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Geoscientific Model Development Discussions
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Interactive comment on "Are contributions of emissions to ozone a matter of scale? – A study using MECO(n) (MESSy v2.50)" *by* Mariano Mertens et al.

Anonymous Referee #2

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This manuscript explores whether the source apportionment of surface ozone would be affected by model resolution. It performed model simulations with the different resolution of the model itself and the emission inventories. The difference in the source apportionment using a self-consistent tagging method is attributed to the model resolution and emission inventory resolution. The topic itself and the self-consistent tagging method are interesting. However, the analyses presented in the manuscript are too useful; the discussion and conclusions are not insightful (or not having any new results as pointed out by Anonymous Reviewer #1). I'd suggest the following items to improve the manuscript.

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Discussion paper

1. better defining the differences between simulations/models, be specific about what processes causing the variations in source apportionment. Here are just a few examples to improve.

(a) Meteorological inputs such as temperature and light are different in some simulations, which would result in different biogenic emissions in methods of ‘on-line calculated’ and ‘calculated by EMAC.’

(b) Same anthropogenic emissions in different resolution might result in the same total emission but large regional differences. How do these emissions differ?

(c) What are actually causing the differences in STE flux in the coarse vs. fine resolution model? Could it be related to on-line vs. off-line meteorology/convections and/or temporal and horizontal averaging of meteorological inputs (just some examples I am familiar with, like in Yu et al. (2018) and Hu et al. (2017); certainly, many other literature on this topic are available)? The contribution from downward transport seems to be the largest differences among models, and it should be quite interesting to explore.

(d) It looks like the total lightning NOx emissions are the same across simulations, do their also have the same 3D distribution?

“Inter-model differences’ should be better defined and documented and can provide insights on the calculated contributions. Specific discussion of these processes rather than vaguely saying because of the resolution would make this paper more useful.

2. the terms used in the manuscript are very confusing for readers from outside the MESSy model community, particularly when referring to the specific simulation. For example, CM50 is used to compare with EMAC, while one refers to the resolution of 50km of one model; the other refers to a different model. ET42 refers to “the MACCity emissions are transformed to the coarse grid of EMAC (T42), to investigate the impact of the resolution of the emission inventory.”, but it sounds like it is done by the COSMO model only, so do all the REF, EBIO, EVEU simulations. Table 2 seems to suggest

that EMAC also has those four simulations. Table 1 is not useful in the context of this manuscript but just adds confusions by adding a bunch of acronyms. This manuscript should not be 'read very much like a technical report for MESSy users' as pointed by the other reviewer. Readability should be improved.

3. this paper could benefit from a section of model evaluation by adding comparisons with observations. This way could suggest which simulations are 'in practice' better and if the model simulations are actually realistic.

4. the metrics used to quantify simulation difference: this manuscript mostly uses the average concentration of ozone and relative contribution of a specific source. These tend only to show minimal differences among simulations; even though the manuscript claims 'up to 20%' in the calculated contribution of transport emissions, the absolute amount is small. One way to improve is looking at the probability distribution of concentrations or contributions, which could be much more useful to examine differences in model chemical pathways and for specific air pollution episodes, i.e., examples like in Fiore et al. (2002) and Yu et al. (2016).

Example literature

Fiore, A. M., Jacob, D. J., Bey, I., Yantosca, R. M., Field, B. D., Fusco, A. C., and Wilkinson, J. G., Background ozone over the United States in summer: Origin, trend, and contribution to pollution episodes, J. Geophys. Res., 107(D15), doi:10.1029/2001JD000982, 2002.

Yu, K., Jacob, D. J., Fisher, J. A., Kim, P. S., Marais, E. A., Miller, C. C., Travis, K. R., Zhu, L., Yantosca, R. M., Sulprizio, M. P., Cohen, R. C., Dibb, J. E., Fried, A., Mikoviny, T., Ryerson, T. B., Wennberg, P. O., and Wisthaler, A.: Sensitivity to grid resolution in the ability of a chemical transport model to simulate observed oxidant chemistry under high-isoprene conditions, Atmos. Chem. Phys., 16, 4369-4378, https://doi.org/10.5194/acp-16-4369-2016, 2016.

Hu, L., D. J. Jacob, X. Liu, Y. Zhang, L. Zhang, P. S. Kim, M. P. Sulprizio, and R. M. Yantosca (2017), Global budget of tropospheric ozone: Evaluating recent model advances with satellite (OMI), aircraft (IAGOS), and ozonesonde observations, Atmospheric Environment, 167, 323-334, doi:https://doi.org/10.1016/j.atmosenv.2017.08.036.

Yu, K., Keller, C. A., Jacob, D. J., Molod, A. M., Eastham, S. D., and Long, M. S.: Errors and improvements in the use of archived meteorological data for chemical transport modeling: an analysis using GEOS-Chem v11-01 driven by GEOS-5 meteorology, Geosci. Model Dev., 11, 305-319, https://doi.org/10.5194/gmd-11-305-2018, 2018.

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