

Interactive comment on “Estimating the influence of transport to aerosol size distributions during new particle formation events” by Runlong Cai et al.

Anonymous Referee #1

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This is a very well-written manuscript dealing with an important topic: the effect of transport on interpreting new particle formation (NPF) events using particle number size distribution (PNSD) measurements. Although it is well known that PNSDs are affected by inhomogeneities in measured air masses, no proper tools to take this into account in analyzing NPF event have been proposed so far. This manuscript addresses this topic. I have couple of issues that the authors could discuss a bit more in the paper and a few other relatively minor comments. After the revisions, the paper should definitely accepted for publication.

Main issues

C1

The authors do not comment anything about the width of the considered size range [d_i , d_j]. It is clear that there are both benefits and drawbacks of using either a narrower or broader size range. For example, a broad size range would worsen some of the assumptions stated on page 6, such as the influence of primary emissions and constancy of the particle growth rate (GR). A very narrow size range would probably cause more noise into some of the terms that influence the calculation of TR from equation 10. Please discuss shortly this issue in the paper.

As demonstrated by the equations derived in this paper, knowing the particle growth rate (GR) is needed to estimate the transport effect on NPF (the same concerns also calculating other relevant quantities related to NPF like the particle formation rate). The authors need to assume a constant GR to apply equation 10. I have a few comments related to this. First, the authors state on page 6 that constant GR is a good assumption over the size range 10 to 50 nm. This is only true if particles are growing by condensation of essentially non-volatile vapors. A number of studies have reported a strongly size-dependent GR in the sub-20 nm size range, and usually explained this feature either by more and more volatile organic vapors being able to condense onto particles as they get bigger. Furthermore, any contribution to GR from heterogeneous processes in growing particle would probably make GR not constant with particle size. This may be important, as e.g. Paasonen et al (2018, Atmos. Chem. Phys. 18, p. 12085) showed that, in long-term data from one measurement site, the average GR increased by about a factor 3 from the particle diameter of 10 nm to the diameter of 100 nm. Second, in cases where the transport effects are most important, it may either be very difficult to determine GR from measured PNSD data or, in case GR can be determined, it might not reflect the real GR of the measured particle population. The authors should bring up these issues and also comment shortly whether, and in which cases, they would cause problems in determining TR from equation 10.

Minor issues

In principle, all figures should be cited in a numerical order in the text. This is not the

C2

case for Fig. 3a on line 14, page 6. However, in this case referring to figure 3a there is understandable as it is given as an example and then treated in more detail later in the text. To make this clear, it would replace "(see Fig. 3a)" on this line with "(see Fig. 3a in section 4.1)".

There is a large body of literature on liquid-phase reactions in aerosol particles after the study by McMurry and Wilson (1983) cited on line 5, page 7. I would recommend adding one or two more recent papers into here.

Grammatical issues:

page 2 line 24: . . . , no dramatic increase . . . was observed, . . .

page 2, line 4: . . . contribution to . . .

page 8, line 24: . . . at around 10:30

page 10, line 30: . . . were formed . . .

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