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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.

Anonymous Referee #2

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Chan et al. present a comparison of 4 different sub-3 nm inversion methods for the PSM. This comparison examines atmospheric observations in Beijing, China in contrast to previous studies which focused on laboratory measurements. Their results show that low raw counts led to unrealistic size distributions from step-wise and kernel methods. Overall, this paper goes into detail the four inversion methods. Their conclusions that the higher raw counts lead to more accurate data inversion and better agreement between the methods. This is not super surprising. Thus, the authors should instead focus more of their interesting results on their pre-treatment of the data. The manuscript is well written however it is not clear from their observations what the community should do. The authors need to address the below major comments before

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Discussion paper

this paper can be consider for publication.

Major comments: 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?

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 $\sim$0.02. Where did this come from?

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.

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.

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?

Minor comments:

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?

Line 41: once should be one

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

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

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.

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?

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

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