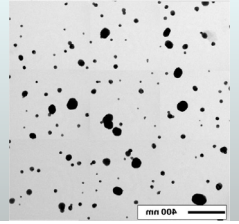
Fachhochschule
Nordwestschweiz



The Need for a Periodic Inspection of Vehicle Emissions

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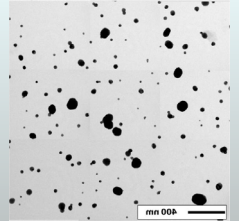
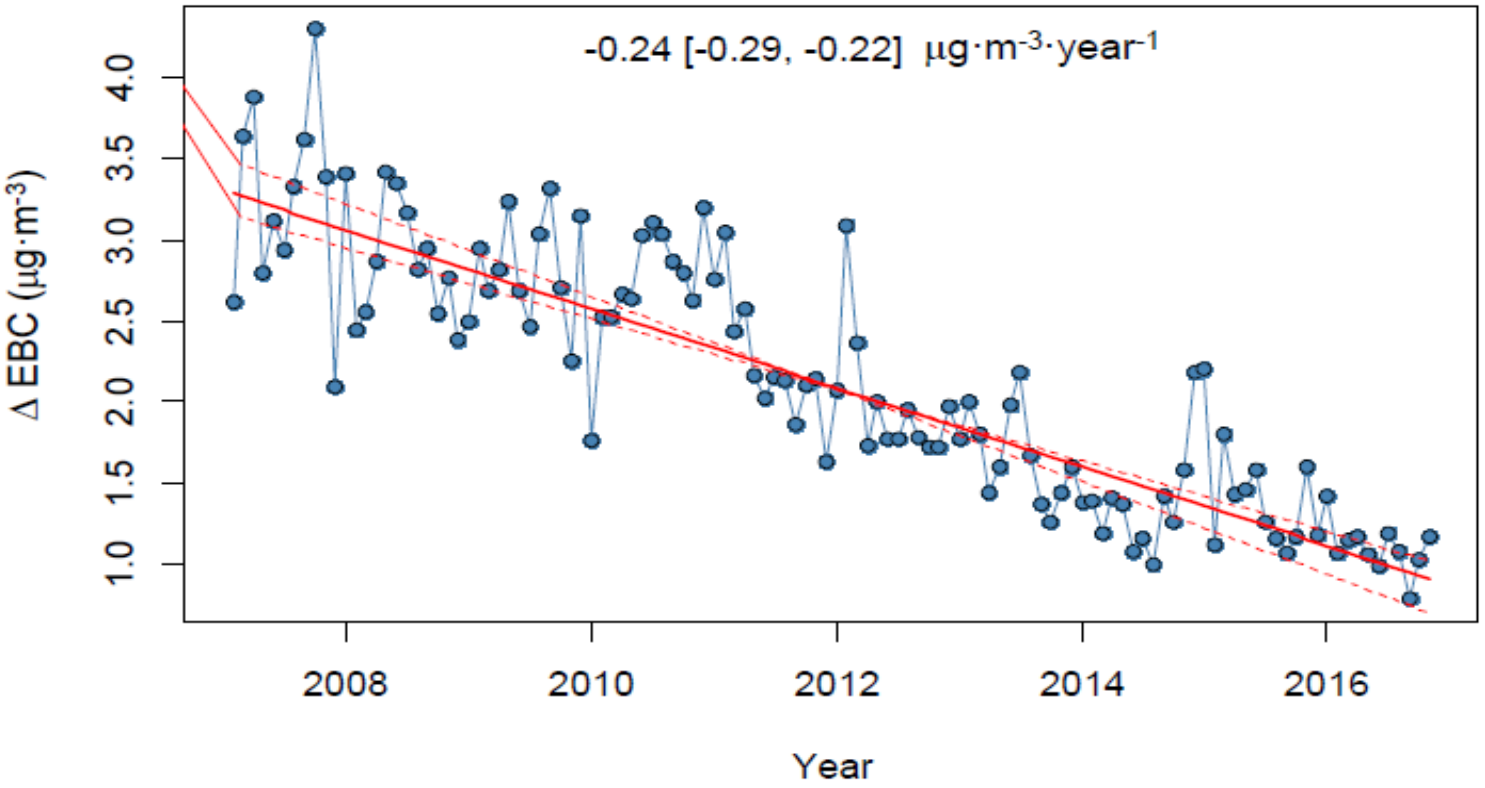
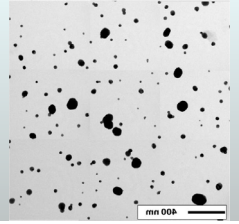


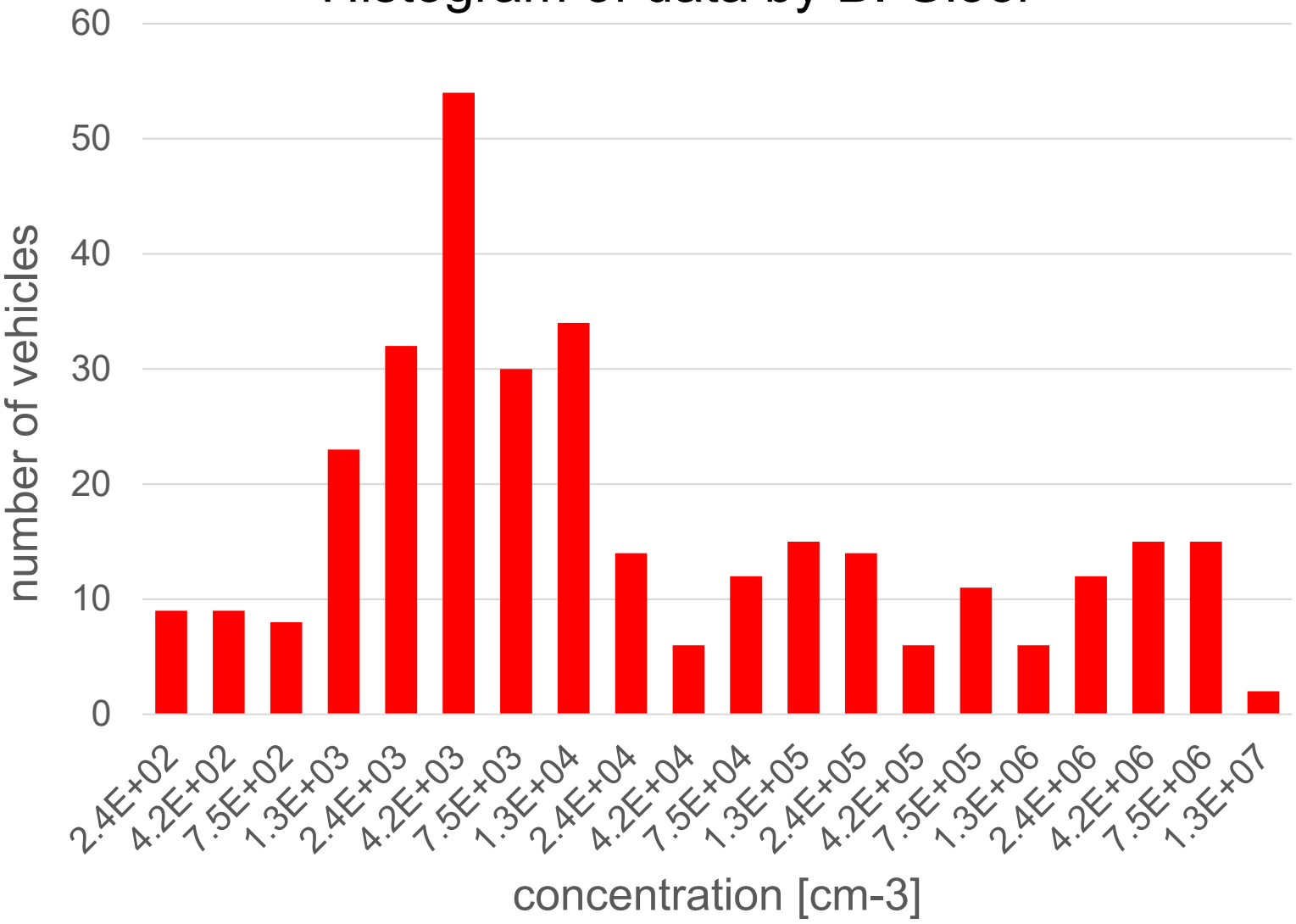
Change in black carbon concentration at the road side station Härkingen, Switzerland, from Hüglin, 2017

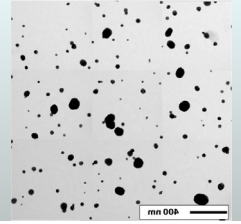


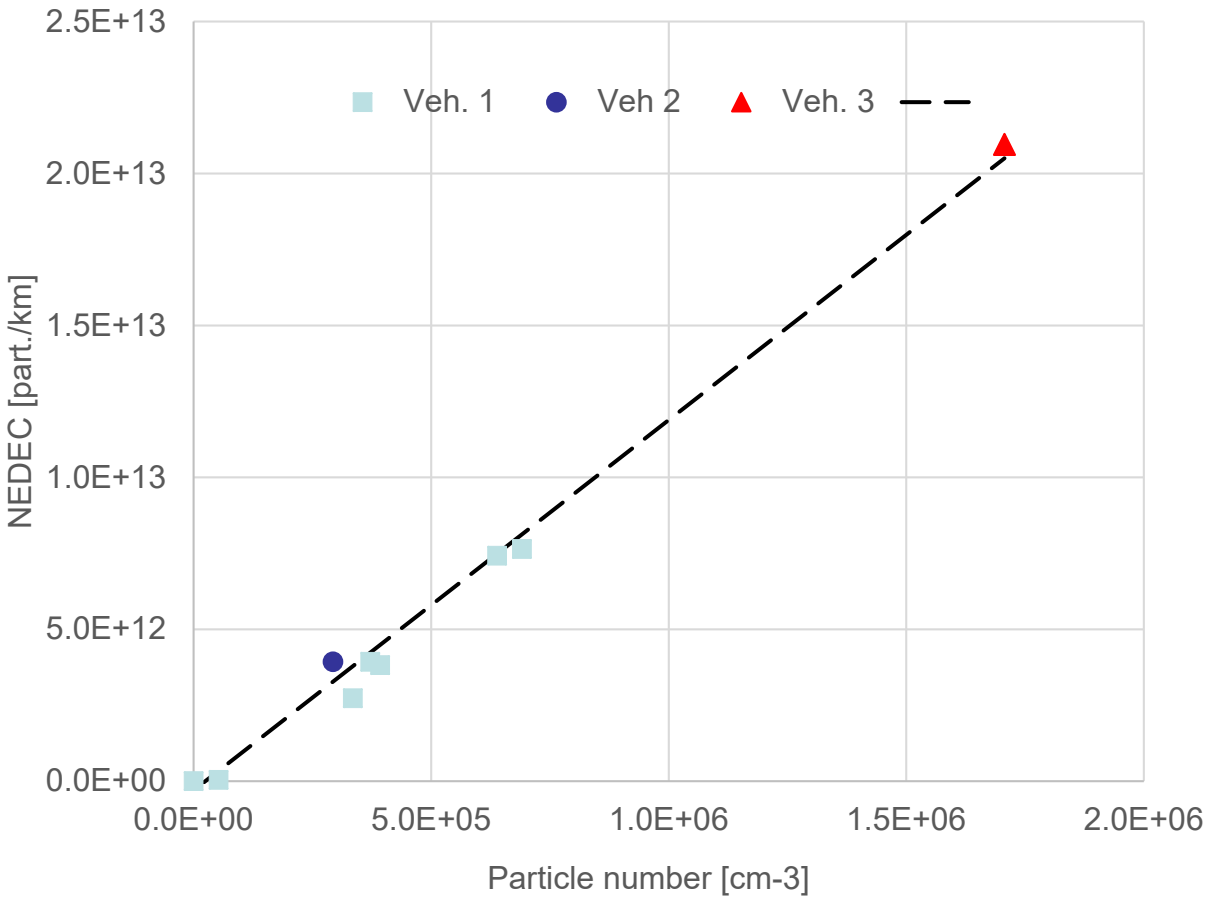
Kurinawan und Schmidt-Ott (2006): 5% of ‘super polluters’ are responsible for 43% of elemental carbon emissions



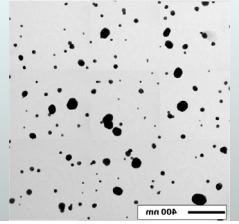
Histogram of data by B. Gloor



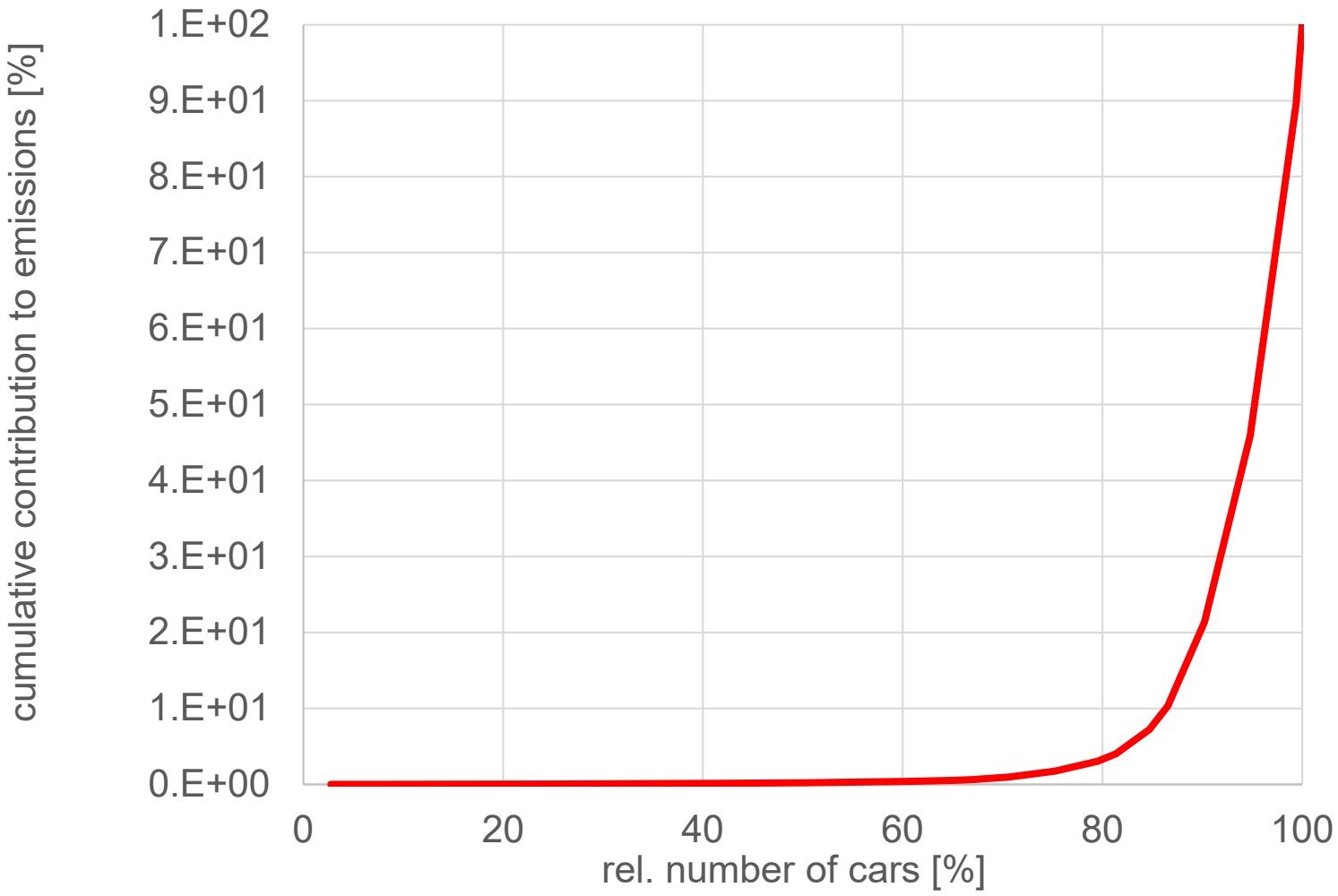


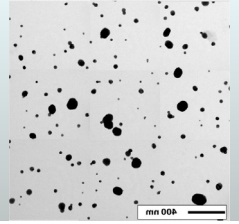


Comparison of particle number, emitted during a NEDC cycle versus number concentration in low idle of 3 different diesel vehicles with cracked DPF or variable bypass (from Kadijk et al., 2017)

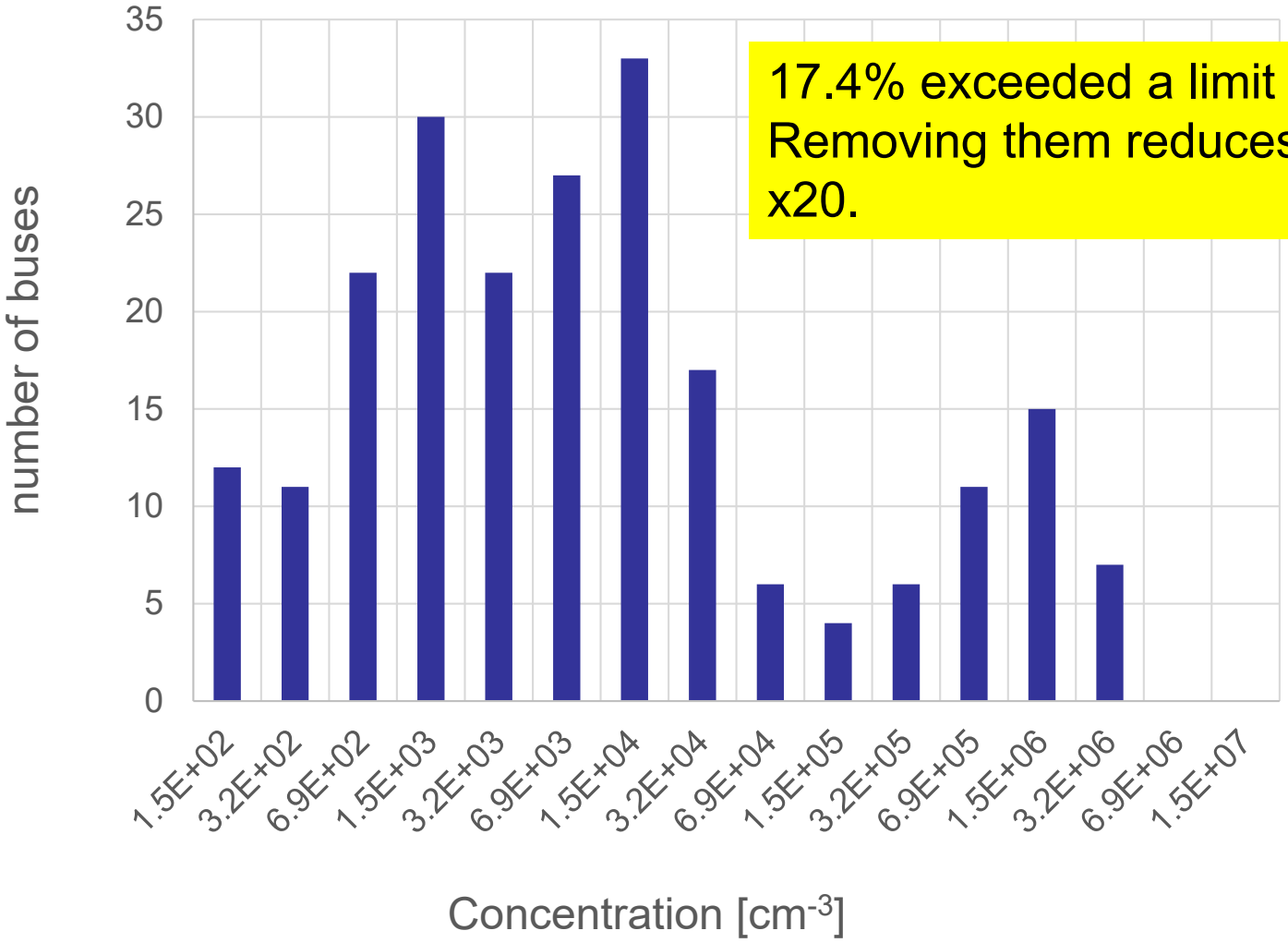


Cumulative contribution to fleet emission



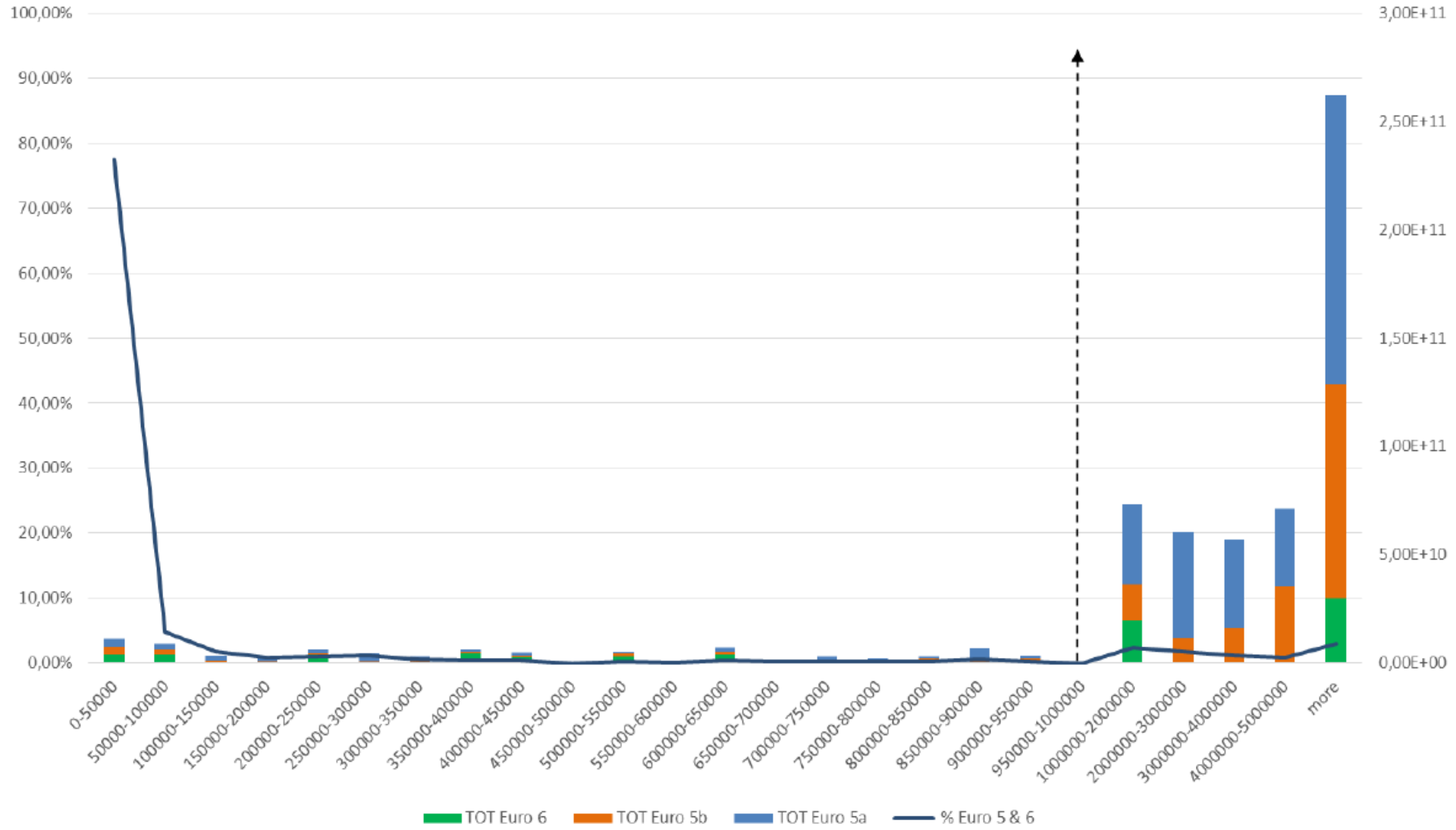


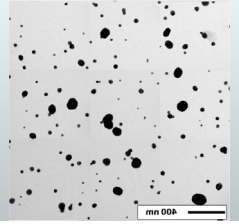
Histogram of particle concentrations for the public bus measurements in Santiago di Chile (Reinoso, 2016).



17.4% exceeded a limit of 2.2x 10^5 cm^{-3}
Removing them reduces fleet emissions x20.

Simulation of the total particulate emissions [#/cm^3] emmitted by the Euro 5 and 6 vehicles in Belgium
(6,07x10^{11} #/cm^3)

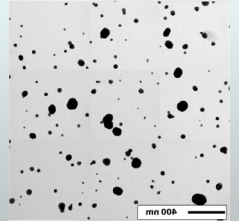




Construction engines:

Nauroy et al. (2017) measured emissions from more than 100 construction engines, equipped with particle filters. 22% exceeded the limit of 250’000#/cm^3.

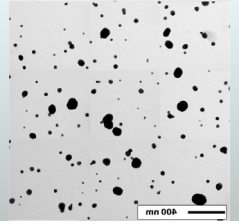
There is an urgend need to indentify these high polluters,
PTI is an option therfore



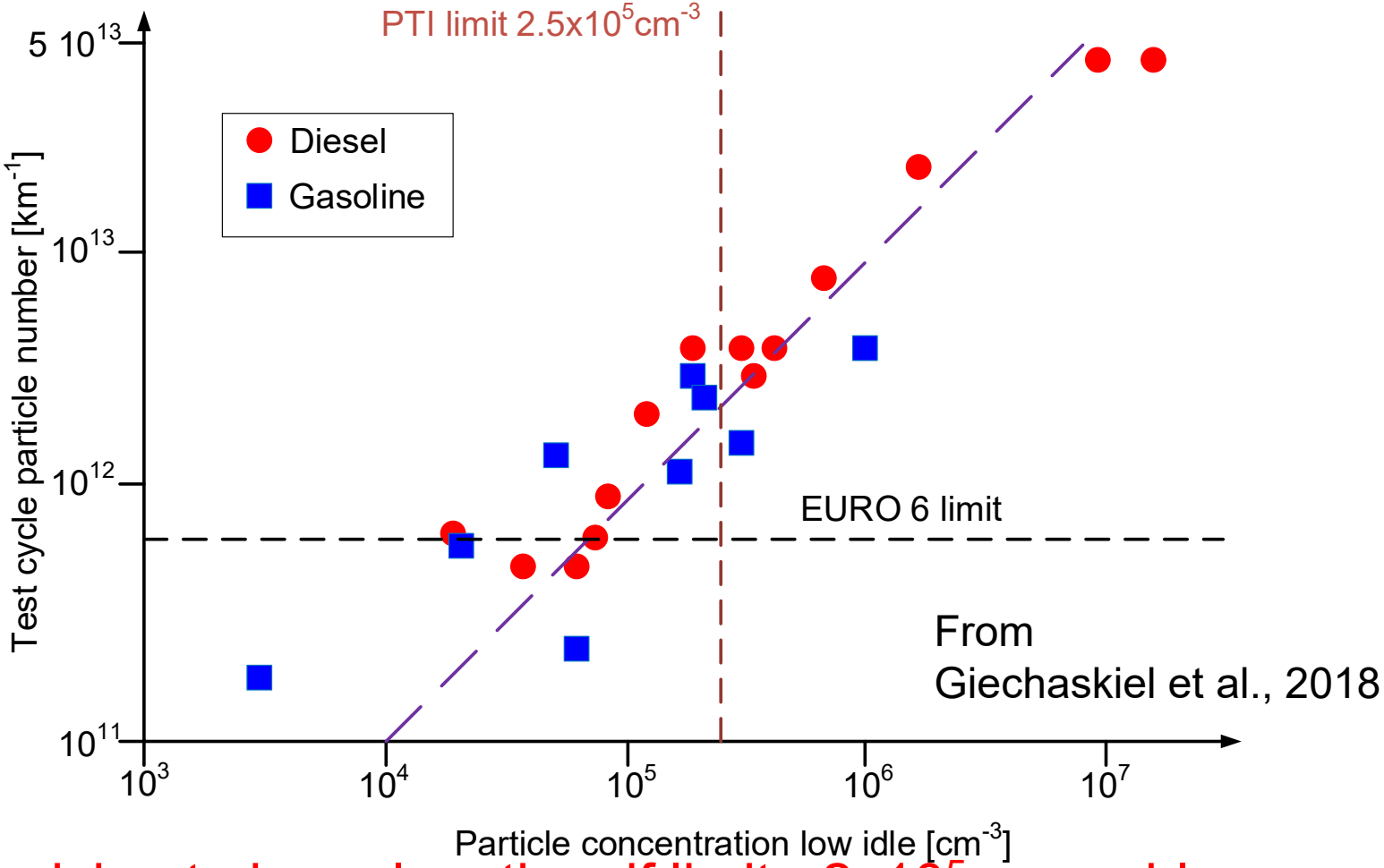
Pass/Fail Criteria

Requirements:

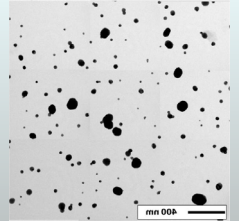
- Has to be less strict than type approval testing
- Has to be low enough to detect high polluters
- Should be related to what can be acheived with state of the art technology
- Allow a fast and simple test



results from cycle test as done for type approval and low idle measurements.



Comparision to homologation: if limit >$2x10^5$ no problem



rel. fraction of cars in a particle emission range (blue) and cumulated average fleet emissions of cars (red). Calculated from data by Gloor, 2018.

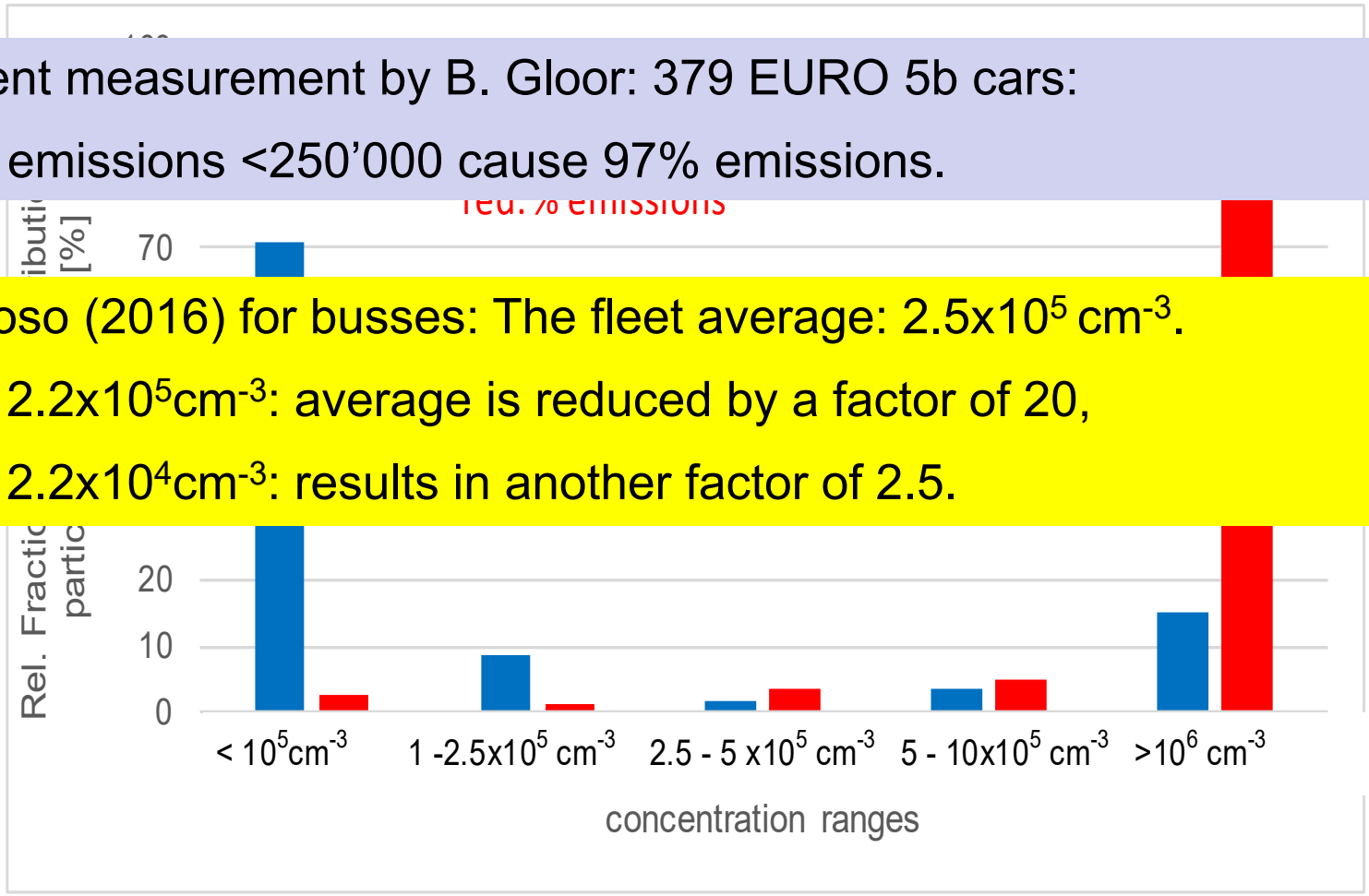
Recent measurement by B. Gloor: 379 EURO 5b cars:

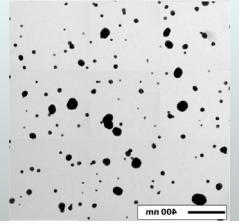
10% emissions <250'000 cause 97% emissions.

Reinoso (2016) for busses: The fleet average: 2.5×10^5 cm^{-3}.

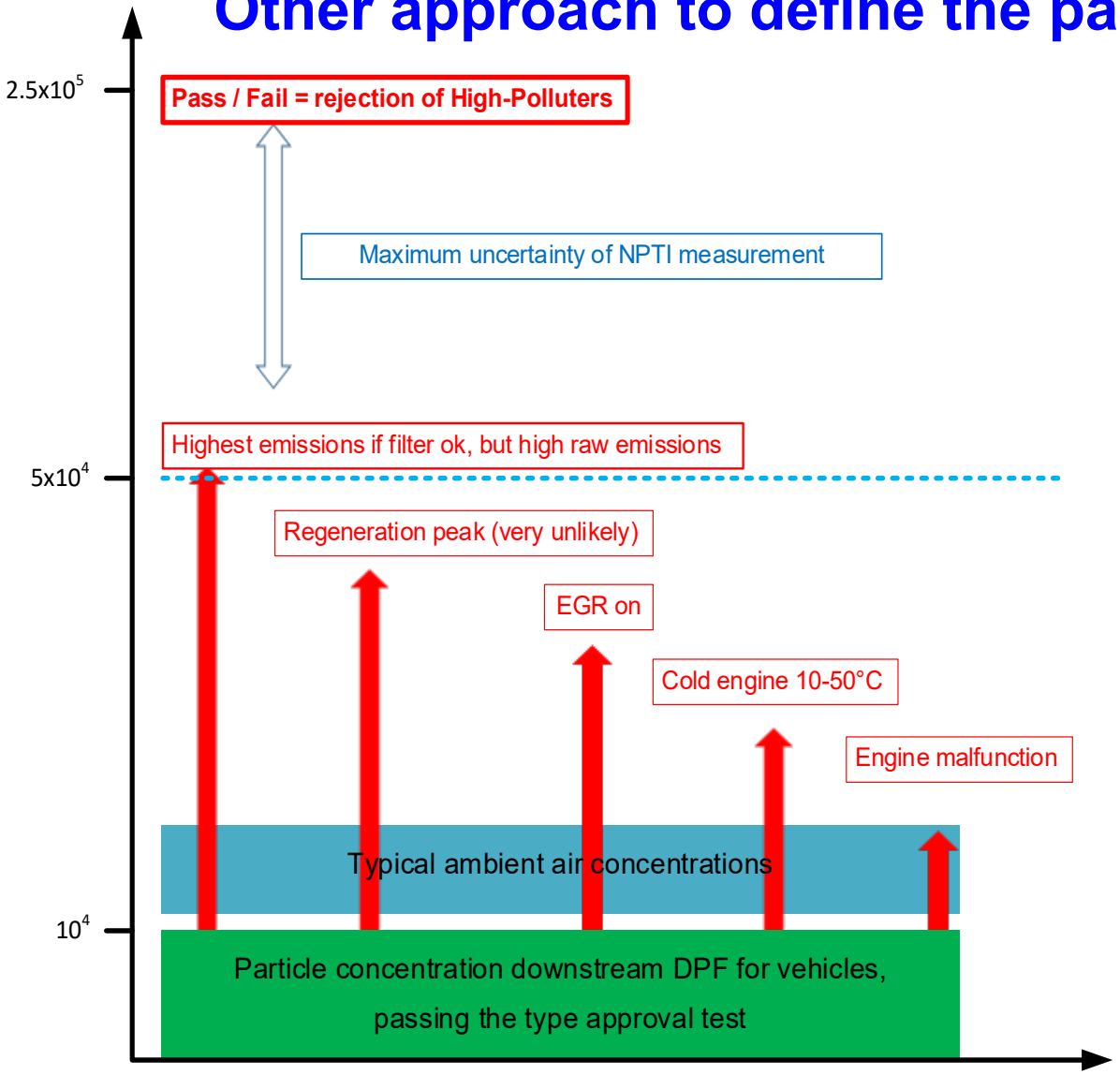
Limit 2.2×10^5cm^{-3}: average is reduced by a factor of 20,

Limit 2.2×10^4cm^{-3}: results in another factor of 2.5.

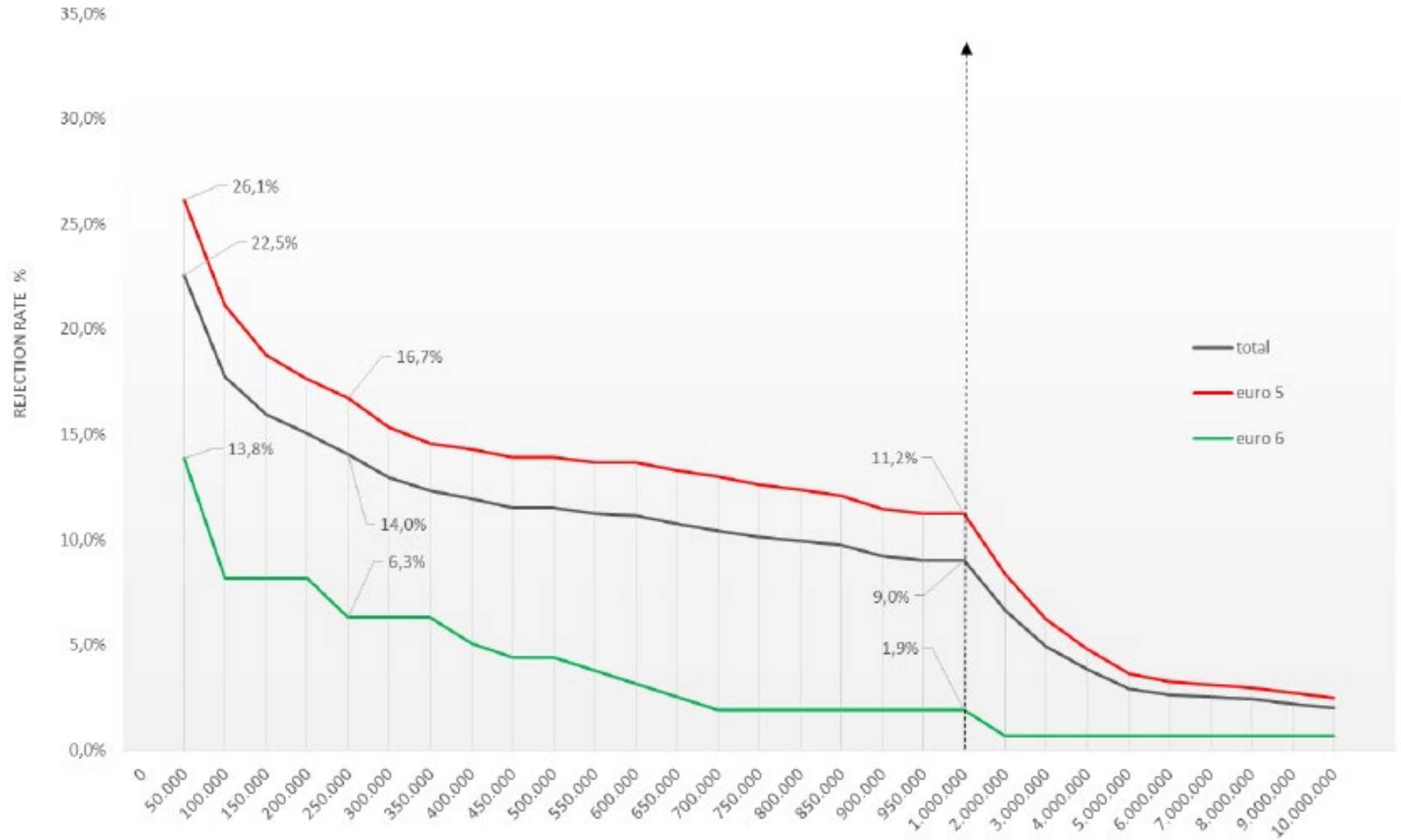


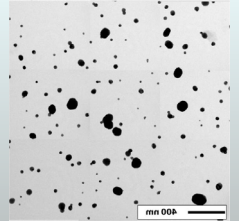


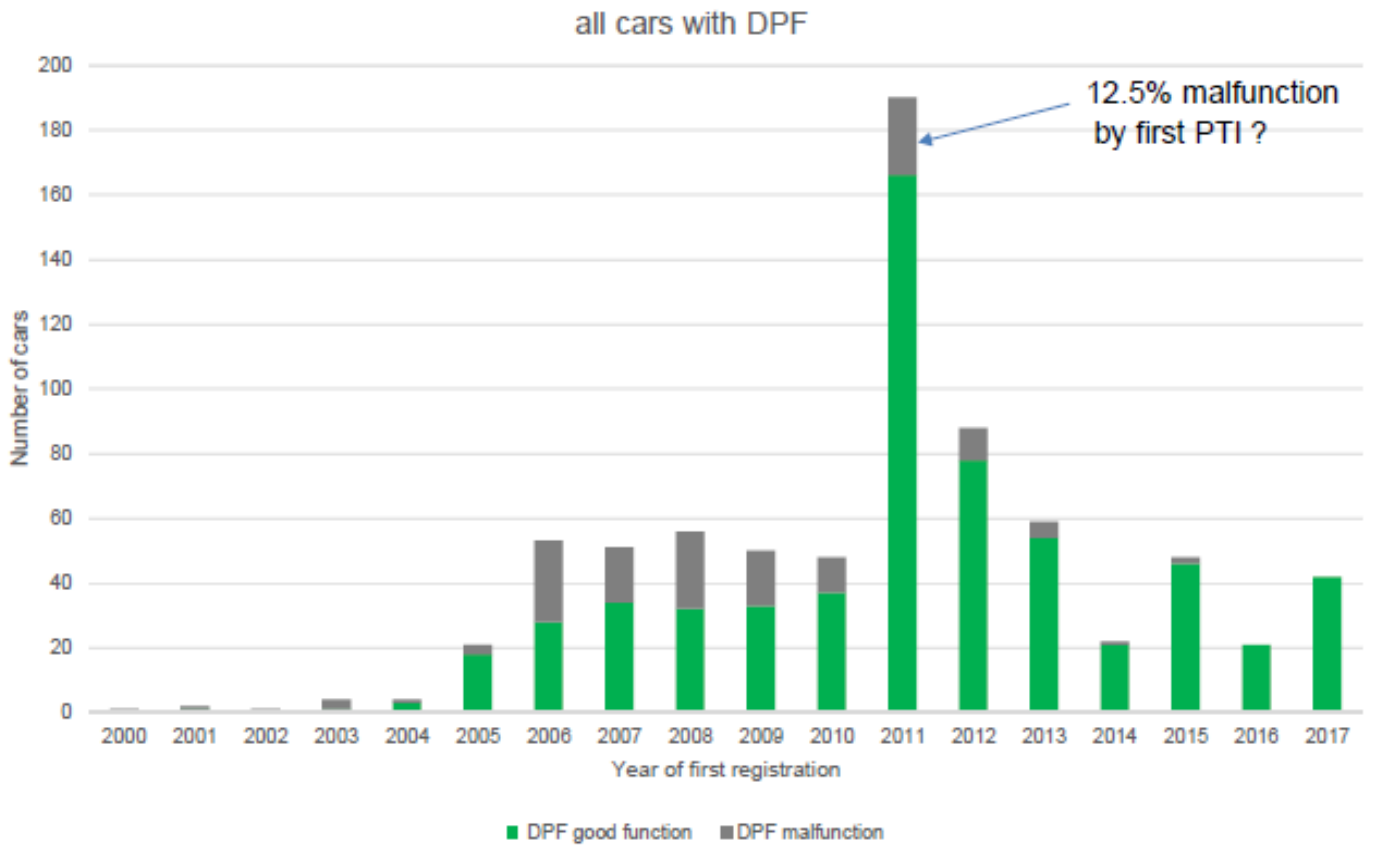
Other approach to define the pass/fail criteria:



Expected rejection rate in function of the limit value for Euro 5 and euro 6 vehicles [#/cm³]



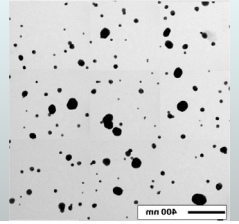




Pass/fail criteria:

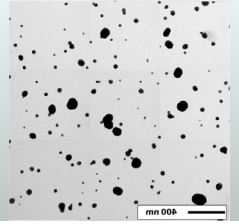
100’000 cm^{-3} for cars ≥ 5b

250’000cm^{-3} for cars ≤ 5a (equipped with a DPF), measured at low idle, from B. Gloor



Conclusions / outlook

- Fleet emissions are dominated by few high polluters
- Introducing PTI again is important
- Measuring at low idle is possible, allow a very fast and low cost test
- The limit should be in the range of 1 to 5 $x10^5 cm^{-3}$
- Gasoline engines also need to be considered
  - Mexico city: 30'000 cars tested, 2% high polluters ($>10^6$ cm^{-3}) cause 62% emissions
  - Kadijk et al: from 12 tested vehicles 2 with defect 3-way catalyst



Thank you for your attention

?? Questions ??