

Referee comment on “Measurement report: Atmospheric new particle formation in a peri-urban site in Lille, Northern France” by Suzanne Crumeyrolle., et al, Atmos. Chem. Phys. Discuss., <https://doi.org/10.5194/acp-2022-436>, 2022

Anonymous Referee.

Crumeyrolle and co-authors present a measurement report on a long-term dataset from Lille, a large city located in France. The authors performed an extensive analysis of the particle number size distribution and meteorological parameters, in order to explain the factors involved in the new particle formation events over Lille. Crumeyrolle et al., reported that the majority of the NFP observations occurred during spring and summer. It was found that  $T > 275\text{K}$ ,  $RH < 45\%$ , and high solar radiation favored the NPF appearance. Additionally, the authors stated that despite the relatively high CS, new particle formation is observed. This observation is in concordance with other studies in large cities.

I very much appreciate the analysis of this long-term dataset. The results are clearly presented and extensively discussed. The manuscript is a valuable contribution to the field. I would recommend it to be published on ACP after addressing the following comments.

### **Specific comments:**

Line 70: what do you mean by promoting growth rate? Do you mean, by promoting an increase in the growth rate?

Line 99: please define GAW.

Line 128: Please rephrase “SMPS dry (using a Nafion) particle number size distributions were also used for CS and growth rate (GR)”, you can delete growth rate and only use GR, since growth rate was defined before.

Line 192: can you please comment more about this “This might show that ATOLL is under the influence of air masses or particle and precursor sinks that favor the burst of UFP”. It is an interesting observation.

Line 219: When the starting time and growth rate are discussed, the authors refer to the local time, not UTC time as in Fig. 3. This certainly is helpful to take into account the dynamic of the site where the monitoring was done. Can you please, refer to the caption of Fig. 4 that the time there is local?

Line 222: please define “colder period”. Is it colder than July? I think it is missing the comparative sentence. By looking at Fig. 4, to me, the “colder period” comprises March, April, and May. Or does it include winter?

Line 231: here it is stated that the colder months are (March and November). I think the colder period should be more clearly defined otherwise it can be confusing.

Page 13: Can you please rephrase this sentence “GR15.7-30nm values were, in addition, plotted as a function of temperature for all years and seasons in Figure 5, which highlights that below 20°C, GR15.7-30nm values are lower than 6 nm.h<sup>-1</sup>, while, under warmer conditions (T >20 °C), GR15.7-30nm reach values up to 16 nm.h<sup>-1</sup>”.

Page 13: can you please explain a bit more why you think this: “As previously observed in Figure 3a, the mean geometric diameters reached by the end of all NPF events are similar and averaged around 50 nm. This can be explained by the presence of a pre-existing mode of particles centered around 50 nm”. Thanks

Caption Figure 6. The authors refer to spring (MAM, top) and summer (JJA, bottom) seasons. Is this classification related to the “warmer period”?

Line 259: please rephrase this sentence “at moderately high RH (RH >40%), hydrophilic aerosols could growth which will enlarge the sink for precursors and...”

Line 260: can you please comment briefly on this? “high RH values limit some VOC (Volatile Organic Compounds) ozonolysis reactions, which further prevents the formation of condensable vapors necessary for nucleation”. How does the RH affect the ozonolysis reactions?

Line 270: can you please mention that an example of biogenic compounds that inhibit NPF events is isoprene and cite Heinritzi et al., 2020 (Atmos. Chem. Phys., 20, 11809–11821, 2020)?

Can you please give more detail on how the CS was calculated? Please add this information to the method section. Thanks.

In section 3.5, probably <https://doi.org/10.1038/s41586-020-2270-4> and Environ. Sci.: Atmos., 2022, 2, 491, can be useful for the discussion.

The author may suggest that monoterpene emissions probably play a role in the observations. Since ATOLL is located at a peri-urban site, are there other precursors possibilities?

For describing Fig. 3, the authors refer to the median, and later (on page 13) they refer to the mean geometric diameter. Can you please comment briefly on how those concepts compare? Are they similar or is there any conversion in between?

Page 13: can you please explain a bit more why you think this: “As previously observed in Figure 3a, the mean geometric diameters reached by the end of all NPF events are similar and averaged around 50 nm. This can be explained by the presence of a pre-existing mode of particles centered around 50 nm”. Thanks.

### Technical comments:

Line 17: please add a dot after “particles” to finalize the sentence.

General: please define how the abbreviations are written, condensation sink (CS) or Condensation Sink (CS)? the same applied to other abbreviations such as UFP, GR, etc.

Line 23: probably it is better to write: using a 4-year long-term dataset, without mentioning the exact date (in the abstract).

Line 29: please change Growth Rate to growth rate.

Line 32: please change “reaches” to “reached” to keep the abstract in past.

Line 35: please change “New Particle Formation” to “New particle formation” to be consistent with the abstract.

Line 36: Please change “The latter” to for example “These particles”.

Line 39: Please rephrase this sentence “The freshly-formed particles then grow to larger sizes, from a few nm in particle diameter up to sizes ( $D_p > 100$  nm) at which they may act as cloud condensation nuclei (CCN,..”. A possibility could be “The newly-formed particles then grow to larger sizes ( $D_p > 100$  nm) at which they may act as a cloud condensation nuclei (CCN).

Line 52: There is a parenthesis missing at the end of the sentence “Differences were found in both the seasonality and intensity of NPF events according to the site type (urban, traffic, regional, background, rural, polar, high altitude (Dall’Osto et al., 2018; Sellegri et al., 2019)”.

Line 124: can you please add which diameter range you consider to be Aitken mode?

Line 67: please change “A recent study (Bousiotis et al., 2021) using large datasets (16 sites) over Europe (6 countries) highlighted...” to “A recent study (Bousiotis et al., 2021) used a large dataset (16 sites) over Europe (6 countries) and highlighted that...”

Line 95: please change “(Métropole Européenne de Lille, more than 1.1 million inhabitants)” to “(Métropole Européenne de Lille with more than 1.1 million inhabitants)”

Line 112: please rephrase “The instruments use in this study focused on aerosol properties including number size distributions, chemical composition, and optical properties, and details are described below”. For example, “The instruments used in this study measure the aerosol properties including number, size distributions, chemical composition, and optical properties. The details are described below”.

Line 119: please rephrase “Typically, the scan time was chosen to be 300 seconds. To take into account the multiple charge effect and the losses through diffusion, particle concentrations were corrected using the equation given by the manufacturer specifications (AIM 10.2.0.11)” to e.g.,

“The scan time was 300 seconds and the particle concentrations were corrected by taking into account charge effects and diffusion losses”.

Line 129: please change “which” to “which”.

Line 134: please rephrase “First, the NPF starting time was identified when the newly formed mode was observable in the first bins of the SMPS (15.7 nm) and the time of peak concentrations for particles with a diameter of 30 nm ( $N_{30}$ ) during NPF were manually identified” to “First, the NPF starting time was identified when the newly formed mode was observable in the first bins of the SMPS (15.7 nm). The final time was manually selected and it was defined as the time at which the particle concentration of 30 nm-particles reached a maximum”. (For example).

Line 144: please change “5 L.min<sup>-1</sup>” to “5 L min<sup>-1</sup>”

General: sometimes it is written X % and other times X%, please be consistent.

Line 173: please change “(polar, rural, high altitude, remote, urban)” to “(polar, rural, high altitude, remote, and urban)”

Line 205: please change “(See supplementary materials)” to “(see supplementary materials)”

General: There is inconsistency in the font size and font type used along the manuscript, please unify.

Y label of Fig. 4b and along the manuscript: please change “(nm.h<sup>-1</sup>)” to “(nm h<sup>-1</sup>)”.

Page 13: please change “Over urban areas (Beijing or Shangai)” to “Over urban areas such as Beijing or Shangai”.

Figure 3. Do the plots shown here represent an average or are they representative examples?

Figure 5. please change “(nm/h)” to “(nm h<sup>-1</sup>)”.

Figure 6b: please change “(W/m<sup>2</sup>)” to “(W m<sup>-2</sup>)”.

Line 247: please change “total solar radiations” to “total solar radiation”.

Line 255: there is one line spacing missing between studies and (Duplissy...).

Line 262: please change temperature conditions (T) to (T).

General: I would recommend increasing the font size of the axis on the plots, for example in Figure 6b, Figure 7, etc.

Line 276: please change “(larger than 2 10<sup>-2</sup> s<sup>-1</sup>)” to “(larger than 2.10<sup>-2</sup> s<sup>-1</sup>)” or “(larger than to 2e-2 s<sup>-1</sup>)”. The same for lines 278 and 279.

Line 359: typically, there is a space between the number and the unit, e.g., 10 h instead of “10h”.