

## ***Interactive comment on “An Analysis of New Particle Formation (NPF) at Thirteen European Sites” by Dimitrios Bousiotis et al.***

**Anonymous Referee #1**

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This manuscript summaries long term measurements of particle number size distributions at thirteen European sites and derives the characteristics of new particle formation (NPF) events including NPF frequencies, formation rates of 10 nm particles, and growth rates of nanoparticles. While it is absolutely necessary to list the parameters for NPF events across Europe, it would be good to compare the numbers internally among the thirteen sites and externally with other continents, although the latter might not be necessary. Overall, I found that this manuscript a little bit hard to follow, since it is more like, or focus too much on, a combination of summaries of NPF events in a number of countries, which lacks the inherent connection between each part of the manuscript in the current format. At the moment, I would suggest the authors to address my following concerns.

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1. This is actually my main concern and has been brought up in the general comments. Although the characteristics can be inferred from the available figures and tables, I would suggest the authors consider adding a general session, in addition to their conclusion, to summarize the NPF events in the thirteen sites/five countries. In fact, I believe some of the contents in the current conclusion should be moved into the new session. In this session, a quick idea on NPF events in these thirteen European sites can be established. If the authors want, they can even compare these events with those in other locations. The current description by countries, unfortunately, offers many details on concentrations of atmospheric tracers and meteorological parameters, and even the characteristics of NPF events in a particular location. This is OK but too descriptive, like a compilation of 5 papers. I believe that the details should appear in a manuscript that is specific for a location, instead a review like this one. I mean, one is less impressed by these without a logic or a general rule.

2. Elaborate how to exclude particles deriving from primary emissions next to pollution sources, such as traffic, which is important since the NPF frequencies are the highest at roadside sites in summer (Line 671).

3. Table 1 summaries the data availability of the thirteen sites. I noticed that some of the references do not match the available data, for example, the DENRU site, and thus assume the references are just a reference for the site instead of the data that have been discusses in the manuscript? Is it right? If yes, please add a footnote. Also, the size range for particles are not identical from one site to another, in contrast to the statement in Line 133. As a result, the range for particle growth rate calculation could be different, since “the size range between the minimum available particle diameter up to 30 nm” (Line 182) was used, which might lead to a minor correction in the growth rate. Lastly, these measurements were performed across at least 10 years, is there a distinguishable trend for NPF frequency, formation rate, and growth rate there?

4. The chemical composition of PM<sub>2.5</sub> or PM<sub>10</sub>, in my mind, would not tell us a piece of evidence that is conclusive. I would rather use “CS” only to illustrate how particles

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work as a scavenger. I don't believe that sulfate in PM<sub>2.5</sub> is a good tracer to tell the mechanism.

5. The regional events are now defined as NPF events over hundreds of kilometers, and thus basically the manuscript is comparing two sites within one country. In addition to the statistics in the manuscript, have the authors tried to identify NPF events in an even larger distance? Clearly, we have to take wind direction and speed into account to make sure that what we are looking at are still "regional"? I would imagine that meteorology plays a big role here.

Minor comments,

6. It would be great, if the authors can use different colors to denote the site type in Figure 1. For those that are very close, please use a zoomed-in window. This practice may help understand the regional events later (Line 551).

7. Consider a better color-coding for the seasons in Figures 1 and 8.

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