

Referee comments to acp-2019-95

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

General comments

The manuscript addresses an important issue regarding air quality, as RWC is a major emission source in many countries with large influence on air quality, exposure and human health. The MetVed model uses a novel approach, including different detailed data sources. It is of high importance that the methodology is applicable in a similar or adapted version for other countries, though depending on the data availability. Verification shows that the model have limitations estimating real life emissions especially in winter, but still the model provide improvements according to other models. The high temporal and spatial resolution supported by the MetVed model allow for detailed air quality modelling, exposure assessment and human health effect estimation.

The manuscript provide a novel approach, that can support and improve the temporal and spatial RWC emissions inventories not only in Norway, and is found to be a valuable input to emissions and air quality studies.

Specific comments

The uncertainty of wood consumption is stated to be below 3 % with reference to SSB, 2018 (p5 l3). Does the authors find this uncertainty level accurate? How is untraded fuelwood handled and how widespread is the private untraded wood for RWC?

Technical corrections

P2 L8 states that NO_x and PM concentrations remain a major concern for human health, but health effects due to air pollution is not restricted to NO_x and PM. This should be clarified.

P2 L11-12: add reference

P2 L13-14: add reference

P3 L1: "In Norway, where there are approximately 3 million individual wood burning installations, and so establishing the emissions from each individual point source constitutes a challenge" should be corrected to "In Norway, where there are approximately 3 million individual wood burning installations, establishing the emissions from each individual point source constitutes a challenge"

P3 L7-8: change "(CLRTAP; (<http://ceip.at/>))" to "(CLRTAP; <http://ceip.at/>)"

P3 L23: could this statement be supported by more references than Timmermans et al., 2013?

P4 L4: change to "...heating demand, which..."

P4 L14: change to "...in Norway, and energy..."

P9 L15-18: you introduce 3 categories (inactive, secondary and primary) of RWC installations, but you only use the latter two categories in the MetVed model as "At the moment, there is no way to establish exactly which of the listed installations are in disuse". Could you extend this part with a description of what is needed to identify inactive installations and if this will be included in an updated version of the model.

P9 L33: it would increase the clarity if the equation is extracted from the text to a separate line with equation numbering. Further, check if the equation is correct or it should be $PE_{HT}=FP_{HT}/N_{HT}$

P11 L10: missing a closing bracket

P11 L25-26: It is not clear from fig. 3d that the CH₄ EF show a general decline, as stated in the text. From the figure it looks as the CH₄ EF is (almost) constant.

P11 L 30-34: The difference between installations newer than 1998 is large between the fire rescue agency and the survey. Has the reason for the difference been evaluated? If the fire rescue data has large uncertainty, it is interesting to know if it is only the case for this parameter and why. If the survey have large uncertainty, e.g. due to limited number of respondents, it should be mentioned if the same survey is used for other information in the MetVed model.

P12 L4: please clarify the method for estimating sales. What is the reason for choosing this methodology and what is the data foundation?

P12 L11: clarify if CLRTAP refer to the Norwegian emissions reported to CLRTAP, as the phrasing can be misinterpreted to refer to the reporting guidelines for CLRTAP, which include EFs for more technologies than new and old.

P12 L20: add reference to figure 4.c

P13 L21-23: consider rephrasing this to make it more easy to read.

P13 L23: change "...MetVed done based..." to "...MetVed is done based..."

P13 L 29: what does NBV refer to? Include a reference.

P14 L13: change to "...Norwegian official emission factors (Tab. 1) is used."

P14 LL 16: change to "...exception. In..."

P14 L21: change to "...EMEP) closely related..."

P 14 L26: change to "...same scale, as..."

P 15 L6: change to "...Trondheim, that has the fourth highest..."

P15 L 17: change to "...Additionally, MetVed considers the dwelling size..."

P 15 L 31: change to "...particle, subject only to..."

P16 L 22: change to "...Compared to NBV emissions, which were calibrated..."

P17 L18-19: change to "When apartment emissions were emitted in the second layer, the surface concentration was reduced to $3.76 \mu\text{g m}^{-3}$, and when smaller buildings emit in the second layer, a further reduction to $3.19 \mu\text{g m}^{-3}$ is observed"

P 18 L 6: change to "...dependence, suggesting that..."

P18 L12: change to "...For most of the air quality stations..."

P18 L16-17: change to "...All urban measurement sites..."

P18 L34: change to "...the region, and the area..."

P19 L3: change to "...other than wood based, which represent..."

P22-24: the layout of references needs to be standardized

P22 L2: include year ("Aasestad, K., 2010:")

P22 L9: correct name format

P22 L13: include year ("Denby, B. R., et al., 2013:")

P23 L34: correct year to 2000

P24 L 8: include year

P27: consider rearranging the maps 1-7 according to the location on the national map

P28:

Figure 3a; consider changing the chart title to "National Norwegian firewood consumption and emissions"

Figure 3c; clarify "EF producer" and "Producers EF"

Figure 3d: change the layout. Not all categories/lines are visible, and it is not possible to distinguish $PM_{2.5}$ and PAH, and CH₄ and PM_{10}

P28: the figure text for figure 3c include errors and must be corrected. The layout of figure 3d should be improved, as different categories are visualized with very similar colors.

P29:

Figure 4a; what do the red and the green dashed lines show?

Figure 4c; it is not clear what the yellow line shows. If it is the wood ovens efficiency, it indicates that the efficiency is decreasing. That doesn't sound correct, as the new stoves are more efficient. P13 L 11-12 seem to describe that the yellow line show the decreasing fuel consumption? Please clarify both in the text and in the figure text.

P29:

Figure 4b; Y-axis % or % change (see L19-20)?

Figure text; weighted by population or number of dwellings (see L18)?

P31: The layout of figure 6a should be improved, as different categories are visualized with very similar colors. E.g. consider to decrease the number of categories (e.g. by leaving out offroad and shipping). Consider to change the order of the categories in the legend to follow the order on the chart. Figure 6 lack indication of a and b.