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Atmospheric Measurement Techniques Discussions

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

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–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?

-We have added a new sentence with references in regards to the line losses

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

-You are correct, we have changed the units

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

-We have added a sentence of some errors

–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

-We have included the derivation of the step-wise method in the SI section

–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.

-Combining two scans is a compromise between better data quality and better time resolution. Separating the scans yields better time resolution, but if the data is noisy, averaging two scans may yield better quality data as averaging two individual scans can average out random fluctuations. In our study, we measured the urban atmosphere where particle growth can be approx. 1nm/hr, we do not need such high resolution. However, chamber experiments or measuring car exhaust, doing separate scans may be ideal. We have expanded the explanation of the time resolution in the summary section

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

-We have added different colours to separate the up and down scan

–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 approx. 2.6 nm.

-You are correct, Fig. 1 used 11 channels for the inversion of the single scan. We have changed the text to reflect this and include the size channels used.

–P9, L278: What do the authors mean by “data is good”? Please be more specific in terms of what distinguishes “good” from “bad” data.

-We have added a sentence to indicate what is “good” data and “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.

-This sentence did not correlate with our results and we have removed it. We did not force the concentrations in each size bin to be zero – rather the total concentration. We do not understand why we would normalize. What we see in Fig. 2 reveals already whether the inversion has been over- or underestimated.

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

-We have added this in the summary section

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

-We have now provided an explanation of how the thresholds are calculated in the data quality check and in the summary section

–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?

-We have added a few sentences to elaborate on this issue in the summary section.

–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.

-We have added a few sentences to explain the EM method and clarified the section to make it easier to understand for the reader

–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?

-We have clarified this in the summary section.

–P1, L18: "haze event“

-Changed

–P2, L41: "one“ instead of "once“

-Changed

–P2, L50: “the activated particles are further grown”

-Changed

–P2, L51: “are activated in the first stage”

-Changed

–P3, L97: “5.33 mm/month”?

-It is the average of all three months. We added ‘overall’ to the sentence.

–P4, L11: “can measure a maximum particle concentration of up to 10e5 #/cm3”

-Changed

–P4, L114: “so that they can”

-Changed

–P4, L127: delete the word “be”

-Changed

–P4, L131: “the data were”

-Changed

–P6, L165: ”where Ri is the particle number concentration for a saturator flow rate of si”

-Changed

–P7, L205: “directly”

-Changed

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

-Changed

–P9, 278: “This is in line with”

-Changed

–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”

-Changed

–P10, L313: “who” instead of “which”

-Changed

–P11, L335: What do the authors mean by “large”?

-Larger than 2 nm. We have changed the text.

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

-This is correct and we have changed the text

–P13, L392: “approximate” instead of “appropriate”?

-Changed

–P16, L436: “Comparison between inverted and raw data”

-Changed

Please also note the supplement to this comment:
https://www.atmos-meas-tech-discuss.net/amt-2019-465/amt-2019-465-AC1-supplement.pdf

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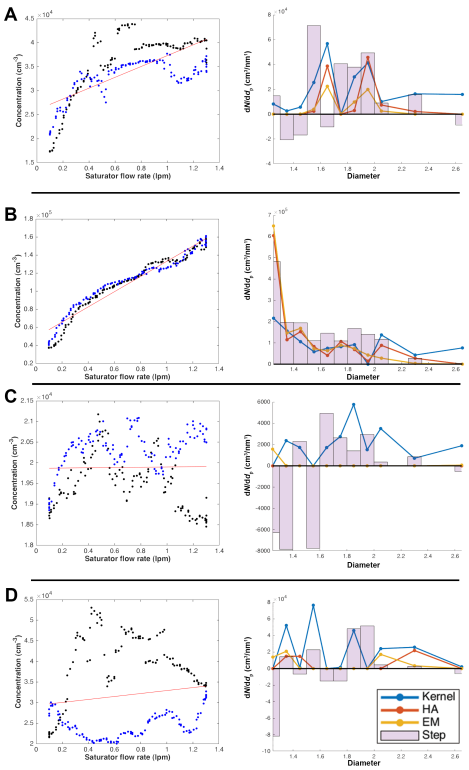
A
B
C
D
Concentration (cm^{-3})
Saturator flow rate (lpm)
dN/dd$_p$ (cm^3/nm^2)
Diameter
Kernel
HA
EM
Step

Fig. 1.

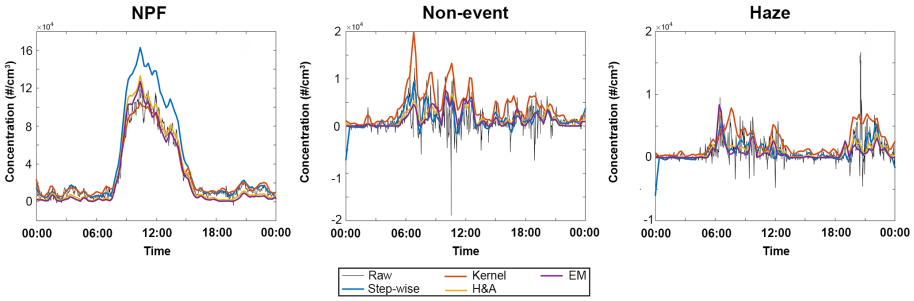
NPF
Non-event
Haze
Concentration (#/cm^3)
Time
00:00
06:00
12:00
18:00
00:00
Raw
Step-wise
Kernel
H&A
EM

Fig. 2.

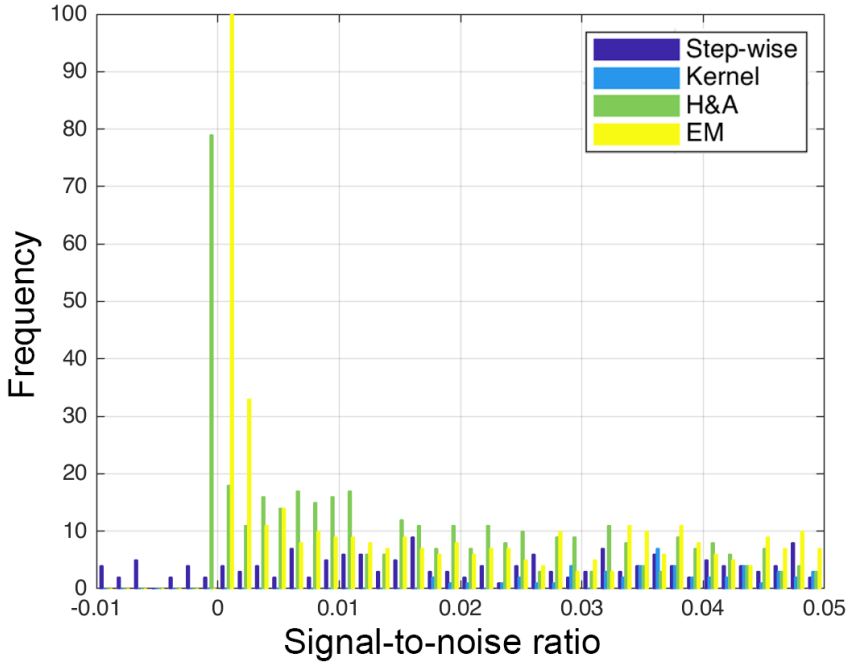
Step-wise
Kernel
H&A
EM
Frequency
Signal-to-noise ratio
100
90
80
70
60
50
40
30
20
10
0
-0.01
0
0.01
0.02
0.03
0.04
0.05

Fig. 3.

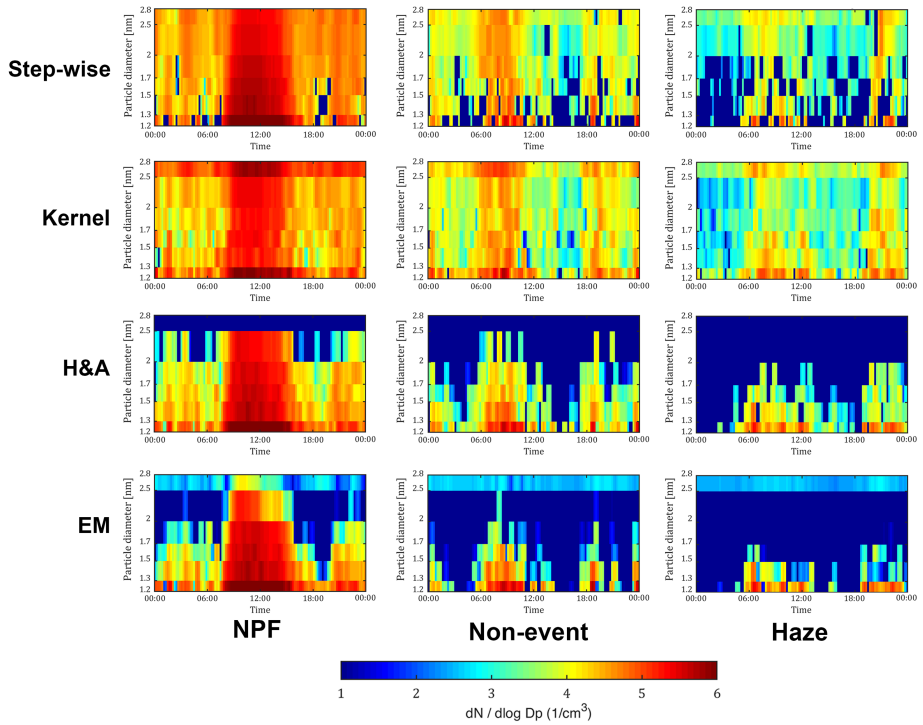
Step-wise
Kernel
H&A
EM
Particle diameter [nm]
Time
NPF
Non-event
Haze
dN / dlog Dp (1/cm3)

Fig. 4.

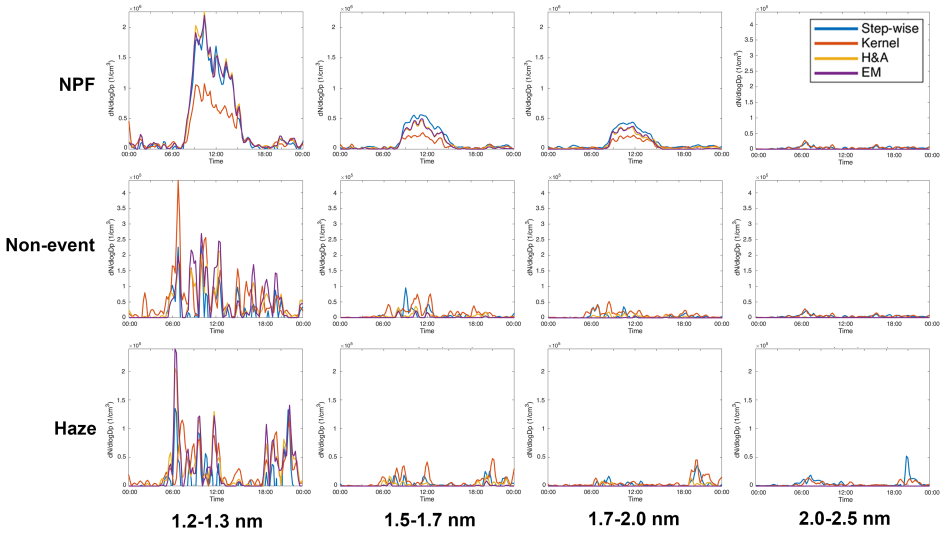
NPF
Non-event
Haze
Step-wise
Kernel
H&A
EM
1.2-1.3 nm
1.5-1.7 nm
1.7-2.0 nm
2.0-2.5 nm

Fig. 5.

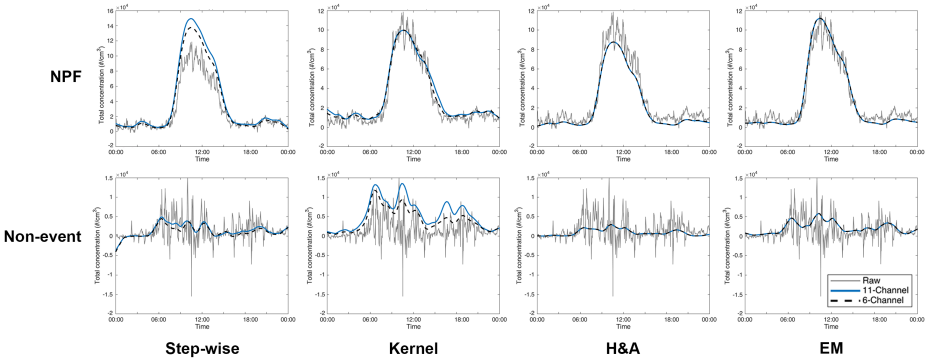
NPF
Non-event
Raw
11-Channel
6-Channel
Step-wise
Kernel
H&A
EM

Fig. 6.

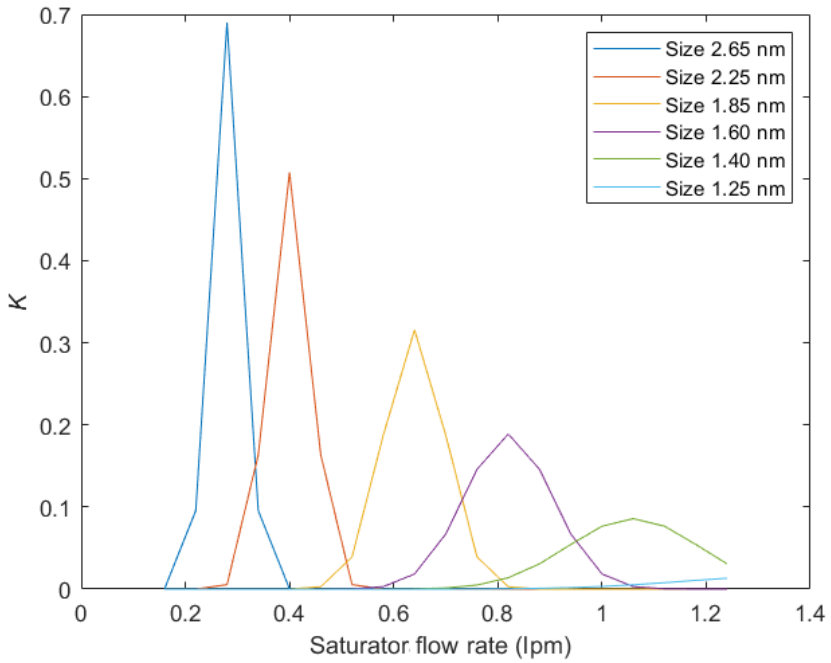
Size 2.65 nm
Size 2.25 nm
Size 1.85 nm
Size 1.60 nm
Size 1.40 nm
Size 1.25 nm
K
Saturator flow rate (lpm)
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.2
0.4
0.6
0.8
1
1.2
1.4

Fig. 7.