

Review acp-2021-466; Miska Olin et al. ; Contribution of traffic-originated nanoparticle emissions to regional and local aerosol levels

The study describes an elegant empirical way to update the only European size-resolved Particle Number inventory and evaluates the results against observations. Ultra fine particles (UFP) and particle numbers (PN) in the atmosphere are not regulated like PM_{2.5} or PM₁₀. There are no air quality limit values nor obligations to monitor these metrics. As a result our understanding, emission data, measurements, concentrations and related information is scarce. Clearly more information is needed and the paper is a welcome and original contribution, and fitting for ACP. In my opinion the paper can be published after some corrections and further clarifications have been made.

Major points

In the introduction first & second paragraph it would be good to already stress/explain that the EUCAARI inventory by definition considers only particles > 10 nm. The reason being that for many emission sources size-resolved PN measurements are extremely scarce, and EFs for <10 nm are either non-existent or highly variable. Literature is also often not clear about the cut-off. To have a more robust result the EUCAARI inventory was made for size bins of 10 nm and up. However, as pointed out by the authors, this does not mean that the PN, 10 nm are not important and it is very relevant to investigate this. Therefore “updating” mostly means extending the range of the inventory to include an important but difficult size range.

It is also suggested to explain a bit better that the road transport regulation for PN > 23 nm for non-volatile PN was chosen to have a reproducible measurement. For a standard this is a great advantage. However, a large part of the emitted PN are volatile and it is questionable if this standard for non-volatile PN > 23 nm has any relation or even correlation with the real world total (volatile + non-volatile) size -resolved PN emissions. This relates also to L 301 where some remarks are made about “unregulated vehicle -emitted particles” but volatile particles > 23 nm are also unregulated. So, that is not well-defined in the MS because it suggests road transport particles > 23 nm are regulated but it is only a fraction of these.

Somewhere in the introduction explain more clearly why you choose to do simulations for a year (2008) that is by now 12-13 years in the past. It is not trivial. Many things have changed by now especially in road transport but also e.g. shipping with fuel sulphur regulations.

L186 The updating process was stopped at 57 nm, meaning no changes for $D_p > 57$ nm. Many studies investigate ultra-fine particles which are defined as < 100 nm. Although not the subject of study it would be good to state in discussion or conclusion what the impact of the update is for anthropogenic UFP emissions, especially for road transport. How much does UFP increase? This may help to put in perspective with other studies.

L190 – why was the scaling done using measurements from 2015 onwards. It would also be possible to use the trend in reported PM_{2.5} emissions from Finland for road transport exhaust (available at <https://www.ceip.at/>). Does that give different results? Or do you have a motivation why that would not work?

In the conclusions e.g. around L 415 it would be important to stress / mention that road transport is not the only anthropogenic source where such an update (adding the smaller particles) would have

an impact. I would expect that for aviation (airports close to a city) and shipping (in the case of port cities) this would further increase the PN emissions. You do not have to add these emission here but it is good to mention that this should be addressed as well. How would further addition influence your model results? Is there room for this or would it lead to overestimating?

L 345 and further: Do you think having substantial sub-10 nm BC particles is realistic? As BC is a product of incomplete combustion it seems not very likely to me? You state it could also be other non-volatile components such as metals but if that is the case, isn't it better to call it non-volatile instead of BC?

Moreover & related, I find this "based on results from one diesel bus" (L82) rather tricky in the light of the whole study. How representative is one Finnish diesel bus for the whole European fleet? Why do the authors feel that is good enough? I think this needs better discussion and motivation.

Minor points / corrections

L38 regulated in **road transport** emission standards [it is better to be specific here]

L80 composition of NCA - easier for the reader to have "composition of 1-3 nm sized particles"

L82 chemical composition "obtained from a computational fluid dynamics (CFD) simulation" I find that hard to understand. How can you obtain chemical composition from a CFD simulation? Can you rewrite / explain a bit better?

L143 for ~~the~~ both

L170 and further: The CO₂ trick is transparent and elegant but some more discussion or caution on how reliable it is to scale that way to 2008.

L174 " the EF of PM_{2.5} has probably been higher in 2008." Not probably but certainly – you can check the EEA/EMEP emission inventory guidebook for EFs for different EURO classes.

L 178 is **the** same

L202 – I am not sure how reassuring the "European average" is . This will be mixing e.g. the UK, Sweden, Bulgaria, Portugal etc. The average may not be very representative of what is seen in the different countries if fleet ages and dominant fuel types are highly variable. On average they may cancel out but PN exposure is about the local urban emissions not about the average emission.

Table 1 – Table top row - Please add the size range behind Nucleation and Soot. Easier for the reader.

L229 from the all

Table 2 – caption "(the more intended one being bold)." This is cryptic – please rewrite e.g. you mean the best performing in bold?

L 304 so that ~~the~~ half

L335 the lie on the range = lie in the range

L336 – please rewrite – "travel to human body" is wrong /strange

L 366 after ~~the~~ updating

L384 “previously underestimated emissions of sub-50 nm particles” I would say “previously partly excluded or partly non-estimated emissions of sub-50 nm particles “ The EUCAARI inventory had on purpose a cut-off at 10 nm. In that way it was not “underestimated” but simply not estimated.

L386 “The reason for the overestimations may be related to overestimated new particle formation” Don’t you think that must be related is better? Because the model runs with the original inventory do not include any anthropogenic particles < 10 nm but still give the overestimation?.

L391 – cryptic – please rewrite

L396 total **anthropogenic** particle number (or is that not the case?)

L405 replace fuel-combusting vehicles with combustion processes – I don’t think the fact that it is a vehicle is important.

L413 whenever = provided