The behaviour of charged particles (ions) during new particle formation events in urban Leipzig (Germany). Response to reviewers round 2.

Note: Review comments are displayed in plain text, responses to those comments are displayed in blue and sections that have been added to the text are coloured *green (and italicised)* We thank the reviewers for their insightful comments and provide responses below.

Reviewer: 2

1. Fig. 5: the p-values are hard to read. Their location should be adjusted, or they could alternatively be mentioned in the figure caption

Thanks for the suggestion, we have opted to include them in the figure caption. Please see below in bold.

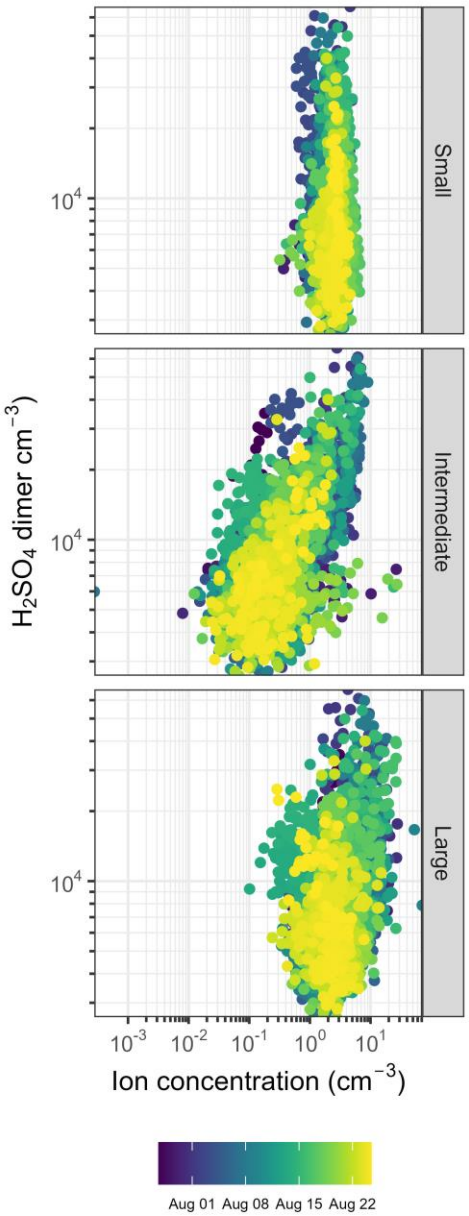


Figure 5: Correlation of H_2SO_4 dimer with small, intermediate, and large ions, coloured by date. ***The R^2 values are 0.0014, 0.27, and 0.079, respectively, and the p values are >0.05, <0.05, and <0.05, respectively.***

2. Fig. 4: The lines in this figure may be hard to separate from each other for people with some form of colour blindness. I suggest going through all the figures with Coblis – Color Blindness Simulator

Great suggestion, thanks. We have fixed these figures and swapped the palette for a similar, but colourblind friendly one. Please see figure below.

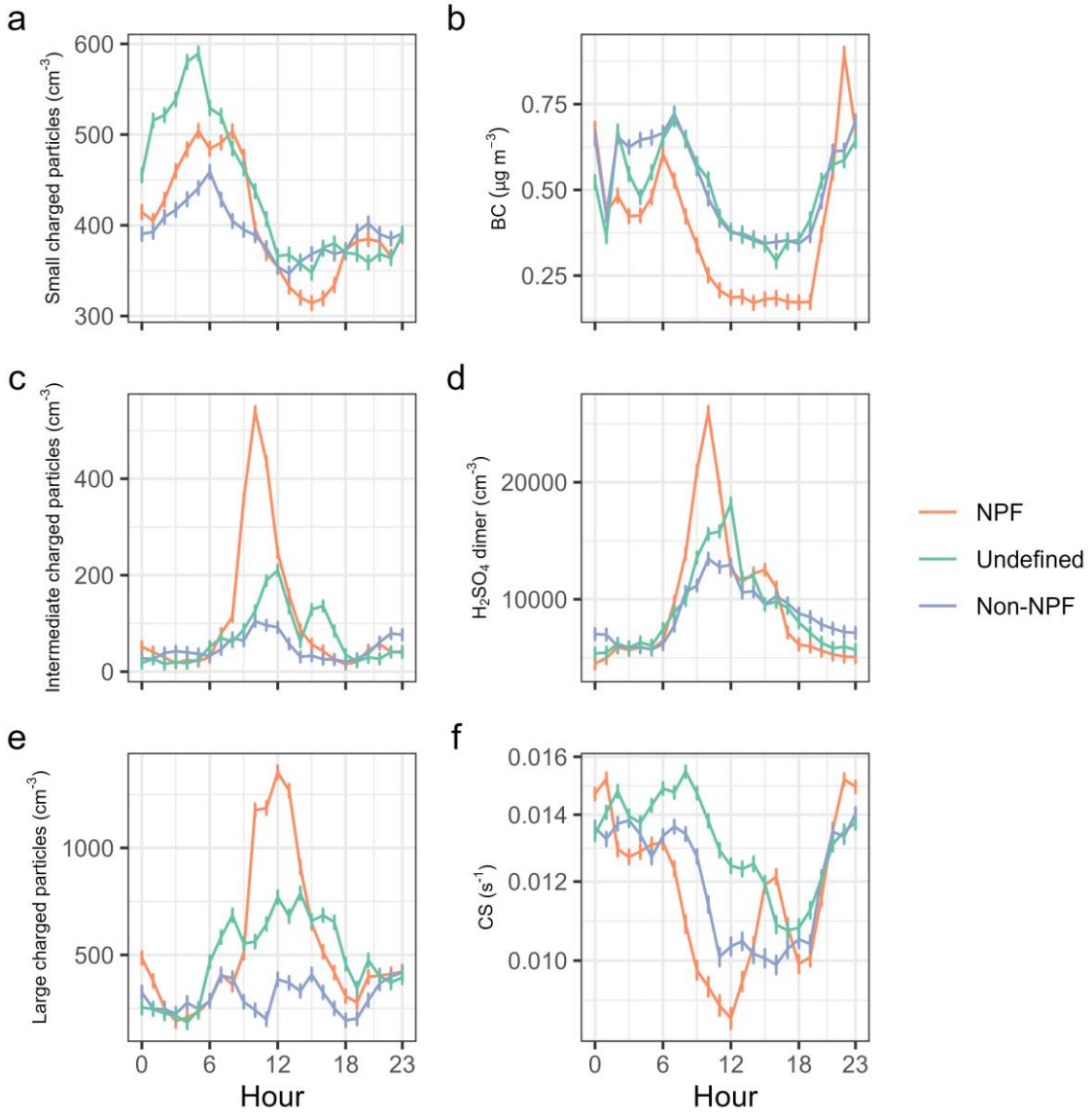


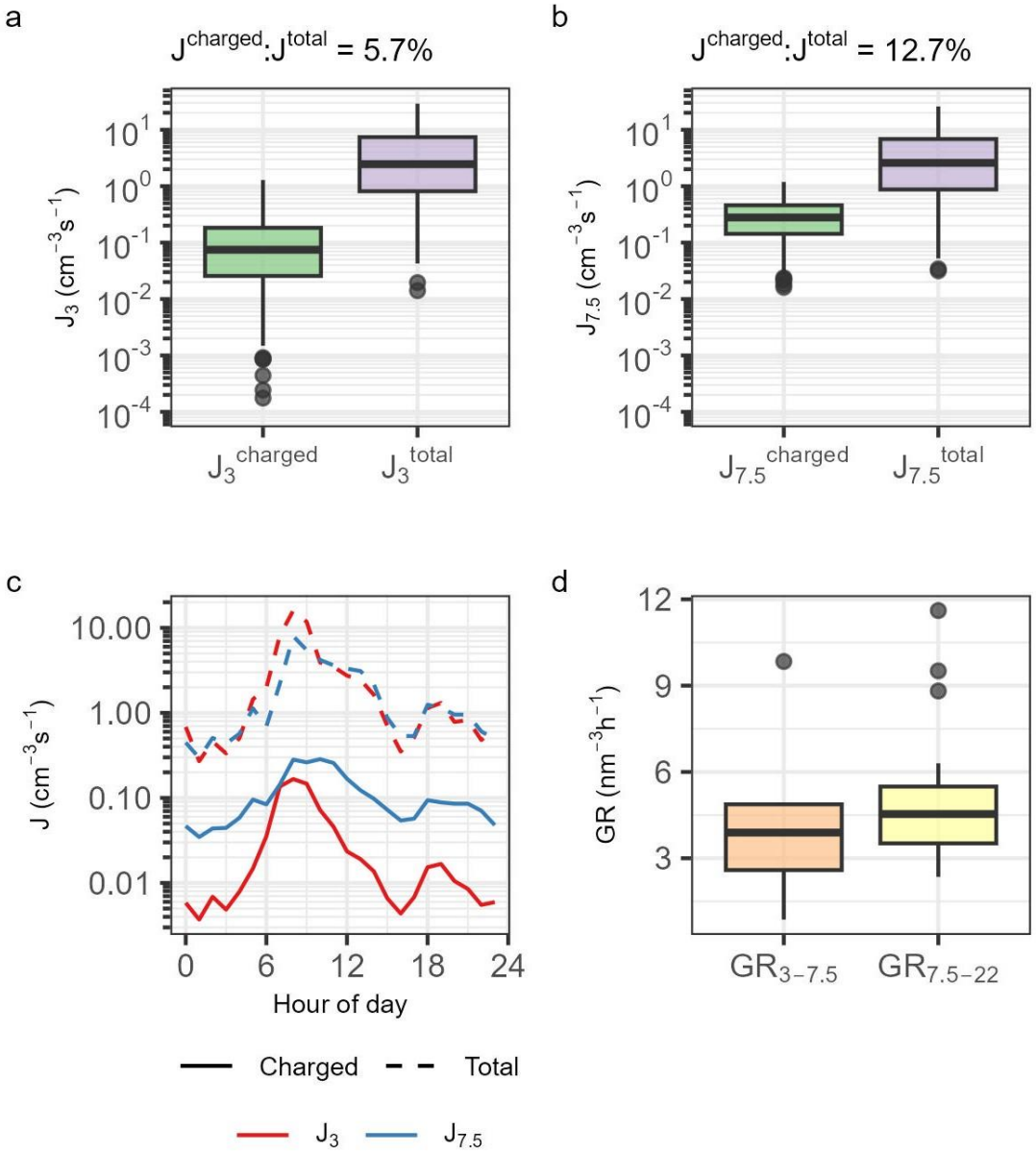
Figure 4: Mean diurnal cycles of (a) small (0.8–1.6 nm), (c) intermediate (1.6–7.5 nm), and (e) large (7.5–22 nm) charged particles, as well as (b) BC, (d) H_2SO_4 dimer, and (f) CS on new particle formation (NPF) event, undefined, and non–NPF event days. The vertical lines represent the standard error of the mean.

3. Line 303: "…mobility classifications…". Should it not be diameter classifications?

Correct, thanks for highlighting this

4. Fig. 6: In the title, it would be tidier if Jion → Jion

Following this and a suggestion from reviewer #3, we have tidied up the text on this figure. Please see the below.



"Figure 6: Apparent formation rates of (A) 3–7.5 nm charged particles (left) and total particles (right) and (B) 7.5–22 nm charged particles (left) and total particles (right). Calculated from 9 new particle formation (NPF) event days using 10–minute means. (C) the diurnal cycle in formation rates on NPF days, and (D) growth rates (GR) of 3–7.5 and 7.5–22 nm charged particles. The coloured rectangle represents the middle 50% of the data, with the central horizontal line indicating the median value. The whiskers (vertical lines) extending from the rectangle show the spread of the data. Data points beyond the whiskers show outliers."

5. Line 215: the parentheses and comma from "(change of dp over time,)" should be removed.

Thanks, this has been done

6. Line 412: "J3-7.5charged is higher than J7.5-22charged" should be J3-7.5charged is lower than J7.5-22charged

This has been corrected.

Reviewer: 3

In the revised manuscript the authors stated that the charged particles were classified into small (0.8-1.6 nm), intermediate (1.7 – 7.5 nm) and large (7.5 – 22 nm) fractions by mass diameter. Yet the authors explained that their size conversion was based on Ku & de la Mora (2009). I am afraid it is getting more confusing. Ku & de la Mora (2009) provided a means to link mobility diameter to mass diameter. If what you get from the size conversion was dp as defined in Ku & de al Mora (2009), your size classification is actually based on mobility diameter. For example, a mobility of 3.2 $cm^2V^{-1}s^{-1}$ is about 0.8 in mobility diameter. For better clarification, please include the mobiulity range for your size classification.

Ku and de la Mora (2009) provide an approximation for the effective gas diameter, which can be used to convert mass diameter to mobility diameter (i.e., $d_e = d_m + D_g$ where d_e is the electrical mobility diameter, d_m is the mass diameter, and D_g is the effective gas diameter, which is roughly .3 nm). We converted the size cuts from previous papers (for example, 0.8 – 1.6 nm mass diameter) to a mobility diameter and reperformed our analyses (1.1 – 1.9 nm). For clarity, we include the following

"The air ion/charged particle population was classified into small (0.8–1.6 nm mass diameter, 1.1—1.9 nm electrical mobility diameter), intermediate (1.6–7.5 nm mass diameter, 1.9—7.8 nm electrical mobility diameter), and large particles (7.5–22 nm mass diameter, 7.8 – 22.3 nm electrical mobility diameter) for analysis, following the classification system outlined by Tammet (2006)."

And later on…

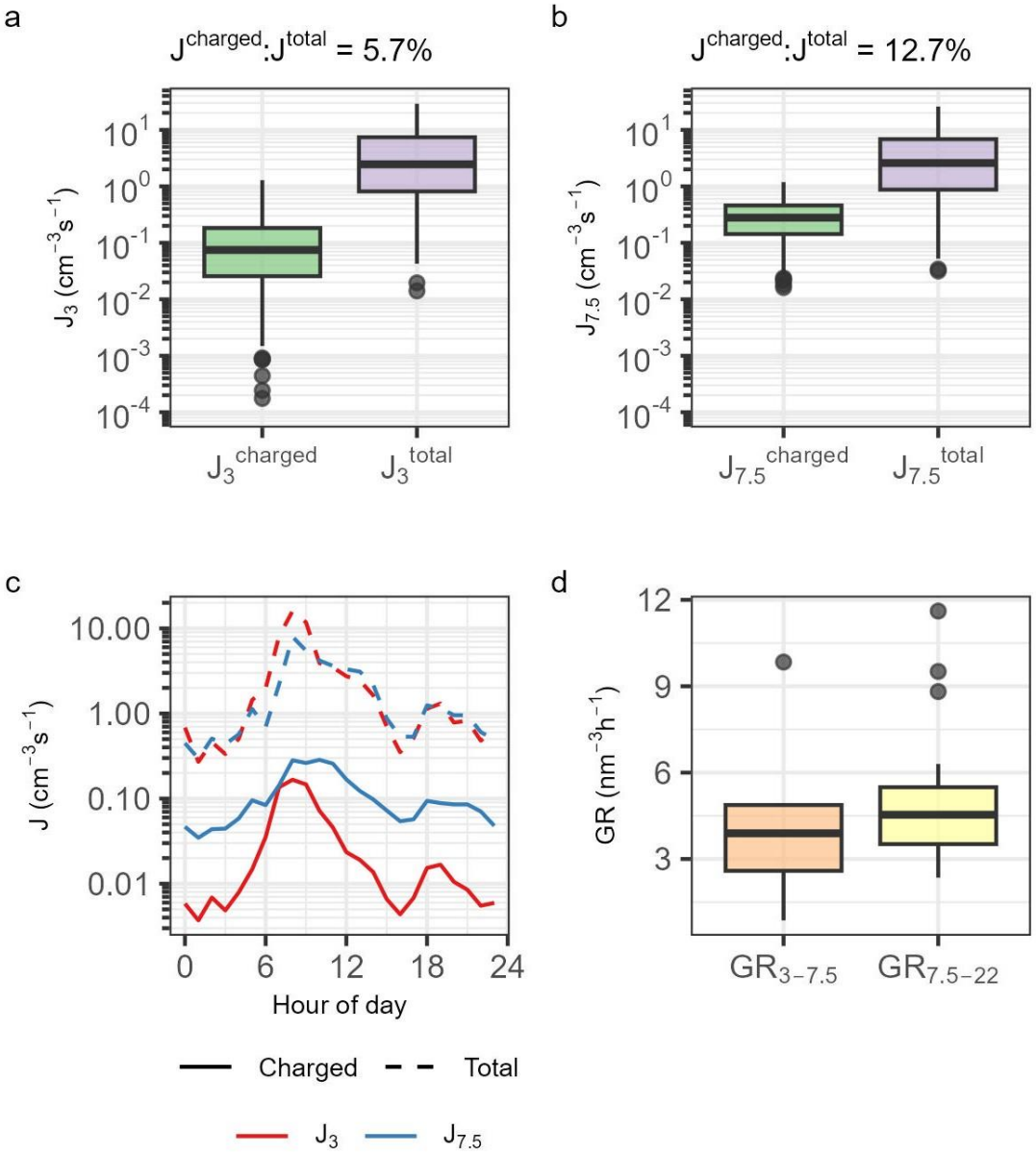
"A NAIS was used to measure the particle number size distribution (PNSD) of naturally charged, and also the sum of naturally charged and neutral particles from 0.8–42 nm (3.2 to 0.0013 cm^2 V^{-1} s^{-1}) by their mobilities. From here onwards we refer to all diameters as mass diameters for consistency with the literature (e.g. Tammet et al., 2006; Ku & Fernandez de la Mora, 2009)."

On P26L34: "Observed ratios of charged to uncharged particles…": shouldn't it be total? The same issue is also in the conclusions

Yes, thank you. We have fixed it in both locations.

Technical issues: the authors used charged and total in the superscript of formation rates and size ranges in the subscript. However, Fig. 6 was presented with a completely different notation scheme.

In line with this and a recommendation from reviewer #1, we have revised this figure and present it below



"Figure 6: Apparent formation rates of (A) 3–7.5 nm charged particles (left) and total particles (right) and (B) 7.5–22 nm charged particles (left) and total particles (right). Calculated from 9 new particle formation (NPF) event days using 10–minute means. (C) the diurnal cycle in formation rates on NPF days, and (D) growth rates (GR) of 3–7.5 and 7.5–22 nm charged particles. The coloured rectangle represents the middle 50% of the data, with the central horizontal line indicating the median value. The whiskers (vertical lines) extending from the rectangle show the spread of the data. Data points beyond the whiskers show outliers."