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Interactive comment on “Analysis of the atmospheric composition during the summer 2013 over the Mediterranean area using the CHARMEX measurements and the CHIMERE model” by L. Menut et al.

Anonymous Referee #1

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This manuscript, submitted in the special issue "Special Issue: CHemistry and AeRosols Mediterranean EXperiments (ChArME_x)" studies the atmospheric composition in terms of ozone concentration, particulate matter and aerosol optical depth over Europe and the Mediterranean during summer 2013. The study is based on both field campaign measurements (ChArME_x/ADRI_{MED}) and modeling using the chemistry-transport model CHIMERE. Results show the ability of this model to reproduce the atmospheric composition over the Mediterranean in terms of ozone concentration, particulate matter and aerosol optical depth. It is also interesting to show the contribution

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of the different species to the pollution over this region. However, before publication in ACP, the authors should correct several issues presented below.

Major comments:

- there is an inconsistency between the title of the paper and the objectives announced at the end of the introduction. Reading the title, I expected to find in this study a detailed analysis of the atmospheric composition over the Mediterranean during the summer 2013, rather than a successive evaluation of different parameters. The analysis of the contribution of the different species presented in section 6.2 should come earlier in the paper. However, this evaluation is also interesting as CHIMERE shows its good performance with regards to the CHARMEX measurements. Therefore, I suggest either to change the title and explicitly mention the evaluation part of the paper, or reorganize the paper to give more importance to the analysis part.

- The discussion regarding the performance of the model should be longer for some parameters, and the authors tend to be too affirmative while the figures and the table reveal some discrepancies between the model and the observations. For example, I would appreciate to have more explanations on the differences in AOD between MODIS and CHIMERE (notably in the Atlantic ocean, in the Middle-East, near the Caspian Sea), on the negative correlations in the daily mean PM₁₀, and on the discrepancies in the measurements of Cape Corsica (Figure 14). These deficiencies of the model should also be mentioned more clearly in the abstract.

- With regards to the aerosol part of the paper, other variables than AOD could also have been evaluated. I think that the ADRIMED field campaign has provided measurements of the vertical aerosol distribution, optical properties (single scattering albedo, asymmetry parameter), or size distribution, which could reinforce the quality of the evaluation presented in the paper.

Specific comments :

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- Page 23078 L13-21: Other studies (Moulin et al., 1998, Middleton and Goudie, 2001; Israelevich et al., 2012) could be mentioned in this paragraph, to explain the transport of dust aerosols over the Mediterranean basin.

- In the introduction, the use of regional climate models such as COSMO (Vogel et al., 2009), RegCM (Santese et al., 2010), SKYRON (Spyrou et al., 2013) and ALADIN-Climate (Nabat et al., 2014) in order to quantify the aerosols over the Mediterranean and estimate their impact on regional climate should be mentioned. Such field campaigns like ADRIMED devoted in studying aerosol properties are important to improve the representation of aerosols in the climate models.

- Page 23081 L12-21: Is it possible to compare this data on vegetation fire events to a climatology ? Thus the authors could justify the last sentence of this paragraph (L20-21).

- Page 23081 L24-27 : It is true that meteorological variables are generally measured country by country, but there has been an effort in the ChArMEx and HyMEX programmes to gather datasets (<http://mistrals.sedoo.fr>). The authors could consider adding for example an evaluation of 2m temperature.

- Page 23082 L8-10: The resolution (50km x 50km) can indeed raise the question of the representativeness of the model compared to measurements, but I do not understand why ozone can be evaluated and not NO₂ ?

- Page 23083 L2-6: The instrumentation regarding the ATR-42 and the Falcon-20 should be presented in section 2.3.

- Page 23083 L15-16: Why use only the MODIS instrument ? It could be interested to have also other instruments such as MISR or SEVIRI. Notably the use of instruments onboard geostationary satellites enable to have a better spatial and temporal resolution.

- Page 23084 L6-7: Could you give more details on the method to build an unified AOD

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product, including the two MODIS sensors, as well as the Deep Blue algorithm ?

- Page 23085 L14: It is not clear if you use forecast or analyses for the global meteorological fields ? Could you also give more details on the WRF simulations ?

- Page 23086 (Section 3.2) : Are there gaseous and aerosol species at the boundaries of the domain ? Further in the text (Page 23089, L19) you mention a global climate model for the boundary chemical fields. Could you clarify this point ?

- Table 3: The average bias should be added in the table.

- Table 4 / Page 23088 L4: Are the correlation and RMSE calculated from daily mean values as indicated in the text or from hourly values as indicated in the caption of Table 4 ?

- Page 23088 L17-18: Could you give examples of this contrast between Ajaccio and Bastia ? It does not seem obvious for me, notably between 6 and 11 July.

- Page 23089 L12-13: Is this due to spectral nudging ?

- Page 23089 L16: What are “trends” for you ? This should be clarified.

- Page 23089 section 4.2: The calculation of statistical scores could help the reader to judge the performance of the model.

- Page 23090 L1-2: Please remove the “s” to “Aerosol Optical Depth”.

- Page 23090 L20: I think that the highest AOD values are rather recorded over the Sahara and the Middle-East.

- Page 23090 L23: There are however some discrepancies between MODIS and CHIMERE (see my remark in major comments).

- Page 23090 L25: What is τ_{Ae} ?

- Page 23091 L2-3: Could you give information on the location of the AERONET stations (with a map for instance) ?

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- Page 23091 L9-10: This affirmation should be moderated, as Figure 10 clearly shows differences between observations and CHIMERE.

- Page 23093 L8-9: Could you justify the overestimation of the vertical diffusion in the models ?

- Page 23093 L14-15: Why not present in another figure the distribution between aerosol species only for PM₁₀ ? It would enable to justify more precisely the differences between the model and the observations.

- Figure 4: Could you indicate the flight numbers ?

- Figure 8: The caption should be detailed. Altitude is notably missing.

- Figure 9: The color scale is not really adapted over Europe and the Mediterranean. I think that the yellow colors ranging from 0.1 to 0.4 could mask local maxima. Could you modify the color scale ?

References:

Israelevich, P., Ganor, E., Alpert, P., Kishcha, P. and Stupp, A. (2012). Predominant transport paths of Saharan dust over the Mediterranean sea to Europe. J. Geophys. Res., 117 : D02205, 2012, doi :10.1029/2011JD016482.

Middleton, N.J. and Goudie, A.S. (2001) : Saharan dust : sources and trajectories. Transactions of the Institute of British Geographers, 26: 165–181, doi: 10.1111/1475-5661.00013.

Moulin, C., Lambert, C. E., Dayan, U., Masson, V., Ramonet, M., Bousquet, P., Legrand, M., Balkanski, Y. J., Guelle, W., Marticorena, B., Bergametti, G., and Dulac, F. (1998): Satellite climatology of African dust transport in the Mediterranean atmosphere, J. Geophys. Res., 103, 13137–13144, doi:10.1029/98JD00171.

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ity using a coupled Regional Climate System Model Climate dynamics, in press, DOI:10.1007/s00382-014-2205-6 Santese M, Perrone MR, Zaakey AS, Tomasi FD, Giorgi F (2010), Modeling of saharan dust outbreaks over the Mediterranean by RegCM3: Case studies. Atmos Chem Phys, 10:133–156.

Spyrou C, Kallos G, Mitsakou C, Athanasiadis P, Kalogeri C, Iacono M (2013) Modeling the radiative effects of desert dust on weather and regional climate. Atmos Chem Phys, 13:5489–5504. doi:10.5194/acp-13-5489-2013.

Vogel B, Vogel H, BuÂlmer D, Bangert M, Lundgren K, Rinke R, Stanelle T (2009) The comprehensive model system COSMO-ART radiative impact of aerosol on the state of the atmosphere on the regional scale. Atmos Chem Phys, 9:8661–8680. doi:10.5194/acp-9-8661-2009.

Interactive comment on Atmos. Chem. Phys. Discuss., 14, 23075, 2014.

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