

Atmos. Chem. Phys. Discuss., referee comment RC1
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Comment on acp-2021-527

Anonymous Referee #1

Referee comment on "Technical note: Quality assessment of ozone reanalysis products and gap-filling over subarctic Europe for vegetation risk mapping" by Stefanie Falk et al., Atmos. Chem. Phys. Discuss., <https://doi.org/10.5194/acp-2021-527-RC1>, 2021

General comments:

This technical note by Falk et al. assesses the quality of 3 global/regional ozone reanalysis products for 4 (/5) sites in Northern Fennoscandia. It focuses on the representation of the observed ozone climatology and specifically the (well-defined) seasonal cycle. Furthermore, this study illustrates a gap-filling technique for 2 weeks of missing ozone observations and suggests that this gap-filling technique is preferred over the use of ozone reanalysis data.

The science is solid and applied methods such as the gap-filling technique accounting for time-lags between observational sites are appropriate. I am in favor of publication of this paper after the following minor adjustments (specific & minor comments) have been addressed.

Specific comments:

The title suggests a specific focus on biome modeling and ozone risk mapping which is also properly introduced in the Introduction section. However, throughout the rest of the manuscript this focus is lost and is shifted towards a quantitative assessment of the reanalysis products and the gap-filling method with minor discussion points on the further implication on biome modeling and ozone risk mapping. I suggest the authors to revise the title or to, preferably, put additional effort in quantifying the effects of the use of these different reanalysis products (and also gap-filling techniques) on biome modeling. For example: This manuscript shows that the representation of CAMSRA is poor in winter, but

good in summer which coincides with the growing season and maximum in ozone uptake (e.g. Hayes et al. (2019)). The resulting effect on integrated flux quantities such as POD_y might therefore be limited.

It is unclear why specifically these 3 ozone reanalysis products have been chosen to include in this study and other tropospheric ozone reanalysis products such as TCR-2 or JRA-55 have been excluded. See for example Huijnen et al. (2020) and Park et al. (2020) for global and regional application of these reanalysis products including comparisons with CAMSRA respectively. Especially the use of the MACC reanalysis data is questionable. This product has already been identified as less accurate compared to CAMSRA in other studies (e.g. Inness et al. (2019)) and is, as far as I am aware, not supported anymore because it is replaced by the CAMSRA system.

For CAMSRAQ, the period of 2014-2018 is used to compute the daily mean ozone climatologies compared to the period 2003-2012 for the MACC and CAMSRA products. The authors should discuss if and how this relatively short period affects the computed climatologies (also with respect to observations which cover an even longer period) also considering the anomalous summer of 2018 as the authors show in their Fig. 6b.

In the results Section the authors show the divergence of reanalysis products from generalized ozone climatology for northern Fennoscandia spatially (Fig. 4 and accompanied text in line 167-179). The main analysis of this subsection mainly focuses on the seasonal skill scores (from RMSE) which can also be derived from Fig. 3, rather than the spatial patterns in the divergence. Furthermore, the need for presenting these spatial patterns appears to be limited also because they do not play a prominent (if any) role in the Abstract and Conclusions. The authors should more strongly motivate and discuss these spatial patterns or remove Fig. 4 and combine the text with the analysis presented in line 147-166.

Minor comments:

page 1, line 1: "regional or global" -> "regional and global".

page 3, line 74: "such as a" -> "such as".

page 6, Fig. 2 label: "6.6. ppb" -> "6.6 ppb".

page 6, Fig. 2 label: "The magnitude ... late summer". In my opinion this does not belong in a label also because it is repeated in the main text.

page 6, line 140: "In the following". Add subject.

page 7, line 146: "ozone reanalysis product" -> "ozone reanalysis products"

page 7, line 161: "This indicates an insufficient vertical resolution of these models". What is the vertical resolution of these datasets (e.g. the height of the surface layer)? To be included in the methods (Table 2).

page 7, line 166: "observation" -> "observations" or "observed".

page 8, Fig. 3: I suggest using same xticks as in Fig. 2 for better comparison between the two.

page 8, Fig. 3 label: "The global ... low [O₃]." . In my opinion this does not belong in a label also because it is repeated in the main text.

page 8, line 167: The term "tropospheric ozone background" has been used throughout the manuscript (at multiple instances before and after this line). As this study deals with the ground-level ozone climatology I ask the authors to consider the terminology "ground-level ozone background" to avoid ambiguity.

page 9, Fig. 4: The colorbar-label is cut off. For (a) and (b) also the xlabel "Longitude" is cut off just short. For all other Figures the sublabels are located above the panel while for this Figure they are located below the panel. Furthermore, the labels could benefit from some extra dpi if possible.

page 10, line 183-185: "given in ... of ppb". Can be removed.

page 12, line 233: Remove closing bracket.

page 12, line 236: "an RMSE" -> "a RMSE".

page 12, line 239: "Conclusions" -> "Discussion & Conclusions".

References:

Hayes, F., Mills, G., Alonso, R. et al. A Site-Specific Analysis of the Implications of a Changing Ozone Profile and Climate for Stomatal Ozone Fluxes in Europe. *Water Air Soil Pollut* 230, 4 (2019). <https://doi.org/10.1007/s11270-018-4057-x>

Huijnen, V., Miyazaki, K., Flemming, J., Inness, A., Sekiya, T., and Schultz, M. G.: An intercomparison of tropospheric ozone reanalysis products from CAMS, CAMS interim, TCR-1, and TCR-2, *Geosci. Model Dev.*, 13, 1513–1544, <https://doi.org/10.5194/gmd-13-1513-2020>, 2020.

Inness, A., Ades, M., Agustí-Panareda, A., Barré, J., Benedictow, A., Blechschmidt, A.-M., Dominguez, J., Engelen, R., Eskes, H., Flemming, J., Huijnen, V., Jones, L., Kipling, Z., Massart, S., Parrington, M., Peuch, V.-H., Razinger, M., Rémy, S., Schulz, M., and Suttie, M.: The CAMS reanalysis of atmospheric composition, *Atmos. Chem. Phys.*, 19, 3515–3556, <https://doi.org/10.5194/acp-19-3515-2019>, 2019.

Park, S., Son, S.W., Jung, M.I. et al. Evaluation of tropospheric ozone reanalyses with independent ozonesonde observations in East Asia. *Geosci. Lett.* 7, 12 (2020). <https://doi.org/10.1186/s40562-020-00161-9>