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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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–Line 271: The authors used rather long scan times or 4 minutes. During nucleation and growth events, particles are rapidly changing in concentration and diameter (up to 100 nm/hr growth rates have been observed). Are these analysis techniques and inversion methods going to be useful in these situations?

-As mentioned earlier to Referee 1's comment, we can expect particle growth to be < 5 nm/hour at the particle size range in our case study of an urban atmosphere (see Lehtipalo et al. 2014 for growth rate results using the PSM). Measuring 100 nm/hr is impossible with the PSM and we would suggest using e.g., a DMA train in these cases.

For a PSM, a 4-minute scan results in a time resolution of upwards to 15 nm/hr

–Line 308: It would be helpful if the authors could put signal to noise bounds on when each inversion method works/doesn't work. In this paragraph, they mention a ratio but it's not obvious how this relates to signal to noise which is a more used parameter. (It's also not explained well what this ratio is they are referring to.) The conclusions mention signal to noise of âĹij0.02. Where did this come from?

-We have now added in the summary section a more detailed explanation of the signal-to-noise ratio calculation and how users can use this.

–Line 343: The constant pool of 1.7 nm particles is attributed to coagulation controlled particle growth. This seems like a bold state to claim without more results. The authors should better justify this with coagulation calculations or composition measurements etc. However, I realize this is outside the scope of this study so may be best to just remove this paragraph.

-We have removed the paragraph

–All of the Figures are impossible to read. I could not determine if the science presented was sound because the figures are tiny and the font is blurred. The SI figures need to be fixed as well.

-We have made all the figures more legible

–The most important issue of this study is that it is not clear what we the community should do. The authors tried to lay out specific steps but the message is confusing. Which inversion method should we use; is EM applicable for all conditions? What are the uncertainty bounds on the inversion methods? Is the PSM's proprietary inversion method (I didn't think a method could be proprietary) going to move to EM?

-We have expanded the summary section to thoroughly detail recommendations/user considerations. We do not know Airmodus' future in adopting a proprietary method. Here, we simply report our analysis. In regards to the uncertainty bounds, we did not discuss the inversion specific uncertainties. However, we provide the code and sample data used in this study so the user may estimate the uncertainties in the PSM data.

–Line 35: bit misleading to say SMPS measures sub 3 nm size distribution and then cite Wang and Flagan. More accurate to cite nano DMA and ultrafine CPC or DEG CPC papers, or their combined SMPS from Jinkun Jiang. Also, why not include mass spectrometers?

-We have removed the reference and cited properly. Mass specs are out of the scope of this study.

–Line 41: once should be one

-Changed

–Line 60: which manufacture? No where do the authors say Airmodus.

-We have added Airmodus to the sentence and also in the Introduction, when it was first mentioned

–Line 124: I know this is outside this paper but I've always wondered about the mixing efïňĄciency and wall loss changes as the saturator flow is varied from 0.1-1.3 LPM.

-We are not sure if there are any studies regarding this, but theoretically, there are changes. However, these will not affect the inversion methods. In addition, the instrument function is always calibrated in the lab and it includes all changes in the mixing efficiency and any losses.

–Line 135: How do the authors know there were periods of no sub 3 nm particles if they're relying on their inversion method to tell them this information? Their statements would be more justifiable if there were a second instrument measuring particles in addition to the PSM. The authors spend the whole paper getting the readers to think there is major uncertainty in the PSM measurement/inversion method then to say that they relied on it to determine when 3-nm particles were present seems a bit contradictory.

-We have modified the sentence to make it clearer. In addition, we determine whether there are no sub-3 nm particles based on the correlation between saturator flow rate and concentration. It is not physically possible if there is a negative correlation. In addition, when concentration of sub-3 nm particles is high, it is reasonable to believe that the particles are there (Kangasluoma 2020). At low concentrations close to the detection limit of the PSM, problems may arise and we attempt to discuss this in the manuscript.

–Section 2.5: The authors define Ri to be different (particle number concentration or particle concentration raw counts) between each inversion method and it's very confusing. This get more confusing with the authors refer to R1.2-2.8 and total concentration. What Ri is that?

-This is a mis-type. R_i is the raw concentration and we have changed the text to reflect this.

–Line 232: Are these diameters mobility diameters or geometric diameters?

-Mobility. We have modified the sentence

Please also note the supplement to this comment:
https://www.atmos-meas-tech-discuss.net/amt-2019-465/amt-2019-465-AC2-supplement.pdf

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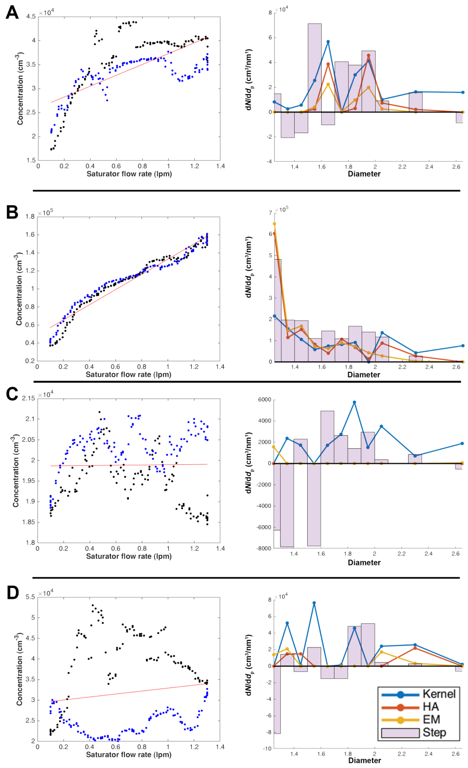
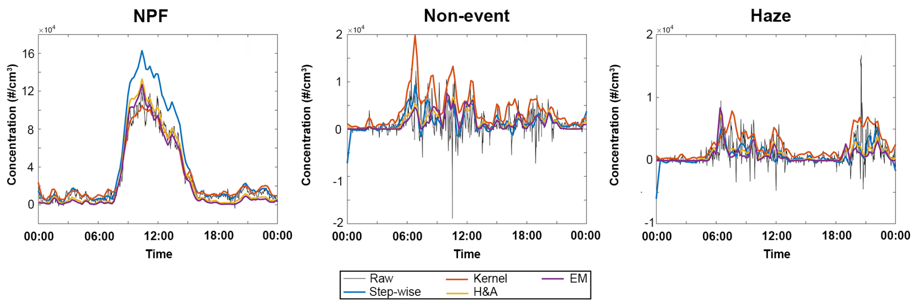


A
B
C
D
Concentration (cm⁻³)
Saturator flow rate (lpm)
dN/dd$_p$ (cm^{-3}/nm^{-1})
Diameter
Kernel
HA
EM
Step

Fig. 1.



NPF
Non-event
Haze
Concentration (#/cm³)
Time
Raw
Step-wise
Kernel
H&A
EM

Fig. 2.

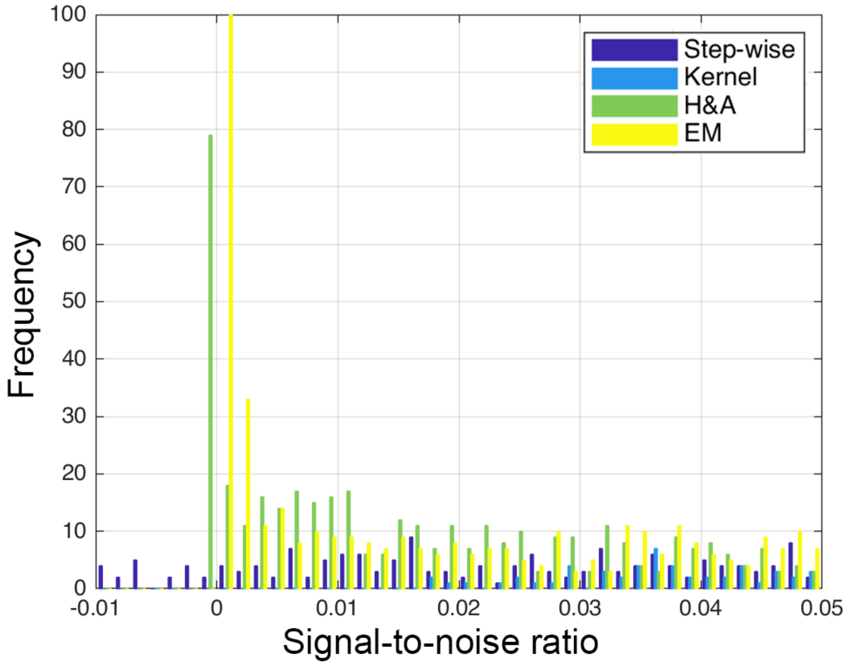

Frequency
Signal-to-noise ratio
Step-wise
Kernel
H&A
EM
100
90
80
70
60
50
40
30
20
10
0
-0.01
0
0.01
0.02
0.03
0.04
0.05

Fig. 3.

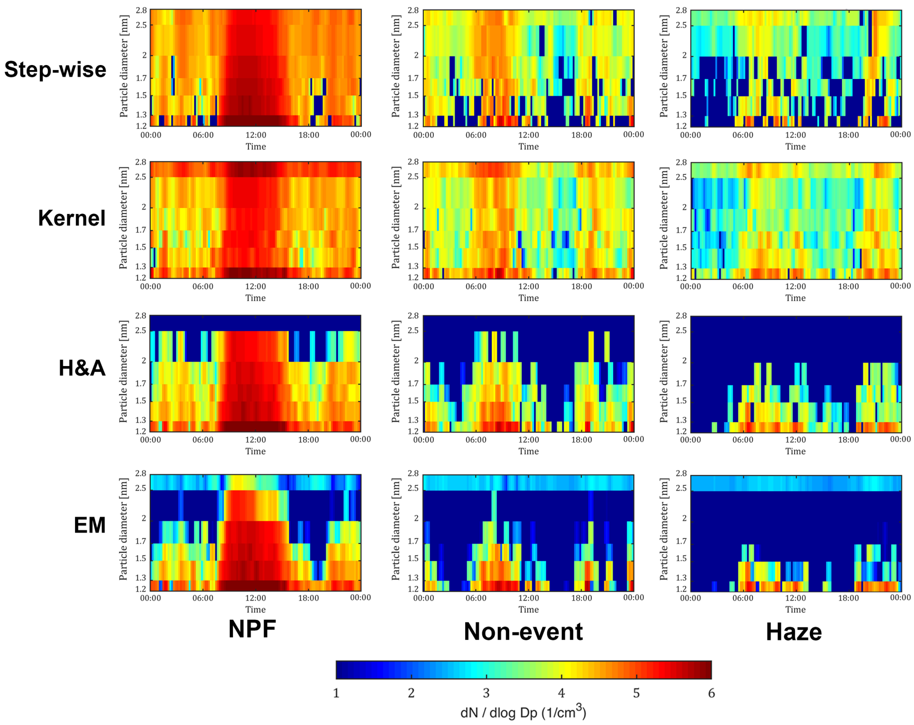
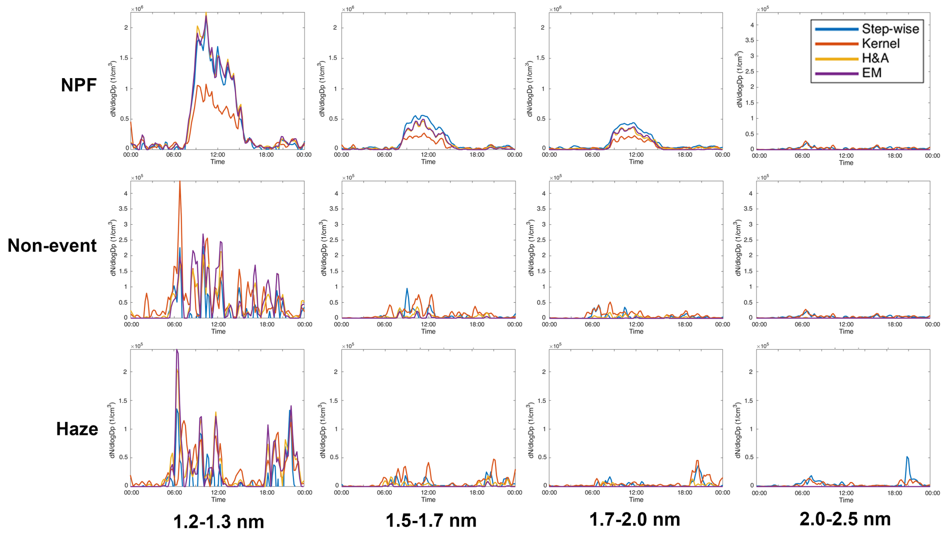
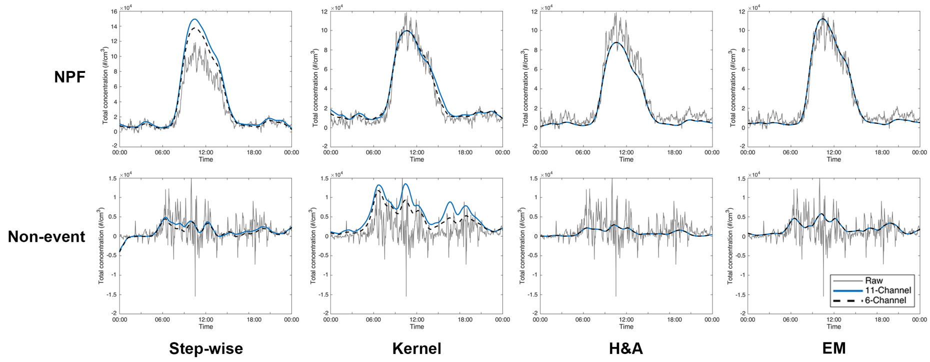

Step-wise
Kernel
H&A
EM
NPF
Non-event
Haze
Particle diameter [nm]
Time
dN / dlog Dp (1/cm3)

Fig. 4.



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

Fig. 5.



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

Fig. 6.

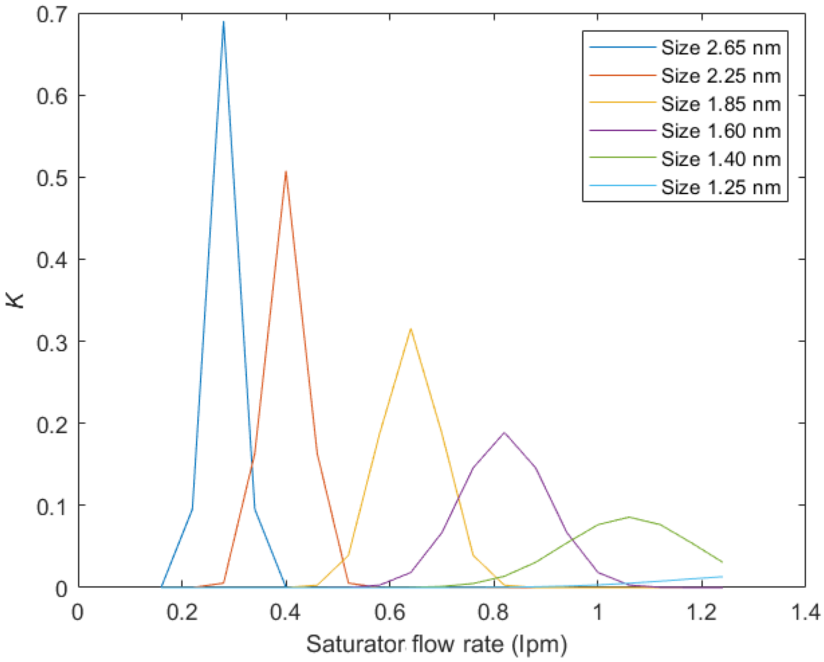

0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
K
0
0.2
0.4
0.6
0.8
1
1.2
1.4
Saturator flow rate (lpm)
Size 2.65 nm
Size 2.25 nm
Size 1.85 nm
Size 1.60 nm
Size 1.40 nm
Size 1.25 nm

Fig. 7.