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Evaluation of the Naneos Partector 2 Pro ultrafine particle monitor to support WHO's 2021 good practice statements

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Introduction
The 2021 WHO Air Quality Guidelines[1] included four good practice statements to help guide actions to decrease concentrations of ultrafine particles (UFP) and ultimately reduce population exposure to UFP. The good practice statements included recommendations to expand common air quality monitoring to include size-segregated and real-time measurements of UFP along with particulate matter (PM) mass measurements and to advance UFP monitoring technologies and approaches. Although instrumentation to monitor UFP has been developed and such instruments are active worldwide, their extensive space, controlled operating environments, and expertise requirements make them unsuitable for large-scale deployment into established air quality monitoring networks. A small, handheld UFP device called the Naneos Partector 2 Pro[2] (hereafter referred to as the P2 pro) based on a measurement technique involving unipolar diffusion chargers has shown promise as an alternative candidate monitor to be deployed at scale.

Objectives
This study's primary objectives are: (*i*) to test and evaluate the P2 pro's ability to monitor continuously in ambient conditions for 12 months, and (*ii*) to evaluate the P2 pro's measurement performance with a focus on total particle number concentration (PNC) and particle size distributions. The UFP size range and size bins that will be evaluated correspond to the eight size bins the P2 pro reports, specifically, bins with 10, 16.3, 26.4, 43, 69.8, 113.5, 184.6, and 300 nm midpoints.

Methods
At the time of writing, twelve research groups based in Australasia, Asia, North America, and Europe have deployed P2 pro devices during, or before January 2025 and will monitor UFP for at least 12 months. The devices are installed in established air quality monitoring sites that generally include PM mass measurements. The devices will also (at least periodically) be colocated with mobility particle size spectrometers (MPSS) and/or condensation particle counters (CPC) which will be used as reference instrumentation for the evaluation of measurement performance of the UFP metrics. The monitoring sites cover a range of environments ensuring a diverse range of UFP characteristics and climatic zones. Monitoring is occurring within and outside urban areas with variable proximity to primary UFP emission sources. The 12 monitoring teams will monitor the P2 pro to identify potential malfunctions or failures quickly and intervene when necessary to maximise data capture rates. Observations will be uploaded monthly to allow for central storage and management to ensure consistent data analysis approaches. Furthermore, the Partector will be evaluated with the performance and uncertainty metrics contained within the CEN/TS 17434:20203 technical specification to allow for comparison among other UFP monitors and offer insight on what monitoring applications the P2 pro is most suited to.

Results
The P2 pro is being tested in 12 locations across the world and the evaluation period will run from January 2025 to December 2025. There have been no major failures or issues that have led to significant data loss. The P2 pro devices are performing well and are reporting observations reliably. The digital infrastructure is being developed to enable harmonised and consistent data analysis across all monitoring sites and devices. The exact procedures for the intercomparisons between the device under test and reference instruments (generally, MPSS) in the scope of CEN/TS 17434:2020 are under development. Comparisons will also be made with previous studies which have tested the Partector for shorter durations[4] or in specific conditions.[5]

Conclusions

The 2021 WHO Air Quality Guidelines delivered good practice statements relating to UFP. To support these statements, the handheld Naneos Partector 2 Pro UFP device is currently under test in 12 locations around the world. The evaluation of the device and the study's outlined objectives are the first steps towards generating the required datasets to robustly calculate UFP's exposure-response functions in the future.

References

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[4] Asbach, C., Todea, A. M., and Kaminski, H. (2024). Evaluation of a Partector pro for atmospheric particle number size distribution and number concentration measurements at an urban background site. Aerosol Research, 2(1):1–12.

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