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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Assessment of the radiative effects of aerosols in an on-line coupled model over the Iberian Peninsula" *by* Laura Palacios-Peña et al.

Anonymous Referee #1

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General comments: From my understanding, the paper "Assessment of the radiative effects of aerosol in an on-line coupled model over the Iberian Peninsula" presents results of a numerical study focused on the sensitivity of atmospheric aerosol particles optical properties over Iberian Peninsula (IP), nominally Aerosol Optical Depth (AOD), Ångström Exponent (AE), and backscattering vertical profile, to the feedbacks induced by the aerosol direct and indirect radiative effects. Two numerical experiments using the WRF-Chem model were performed, one simulating AOD and AE fields and aerosol vertical distribution turning off aerosol particles radiative effects in the model, and a second experiment turning on the aerosols radiative effects, both the direct and the indirect. To assess the impacts (improvement or deterioration) of the on-line coupling

of aerosol direct and indirect radiative effects on the simulation of AOD and AE field over IP, observational data of AOD and AE were taken from database products of the MODIS aboard of Terra and Aqua orbital platforms and Aerosol RObotic NETwork (AERONET) ground based stations in the IP. As observational reference for aerosol vertical distribution they have used data from the EARLINET station in Granada. The study is focused on two distinct aerosol scenarios over IP, one consists of an episode of Saharan dust transport toward the southern region of IP, and the second of a biomass burning event that occurred in the north region of Portugal. Although the scientific goal of the paper is of significant relevance, the paper exposure needs improvements. Beginning from the title, in my view, the authors did not assess the aerosols radiative effects as the title suggest. So far, their major focus has been on the response of aerosol optical properties field over IP, mainly AOD and EA, to the on-line coupling of the aerosol radiative effects in the model. Therefore, I think there is a need to adequate the title in order to accurately express the paper goal and content. For the sake of clarity, the authors should make clear the distinction between what they refer as radiative feedbacks and the aerosol radiative effects. Given the role of the numerical experiments on the manuscript goals and conclusions, there is not much discussion on the model system and simulations configurations, physical and chemical modules, leaving it to references. Further details are needed, especially as regard to the model aerosol microphysical and optical modules, which have relevant impact on the variables analysed, and indirect and direct radiative effects parametrization. Also, there is not much discussion about the mechanisms that drive the feedbacks induced by the on-line simulation of the aerosol direct or indirect radiative effects on the aerosol field over IP. Results and discussions are essentially describing the discrepancies between simulations results and observation without further discussion on the potential drivers.

Specific comments: Page 2, Line 09: "Light-absorbing aerosols such as biomass burning exert a warming influence. . ." That may be true for black carbon aerosol particles, however biomass burning aerosol plumes are not only composed by black carbon. Biomass burning plume as a whole may have a cooling effects (references example:

Schafer et al., 2002, Observed reductions of total solar irradiance by biomass-burning aerosols in the Brazilian Amazon and Zambian Savanna, GRL, Volume: 29 Issue: 17; Procopio et al., 2004, Multiyear analysis of amazonian biomass burning smoke radiative forcing of climate, GRL, Volume: 31 Issue: 3). Page 3, Line 14: Please, include specifically which modelling output are you refering to.

Page 5: Emissions sources are discussed here, however nothing is said about the dust emission, one of the aerosol type focus of the study.

Page 5, Line 17: "... aerosol particles are represented by two lognormal size distributions, corresponding to an Aitken mode and an accumulation mode...": Considering that an event of Saharan dust outbreak is analysed, a coarse mode consideration wouldn't be relevant? The absence of a coarse mode aerosol in the model parametrization certainly helps to explain the discussed model difficulty to simulate Angstrom Exponent variability.

Page 6, Line 18: MODIS Angstrom Exponent is only available for ocean region? If yes, so the analysis was not restricted to Iberian Peninsula, but also over the surround sea and ocean.

Page 8, Line 1- 5: Certainly MODIS retrievals have issues, but also it would be important to discuss the modelling issues that can contribute to the discrepancies.

Page 8, Line 1 – 2: Is the correlation coefficient obtained from model simulation comparison with MODIS data distinct from that calculated for the comparison between model simulation against AERONET? If so, why is correlation coefficients for model x MODIS much higher than correlation coefficients for model x AERONET (Table 3)? How does MODIS AOD compare with AERONET stations AOD?

Page 10, Line 4 – 5: The inclusion of more days in the analysis may provide a better analysis from the statistical perspective. Page 18, Table 1: A map of the distribution of the AERONET sites and the EARLINET station in Granada would be helpful to the

readers to follow the discussions. For example, that can be done in one of the AOD field map from the simulation.

Technical corrections: Although the comprehension of the manuscript is not affected, I would recommend that the authors make use of an editing service, so that the writing can be improved. There are many sentences that need improvements; here I list some of them.

Page 1, Abstract first line: "...over the Earth's climate..." to "... on the Earth's climate..."

Page 2, Line 3: "...cause changes are: (1) scattering and absorption of solar radiation..." to "...cause changes are: (1) scattering and absorbing solar and terrestrial radiation..." Dust aerosol in particular may affect terrestrial radiation.

Page 2, Line 14: The sentence "The large uncertainty quantifying these ..." read better as "The uncertainty quantification of these aerosol effects on the Earth radiative budget is much higher..."

Page 3, Line 22: "...altering the global budget indirectly..." to "...altering the global energy budget indirectly..."

Page 3, Line 27: "The grid size is 6000 cells..." to "The grid size consists of 6000 cells..."

Page 7, Line 18: "We can then state then that the changes..." to "We can then state that the changes..." Page 9, Line 16: replace "...10 (a) & (c)..." to "...10 (a) and (c)..."

Page 9, Line 21: " Sagres stations ..." to "Sagres station..."

Page 10, Line 3: "Several specific days ..." to "Two specific day..."

Page 19, Table 1 and 2: Part of the table at the right side is missing.

Recommendation for the figures legends: Include the period over which mean field

AOD and AE are calculated and avoid abbreviations such as S.L (significant level)

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