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Interactive comment on “The regional aerosol-climate model REMO-HAM” by J.-P. Pietikäinen et al.

Anonymous Referee #1

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Review of "The regional aerosol-climate model REMO-HAM," by J.-P. Pietikainen et al., GMDD, 5, 737-779, 2012.

General Comments

This manuscript describes the development and initial application of a regional aerosol-climate model for a 1-year simulation at two spatial scales over Europe. The model is compared to the global aerosol-climate model ECHAM5-HAM and observations made at four European measurement sites. My overall impression is generally favorable. The manuscript is nicely organized, in that it first describes the model that is its starting point (REMO), then the modifications made to the model, then the application and evaluation.

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However, there are several points that should be clarified, as detailed below. Furthermore, while I recognize that actually using the model to address scientific questions is beyond the scope of this paper, I would like to see some discussion of what scientific questions this model will be able to address. In short, why is this model needed?

Specific Comments

Abstract: It seems contradictory to say that REMO-HAM "includes all of the major aerosol processes" but then to note that total number concentrations are "underestimated due to the missing boundary layer nucleation and online secondary organic aerosol model." Also, it seems that aerosol effects on radiation are not included, so I think this statement needs to be qualified.

Introduction: Please provide some more details for the references given on 741.11–14. Instead of merely listing those papers, say something about what was learned from them, or how they differed from each other. How does the present study build on and differ from that previous work?

In the model description, please clarify which processes are included and which are excluded. On first reading the paper, I thought aerosol direct and semi- direct effects were included in REMO-HAM until I got to 757.25, which implies that modeling the direct effect would be a valuable addition.

Lateral and upper boundary: What is the vertical extent (model top) used for these simulations? How many vertical layers are used? For the comparisons at Jungfraujoch, what model layer corresponded to the pressure observed at the site, and how much does this affect the particle number concentrations?

For the model evaluation, it would be helpful to compare the performance to that of other models, to establish what are expected performance criteria for total particle number. Also, the discussion on page 751 is rather unclear, and unlike the minor technical corrections listed below, really impairs the ability of the reader to understand the

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paper. Here is a suggested partial rephrasing: Although a boundary layer (BL) nucleation scheme has been implemented in the models, this scheme was turned off for these simulations. The absence of BL nucleation may have contributed to the underestimation of particle number at Hyttiala during spring and autumn, which are typical nucleation event times at that site (Dal Maso et al., 2005).

751.17 This is unclear. Do you mean that the number concentration does not differ seasonally? Or does not differ between ECHAM5-HAM and REMO-HAM? On 751.18 the text says that the "except for the nucleation and Aitken mode" the number concentrations does not differ much (between ECHAM5-HAM and REMO-HAM at Hyttiala). But on 751.26 the text says "Unlike at Hyttiala, the nucleation mode concentrations [at Melpitz] differ the most" [between ECHAM5-HAM and REMO-HAM].

Technical Corrections - noted by page and line number

739.7: was → were

739.25-26: "This effect is known as..." or "This is an effect referred to as..." Also, it is usually called the aerosol "semi-direct effect" rather than the "semi-indirect effect".

740.1 insert "The" before "indirect effect is"

740.4-5 reduced -> reduce and prolongs -> prolong

740.20 delete "the" before "nucleation"

741.16 delete "will concentrate to"

742.9: does REMO use a sigma-pressure coordinate system? If so, consider adding "sigma-pressure" after "hybrid".

743.6 "population" should be plural, "populations", or perhaps "modes".

743.9 intermodal

743.13 ...insoluble Aitken, accumulation, and coarse modes, and one soluble...

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743.14 standardize spelling as "sulfate" or "sulphate" throughout the paper

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743.15 "component" should be "components"

743.19 (Jacobson et al., 1996)

743.19-20 Are both of these two water uptake methods used, or does the user select either one method or the other at runtime?

743.26 "committed to" -> "placed in"

744.16 "excluding sea salt and DMS emissions"

744.19-20 "All the emission species...primary emissions." I do not understand what this sentence means. "Primary" species are those which are emitted.

744.21 insert "the" before "marine biosphere"

745.4 delete "being"

745.18 "organic" matter

745.18+ Awkward. Perhaps "With the exception of the fire and fuel sectors, soluble organic matter is emitted as organic carbon and is divided between..."

745.24 mode "parameters". What are these parameters? Perhaps cite Vignati et al. again?

746.6 It is confusing to mention a "new" double-moment scheme and cite a paper from 1996. Also, I think one reference should be sufficient here. "In order to use the information in the stratiform clouds, we implemented the double-moment cloud microphysics scheme of Lohman et al. (2007)."

746.24 crystals

747.25 delete repeated "the"

747.28 what is the spatial resolution of the driving data?

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748.13 "are used as boundary data"

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748.16, 19, and elsewhere: delete "the" before a numbered figure.

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748.16 Figure 1 shows...

748.24 insert "the" before "time period"

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749.23-24 All the longitudes are given in minutes, but they should be in degrees.

749.27 delete "the" before "Differential"

750.1 Condensation Particle Counter (CPC) data was used for total number concentration at Jungraujoch (Collaud Coen et al., 2007, 2011) and at Mace Head (O'Connor et al., 2008).

750.4 insert "a" before "Scanning"

750.13 "From all" -> "Of" and delete repeated "the"

752.11 delete "(The Alps)"

752.19 change "later on" to "in Section x.y".

752.28 starts -> start

754.10 "lead" -> "led"

755.12 delete "the" before "otherwise"

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755.21 "concentrations decrease" or "concentration decreases"

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755.21 "not anymore high enough" should be "no longer high enough" or "too low" or "insufficient"

755.27 "unrealistic" -> "unrealistically" and "with" -> "on the"

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755.28 "another" -> "other"

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756.14 "lowest model layer"

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756.22 "was the same for both simulations"

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756.25 "It should also be mentioned"

757.1 "presentation" -> "representation"

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757.16 "the nudging method" -> "nudging"

757.19 "both models reproduce"

757.21 "Both models have a warm bias"

757.22 "seems to overestimate" -> "overestimates"

757.25 Insert "The" before "direct effect"

758.1 insert "a" before "dry bias"

758.3 delete "more"

758.8 "decreases exponentially" (both words misspelled)

758.18 "The simulations were done"

758.20 "the ECHAM5-HAM simulation"

759.8 "lead" -> "led"

759.11 see comment for 755.21

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759.15 "to" -> "in"

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759.24 "was" -> "were"

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759.25 "CRU observations"

768 "orographies" is misspelled. Change "used domains" to "domains used". Shown on the left hand side is...

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770 Fig. 3. Put the locations as the titles for each panel, as in Fig. 4. Change the legend and/or caption to say that the black line is "measurements" or "observations".

775 Fig. 8. Same comment as above. Also, REMOHAM is missing a hyphen in the legend.

777 Fig. 10 "mean" -> "means"

Interactive comment on Geosci. Model Dev. Discuss., 5, 737, 2012.

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