Atmos. Chem. Phys. Discuss., 15, C12129–C12133, 2016
www.atmos-chem-phys-discuss.net/15/C12129/2016/

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Effects of aerosols on solar radiation in the ALADIN-HIRLAM NWP system" *by* E. Gleeson et al.

Anonymous Referee #2

Received and published: 1 February 2016

This manuscript, submitted to Atmospheric Chemistry and Physics, presents an interesting study of the sensitivity of the ALADIN-HIRLAM NWP system to the aerosol optical properties and the choice of the radiative scheme. The authors show the importance of considering realistic aerosols and their optical properties to simulate shortwave radiation. They have used a single-column NWP model to carry out simulation with different aerosol optical properties and radiative schemes. The dependence of the direct aerosol effect on relative humidity and aerosol vertical distribution has also been investigated. As a result, the authors present many sensitivity simulations that are not always completely exploited. The paper should be clarified to put forward the most important results. Moreover, the authors should pay more attention to the use of the English language. Consequently, I suggest a major revision of the paper before

publication in ACP.

Main comments:

- Structure of the paper: The authors have written many small paragraphs where the different sensitivity experiments are briefly presented, without logical transitions between them. I suggest to reorganize the results, maybe remove some simulations that are not useful, and focus on the main results. Moreover, all the curves of the different figures should be exploited, otherwise they can be removed.

- Some hypotheses made by the authors seem to be very simplistic. For example, I wonder if it is really interesting to use radiative schemes with only one SW spectral band (especially in the case of wildfires, with aerosol optical properties highly dependent on wavelength), which are now scarcely used in NWP models. Another simplistic hypothesis is the absence of vertical aerosol distribution in the HLRADIA radiative scheme.

- The simulations have been run under clear-sky conditions, which is a first step to estimate the effect of aerosols on SW radiation. However I think that it limits a lot the results of this paper, as clouds highly modulate the direct effect of aerosols (and of course also the indirect effect which is unfortunately not considered in this paper). Indeed, in the presence of clouds, the direct effect of aerosols should be less important. Simulations with all-sky conditions would reinforce the results of this study.

Specific comments :

- The abstract should be rewritten, to give more precise and concise results. It is also abnormal to mention only one radiative scheme and not the two others.

- Page 32520 lines 16-25: Many (simplistic ?) statements without any reference in the beginning of the introduction.

- A state of the art concerning the use of the indirect effect in NWP models should be added in the introduction, in the same way as it is done for the direct effect.

- Page 32521 lines 26-27: optical properties also depend on the type and the size of the aerosols

- Page 32522 lines 16-19: aerosol vertical distribution. Has the climatological vertical profile used in the ALADIN-HIRLAM system been evaluated against observations (e.g. lidar) ? Where does it come from ? Please also add a reference for : "There are considerable variations in the vertical distribution of aerosols over Europe."

- Page 32522 line 29: For the LW effect, it could be interesting to have a case with dust particles.

- Page 32524 line 10: "the excluded terms can be estimated by prescribed forcings". How is it done in your simulations ? Why do you not consider horizontal advection ?

- Page 32525 line 2: HLRADIA and ACRANEB2 are here mentioned for the first time, but are not defined.

- Page 32525 line 6: is the indirect effect of aerosols included in your simulations ?

- Section 2.3: a comparative table with the different characteristics of the three radiation schemes would be useful for the reader.

- Page 32525 line 13: what is this "new treatment of aerosols" ?

- Page 32525 lines 19-20: how many SW and LW radiation bands ?

- Page 32525 lines 25-28: what are the differences between these cloud liquid and ice IOP parameterizations ? To what extent do they impact the results, knowing that you have run clear-sky simulations ?

- Page 32528 lines 13-14: I did not found the description of IFS aerosols in the introductory part of Sect.2. The work by Morcrette (ECMWF, 2004) is not in the references of the paper.

- Section 2.3.3: how are the aerosols considered by the ACRANEB2 radiation scheme

?

- Page 32531 lines 10-11: why use only output from the first time-step each hour ?

- Page 32531 lines 13-14: three aerosol configurations are mentioned here, while there are four configurations in Table 1. More generally, Table 1 should be clarified, perhaps with more columns with the different options. Clear names should also be given to all simulations.

- Page 32532 lines 3 and 6: "parameterized aerosols IOPs" is not clear to define the simulations.

- Page 32532 lines 6-7: "This was only done using the HLRADIA parametrization". According to Table 1, relative humidity experiments were also run with IFS.

- Page 32532 line 10: "arbitrarily chosen" Could you explain this choice ?

- Page 32532 lines 23-24: It is worth mentioning that the assimilation of AOD is included in the MACC reanalysis. I would say Northeastern Europe instead of "much of Europe".

- Page 32532 line 26: Please give precise values (averages / maxima) when you comment figures.

- Page 32533 lines 12-15: How have you calculated AOD for wavelengths beyond 1020 nm ? The IFS radiation scheme ranges from 185 to 4000 nm, while AERONET measurements only range from 340 to 1020 nm.

- Page 32534 lines 7-10: Please comment also the simulation with Tegen AOD.

- Page 32535 lines 21-23: I think the differences between the radiation schemes are not so "small". It would be interesting to have an idea of the bias of NWP models in terms of surface radiation.

- Section 4.2.1: The sensibility of AOD seems to be dominant in the diffuse radiation, can you comment on that ?

- Page 32536 lines 5-6: Even if the IFS and ACRANEB2 assume “a relative humidity of 0.8 for the climatological land aerosols”, is it possible to make a test with a different assumption ?

- Section 4.2.2 Please add a conclusion to this paragraph.

- Page 32537 lines 10-11: I don’t understand this statement : “in HLRADIA the vertical profile is considered for the heating rates at atmospheric levels”. Please explain.

- Page 32538 lines 26-27: to what extent using “constant relative humidity” and “climatological vertical profiles” is “acceptable” ? There is no comparison to observations in this paper.

- Figure 7: Please clarify the caption.

Interactive comment on Atmos. Chem. Phys. Discuss., 15, 32519, 2015.