Geoscientific Model Development Discussions

Geosci. Model Dev. Discuss., referee comment RC1
https://doi.org/10.5194/gmd-2021-198-RC1, 2021

Comment on gmd-2021-198

Anonymous Referee #1

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-RC1, 2021

General comments

This preprint presents high-resolution air quality modelling at local scale/street level across Europe, performed with the uEMEP_v6 model, which downscales emission input and combines regional calculations with the EMEP model with Gaussian plume modelling of receptor points to obtain annual mean concentrations of NO_2, $PM_{2.5}$, PM_{10} and O_3 in a very high resolution subgrid (down to 100 m resolution). Results presented are comparisons of EMEP and uEMEP model results country by country for Airbase monitoring stations across Europe, as well as sensitivity studies with respect to resolution, weighting of relative traffic distribution, proxies for residential combustion emissions, use of national emission and proxy data with higher detail than the EMEP data, and NO_2 chemistry schemes for the NO_2-NO_x-O_3 reactions. Model results are seen to significantly improve in comparison with measurements, for NO_2 and O_3 when the uEMEP model is applied whereas little improvement for $PM_{2.5}$ and PM_{10} is gained using the downscaling approach.

The manuscript addresses the highly relevant scientific question concerning how to obtain high resolution air quality estimates at the urban scale in an operational way, using publicly available data. The different parts of the methodology are known, but the combination is novel and the uEMEP model tool is potentially extremely useful for air quality and population exposure studies across Europe. The manuscript is well-written and the structure and argumentation of the study is easy to follow with a few minor details that could be clarified (se Specific comments). All model code for the uEMEP model and the visualization tools is publicly available for this study.

Specific comments:

When investigating annual mean values, a rotation symmetric approach for the Gaussion dispersion is used. This implies the assumption that the wind is equally distributed from all directons over a year. In reality these wind distributions will probably be quite different.

Could the authors elaborate on if this rotation symmetric approach is more or less accurate in different locations? And what potential comparisons of the approach to applying actual annual met-data would show?

When the OSM data are applied across Europe, a weighting based on the Norwegian traffic data is used – can the authors elaborate on what this means for the distribution of local emissions in the rest of Europe?

The NO-NO_2-O_3 chemistry for annual mean values is based on a calculation including a frequency distribution of the concentrations of NO, NO_2 and O_3. It is a little unclear from the manuscript, if these frequency distributions are acquired from Norwegian stations only, or if all available measurements from Europe have been taken into account? The dependency on solar input in the photochemical reactions must mean that the frequency distribution will differ across Europe?

The results of the uEMEP calculations correspond to street-level, but the building configuration is not included, and common situations with development of street-canyon circulation vortices are therefore also not taken into account. Can the authors elaborate on what this means for the results at street-level in the large cities with tall and dense building mass?

Regarding $PM_{2.5}$: All annual mean concentrations for (NO_2 and) $PM_{2.5}$ increases when the uEMEP downscaling is applied compared to the EMEP model results. In two countries (Austria and Finland), the EMEP model is already overestimating the $PM_{2.5}$ concentration, and applying the uEMEP model only increases the overestimation. Wouldn't the authors expect that downscaling using proxies would give a more precise result for the distribution, and thereby a more accurate replica of what is observed? Or is there an underlying risk, that uEMEP increases the concentrations in general?

Figure 10: is this results for the whole of Europe, i.e. a mean of all countries?

Figure 11 and 12: It would be good with a little more explanation in the Figure captions, e.g. a note whether this is all of Europe, or only Norway.

Figure 12: the conclusion that the correlation is clearly highest for power law index 1 is putting much trust in the decimals of the correlations. As the numbers are 0.567 (~0.57), 0.574 (~0.57) and 0.557 (~0.56), one could wonder how much the third decimal of the correlation estimate is worth in terms of accuracy?

In the discussion: "Though the problem remains that uEMEP does not take into account

dispersion in street canyons, where a number of traffic site measurements are made, it is generally the case that the spatial representativeness of the uEMEP calculations is suitable for comparison with these measurements." How does the authors know, that this is the case?

Technical comments:

Figure 14: the order of the components is NO_2, $PM_{2.5}$ PM_{10}, but in the text the order of discussion is NO_2, PM_{10} and $PM_{2.5}$. Would be easier to read if the order is the same both places.

Line 315: all five methods are described in suppl,. but in the figure, there are results for 6 methods? Not easy to follow the names of the 6 methods in the text in the manuscript as they are not consistently defined (nor in the supplementary material).

Line 319: "Since the Romberg scheme is specifically designed to reflect measurements, providing the correct NO_2/NO_X ratio, this means that the chemistry schemes are overestimating the NO_2 contribution when applied to annual mean concentrations." It is somewhat difficult to understand what is meant here?

Table 2: within an region – should be: *within* a region

Line 374: verses – should be *versus*

Figure S5: verses – *versus* + include should be – *included*