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Interactive comment on "Ultrafine particle sources and in-situ formation in a European megacity" *by* M. Pikridas et al.

Anonymous Referee #1

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Two of the most topical subjects in atmospheric science are the effects of megacities on local, regional and global pollution, and the sources and behaviour of nanoparticles. This paper studies the greater Paris region, which in terms of population exceeds the 10 million requirement to be called a megacity, and the focus of the work is on the fraction of particles smaller than 500 nanometres, hence including the ultrafine (nano) particle fraction normally taken as that below 100 nanometres diameter. The paper describes the results of two field campaigns and associated measurements involving collection of data at three fixed sites across Paris, data from two mobile laboratories and the use of an aircraft to evaluate transport of pollutants in the urban plume. The data presented focus especially on the frequency of new particle formation (NPF) events, the average particle number size distributions and the extent of the downwind urban

plume.

The paper is extremely descriptive in character with qualitative interpretations of data but no attempts at model simulation. While the additional data add to the already large base of knowledge on ultrafine particles in the troposphere, the paper contributes rather little beyond that, giving few new insights into nanoparticle behaviour. The objectives set out for the work in the last paragraph in the introduction are rather unambitious and relate to the effect of the Paris megacity on the downwind areas, and the frequency and spatial characteristics of new particle formation events. To address such objectives fully would require measurements over at least a full year but these were in fact limited to campaigns of one month in summer and one in winter, and these are not set in the context of a long-term dataset so it is not known whether they are representative or not. Consequently, as a contribution to knowledge, the most useful part is probably the downwind measurements of the urban plume.

Specific points of a conceptual nature which need to be addressed further include the following:

(a) The title refers to ultrafine particle sources but the reader learns only about NPF events and nothing about the other sources of particles. Either the title needs to change or the content needs to be enhanced if possible to throw light on other sources, although the design of the experiments is not good from this perspective.

(b) From the section on instrumentation and the list of instruments in Table 1, it is clear that ultrafine particle measurements were made with a substantial range of different instruments using at least two different methods of drying of the air stream. For some of the instruments, the drying method is not clear and it would be useful if these were added to Table 1. Given the substantial range of instruments and at least two drying methods, it would be essential to intercompare the CPCs with one another and the SMPS/DMPS/EAS instruments with one another. This is not reported and there are consequently question marks over the comparability of measurements by the differ-

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ent instruments. If an intercomparison was conducted, this needs to be included and a description given of how divergences in readings were accommodated in the data analysis.

(c) It has been noted by a number of authors that both particle number counts and particle size distributions in urban areas changed substantially with the introduction of zero sulphur motor fuels. This effect needs to be mentioned together with information on the sulphur content of motor fuels in the Paris region at the time of these experiments. This critically affects the particle size distribution and aerosol lifetime.

(d) Section 3.1 deals with the estimation of condensation sinks, but the method by which these were estimated is not adequately described. Section 3.3 gives adequate detail on how the humidity-adjusted size distribution was calculated but this is only part of the method.

(e) Figure 8 shows average size distributions for each season and site and these are briefly discussed on page 5676 going into 5677. Given that the paper, judging from the title, is concerned with the sources of ultrafine particles and that other workers have sought to elicit source information from number size distributions, this section is very disappointing and gives few if any insights into the factors giving rise to these size distributions. The quite substantial differences between summer and winter are not explained other than by an indication that similar behaviour has been observed elsewhere, and the inter-site differences are described but not explained.

(f) The discussion of new particle formation in Section 6 is one of the stronger parts of the paper but the critical omission is the measurement of sulphur dioxide concentrations. Are there no useful data available from anywhere within the domain of the experiments? Without this information, the discussion is very incomplete as the authors acknowledge at the end of page 5685.

Overall, the paper is excessively descriptive without proper quantitative analysis of the data, although critical omissions in the measurement plan inevitably lead to a less than

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satisfactory outcome. The most useful part of the paper relates to estimates of the extent of the downwind plume which remains limited in value by the very restricted nature of the measurements taken.

The paper is well written in excellent English with pleasingly few typographic errors. Two which require corrections are as follows:

(i) Page 6598, line 1 – the spelling of authors' names is incorrect. (ii) Page 5710, legend to Figure 10, 3rd line – should read exponential decrease (not decease).

Interactive comment on Atmos. Chem. Phys. Discuss., 15, 5663, 2015.