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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Evaluation of aerosol number concentrations in NorESM with improved nucleation parameterisation" *by* R. Makkonen et al.

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We thank the anonymous referee for suggestions, which have improved the manuscript. We answer the specific questions below. The referee comments are in bold.

Intro: the word demanding is used too many times, please rephrase.

We have replaced the second instance with different wording in the revised manuscript.

Intro: please motivate and highlight why the target of the paper was set to study the relative roles of the two processes on the number concentrations (last para

of Intro).

The motivation to separate secondary and primary aerosol is described in the second-to-last paragraph in the introduction: primary emissions dominate aerosol mass, while secondary aerosol formation likely dominates particle number even in the atmospheric boundary layer.

2.1: Some acronyms (such as NCAR and CPL-7 here, and DMS later) are undefined.

CPL-7 is not an acronym, but rather a short name for the Community Earth System Model (CESM) coupler and version. We have defined the other acronyms in the revised version of the manuscript:

"...developed at the National Center for Atmospheric Research (NCAR)."

"The dimethyl sulfide (DMS) and dust emissions..."

2.1: HAMOCC is not referenced and not explained. NorESM climate response could be very shortly summarized, esp. if it helps to understand simulation deïňĄciencies later.

We have included two references for HAMOCC:

"...and the ocean biogeochemistry HAMburg Ocean Carbon Cycle model HAMOCC (Maier-Reimer, 1993; Maier-Reimer et al., 2005) is coupled to the ocean model."

We have included the following sentence in section 2.1:

"...in terms of climate response and future scenarios (Iversen et al., 2013). According to Bentsen et al. (2013), NorESM underestimates cloudiness by 13-24% (ISCCP and CLOUDSAT, respectively) and continental near-surface temperatures by about 1.1 K globally averaged. The climate sensitivity of NorESM is in the lower range of CMIP5 models (Iversen et al., 2013)."

2.2: "lump together" is not good language. Please rephrase (used also later in the text).

In the revised version of the manuscript, we have rephrased the sentence to:

"The black carbon and organic carbon (OC) associated with biomass burning are emitted to an internally mixed mode."

2.4.3: Please open up and reference "CLOUD"

In the revised manuscript we have written:

"Experiments in CLOUD (Cosmics Leaving Outdoor Droplets) project at CERN (Centre européen pour la recherche nucléaire) have shown..."

3.1: Motivate why ECLIPSE is not used here.

In our approach the evaluation of NorESM was done based on commonly used configurations, also regarding emissions. While additional simulations with different emissions would have been possible, we think that the number of sensitivity runs is already rather large.

3.3, 2nd sentence: something is missing here, please correct.

We have revised the sentence in the revised manuscript to:

"With more vapour available for growth, more nucleated particles will survive to reach the detection limit of the CN counter or the nucleation mode of NorESM."

3.4: the simulation acronyms are rather cryptic and difficult to follow. If possible, try to improve and explain better in a separate Table (as attempted already).

We acknowledge the above comment and understand that it can be difficult for the reader to memorize several simulations acronyms. However, even after reconsideration we think that the selected acronyms are most suitable for our purposes. The acronyms are used mainly for figures and tables, but in the text we have tried to rather describe

the experiments in addition to respective acronyms.

5.2: The text and Figures are not synchronized. Please correct, for instance, by changing the order of appearance of the Figures.

We have changed the order of figures to match the sections in the revised manuscript.

5.2 – 5.5: The validation against different types of observations is very good. Yet, I'd suggest adding a short summary to each sub-chapter to help reader to find the essential result before going into the details.

For the revised manuscript, we have modified the sections to help the reader find the essential result for each category.

Conclusions, 4th para: the word "meteorology" is used a number of times in a slightly odd meaning. Please replace by something more appropriate, such as "atmospheric circulation", or "atmospheric state".

We agree that "atmospheric circulation" would describe the property more suitably than "model meteorology". The paragraph has been modified in the revised manuscript.

Figure 3. The blue dots are very hard to see, please improve.

We have adjusted the colors in the revised manuscript for improved readability.

Figure 12. Try to include the legends for different lines.

For the revised manuscript, we have duplicated the legend (shown in Fig. 5) to figures 6-12 to improve readability.

Interactive comment on Atmos. Chem. Phys. Discuss., 13, 26389, 2013.