

Summary

This study characterizes NPF in a coastal city in China and discusses the NPF contribution to CCN concentration. There is an in depth comparison of how NPF events differ from non-NPF days in terms of the aerosol size distribution, chemical composition/hygroscopicity, and precursor gases. I thought the authors did a good job of discussing their results and explaining how different mechanisms contribute to formation and growth of NPF. My comments are mostly about clarification/the need for additional details about the methods.

Major Comments

- I would suggest reframing the goal in the (introduction) and outcome (conclusion) of this study away from wording such as “quantification of its ultimate climate effects” (Line 76) and “climatic impact of NPF” (Line 392). While this study does quantify and discuss mechanisms of NPF and their contribution to CCN concentrations, it may be more precise to frame this work as defining the CCN efficiency or cloud nucleating ability of NPF, or the *potential* climatic impact of NPF. Better understanding and representing CCN concentration is an important bridge to understanding their climate effects, but an actual cloud impact due to CCN is not quantified in the paper.
 - On this note, it would also be helpful to state more directly at the end of the introduction the primary new aspect of the work. Is it new/unique because of the region specifically? Because of the focus on linking observations to the various mechanisms? Initially it read to me like the unique aspect was linking NPF to CCN, which the authors recognize in Lines 64-70 has been done in other studies.
- It is specified that the study includes 46 NPF days, but there is no number given for the non-NPF cases. There are many claims made about the differences in NPF and non-NPF conditions in the Supplement figures, and I think that some context needs to be given as to how much more data is being considered in the non-NPF subset compared to the NPF events. For example, if the rest of the full year is included in the non-NPF subset, that could be a large quantitative difference compared to 46 days.
- Additional detail would strengthen the measurement and instrumentation section, especially for the OC/EC analyzer, WPS-1000, AE-33, and chromatograph. For example, not all instruments are given a time resolution, and it is not clear how different observations are combined. Are certain datasets averaged over some time

period? How do you combine high resolution in situ aerosol observations with 1-hr meteorological data? What are the uncertainties of each of these observations, and how do these uncertainties impact the analysis/results?

- Additional details would also strengthen the analysis methods section:
 - The section reads a bit like a list of equations and needs more description of how these tie together and what they will be used for in later analyses.
 - How well does the log-normal distribution fit the observed particle size distributions (Lines 130-131)? How well does the Kulmala et al. (2012) nucleation size mode range apply to observations here (Line 135)? Under what conditions are the last two terms in the FR equation negligible (Line 137)? Does the “overall chemical composition of particles” come from observations (Line 156-157)?

Minor Comments

- Lines 51-60: What factors govern formation rate and growth rate?
- Lines 55-56: How is NPF occurrence constrained by temperature and humidity?
- Line 63: Can you be more specific on what the “various atmospheric conditions” refers to?
- Line 76/77: What exact mechanisms are being referred to here? Different ones than nucleation mechanisms listed in Line 72?
- Line 86-90: It seems like these first two sentences could be combined to be more concise.
- Line 103: OPC is not defined.
- Line 140: This seems to be a repeat equation in the text.
- Line 201: Can you clarify that pollution levels were higher *on NPF days* in spring and winter? From Fig. S3 at first glance it looks like pollution levels are highest in spring and summer.
- Line 205-206: I am not seeing that secondary organic ion concentrations are similar between NPF and non-NPF days in spring from Fig. S4. Is this a typo?
- Line 208-209: Is the hygroscopicity parameter calculated for only nucleation mode particles? Or for all observed aerosols?
- Line 266-267 & Fig. S8: It looks like kappa decreases with time in fall and that there’s a small net decrease in spring. Summer appears to be the only season with a substantial increase, but it also oscillates quite a bit. This is explained more in the next paragraph, but it is not immediately clear from Fig. S8 that kappa generally increases following NPF events in the other 3 seasons.

- Fig. S9: Would it be possible to put all panels on the same x-axis scale to make it easier to compare differences in magnitude between seasons?
- Line 275: This section discusses meteorology in addition to chemistry. Would it make sense to add meteorology into the section title?
- Line 350-351: If this section is about spring, I think the reference needs to be changed to Fig. S12a. Also, at SS = 0.4% I do not see what would be considered a “rapid decline” in CCN from that panel.