Geoscientific Model Development Discussions

Geosci. Model Dev. Discuss., referee comment RC1
https://doi.org/10.5194/gmd-2021-216-RC1, 2021

Comment on gmd-2021-216

Anonymous Referee #1

Referee comment on "MagIC v5.10: a two-dimensional MPI distribution for pseudo-spectral magnetohydrodynamics simulations in spherical geometry" by Rafael Lago et al., Geosci. Model Dev. Discuss., https://doi.org/10.5194/gmd-2021-216-RC1, 2021

The present paper is an investigation of the parallel performance of the numerical dynamo simulations in a rotating spherical shells for the massively parallel computers using the open source program MagIC. MagIC has been parallelized by the MPI in one direction, and MPI communication in MagIC has been used for switching between the radial domain decomposition and decomposition over spherical harmonics mode, and also parallelized by OpenMP for SMP parallelization. In the present paper, the authors implement two dimensional MPI parallelization to improve parallelization scale and compare the parallel performance with the original 1D-MPI with OpenMP version. As described in the introduction, 2-D parallelization is not new technique, and the present parallelization is the almost same as the parallelization for Calypso and Rayleigh in Matsui *et al.* (2016). However, there is no paper about the technical detail for 2-D MPI parallelization for the spherical dynamo code using Calypso or Rayleigh. Consequently, I recommend to accept the present paper with minor revision. And, I have a few question to the authors.

First, I would like to point out that the present scaling tests are not in the practical range for the productive runs. Dynamo simulations in a rotating spherical shell are performed a few million time steps or even tens thousand steps. The minimum elapsed time is still more than one second in Figure 7, so it suggests that the present model needs approximately 12 days for one million steps. I guess that the practical problem size would be the half of the horizontal resolution for the productive runs. I recommend that the author describe the reason how they choose the spatial resolution and target elapsed time for the productive runs.

Another question is that the authors perform data communications for each radial layer and each scalar component in the 2D parallelization. Calypso and Rayleigh perform these communications with single MPI_ISEND/IRECV or MPI_ALLREDUCEV, respectively. Can authors discuss the advantage of the present communications from Calypso or Rayleigh's approach?

And, SHTns is used in the present study. I wonder if the authors calculate the Legendre polynomials at Gauss-Legendre points in the initialization, or calculate during each

Legendre transforms. I remember that SHTns has both feature, so it would be helpful which approach is chosen and why the authors choose one.

Lastly, the authors defined T_t. However, I can't find any information for T_t in Table 3. Can I find the data from the other table? So, I lost a direction to figure out the following discussion using T_t in page 26. Please provide how to figure out T_t.

And, these are some minor suggestions:

- In line 2, Can 'magnetohydrodynamics' be one word?
- In line 5, I think "parallelization" would be more explicit than "implementation".
- in line 27, "mag" would be capitalized as "MAG" or "Mag"
- In line 65, Full name should be represented for "Non-Uniform Memory Access (NUMA)" first.
- In line 117, It would be better to add dimensionless "self" gravity.
- In equation (14) and (15), the diffusion term appears in the left hand side and right hand side, respectively. I would like to show this term in the same side in the both equations.
- In line 202, I would like to show the equation using $M_l^{\delta t}$ and $B_{lm}{}^t$ below of the equation (17). I looked for the definition of $M_l^{\delta t}$ and $B_{lm}{}^t$ for a while.
- in line 329 and 330, I prefer to say "component" instead of "field", if the scalar "field" includes toroidal and toroidal components for vectors.