

Interactive comment on “Regional effects of atmospheric aerosols on temperature: an evaluation of an ensemble of on-line coupled models” by Rocío Baró et al.

Anonymous Referee #4

Received and published: 8 February 2017

General comments: The manuscript “Regional effects of atmospheric aerosols on temperature: an evaluation of an ensemble of on-line coupled models”, focusing on the prognostic of the temperature field at 2 meters across Europe, main goal was to evaluate the performance of individual outputs from distinct simulations based on two modelling systems, WRF-CHEM and COSMO, against the performance of an ensemble based on these same individual simulations. A relevant aspect of the study is the performance assessment of both individual runs and the ensemble under different modelling context of aerosol particles effects prescription: a) neglecting any aerosol effects; b) including only aerosol-radiation interaction; c) and including aerosol-radiation plus aerosol-cloud-radiation interactions. According to the manuscript, the main conclusion

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obtained from the analyses is that the inclusion of aerosol effect feedbacks did not have a significant impact on the bias observed between modelled and observed temperature. However, the spatial and temporal variability are better represented when aerosol radiative effects are included in the simulations. The subject of the manuscript is within the scope of ACP and it is a relevant scientific issue. However, there is several issues regarding the way it is addressed. Therefore, I think that the manuscript needs some work before its acceptance.

There are some points/aspects in the manuscript that I would like to comment: The manuscript has a critical issue, a fundamental element behind the scientific object discussed is the aerosol effects, in both radiation and clouds, nevertheless, the aerosol horizontal and vertical distribution loading is absolutely absent from the manuscript. To address the influence of these effects on the surface temperature it is crucial to have, at least, a clear notion on the aerosol horizontal loading, observed and modelled. The difference between them may be critical to understand the potential discrepancies between model and observation regarding temperature. The daily variability of the aerosol loading, at least over the regions highly affected by the fires and dust episodes would be also important to the understanding of the model performance as regard to the temporal variability of the surface temperature. That would help to better contextualize some of your conclusions.

Although the focus is on the aerosol effects feedbacks on the surface temperature, to provide a comprehensive perspective of the aerosol effect feedbacks, I would recommend the authors to describe the dominant meteorological context during the episodes, with special focus on those variables that govern the surface temperature field. Meteorological scenario (large scale patterns) is also relevant since it can enhance or mask aerosols effects feedbacks.

Though the manuscript emphasizes the ensemble performance evaluation, the modelling experiment done it is well designed and it opens many and relevant/interesting possibilities of analysis that could be explored to evaluate modelling issues and the

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feedbacks induced by aerosol-radiation and aerosol-cloud-radiation prescription and, therefore, improve the manuscript discussion and results. A reason to suggest this is that, although the characterization of the uncertainty associated to the use of different modelling systems is pointed out as one of the manuscript goal, few is discussed on this matter throw out the topic of results. Being the WRF-CHEM individual models dominant and presented basically the same configuration, although from distinct institution, the ensemble results seems to resemble WFR_CHEM features, which is clear when Bias are analysed. Moreover, I wonder about the inclusion of a WRF-CHEM model version with a spatial resolution substantially higher than the others an its influence on the ensemble results. I also wonder about the effectiveness of the discussion largely based on domain-averaged values given the domain considered. As highlighted before, the experiment design provides interesting alternative to explore aerosol prescription effects if the analysis was not only focused on domain-averaged values. The simultaneous analyses of the inclusion(exclusion) of aerosol effects based on the ensemble field seems to be a challenge since the ensemble may reflect compensation between features from individual models.

Specific comments:

Page 2, Line 03: "...due to direct aerosol-radiation..." to "... due to the direct aerosol-radiation..."

Page 2, Line 04: "...from aerosol-cloud interactions..." to "... from aerosol-cloud-radiation interactions..."

Page 2, Line 09: "...and minimum temperature over Europe..." to "...and minimum temperature at 2 meters over Europe..."

Page 2, Line 10: "The evaluated model outputs originate..." to "The evaluated models outputs originate..."

Page 2, Line 11: "The case studies cover two important..." to "The cases studies cover

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two important. . .”

Page 2, Line 12-13: “. . .a heat wave and forest fires episode. . .” to “. . .a heat wave event and a forest fires episode. . .”

Page 2, Line 19: “. . .those areas closest to emissions sources. . .” to “. . .those areas closest to significant emissions sources. . .”

Page 2, Line 17: “the spatio-temporal variability and correlation coefficients are improved for the cases under study when atmospheric aerosol radiative effects are included, especially for those areas closest to emissions sources of atmospheric aerosols” How can one see that without any plot showing emissions and/or aerosol loading in the manuscript?

Page 2, Line 21 -22: “Atmospheric aerosol particles are known to have an impact on Earth’s radiative budget due to their optical, microphysical and chemical properties, . . .”

to

“Atmospheric aerosol particles are known to have an impact on Earth’s radiative budget due to their interaction with radiation and clouds properties, which are dependent on their optical, microphysical and chemical properties . . .”

Page 2, Line 23-26: “They influence climate by modifying both the global energy balance through absorption and scattering of radiation (direct effect), and by acting as cloud condensation nuclei, thus affecting cloud droplet size distributions and lifetime (Twomey 1977; Lohmann and Feichter, 2005; Chung, 2012) and the reflectance and persistence. . .”

to

“They influence climate by modifying the global energy balance through both absorption and scattering of radiation (direct effect) and by acting as cloud condensation nuclei, thus affecting clouds droplet size distribution, lifetime (Twomey 1977; Lohmann

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and Feichter, 2005; Chung, 2012) and reflectance (indirect effects) . . .”

Page 3, Line 15-17: “. . .the air quality model evaluation international initiative (AQMEII) in its phase 2 (Alapaty et al., 2012; Galmarini et al., 2015) focused on the assessment of. . .”

to

“. . ., in its phase 2, the air quality model evaluation international initiative (AQMEII) (Alapaty et al., 2012; Galmarini et al., 2015) focused on the assessment of. . .”

Page 3, Line 20: “. . .aerosols, radiation, clouds, and precipitation. . .” to “. . .aerosols, radiation, clouds and precipitation. . .”

Page 3, Line 20: “. . .a coordinated exercise of Working Groups 2 and 4 of the COST Action ES1004 (EuMetChem, <http://eumetchem.info>) emerged, in order to take into account the radiative feedbacks, due to atmospheric aerosol effects over meteorology. . .”

to

“. . ., a coordinated exercise of the working groups 2 and 4 of the COST Action ES1004 (EuMetChem, <http://eumetchem.info>) emerged in order to take into account the radiative feedbacks of atmospheric aerosol effects on meteorology.”

Page 3, Line 26: “. . .of their strong potential of aerosol interactions. . .”

to

“. . .of their strong potential for aerosol-radiation and aerosol-cloud-radiation interactions. . .”

Page 3, Line 28: “. . .onto meteorology. . .” to “. . .on meteorology. . .”

Page 4, Line 1: Specify temperature at which level (surface, 2 meters?) the paragraph is referring.

Page 4, Line 5: “Forkel et al. (2012) studied an episode in June and July. . .” specify

the nature of the episode that is discussed here.

Page 4, Line 7: "...this reduction was reflected in its spatial distribution of the planetary boundary layer height. ..." please, clarify.

Based on the first sentence of the last paragraph: Page 4 Line 11: "However, all these studies are based on individual model evaluations and do not take into account an ensemble of regional models, in order to build confidence on model simulations and to characterize the uncertainty associated to the use of different modelling systems"

I'm tempted to suggest another perspective on the sentence that describe the manuscript main goal (just a suggestion)

from

Page 4 Line 14: "...the objective of this work is to assess whether the inclusion of aerosol radiative feedbacks during two important atmospheric aerosol episodes of the year 2010 improves the outputs of an ensemble of regional on-line coupled models for maximum, mean and minimum temperature at 2 meters over Europe."

to

"...the objective of this work is to assess whether the outputs of an ensemble of regional on-line coupled models simulations including aerosol radiative feedbacks, during two important atmospheric aerosol episodes of the year 2010, improves the prognostic for maximum, mean and minimum temperature at 2 meters over Europe"

Page 4 Line 23: "...the Russian 2010 heatwave and wildfires episode in summer 2010 (25 July-15 August 2010) ..."

to

"...the Russian heatwave and wildfires episode in the summer of 2010 (25 July-15 August 2010)..." Page 5 Line 1: "...which does not consider any feedbacks to meteorology with simulated aerosol (NRF),"

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to

“...which does not consider any aerosol effects feedbacks to meteorology (NRF),”

Page 5 Line 2: “...where aerosol-cloud interactions based on simulated aerosol concentrations and direct and indirect aerosol effects are considered (ARI+ACI).” I think this sentence needs to be improved.

Page 5 Line 11-12: “...with different chemistry and physics options and performed episodes...” The last part of the sentence “and performed episodes” did not make sense to me, please, clarify.

Page 5 Line 14: “...grid with of 0,125deg /approximately 14 km) there is an additional...” to “...grid with of 0.125 deg (approximately 14 km) and there is an additional...”

Page 5 Line 21: “...uses the Model for Simulating Aerosol Interactions and Chemistry (MOSAIC)(4 bins)...” Please, provide the meaning of “(4 bins)”.

Page 6 Line 3: “2.2 Emissions and boundary conditions” The topic is mentioning “boundary conditions” but it only describe emissions sources. How about dust emission, since one of the case study focus is on an event of dust transport.

Page 6 Line 9: “...volatile organic compounds...” to “...volatile organic compounds...”

Page 6 Line 25: “...alter significantly any of our results...” to “...alter significantly our results...”

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