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Revised Title: A Phenomenology of New Particle Formation (NPF) at Thirteen European Sites

Author(s): Bousiotis et al.

REVIEWER #1

I thank the authors for their extensive revisions to the manuscript. The improvement to the structure makes the manuscript much easier to read and the addition of the separate discussion section more clearly articulates the findings of the manuscript. I recommend publication after consideration of the following minor details. Line numbers refer to the track changes version of the manuscript.

Lines 215-225: Thank you for the addition of this description. I find the information it presents to be helpful, however, the presentation of the information could be improved. For instance, in the second sentence “such formation still occurs” I believe is about traffic related npf, but the wording is unclear. I am also unsure what is meant by “using average conditions for comparison would lead to negative values” negative values of what? It isn’t clear to me why the comparison would have a definitive sign. Finally, the last sentence would benefit from being broken into 2 sentences to increase readability.

RESPONSE: Text was updated for all cases suggested.

- For first one “associated with traffic emissions” was added.
- For the second an explanation for the reason negative values are expected was added. The text now reads “Using average conditions for comparison would lead to negative formation rate values in most cases, since in order for an NPF event to occur, traffic related particles are usually reduced to a greater extent compared to the formation from NPF, leading to lower particle concentrations on event days as found from a previous study in Marylebone Road, London (Bousiotis et al., 2019).”
- The final sentence was broken into two. The text now reads “This may result in an overestimation of the formation rates at roadside sites presented in this study. The choice of a time window for which we would have the maximum effect of secondary particle formation and the minimum possible effect from traffic related particle formation attempts to reduce this discrepancy as much as possible.”

Table S6: I typically think of ND as standing for “not detected.” Since here no measurements were made, it isn’t exactly the same thing. I suggest a different abbreviation. The abbreviation should be defined in the caption.

RESPONSE: All ND abbreviations were replaced with NA as data were not available for these periods.

Line 1123-1124: “The most consistent result found throughout the areas studied, regardless of the geographical location, was the higher frequency of NPF events at rural background sites compared to roadsides.” I wonder how consistent this result truly is. I suggest reconsidering the phrase “most consistent result...regardless of geographical region” for comparing rural background and roadsides. From Figure 2, only 3 of the countries had measurements at roadsides. For Finland, the results for urban background and roadside are quite similar. So that leaves 2 out of the 5 countries.

RESPONSE: The text was updated to clarify that the result is consistent among the countries of this study with available data for both types of sites. Text now reads “A higher frequency of NPF events at the rural background sites compared to roadsides was found for all countries with available data for both types of site.” As for the Finnish sites, while the reviewer is correct about the similarity of the urban background site and the roadside, the text discusses the relation between the rural background sites and roadsides.

Lines 1151-1153 “Finally, it should be noted that no clear interannual trend...” I think this statement should be made significantly earlier in the manuscript so that the reader isn’t wondering throughout the long

manuscript what role trends might play. I think a slightly revised version of this sentence would be appropriate at the beginning of section 3.

RESPONSE: To mention the lack of interannual variations, the sentence in the introductory part of section 3 was changed to: “The annual number of NPF events, growth rate and formation rate for all the sites is found in Table S6, for which no clear interannual trend is found for any of the sites in this study. This may be due to the relatively short period of time studied for such variations to be observed.” (line 250).

REVIEWER #2

This manuscript provides a useful overview of new particle formation across Europe. To me the big-picture summary expressed in the figures is that, all things considered, formation and especially growth rates are remarkably uniform across time and space. Yes there is variability, but it is not so large. This is most notable for the growth rates. If the authors agree with this assertion, in my opinion this would be worth including in the abstract. Further, I suggest keeping the y axis range as constant as possible in the summary figures - most of these have similar maximum values (i.e. growth rates between 6 and 10 nm/h) and the presentation would profit from the immediate visual similarity in the ranges.

RESPONSE: The phrase “(though in many cases differences between the sites were small)” was added in the abstract (line 47). Additionally, Y-axis ranges in both growth and formation rate figures are now uniform across all figures.