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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

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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 .

The paper by Kalivitis et al. presents CCN measurements as well as aerosol chemical composition data from the Eastern Mediterranean marine boundary layer. It leads to the conclusion that the condensation of gaseous sulfuric acid and organic substances onto newly formed particles induces their growth to particle sizes that are relevant for

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the activation into cloud droplets.

The information given in this manuscript is relevant for the readers of ACP and of interest for the community in general. However, there are a few issues as detailed below that have to be addressed by the authors before I can recommend the paper for publication in ACP.

I have basically problems with the presentation of results in the figures. The authors draw a lot of conclusions from their measurements but they are not nicely represented in the figures. Improving the figures could make it much easier for the reader to spot the points that are made in the text. At the moment, I am not able to follow every conclusion because the figures not necessarily illustrate them. Therefore, in the following, I raise several questions and suggest improvements (including technical corrections) for a revised version of the figures:

REF:Fig. 1: unit of the flow rate is $\text{cm}^3 \text{min}^{-1}$

ANS:We apologize for this oversight. Corrected.

REF:Fig. 2: Please indicate in the caption what the arrows in the figure mean.

ANS:We changed arrows into dashed lines and added the following text to the figure caption:

“The dashed vertical lines in the figure indicate the times when newly formed particles started to appear to the measured size spectra during the three NPF events concentrated in our analysis.”

REF:Fig. 4: Here it would be good to make two panels out of it, one showing the data for 25 – 28 August and the other for the period after the NPF event. At the moment no clear distinction between the two data sets is possible. You should show the regression lines for both periods as well as the fit parameters and correlation coefficients. Alternatively, they could also be listed in a table for easy comparison. Btw, the color of the equation for the N130 data set shown in the legend does not match the color of the

symbols.

ANS:We split the data into two sub-figures, as the reviewer suggests, and made separate regression lines for these subsets of data. The caption of Figure 4 was modified into the following form:

“Relation between the total number concentration of particles with diameter larger than D , ND , ($D = 90, 100, 110, 120$ or 130 nm) and measured CCN number concentration at the supersaturation of 0.2% . The data are from two periods in 2012: from 25 August at 23:05 to 28 August at 10:45 (panel a) and from 1 September at 23:15 to 2 September at 17:15UTC+2 (panel b).”

The text referring to Figure 4 was modified accordingly.

REF:Fig. 6: Please mention that the mass concentrations in panel a are PM1 masses.

ANS:The caption of Figure 6 was modified into the following form:

Time evolution of the aerosol chemical composition during the period 28 August – 2 September 2012. Left panel: absolute concentrations ($\mu\text{g m}^{-3}$) in the PM1 fraction of the measured aerosol, except for EC which was measured in the PM10 fraction . Right panel: relative contributions to the non-refractive PM1 mass

REF:Fig. 7: As in all other time series and diurnal cycle plots the x-axis label is missing. Is it local time? Also in this figure one panel showing the mass fractions rather than concentrations would certainly make sense. I am not sure if Fig. 7a (diurnal cycle as an average over the whole August to September period) is telling you anything if you want to explain the chemical composition during the NPF event and possible implication on cloud droplet activation during NPF events.

ANS:The time in the x axes of Figures 7, 8 and 9 refers to local winter time (UTC + 2 hours). We added the label “Time (UTC + 2)” to x axis of these figures. For the figures representing time series, we added the label “Date”.

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The purpose of Figure 7a is to support our analysis on how primary and secondary aerosol components behave over a diurnal cycle at this site during this time of the year. Therefore, we feel it is important to keep Figure 7a in the paper. Figure 7b then shows the same aerosol components behaved during the time period of most active NPF.

REF:Fig. 8: In this figure the diurnal cycle of kappa is averaged over a different time period than the chemical composition in Fig. 6. How are you able to find a link between these parameters, if you compare apples and oranges? What do you mean with “normalized into the range [0, 1]”? I do not understand how you get from the values in panel a to b. I would have expected that you divide each data point of the diurnal cycle by the average kappa value measured at this diameter. This at least should give you the relative diurnal variation, but in this case the data points would be also larger than one. So, I simply do not understand the calculation of kappa(normalized).

ANS:Figure 6, like the figures representing either time series (Figures 2 and 5) or diurnal cycles (Figures 7 and 9) of directly measurable aerosol properties, cover the period from 28 August to 2 September. The size-segregated CCN measurements were not available after 22:55 on 30 August, and for this reason Figures 8, 10 and 11 do not extend to the end of 2 September. There was a typo in the captions of Figures 7, 9 and 11: it should read 28 August not 29 August. These dates were corrected in the figure captions.

We clarified this timing issue by adding the following sentence at the end of section 2.2:

“During the study period concentrated in this paper (28 August to 2 September 2012), size-segregated CCN measurements were not available after 22:55 on 30 August, and the total CCN concentration measurements at the 0.2% supersaturation initiated at 23:15 on 1 September.”

Figures 6 and 8 are not directly comparable anyway, as the first one represent time

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series and the second one diurnal cycles.

The scaling procedure in Figure 8b was revisited; we repeated the scaling once again by forcing the average value of each quantity to be equal to unity. We added the explanation of this procedure to the caption of Figure 8 and in paragraph 3.2 “In Fig.8a the daily variation of the hygroscopicity (κ parameter) of 60–120 nm particles averaged over two full days is presented and in Fig. 8b the corresponding normalized values to the average κ of each diameter”

REF:Fig. 9: What exactly is plotted here? The individual organic components as fractions of the total organic mass? Please clarify in the caption and/or y-axis label.

ANS:Correct, they are the fractions of individual organic components of the total organic mass. We clarified this by modifying the figure caption into the following form:

“Diurnal variability of the three major classes of organic aerosol obtained from the PMF analysis, along with the O/C ratio, during the period 28 August to 2 September. The quantity f(OA) represents the fractions of individual organic compounds of the total organic mass, where OA refers to OOA, OOA-BB or α -pinene SOA.”

The scale of the left y-axis in our original figure was also modified to reflect the current dataset.

REF:Fig. 10: Here the legend is missing! Again, the plotted time period is different from the periods shown in the other plots (Figs. 5-9). For better comparison the x-axis range should be extended. I guess it would also make sense to present the diurnal cycle of the maximum activation fraction.

ANS:The diurnal cycle is added as Figure 10b. The legend is now added (Fig. 10a in the revised paper), in addition to a figure displaying the diurnal cycle of the maximum activated fraction (Fig. 10b).

The issue of having different time periods in different figures have been addressed in our response to the referee comment on Figure 8.

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REF:Fig. 11: This is just another time period you concentrate on. Why not showing an average over all days?

ANS:The issue of having different time periods in different figures have been addressed in our response to the referee comment on Figure 8.

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

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