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

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Due to their multiple effects on climate and human health, aerosol particles are a key component of the Earth's atmosphere. The understanding of these effects however remains incomplete, which in turn affects their quantification at the present time as well as future predictions. These limitations highlight the need for continuing the efforts to organize long term monitoring of the climate-relevant aerosol properties in as broad a network as possible.

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. This work, which is focused on the particle number concentration and particle number size distribution (PNSD), is part of a wider project, one of the objectives of which is to document the variability of climate-relevant aerosol properties based on available in-situ near-surface measurements. To investigate the spatial variability of the abovementioned aerosol physical properties, observations collected at 57 sites connected to the Global Atmosphere Watch (GAW) network were analysed for a reference year (2017). 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.

As a result of enhanced sources, N_{tot} is generally higher during warmer seasons at all sites (in connection with atmospheric boundary layer dynamics for mountain sites). In addition, based on available MPSS data, the major contribution of Aitken mode particles (30-100 nm) to the total particle number concentration also appears as a common feature of all environments. In contrast, the observed levels of N_{tot}, between 10^1 and 10^4 cm^{-3}, and the magnitude of its seasonal cycle, exhibit, together with the variations of the PNSD, some distinctive behaviour for the different geographical categories and environmental footprint classes, with additional site-dependent characteristics. Among other factors (including the nature and proximity of the particles sources), the level of anthropogenic influence appears to strongly affect the observations.

This work will be completed in the near future with a trend analysis to document the temporal variability of the particle number concentration and PNSD.

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