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Atmospheric Chemistry and Physics Discussions

Interactive comment on "On the functional form of particle number size distributions: influence of particle source and meteorological variables" *by* Katia Cugerone et al.

Anonymous Referee #3

Received and published: 18 May 2017

General – The authors examine particle size distributions from about 0.3 um to 5 um diameter using two optical particle counters (OPC) located in Milan and on Oga-San Colombano at 2250 msl. They use a skewness-kurtosis plane based on the statistics of the measured size distributions to consider several possible statistical distributions that are commonly used to represent aerosol particle size distributions. They show that the Johnson SB (and SU) are capable of representing relatively complex distributions over the size range of the OPC (0.3-5 um) depending on factors that control total number concentrations, including wind speed and precipitation.

This paper offers a new (to me) and interesting approach to contrasting particle size distributions, although it would have been more interesting had the size distributions

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covered sizes down to 20 or 30 nm, rather than starting at 300 nm. The work appears to be targeted towards models that use modal representations, but the skewness-kurtosis plane with separation by total number concentration seems like it has potential as a tool for analysis of size distributions.

The paper is well organized, and the figures are well done, but a careful editing of the paper for grammar is required as misinterpretations are possible. The figure captions could use some additional detail.

Specific comments:

1. Page 3, lines 4-5 – You first say the PNSD pattern does not change, and then you say that it varies by site and season. Please clarify. Also, clarify "In this case": winter?

2. Page 3, line 10 – What do you mean by "background"? Its meaning in this context needs to be clarified.

3. Page 4, line 1 – What model number? Did you use two counters, one at each site, or was one counter transported between sites? If two counters, were they the same model at both sites? If two counters, how were they compared and validated to determine possible differences associated with the counters rather than the sites? It is not uncommon for these types of counters to have large uncertainty in the smallest nominal size. Was the lowest size evaluated in any way?

4. Page 4, lines 17 and 19 – do you mean ug/m3?

5. Page 4, line 20 – Similar to 'background', how do you define pristine?

6. Page 4, Line 23 – What are low aerosol levels?

7. Page 4, lines 25-29 – This tells us nothing other than you have measured some other things (NOx and meteorological quantities). Perhaps that is what you intended, and there is simply a grammar issue? Otherwise, is there a reference for the "influence" investigation? NOx may be considered a component of the aerosol, but it is not an

"aerosol compound".

8. Figure 1 – Why did you choose August 2012 (MI8) rather than August 2011 (MI6) that is at the same time as SC2?

9. Page 5, lines 6-8 - Figure 1 – The inflections in the distributions between about 0.4 um and 0.8 um are present at both sites, but particularly evident in the Milan results. Rather than "droplet mode particles", the inflections may be a symptom of ambiguities in the scattering function for the particular angle of the OPC, sometimes referred to as Mie ambiguities. Some of the peaks and valleys above 1 um may also be due to this potential problem. The exaggerated inflections in the Milan PNSD relative to the SC PNSD may be due to differences in the index of refraction or the apparently less steep Milan distributions from 0.3 to 0.7 um compared with the SC distributions. You should look at the scattering function versus particle diameter for the counters. If ambiguities are present (i.e. a similar amount of light scattered into the collection angle by particles of different sizes), the common solution is to average across the bins covering the ambiguity size range.

10. Figure 2 – Indicate what the lines refer to in the caption.

11. Page 7, line 7 and Figure 3 – The fits in Figure 3 are very good considering the detail. Not being familiar with the JSB distribution, I would to see your fitting process discussed in a little more detail, including the Maximum Likelihood Method. The details could be added to the supplement.

12. Page 10, lines 10-17 – Higher values of NOx/NO2 may indicate closer temporal proximity to sources. They also suggest the possibility of a greater fraction of particles from primary emissions, but it does not guarantee that primary particle emissions dominate over secondary. Also, it sounds like "These findings support our hypothesis that in urban sites during winter season the increase of primary aerosols emission by local sources causes an evident increase of primary aerosol compounds concentration." is saying that an increase of primary aerosol emissions causes an increase in primary

aerosol concentrations. I presume that is not exactly what you intended. I suggest saying something like particle concentrations increase when sampling is done in closer photochemical proximity to sources. Remove references to primary or secondary; they are not needed.

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