

Personal Monitor for Particulate Matter



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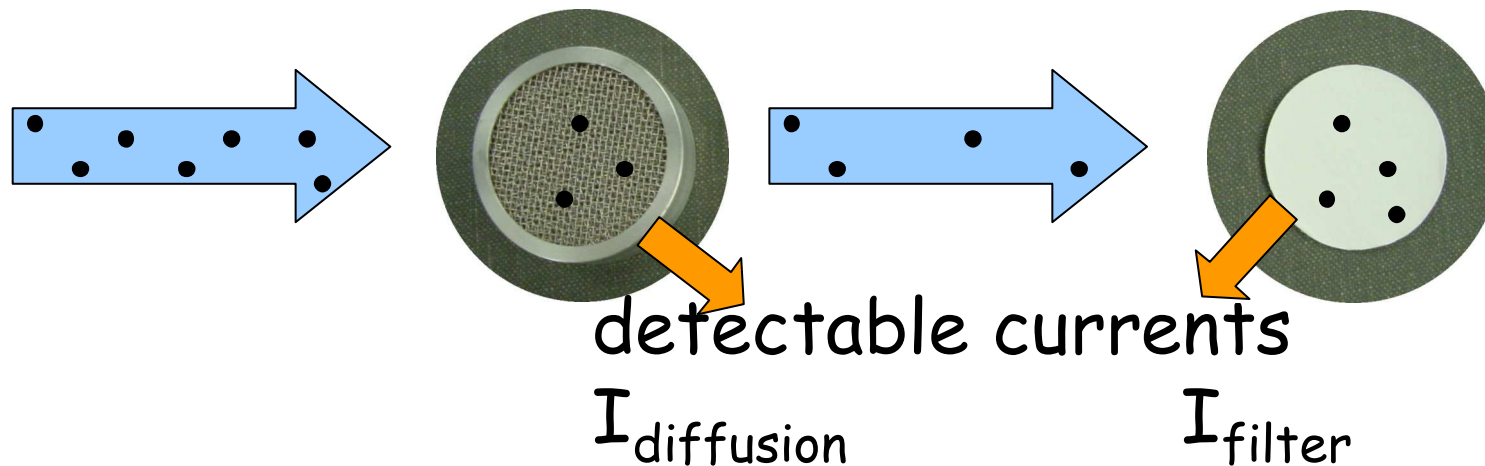
The diffusion size classifier (DiSC)



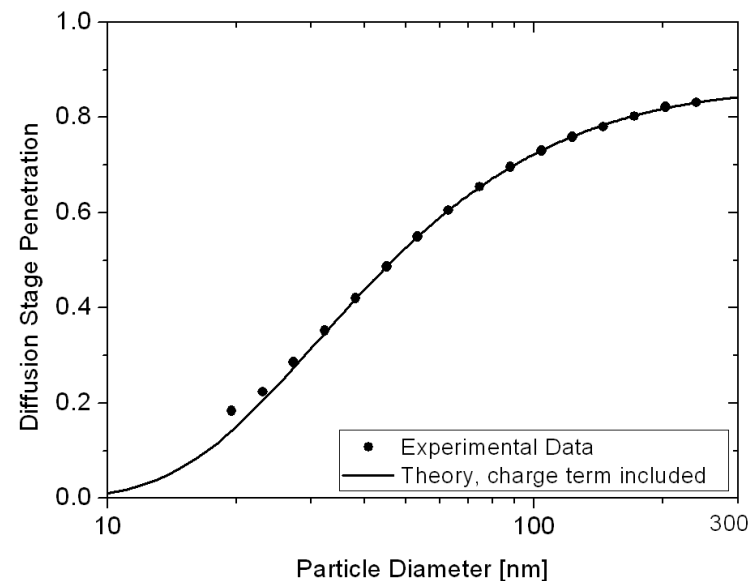
- The diffusion size classifier is a comparatively simple and robust instrument which can determine 3 quantities simultaneously with a high time resolution (1 second):
 - Particle number concentration
 - Average particle diameter
 - Lung-deposited surface area
- The instrument is based on charging and current detection, there is no working fluid like in a CPC.

The operating principle

- Particles are labelled with positive charges in a unipolar charger, so that they can later be detected by the current they induce
- Particles are deposited by diffusion in a "diffusion stage" and detected as an electrical current
- Remaining particles end up in a filter stage and also produce an electrical current

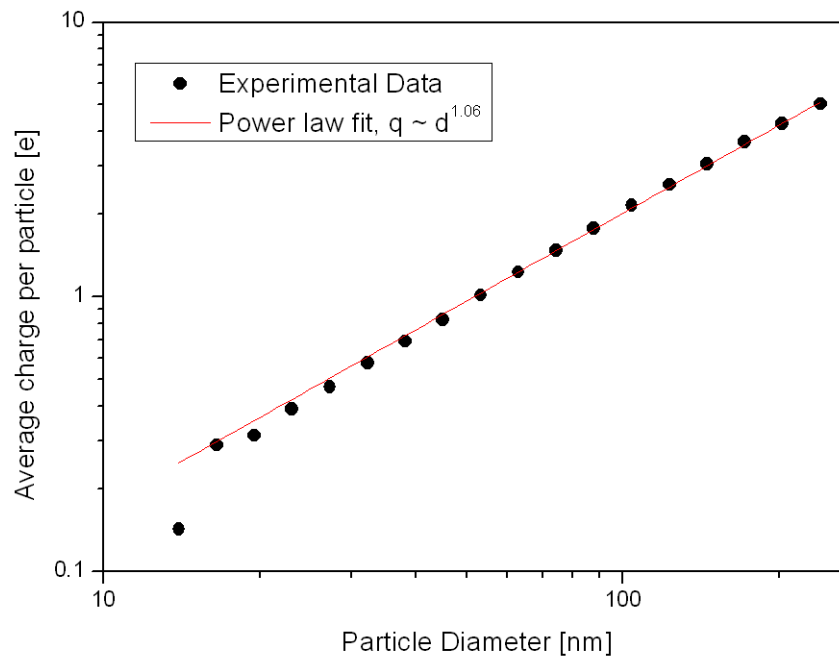


- Diffusion stage penetration is size-selective
- Graph shows experimental penetration values of diffusion stage for NaCl particles
- Measured ratio $I_{\text{filter}}/I_{\text{diffusion}}$ \rightarrow particle diameter



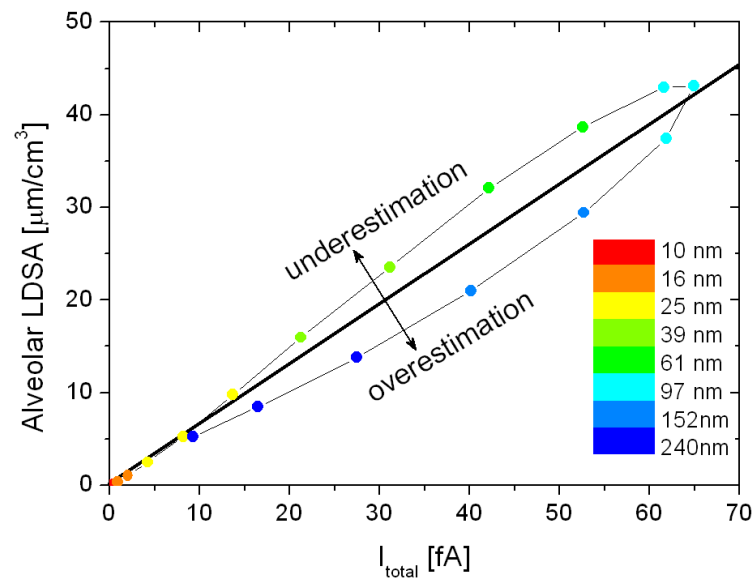
Number determination

- Charge per particle is a function of particle diameter => once the particle diameter is known, we can compute the particle number from the total current and the flow rate
- Power-law fit describes charging very well



Lung-deposited surface area (LDSA)

- DC signal correlates well with lung-deposited (alveolar or tracheobronchial) surface area
- Toxicologists believe surface area is important
- Graph shows correlation of DC signal with LDSA for particles in the size range of 10...240nm



Instrument specs (appearances)

- Weight: 670 g
- Size: 40x90x180 mm
- Battery life: 8 hours
- Data storage: SD-Card (up to 8GB)
- (optional) USB connection to PC

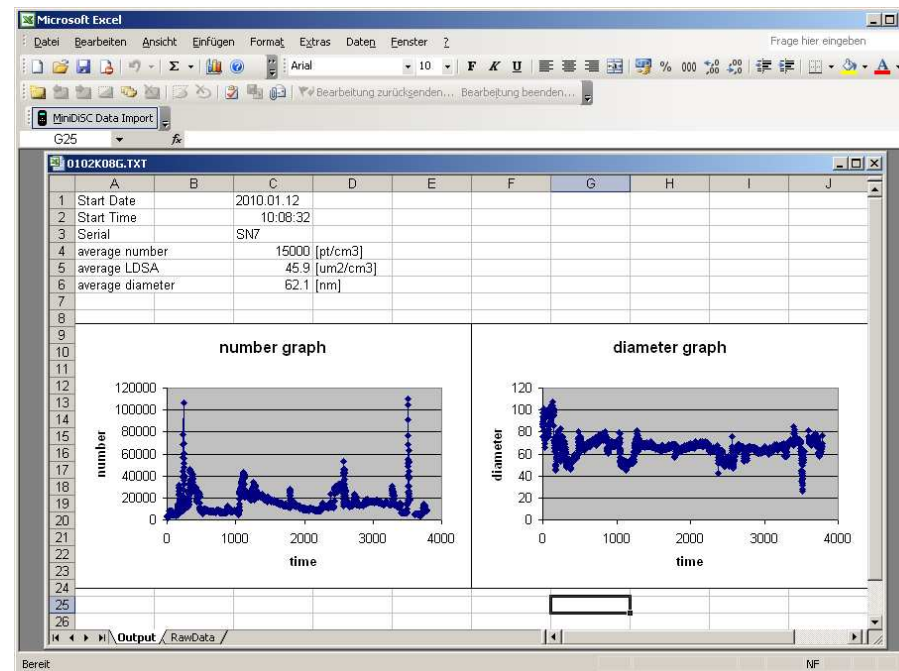


Instrument specs (inner values) ^{n|w}

- Particle number, average size, DC signal with **1s time resolution**
- Detection limits:
diameter ~10...300nm
number ~10³...10⁶ pt/ccm
- Accuracy typ. +/-30%
- Easy to use: turn on, press record button, load data in Excel

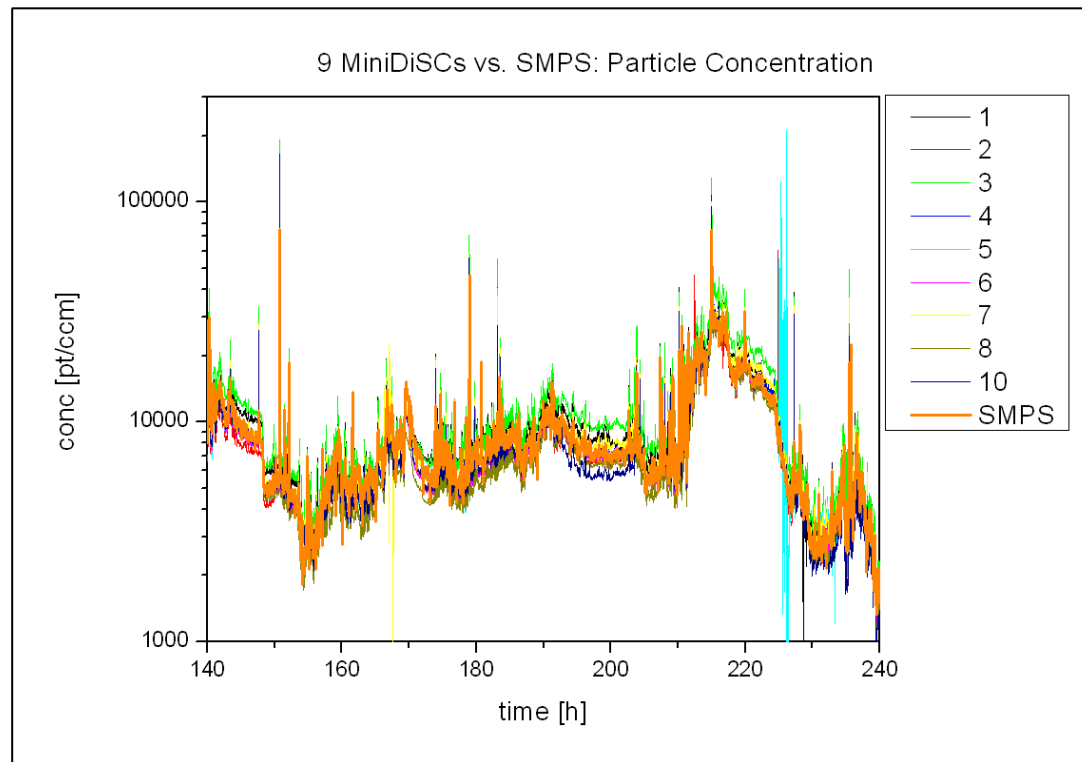


- Data files are stored on the SD-card
- Data files can be imported with one mouse click with an Excel add-in:



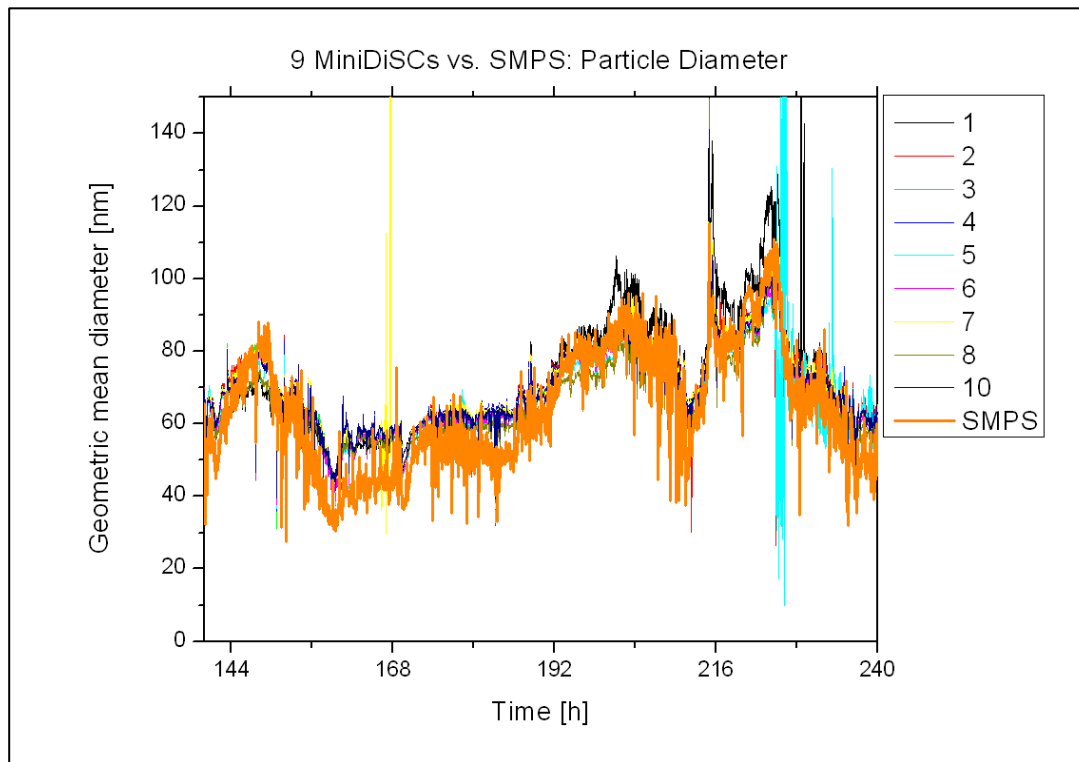
Some results

2-week comparison of 9 miniDiSCs with a TSI SMPS
Ambient air sampled in Windisch, Switzerland



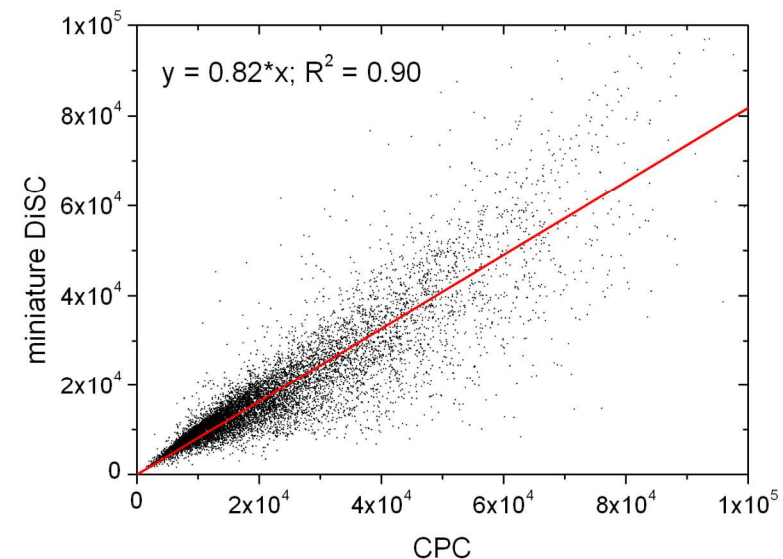
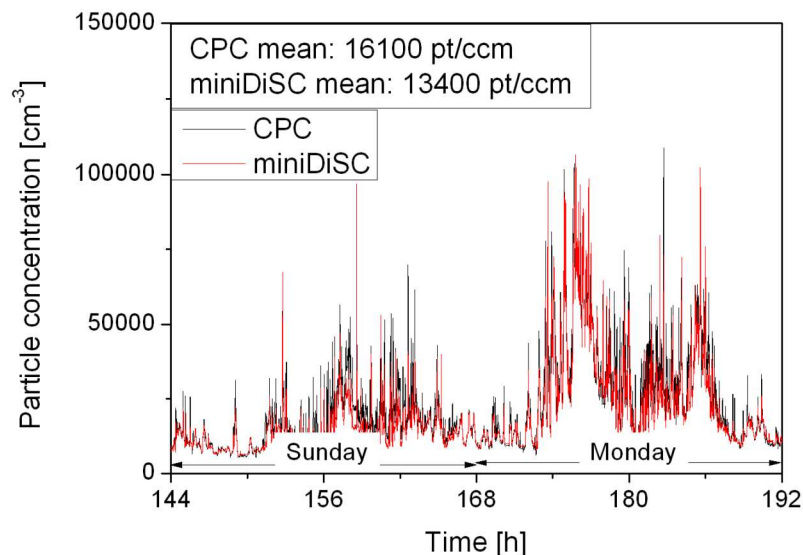
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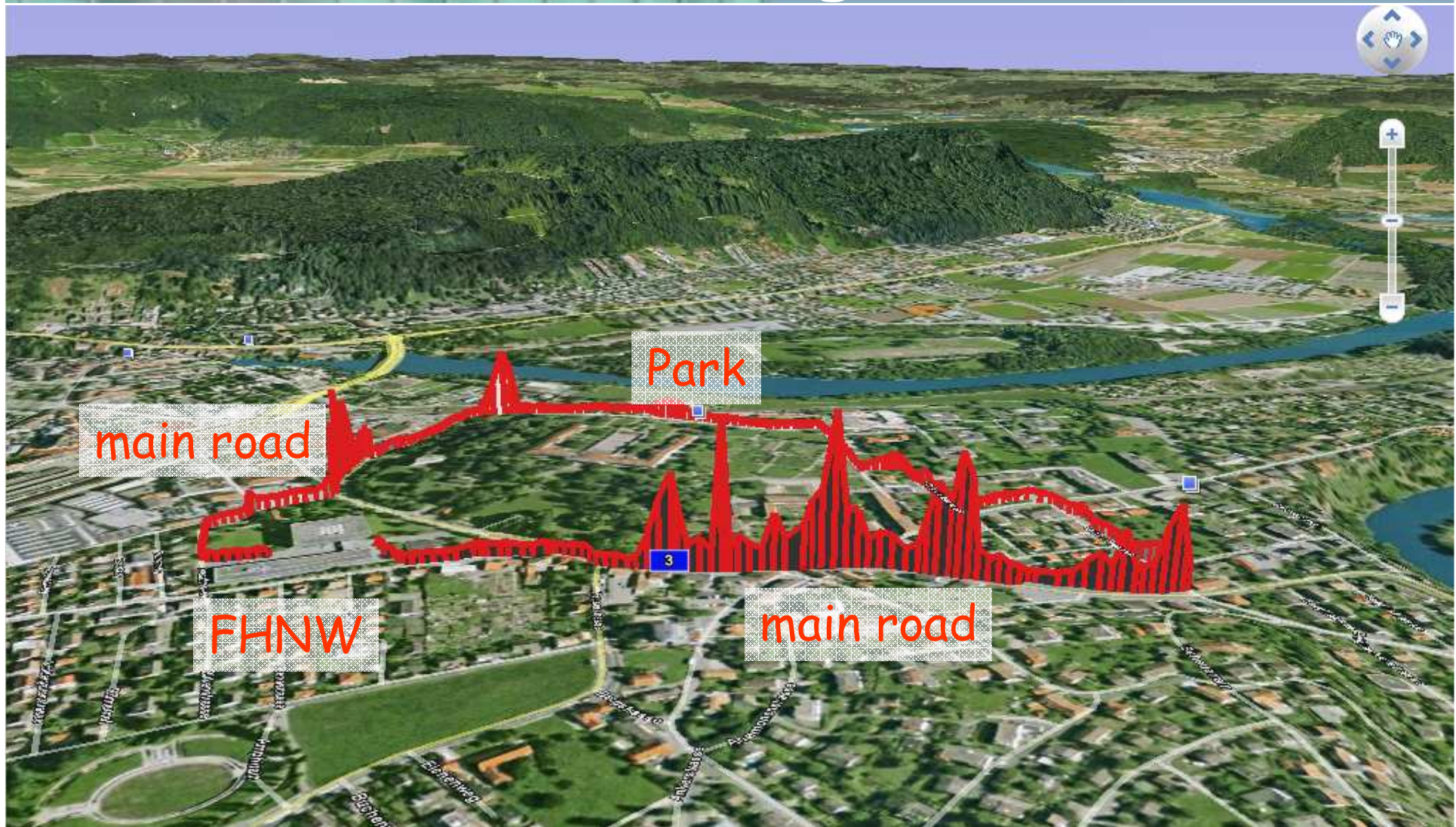


Some Results

MiniDiSC and TSI CPC 3775 co-located next to a Swiss highway for 1 week; CPC has a lower cutoff of 5nm and can see smaller/more particles than the miniDiSC.



Personal monitoring



- Units are expected to be available towards September 2010.

Contact martin.fierz@fhnw.ch for more information.