Atmos. Meas. Tech. Discuss.,
doi:10.5194/amt-2020-188-RC1, 2020

Atmospheric Measurement Techniques Discussions

Interactive comment on "Assessing the accuracy of low-cost optical particle sensors using a physics-based approach" *by* David H. Hagan and Jesse H. Kroll

Anonymous Referee #1

Received and published: 17 July 2020

This work by Hagan and Kroll presents an open source model, opcsim, based on mie theory that they suggest can be used to evaluate the ability of low-cost optical particle sensors (optical particle counters and nephelometers) to accurately characterize the size distribution and/or mass loading of aerosol particles. The authors use this model to evaluate the ability of different sensor technology to measure PM2.5 mass concentration and the effect of RH, aerosol composition and size distribution on these sensors. My concerns relate more to the authors use of the model to evaluate low cost-sensors and their conclusions from it. I realise that the authors did not want to be too specific (e.g. focusing on one particular sensor), but I did find that the findings are quite broad. I think this is best highlighted by their conclusion that the lower particle

size cut off is critical, especially for low-cost particle sensors, as this can be relatively high (ca. 500nm). To me this is kind of obvious, even the very best OPC will not be able measure particles below their lower size bin. Consequently, it not surprising that this is a large source of error for a low cost OPC relative to an OPC that has a lower size cut off. In my opinion, the results from the model simulation seemed to be overly affected by the lower size cut off chosen for the low and high cost OPC. I further detail some of more these concerns in the specific comments below.

Overall, in my opinion, the paper is well written, clearly presented and the model will be of interest and use to the community to evaluate new sensors and their potential errors prior to lab testing.

Specific comments

Page 20, line 19: The authors state 'Even under conditions where the aerosol is not absorbing, the low-cost OPC largely underestimates the mass due to its high minimum size cutoff' If the errors are associated more with the size cut off, then how can you make statements about the effect of aerosol refractive index on the low-cost sensor?

Page 22, line 5: Is this issue with this comparison that the chosen model aerosol mostly falls below the size detection limit of the low cost OPC (is 500nm)? For me, when I look at Fig 5, when the GM of the aerosol is above 500nm the low cost OPC performs well. I do not quite see the point of this simulation, as these uncertainties related to lower size cut off are inherent for any OPC, irrespective if they are low or high cost?

Page 23. Line 8-10: Could you provide an estimation of the absolute error for low particle mass concentrations from the literature?

Page 25, line 25: For urban environments where the PSD is changing, could this error in low-cost OPC be mitigated by sampling for a longer time period? For to put it another way, is this error dependent on sampling time resolution of the OPC?

Table 4: These NIST standards are very expensive, perhaps you could suggest

cheaper alternatives?

Interactive comment on Atmos. Meas. Tech. Discuss., doi:10.5194/amt-2020-188, 2020.