Comments to the Author:
Dear Dr. Nabat,
I am pleased to accept your paper for publication Atmospheric Chemistry and Physics. However, the reviewer pointed at some relatively minor issues in the manuscript. Therefore, I would to ask to address the risen questions before the publication. I would like especially emphasize that if you agree with the reviewer critics you should make appropriate modification of the article before publication.
Best regards,

Oleg Dubovik

Authors: We would like first to thank the reviewers for the reevaluation of our work and their positive comments and new suggestions. We have addressed all the remaining comments and questions in detail, and clarified the mentioned points. Please find below our point-by-point replies highlighted in bold. Corrections in the text are indicated in italics (page and line numbers refer to the revised manuscript).

Reviewer 1 :

General comments:

This paper aims at characterizing the dust aerosol radiative effects over the Mediterranean. The focus is done over a specific period, the summer 2012, in which in-situ measurements were made as part of the campaign TRAQA/CHARMEX. This paper addresses several different questions: (i) the ability of a model dust emissions scheme to produce realistic fluxes and then aerosols concentrations, (ii) the impact of these dust concentrations on the daily radiation variability, (iii) the impact of the use of a deterministic scheme in place of a climatology, (iv) climatological differences between 'dusty' or not days, (v) a comparions between several AOD satellite products.
This leads to a very long paper, mixing several concepts: climate and a specific studied case, model sensitivity tests, model comparisons (with MACC), data comparisons, impact of aerosols on radiation, comparisons between model outputs and measurements. The result is sometimes not very clear and several issues has to be corrected before publications. Removing unnecessary parts could make the article more clear and precise.
The authors made a complete revision and proposed answers to all questions adressed by the reviewers.
However, a large number of problems are not really solved. If some sections were moved or reorganized, the paper has the same length (24 pages in pre-print format) and the same number of figures.
Authors : We would like to mention that we have tried to answer all the remarks of both reviewers, which makes us add and remove some elements in the paper. We have notably reorganized the paper in order to get it clearer even if it finally has the same length. However, the number of figures has been reduced (13 figures instead of 14, and we should also mention the removal of the subplots included in Figures 8, 11 and 12 of the first version).

Note that for Figure 11, the geopotential height disappears (but is cited in the caption).
Authors : After recalculating the dusty days for Murcia, we have modified Figure 11, and just forgotten to add the geopotential height : this problem has now been corrected.

1. The "climatological" point of view remains in the whole manuscript (except in the title). Even if the authors remind us the definition of climate, a study over a summer is not really a climate study.
Authors : As this point remains a remark mentioned by both reviewers, we have decided to remove the words « climatological effects » from the paper. We have just mentioned in the

discussion part the need for longer simulations to deal properly with climate.
Page 1 Line 1 : The present study investigates the radiative effects of dust aerosols
Page 1 Line 19 : to focus on the radiative effects
Page 2 Line 76 : and consequently represents a documented case to evaluate the aerosol schemes of regional climate models. Indeed the analysis of study cases is made possible by the use of a reanalysis
Page 2 Line 143 : before assessing the radiative aerosol effects
Page 2 Line 146 : aims at studying the radiative effects
Page 2 Line 155 : the radiative effects of aerosols are studied in Sect. 4
Page 16 Line 830 : to reproduce local meteorological variations.
Page 19 Line 960 : This study has shown the radiative effects of dust aerosols in summer 2012
Page 19 Line 966 : providing an interesting case to estimate the radiative effects of dust aerosols.
Page 19 Line 970 : As a matter of fact, the composite study and the analysis of the utility of prognostic aerosols should be redone on a longer period to better understand the interactions between dust aerosols and regional climate
Page 20 Line 1018 : and then to estimate the radiative effects of dust outbreaks

2. The domain size. The justification here is that the domain was enlarged compared to the previous ALADIN configuration. To enlarge a non-adaptated domain is not convincing if the domain remains not large enough. But we can consider here that the domain may cover the largest part of aerosols observed over the Mediterranean sea,
Authors : We agree with the reviewer, the domain has been designed to cover the sources of aerosols affecting the Mediterranean area.
Page 3 Line 210 : The spatial domain of our simulations has consequently been extended compared to the previous study of Nabat et al. (2015), in order to include all the sources generating aerosols that can be transported over the Mediterranean basin. As far as dust particles are concerned (Middleton and Goudie,2001 ; Israelevich et al., 2012), the following sources are notably included in the domain: North African sources (Morocco, Algeria, Tunisia), the Hoggar mountains, the Tibesti Mountains, the Bodele depression, Libya, Egypt as well as sources near the Red Sea (northeast Sudan, Djibouti).

3. Use of the MACC outputs for the comparison. The section was shortened but not removed, the authors considering this is important.

4. The definition of the dusty days was changed. The use of the Angstrom coefficient could be useful. This is strange to read that a very important parameter is not used to define a model criterio because the model does not compute this parameter. In this case, instead of an unsuitable criterion, change directly your model. In my frist review I wrote "the results are difficult to understand". The authors answered "We admit that the method could be difficult to understand". There is here a confusion: the method is not "difficult to understand", it is not robust. Thus, the results (not the method) could be difficult to understand.
Authors : We had changed the definition of dusty days, which is now based on dust AOD instead of total AOD. In that sense, we think that this new definition is very close to a definition based on Angstrom exponent as the latter would also help to identify days with high dust loads. Indeed, we admit that Angstrom coefficient is a very important parameter, and we will try to include it in a future version of our model (added in the discussion part of the paper). However, it is worth mentioning that another reason why the Angstrom exponent has not been used in the composite study is the absence of this parameter in some stations where AOD observations are given by AERUS-GEO instead of AERONET (the two buoys, Fès, Ajaccio and Nice).
Page 20 Line 998: Future developments on this aerosol scheme will be carried out to improve the representation of aerosols in the model. For example, the implementation of Angstrom exponent

will make the definition of dusty days for the composite study more robust.

With this definition of dusty days based on dust AOD instead of total AOD, we think that our method is more robust, but indeed the results could still be difficult to understand. Consequently, we have modified Section 4.3 in order to make the results as clear as possible.
Page 16 Line 782 : as expected, the difference in AOD between dusty days and the set of all the days is clearly positive in the PROG simulation (0.19), very low in PROG-M (-0.01) but not necessarily zero as the number of dusty days varies from one month to another (AOD is monthly constant in PROG-M), and equal to zero in NO (no aerosols)
Page 16 Line 808 : Few changes between the three simulations are observed in cloud cover and TSR
Page 16 Line 822 : In other terms, without prognostic aerosols, the warming simulated by CNRM-RCSM during dusty days is too strong compared to observations, which is corrected in PROG.
Page 18 Line 897 : In fact, this composite analysis has shown that significant differences are observed between dusty days and the set of all the days, which come both from weather changes (notably due to southwesterly winds bringing warm air) and from the presence of dust aerosols that alleviate this warming by reducing incoming solar radiation. These results underline the importance of the use of prognostic aerosols to represent daily variations in weather parameters such as temperature and radiation.

Finally: I suggest that the authors make minor revisions in the manuscript. It is important to remind more clearly the limitations of their study, by adding more precise arguments in the section "4.5 Discussion". Indeed, as it is written, the paper tends to oversell what is really inside. It is needed to remind that the model is a climate model and, thus, has some poor or simplified parametrizations: for example, the number of bins is low and may conduct to erroneous conclusions when the 'aerosol fine mode' is needed.
Authors : As suggested by the reviewer, we have added the following elements in the discussion part (Section 4.5), which constitute limitations of the study :
- the low number of bins for dust aerosols
- the simplified bulk approach for aerosol modeling
- the absence of internal mixing
- the absence of secondary organic aerosols
- the limitation to a three-month period
Page 19 Line 970 : the composite study and the analysis of the utility of prognostic aerosols should be redone on a longer period to better understand the interactions between dust aerosols and regional climate (...)
Page 20 Line 992 : Finally, the low complexity of the aerosol scheme used in the present work could constitute another limitation. In particular, the low number of bins for dust aerosols (only three), the absence of detailed processes representing the formation of secondary aerosols, the choice of a bulk approach for aerosol modeling and the absence of internal mixing are limitations to the present work. (...) However, some of the simplifications remain necessary to keep a low numerical cost in order to be able to carry out easily multi-annual climate simulations with a coupling between the different components of the regional climate system (atmosphere, aerosols, land surface and ocean).

Reviewer 2 :

In this review the authors answer to the criticism raised by both reviewers. Some points have been improved but some other open questions still remains. Thus, the confusion on climate and meteorological scales still exist and in this sense I enclosed an annotated with the proposal of some

changes in the text, especially in the abstract and introductory section. By one hand the scheme the authors tested is oriented for climate studies, but it is clear that they test the scheme in a scale that is not climatic. They use a set of data collected in the Mediterranean region during a limited period to test the performance of the model. In this sense the initial statement of the abstract is inadequate.
Authors : We have taken into account the annotations of the reviewer. In particular, we have now removed the words « climatological effects » from the paper.
Page 1 Line 1 : The present study investigates the radiative effects of dust aerosols
Page 1 Line 19 : to focus on the radiative effects
Page 2 Line 76 : and consequently represents a documented case to evaluate the aerosol schemes of regional climate models. Indeed the analysis of study cases is made possible by the use of a reanalysis
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Page 20 Line 1018 : and then to estimate the radiative effects of dust outbreaks

Another point is that the authors answer to the different questions raised by the reviewers, and some cases the authors agree with the comment but finally they didn't modify the manuscript accordingly. This is the case of my comment with my comment on the discrepancies between the model and lidar retrievals. The author apparently agreed with my comment, but they finally didn't modify the text. Both the abstract and the text must be modified according to the disagreements shown in the results.
Authors : The sentence in the abstract about the representation of dust vertical and size distributions has been modified according to the reviewer's remark, as well as the paragraph in Section 3.4.
Page 1 Line 13 : The dust vertical and size distributions have also been evaluated against observations from the TRAQA/ChArMEx campaign.
Page 10 Line 577 : In summary, the dust extinction simulated profiles have been evaluated against these lidar profiles, showing the variability in the altitudes of dust aerosols.
Page 10 Line 616 : To summarize, we have shown in this section the strengths and the weaknesses of CNRM-RCSM5 to simulate the evolution of aerosols during summer 2012

Another point that requires improvement is that of the quality of the figures. The authors answer that they will review the quality of the figures and they will include units and labels in the axes, but I find the same problem that in the original review, see Figure 6 as an example.
Authors : Units are now included in all the figures, and Figure 6 has been corrected.