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

### **Anonymous Referee #1**

Received and published: 18 May 2011

#### General comments:

The manuscript presents long term measurements of ion concentrations in the mediterranean marine boundary layer. Measurements were conducted at the well-established Finokalia station from April 2008 to April 2009. The paper focuses on night-time enhancement of the atmospheric ion concentration in the size range from 0.8 to 42 nm. The manuscript is well written and is in the scientific scope of ACP however I think the manuscript need few improvements before being published in ACP. The analysis presented in the paper is only qualitative. A more statistical approach would significantly enhanced the paper. Furthermore, if the ion concentration annual variability is well analyzed, the daily variations of ion concentration pattern and especially the night-time enhanced ion concentration episods need a more accurate analysis. SMPS data were not presented. However calculations of condensational

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and coagulations sinks would help the analysis.

To conclude, I recommend publication in ACP after considering those few comments. Few specific comments are listed below.

Specific comments:

- Introduction: pp 11811, l6 - The ion spectrometer is mentioned. What is it meant here: AIS or BSMA ?
- pp 11811, l8 - Typo: The lowest limit of the DMPS is 3 nm (not 83 nm) in Hirsikko et al., 2007.
- pp 11811, last line: add "ion" between "day time" and "concentrations".
- pp 11813, l14: What are the station's routine measurements ?
- pp 11814, l17-20: Authors made the assumption that higher ion concentrations at night are due to a weaker dilution of the MBL through thermal mixing. What does it mean in terms of ions sources ? Is it assumed that ion sources are the same during the day and the night ?
- pp 11814, l21: The annual variability is investigated through meteorological parameters analysis such as the temperature or the wind direction and speed. In my opinion the same analysis should be done to investigate factors controlling the observed ion concentration daily pattern.
- pp 11815, l1: The radon is suspected to be the main source of atmospheric ions at the measurement site. This comment is speculative without more analysis, I'm not sure it is relevant to mention the radon to explain the observations.

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- pp 11815, I6: No clear dependence was found between RH and ion concentration. What is it meant here ? I think a more statistical analysis should be done for each factor (T, RH, WD, WS, BC and ozone). This would provide a more accurate analysis. Again, I think an average daily variation pattern could be presented and analyzed.
- pp 11815, I23: Here ozone is assumed to be a tracer of polluted air mass. I think an analysis of air mass back-trajectories for polluted and non-polluted events in terms of BC and ozone could improve the analysis.
- pp 11815, I28: "On the other hand values for ozone levels lower than 30 ppbv can be attributed to advection and dry deposition mechanisms reducing air ions concentrations as well." I'm not sure to understand what authors mean. Please clarify.
- In the section "Enhanced ion concentrations during the night at Finokalia": SMPS data were not presented. In my opinion, condensational and coagulation sinks should be analyzed. Such new informations could help to understand the observed phenomenon.
- pp 11816, I26: According to the figure 6, the cluster concentration is enhanced at night. Authors connect this cluster production to the nucleation process. In my opinion, the cluster lifetime is too short to be connected to a nucleation event that will occur few hours later. On the figure 6, the night-time ion concentration enhancement seem to be strongly decreased prior to the nucleation event. Mean values of cluster ion concentration during the night and just before the nucleation is triggered could help to investigate the role of such night-time enhancement on the nucleation occurrence.

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- pp 11818, I9: Again, I think a statistical analysis of an average event vs. non-event day would improve the clarity of the paper.
- pp 11819, I10: A map with sector description would be useful to understand the air mass origin analysis.
- pp 11819, I16: In my opinion there is a conflict between two results here: "The results showed intrusion of air masses from higher altitudes for the majority of the events and thus influence of cleaner air masses" and "the contact of air masses with the soil was the major source of atmospheric ions for Finokalia". Moreover, Hysplit backtrajectories were computed to reach the sampling site at 1000 m a.s.l. How could you explain that air masses from higher altitudes could be enriched in radon ? Again, no radon measurements are presented here, so I do not think it is relevant to speculate that much on the potential role of radon on the night time enhancement events.
- Conclusion: Do the authors have some assumptions to explain their observations ? I think the presented results should be more discussed.
- References: The reference Gagné et al., 2011 is now available in its final form.

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