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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Hygroscopic properties and CCN activity of atmospheric aerosols under the influences of Asian continental outflow and new particle formation at a coastal site in East Asia" *by* Hing Cho Cheung et al.

Anonymous Referee #4

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The manuscript "Hygroscopic properties and CCN activity of atmospheric aerosols under the influences of Asian continental outflow and new particle formation at a coastal site in East Asia" by Cheung et al., focuses on the analysis of a 1-year dataset of aerosol and cloud condensation nuclei (CCN) properties measured at the northern tip of Taiwan Island. The article does present a new dataset that assists in characterizing aerosol cloud interaction in east Asia. The backward trajectories analysis is applied to separate the Asian continental outflow from local emissions. Significant difference of aerosol and CCN properties also been found between NPF and non-NPF days and

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potential contribution of NPF to NCCN has been discussed.

The paper is in general well-structured and presents some interesting results. However, from technical aspect, the measurement and method used in this paper may cause large uncertainty, the authors are supposed to be more cautious when implement scientific discussion. Overall, I don't recommend for publish in ACP at current stage. However, the manuscript is in principle publishable if most aspects commented below can be properly addressed.

Major and specific comments:

1) Page 6 line22. The eq2. and eq3. are originally proposed by Petters and Kreidenweis (2007). They suggest this relationship only exist when kappa>0.2. However, in this study, I noticed kappa<0.2 often occurs. The following equation (eq.6. in their paper) can be used for derive more appeasable kappa values:

S(D)=(Dˆ3-D_dˆ3)/(Dˆ3-D_dˆ3 (1-κ)) expâĄą((4σ_(s/a) M_w)/(RT_W D)) (1)

2) Page6 line26-27. The author assume Dd equals to Dss calculated by eq.1. This approach is simple but not being widely used. The Dss in this study is often referred d_act in many previous studies. They often give a brief discussion of how well d_act is related to the chemical composition. But to my best knowledge, most studies use such diameter (d_act or Dss as) didn't further calculate into kappa (Furutani et al., 2008 , Quinn et al., 2008, Burkart et al., 2011, Leng et al., 2013). In my personal understanding, Dss calculated by eq.1. contains too much uncertainty, if further calculated into kappa and intercompare with other studies, there might be misleading results. If the authors still like to use the approach in the current version of manuscript, I suggest authors provide a thoroughly discussion on why this method works (e.g. include high-quality references, compare the kappa with those derived from size-resolved measurement at same location, etc.).

3) Page 9 line19-20: The author claims the lower kappa in July-August 2017 is consist

with chemical composition measurement. However, I noticed that there were many inconsistencies for the rest of the period. One clearly inconsistency is that in June 2017, the kappa is relatively higher while OC fraction is also very high. I suggest the author give a proper explanation of why kappa and chemical composition shows many inconsistencies otherwise I will suspect the kappa value derived from non-size-resolved measurement.

4) Section 3.3. The authors suggested NPF enhance NCCN due to coagulation and give a thorough discussion of why it is possible and logical. However, without any quantitively and semi-quantitively estimation and without comparison with other possible pathways (e.g. vapor condensed on sub-CCN, coagulation between sub-CCNs, Oxidation process etc.), it is hard to say coagulation between small particle and sub-CCN is the major cause of CCN enhancement without additional evidence.

5) Page5 line1-7. How many data points has been removed? Are those points accounted for a large proportion?

6) Page5 line18-19. Have you also check the sample flow of CCNC and how good was that? Considering your way of calculating kappa may be very sensitive to accurate reading of number concentration. The total flow (flow entering the CCNC, which then split into sample flow and sheathe flow) is important for the accuracy of SS while the sample flow will affect the NCCN reading.

7) Page7 line14-15. The end-point of the trajectories was 200m above ground level. Is the result from such setting consist with those for a lower (e.g. 20m a.g.l.) altitude? If not, what is the specific reason for choosing 200m?

8) Page8 line32-33. It is too arbitrary to say NPF contribute NCCN only because NCN and NCCN are consist. If the aerosol loading is higher, then both NCN and NCCN are expected to be higher. Please show PM2.5 value of these months to rule out such possibility.

9) Figure 4. The plots should be improved. It is very difficult for the readers to grasp the variation from these plots. I suggest the authors totally redesign the whole figure or at least adding some vertical grid lines in each plot.

10) Figure 5. Sea salt is a type of aerosol particle, it contains multiple components and some of these components have various possible sources. Please define what is 'sea salt' refers to in this figure and clarify how it is derived from measurement.

11) Figure 5. I notice kappa significate increased between 21:00 LT and 2:00 LT. Do you have any explanation for that?

Minor comments: 12) Page2 Line 4. I suggest not use the word 'campaign', it is more like a continuous measurement

13) Page4 line9-10. Yue et al., (2011) is not a short-term intensive study.

14) Page6 line10-11. When NPF occurs, NCN for size<13nm is not negligible. It is more logical to say 'the particles out of the measured particle size range has negligible contribution to NCCN'.

15) Page10 line22. The author report 31 NPF events during warm season with an occurrence frequency of 58.5%. The occurrence frequency should be number of NPF days divided by total days. In such case, did you mean there are only 53 days with PSD data during 4 months?

16) Page15 line13-21 DOI links are incorrect, please check carefully.

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