**Atmospheric
Chemistry
and Physics
Discussions**

Interactive comment on "Black carbon concentration and deposition estimations in Finland by the regional aerosol-climate model REMO-HAM" *by* A. I. Hienola et al.

Anonymous Referee #2

Received and published: 3 November 2012

The authors describe the performance of the model REMO-HAM with respect to reproducing black carbon concentrations at near surface levels at five Finish measurement stations. In addition, BC deposition over Finland and in particular on snow is calculated. While the structure of the paper is good and the presentation of results nicely done, the frame of this study, meaning the chosen time period and the geographical extension of considered BC emissions, needs justification and the study lacks more thorough interpretation to give the results and interpretations credibility.

General comments
(1) It is unclear why the year 2005 is chosen when only two of the five stations have

data available for this year. Based on Table 2, for the year 2008, all stations have recorded BC data. The authors state (p. 24402, l. 22 ff) that this study is only to be taken quantitatively. What do the authors hope to achieve with this? In which way do the results enhance our understanding of BC concentrations and deposition over Finland especially as long-range transport is not discussed?

(2) It is not clear why emissions outside of Finland and associated analysis on long-range transport (e.g., back trajectories) are neglected.

(3) Regarding the interpretation of the results: Even though the focus is put on BC, reference to the performance of the model with respect to other aerosol chemical species such as e.g., sulfate could be given for comparison and for a more profound interpretation of the results. In sect. 3.1 results are only reported but hardly any interpretation is given. More information regarding the specific sources of measured BC concentrations will help to identify the reason for the discrepancies between observations and model results. Does BC come of fossil fuel combustion or biomass burning? Are measurements of tracers like levoglucosan or potassium available to identify the BC origin? Were there any fires (not only in Finland) detected that are responsible for high BC concentrations? Were certain seasons especially cold generating the need for more domestic heating? In how far does the emission inventory consider these sources and their variance? Some more detailed elaboration on potentially missing sources in the inventory is necessary beyond what is stated in the last sentence of sect. 3.2.2.

Specific Comments
BC and soot are used like synonyms throughout the paper even though they do not refer to identical substances. I recommend sticking to the usage of BC for the scope

of this paper.

p. 24397, l. 11ff: the two major UNEP and WMO reports from 2011 regarding the climate effects of reducing BC emissions should be mentioned. (And please not that BC is not only of interest for atmospheric scientists, it has gained much political and public interest within the last years and especially this year (2012).)

Model description in general: Some more details on the geographical area considered and the vertical resolution are needed.

p. 24400, l. 4: "...although many parts have been..." If these changes are relevant for this study, state them or refer to a respective calculation.

p. 24401 Experimental data: please add information on the location categories of the stations such as urban, semi-urban, rural or remote

p. 24402, l. 10ff: What do you mean? Does this refer to incomplete combustion in general or to respective sources located in the immediate vicinity of the station?

p. 24402, l. 13: The time resolution of 1 minute seems extremely high for BC measurements especially for places like Pallas where no high concentrations are expected.

p. 24403, l. 4: please add "... within the grid cells where the measurement sites are located...". If this is what you were trying to say.

P. 24403, l. 6: CDO mapping tool, either explain or give a reference for the reader who is not familiar with it.

p. 24405, l. 21f: "REMO's constant under-predictive..." More explanation is needed why "suddenly" you refer to the wet removal scheme.

p. 24406, l. 17: include the information on the widths and number of intervals

Fig. 7: write the OVL in each box

p. 24407, l. 3f: move "and the monthly Z-score...." to the next paragraph where you describe the U-test. Include the number of samples that you apply the U-test for so the reader doesn't have to calculate it

p. 24410, l. 5f: "This may hint to ..." the logic is not clear. The authors say that BC is overestimated for this case and then conclude that residential wood-burning might

be missing in the inventory. Please explain what you mean. Also the reference to the domestic heating source appears somewhat out of nowhere. There is no evidence in the data for this as you present it (see comment earlier, if there is potassium or levoglucosan to back up this assumption). This interpretation needs more thorough discussion.

p. 24410, l. 8: "conservatively" what does this mean?

p. 24411, l. 10: "a clean Northern Finland atmosphere, "a statement about the whole tropospheric column cannot be made if only near-surface concentrations are considered. Be more specific here.

p. 24412, l. 15: compare these values to the total emissions and/or concentrations over Finland to put it into context.

Fig. 2: Indicate the year for the model run and the year of measurements for each plot.

Fig. 9 and 10: units for BC are missing

Technical Comments

p. 24396, l. 20f: please rephrase: "...and biomass. Both natural processes and anthropogenic activities are responsible for the emission of BC. Black carbon particles absorb..."

p. 24397, l. 2: replace "assessing and ..." by " resulting in an increase..."

sulfate or sulphate?

Biofuel or bio-fuel?

p. 24400, l. 10: pluralize "... aerosol populations as well as their size-distributions and compositions..."

p. 24401 l. 28: "... (2011) and their locations are presented in Fig. 1."

p. 24402, l. 13: "The time resolution of the instruments..."

p. 24405, l. 15: delete "less-than-perfect"

p. 24405, l. 23f: delete "dangerous"

p. 24405, l 27: delete "attractive"

p. 24409, l. 7: "diagrams"

p. 24009, l. 9: "...represents the 3-h BC average mass concentration."

p. 24410, l. 3: "omnipresent" doesn't work here. Please state more exactly what you mean

p. 24410, l. 5: replace "fact" by "a result that..."

p. 24411, l. 8: replace "the entire Finland" by "the whole country".

p. 24412, l.19: "REMO-HAM"

p. 24412, l. 26f: "... additional information on the agreement between shape and spread of the distributions of modeled and measured data."

Fig. 4: before stars were used for the model, now it's squares...

Fig. 5: caption: "...: model vs measurements."

Fig. 12-14: include info "REMO-HAM for the year 2005"