Global variability of aerosol physical properties retrieved from the network of GAW near-surface observatories

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Introduction / Context

Aerosol particles are a key component of the **Earth's atmosphere**, but our **understanding** of their effects remains **incomplete**. Continuing the efforts to organize **long term monitoring** of the **climate-relevant aerosol properties** in **as broad a network as possible** is **essential** to bridge the current gaps. The value of such measurements, which are performed in compliance with **homogenous protocols** and meet **high quality standards**, is clearly demonstrated in the present analysis and in the companion studies related to the SARGAN initiative (Laj et al., 2020).

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Objectives of the analysis / Methods

Investigate the spatial variability of the particle number concentration and size distribution based on available in-situ near-surface measurements

- Observations collected at **57 sites** connected to the **Global Atmosphere Watch (GAW) network** were analysed for a reference year (2017, or 2016 when the 2017 coverage was not sufficient);

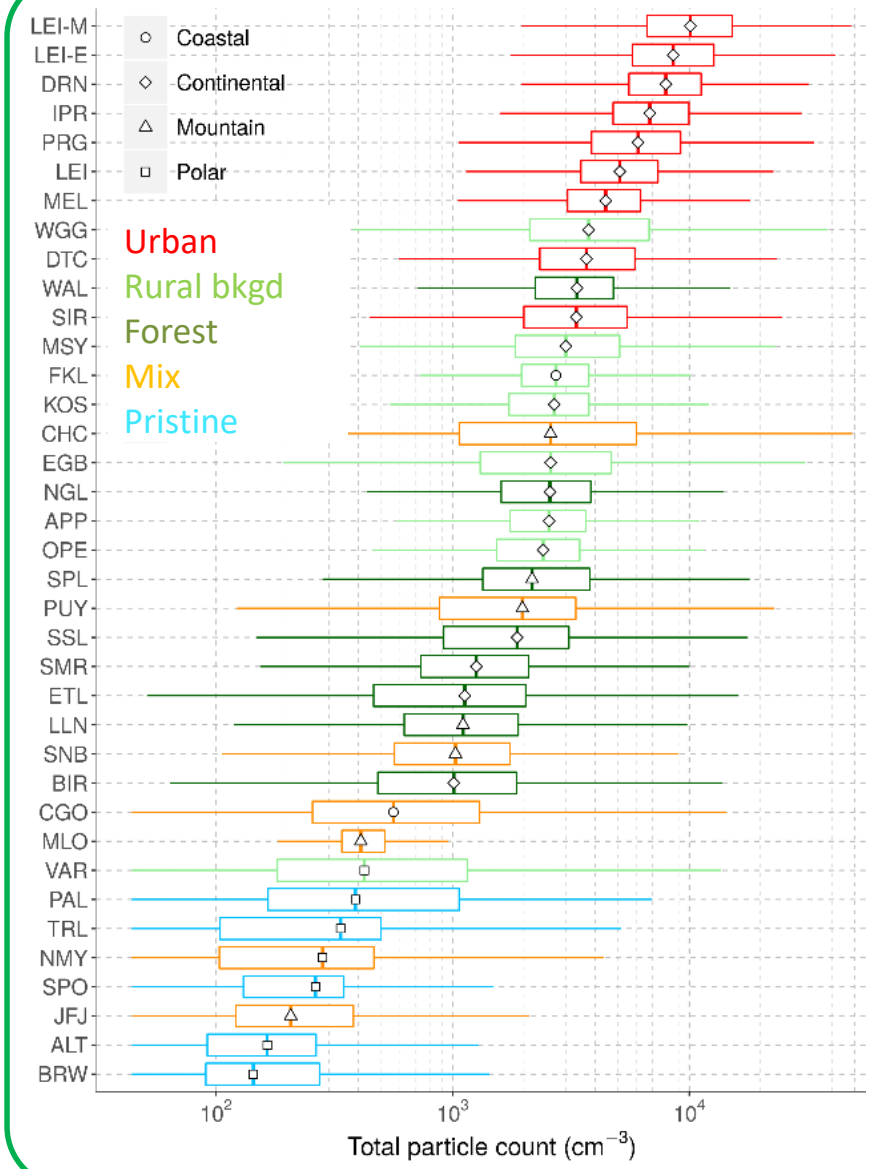
- Measurements performed with **condensation particle counters** (**CPC**, 21 sites) and **mobility particle size spectrometers** (**MPSS**, 36 sites) were both included in the analysis; in the latter case, the **total particle number concentration, N_{tot}**, was calculated over the diameter range 10 – 500 nm;

- For each site, annual and seasonal statistics were computed for N_{tot}; corresponding results were considered only if **75%** of the hourly data was available over the statistics reference period (coverage constraint not applied to BRW, MLO and SPO);

- Results are discussed with respect to the **classification of the stations** reported in Laj et al. 2020, which includes both a geographical and footprint criteria.

Results (adapted from Laj et al., 2020)

Yearly statistics of N_{tot}



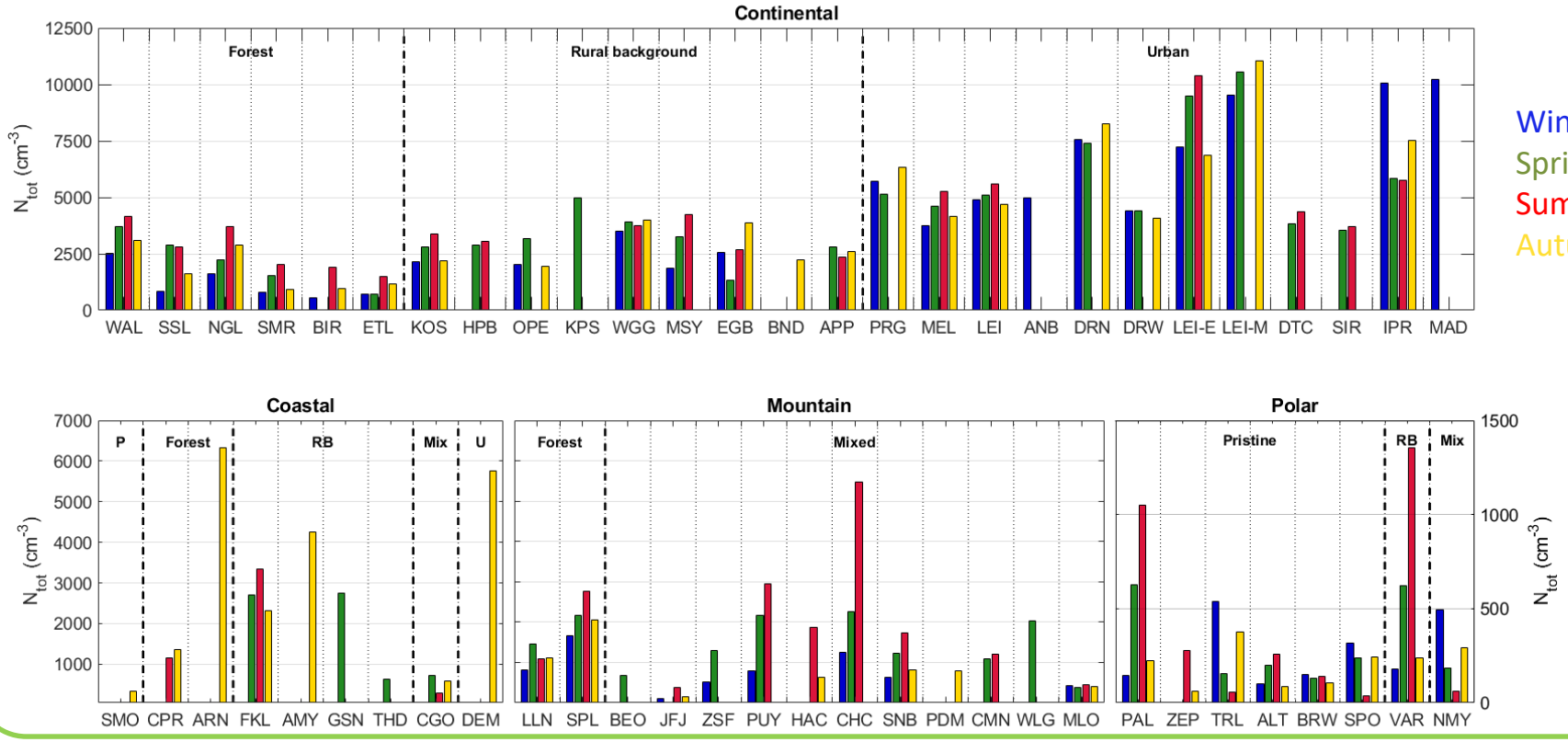
- **Lowest N_{tot}** are mostly measured under conditions of **minimal anthropogenic influence**, at **polar sites**, where a **clear seasonal cycle** is also observed;
- In contrast, stations located in **urban areas** exhibit the **highest N_{tot}**, with a less pronounced seasonal variation;
- Mountain and **non-urban** continental and coastal stations are characterized by **intermediate N_{tot}**, with a relatively clear signature of their dominant footprint;
- Particle concentrations measured at **mountain sites** tend to be **lower** compared to neighboring sites located at **lower altitude**, and are **strongly influenced** by the **atmospheric boundary layer height variability**;

➡ The level of anthropogenic influence is among the main drivers of N_{tot} variability.

Lower and upper edges of the box indicate the 25th and 75th percentiles, respectively. Length of the whiskers represents 1.5 interquartile range.

Results (adapted from Laj et al., 2020)

Seasonal medians of N_{tot}



Stations grouped according to their geographical category, and are further sorted based on their dominant footprint.

- As a **common feature**, **N_{tot}** tends to be **higher during warmer seasons** at all sites as a likely result of **enhanced sources**.

Current / Future work

- Deeper analysis of the PNSD for the reference year;
- Trend analysis to document the temporal variability of the particle number concentration and PNSD.