General comments:

This manuscript describes the application of the sweep interpolation with fourth-order accuracy in the GEM. As we all know, the interpolation algorithm for the velocity and tracer densities is vital for the semi-Lagrangian method. The authors proposed an elaborate idea of combining two interpolation stencils to cancel the leading errors. The sweep algorithm is efficient as the third-order one but with higher accuracy as the fourth-order one, and it is easy to implement. The numerical experiment results illustrate the efficacy of the sweep interpolation algorithm. I recommend the publication of this manuscript subject to a minor revision.

We would like to extend our sincere appreciation to the reviewer for the positive and constructive feedback on our manuscript. We are pleased to hear that our work on the sweep interpolation algorithm with fourth-order accuracy in the context of GEM has been well-received. We wholeheartedly agree with the reviewer's acknowledgment of the significance of the interpolation algorithm in semi-Lagrangian methods. To emphasize the importance of “sweep interpolation” in “semi-Lagrangian method”, we have slightly revised the title of the paper to “Sweep Interpolation: A Cost Effective Semi-Lagrangian Scheme in the Global Environmental Multiscale Model”. In the following, we address the reviewer’s comments.

Specific comments:

It would be better that some details can be further explained:

- In 2D, there are four possible stencil combinations as shown in Fig. 1 of Mortezazadeh and Wang (2017). Is the selection of forward and backward interpolation stencils related to the parcel characteristic line? Or if the two stencils change according to the backward trajectory?

  The selection of the backward and forward only relates to the time step. As mentioned in the reference paper and the current manuscript, backward and forward interpolation are used in successive time steps, otherwise the truncation error won’t be cancelled every two time steps. For 2D cases, there isonly onepossible stencil combination, backward in x and y directions, and then forward in x and y directions, and this combination is not related to the parcel characteristic line or position.

- The description of the tests is too brief, such as sec. 3.1. Please add more information, such as what the spatial resolution is?

In response to the request for a more detailed description of the tests, particularly in Section 3.1, we have made the necessary additions to enhance the clarity of the paper.
On page 6, we have included additional information about the flow field and grid resolution: "The flow field utilized in this benchmark is positive definite. The spatial resolution used in both horizontal directions is approximately 105 [km] and a time step of 7200 [s] is employed, which yields a maximum value of Courant number of 0.85426."

Furthermore, on page 8, we have added the following: "The horizontal spatial resolution and time step used in this example are, respectively, 205 km and 3600s, which yields a horizontal Courant number (CFL) of 5.0."

- Why the total mass of sweep scheme is decreasing, while cubic scheme is increasing in Fig. 5.

In response to the above question regarding the differences between cubic and sweep interpolations in the atmospheric methane-like tracer test case (Figure 5b) and the reasons behind these differences, we have added the following explanation:

"Although sweep interpolation was able to better control the mass error growth over the simulation time compared to the cubic interpolation for this case, it is not necessarily expected to perform better in all cases. Based on our discussion in the previous section, we expect sweep interpolation to provide almost the same accuracy as cubic interpolation. This is supported by Fig 5(b), which shows that sweep and cubic interpolations produce mass errors that are of the same order of magnitude. However, since both methods rely on different finite difference approximations, we expect to see differences in the evolutions of their respective error trends, which is confirmed by the results of Fig. 5(b)."

Technical corrections:

L77: The variable staggering in the vertical direction is the Charney-Phillips grid, so it should not be the Arackawa-C grid in the vertical direction.

To answer this comment and to provide further clarification, we modified the paper accordingly:

"The governing equations are formulated using spherical coordinates together with a log-hydrostatic pressure type terrain following vertical coordinate (Husain et al., 2020). They are discretized on an Arakawa C grid (Arakawa, 1988) in the horizontal, whereas in the vertical direction, they are discretized using a Charney–Phillips grid. Tracer transport is accomplished by first solving the advection equation for a passive tracer and then by adding contributions from physics forcings in split mode. The current interpolation scheme in GEM is fourth-order-accurate cubic Lagrange interpolation. It is used to calculate the variables at the departure point, as well as to perform the exchange of data on the boundaries of the two sub-grids of the global Yin-Yang grid. In this study, we document the impact of using sweep interpolation for the advection of tracers as well as for the exchange of data between Yin and Yang subgrids in GEM."

L83: "sub grids" to "subgrids"

Thank you for the comment. We have modified the word accordingly.

L116: " ,on 1D" to ", along the 1D direction"?

Thanks, the modification has been applied.