

Geosci. Model Dev. Discuss., referee comment RC1  
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## Comment on gmd-2022-42

Anonymous Referee #1

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Referee comment on "Improved Advection, Resolution, Performance, and Community Access in the New Generation (Version 13) of the High Performance GEOS-Chem Global Atmospheric Chemistry Model (GCHP)" by Randall V. Martin et al., Geosci. Model Dev. Discuss., <https://doi.org/10.5194/gmd-2022-42-RC1>, 2022

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### General Comments:

The paper outlines the developments under GEOS-Chem version 13 series to increase the accessibility, accuracy, and capabilities of the global atmospheric chemistry model focusing on the new generation high-performance GEOS-Chem (GCHP). Overall, a number of significant improvements are described and quantified spanning the model performance, ease of use, and resolution/accuracy.

The Introduction section provides an overview fundamental concepts with respect to atmospheric composition modelling, with particular focus on Chemical Transport Models and the development of GEOS-Chem.

In general there is a lot of repetition of listing the novelties at the end of the Introduction, again in Section 4 (in particular in Table 1) and in the beginning of different sections (e.g. Sec.7). The paper can be streamlined by making a single listing and then directly going into the details in sub-sections.

Section 6 can perhaps benefit in clarity by being shortened and made more succinct, or even removed altogether/moved to a supplement as it contains software engineering details that are esoteric and may not be of relevance to a general audience, and elaborates on problems of previous releases.

The the end of Sec. 7, some details on what was removed, or a specific reference to the relevant documentation section/site should be added.

Finally, it is proposed to restructure the manuscript to have the very important Sections on the numerical calculations and model quality developments and performance assessment first (Secs.8,9), and then follow with the software engineering (containers, build system) aspects.

### **Specific Comments:**

*Comments are prepended by page and line number of the pre-print.*

p.4 l.101-104: Please consider rephrasing the sentences to make the meaning more clear (in particular the transport processes).

p.6 l.6: Not clear what an "unsatisfied" import is. Please explain briefly in text.

p.6 l.159-161: The paragraph is not providing specific information. Authors could elaborate on specific gaps in ESMF. Does MAPL presently only provide an additional regridding method?

Sec. 3.2: Perhaps a table with a synopsis of the resolution, grid-type, time span/step, for the different analyses would assist the reader.

p.8 l.211: Instead of just stating "20 model days on 2304 cores", the relative improvement on equivalent hardware would better showcase performance gains. Or even better refer to to the relevant Section 7.5 (Fig.3).

p.9. l.257: "The original version of GCHP was implemented as a code repository" - meaning not clear, please rephrase: Do you mean implemented as separate code base?

Fig.4: some results are cut/not visible in the left panel. Though it's clear it's under a minute, the presentation can be improved.

Fig.5 (and Sec.8.1) Is the error in units of Pa or hPa?

p.18 l.485: Can the authors quantify the approximate magnitude of the error/improvement regarding moisture in air mass flux?

**Editorial comments:**

Web addresses should be added as references instead of inline.

p.6 l.168: surface quantities -> surface variables

p.8 l.208: opportunities -> capabilities

p.8 l.212: actual time -> wall-clock time

p.8 l.226: use of winds -> use of wind fields

p.8 l.227: to and from a latitude-longitude grid to and from cubed-sphere grid -> between latitude-longitude and cubed-sphere grids; and similar for restaggering

p.8 l.234: FlexGrid is only for latitude-longitude -> FlexGrid only supports latitude-longitude

p.9 l.237: Remove nimble

Sec. 6 title: Software collaboration -> engineering

p.20 l.501: vector components typo

p.20 l.505: familiar -> straightforward/simple/elementary