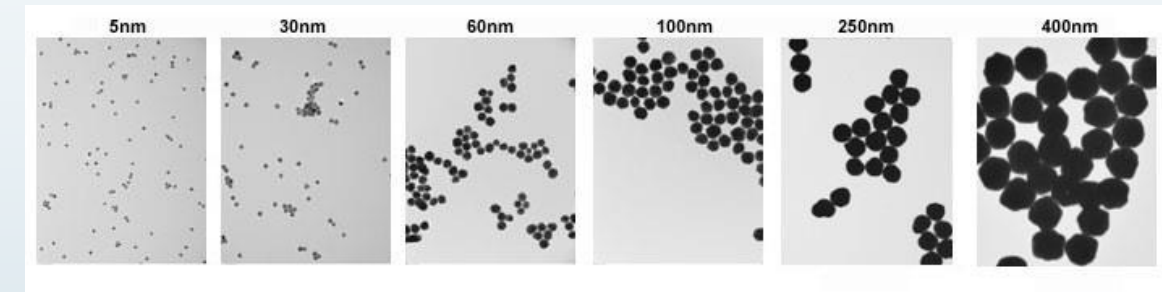
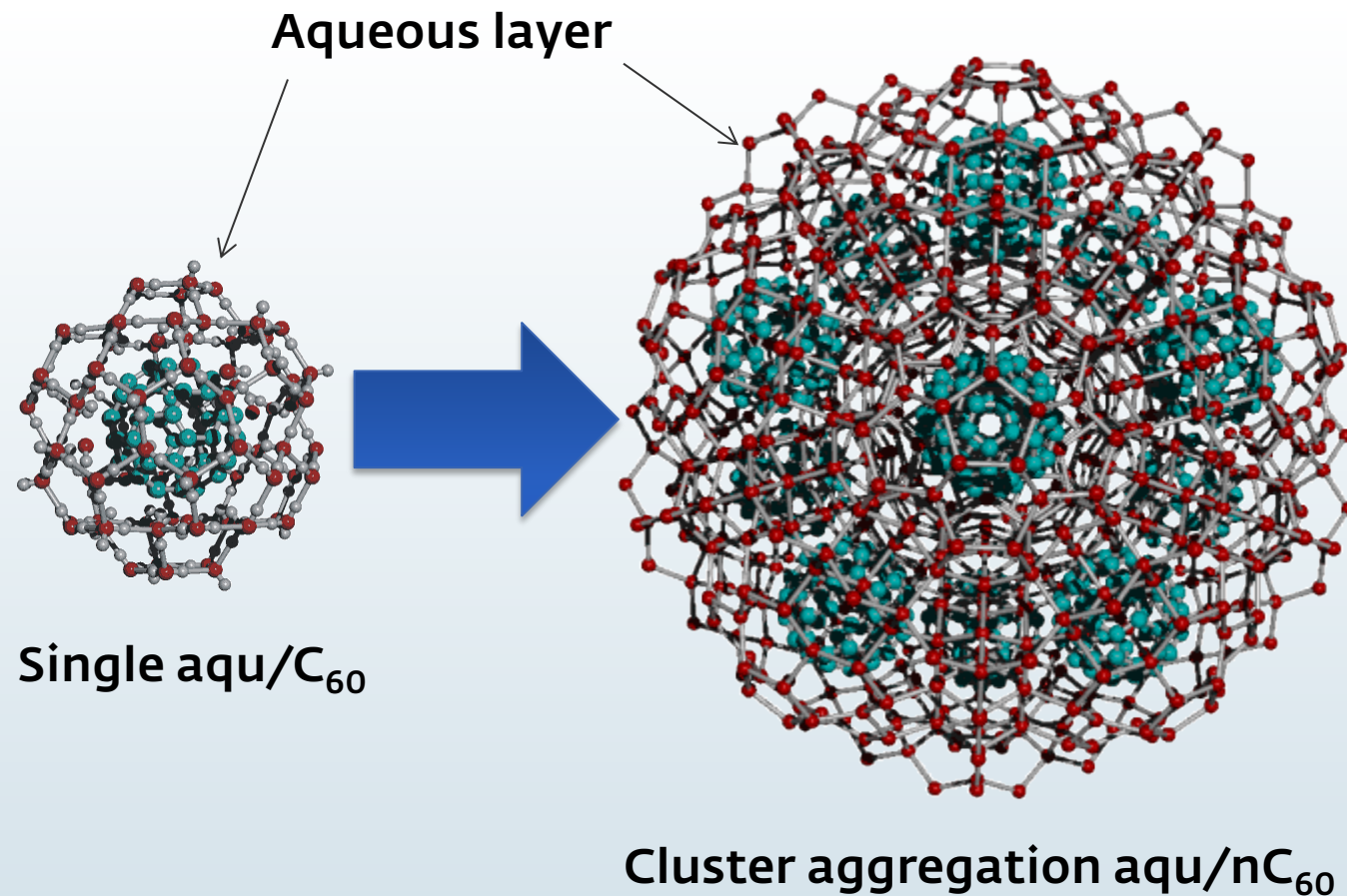


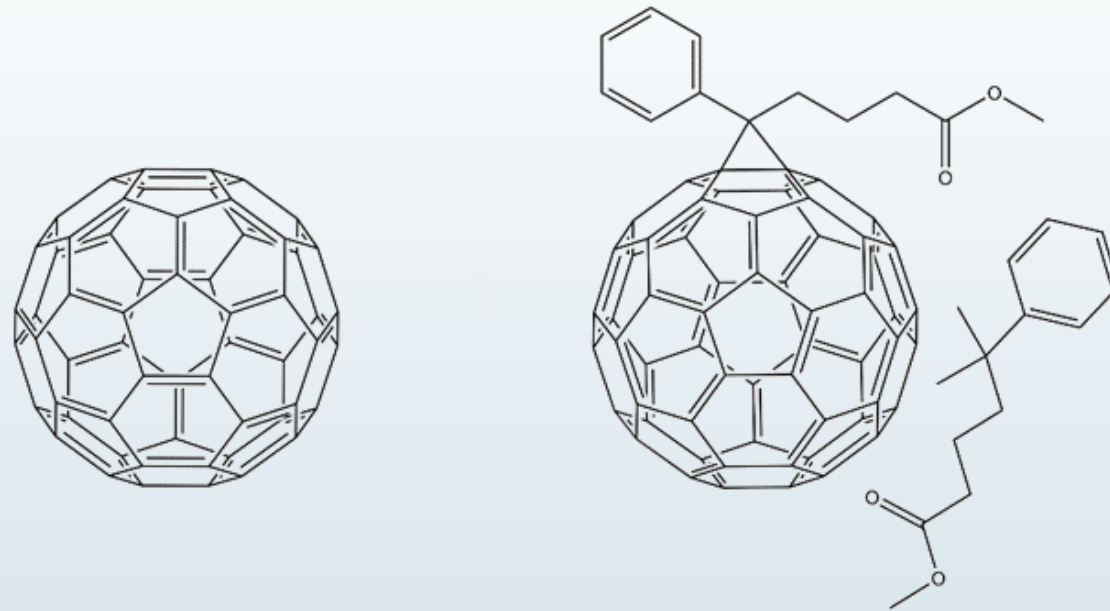
Can we find nanoparticles in the environment?

Patrick S. Bäumlein

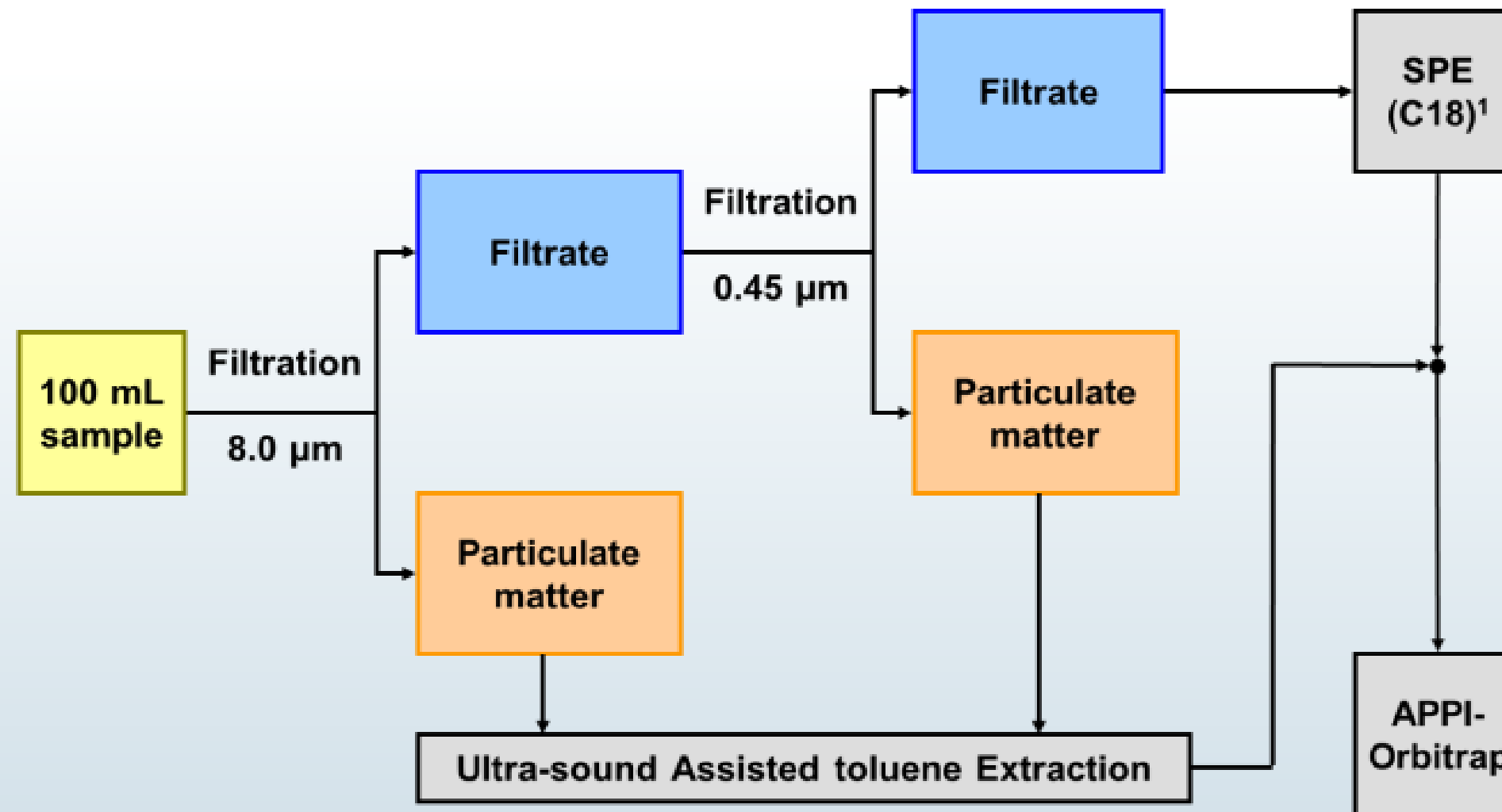
Which particles are we interested in?



Functionalised Fullerenes



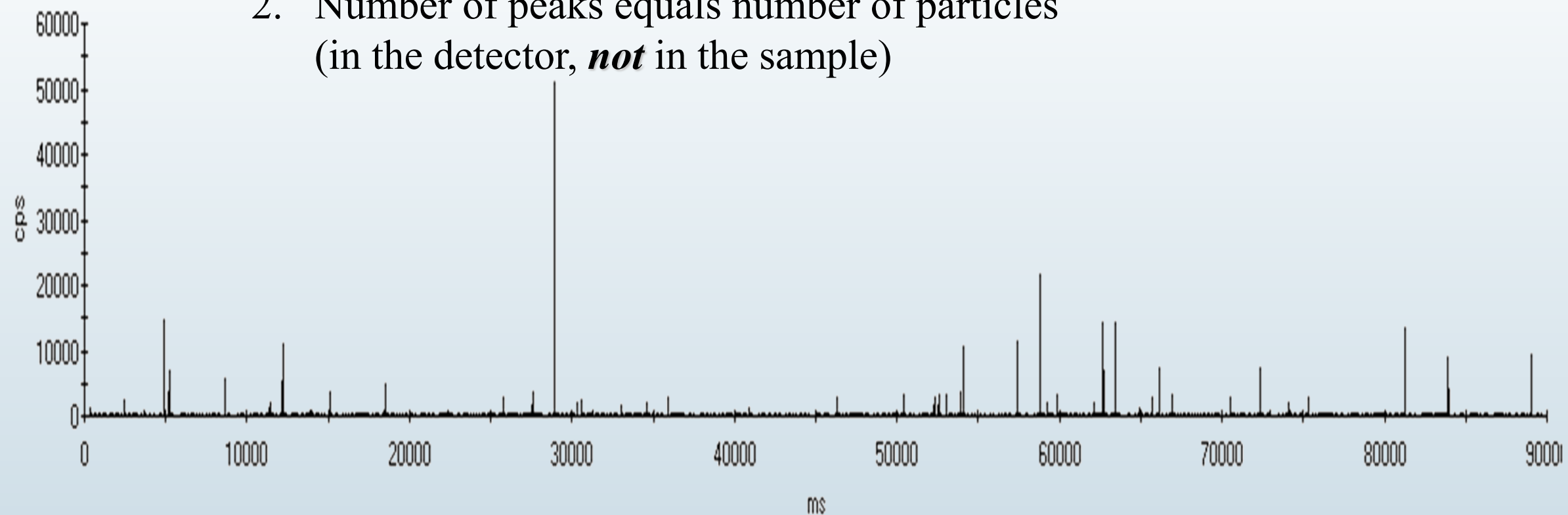
Fullerene method



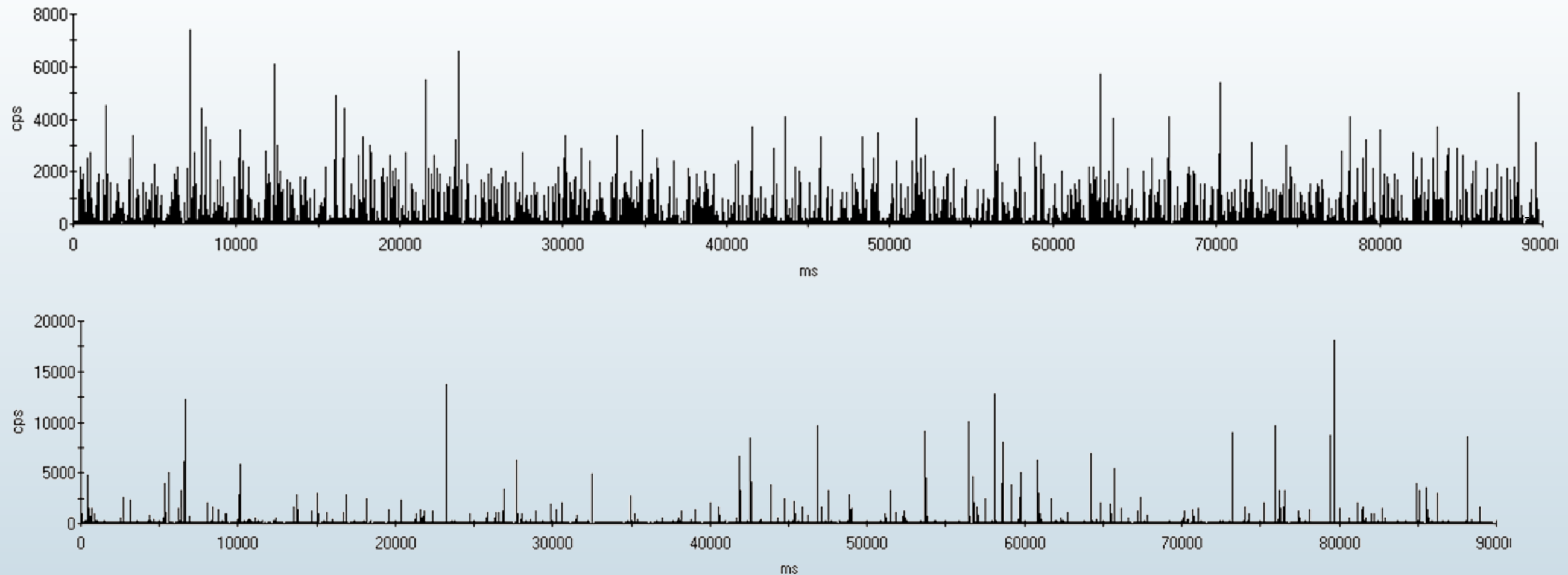
E. Emke, J. Sanchis, M. Farre, P. Bauerlein, P. de Voogt, Determination of Several Fullerenes in Sewage Water by LC hr-MS using Atmospheric Pressure Photo Ionisation, *Environmental Science: Nano* 2 (2015) 167-176.

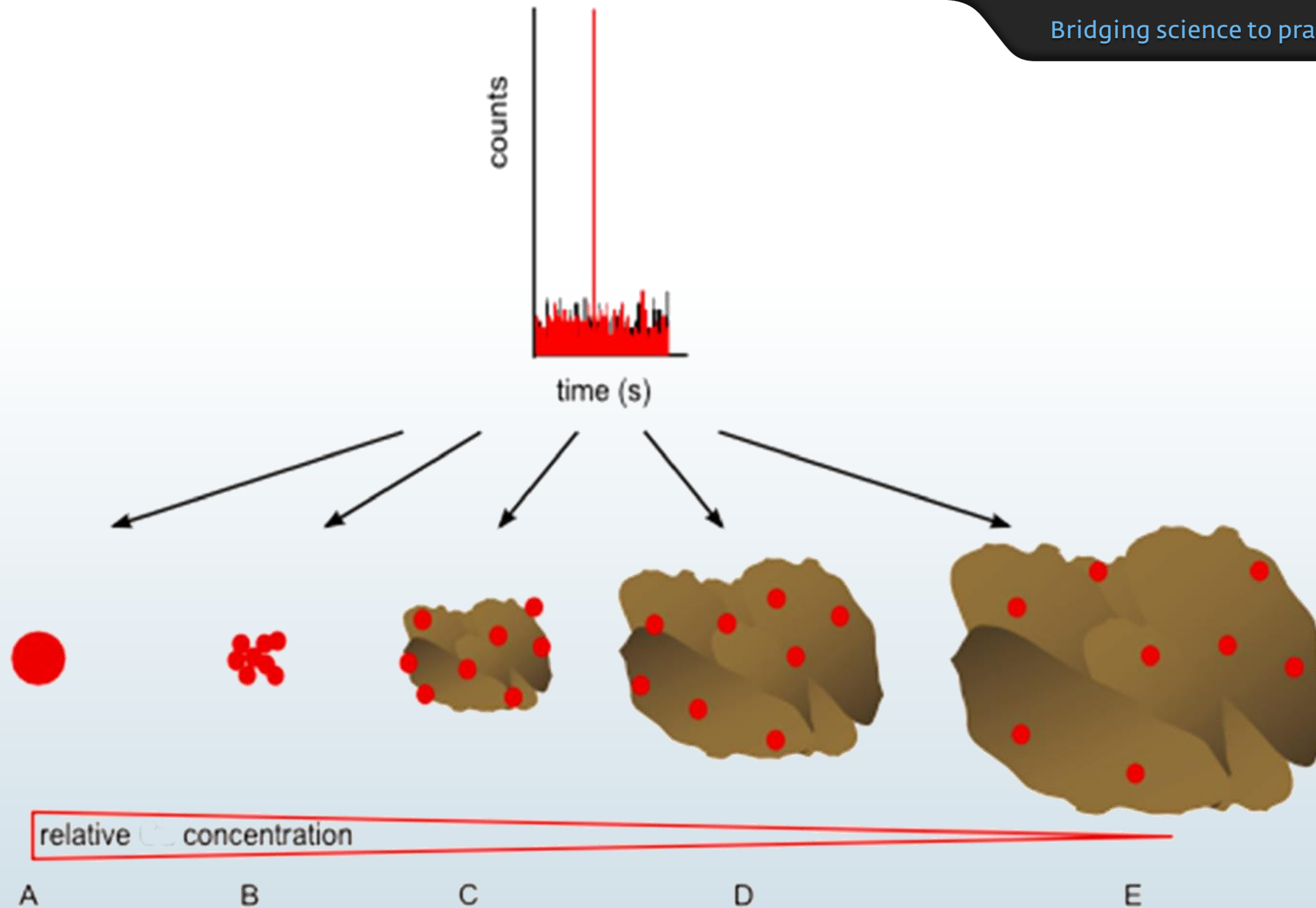
Single Particle ICP-MS

1. Peak height corresponds to particle size
2. Number of peaks equals number of particles
(in the detector, *not* in the sample)

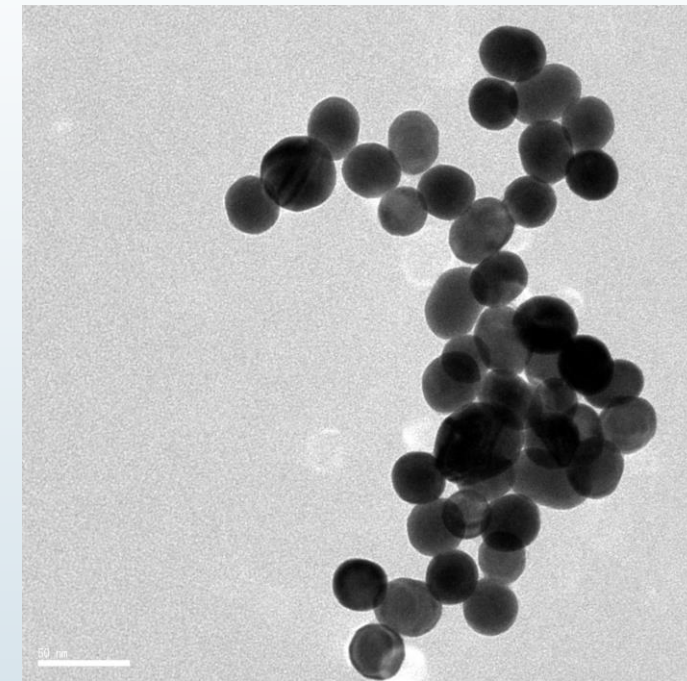
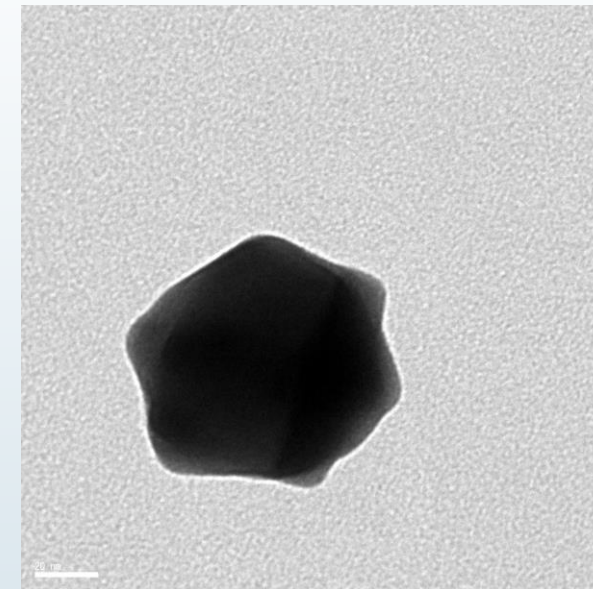
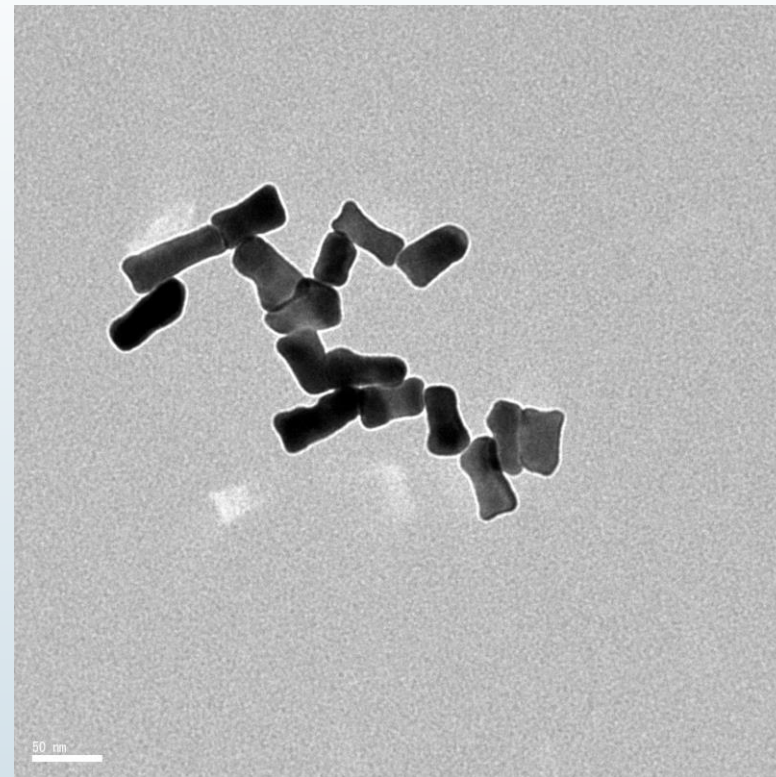
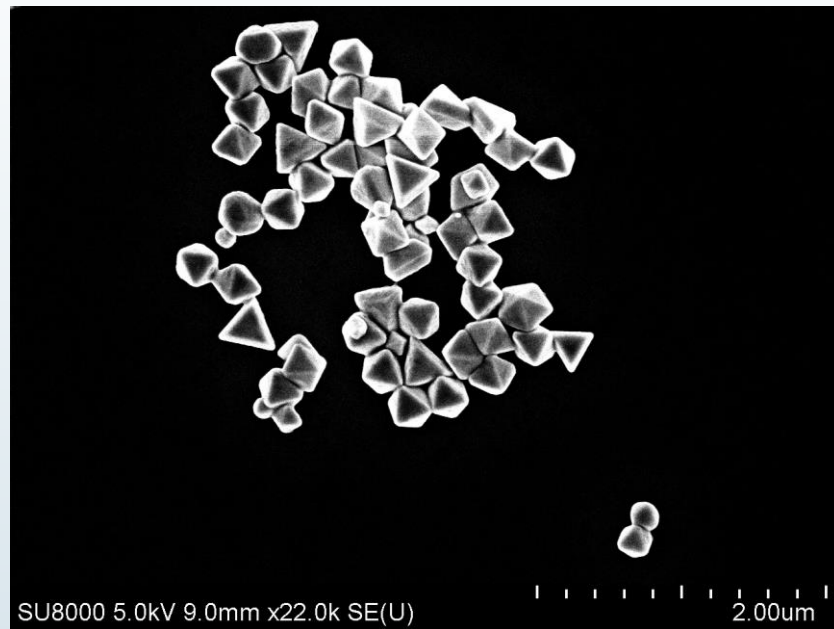


Dilution is the solution



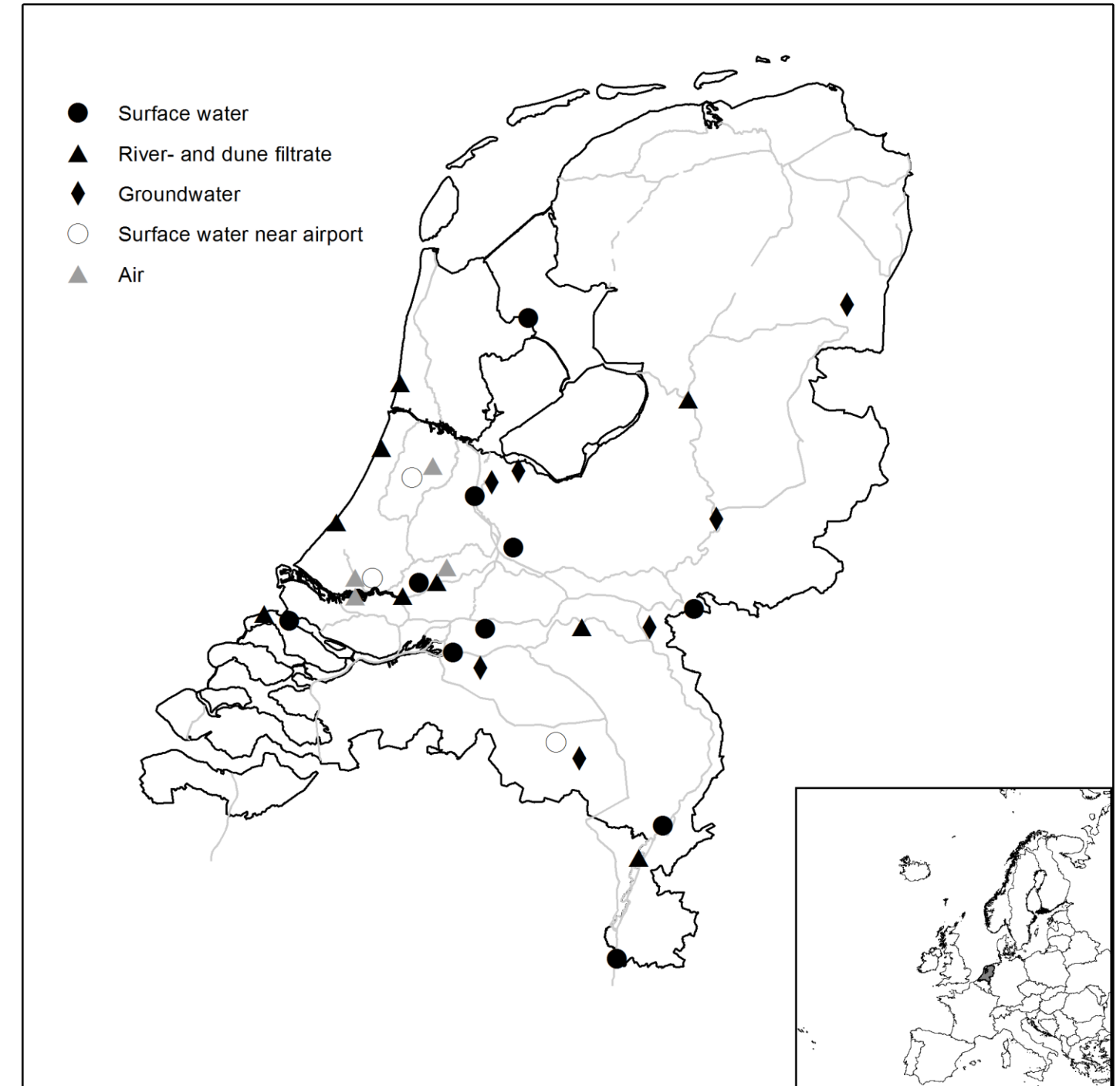


J. Navratilova, A. Praetorius, A. Gondikas, W. Fabienke, F. von der Kammer, T. Hofmann, Detection of Engineered Copper Nanoparticles in Soil Using Single Particle ICP-MS, International Journal of Environmental Research and Public Health 12 (2015) 15020.

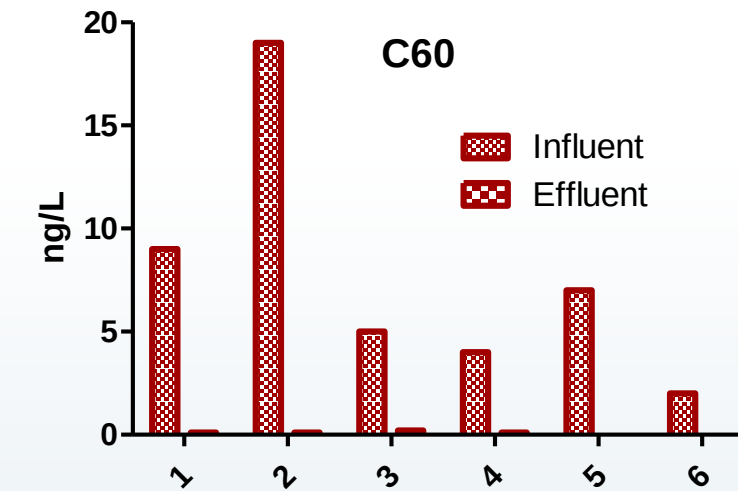
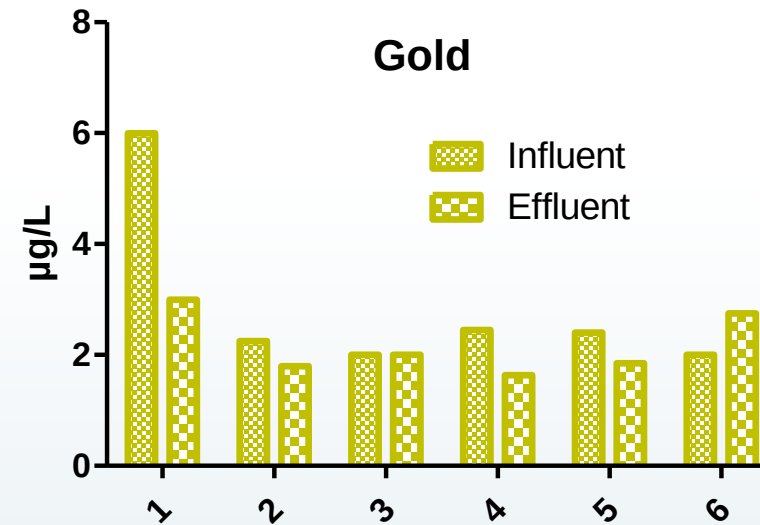
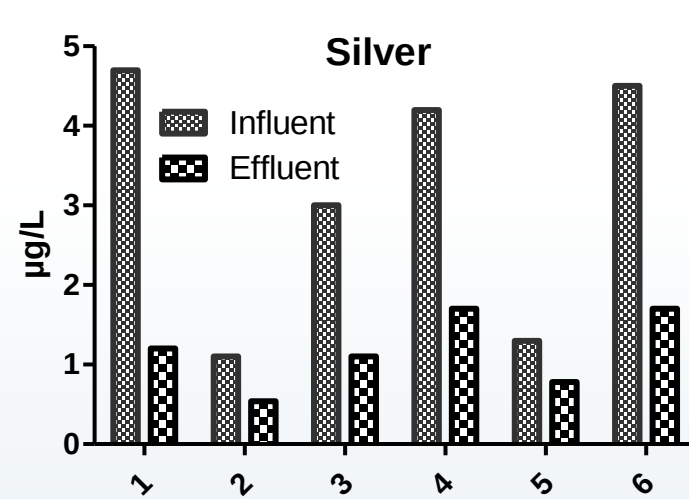


Sample locations

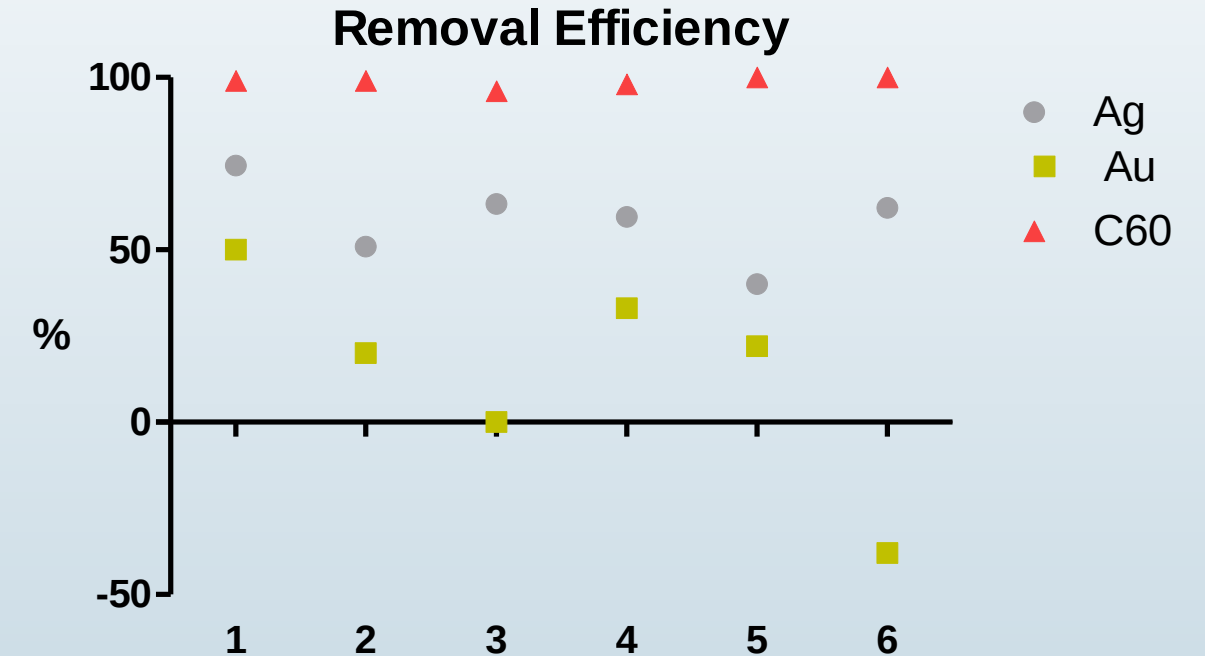
- 6 STP (influent, effluent, sludge).
- 36 drinking water abstraction sites (3 dune filtrates, 22 surface waters, 7 ground waters, 4 bank filtrates)
- 3 surface waters near airports
- 3 surface waters from harbours
- 3 air samples



RWZI's



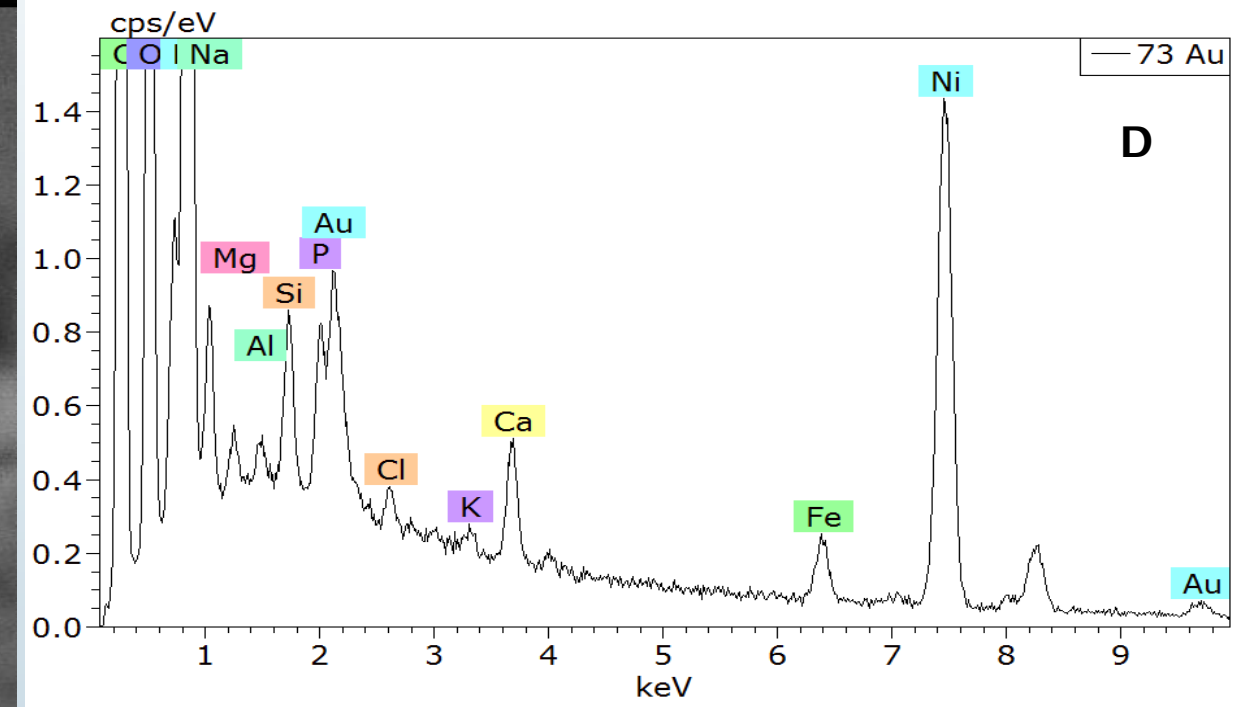
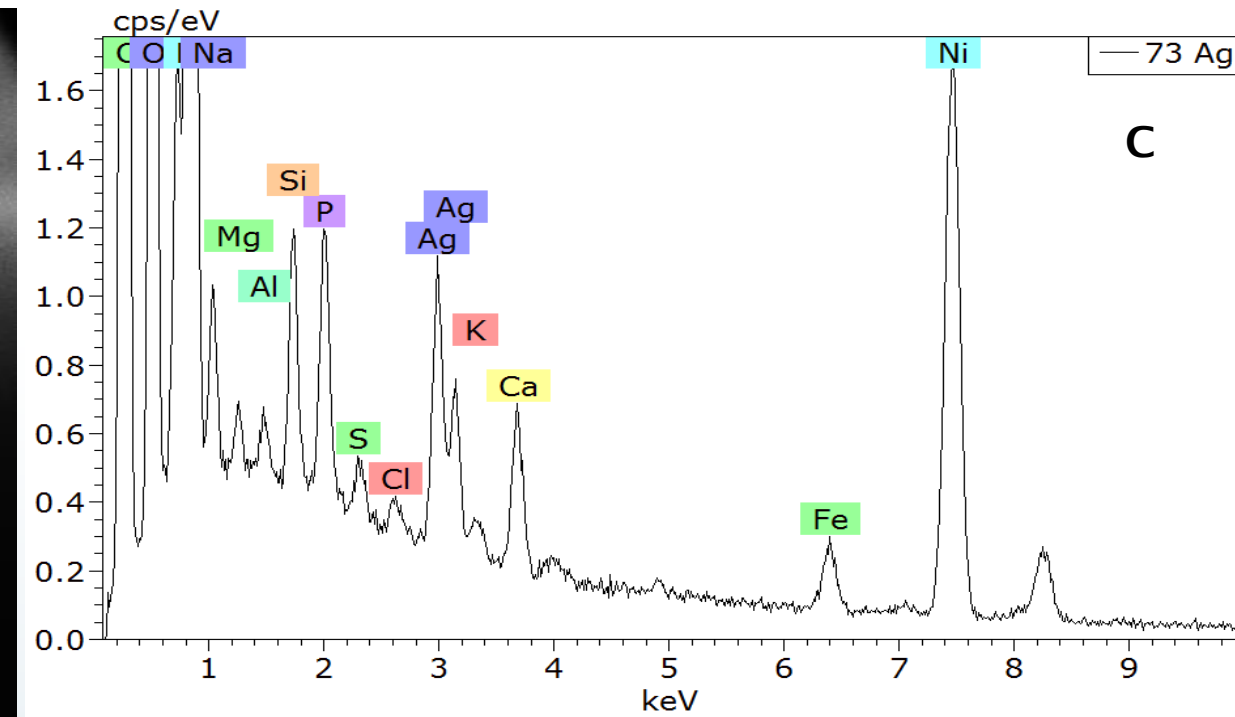
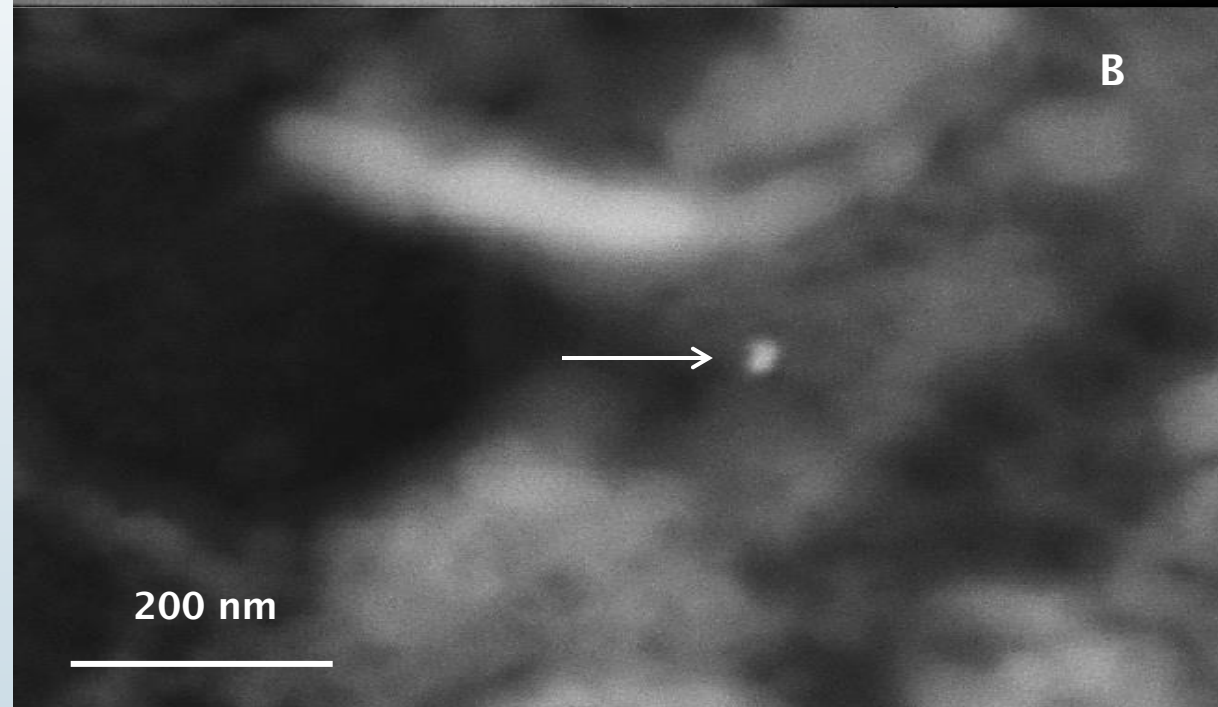
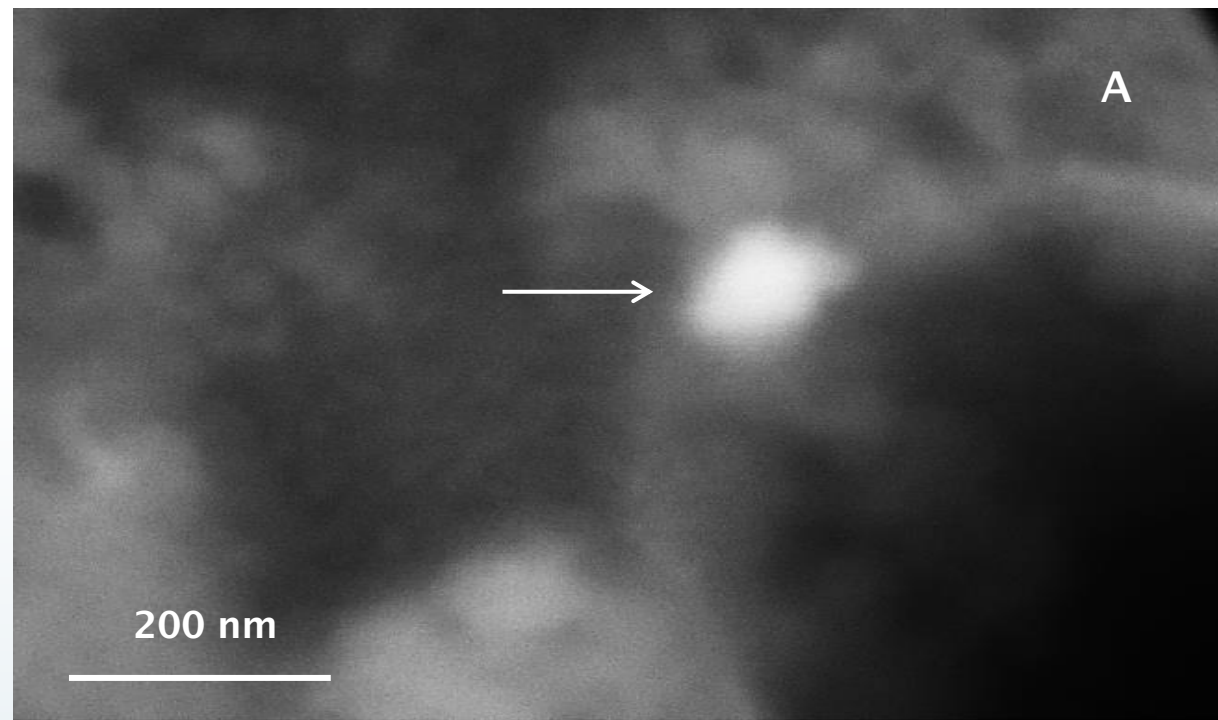
€5.5 Million per year



SP-ICP (influent samples)

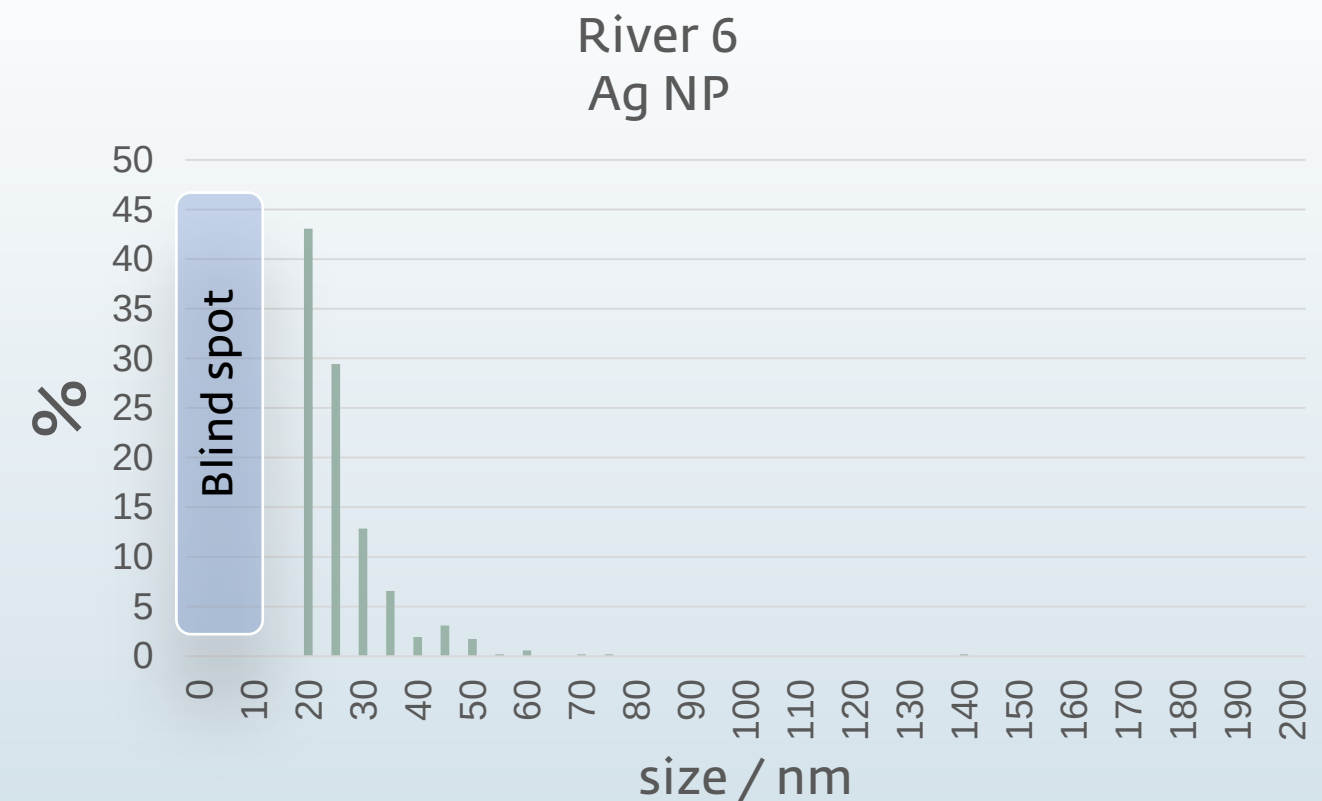
Particles (nm) per litre

		Ag			Au	
STP	25-50 nm	50-100 nm	>100 <i>nm</i>	25-50 <i>nm</i>	50-100 <i>nm</i>	>100 <i>nm</i>
1	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
2	7000	n.d.	n.d.	n.d.	n.d.	n.d.
3	9000	n.d.	n.d.	6000	n.d.	n.d.
4	13000	5000	3000	3000	n.d.	n.d.
5	11000	n.d.	n.d.	14000	4000	n.d.
6	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.



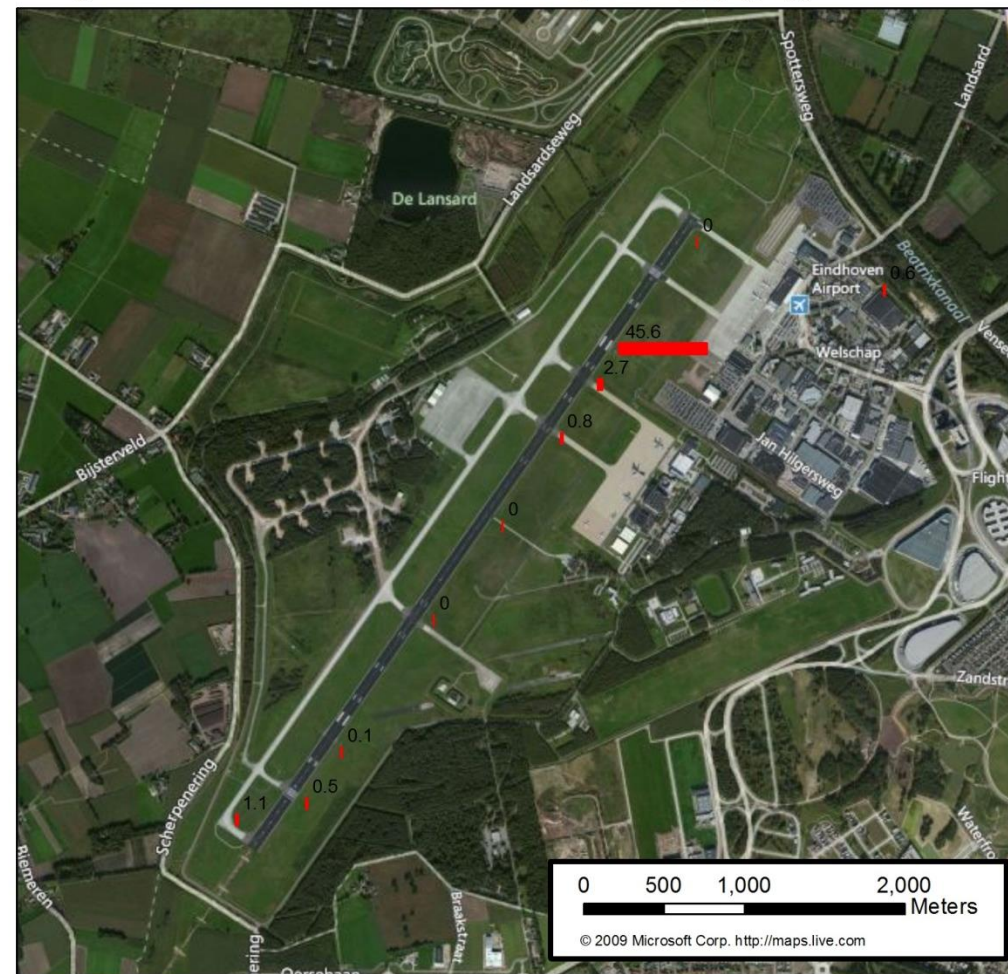
SP-ICP-MS

River	Ag ng/L	NP/L*	Average size / nm	C60 / ng
River 1	5	23640514	32	0.9
River 2	26	73702781	33	<0.5
River 3	4	23640514	29	0.7
River 4	22	75788709	33	<0.5
River 5	2	9039020	29	<0.5
River 6	171	1.082E+09	26	<0.5
River 7	5	18078040	33	1.1
River 8	5	21554586	30	0.8



Organic particles (C₆₀)

Vliegveld Eindhoven - Resultaten analyses C₆₀ (ng/kg)



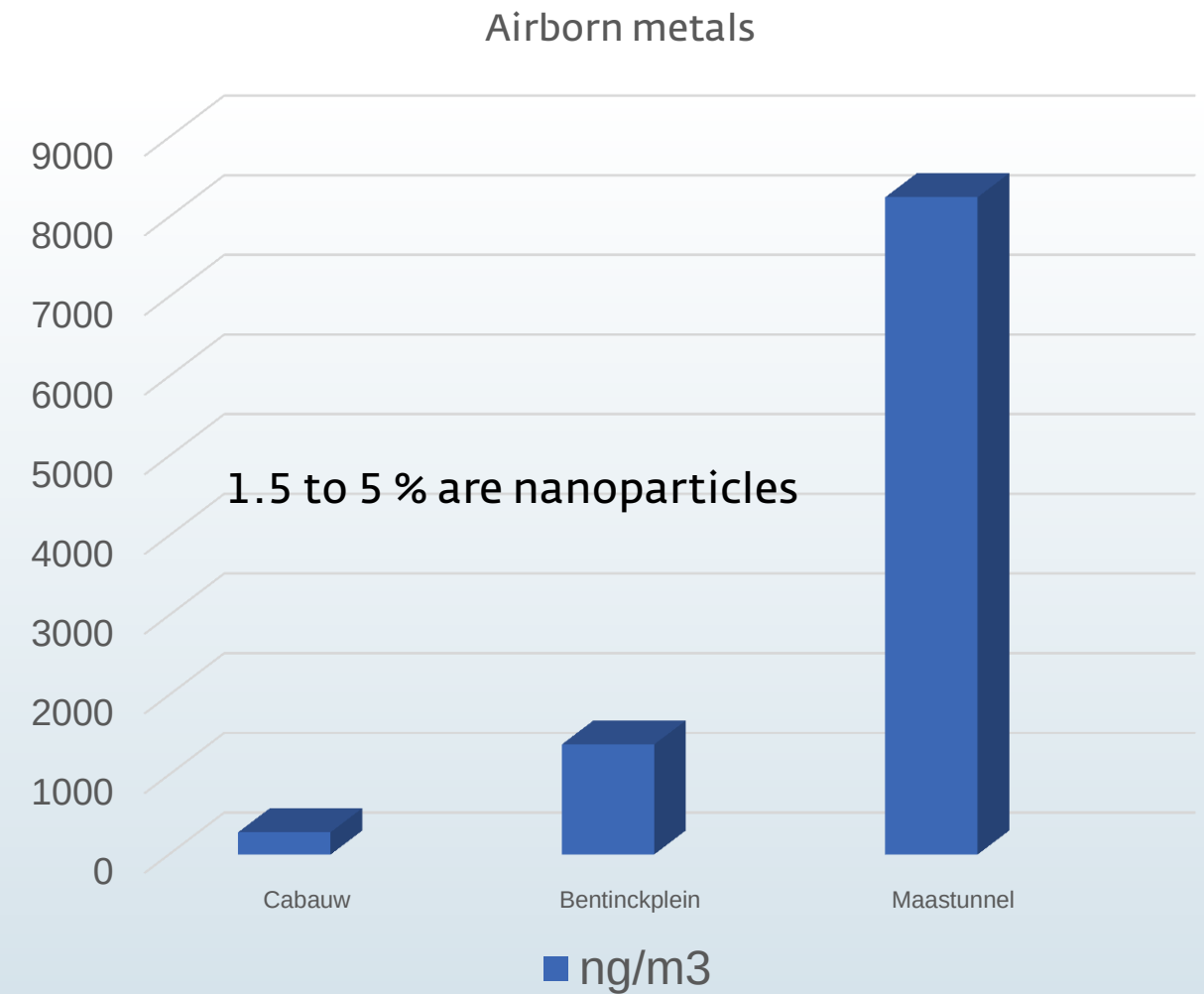
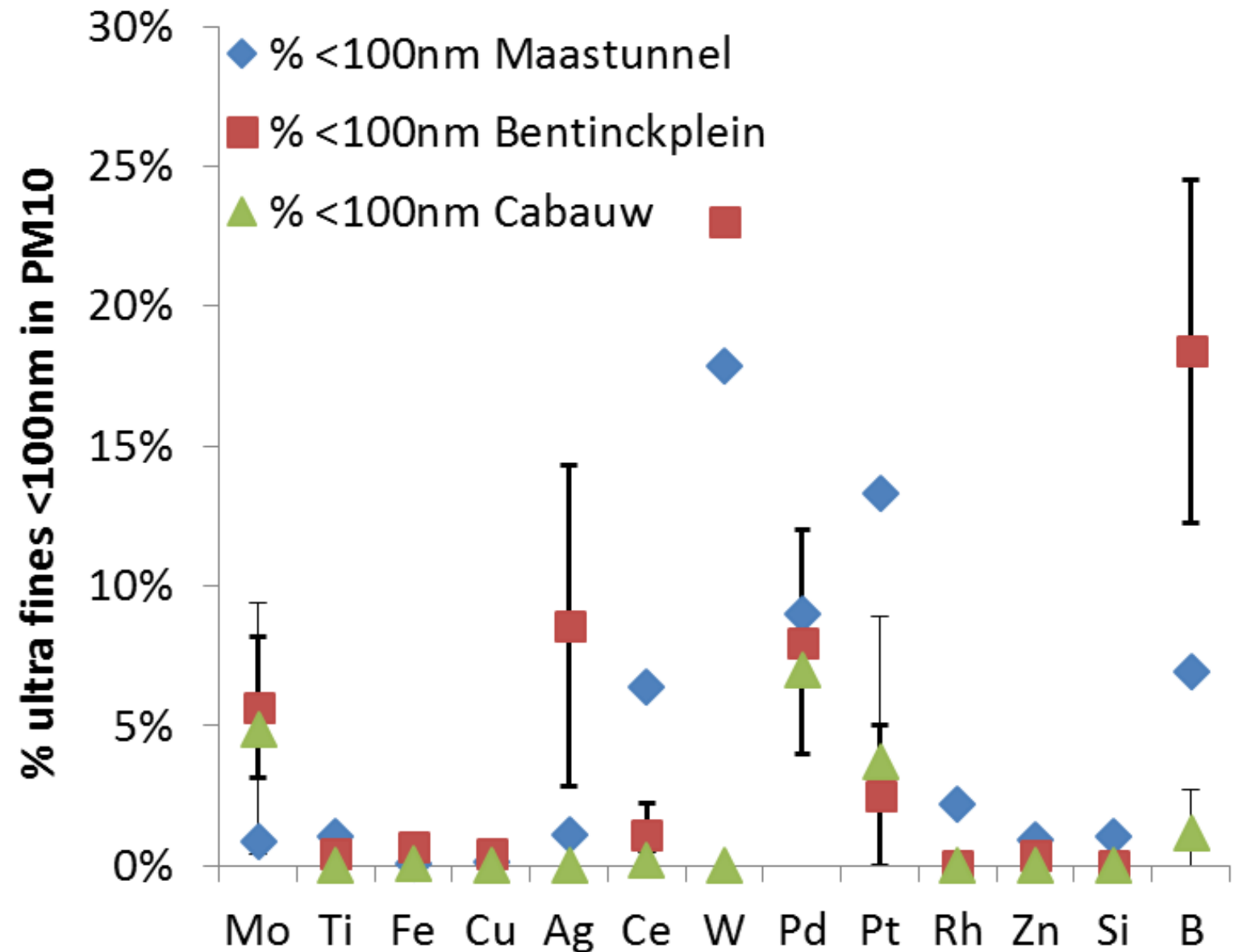
C₆₀ was found at Bentinckplein (5 pg/m³)

C₆₀ was found on the run way (46 ng/kg)

Air Samples - locations



Particles in the air



5 pg/m3 C₆₀ Bentinckplein

Measuring in the environment

Pitfalls

- Concentrations are often too low to prove the presence of nanoparticles
- The data often leaves room for speculation and is not unequivocal
- Measuring nanoparticle is in most cases more laborious than ordinary chemical compounds
- It is difficult and sometimes impossible to discriminate between man-made and natural nanoparticles

Acknowledgement

