

## ***Interactive comment on “Profiling of aerosol microphysical properties at several EARLINET/AERONET sites during July 2012 ChArMEx/EMEP campaign” by M. J. Granados-Muñoz et al.***

**M. J. Granados-Muñoz et al.**

mamunoz@jpl.nasa.gov

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The authors would like to thank both reviewers for their comments and suggestions, which have helped to improve the quality of the manuscript. Please, find below a detailed response to the reviewer's comments.

Comment: The manuscript titled "Profiling of aerosol microphysical properties at several EARLINET/AERONET sites during 2012 ChArMEx/EMEP campaign" intends to analyze the microphysical properties of aerosols at five different lidar ground-based

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stations, and to use the results obtained for the validation of different mineral dust models. The paper addresses an interesting and sound topic related to the aims of the ChArMEx campaign. The English language and presentation are very clear and up to the standard of an international journal. The figures and tables in the manuscript are also relevant. The paper is well organised and detailed. I strongly appreciate the effort of the authors to compile different ground-based observations and models. In this sense, the authors present a nice description of the state of the atmosphere during the ChArMEx campaign (9–11 July 2012). This technical work is noticeable; but somehow does not importantly contribute to science. After having read carefully the paper, I am not feeling having learnt a lot, for the following reasons. Most of the paper is devoted to the description of aerosol optical properties, aerosol mass and layering at different stations. The processes involved in the dynamics of transport of dust to the Mediterranean are widely known (as also stated by the authors in the references included). These processes were largely studied in a number of publications, such as Pey et al., 2013; Salvador et al., 2014; Gkikas et al., 2013 and 2015; Sicard et al., 2015; just to cite some recent papers. The models used (BSC-DREAM8b, NMMB/BSC-Dust, DREAM8-NMME, COSMO-MUSCAT) are not new either, and have been extensively validated in other studies (e.g. Perez et al., 2008; Pérez et al., 2011a, 2011b; Basart et al., 2012; Haustein et al., 2012; Mona et al., 2014, and especially, in Biniotoglou et al., 2015, among many others). Also, using GARRLIC and LIRIC for retrieving microphysical properties is not a new contribution either. Therefore, the authors should clarify which part of the manuscript is innovative and how this paper contributes to an advancement of the scientific knowledge.

Response: The main contribution of this manuscript is the analysis of the microphysical properties, which has not been presented in the previous studies mentioned by the reviewer, mostly based on the analysis of the optical properties. As far as LIRIC is concerned, results presented here follow a whole event during a continuous period of time in different stations operating simultaneously and thus providing vertical, horizontal and temporal coverage. Up to our knowledge, only the study by Chaikovsky et

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al. (2016) provides information about different lidars measuring simultaneously. However, those lidars were located at the same site for inter-comparison purposes and the temporal evolution of the aerosol microphysical properties was not considered either. In studies other than Chaikovsky et al. (2016), LIRIC was applied to single sites with a single lidar and for specific selected case studies. In this sense, we show the capability of LIRIC to provide information about aerosol microphysical properties with a high vertical and temporal resolution in a simple, automated and robust way within a network such as EARLINET, providing regional coverage. The easy implementation of LIRIC in EARLINET/AERONET stations and the quality of the results obtained make it very suitable this kind of analysis within networks and during special campaigns. Additionally, information provided by LIRIC in such scenarios could be used to test and improve the performance of dust and aerosol forecast models. In previous studies, models have been mostly validated using optical and column-integrated properties, but not many validations of the microphysical properties profiles are available, except for the study by Biniotoglou et al. (2015). Our study goes one step further than the one by Biniotoglou in the sense that the same dust event is evaluated regionally and we include also an evaluation of the temporal evolution at Granada station. Biniotoglou et al. (2015) is a comprehensive analysis but applied to independent case studies at different stations. The addition of COSMO-MUSCAT in our study with respect to the one by Biniotoglou et al. (2015) it is also worthy to point out. The comparison between COSMO-MUSCAT and the other three analyzed models is in our opinion quite interesting, since COSMO-MUSCAT is based in a different philosophy.

Comment: Also, the authors have to further improve the discussion on the skills of the models. The authors calculate the relative bias (what the authors call the Relative Differences); but is this figure good enough to characterize the models? The bias may largely compensate with the layers where under- and overestimations are produced. In other words, a "zero" bias can come from very large absolute errors that compensate. The authors may use the US EPA (1991; 2005) indicators of those statistical figures coming from FAIRMODE initiative in order to have an idea of the ability of the models

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for reproducing dust mass concentration. It would also be desirable to find some information related to the temporal skills: correlation coefficients, variability, etc. Moreover, the authors do not provide any insight on the differences between the models (for instance, why some models indicate dust and some do not) or their skill. This has to be extended in the manuscript.

Response: We agree with the reviewer that additional parameters are needed to better evaluate the model since the use of a single parameter can lead to misleading conclusions. Additional parameters from the documentation suggested by the reviewer have been included in the analysis, namely the root mean square error, the normalized mean bias and the normalized mean standard deviation. The correlation is now also included to evaluate the temporal skills of the models together with the new statistical parameters. Figure 13 have been modified including these parameters (see figure attached below). The new figure caption is as follows:

"Figure 13. Vertical profiles of the correlation coefficient between LIRIC and the models time series for every altitude level, the root mean square error RMSE, the normalized mean bias NMB and the normalized mean standard deviation NMSD."

In order to avoid confusion, some parameters presented in the previous version have now been removed since they do not provide additional information. Discussion has been modified according to the results observed using the new parameters and extended where necessary. Additionally, the results section has been reorganized in order to make it easier to follow and try to emphasize the main findings and conclusions inferred from the present study.

Other minor comments: 1. I cannot find the reference Gama et al. (2015) in the literature section. Response: The reference was not included in the references section. We apologize for the mistake and the reference is now added to the list. "Gama, C., Tchepel, O., Baldasano, J. M., Basart, S., Ferreira, J., Pio, Cardoso, J., and Borrego, C.: Seasonal patterns of Saharan dust over Cape Verde-a

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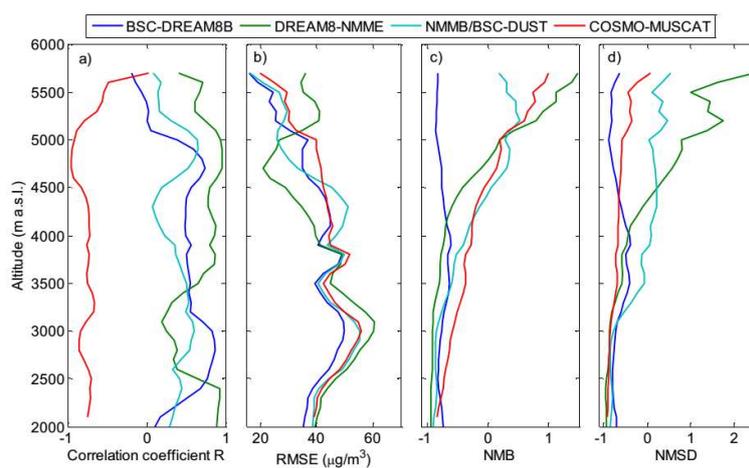


Fig. 1. Figure 13

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