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Geoscientific Model Development Discussions

Interactive comment on "Ellipsoids (v1.0): 3D Magnetic modelling of ellipsoidal bodies" *by* Diego Takahashi Tomazella and Vanderlei C. Oliveira Jr.

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Dear Dr. Clark,

First, we would like to thank you for reading and reviewing our manuscript, as well as thank you for all the constructive comments made in this discussion.

Indeed, there is no original mathematical breakthrough about ellipsoid modelling in our manuscript, but a review of a disperse literature that has been published since the

second half of the nineteenth century.

The response for the specific comments:

1 - *On line 5 "only finite bodies" might be better than "only bodies".*

Thank you, we have included the word "finite".

2 - *Line 27. The geoscientific community does indeed lack a FREE easy-to-use-tool for ellipsoid modelling, but commercial software packages (which are not cheap), such as Tensor Research's ModelVision or GSS Potent, include ellipsoid modelling.*

Thank you for your review. We have included a sentence pointing out the absence of free softwares for the magnetic modelling of ellipsoidal bodies.

3 - *I think it is worth pointing out to the readers that there is a fundamental non-uniqueness of ellipsoidal sources, analogous to the equivalence of concentric spheres with the same magnetic moment. As pointed out by Clark (2014), co-located confocal ellipsoids with the same total magnetic moment vector produce identical anomalies. As the size of the equivalent ellipsoid increases, while maintaining the positions of the foci, its eccentricity decreases. Note that this does not imply, for isotropic susceptibility without remanence, that confocal ellipsoids with appropriately scaled susceptibilities will produce identical anomalies, unless the geomagnetic field happens to lie along one of the principal axes. If the field is oblique to the axes, then the deflection of the induced magnetization due to shape anisotropy will vary, depending on the size of the ellipsoid. In practice, the presence of remanence or anisotropy introduces uncertainty into interpretation of the orientation and axial ratios of the ellipsoid from its total magnetic moment.*

This is a very good suggestion. We have included a new section presenting a discussion about this ambiguity and also included a numerical simulation illustrating its effect.

The code for generating the results presented in this new section can be found at:

http://nbviewer.jupyter.org/github/pinga-lab/magnetic-ellipsoid/blob/master/code/confocal_triaxial_ellipsoids.ipynb

4 - *It would be a simple matter to include remanence into the model. I recommend this for a future version.*

Actually, the remanence is already included in our code. Although we have not included in the manuscript a numerical test illustrating an ellipsoid with remanence, we have created some cookbooks that can be found at the online repository:

http://nbviewer.jupyter.org/github/pinga-lab/magnetic-ellipsoid/blob/master/code/Cookbook_triaxial.ipynb

http://nbviewer.jupyter.org/github/pinga-lab/magnetic-ellipsoid/blob/master/code/Cookbook_prolate.ipynb

http://nbviewer.jupyter.org/github/pinga-lab/magnetic-ellipsoid/blob/master/code/Cookbook_oblate.ipynb

These notebooks illustrate the field produced by triaxial, prolate and oblate ellipsoids with remanence. We could include, in the manuscript, a section showing these cookbooks.

5 - *Perhaps a future version could also generalize the model to consider ellipsoids immersed in a permeable medium. Stratton (2007) gives formulas that could be used for this.*

Thank you for your suggestion. We will consider this in a future version of our code.

Please also note the supplement to this comment:
http://www.geosci-model-dev-discuss.net/gmd-2017-44/gmd-2017-44-AC1-supplement.pdf

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