General comments:

Aerosol hygroscopicity is a fundamental parameter in atmospheric physics and chemistry, making the results of this study highly relevant to the scope of ACP. While new particle formation (NPF) events are typically associated with active photochemistry and do not directly affect optical hygroscopicity (f(RH)), the unique condensation mode chemical reactions occurring during NPF events could have an impact. Therefore, NPF events offer a valuable opportunity to study how the composition of condensation mode aerosols evolves during NPF and how this affects aerosol hygroscopicity. This study presents comprehensive results on the differences in aerosol composition and f(RH) between NPF and non-NPF days, along with closure studies revealing changes in the hygroscopicity of organic aerosols. Overall, this study provides valuable comparisons between NPF and non-NPF days, such as differences in the RH dependence of f(RH) and organic aerosol hygroscopicity. As a measurement report, I recommend publication after the following comments are addressed.

Response: Thank you very much for your thorough review and constructive comments on our manuscript. As you are concerned, there are several problems that need to be addressed. In response to your valuable feedback, we have carefully considered and made revisions as follow.

Major comments:

1. In the abstract, authors stated that " NPF occurs frequently and has an obvious effect on f(RH)"

does NPF could really impacts on fRH? How was this concluded? NPF means new particle formation, the aerosols with at least size of 150 nm could impact on aerosol scattering thus fRH, and with obvious impacts need aerosol size to be more than 200nm. Authors could estimate how long a newly formed particle could grow to size of more than 200 nm. If authors did the calculation, they would realize that fRH could not be affected by local NPF events, only chemical reactions happened on condensation mode could affect fRH, therefore, if authors find fRH changes during NPF events, it could be condensation mode reactions happened simultaneously with NPF events that changed fRH not the NPF reaction and formation chain.

Response: We sincerely thank the referee for bringing this to our attention. We agree with your point, and your suggestions are very helpful to improve the quality and scientificity of our study. It is highlighted that *f*(RH) differed significantly between NPF and Non-NPF days in Xiamen, primarily driven by the aerosol chemical compositions, particularly nitrate and sulfate. Sulfate was a major contributor to SNA on NPF days, distinguishing them from non-NPF days. We have updated the contents as suggested in Line 23-25 and Line 619-622.

"In the relatively clean atmosphere of Xiamen, NPF events occur frequently, and the variation in chemical composition during the events has a substantial influence on the aerosol scattering hygroscopic growth."

"Sulfate was highlighted as the dominance in SNA during NPF days, with weaker *f*(RH)

compared to non-NPF days. It is likely that the condensation mode reactions occurring simultaneously with NPF events changed the aerosol chemical composition and had an obvious effect on *f*(RH)."

2. In the abstract, authors state that "main source (30.78%) of the hygroscopicity parameter κf(RH)"

κ f(RH) is not a parameter with absolute amount, therefore, authors cannot say their source, only could state what its variations were driven by what kind of aerosol component. For example, NH4NO3 played a dominant role in κf(RH) changes/enhancement. Your statement about influences of organic aerosol is correct.

Response: Thank you very much for kindly reminding us to clarify this point. For the aerosol hygroscopicity during NPF days, NH_4HSO_4 (ABS) was the most dominant contributor, as revealed by the aerosol hygroscopicity–chemical composition closure. We agree with the comment and revised the sentence as follows.

"Aerosol hygroscopicity-chemical composition closure demonstrated that NH_4HSO_4 was the main driving force (30.78%) of the hygroscopicity parameter $\kappa_{f(RH)}$ when NPF events happened, while NH_4NO_3 played a dominant role in $\kappa_{f(RH)}$ (up to 35%) for non-NPF days."

3. Sect 3.5, OA was not attributed as POA and SOA factors, discussions on OA density should be included.

Response: Thanks for the referee's valuable suggestion. We have divided the OA factors into primary organic aerosol (POA) and secondary organic aerosol (SOA) factors by the PMF/ME-2 method. The proportion of POA and SOA in OA are displayed in Figure S6. The discussion of POA and SOA with κ_{OA} is shown in Line 562-571. We apologize for the omission of OA density, and the revisions are shown in Text S3.

"The proportion of POA and SOA in OA in our study (Figure S10) showed higher SOA mass fractions on non-NPF days than on NPF days. It is evident that high SOA mass fractions on non-NPF days corresponded to high κ_{OA} values. The results from these previous studies (Wu et al., 2016; Kuang et al., 2020; Kuang et al., 2021; Chang et al., 2010) also highlighted that SOAand oxygenated organic aerosols, were likely to be the determinants of κ_{OA}. Furthermore, SOA dominated OA mass both in this study and previous studies; however, κ_{OA} values differed much across studies. Noted that the hygroscopicity of SOA might vary significantly under different emission and atmospheric conditions due to variations in VOC precursors and SOA formation pathways (Kuang et al., 2021)."

"The volume concentration of BC was calculated by assuming a density of 1.7 g cm^{-3}, and the volume concentration of OA was calculated by assuming that the density of POA is 1 g cm^{-3} and density of SOA is 1.4 g cm^{-3} (Wu et al., 2016)."

Specific comments:

1. L21, bracket of f(RH) can be deleted

Response: We thank the referee to point out this. We have deleted it.

2. L22, describe the aerosol indirectly hygroscopicity
Response: We thank the referee. We have corrected it.

3. L22, varies greatly due to the influence of aerosol chemical composition and size
Response: Thanks, we have corrected it.

4. L91-93 Zhao et al. (2019) have summarized this in China
Zhao, C., Yu, Y., Kuang, Y., Tao, J., and Zhao, G.: Recent Progress of Aerosol Light-scattering Enhancement Factor Studies in China, Advances in Atmospheric Sciences, 36, 1015-1026, 10.1007/s00376-019-8248-1, 2019.
Response: Thanks. As suggested, we have added this literature citation.

5. L97-98 "between f(RH) and NPF events", as stated in the major comments, NPF itself does not affect, however the unique condensation mode chemical reactions during NPF events could affect.
Response: We thank the referee to point out this. We have modified the contents as follows.
"However, the exploration to the variation of *f*(RH) during NPF days is quite few in China."

6. L132 Nephelometers
Response: Thanks, we have corrected it.

7. L136, this is weird, you already have a "dry" nephelometer in the fRH system
Response: Thanks. This separate nephelometer measured the aerosol scattering coefficient under ambient humidity conditions.

8. L146, which type of ACSM, Q-ACSM, Tof-ACSM?
Response: We thank the referee. It is a Q-ACSM. We have added this information in Line 154-157.

9. L147, how BC mass concentrations were corrected, because AE31 is not as AE33 which have auto correction for loading effect?
Response: Thanks. To ensure the data accuracy of the AE-31 aethalometer, we perform a zero-point calibration every two months. During calibration, a filter is connected to the sampling inlet of the instrument and the BC concentration reading is observed on the instrument panel; a concentration of approximately 0 is normal. Zero-point calibration is conducted after a new filter band is changed and typically takes 1-2 hours. In addition, the aethalometer is regularly returned to the manufacturer for system calibration.

10. L298, SO42- etc, use SO4 is fine, or sulfate, because the ACSM doe not measure the ion form of sulfate

Response: We thank the referee to point out this. We have corrected it.

11. L328, fewer hygroscopic particles were born is not correct, because NPF itself doe not affect fRH, as you can see from Fig.3 that fRH is lower before NPF event, therefore, it is the background aerosols during NPF events that have lower hygroscopicity

Response: We thank the referee for this useful suggestion, and we have corrected the contents as follows.

"This illuminates that aerosols had a lower hygroscopicity during the NPF event in Xiamen."

12. L 332-336, this is speculative, however, authors could state that "On the basis of aerosol chemical compositions during NPF, it could be speculated that ……"

Response: Thank you for this helpful comment. We have made the revisions as follows.

"On the basis of aerosol chemical compositions during NPF, it could be speculated that when particle formation occurs in NPF days, the condensation of large quantities of sulfuric acid and organic vapours onto the pre-existing particles, resulting the conversion of mixed state on the surface of particles from external mixture to internal mixture and alteration of the optical and chemical properties of particles, which in turn might change the aerosol scattering hygroscopicity growth (Wu et al., 2016)."

13. L356-357, The ACSM measures bulk aerosol compositions, if authors calculated the volume size distribution from PNSD measurements, it could be found that newly formed particle rarely affect bulk ACSM mass, meaning that the different bulk chemical compositions between NPF and non-NPF days could not attributed to formation mechanisms of new particles, it could only be attributed to different background aerosol when NPF occur, and reactions happened on existing condensation mode particles. This sentence could be rewritten as "indicating the remarkably different bulk aerosol compositions and condensation mode aerosol formation mechanisms between NPF and non-NPF days"

Response: Thank you for this constructive comment. We have improved the content as follows.

"Sulfate dominated the SNA during the NPF days, characterized by weaker aerosol hygroscopic growth compared to non-NPF days, indicating the remarkably different bulk aerosol compositions and condensation mode of aerosol formation mechanisms between NPF and non-NPF days."

14. L422-425, the difference of organic and inorganic aerosol fraction is the reason, not sulfate. Indeed, kappa of ammonium sulfate is slightly lower than that of ammonium nitrate, however, not the major cause.

Response: We thank the reviewer for this useful suggestion, and we have made the revisions as follows.

"The relative low value of $f(80\%)$ for NPF days can be explained by the fact that the organic and inorganic aerosol fractions were distinct, with sulfate being the

predominant component of the inorganic aerosol during this period.”