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Geoscientific Model Development Editorial Board

Minusio, 3 January 2022

**From emission scenarios to spatially resolved projections with a chain of computationally efficient emulators: MAGICC (v7.5.1) – MESMER (v0.8.3) coupling**

Dear Dr. O'Connor,

Please find enclosed the revised manuscript, the revised supplement, and a tracked changes version of the manuscript. For the answer to the reviewers, we refer to the point-by-point answers we posted in the interactive discussion.

During the revisions, we introduced the following main changes:

1. The discussion and parts of the methods were extended to address the aspects raised by the reviewers (for details, please refer to the point-by-point answer we posted in the interactive discussion).
2. MESMER's current version (v0.8.3) was calibrated using the new stratospheric aerosol optical depth (SAOD) time series employed by the sixth assessment report of the Intergovernmental Panel on Climate Change (IPCC) and all Earth System Model (ESM) runs available in our archive for the 25 ESMs considered in this study to create a new set of emulations. While the new emulations exhibit minor quantitative differences compared to the original emulations, no qualitative findings were affected by these changes. For the analyses carried out in this paper, MESMER v0.8.1 and v0.8.3 lead to identical results. Hence, the small differences in the emulations, which are visible for some ESMs (see e.g., Figs. 3 and 4) can be attributed to the new SAOD time series as well as to the available ESM runs (e.g., an additional scenario became available in our archive for NorESM2-LM).
3. Figure 2 and its caption have been reworked to increase readability.
4. A small bug in the code that derives the data for plotting in the figures comparing different MESMER configurations was removed (the emulation error was mistakenly depicted as zero in some cases in the originally submitted study). Furthermore, the labels in these figures as well the figure captions were rewritten to increase the accuracy of their description.

Additionally, minor changes have been introduced throughout the text to improve text flow and reduce typos. These can all be found within the tracked changes version of the manuscript.

We are confident that the revisions increased the quality of our study.

Yours sincerely,

A handwritten signature in blue ink that reads 'L. Beusch'.

Lea Beusch  
(on behalf of all co-authors)