Response to Reviewer 2

Review of "Symmetric Equations on the Surface of a Sphere as Used by Model GISS:IB"

Manuscript ID: gmd-2018-126
Title: Symmetric Equations on the Surface of a Sphere as Used by Model GISS:IB
Authors: Gary L. Russell, David H. Rind, and Jeffrey Jonas
Recommendation: accept after minor revisions

Summary:

This study propose a new methodology to represent two-dimensional flow on a sphere. Reinterpretting previous studies, the approach in this study use specific angular momentum on the unit sphere and avoid problems associated with singularities in effect. The authors provided applications for some vector calculus and the shallow water equations. They also performed standard test simulations for the shallow water equations and compared with other schemes.

The manuscript is generally well written and organized, though some typos and lacks of descriptions are found. The presented methodology gives the concise and elegant representation of the shallow water equations on a sphere, and it is valuable for the GMD readers. Although the practical advantage of the proposed representation are not evaluated, it seems suitable that this point be addressed in further studies.

Therefore, I recommend the acceptance after minor revisions.

Comments:
1. Page 2, Line 11:
Replace "Putman and Lin" with "Putman and Lin (2007)."
Manuscript modified.

2. Page 3, Line 4–6:
It is easier to read if what among/between the similarities and differences are discussed is specified.
Similarities now state "(he again uses u cos phi)" and differences are stated in the next sentence. Manuscript modified.

3. Page 3, Line 17:

Replace "[]" with "()."
Manuscript modified appropriately.

4. Page 5, Line 6–8:
Can we derive Eq. (2.5) only from the forementioned relationships?
The more easily understood formula for A in Eq. 2.5 is now mentioned first. The more complicated formula for S in Eq. 2.6 is simply computed as AxP. Paragraphs 2 and 3 of Section 2.1 are appropriately modified in the manuscript.

5. Page 6, Eq. (2.11)
Place a period at the end of the line.
Manuscript modified.

6. Page 6, Line 10:
Something should be missed in the last sentence.
"=" is replaced with "is". Manuscript modified.

7. Page 6, Line 13–14:
The numbering of the faces are not shown in Fig. 1. Additionally, I am not sure that the way of description of order is common, whereas I can guess it.
The legend of Fig. 1 states that the upper diagram relates to north polar Face 1; faces are numbered in the lower diagram. [No change to manuscript.]

8. Figure 2:
Please specify what the grid level 2.
"Grid level" is defined in the second sentence of Section 3.5. Although Fig. 2 is first mentioned in the last sentence of Section 2.1, there is no necessity to discuss "grid level" at this point. [No change to manuscript.]

9. Page 20, Line 7–8:
Please add descriptions about the reasons for the observed facts.
The desired explanations are added to the final paragraph of Section 4.1: "All of the symmetric equation models use some amount of upstream advection of momentum. This causes a continual loss of total energy and of structure to the prognostic variables, and is the reason for the continual degradation of the l2 norms in time. The Arakawa B grid and C grid schemes are designed to approximately conserve total energy." Manuscript modified.

10. Page 20, Line 19:
Please insert the year number for the reference.

Manuscript modified.