Author's Response

I would like to express my sincere gratitude to Dr. Jones (Reviewer 1) for his continuous, patient, and highly valuable feedback throughout the review process of this paper. I am also deeply grateful to Reviewer 2 for their constructive comments on the manuscript, particularly for bringing the recent relevant literature to my attention, which has greatly helped to contextualize and strengthen the scope of this study.

Since Reviewer 1 has recommended the acceptance of this article in its current form, the following sections provide my point-by-point responses exclusively to the comments raised by Reviewer 2.

Response to the Reviewer comments (2)

In Section 2.2, around line 130, the manuscript states that modern implementations formulate the relevant inner products in three-dimensional Euclidean space to obtain coordinate-invariant expressions, citing Ullrich et al. (2009). This discussion could be strengthened by also citing recent work on closed-form face-level geometry for spherical polygons. For example, Chen et al. (2026) provide formulas for the mass centroid, first moment, and area of arbitrary spherical polygonal faces, including boundary-integral expressions for great-circle polygons and correction terms for constant-latitude edges. This reference would help clarify the distinction between the coordinate-invariant mass centroid of a spherical face and the pivot longitude introduced later, which is a metric-weighted reference coordinate for the longitudinal second-order moment.

I highly appreciate the reviewer for bringing this important and recent literature. I agree that incorporating this reference significantly strengthens the theoretical distinction between a purely geometric mass centroid and our proposed pivot longitude. Following your suggestion, I have inserted the Chen et al. (2026) citations at two appropriate locations to maximize clarity:

- I added a sentence noting that Chen et al. (2026) summarize a variation of 'face centerpoints' and provide formulas for the mass centroid (L121).

This directly helps to clarify the distinction between a coordinate-invariant physical mass centroid and the metric-weighted reference coordinate introduced in this study.

- I also cited Chen et al. (2026) alongside Ullrich et al. (2009) to highlight recent advances in closed-form geometry, providing a sharp contrast to J99's maintenance of the formulation on the spherical coordinate framework (L134).

The discussion around line 270 is difficult to follow because it moves from the RLL-grid case to unstructured source grids without explaining the connection. The preceding discussion focuses on regular latitude-longitude cells, where the mid-longitude offset can coincide with the pivot longitude and reduce or eliminate the inconsistency. Unstructured source grids are a different geometric setting, often represented by general spherical polygons with great-circle-arc edges. If the intended point is that CDO users cannot encounter this issue for unstructured source grids because REMAPCON2 is unavailable, this should be stated directly. Otherwise, the paragraph may suggest that the RLL-specific cancellation also applies to unstructured grids, which would require justification.

I agree with the reviewer that the previous transition to unstructured grids was abrupt and potentially misleading regarding the generalization of the RLL-specific error cancellation. The intended point was precisely that CDO users using unstructured source grids do not encounter this inconsistency because the `REMAPCON2` command is natively unavailable for unstructured settings. To eliminate any ambiguity and follow your explicit guidance, I have rewritten the paragraph to state this directly (around L273).

Around line 290, the manuscript mentions possible inaccuracies in J99/SCRIP intersection computation, but the type of inaccuracy is unclear. Please clarify whether this refers to the geometric treatment of edge types, such as great-circle versus constant-latitude edges, or to floating-point robustness in edge-edge intersections. This distinction

matters because the experiments are intended to isolate sensitivity to inconsistent reference longitudes. If overlap-construction errors are also present, it may be difficult to attribute the observed errors to the longitude-offset issue alone. Chen et al. (2026) may be useful here, as they discuss robust spherical edge-edge intersections for different edge types and common sources of numerical error.

Yes, I agree. The inaccuracy stated by the original author (Dr. Jones) can be checked at `https://doi.org/10.5194/egusphere-2024-1101-RC2`, the open discussion. The problem is that the computation of intersections is based on a linear expression of longitude and latitude. Therefore, it concerns the geometric treatment of edge types rather than floating-point robustness, which represents a known limitation of SCRIP for general cases.

I have revised the paragraph around (L298) to state that the above inaccuracies are for general grid system, and the experiment in the present study avoids this issue.

I have also inserted a paragraph in the remarks section (L505) as follows:

- Referencing Chen et al., I now explicitly mention that there are geometric edge-type treatments (e.g., parametric cell sides vs. general grid systems) and numerical issues like floating-point robustness in edge-edge intersections.
- I explicitly stated that all experiments in the present paper adopt highly simplified RLL grid systems specifically to avoid such overlap-construction or edge-type errors.
- I also added a caveat noting that in general applications where overlap-construction errors are present, their impacts can influence the remapping results even more significantly than the longitude-offset issue discussed here.

As a minor comment, the manuscript could be more compact. The contribution is a focused correction to the J99/SCRIP second-order conservative remapping formulation, but the central point only becomes fully clear in Sections 2.2 and 2.3. Stating the main goal ear-

lier and shortening some background or derivational material would make the structure clearer and better highlight the proposed correction.

I completely agree that the central point became less immediate due to the length of the background and derivational material. The initial version of this work was relatively focused and compact. However, as documented in the open discussion of the previous submission stage (not current one but 2024 version that was withdrawn), I incorporated extensive experiments to satisfy the requirements raised by a previous referee. Given this track record, completely removing this material now would risk compromising the comprehensiveness required to address those publicly available comments.

Nevertheless, I fully accept your constructive feedback regarding clarity. To resolve this trade-off without deleting the necessary context, I have revised the manuscript as follows:

- Stated the main goal earlier and specified the sections: I have rewritten the final part of the Introduction. It now explicitly states the primary objective and clearly guides the reader by specifying the exact sections where the core correction is formulated.

By restructuring the paper to clarify the specific roadmap at the very beginning, I believe I have successfully restored the focus on the contribution while still honoring the extensive background required by the cumulative peer-review process.