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Atmospheric Chemistry and Physics Discussions

Interactive comment on "The MetVed model: Development and evaluation of emissions from residential wood combustion at high spatio-temporal resolution in Norway" *by* Henrik Grythe et al.

Anonymous Referee #1

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The paper presents a description and evaluation of the MetVed model, a tool that allows estimating residential wood combustion emissions for Norway at high spatial and temporal resolution. The strength of MetVed is without a doubt in its ability to combine very detailed datasets that allow reducing the uncertainty in the spatio-temporal distribution of residential wood combustion emissions, which play a key role in the PM urban levels. The paper is well written and clear and a good contribution for ACP. The following comments should be taken into account before accepting the paper.

General comments The manuscript should be accompanied by a figure that illus-

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Discussion paper

trates/summarizes the general structure/workflow of the MetVed model (i.e. inputs, main functions, outputs). The amount of information used by the model is quite large, and sometimes it is difficult to follow how all this information is combined (and how the different datasets are supplemented). This figure will be very useful for the reader to understand better how the multiple data are combined to derive hourly gridded emission data.

Emission factors are established for three categories as a function of the appliances (fireplace, old stoves and new stoves). Several studies have shown that emission factors can also largely vary according to the type of wood being burned (e.g. maritime pine, eucalyptus). An example of this are the results obtained in the AIRUSE LIFE project (http://airuse.eu/wp-content/uploads/2013/11/R09_AIRUSE-Emission-factors-for-biomass-burning.pdf). Why the wood type influence is not taken into account in the MetVed model? Is it because only one type of wood is being used in Norway? Or because this information is not available? This topic should be discussed in the paper.

The model estimates emissions for several pollutants (i.e. CO, CH4, PM10, PM25., BC and PAH) but the paper does not mention other species that are also relevant in terms of air quality such as Organic Carbon (OC, only appears in Figure 3.D), NMVOC (which influence the formation of secondary organic aerosols) or NOx or climate change (CO2). Is there a specific reason for that? Are NMVOC and NOx emission from RWC considered when performing the air quality modelling exercise?

When performing the atmospheric dispersion modelling exercise, the MetVed emissions are used as input data to the EPISODE model. It is not clear how EPISODE treats the formation of secondary particles (inorganic and organic), which may have an impact in the modelled PM2.5 concentrations. Also, it is not clear which source apportionment method is used (is it a brute force approach?). Residential wood combustion emissions can contribute considerably to the atmospheric organic aerosol burden, particularly in regions with cooler climates, through both primary emissions and significant

secondary organic aerosols (e.g. https://www.nature.com/articles/srep27881). The formation of SOA due to RWC emissions should be discussed in more detail when evaluating the results. âĂČ Specific comments P4 L19-21: This sentence should be revised. The manuscript clearly states that the authors had to perform a huge work in terms of collecting all the input data required by the model (which in some cases was facilitated through personal communication and not through open data portals). In this sense, the application of the tool to another country/region may not be as versatile and transferable as stated. Similarly, it can not be say that the model can be transferred to other emission sectors. MetVed is explicitly designed to estimate emissions for residential wood combustion emissions. Other emission sources (e.g. traffic) would require other type of input data, algorithms and workflows, that MetVed does not currently include.

P7 L23: Can the MetVed model use gridded outdoor temperature provided by a numerical weather model?

P10 L15: A citation should be added (I recommend Quayle and Diaz (1980)). Quayle RG, Diaz HF. 1980. Heating degree day data applied to residential heating energy consumption. J. Appl. Meteorol. 19 (3): 241–246.

P11 L13: This is not shown in Figure 3.a (comparison of emissions reported by CLRTAP and estimated by MetVed)

P13 L26: Spatial and temporal distribution

P13 L27: Not all the emission inventories used for comparison are Norwergian (i.e. TNO_MACC-iii and EMEP are European emission inventories). Also, it should be stated how subdomain emissions have been derived from the original gridded inventories (e.g. for each subdomain only grid cells completely within the domain have been considered, or all the grid cells with the centroid within the domain, etc.).

P13 L29: EMEP and TNO_MACC-iii are not urban emission inventories. This adjective should be remove in all the discussion.

P14 L1: replace 0.1° by 0.1°x0.1° (and remove 7km, it is not true). Also, add a reference to the EMEP inventory.

P14 L8: Not the same spatial resolution, slightly different (i.e. 0.125°x0.0625°). Also, replace TNO-MACC by TNO_MACC-III

P14 L35: Previously it has been stated that TNO_MACC-iii downscaling is based on population density, not dwelling density.

P15 L27: Add a reference to the EPISODE model.

P15 L29: background concentrations should be replaced by boundary conditions.

P16 L3-8: This information should be moved to the previous section (5)

P16 L23: The correlation improvement is mainly occurring in 3 stations. In the other cases differences are rather small and not statistically significant.

P16 L31: Remove "for the MetVed modelled concentration".

P17 L16-19: What happens in terms of model performance when changing the emission vertical distribution? Is the overestimation observed in Oslo (Table 2) reduced? Maybe this feature (vertical allocation of emission) could be the main reason for the general overestimation of PM2.5.

P20 L1: In terms of emissions, which is the main source contributing to total BC emissions? Considering the low BC fraction used in MetVed, I would think that probably road transport is the main contributor. Then, maybe the uncertainty comes from this emission source. Also, the uncertainty can be related to the BC fraction used in the Metved model.

P20 L25-27: This sentence should be removed. See comment on P4 L19-21.

Figure 1: The text that appears in Figures1.D,E and F is not self-explanatory (should be replaced by other options such as D. Wood burning installations, E. Density of wood

burning installations and F. Share (%) of wood based installations. Also, the legend in Figure 1.E is not specified.

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