**Atmospheric
Chemistry
and Physics
Discussions**

Interactive comment on "Night-time enhanced atmospheric ion concentrations in the marine boundary layer" *by* N. Kalivitis et al.

Anonymous Referee #3

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The manuscript describes a year-long experiment to monitor and analyze air ions and their relation to local meteorology and other aerosol parameters. The results for the Mediterranean location complement similar data collected in other regions of the globe. The results are important to the aerosol and global atmospheric chemistry community and should definitely be published. The fundamental data set is large and based on proven instrumental and analytical techniques. The analysis is lacking in several important ways and should be expanded to meet ACP standards before publication. Details for expanded analysis are provided below.

Abstract Line 6 ". . .vary strongly with. . ." or ". . .depend strongly on. . ."

Line 7 The sentence about new particle formation does not fit with the rest of the abstract about ions. Delete or expand.

Line 9 What does enhanced mean? Above average? Greater than one standard deviation above average? This should be explained quantitatively here or in the body of the manuscript. A partial explanation is given in section 3.3, first sentence. Please expand this and present earlier in manuscript.

Introduction Define ions to agree with abstract, charged molecular clusters or particles from 0.8 to 42 nm. Also it would be good to define new particle formation events in similar, practical, observable terms, e.g., an increase in particle concentration by some factor above the average within a specified time limit in a given particle size range.

Page 11811 Line 5. . . . atmospheric ions concentration. . .. Is ions possessive? Then ..ion's. . . Sentence reads better as: . . . study of atmospheric ion concentration is especially important for calculating cluster size. Line 6. Sentence is not clear. If the new particle formation events were suppressed, did they not occur or were they of lesser magnitude than expected? If they did not occur how did the ion spectrometer detect them? If they were of lesser magnitude than expected, what was the basis for the expectation in terms of measured actinic flux, gas and particle phase composition? Line 7. The stated detection limit should be expressed as a concentration and diameter. I don't understand the value of 83nm.

Page 11813 Line 1. Give the number counting threshold and accuracy as well as the size range and time resolution. Line 6. Quantify the "good" performance in this summary. Line 24. Are particle and ion losses in the inlet and tubing to the AIS and SMPS significant? Quantify them as appropriate.

Page 11814 Line 15. Given the large standard deviations, is the + vs. − ion difference significant? Are the secondary maxima in − ions significant? I assume the $\pm$ value is the std. deviation of the monthly mean. What are the uncertainties in the AIS data? Line 25. The four plots in figure 3 do not present the data adequately. Most of the data is in the region where the dots are heavily overplotted and the anti-correlations are not at all clear to me. The line of maximum occurrence could, in fact, be constant with wind

speed within the black region. All that can be discerned is the domain subsets where ions were not observed or those where ions were observed infrequently. The major data set is a black hole with no obvious information. I suggest presenting this data as a contour plot of the two dimensional probability distribution of number of occurrences vs. wind velocity vs. ion concentration. Then you will be able to see a possible relation within the domain of the majority of the data; it might be illuminating.

What are the correlation coefficients and R values?

Page 11815 Line 2. Considering the Earth's surface to be the source of Radon, it's both the advection wind speed and vertical mixing and boundary layer depth that affect its concentration in a simple box model. I note that this is presented more clearly on page 11818. Paragraph 2. The primary sink of ions should be to the Aitken and accumulation mode effective surface area. Thus, it would make sense to first compare ion concentration to surface area derived from the SMPS data. Secondarily, BC may have an effect due to its chemistry and physical, fractal dimensionality, if recently emitted. My comments regarding figure 3 apply to figure 4 as well.

Page 11816 Figure 5 and related discussion. It would be useful for the SMPS to AIS comparison if the diameter scales were the same. Why are the number integrals of the AIS (sum of + and − ions and particles less than that of the SMPS? Given the theoretical charge distribution is this reasonable?

Page 11817 Line 8. Define phenomenal quantitatively.

Page 11818 Regarding figures 8 and 9, see comment about figure 3.

Page 11819 Line 1. It would be very useful to quantify and plot the results of the coagulation model calculations. Line 10. What is the height of the boundary layer, daytime and nighttime, at Finokalia cf. the 1000m HYSPLIT trajectory data set? Line 13. The pie chart figure 11 does not need to be three dimensional; a simple planar chart would be adequate. Present the percentage of each sector in the plot. Line

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20. Do you mean local wind direction or air mass trajectory direction at the origination point or at the end of the trajectory? Line 21. Regarding figures 12, see comment about figure 3 and overplotting of dots.

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