

Interactive comment on “Modulation of radiative aerosols effects by atmospheric circulation over the Euro-Mediterranean region” by Pierre Nabat et al.

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The description of this study is comprehensive, properly structured and well written. I find that it includes a remarkable effort in evaluating the model results with observations, and a very interesting analysis, which improves much our understanding of regional aerosol-climate interactions in the broad Mediterranean region and Europe. I am eager to see this paper published as part of the ChArMEx special issue. Here is a list of comments and suggestions for minor revisions.

-I wonder whether the aerosol feedback has any effect on the NAO index. This could be evaluated by comparing the NAO index between the two simulations (AER and NO).

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-In a former paper, Nabat et al. (Climate Dynamics, 2015) have demonstrated that atmosphere-ocean coupling enhances aerosol radiative forcing effects, in particular on the surface temperature and sea level pressure. How far could this affect the results on aerosol-induced surface temperature anomalies obtained here with a purely atmospheric model? Is there any possible further aerosol-induced change in the NAO index due to such coupling?

-Moulin et al. (Nature, 1997) correlated winter NAO index and summer dust AOD over the Mediterranean and northeastern tropical Atlantic. Indeed, studies have suggested a delayed effect on dust emissions in semi-arid regions due to the impact of drought on the vegetation, but this is likely not something that the dust emission scheme can take into account.

-There is a contrasted situation in the aerosol load, and especially mineral dust, between summer and spring in the Mediterranean region (e.g. Moulin et al., JGR, 2018; see also Fig. 7) : dust is dominant in summer in the western basin (region D) but much less abundant in the eastern basin (region F), especially during the July and August months with dominant northerly winds (see for instance Fig. 7). On the contrary, intermediate spring and fall seasons are favorable to dust transport in the eastern Mediterranean region, with occurrences of Middle-East dust in fall. As a consequence, I find that there would be some interest in discussing also the spring and fall seasons, at least for dust, and possibly in a Supplement.

-Solar and longwave radiations are significantly variable depending on the region and season: it might be useful to additionally show maps of absolute seasonal values (e.g. in complement of Fig. 4) and give relative differences in % (e.g. in complement to Fig. 5 and in the text).

-Decapitalise northern, northwestern, northeastern, southern, southeastern, eastern, and western.

-Units: I think it is preferred to replace the sign "/" by a space and a negative power as

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done in "W m⁻²" (look for km/h and mm/day).

-Page 5, line 20 : "distribution" may be confusing due to the reference of the vertical dimension in the sentence; I suggest "for the particle size distribution of the emitted dust aerosol (vertical flux)".

-P.5, lines 25-29 : this short paragraph might introduce some doubt on the version used here; I suggest to specify "note for information that [...] coupling of the Mediterranean regional sea, not used in the present study".

-P.6-7, section 2.4: you might specify in the relevant methodological sub-sections the type of aerosol remote sensing product and wavelength(s) considered; AOD at 550 nm from AERONET shown in Figure 7 is probably computed and this is worth a statement in the methodology section; a word on uncertainties of observational products used for model comparison would also be welcome; finally, is there a temporal window selection in model data for comparison to observations? For instance, it is specified in the result section that the comparison with AERONET data is performed on common days, but are the model AOD values a daily or daytime average, or a value at 12UTC?

-P.6-7, section 2.4.1: QuikSCAT is missing in the Methodology sub-section on satellite data.

-P.7, line 2: check citation of Mace and Zhang.

-P.7, section 2.4.2: which version of AERONET products is used? Do you use daily averages and is there a minimum threshold of available measurements in a given day for considering the daily average?

-P.8: I suggest that the sub-section 2.5 Classification in weather regimes should better be shifted after section 2.3 Regional climate simulations since this classification is related to climate model results and not to observations.

-P.8, lines 25-26: reformat the citation "(Christensen and Christensen, 2007)".

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- P.9, lines 1-2: check "kotl14" and close the bracket after "Table 3".
- P.9, lines 16-25: it might be useful here specifying the relative radiation biases in % in addition to their absolute values in the different regions (as suggested before).
- P.11, line 17: distributions (plural).
- P.12, line 9: "however" between commas.
- P.15, line 2: "prevents".
- P.15, line 19-20: "a cooling effect" does not seem appropriate with the change by "+0.2°".
- P.21, line 2: "programme" (English spelling, 2 occurrences).
- Table 2: I find that additional columns giving the number of available days, and possibly the overall average AOD for every station would be informative.
- Figure 2: specify in the legend what are the boxes plotted in the upper left map.
- Figure 7: expanding the AOD scale by using a maximum of 0.55 would be helpful to give a better readability ; not duplicating the ordinate legend in a given line of plots would also allow to expand a bit horizontally the graphs.
- Figure 8: you might note in the legend that the AOD scale is different in each plot.
- Figure 9: I suggest to rotate the figure by 90° counter clockwise in order to expand the graphs.
- Figure 11: for better readability of the plots, I suggest using more contrasted colours and symbols for the filled circles (e.g., black circle and black plus?) and bold characters for legends; you might also vertically expand the graph.
- Figures 12-21: rather use bold characters for all legends; not duplicating axes in a given row nor a given line in Figs 16-21 would allow expanding the plots.

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-Figures 22-23: it might be more intuitive to use red and blue for increased and reduced aerosol impacts, respectively, than the opposite.

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