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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Size-resolved particle number emissions in Beijing determined from measured particle size distributions" *by* Jenni Kontkanen et al.

Anonymous Referee #1

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Summary

I recommend major revisions to the current paper, which concern mainly the explanation of the method and the validity of the method.

The paper introduces a very interesting method concept, where one is able to estimate size dependent number emission factors for an urban arae without having to perform specialized emission factor measurements, which require a larger infrastructure to accomplish. Hence, this is a cost-effective method.

However, I raise several critical questions, for which I would need answers before I am convinced that the method really works. The terms in equation (2) are not straightfor-

ward to comprehend. If authors are able to satisfactory examplify some of the terms or assumptions, it is likely that the method becomes more trustworthy. I outline these issues in the major remarks section below.

The introduction provides a very interesting input into the field of particle number size distribution emissions in urban areas, and has been very clearly presented. The result section is very well written and easy to understand and conclusions summarize the important findings well.

Major remarks

Chapter 2.2.1. How is it possible that the transport assumption is evened out? The quantity of the transported pollution to the urban area either depletes the particle concentration or enhances it in total after integrating it over all wind directions. Hence, I suspect there will be systematic bias. For example, if more particles are transported to the measurement site than what was there from the beginning (surrounding area contains more particles than emitted at the measurement site), there is a systematic positive bias of the emission factor, Ei in equation (2). And vice versa if surrounding area has lower concentration of particles. And, there is a time aspect as well: high wind speed means in practice that the concentration that you experience at your urban area starts to resemble more and more the concentration of the long range transported aerosol rather than the urban emissions, since the urban emissions are quickly transported away from the urban area. The section 3.5.1 did not help to understand this issue. I think if the authors can show a concrete example of how this works in reality, it can be made trustworthy.

Chapter 2.2.2. In my view there are two terms involving the mixing vertically, the MLH parameter, and the Ni*dLMH/dt parameter. A higher MLH means pollutants spread out over a larger height, meaning lower dNi/dt and vice versa. Hence, the vertical dilution is alraedy accounted for. So, why do you need the extra parameter dLMH/dt, which also relates to vertical dilution? How do the two parameters dNi/dt * MLH and Ni * dLMH/dt relate to each other? I get your point with the increase in the boundary layer height in the morning causing dilution. But, this goes for both of these parameters. I also get the point in Figure 1, but it does not help me to understand.

What is the foot print area of the method in equation (2)? Traffic from a road more than 500 m away influences the concentration, which makes me believe that the foot print area is rather large? Is it km, or tens of km? But, it does not seem to be the entire urban area, since the emissions of traffic particles is higher from the method than for the entire urban area obtained with the GAINS model as discussed in section 3.6? Second: Is there a way to estimate a value of the size of the foot print area? Or how quickly the influence of urban emissions decrease in this method as function of distance from the measurement site?

Isn't the method rather impractical if you do not know the number of vehicles per hour in your foot print area? I mean, a higher traffic count gives a higher emission factor, Ei (per m squared and s). So, if you do not know the traffic count, you basically do not know why Ei is high. Is it because of high traffic emissions or just high traffic count? So, this method is only useful if you know the average traffic count in the area, meaning you can transform the emission factors to a useful quantity, emissions per m squared and s as function of number of vehicles in the foot print area. Then, with the number of vehicles in other parts of the city, you can get an emission factor for the entire city. But, you can not do that if you don't know the number of vehicles in your foot print area where you measured your emisson factor, Ei, or if you do not know the size of your foot print area.

Specific comment

Lines 55-57. Was the NPF apportioned to the secondary aerosol sources in Cai et al. (2020), or is it considerend as a completely seperate source? Cai et al. (2020) indicate that secondary sources, traffic and cooking together account for 100 % of the particles above 20 nm diameter, leaving no room for NPF as seperate source? This needs to be

explained in relation to the Cai et al. reference.

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