Atmos. Chem. Phys. Discuss., 15, C6829–C6835, 2015
www.atmos-chem-phys-discuss.net/15/C6829/2015/

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Overview of the Chemistry-Aerosol Mediterranean Experiment/Aerosol Direct Radiative Forcing on the Mediterranean Climate (ChArMEx/ADRIMED) summer 2013 campaign" *by* M. Mallet et al.

Anonymous Referee #1

Received and published: 14 September 2015

General comments:

A better knowledge of the radiative influence of the aerosols on the Mediterranean climate is important to estimate their impact on the global warming. The Mediterranean region is rich in a variety of particles from both continental and marine sources. This paper presents the first results of an ambitious experimental campaign, based on surface and aircraft observations that propose a rather complete view of the physiochemical and optical properties of the Mediterranean aerosol. In addition, the data analysis

takes benefit of the expertise from a large group of recognized scientists. Although we could discuss of the relevance of such a long paper, this manuscript brings valuable advanced results on the aerosol properties across the Mediterranean basin. However, some questions arise when reading the manuscript. First of all, if the objectives of the ChArMEx/ADRIMED project are well-presented in the introduction, the aim and the borders of the paper should be better précised, more particularly in view of the fact that the authors continuously refer along the paper to other published results on the same topics (for instance, Section 5.4.1 mainly deals with the results of Nicolas et al. (2015) and Meloni et al. (2015)). Few parts of the manuscript looks like a compilation of results which could have been more synthesized. In particular, our understanding would gain a lot if the authors could provide a synthesis of the different results they obtained to make the reader see how to relate them, as for the AOD data in Section 5.2 or for estimates of the radiative forcing reported in Section 5.4. In addition, the authors present the analysis of the aerosol composition in Section 5.1.4 and the CHIMERE calculations in Section 6.2, but any link is made between the two sections. By the way, the comparison between the different regional models reported in Section 6 does not seem really useful for this paper since all models did not take into account aerosol species in a similar way. I also think that the manuscript could be improved thanks to a more rigorous comparison between the aerosol characteristics at the different sites. To my opinion, the major interest of the paper deals with the estimates of the local radiative forcing and the large dataset concerning the aerosol extinction provided using different instruments and methods. It is clear that this paper merits publication in ACP. I would recommend, however, a revision of the manuscript in view of the comments that I have listed below.

Major concerns:

p. 19642: The description of the general meteorological conditions seems incomplete. In spite of the figure 8, too small and providing pressure by the way, the wind speed, which is the key parameter of the aerosol transport is not really given with a sufficient

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precision in any part of the text.

p. 19645: The comparison between the two coastal sites, i.e., Lampedusa and Ersa indicates a significantly higher mass concentration in Lampedusa. One can expect that the surplus in aerosol concentrations measured in Lampedusa is rather due to height above the sea of the aerosol acquisition, which was closer to the sea surface in Lampedusa than in Ersa. In particular, if we consider that the sea-spray aerosols issued from breaking waves can largely contribute to the PM10 concentrations in the lower layer in such marine environments, a correction factor could be easily used for an accurate comparison by assuming an exponential decay of aerosol concentrations with altitude. The vertical profiles of aerosol concentrations can be then modelled using Toba (1965) as a kernel. The authors can also use the work of Piazzola et al. (2015) who approached the concentrations decay with altitude by a logarithmic law using vertical aerosol profiles measured in the Indian Ocean compared to data obtained from the CALIOP level2 operational products.I would suggest the authors to use this kind of corrective factor to ensure an accurate comparison between the two sites. This remarks can also be considered for the comparison between the volume distributions at four different sites reported in p. 19646.

p. 19646: The impact of the convective processes on the concentrations of anthropogenic aerosols could have been evaluated through the survey of the air-sea temperature difference. This induces a seasonal variation of the anthropogenic aerosols which can explain the differences noted with the ESCOMPTE campaign. This should be included in the analysis of meteorological conditions to produce large concentrations of polluted-smoke particles.

p. 19648-49 : By the way, the comparison of the Ersa and Lampedusa chemical analysis with the data reported during the ESCOMPTE campaign does not seems appropriate. The authors should rather compare their results to sites with quite similar character, whether it is located in theEastern (see, Eleftheriadis et al. 2006; Bardouki et al. 2003) or in the Western Mediterranean (e.g., Piazzola et al., 2012; Sellegri et

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al., 2001). P. 19653: The authors explained the low values of the SSA measured in Lampedusa by the contribution of the coarse mode to the total size distribution, which is attributed to the dust aerosols. Would it be possible that the sea-spray production at the air-sea interface (see next comment) also contributes to the decrease of the SSA trough the injection of coarse and giant particles in the MABL?

p. 19657: The southwest episodes allowing dust transport in the Northern Mediterranean is also often characterized by the occurrence of strong sea-spray injection in the lower part of the Marine Atmospheric Layer through breaking waves in addition to deposition fluxes of the dust particles advected from the Saharan region. This is confirmed by the LNG surface observations reported in Section 5.3.2. Can we consider that the AOD values measured in these conditions should be due the combination of dust and strong sea-spray flux occurring at the sea surface? Could the authors use more the Angstrom coefficient to provide a better analysis?

p. 19666: The main objectives of ten ChArMex project is to investigate how the modifications of the radiative budget due to aerosols affect the sea-surface evaporation fluxes. Concerning the sea-spray aerosols, could the impact on the sea-surface evaporation fluxes and relative humidity profiles be estimated ?

P. 19658 If a strong contribution of dust aerosols is indeed noted all along the campaign, do these results allowed to say if it is different from the past, especially if we consider that the measurement period is known to be the good one (with the autumn season) for Saharan dust intrusion in the Northern Mediterranean.

p. 19651: The results reported in Section 5.2.1, 5.2.2 and 5.2.3 should deserve to be synthesized.

p. 19663: The comparison of the COSMO-MUSCAT with other regional models which does not have the same characteristics (Table 8) seems inappropriate since all models did not take into account aerosol species in a similar way. I am not sure that this part of the paper is very useful.

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p. 19669: Some question also deals with the radiative impact of Mediterranean aerosols, the TOA simulations presented in Fig. 29 at the end of the manuscript, we could expect the authors to relate their results to the potential changes of the radiative budget due to aerosols in the Mediterranean or compare them to the work of Nicolas et al. (2015) and Meloni et al. (2015).

p. 19671: The authors concluded "Non negligible aerosol extinctions (about 50 Mm-1) have also been observed within the Marine Boundary Layer (MBL), due to the presence of polluted or marine aerosols." Maybe I have missed something, but I did not see anything in the manuscript that permits this conclusion.

Minor concerns:

p. 19619 and others: I would replace " sea-salt " by"sea-spray."

p. 19635: A comparison of the aerosol extinction vertical profiles with satellite data, as the CALIOP ouputs could have been interesting.

p. 19646: In parallel, the lowest concentrations are observed at the Ersa station, near the anthropogenic sources of the southern France and Italy. This is well consistent with the absence of intense polluted photochemical or smoke aerosol events during the SOP-1a.

p. 19699: I don't know if it is due to my printed version of the manuscript, but the figures are too small to be clear.

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Interactive comment on Atmos. Chem. Phys. Discuss., 15, 19615, 2015.

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