Atmospheric
Measurement
Techniques

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Discussions

# Interactive comment on "Assessment of particle size magnifier inversion methods to obtain particle size distribution from atmospheric measurements" *by* Tommy Chan et al.

**Anonymous Referee #1**

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The paper by Chan et al. discusses the applicability of four different inversion methods for data measured with a particle size magnifier (PSM). The PSM is a condensation particle counter that measures the particle number density for particles as small as ∼1 nm. By adjusting the saturator flow rate and thereby the supersaturation, different activation diameters can be adjusted. Scanning of the saturator flow rate allows changing the activation size between ca. 1 and 3 nm. In order to retrieve a size distribution for this diameter range an inversion algorithm needs to be applied to the raw data. Chan et al. test the performance of four different inversion algorithms for raw data measured in Beijing between January and March 2018. The conclusion is that one inversion method (EM method) is the preferred one compared to the other ones. In principle,

the presented study is helpful for the community working with PSM data. However, the recommendations provided in Section 4 of the paper are currently insufficient. The authors provide a list of recommendations without defining clear criteria for the rejection of data and the assessment of the accuracy of the inversion. In this respect, the paper should be more specific and needs to be revised before publication.

General comments

P4, L116/L117: The authors should add a comment in how far line losses could affect the outcome of the inverted size distribution. Or are the line losses not at all relevant?

P6, L166: Shouldn't the unit be particles cm-3 nm-1 (as in equation (1) n is multiplied with ddp (unit nm))?

P6, L166: please specify the source(s) of the errors $e_i$

P6, equation (2): it is not clear why $s_{max}$ is used in this equation instead of $s_i$; please add a comment and explain why this is the case

Fig. 1 (and discussion starting P9, L257): It seems that for the inversions always the combined data of one up and one down scan are used. Can the authors please explain why this is done? In order not to lose information for rapidly changing conditions it could make sense to treat the up and down scans separately.

Fig. 1: Please use different colors for the data corresponding to an up or down scan, respectively.

Fig. 1: It is very hard to read this figure (this applies to all figures) due to a very small size. Additionally, it is not clear how the size bins at the right hand side were chosen. In the text it says the size distribution ranged from 1.2 to 2.8 nm with 6 size channels (P7, L215/216). However, in Fig. 1 many more channels are visible and the size distribution ends at ∼2.6 nm.

P9, L278: What do the authors mean by "data is good"? Please be more specific in

terms of what distinguishes "good" from "bad" data.

P10, L316: Please add some discussion why generally no constrain is applied that forces the concentrations in each size bin to be non-negative. Furthermore, the authors should add some discussion why no normalization with respect to the total number concentration (difference between the concentrations in the smallest and largest size bin is performed). This would avoid over- or underestimation of the concentrations.

P13, L393: Please define how the signal to noise ratio can be estimated for the PSM data.

P13, L398/399: A mathematical criterion should be provided that allows to identify such an unphysical correlation.

P13, L400 to 402: What should be done if that comparison yields a difference? How much of a difference should be tolerable? Why is the inverted data not constrained to match the measured concentration difference?

P13, L414: The authors should explain why the EM method is the preferred one. From the previous discussions it seemed that both the H&M and the EM method give similar results.

P13, L415: It is not clear what follows from such a comparison and how it should be performed. What is the criterion for good or bad agreement and what should be done if the agreement is not good?

Minor comments

P1, L18: "haze event"

P2, L41: "one" instead of "once"

P2, L50: "the activated particles are further grown"

P2, L51: "are activated in the first stage"

P3, L97: "5.33 mm/month"?

P4, L11: "can measure a maximum particle concentration of up to $10^5$ #/cm3"

P4, L114: "so that they can"

P4, L127: delete the word "be"

P4, L131: "the data were"

P6, L165: "where $R_i$ is the particle number concentration for a saturator flow rate of $s_i$"

P7, L205: "directly"

P9, L275: "little to no particle size concentration", please reformulate, e.g., to "concentrations close to zero for each size bins"

P9, 278: "This is in line with"

P9, 286: "these methods inverted very little to no concentrations at all from discarded scans"; please reformulate, e. g., to "after the inversions these methods yielded concentrations"

P10, L313: "who" instead of "which"

P11, L335: What do the authors mean by "large"?

P11, L336: "with no particle concentration"; do the authors mean "with zero particle concentration in the size bins covered by the PSM"?

P13, L392: "approximate" instead of "appropriate"?

P16, L436: "Comparison between inverted and raw data"