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Locating urban hot-spots with mobile on-line size-resolved nanoparticle measurement

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Background

- Internal combustion engines are often a dominant sources of fine particles in urban air, which cause an order of magnitude more premature deaths than traffic accidents. Particles are very small, are emitted in the immediate vicinity of people.
- Nanoparticles concentrate along roads and their spatial distribution of nanoparticles is highly non-uniform.
- **<u>Emissions</u> of nanoparticles from internal combustion engines are strongly dependent on current and prior engine operating conditions and their distribution is therefore highly non-uniform.**

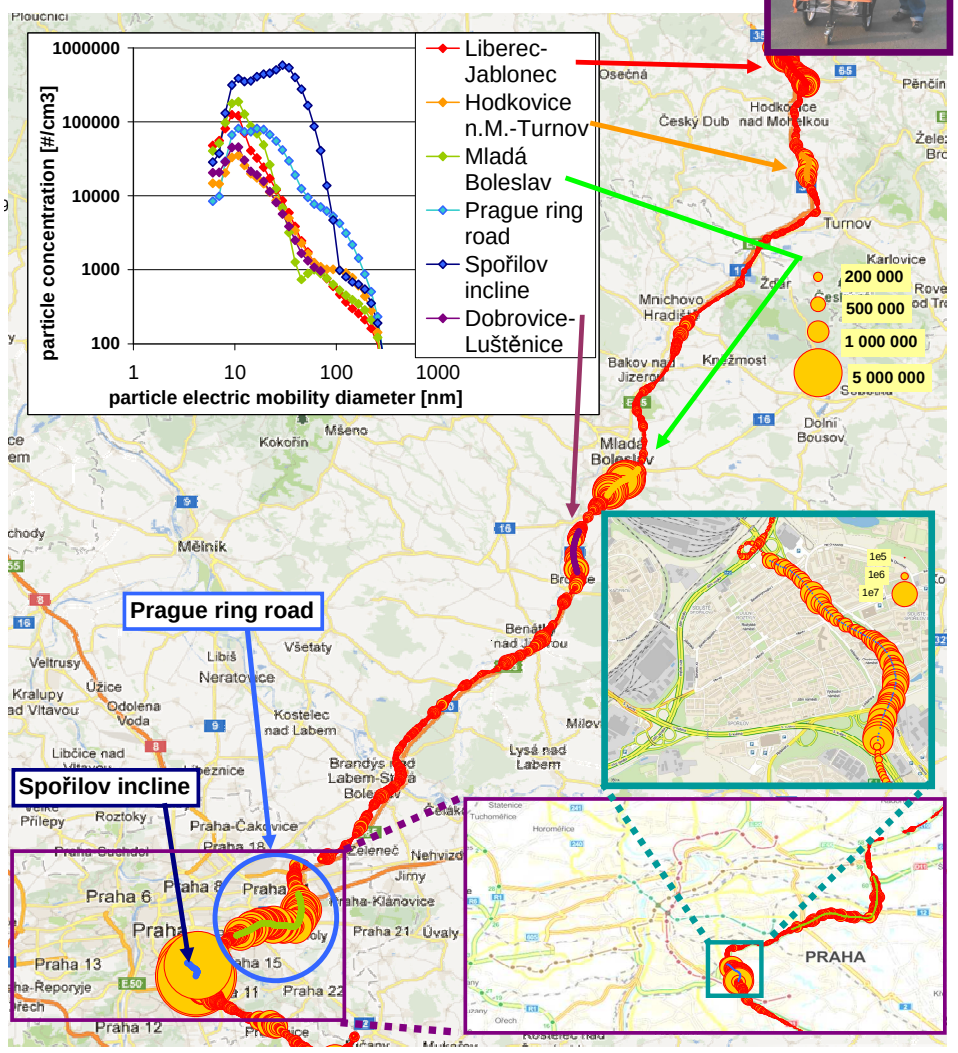
Goal: Compact, mobile, size-resolved measurement of nanoparticles in ambient air near roadways.

Approach

- Fast mobility spectrometer (Engine Exhaust Particle Sizer, TSI Inc.), condensation counter (P-trak, TSI Inc.), notebook, GPS, batteries mounted on a two-wheel hand cart.

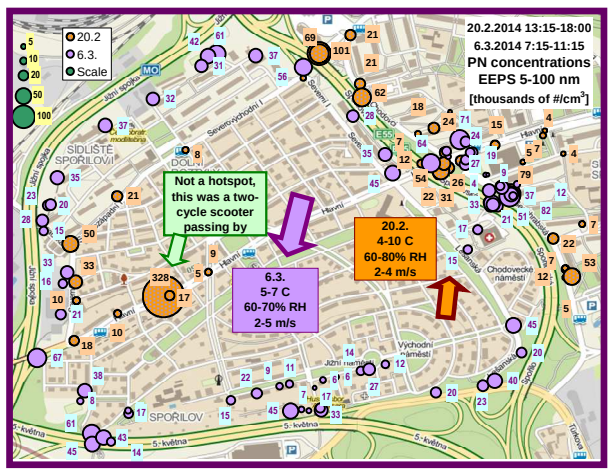
Above-roadway measurements with an instrumented vehicle

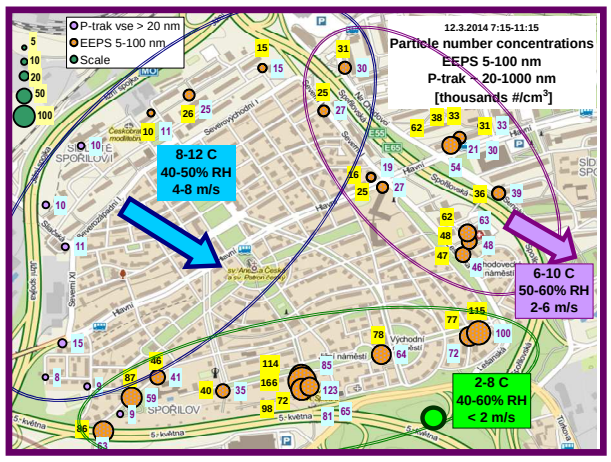
travel from Liberec to and around Prague
measurements 1.5 m above roadway

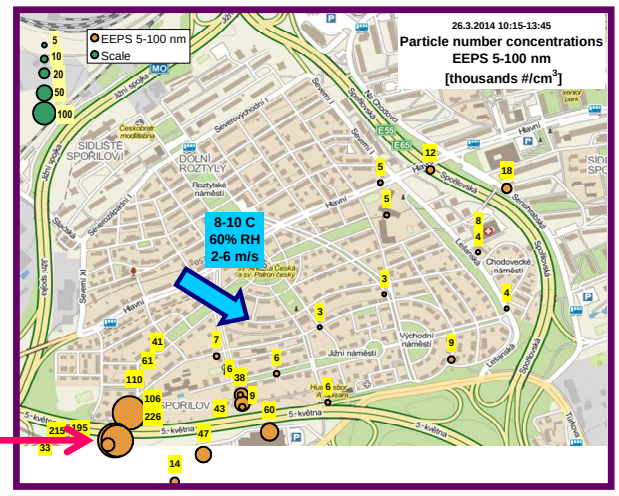


Spořilov neighborhood "instrumented walking tour"

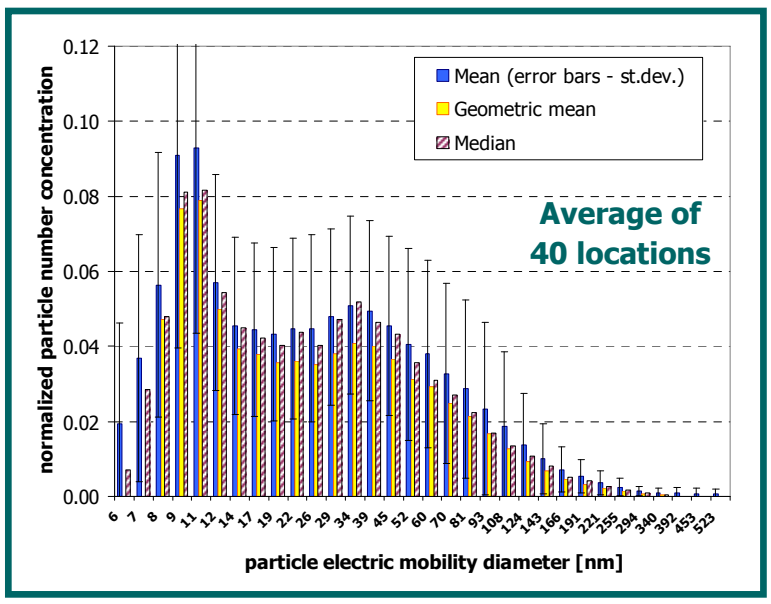
Quantitative measurements taken during 1-5 minute stops, qualitative assessment during walking.



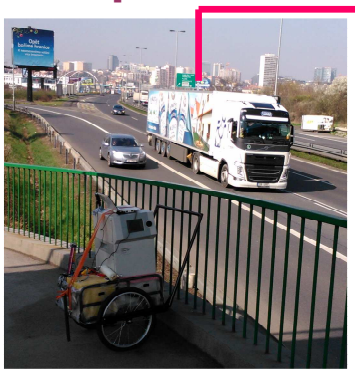


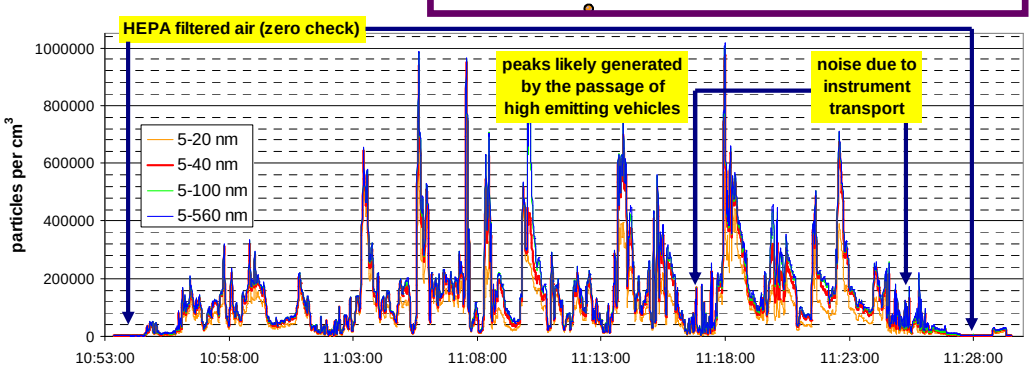


Size: Large peaks found around 10 nm
-- can be missed if measurements start around 15-20 nm (UFP studies) or 23 nm (PMP)
Size distribution corresponds to, i.e., diesel exhaust after thermodenuder
(Rönkkö et al., Environ. Sci. Technol., 2013, 47, 11882-11889)



"Spořilov hotspot": After low-speed travel through congested area of Prague, heavy trucks accelerate onto a freeway and climb a hill – "reentrainment" of material deposited in the exhaust system.





Conclusions

- Local concentration of ultrafine particles and nanoparticle hotspots were assessed by walking around the neighborhood with local citizens with a mobile fast particle electric mobility classifier.
- Concentrations above and near roadways exceed "urban background" (7000 #/cm^3 in Prague) by order(s) of magnitude.
- **Local hotspot found where trucks accelerate out of congested area.**
- **Peaks ~10 nm and in tens of nm observed near urban highways.**
- **Engines are not "black boxes producing emissions" evenly along the way; operating conditions and their history are important and should be considered.**

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