Atmos. Chem. Phys. Discuss., 15, C3634–C3639, 2015
www.atmos-chem-phys-discuss.net/15/C3634/2015/

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Atmospheric new particle formation as source of CCN in the Eastern Mediterranean marine boundary layer" *by* N. Kalivitis et al.

N. Kalivitis et al.

nkalivitis@chemistry.uoc.gr

Received and published: 15 June 2015

We would like to thank the reviewer for his/her positive and useful comments. After each comment of the referee (REF), our answers and actions to the comments (ANS) are given .

General comments:

I recommend to publish this paper upon minor revisions.

The paper present very important findings to be able to understand how important new particle formation in marine areas is for CCN concentrations. Only superficial attempts

have been made previously to elucidate this matter. English language is very clear.

The abstract is short and to the point. The Introduction clearly presents the problem issue at hand, and clearly formulates what measurements are available the research questions addressed. Short and to the point sufficiently described method section. The result section is also condensed, and only accounts for the most important findings.

One discussion topic is omitted in the conclusions section (see below), but otherwise very useful conclusion for future research in this area, where future needs are clearly described.

REF:Specific comments:

Abstract:

"(0.2–0.4 lower kappa between the 60 and 120nm particles)". Unclear sentence, please rephrase.

ANS:We modified this sentence as follows:

"Sub-100 nm particles were found to be substantially less hygroscopic than larger particles during the period with active NPF and growth (the value of κ was lower by 0.2–0.4 for 60 nm particles compared with 120 nm particles), probably due to enrichment of organic material in the sub-100nm size range."

REF:Introduction:

"The probability by which an aerosol particle acts as a CCN at a given supersaturation depends primarily on its size and secondarily on its chemical composition (Dusek et al.,2006). The aerosol chemical composition may, however, have large impacts on the total CCN number concentration (Karydis et al., 2012; Padró et al., 2012)." Contradictory statement. In the first sentence you say that chemical composition influence CCN, and in the second sentence you write that, chemical composition may HOWEVER have influence on CCN.

ACPD
15, C3634–C3639, 2015

ANS:These are not contradictory statements as the first one refers to a single particle and the second one refers to a particle population. However, in order to avoid confusion, we reworded the second sentence into the following form:

“In a population of aerosol particles, the total CCN number concentration is affected by the chemical composition and mixing state of these particles.”

REF:Chapter 2.2. Page 1148. How was the BC concentration determined from the absorption coefficients? Please write if you made some kind of own corrections, or used the corrections found in other literature, or if you just used the BC values that the instrument spits out without further correction.

ANS:The aethalometer data were corrected according to Weingartner et al., 2003. The following sentence was added in paragraph 2.2: ” Aethalometer data were corrected using the empirical formula given by Weingartner et al. (2003). In this formula (their equation 4), the calibration constant C has been calculated to be 2.48 for the Finokalia station in summer and R(ATN) was taken as 1, the value representative for aged particles at remote locations (Sciare et al., 2008).”

REF:Page 11149, line 2. “this” should be replaced by “which”.

ANS:Yes, this was corrected.

REF:Page 11149, line 4. “We made regular calibrations”. When did you actually do these calibrations? Please write the dates down?

ANS:The calibrations took place on a regular basis, once every month, to verify the stability of the instrument. We do not believe that the exact dates provide any further useful information. Instead we changed the corresponding sentence to: “Calibrations by using laboratory-generated ammonium sulfate particles of different sizes, following the procedure of Moore and Nenes (2009), were performed once every month, to verify the stability of the system.”

REF:Chapter 2.3.

ACPD
15, C3634–C3639, 2015

Page 11149. I never worked with scanning flow rate of CCNc: Is there a problem with double charged particles from the DMA in the CCN/CN versus flow rate curve when obtaining critical flow Q50? Could be worth mentioning if double charges sometimes play a role. One example is Snider et al., 2010: JOURNAL OF GEOPHYSICAL RESEARCH, VOL. 115, D11205, doi:10.1029/2009JD012618, 2010.

ANS:This is a good point. The size distribution of the calibration aerosol was sufficiently small so that the multiply-charged particles was a distinct secondary activation peak – which could subsequently omitted from the analysis. This is also stated in Moore and Nenes (2009): " The contribution of doubly charged particles and the DMA transfer function width were neglected, as this introduces negligible uncertainty in the determination of Q 50 for the aerosol size range and the sheath-to-aerosol ratios examined.".

REF:Page 11150. About ME-2 and PMF. I associate PMF with a specific factor analytical tool. I think of ME-2 also as a specific factor analytical tool, but different from the PMF tool. Hence, I would recommend not to refer to your method as PMF, but rather as ME-2 throughout the paper (not only this chapter), and skip writing about PMF at all.

ANS:In the literature there are several algorithms to solve the PMF algorithm, most commonly used are the PMF2 and ME-2. We refer to the PMF as the general source apportionment algorithm and the ME-2 as the solver used.

REF:Chapter 3.1.

Page 11153, lines 10-12. Please indicate that this parameterization for the CCN vs N100 is valid for the NPF periods.

ANS:We modified the last two sentences of this paragraph into the following form, also correcting a typo in the formula, CCN0.2=a*N100+b in the revised version:

"Overall, these data suggest that during active NPF periods, particles larger than about 100 nm in diameter were able to act effectively as CCN at 0.2% supersaturation in the

ACPD
15, C3634–C3639, 2015

measured air masses, which is in line with observations made elsewhere (see Kerminen et al., 2012); we therefore recommend N100 as a proxy for CCN0.2 at Finokalia with a linear correction in a form CCN0.2=a*N100+b, where a and b are the slope and offset determined from our observations. For the dataset considered here, a= 0.57 $\pm$ 0.01 and b = 180 $\pm$ 9 cm$-$3, where $\pm$ represents the standard error of these quantities with respect to the linear fit for all the data in Fig. 4."

REF:Figure 10. The labels for the different colors are missing.

ANS:We added the missing legend.

REF:Conclusions:

It is very important that you mention how often you have such regional new particle formation events, which can give high CCN production. Your referenced papers from Finokalia station clearly show that these kind of strong CCN-producing new particle formation events do not happen very often each year as compared to continental events. Please write how often and write a discussion about this. Otherwise, a reader, which only reads the abstract and conclusions might get the impression that these type of strong events happen very frequently during the year.

ANS:This is an excellent point. In response to this comment, we modified the beginning of the "Conclusions" as follows:

"Atmospheric new particle formation (NPF) is a common phenomenon over the Eastern Mediterranean atmosphere, the observed frequency of NPF event days being close to 30% at Finokalia in Crete. However, there is practically no information whether particles formed in this environment are capable of producing new CCN and how effective this pathway is. The case study presented in this paper. . ."

References

Moore, R. H. and Nenes, A.: Scanning Flow CCN Analysis - A Method for Fast Measurements of CCN Spectra, Aerosol Sci. Tech., 43, 1192$-$1207,

ACPD

15, C3634–C3639, 2015

doi:10.1080/02786820903289780, 2009.

Sciare, J., Oikonomou, K., Cachier, H., Mihalopoulos, N., Andreae, M.O., Maenhaut, W., and Sarda-Esteve, R.: Aerosol mass closure and reconstruction of the light scattering coefficient over the Eastern Mediterranean Sea during the MINOS campaign, Atmos. Chem. Phys. 5, 2253–2265, doi:10.5194/acp-5-2253-2005, 2005.

Weingartner, E., Saathoff, H., Schnaiter, M., Streit, N., Bitnar, B., and Baltensperger, U.: Absorption of light by soot particles: determination of the absorption coefficient by means of aethalometers, J. Aerosol Sci., 34, 1445–1463, doi:10.1016/S0021-8502(03)00359-8, 2003.

Interactive comment on Atmos. Chem. Phys. Discuss., 15, 11143, 2015.