Ambient ultra-fine particle concentration monitoring during a “fine dust alert” event in Stuttgart focusing on high size and time resolution

T.Schripp, P. Oßwald

Institute of Combustion Technology, Chemical Analytics

Stuttgart – “The Beijing of Germany”

Einzelhandel und Feinstaub in Stuttgart

Touristen fragen nach Atemschutz

Von Sven Hahn 28. März 2017 - 13:50 Uhr

Aufgrund der extrem erweiterten

Tourists ask for respiratory protection

Source: www.stuttgarter-nachrichten.de

Ab 2018

Stuttgart verhängt Fahrverbot für ältere Diesel

Baden-Württembergs grün-schwarze Landesregierung bekämpft das Feinstaubproblem in Stuttgart: Ab 2018 werden alle Dieselautos, die nicht die Abgasnorm Euro 6 erfüllen, aus der Landeshauptstadt ausgesperrt.

Stuttgart imposed driving ban on older diesel engines

Source: www.spiegel.de

ENVIRONMENT

Stuttgart: Germany's 'Beijing' for air pollution?

In German "car city" Stuttgart, air pollution has reached harmful levels - again. Authorities are trying "soft" appeals to the public - but environmentalists blame Germany's strong car lobby for the smoggy air.

German newspapers have called Stuttgart "the German capital of air pollution." Comparisons were made to Beijing, China's megacity capital that has been making headlines for months over air pollution problems.

Source: www.dw.com

“Fine dust alert”

- Bases **solely** on weather forecast information / „expected limited atmospheric exchange“
- Usually ranges from 15th October to 15th April („heating period“)

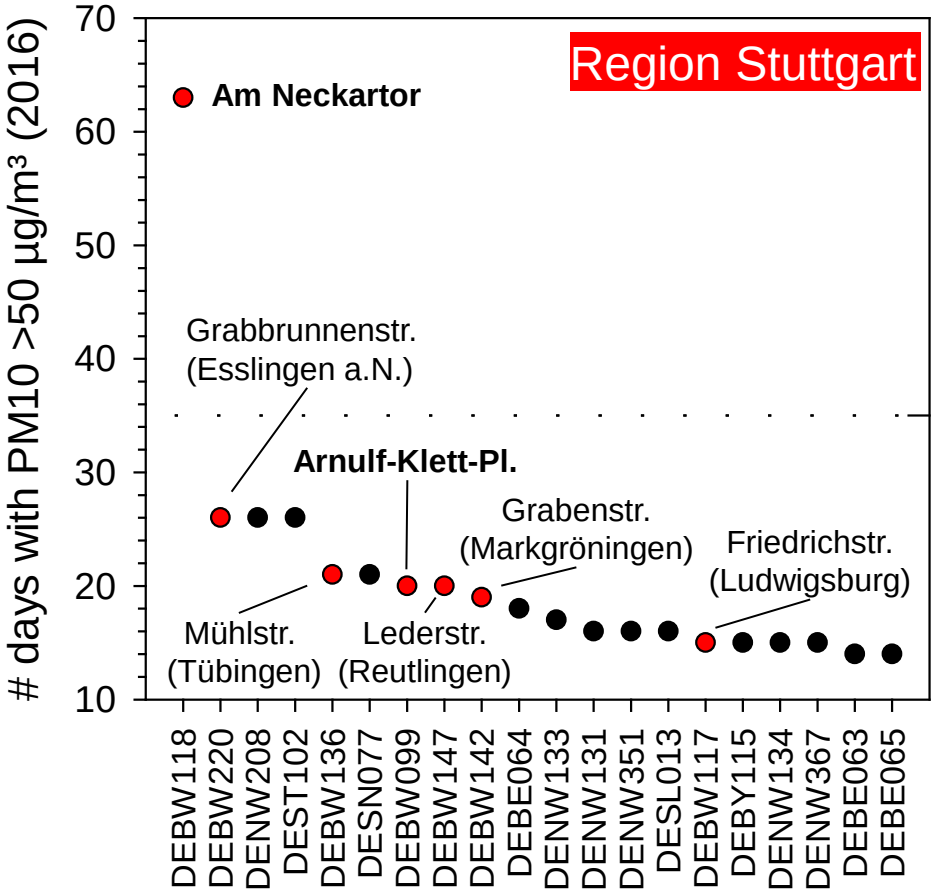
Measures

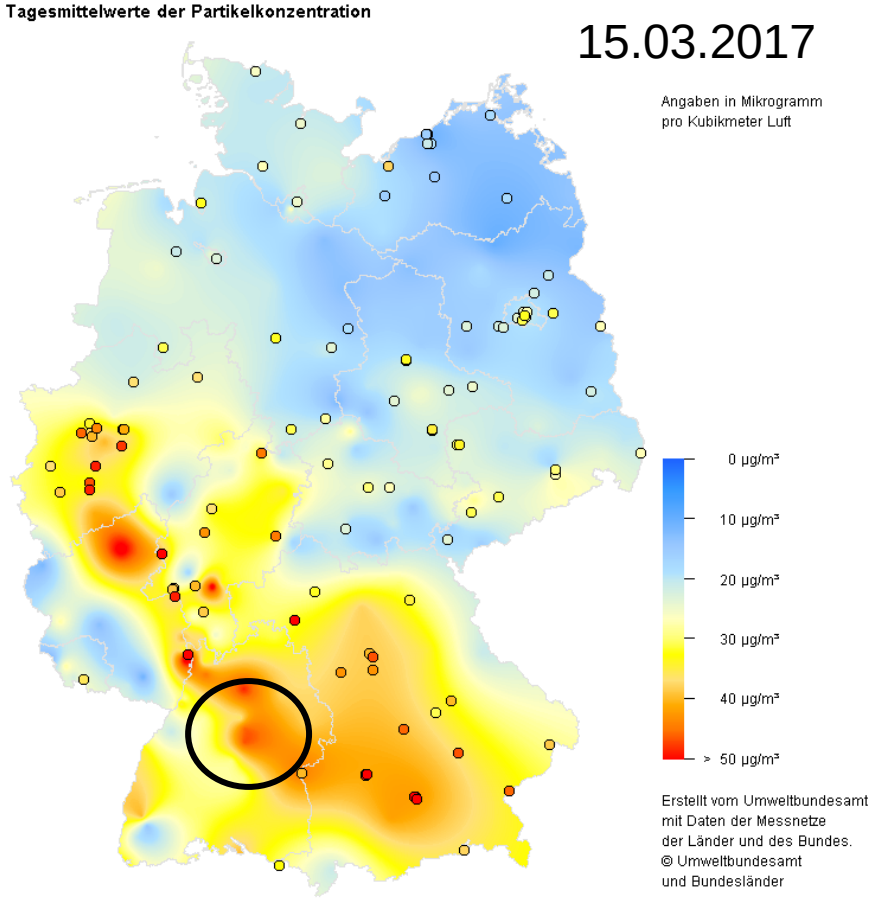
- General public information
- Operation of wood heating systems („comfort heaters“) is prohibited
- Reduced fares for public transport

2016

- 13 „fine dust alerts“
- Conditions apply for 85 days

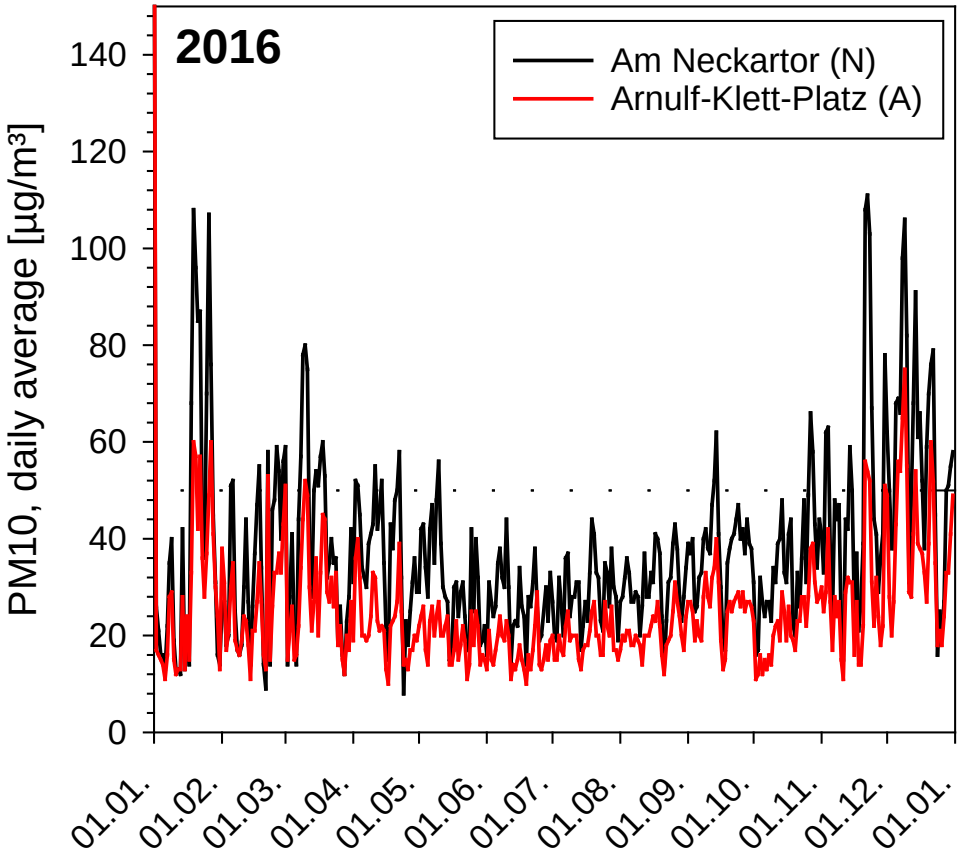
Fine dust monitoring in Germany



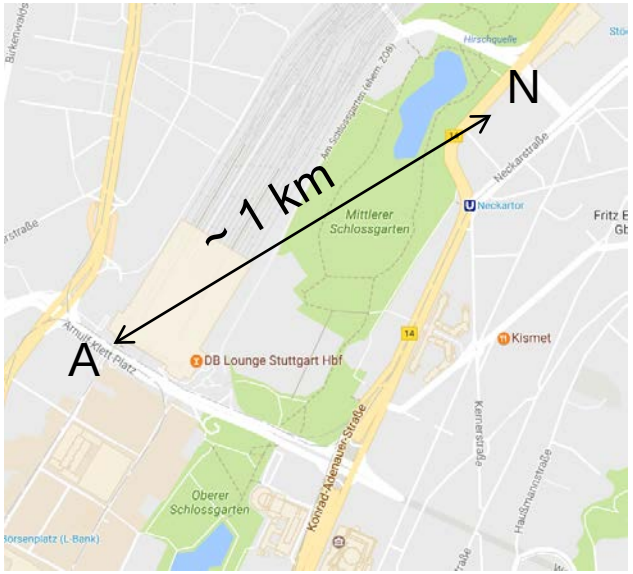


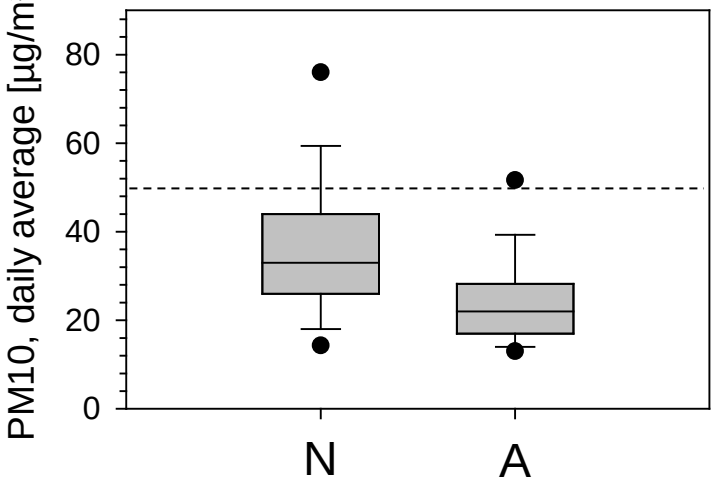
Source: German Environmental Protection Agency (UBA)

Spatial differences in fine dust distribution



Data source: German Environmental Protection Agency (UBA)





Air monitoring at Kernerplatz - Setup

Engine Exhaust Particle Sizer (EEPS)

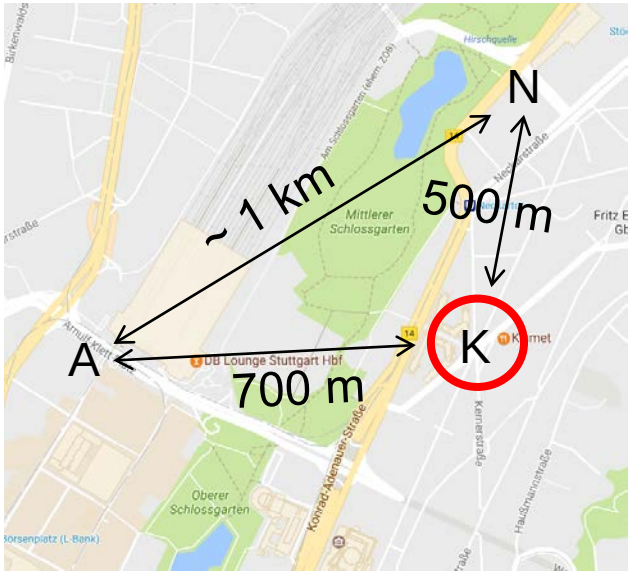
- 5.6 – 560 nm
- 10 / s

Scanning Mobility Particle Sizer (SMPS)

- 8 – 300 nm
- 300 s scan time

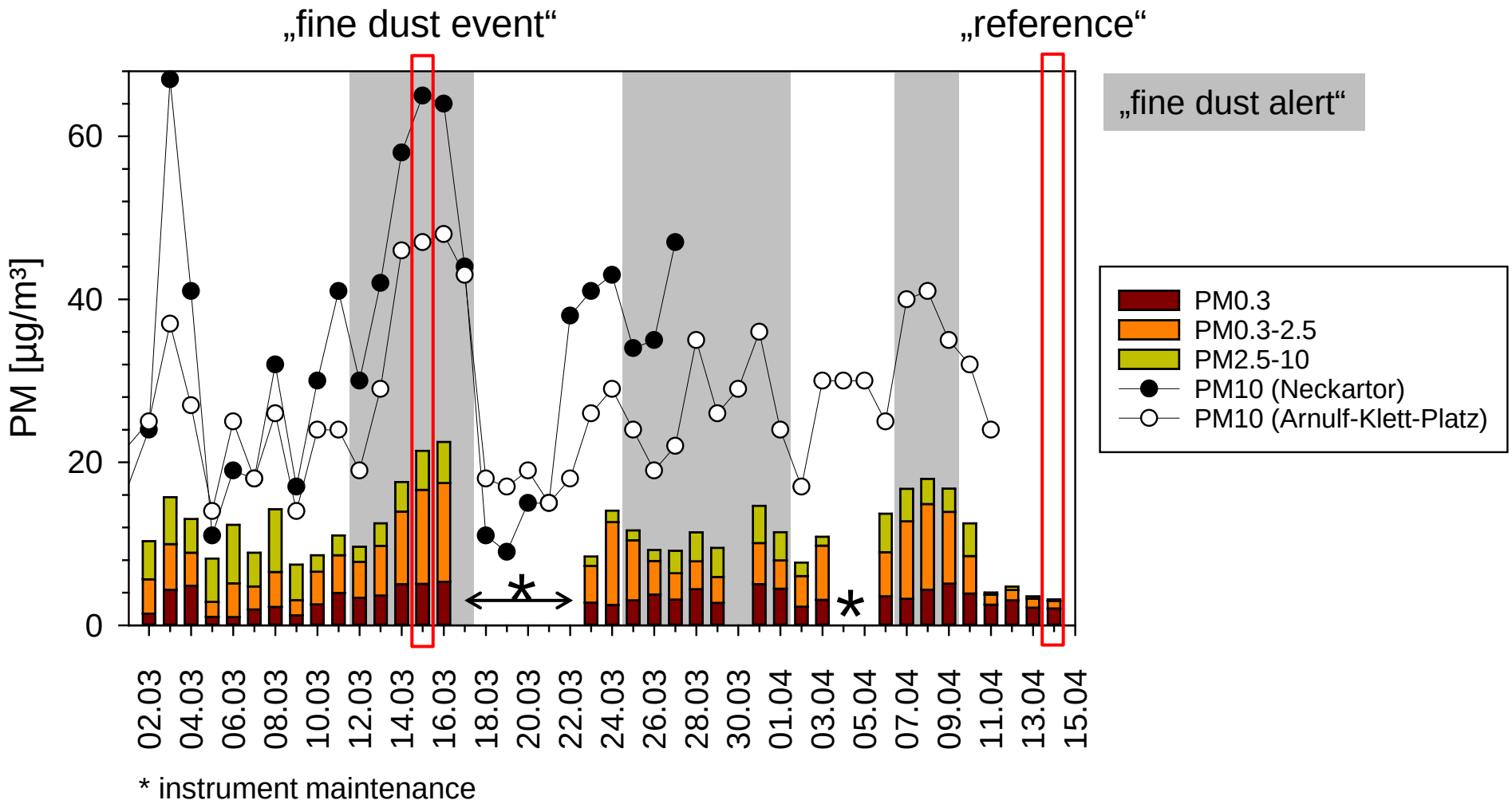
Optical Particle Sizer (OPS)

- 0.3 – 10 µm
- 30 s scan time



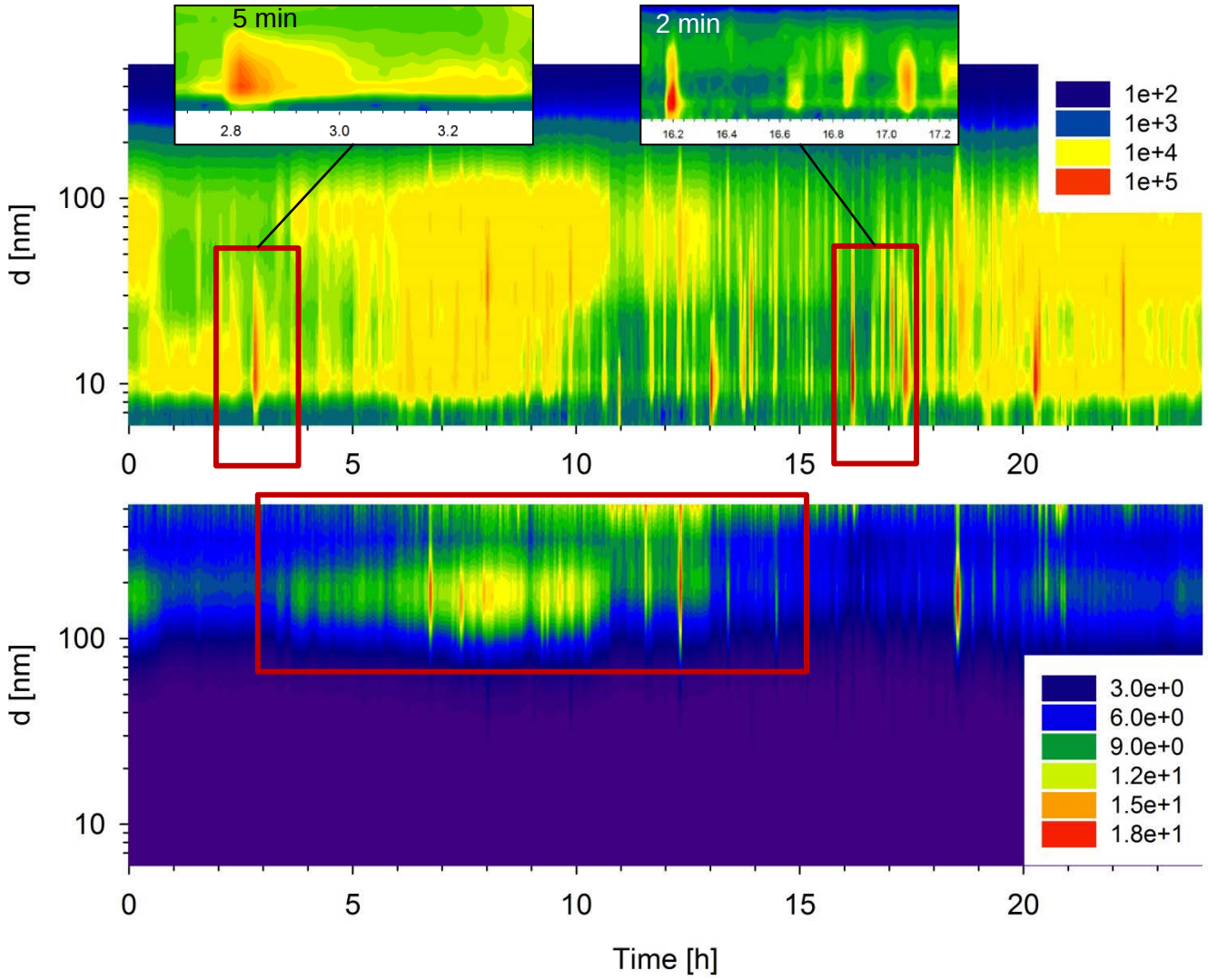
- March / April 2017
- Sampling height 10 m
- Additional: Wind speed, wind direction, temperature, rel. humidity

Air monitoring at Kernerplatz - Results



(Estimated particle density: 1 g/cm³)

Single event identification (15.03.2017)



Particle **number** distribution (log scale)

Singular peak events not strongly contributing to detected particle mass concentration

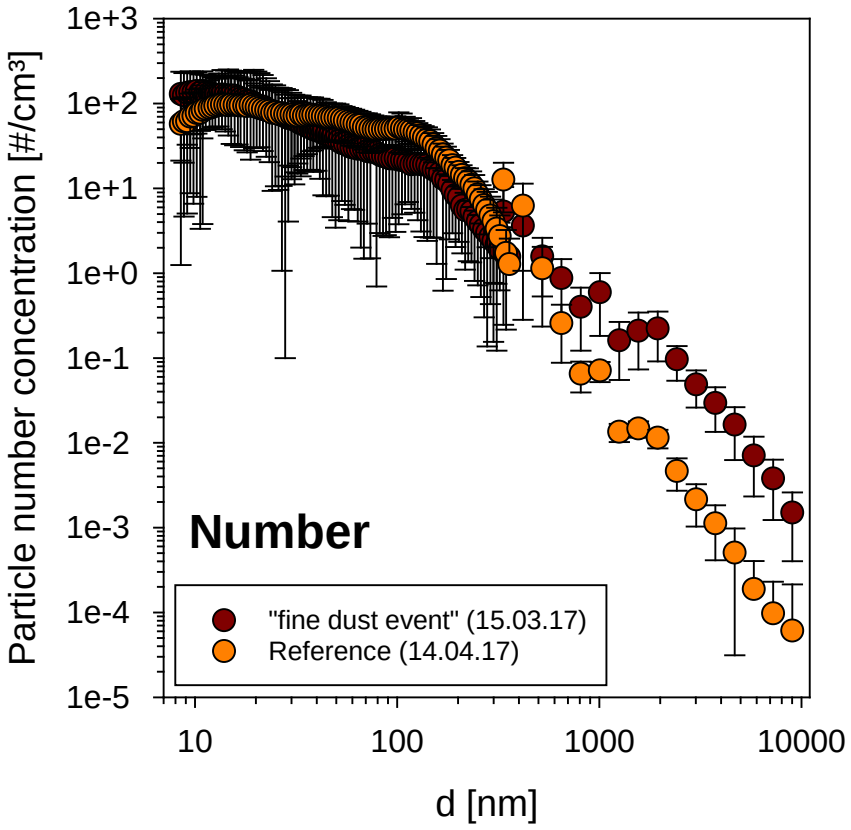
Particle **mass** distribution

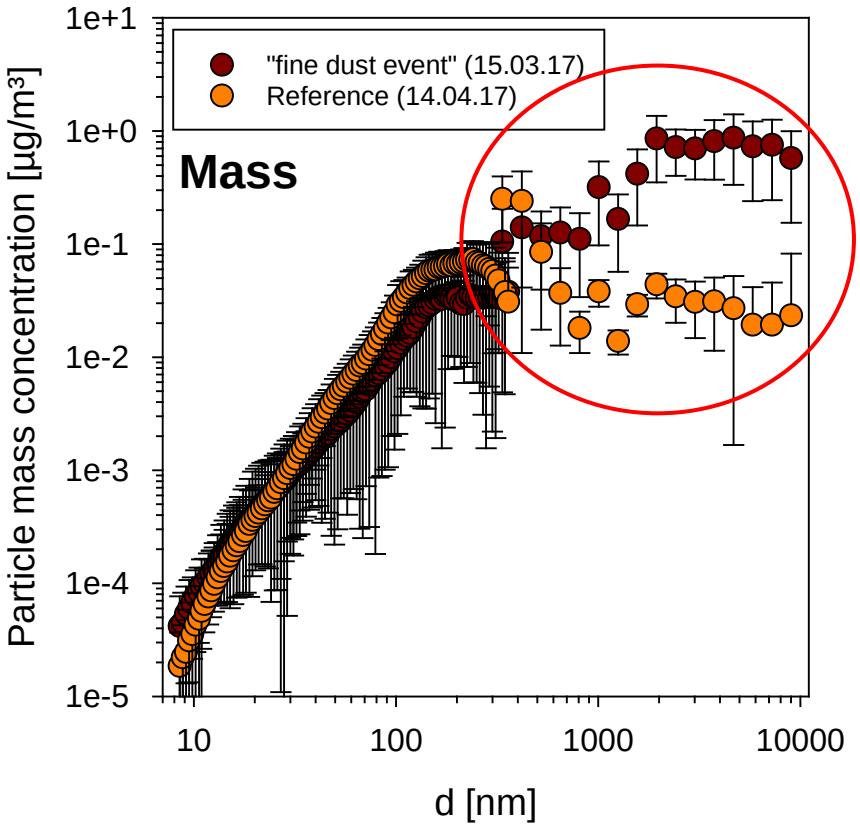
Particle mass dominated by „traffic hours“ (6:00 – 15:00)

Time resolution: 1 s

Particle size distribution

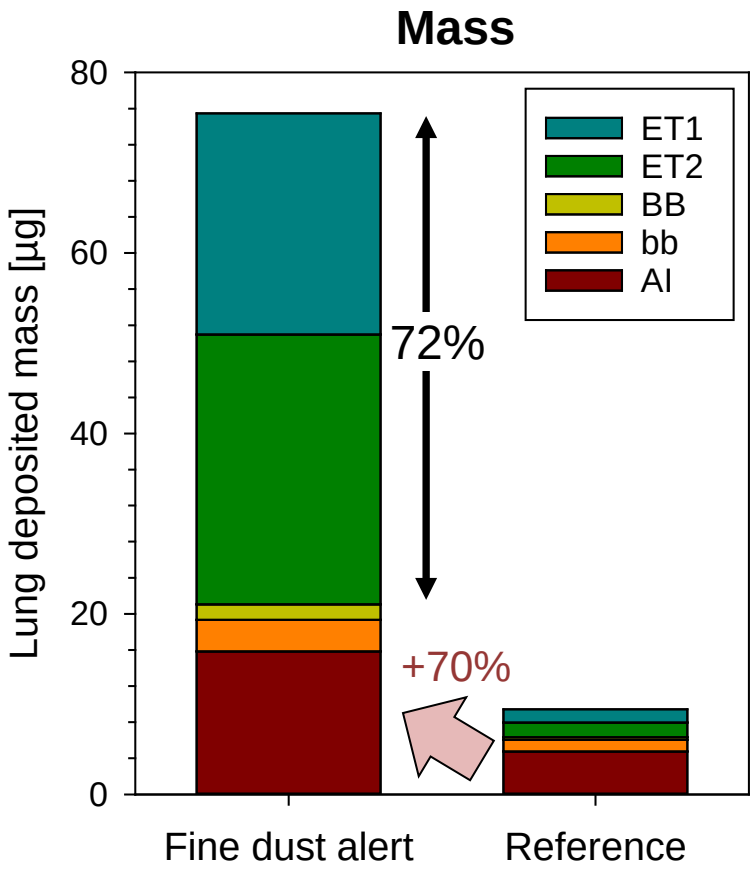
- During the „fine dust alert“ the particles > 0.3 µm are signifcantly higher
- Mass and number distribution feature high concentrations in the range 100 – 300 nm (usually low filter efficiency)

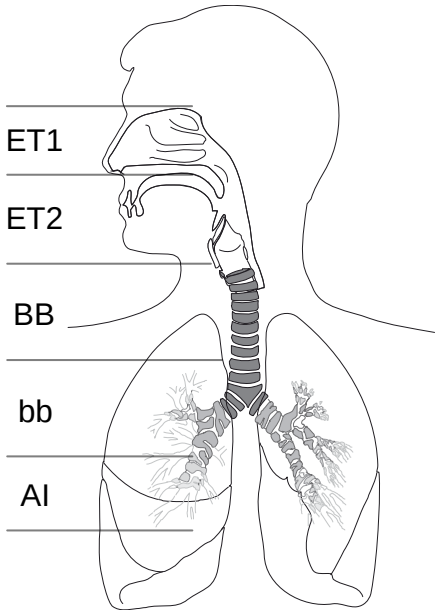




Difference in exposure

- Since the deviation is in the „larger“ particle size fraction the main deposition occurs in the upper respiratory pathways



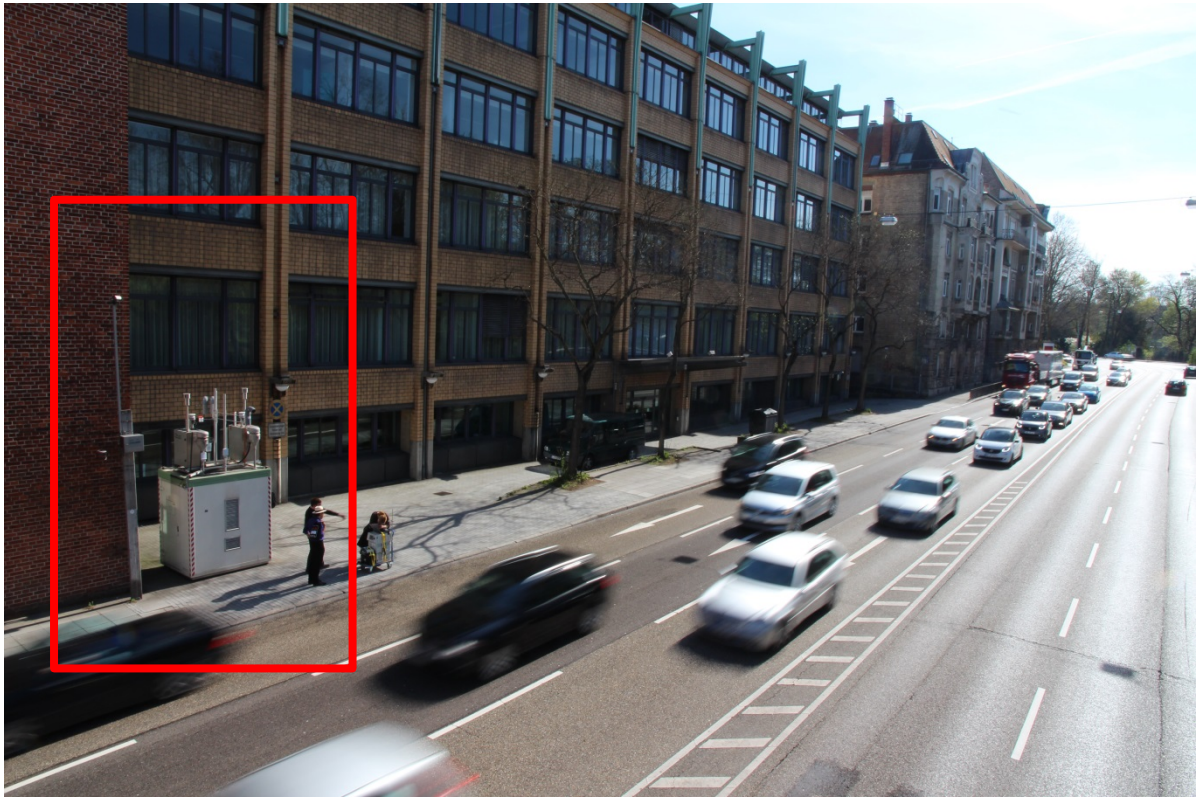


PM10

PM2.5

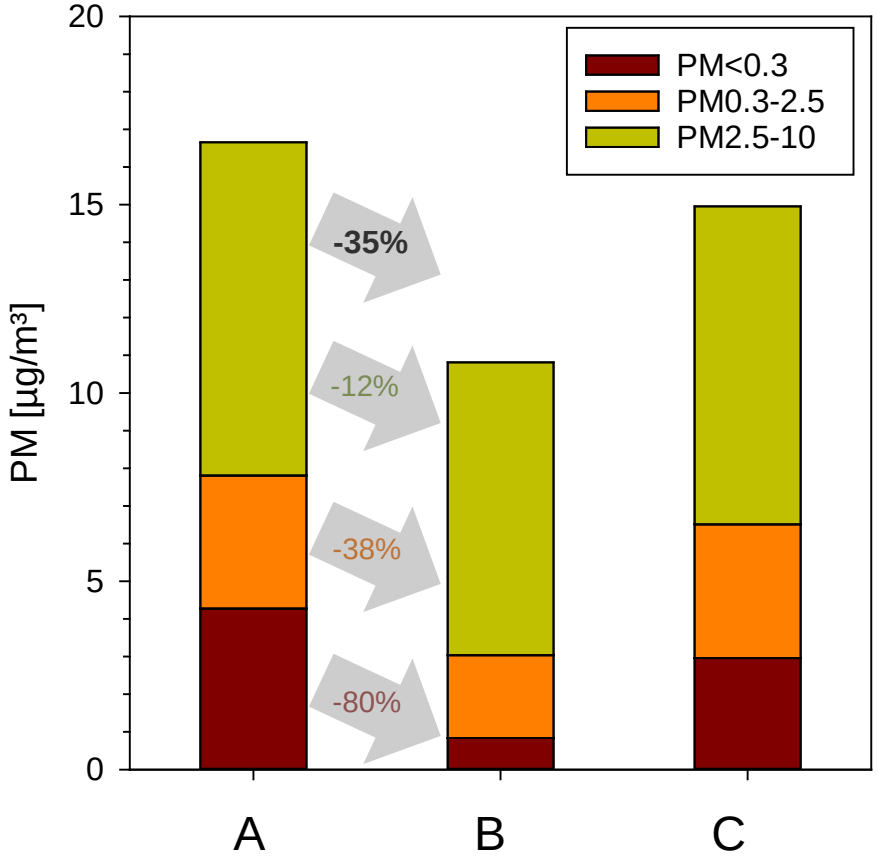
UFP

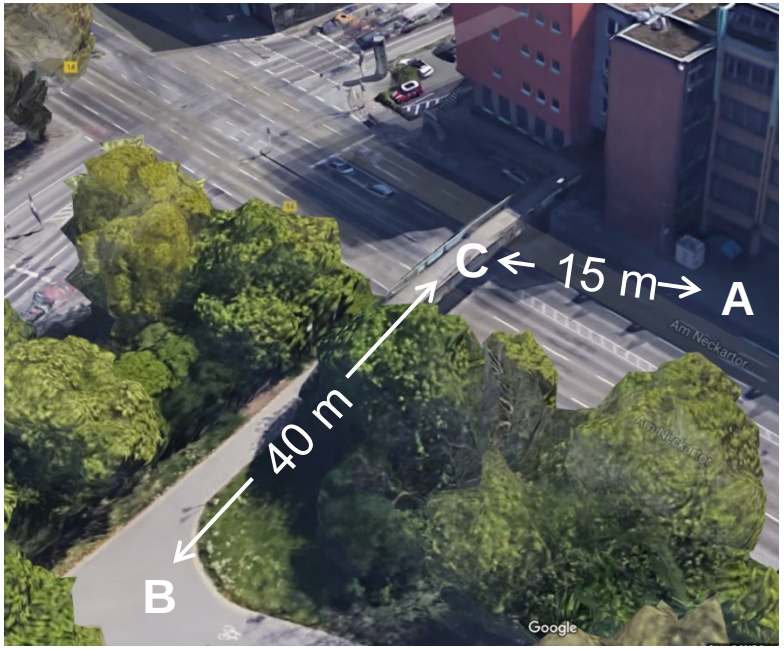
Comparison to Neckartor station

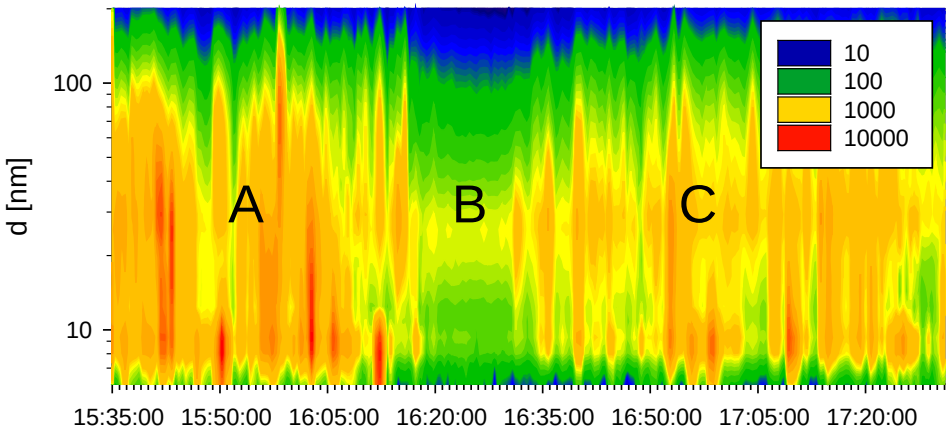


- Mobile EEPS and OPS measurement (5.6 nm – 10 µm)
- Variation of the sampling position around the Neckartor sampling station

Comparison to Neckartor station







- Daily-average PM 36 µg/m³
- Small variation of measuring position has huge impact on measured PM

Private sensor monitoring network in Stuttgart

Home > Wissen > Feinstaubbelastung - Dreck-Sensor im Eigenbau

8. März 2017, 18:56 Uhr Feinstaubbelastung

Dreck-Sensor im Eigenbau

Eine Stuttgarter Initiative hat ein Netz aus selbstgebastelten Feinstaub-Messgeräten aufgebaut, deren Daten im Internet abrufbar sind. So wollen die Aktivisten das Bewusstsein für Luftverschmutzung stärken.

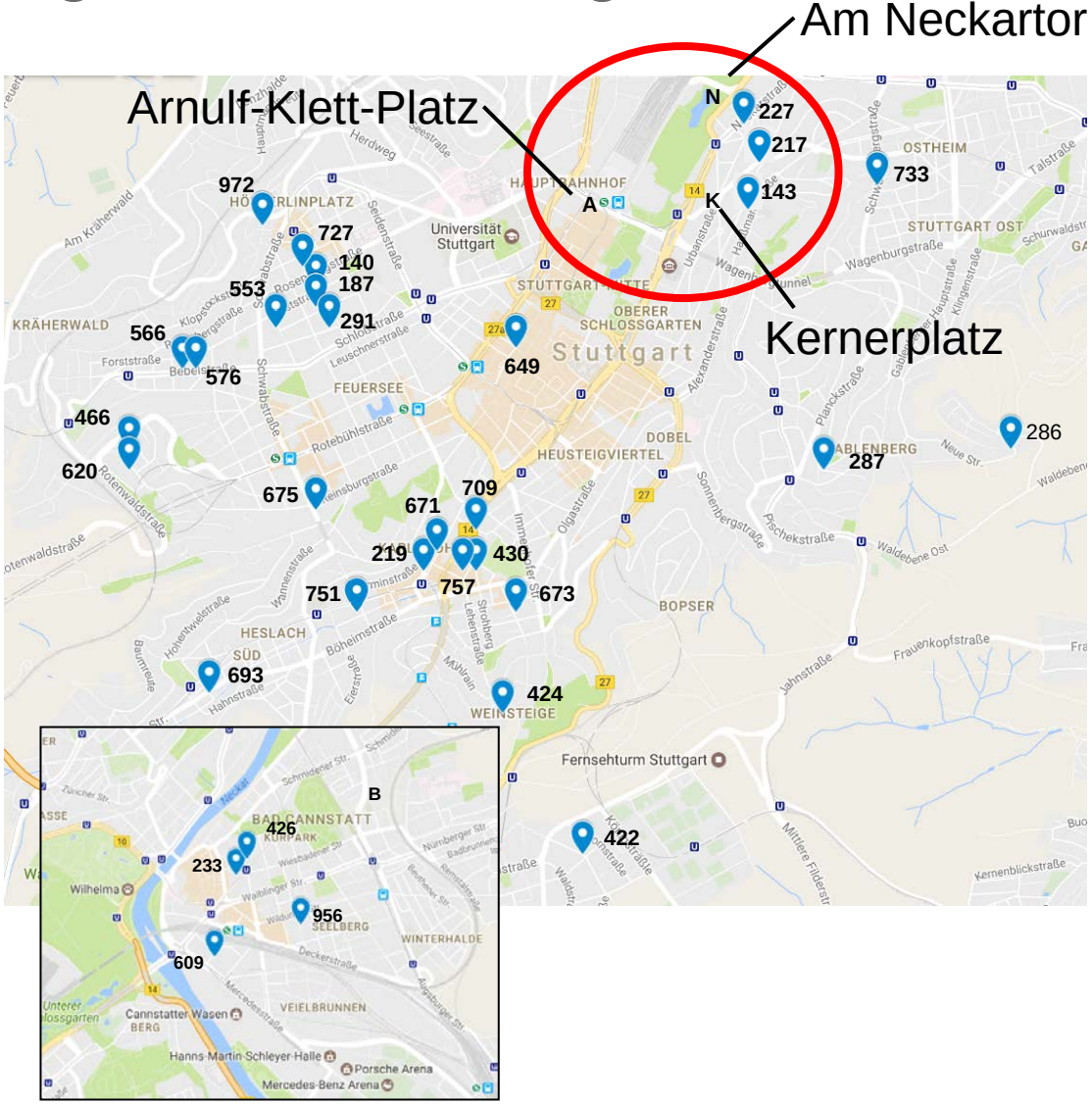
Von Walther Weiss

Feedback

Stuttgart ist die Feinstaub-Hauptstadt Deutschlands. Das

Build your own „dirt“-sensor

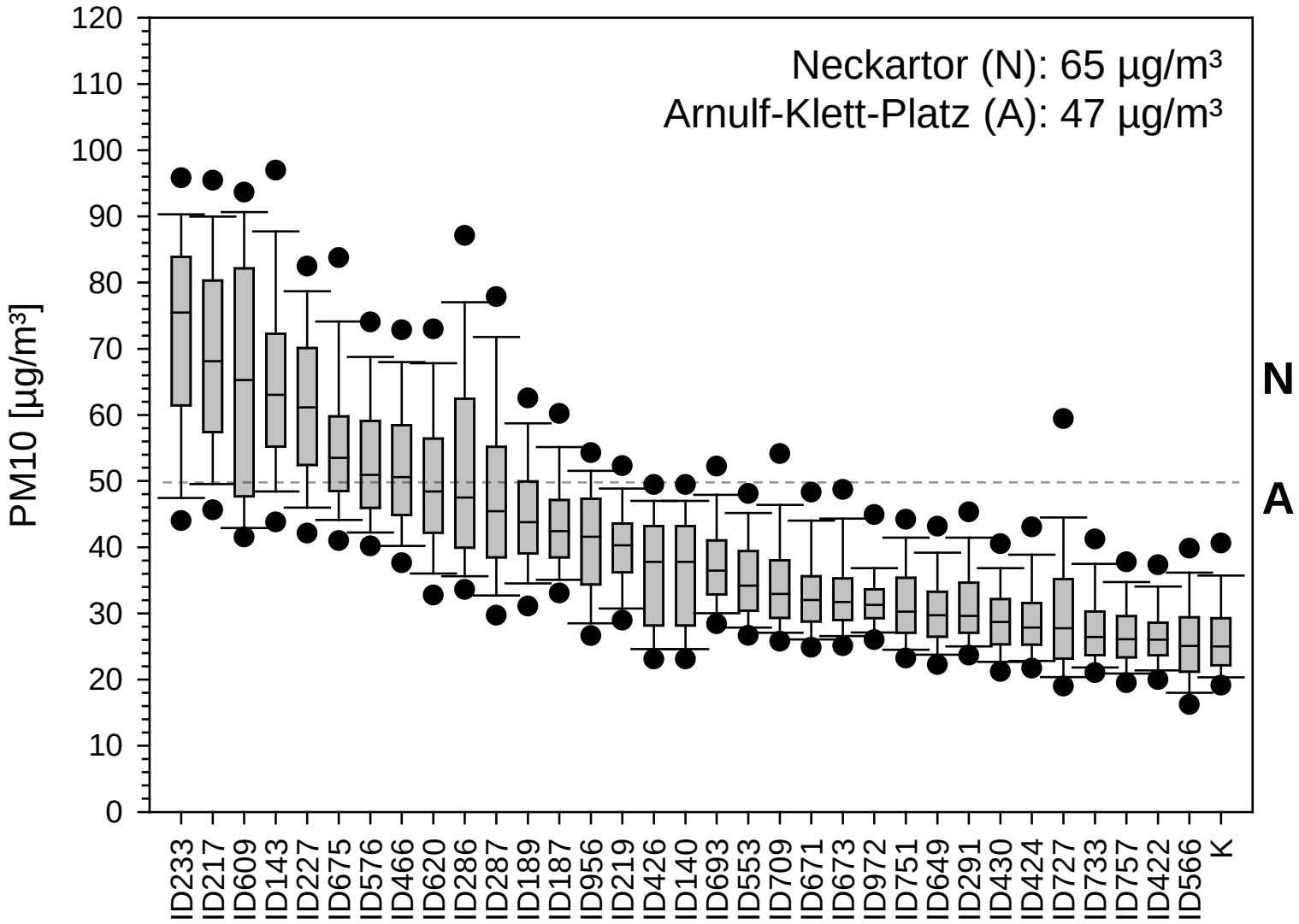
Source: www.sueddeutsche.de



- Light-scattering sensors for PM10 and PM2.5
- Self-built board with WiFi access

http://luftdaten.info/

Results for Wednesday 15.03.2017 (“fine dust alert”)



Conclusions

- Elevated airborne particle concentrations during the selected „fine dust alert“ event were limited to certain areas of Stuttgart
- Single event analysis / assignment of source and observed concentration need time-resolved measurements
- The strongest increase during „fine dust alert“ happens in the range > 0.3 µm; leading to an increased exposure in the upper respiratory pathways
- The public sensor network observed particle mass concentrations from 20 – 100 µg/m³ (daily average) for a day with „fine dust alert“
- Measuring solutions and additional data (e.g. sensors) are available; they should be embedded in a general concept!

Thank you for your attention!

Many thanks to the operators of http://luftdaten.info and their contributors!