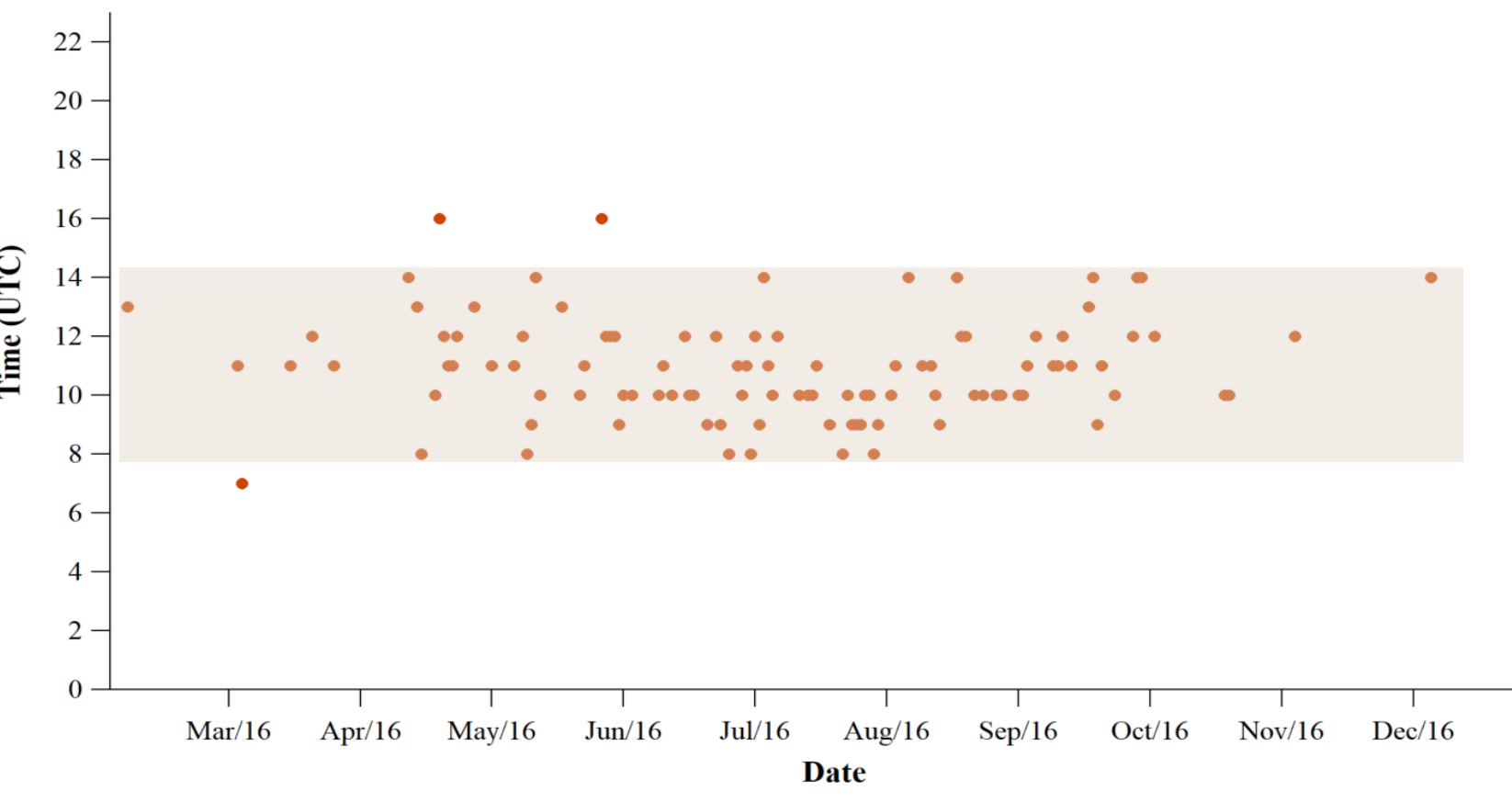


Fig. 5. Time series of the NPF events start at León during the sampling period.

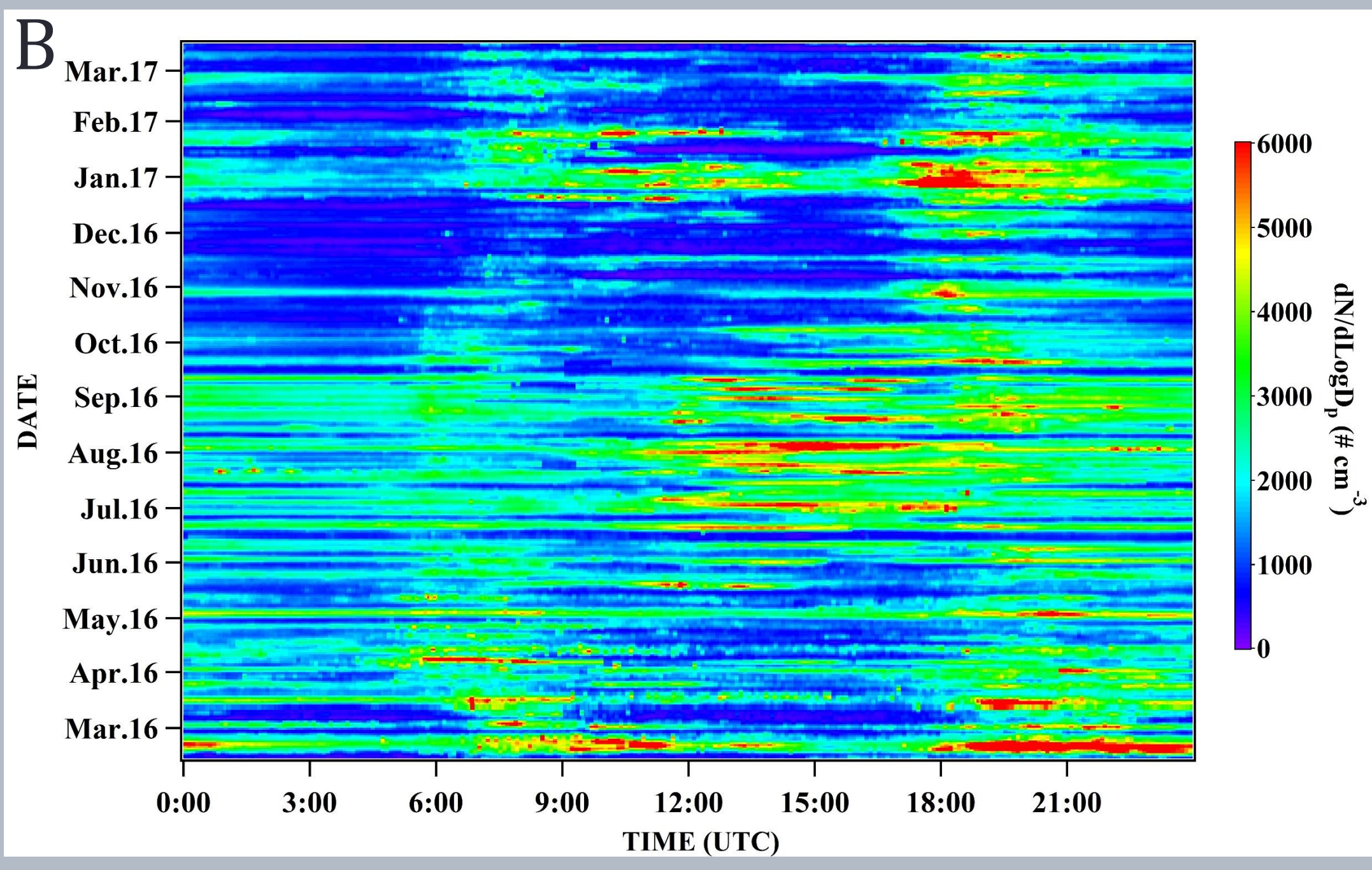
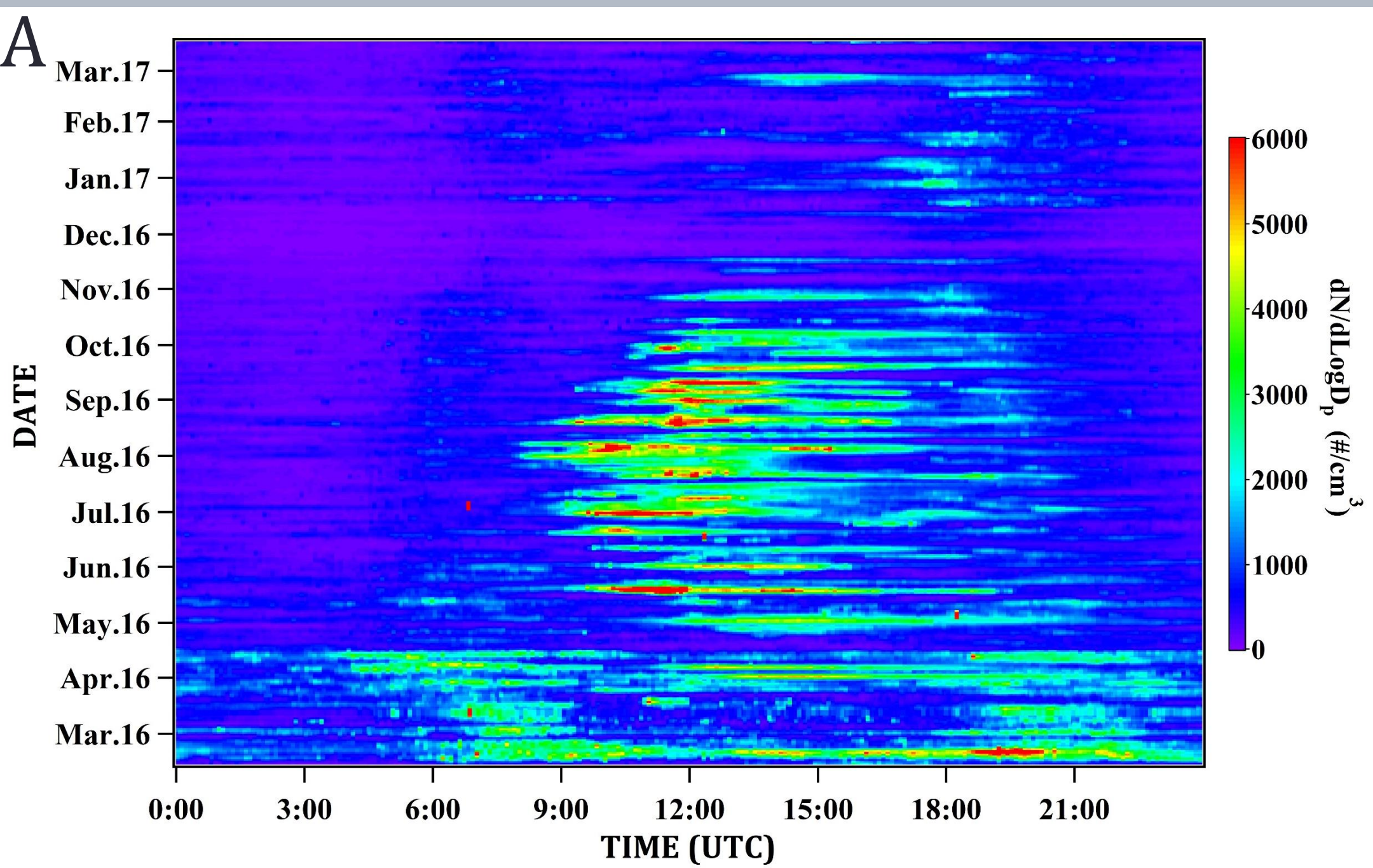


Fig. 3. Temporal variations and daily pattern of A) nucleation mode and B) Aitken mode particle number concentration between March 2016 and February 2017

Table 1. Mean concentration of nucleation, Aitken, accumulation modes and the total particle concentration (# cm⁻³).

Season	<30 nm	30-100 nm	100-661 nm	Total
Winter	1029	2313	873	4215
Spring	1527	2398	704	4630
Summer	1468	2928	861	5257
Autumn	692	1631	562	2885

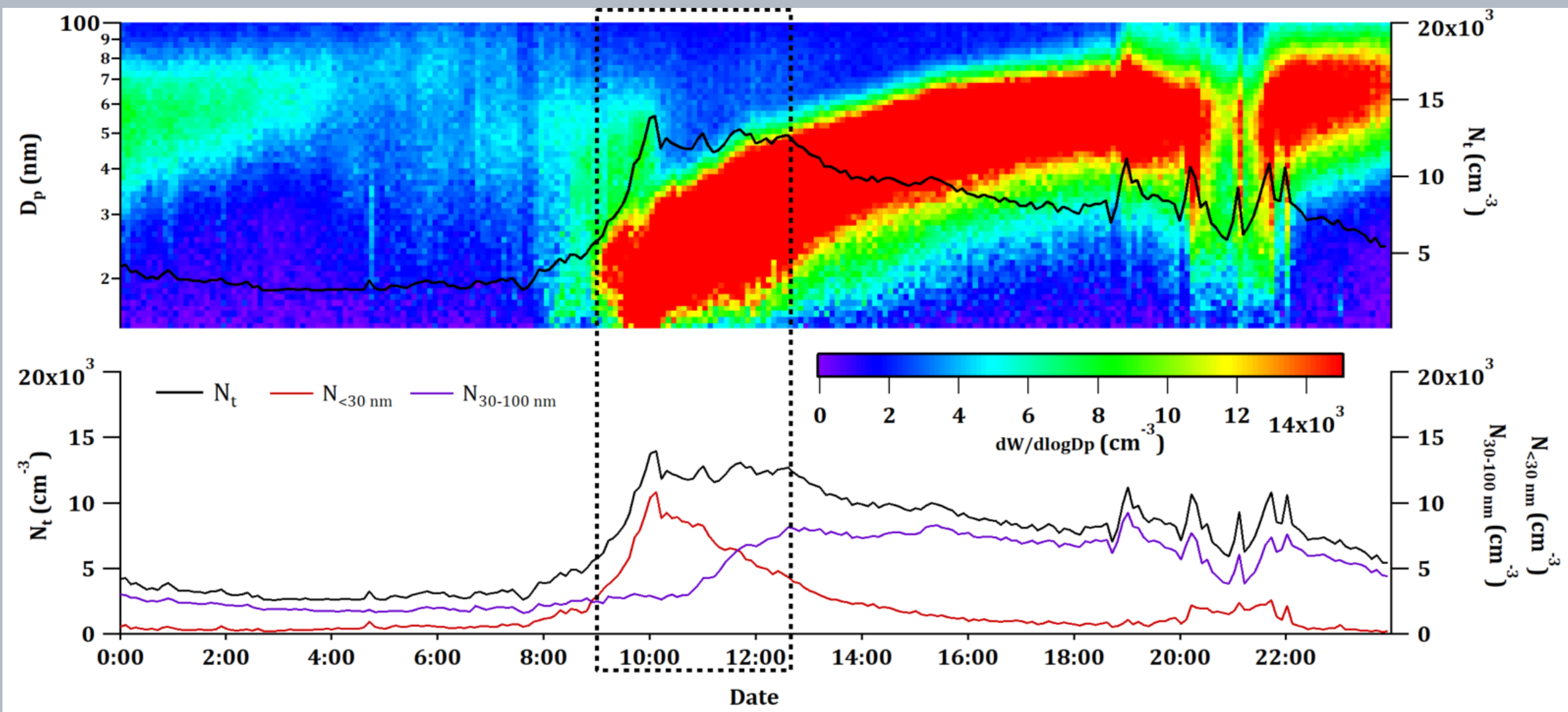


Fig. 7. Example of Ia NPF event. Aerosol number concentration (colour graduated) and number of particles in nucleation (red line) and Aitken (purple line) modes at 24/07/2016.

Table 2. Summary of NPF event occurred on 24/07/2016: growth ratio GR (nm h⁻¹), nucleation rate formation J₁₀₋₂₅ (cm⁻³ s⁻¹), condensation sink CS (10⁻³ s⁻¹), condensable vapour source rate Q (10⁴ cm⁻³ s⁻¹), N_{total} (# cm⁻³), N_{nuc} (# cm⁻³), O₃ (µg m⁻³) and NO_x (µg m⁻³).

Start	End	GR	J ₁₅₋₃₀	CS	Q	N _{total}	N _{nuc}	O ₃	NO _x
09:43	11:00	2.58	0.73	1.4	5.1	12,200	9,200	76.2	3.8

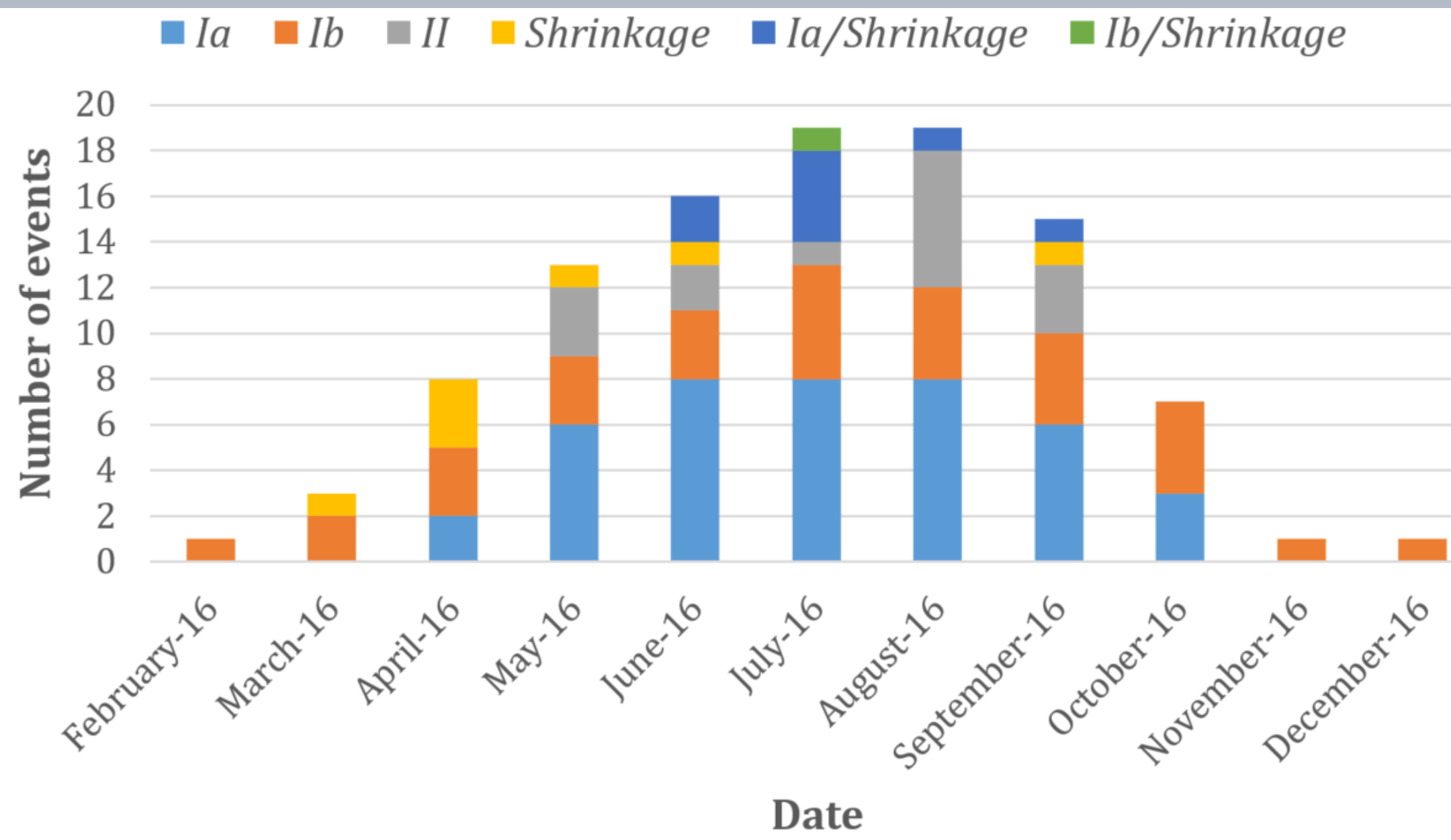


Fig. 6. Number of events based on visual classification (Dal Maso et al. (2005)) along sampling.

CONCLUSIONS

- NPF events occurred primarily between 1100 and 1500 UTC, mainly in spring and summer.
- Nucleation concentration was higher in summer than in winter months, while accumulation and Aitken modes were higher in winter months.

The values of formation, growth rates and condensable vapour source rate of nucleation mode particles, during NPF events, will be studied in detail in all events.

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