Response to referee comments to the paper Fatahi et al "Effect of accounting for public holidays on skills of atmospheric composition model SILAM v.5.7"

We would like to thank the reviewers for the critical comments to the revised version of the paper. They gave us a fresh look at the manuscript and facilitated its revision. Below we outline the introduced changes and answer to the criticism point-by-point.

Response to the general criticism

Following the advice of the Editor and referring to the generic criticism, we substantially reviewed the presentation of the results making them more specific and removing the obscure pieces:

- we introduced a quantitative criterion of the improvement (section Methods), which stressed the purpose of the exercise: to make the model skills, first of all, bias, more homogeneous in time avoiding / reducing their jumps during holidays. This objective differs from the "default" goal of improving the formal model skills. They coincide in cases of the positive model bias when the lower emission in holidays leads to the skill improvement. But for low-bias regions and episodes, it seems detrimental. Nevertheless, it is still a step in right direction: ignoring the emission reduction due to holidays to get smaller bias is just offsetting one error with another. One needs to disentangle the holiday-related error from the overall under-estimation, so that they can be handled separately. The current paper deals with the former issue.
- having the quantitative measure of improvement, we added and discussed a new Table 5 to the Results section showing the effect for all pollutants and major holidays.
- following the repeated criticism on the individual station's time series, we finally decided to remove those non-representative and/or hard-to-generalize examples.
- the style and language of the text have been reviewed and improved

Specific comments

Reviewer 2

Comment

An earlier comment about the names of the stations in figures 2-7 appears to has been slightly misunderstood. The suggestion was to include the station names (i.e. the station_name field in EEA terminology) rather than the station coordinates as identifier of location, which is not directly useful. Also, please include the types of the stations.

As regards figure 7 and the analysis thereof. This concerns a rural station (thus more likely to have a "background" NO2 component rather than be directly affected by traffic) at the border with Germany. The authors mention in their response to an earlier comment that the corresponding discussion has been expanded to make the interpretation provided clearer, but these changes are not identifiable in the revised manuscript (version 4) in the specific section. In essence, based on the results presented, we have no direct way of positively attributing model (BL)-observation discrepancies seen between Dec 24-29 solely to reduced emissions. E.g. although this justifiably seems to be the case for Dec 25-26, the model-observation discrepancy for Dec 27-29 can only be explained with the additional hypothesis of emissions being influenced further to the formal public holidays. This may be the case to a certain extent (fig 11

seems to suggest such a phenomenon, albeit for a different country and mainly for 2019), but authors should clearly highlight the intricacies of drawing these conclusions based on results at a single station. In other words, it should be underlined that the episodic (i.e. meteorology driven) characteristics of this period complicates the interpretation of those time series, although hints on the impact of emissions are also possibly identifiable.

Response

The individual-stations examples have been criticized in several reviews, primarily for the lack of representativeness and generalization options (every case is indeed specific), so we finally decided to remove them all. The message of the paper is now concentrated on the region-, country-, and Europe-scales, as shown in the Table 5, Figures 2-5 for Europe and Figures 6-8 for regions and countries. The peculiarities of an individual station are of little interest unless they are supported by other stations in the region. We hope that it streamlined the presentation and made it more concise and to the point.

Reviewer 3

Comment:

The impact of the three simulations is shown only for temporal correlation coefficient of hourly NO_2, CO, O_3, and $PM_{2.5}$ concentrations (Figs.8-10) and for NO_2 concentration during Christmas period at one station: NL00107 (Fig.7). Figs. 2-6 show daily statistics for NO_2 concentration only for BL and HS simulations during Christmas, New Year, Easter, May and Ramadan holidays.

The purpose of this study to investigate at EU scale, in a systematic way, the effect of the holidays' emissions on air quality models' predictions is interesting, yet the manuscript does not show in comprehensive and concise manner that. The reader would like to see the impact of emissions on NO_2, CO, O_3, and $PM2.5$ concentrations, at stations and over whole Europe, in the manuscript, not in the supplementary material where specific results at stations can be shown.

Response:

Thank you for the outline of the problems! The new Table 5 now presents the effect for all pollutants and all stations in Europe, in a harmonized quantitative way. The examples of the specific stations have been removed due to their low / unclear representativeness. The effect on individual stations is presented in maps of the Figures 6 and 7 and, in a country-aggregated form, Figure 8.

Comment

The study also does not show and discuss the relation between concentrations and emissions' reductions (HS and R3 scenarios) as a whole and by country as a marker for "regional specifics". Moreover, an evaluation of HS and R3 assumptions at stations, by country and station type can give indications about the value of the hypotheses used globally.

Response

There must be some confusion: the section "Regional specifics" and figures there discuss these very points. The section title has been revised to "Regional specifics of the effect of HS and R3 emission reduction" and changes were introduced into the text to highlight this relation.

Comment

In addition to a more careful analysis of the results, their presentation and discussion should be improved, both for language and rationale.

Response

The paper has been carefully read through correcting the language

Comment

Also not all claims are justified. For example "line 185 The impact of holidays on the SILAM spatial skills was the largest for the Christmas week (Figure 2a)". This comment should be supported by Fig.2 where all the holidays should be shown. As it is, this statement seems to be valid for all pollutants.

Response

The statement is indeed valid for all pollutants, with some reservations for PM. It is now supported by the new Table 5.

Comment

Moreover, an analysis and discussion of results as a function of pollutant type, supported by data and images should be included in the study. For example, intuitively, it is expected that the impact of reductions O3 during spring will be different from winter.

Response

The new Table 5 and related discussion now provide an overview of all pollutant types and highlight the ozone specificity.