Geoscientific Model Development Discussions

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Comment on gmd-2022-42

Mathew Evans (Referee)

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-RC2, 2022

This paper describes recent updates to the "High performance GEOS-Chem" atmospheric chemistry transport model. Some of these updates give updated scientific capacity to the model (stretched grid, improved transport) others are more technical and revolve around the software side of running the model (Cmake/spack, containers, multi-node performance). The paper is a useful reference to both the GEOS-CHem community and more widely the geophysical modelling community.

I think this paper should be published. I make some comments below about potential changes which could improve the paper. I do not need to see the paper before publication.

It might make sense to separate the software engineering sides of the modelling (Cmake, containers, multinode performance) from the "science changes" (stretched grid, improved transport). I think this only involves a reordering of sections and some explanation for the order.

Table 1 seems to do a similar job to text around line 80. These feel a bit redundant.

Figure 3 shows a number of common features of the systems used. Cannon is always slower than Pleiades for a certain number of nodes. It is hard to tell on the log scale of the graph but this appears to be a factor of 2. This seems surprising given the cores per node and clock speed advantages of Cannon and the similarity of interconnect, and file system. It might be useful to provide some commentary on this if there is some understanding of why this is, even if it is speculative.

Figure 6. The units of this seem a bit strange to me. Is this the mass moved across a

vertical grid box in a second ie kg s-1? Pa m^2 s-1 appears to be a slightly complicated set of units for this (Pa m^2 s-1= kg m-2 m^2 s-1= kg s-1).

Figure 7 is very attractive. It also highlights the need for us to be able to simulate the composition of the atmosphere at high resolution. The population-weighted NO2 is half at high resolution than at low. It would probably be worth putting in a sentence or two to emphasise this.

Line 630. Would the authors like to provide a list of processes which would most benefit from increased modularization?

Line 21. Transformative is quite a strong word with probably quite a high bar for use. I might think about dropping that word.