Comment on gmd-2021-264
Anonymous Referee #3

Referee comment on "Description and evaluation of the tropospheric aerosol scheme in the Integrated Forecasting System (IFS-AER, cycle 47R1) of ECMWF" by Samuel Rémy et al., Geosci. Model Dev. Discuss., https://doi.org/10.5194/gmd-2021-264-RC3, 2022

The manuscript from Remy et al presents different updates of the CAMS modelling system for tropospheric aerosols since version 45R1, following up on a similar paper written by Remy et al 2019. Updates concern a range of parameterisations from emissions to deposition and an integration with the tropospheric chemistry scheme in IFS. It contains quite useful details about the system configurations used in the different IFS cycles.

The paper in its current state is a bit difficult to read, not well organised and in parts too vague. I would not like to recommend publication in this form. The results and model descriptions are intertwined to the extent that it is confusing.

My recommendations would be:

- Please make a harmonisation in terms of model simulations used. I believe it would be useful if all three model versions 45R1 and 47R1 and 47R1newdep should be shown for all evaluations and tables. I think also that for some evaluation the period February to December 2017 was used, and for others Jan-Dec 2017. Not sure this change in base time period is useful. Even though results for 45R1 are probably (? I did not check ?) already in Remy 2019, they should also be shown here.

- The model changes should be described first and then evaluation results could be discussed altogether in subsequent chapters.

- The statistical data are presented in four different ways: as maps, as time series, as tables, as histograms. It is not clear why the "style of presentation" changes in the course of the manuscript. It would be good to have the same statistics, eg bias, rmse, r, and mnmb available for all evaluations. This could be a few overview tables or more complete annotations in the figures. This would give substance to the often vague statements in the text on quality. Please make sure statistics are available for all three model versions 45R1 and 47R1 and 47R1newdep.

- from table 5: It looks like 45R1 and 47R1 are run on quite different vertical resolution. Shouldnt that be a major factor in all aerosol budgets? This is not discussed as far as I can see it. If the experiments have been made on different vertical resolution, then the changes in budgets are not just because of the changes parameterisations. This would be
interesting to understand for the budgets and the deposition evaluation.

- In general, I am not clear about whether the integration to the IFS CB05 is activated in all 47R1 experiments with IFS-AER? Does mentioning 47R1 and IFS-AER mean (for the experiments shown in this study) that IFS-CB05 is used for all gas phase chemistry?

specific comments:

- table 5 - I think this table comes a bit late.

- table 2+3: Should be simply combined to one sulfur cycle table. Its a bit confusing this way with two tables.

- table 2: SO2 budget - Its a bit counterintuitive that life time goes up when wet deposition as a process is added. Why did dry deposition go down so much in 47R1?

p9 l2: typo “Grythe14 Grythe”

- table 4: the figure caption is incomplete. What is in brackets? Which cycle is shown? maybe show all?

- p7 l11: 46R1 is discussed but what about 45R1?

- table 5 I think the experiments used in this paper: 45R1 and 47R1 and 47R1newdep without data assimilation should be included in this table to clarify what is used.

-p2 l20 : one year of cycling without data assimilation : I think the missing data assimilation should be commented more . How different is the model as compared to the operational model with data assimilation?

-2.1.1 sulfur => Sulfur

-p3 l29: sinks=> sink

- table 6: Why is the life time changing so much for a given bin and different source functions? Each bin has one size and density. Dry and wet removal should be roughly the same, or?

- figure 3: What is the color in the plots? It looks like all dots are plotted...

- figure 7: typo at end

- p22 l15: Budgets are shown for Feb-Dec but then table 11 says Jan-Dec 2017, what is used ? Why not using Jan-Dec throughout? Is the spinup really needed?