

Geosci. Model Dev. Discuss., referee comment RC2  
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## Comment on gmd-2021-198

Anonymous Referee #2

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Referee comment on "Downscaling of air pollutants in Europe using uEMEP\_v6" by Qing Mu et al., Geosci. Model Dev. Discuss., <https://doi.org/10.5194/gmd-2021-198-RC2>, 2021

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This publication present a downscaled version of the EMEP model and its application to Europe for air quality pollutants. The topic is very interesting and certainly relevant with respect to the scope of the journal. The methodological approach is sound and the work is well structured and well presented. I list below a few comments.

### Comments:

- The introduction dives directly into the proposed uEMEP downscaling. I would suggest starting with a paragraph to provide some context and explain why we actually need such a downscaling.
- While the Authors state (L107) that "uEMEP downscales only primary pollutants", downscaled results for O<sub>3</sub> are discussed and shown. A few lines to explain how secondary pollutants like O<sub>3</sub> can be downscaled would clarify a possible confusion.
- Orography variations can be important over two 0.1deg grid cells. Can the authors comment on the applicability of their Gaussian approximation to hilly cities?
- A few remarks regarding Table 2:
  - Caption: an region à a region
  - Please add that the region of +/- 0.1 deg also represents 2x2 grid cells.
  - If my understanding is correct, the source column should precise that only primary contributions are considered (e.g. primary traffic...) and that non-local EMEP includes all secondary contributions as well.
  - It is unclear how the non-local EMEP is obtained from the 2x2 EMEP local fractions. If summed up, how is double-counting avoided? Indeed, the non-local fraction of one given cell reaching the neighbouring cell will be counted as non-local while it is actually local within the 2x2 area, right?
- Can the Authors detail the 2x2 grid cell kernel calculation (L48-49)? For an emission located within a given EMEP cell, say near its SW corner, how are these 2x2 cells defined?

## Technical remarks

- L45: even though detailed in other references (listed), some explanations on how the EMEP local fraction is calculated would be helpful in this work.
- L56: Can the authors comment on the height of the first vertical layer (50m). Does this impact the downscaled results?
- L85: Is the split in tiles motivated by CPU gains only or does it improve the efficiency for other aspects?
- L93: "Weights are based on Norwegian average road situations". Can the authors comment on the validity of this assumption when applying it to other countries
- L99: The choice of population as proxy to redistribute residential heating emissions is known to lead to important issues for some cities (as shown later in the document). Is this initial choice related to data availability?
- L171 and L334: The spatial representativeness of some traffic stations, especially those located in street canyons is lower than 25 meters. Can the authors comment on their choice to keep those stations anyway for the comparison?
- L169 and others: Note that the correlation is actually "r" not "r<sup>2</sup>". The latter is referred to as the coefficient of determination. Please adapt the text or figures accordingly.
- Figures 10 and 12: please explain which station or station averages are shown.
- L229: "the" is doubled twice!
- L311: Can the Authors comment on the robustness of this fitting for other years?