

Geosci. Model Dev. Discuss., referee comment RC2  
<https://doi.org/10.5194/gmd-2021-52-RC2>, 2021  
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## Comment on gmd-2021-52

Anonymous Referee #2

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Referee comment on "Effect of accounting for public holidays on skills of atmospheric composition model SILAM v.5.7" by Yalda Fatahi et al., Geosci. Model Dev. Discuss., <https://doi.org/10.5194/gmd-2021-52-RC2>, 2021

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This manuscript presents and evaluates an approach to incorporate the effect of public holidays on European air quality models. The methodology consists on a simple technic based on the scaling of primary emissions at the country level when holidays occur. Two hypotheses are tested: a first one in which the levels of emissions during holidays are assumed to be equal to the Sundays ones, and a second one where an 80% emission reduction is considered during holidays. Both approaches are evaluated by comparing modelled results against in-situ observations. As described by the authors in the introduction section, which I find it very detailed and comprehensive, several observations-based studies have already highlighted the effect that specific holidays can have on pollutant concentrations. However, a systematic analysis of the holidays effect from a modelling perspective at the EU scale, as well as the description of a methodology to properly incorporate it into AQ models has not yet been addressed with the same level of detail. Therefore, the topic presented in this manuscript is of interest and represents a good contribution to GMD. Nevertheless, there are several aspects of the manuscript – including methods, evaluation and discussion of the results – that, in my view, are not sufficiently convincing in their current form and should be carefully revised before the manuscript can be accepted for publication.

Major comments:

C1. In one of the sensitivity tests, authors assume an 80% emissions reductions during holidays. Authors already mention in the manuscript that the presented approach should be considered only as a first step. However, I think that the hypothesis made (80% reduction for all sectors considered) should be backed up by the analysis of sectoral related activity data. While it is true that for certain sectors this analysis can be challenging due to the lack of data, for others there is information that can be used for this purpose. In the case of the A\_PublicPower industry sector, authors could use the ENTSO-E transparency platform (<https://transparency.entsoe.eu/>), which reports data on hourly electricity generation by fuel type per country. In the case of F\_RoadTransport, authors could use information on traffic counts reported by national transport agencies, such as the Finish transport agency (<https://vayla.fi/en/transport-network/data/open-data/road-network/tms-data>).

C2. Following with the previous comment, it is questionable that all emissions from the C\_OtherStationaryCombustion sector suffer an 80% reduction during holidays. In the case of PM, between 80 and 90% of total emissions are related to residential wood combustion activities (<https://www.ceip.at/>). Several studies have shown that residential wood combustion activities in Europe tend to increase significantly during weekends when compared to weekdays, as people use this fuel for recreational purposes. Examples of these studies are Krecl et al. (2008) and Athanasopoulou et al. (2017). I would expect a similar behavior during holidays (specially Christmas period), when people spend more of their time at home. The PM10 and PM2.5 spatial scores for Christmas shown in the supplementary material already suggest that with the holiday days considered as Sundays (the HS case) the skills of the model deteriorate (correlation decreases and MB increases). Authors suggest that this could be related to the use of fireworks, which are not accounted in the CAMS emission inventory, but this is not proved in the manuscript.

C3. In the abstract section, authors mention that "Spatial and temporal distributions of atmospheric concentrations of the major air pollutants (PM2.5, PM10, SO2, CO, NO2, NOX, and O3) were considered". However, the analysis, evaluation and discussion of the results is very much focused on NO2. Figures 2 to 7 show NO2 results, while results for CO, O3 and PM2.5 are only shown on Figures 8 and 9 (no results for SO2 or PM10 appear in the main manuscript, only in the supplementary material). A more balanced discussion of all the pollutants considered should be provided (or, alternatively, the pollutants not shown in the main manuscript could be removed from the study). In the case of O3, the discussion is focused on the Christmas period, when O3 levels are very low. Discussions for this pollutant should be focused on Easter. In the case of NO2, time series are shown almost exclusively for stations in the Netherlands (Figures 3,4,5 and 7). Considering that the study is performed at the EU level, it would be interesting to see specific results in other regions.

C4. The same prescribed sector-specific emission diurnal profiles are used for weekdays, weekends and holidays, which is a limitation of the study. Authors mention several times in the text that the incorporation of specific weekend and holidays diurnal profiles should be done when available. However, several works have already reported in the past specific Saturday/Sunday diurnal profiles for the road transport sector, which is the main contributor to total NOx emissions. Examples of these profiles can be found in Pregger et al., (2007); Menut et al. (2012); Mues et al. (2014) and Guevara et al. (2021), among others. Following with the hypothesis made by the authors at the weekly level, the same diurnal profiles proposed for Sundays could be assumed for holidays, at least for the road transport sector. I think this point should be addressed more carefully, and perhaps it would be good to produce an extra AQ run assuming a set of specific weekend/holidays diurnal profiles. This would, for sure, bring an added value to the study.

Other comments:

- In section 2.1 authors mention that they consider events marked with "National holiday", "local holiday" and "common local holiday" when retrieving holiday events from the Calendarific API. I understand that "local holiday" and "common local holiday" refer to holidays that are only occurring in a specific region(s) of the country – while in the rest of the country is a normal working day. Considering that the emission scaling approach proposed is at the country-level, should not only "National holiday" be considered?
- In Table 4 – Meteorological driver, should not be "interpolated to 0.2x0.2" instead of "0.1x0.1"?
- Line 135, define GNFR acronym + revise the number of GNFR sector (it is 16 and not 7. Note that the GNFR\_F sector is split by fuel type)

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