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Geoscientific Model Development Discussions

Interactive comment on "Non-singular spherical harmonic expressions of geomagnetic vector and gradient tensor fields in the local north-oriented reference frame" *by* J. Du et al.

Anonymous Referee #2

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This paper provides new expressions for the gradient, the double-gradient, and some elements of the triple-gradient tensors that are stable at the poles in the local-north frame. Calculations of the gradient and double-gradient are provided for two field models. Unless one is performing a global analysis that includes data at or very near the poles, then I see the impact of this paper as limited. However, the paper still provides a useful alternative to the standard gradient and double-gradient formulae and should be published, but with more emphasis on comparison with the standard formulae. Too much effort is spent talking about the usefulness of gradients. This is not a paper about convincing people to use gradients, it is a paper about using new, better formulae than the standard ones.

GENERAL COMMENTS:

1) Given that the expressions are stable at the poles, are there any other advantages in using them? I ask this because, as stated earlier, unless one is doing a global analysis that includes data at the poles, can't you just rotate the underlying spherical coordinate system such that the pole is no longer in the area of interest, which means you can use the standard expressions? Are the new expressions less computationally intensive? Do they require less storage?

2) Even in the case where I want to compute the gradient and double-gradient at the poles, can't I rotate the coordinate system around the polar axis to eliminate the problems with 1/sin(theta)? If so, why use your new expressions?

3) Tables 1 and 2 and Figures 1 and 2 are fairly useless given that you should be showing the superiority of your new expressions over the standards. Therefore, you should have similar tables and figures for the standard expressions, being sure to show the polar neighborhoods in which the standard expressions begin to degrade. Furthermore, why have you not included polar projections in Figures 1 and 2 since this is the most important area for comparison? Also, you do not need to show two field models, just show either Figure 1 or 2.

4) At the poles you (arbitrarily) define x_p and y_p to be aligned along some meridians and you show the smoothness of the functions across the poles when approached along these meridians in Figure 3. However, what happens if you approach the poles from an arbitrary meridian? Are the functions still smooth?

Interactive comment on Geosci. Model Dev. Discuss., 7, 8477, 2014.