Comment on acp-2022-341
Anonymous Referee #2


This work reports size-resolved single particle composition and cloud condensation activity results during the EURECA and ATOMIC campaigns from January to February 2020 over the tropical North Atlantic. They concluded that aerosol hygroscopicity and CCN number concentrations during wintertime long-range transport events over the Caribbean are affected by African smoke more than dust. The main content of this manuscript is well within the scope of ACP. The manuscript is well-prepared in general. However, as the other referee commented, the writing and interpretation of your results, especially the part to support of your major conclusion, need to be carefully revised. I would also recommend the publish of this manuscript after the following issues are fully resolved.

General comments:

A major part of your results is size-resolved chemical composition, which you used to support your main conclusion. However, from your methods, I did not see a clear explanation how you obtained this “size-resolved” information and it should be an really important part for your methodology. As you stated “EDX is a semiquantitative method”, then how did you ensure the accuracy of the results in Fig. 4, Fig.5 and Fig. 7, and eventually drove your conclusions?
According to Fig. 7b, you stated the CCN counts correlate quite well with smoke number fraction. Could you also plot similar figure for dust number fraction with CCN counts?

Continued with my comment above, you only measured the chemical composition of particles at diameter < 0.7μm. You also agreed that there might be more dust particles in the supermicron range. These particles may also be good CCN as they are large enough. However, you did not measure those. From this perspective, I might not agree that smoke has a larger effect on CCN number concentration than dust. You should consider how to re-interpret your results.

On page 24, you gave several reasons that smoke particles may act as CCN. However, I did not really agree with those reasons you provided starting from line 466 till the end of this paragraph. First, you did not have any direct evidences for these explanations. Second but more importantly, you just mentioned in line 405 that smoke particles lower submicron aerosol hygroscopicity. Then these particles can act as CCN would not be due to the elevated hygroscopicity or κ, which arises from the presence of water-soluble compounds, for instance WOSC, aged organics or other salts.

Specific comments:

Line 161-162: BC particles did not evaporate at 500 °C, either. How did you exclude them?
Line 185-203: Please provide detailed information how you obtained size-resolved chemical composition for particles.

Line 202: Similar to my general comments, since you studied particles at size below 0.7μm, where dust might not be as abundant as smoke, then how did you drive the conclusion about the dust effect on CCN activity?

Line 246-248: How did you prove current statement? From which figure? This sentence fits better into conclusion part, but not the starting of results. Again, how did you identify smoke particles? It came up without any description, though you explained it later afterwards. Please consider rephrase your results structure.

Line 266: Were the Aitken size mode particles from the marine background? Why?


Line 325 to 327: Then what is the morphology of smoke particles in your study? You should provide more information of your current results.

Line 354: How did you obtain the number fractions of each kind of particles? Please add
this part into your methodology.

Line 366 to 370: Please consider rewrite the sentence, it is confusing.

Line 381: From Fig. 5, I cannot directly see those particles are the largest ones. Maybe you can plot a figure for the normalized mean diameter of each particle type, which is more obvious.

Line 382-384: I cannot understand what do you mean “clean” here, please clarify. The number concentration or mass concentration of particles were lower for clean marine conditions?

Line 408: Sometimes you used “dusty conditions”, sometimes you used “continental influenced aerosols” or sometimes referred to “CAT Event”. At line 415, you used “smokey conditions”. Could you please be consistent?

Line 427 to 428: Did they obtain those values at the same S? Otherwise, you cannot directly compare them.

Line 454: Could you compare the results at those two CAT Event or for those three Clean
Marine Period? For instance, for those two CAT events, the CCN concentration was different with different hygroscopicity, even though they are both influenced by the continental transport. Could you please give the potential reasons and make proper discussions.