Ultrasonic Personal Air Sampler (UPAS) v2.1 PLUS

PM sampling + Optical PM sensor + GPS + Motion

(Actual device size)

The UPAS is a compact filter sampler built around ultrasonic pumping technology. The UPAS is smaller, lighter, quieter, more affordable, and easier to use than conventional air sampling equipment. The UPAS also includes a GPS module that can be used to log time-resolved data on the device location.

The UPAS v2.1 PLUS adds time-resolved PM sensing to the UPAS v2.0/v2.1. The optical PM sensor and GPS module provide data useful for evaluating spatial-temporal aspects of exposure. On-device pairing of the optical PM sensor and integrated filter sampler allows the user to normalize the sensor $PM_{2.5}$ data by the "gold standard" filter-derived exposure metric.

The UPAS is silent and light enough to be worn directly in a person's breathing zone. The interchangeable size-selective PM inlets and filter cartridges integrate directly with the pump, so no cumbersome tubing or tape is needed!

"I like the UPAS because it is easier to use."
- Dr. Robert Blount, University of Iowa

HIGHLIGHTS
Integrated size-selective PM inlets
Wireless setup via mobile application
Active, accurate sample flow control
Small and quiet; minimal ergonomic burden
Comprehensive, time-resolved data logging
GPS location tracking
Long battery endurance for extended sampling

SPECIFICATIONS	
Exterior size	128 mm × 70 mm × 36 mm
Weight	250 g (without inlet or filter cartridge)
Noise	< 45 dB
Flow rate range	1.0 to 2.0 L min^{-1} ± 4% (actively controlled)
Size-selective inlets	$PM_{2.5}$ (1 L min^{-1} and 2 L min^{-1}), Respirable PM (2 L min^{-1}), PM_{10} / Thoracic (2 L min^{-1})
Filter size	37 mm (default) or 25 mm; quick-change filter cartridges for easy in-field handling
Battery type	Li-Ion, 24 W-h
Battery life	15 to 48 h, depending on filter media and sample settings; extendable via external battery or line power.
On-board sensors monitor:	• Fine PM mass concentration (Sensirion SPS30) • GPS location of UPAS (can be deactivated) • Light (Lux, IR, UV, UV index; relative levels only) • Motion/acceleration (linear & angular, 6 DOF) • Air temperature/pressure/relative humidity • Sample flow rate • Differential pressure across the sample filter • CO_2 concentration (Sensirion SCD43)* • Qualitative tVOC and NOx levels (Sensirion SGP41)* * These sensors are experimental features and the quality of these data is uncertain.

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Revision 2.8, May 2026

Filter sampling

The UPAS has been laboratory- and field-tested alongside the Personal Environmental Monitor (PEM), the Harvard Impactor, the Mesa Labs/BGI Triplex Cyclone, and the Personal Modular Impactor (PMI) in these studies:

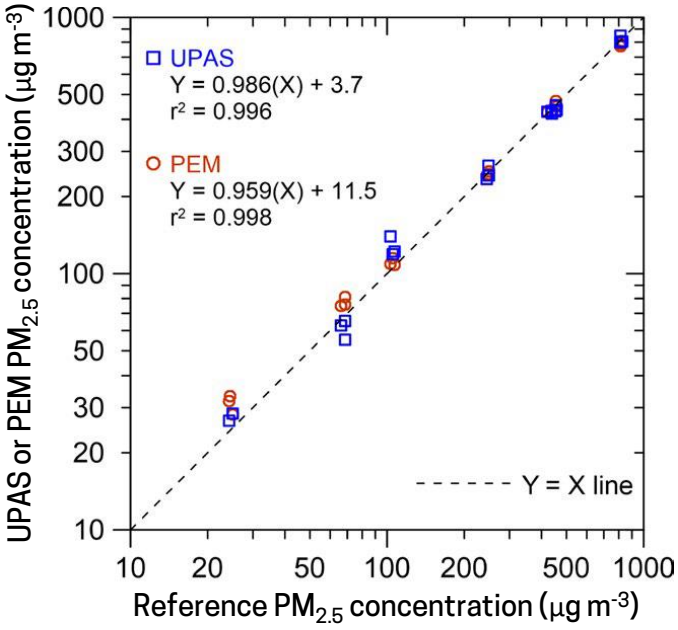
Volckens, J., et al. Indoor Air, 2017, https://doi.org/10.1111/ina.12318

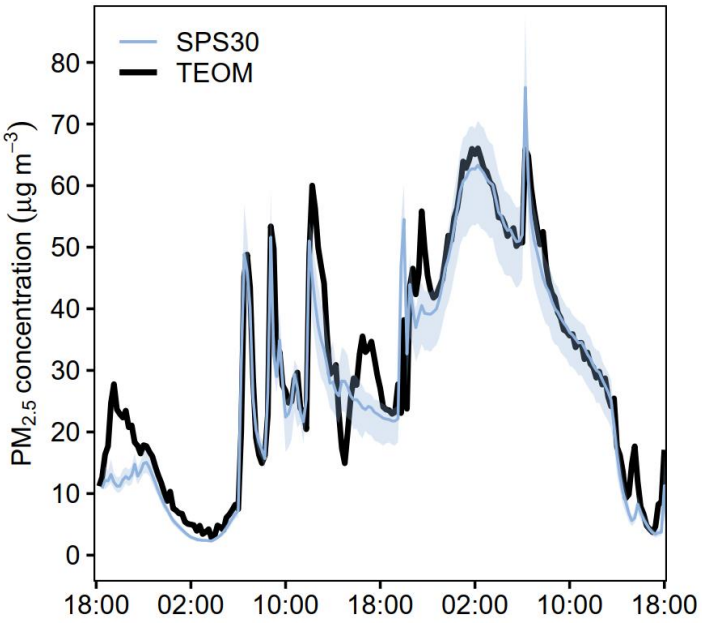
Arku, R.E., et al. Environment International, 2018, https://doi.org/10.1016/j.envint.2018.02.033

Pillarisetti, A., et al. Environment International, 2019, https://doi.org/10.1016/j.envint.2018.11.014

Li, X., et al., Aerosol Science & Technology, 2024, https://doi.org/10.1080/02786826.2024.2415481

Right: Performance of the UPAS relative to a conventional 16.7 L min^{-1} filter sampler consisting of a URG-2000-30EGN-A cyclone and URG-2000-30FG filter holder.





Particulate matter sensing

The UPAS v2.1 PLUS includes a Sensirion SPS30 optical particulate matter sensor to capture time- and location-resolved variations in fine particulate matter concentrations. We recommend correcting the SPS30-reported $PM_{2.5}$ concentrations against a concurrent filter-based $PM_{2.5}$ measurement to improve the accuracy of these time-resolved $PM_{2.5}$ estimates. For more information, see Tryner et al., 2020: https://doi.org/10.1016/j.jaerosci.2020.105654

Left: 15-minute average $PM_{2.5}$ concentrations measured in a home polluted with wildfire smoke over 48 h using five SPS30 sensors and a tapered element oscillating microbalance (TEOM). The blue line and shaded area indicate the mean and range of concentrations measured by the five SPS30 sensors.

GPS location sensing

The UPAS can log its GPS location at timestamped 30-s intervals (assuming that a GPS signal is available at the time). GPS data can be used to estimate the proportion of PM exposure that a person received in different locations. For an example application, see Li et al., 2024: https://doi.org/10.1080/02786826.2024.2415481

Right: $PM_{2.5}$ exposure vs. location recoded by a UPAS v2.1 PLUS. Green, yellow, and red markers indicate increasing $PM_{2.5}$ levels.

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