

## ***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 #5**

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The manuscript proposes that the skewness-kurtosis plane (the size distribution projected into the third and fourth moments) can be used to follow changes to the particle number size distribution (PNSD), and that four-parameter Johnson SB (JSB) distribution as being sufficient for observing changes to the PNSD in a way that maps to the skewness-kurtosis plane. The authors present PNSDs from four measurement campaigns under different NO<sub>x</sub> and meteorology conditions. This manuscript includes a few interesting ideas that are less well-known to the broader ACP community, and has potential for novelty and impact. However, at present time the manuscript is strongly recommended for revision and re-submission. The reason for this is recommendation that each of these ideas introduced are not fully developed. As a result, the reader

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is mostly left with an impression that what is demonstrated is that the size distribution changes when there are changes in meteorology or emission sources, which could be characterized more informatively using traditional approaches (number concentration, modes, etc.).

The conclusion that the JSB can be used to represent PNSDs does not appear to be well-supported by the material that is presented. As one of the other reviewer notes, PNSDs can be multimodal, and representing each of these modes well is in itself a challenge. There is no indication regarding the modality or quality of fit permitted by JSB. What is presented seems to be that the range of skewness and kurtosis in observed PNSDs fall within the range that can be represented by the JSB distribution except at high concentrations. Furthermore, it is not demonstrated that JSB outperforms other parametric distributions for representing PNSDs (except for the reason of having four fitting parameters), and the authors even note in the conclusions that the other parametric representations may be adequate.

Regarding the use of the skewness-kurtosis (S-K) plane, does it provide more information that cannot be achieved by examining other parameters of the PNSD conventionally used (e.g., first and second moments of lognormally transformed data)? Given the long history of modeling PNSDs, the mode gives some indication of whether the dominant source is likely anthropogenic or biogenic; the geometric standard deviation may be related to the extent of atmospheric dispersion. It is not clear from the results presented whether 1) changes in PNSDs in the S-K plane cannot be detected in a conventional parameter space, and 2) any approximate delineations can be proposed that link physical processes to regions in S-K that could demonstrate its usefulness.

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