



EGUsphere, referee comment RC1
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Comment on egusphere-2022-873

Anonymous Referee #1

Referee comment on "Global nitrogen and sulfur deposition mapping using a measurement–model fusion approach" by Hannah J. Rubin et al., EGU sphere, <https://doi.org/10.5194/egusphere-2022-873-RC1>, 2022

Review of Rubin et al., submitted to EGU sphere.

Global nitrogen and sulfur budgets using a measurement model fusion approach

This paper aims to make an improved estimate of global total nitrogen and sulfur deposition by fusion of measured and modelled wet and dry deposition. MMF is a powerful method for vastly improving budget of N and S in the atmosphere, and for estimating exposure to ecosystems of deposition. Thus, a paper on the subject, showing the power of the method is very much appreciated.

The manuscript is well written, however, the methods as explained have weaknesses and the final results of the MMF show too weak influence of the observations. The comparison to observations shows too large deviation and it is not clear if it is made with independent observations.

Thus, there is need for improvements to the methods before the manuscript can be accepted for publishing.

The causes for major revision are

- In this work, observed wet deposition is fused with modelled wet deposition. The more common method is to fuse the concentration in precipitation, not wet deposition in itself. Precipitation and wet deposition has a larger variation in space compared to

concentration in precipitation. Fusing the latter would allow for a longer length-scale in the fusion. Precipitation should be applied after the fusion of concentration in precipitation.

- Here the grid resolution (1 degree) was used as maximum length-scale, which is very short (too short) and will cause for in principle only one or a few grid boxes to be influenced by the observation. There was no scientific explanation to the choice of this length-scale, which can be considered too short. The fusion method explained here, was rather used to estimate the observation error within the gridbox, but is that really how it should be done? Is the observation error dependent on the distance of the observation to the middle of the grid box? (answer is NO). The grid centre in the model is not the actual centre but an average of the whole grid.
- The final product shows very little influence from the observations, which is not reasonable to my experience, and a result from the erroneous method. The figures show that the MMM (pure model) and MMF are very similar also in places with dense observations, and the MMF has a large deviation to observations (see e.g. the bias in deposition in China and US).
- The comparison to observations is not clear whether it is by independent or dependent observations, but in whichever case the comparison shows also too weak influence from the observations in the MMF product. It is strange that even in the specific grid box of the observations, the MMF deviate very much to the observed deposition.

For these reasons I recommend that the authors revisit their methods, to improve the MMF results before resubmitting.

For the updated manuscript please also note the following suggestions:

Row 112-116. I suggest not to include datasets in the manuscript that are only promising. There are likely many promising national datasets in the global arena that potentially could be used, and to include all that are not used will be a paper in itself.

Row 136: title: please state MMF procedure

Row 165-166: change to "... include measurements from Asia, Europe and North America, and the dry deposition MMF surface includes measurements from the USA and Asia, ...". Explanation: many parts of the world are not covered for wet deposition either. The phrasing was now overenthusiastic about the coverage of wet deposition observations.

Table 1. row open oceans has values in "non-coastal" but not in "coastal". This does not seem correct to me, it should be the other way around. Are the columns mixed up?

Figures: in general – please label panels a-f etc, it is easier to understand the description if all panels are referred to and labelled.

