

***Interactive comment on* “Characterization of aerosol properties at Cyprus, focusing on cloud condensation nuclei and ice nucleating particles” by Xianda Gong et al.**

Anonymous Referee #2

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Review of “Characterization of aerosol properties at Cyprus, focusing on cloud condensation nuclei and ice nucleating particles” by Gong et al.

This manuscript focuses on the abundance, properties, and sources of CCN and INP on the island of Cyprus. Measurements at Cyprus are unique from other regions since Cyprus can be influenced by a range of different and complex aerosol mixtures, including mineral dust from the Sahara Desert and anthropogenic aerosols from Europe and the Middle East. From the CCN measurements the authors conclude the Aiken mode aerosols contain organics and the accumulation mode aerosols contain sulfate. On the topic of INP, the authors suggest the INP are mainly from long range transport with

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a few samples influenced by biological INP from Cyprus. A parameterization based on $N > 500$ nm overestimate INP by 1-2 orders of magnitude, and measured n_s values were much lower than n_s values for mineral dust.

This study adds to the growing body of data on the abundance, properties, and sources of CCN and INP in the atmosphere. The data analysis in this manuscript is especially impressive. However, I felt that a few of the conclusions were too strong or not well supported. Below are comments the authors should address before publication:

1. When discussing the INP data (Abstract and Section 3.4) the authors refer to the aerosol particles at Cyprus as “anthropogenically polluted aerosols”. This gives the impression that anthropogenic aerosol dominated during the campaign. On the other hand, in the Introduction and Experimental they discuss both natural and anthropogenic sources for Cyprus, and their results show relatively low NO_x concentrations during most of the campaign. Based on this, is “anthropogenically polluted aerosols” the best description of aerosols at Cyprus during the measurements.

2. Page 10, lines 25-30 and Abstract. The authors suggest the presence of sulfate in the accumulation mode aerosols based on a median kappa value of 0.57. Could a Kappa of 0.57 also be explained by a mixture of sodium chloride and organics? Please discuss if there are other possible explanations of $\text{kappa} = 0.57$.

3. Page 8, line 15-18. Change “less than 5% of the trajectories” to “approximately 5% of the trajectories” or something similar since less than 5% could be 0%.

4. Page 8, line 25-26. Change “the corresponding air masses originating from the Sahara Desert or the desert regions in Syria and Iraq” to “the corresponding air masses originating from dust areas” to be consistent with what is shown in Figure 5.

5. Page 11, lines 20. “These observations are indicative for the absence of nearby sources, and hence we conclude that the sampling INP, at least those ice active at < -15 C, originate from long range transport.” I do not think this conclusion is well supported

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since Fig S9 is also consistent with similar concentrations of INP from nearby land and ocean.

6. Page 12, line 20-22. Is a log-normally distributed Ninp population proof that the INP originated from long range transport rather than local sources? This seems like too strong of a statement, since it implies that the only mechanism capable of producing a log-normally distributed Ninp population is long range transport. Welts et al. 2018 showed that a lognormal distribution can be explained by random dilution during transport, but did they show that this is the only mechanism capable of forming a log-normally distributed population? Please discuss in the manuscript.

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