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Nonlinear Processes in Geophysics
Discussions
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Interactive comment on "Estimation of the total magnetization direction of approximately spherical bodies" *by* V. C. Oliveira Jr. et al.

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We would like to thank Referee J. Ebbing for his constructive comments. Below we present our comments on his recommendations.

General comments

Referee's comment: *"First, the magnetization direction of the spherical body is inverted and afterwards the magnetization of the prism to study the error introduced by a non-spherical geometry. But at the same time the inclination and declination are changed, so that no direct comparison with the inversion for the spherical body is possible. I would suggest inverting first for the same parameters, but by only changing geometry and in the second step changing inclination and declination more drastically compared*

to the applied inducing field. If the method is supposed to be able to resolve remanent magnetization, it would be interesting to see how the method performs for anomalies with reversed magnetization."

Thank you very much. To adress this recommendation, we have applied our method to estimate the magnetization direction of two synthetic bodies with the same magnetization and different geometries. The first one is a sphere with radius $R = 2000\,m$ and the second synthetic body is a cube with length side $R = 2000\,m$. The centers of these two synthetic bodies are located at the same Cartesian coordinates $x_0 = 0\,m$, $y_0 = 0\,m$ and $z_0 = 2000\,m$. They also have the same magnetization vector with inclination $-9.5°$, declination $-167°$ and intensity $3.5\,A/m$. The simulated geomagnetic field has inclination $9.5°$ and declination $13°$. Note that the synthetic bodies have reversed magnetization. The total-field anomaly produced by these bodies were calculated on the same regular grid with constant vertical coordinate $z = -150\,m$. These data were corrupted with a pseudo-random Gaussian noise of null mean and standard deviation $5\,nT$.

We obtained the estimated inclinations $\hat{I} = -9.49770° \pm 0.00036°$ and $\tilde{I} = -9.50764° \pm 0.01022°$ and declinations $\hat{D} = -167.01021° \pm 0.00069°$ and $\tilde{D} = -166.98518° \pm 0.07527°$ for the synthetic sphere. For the synthetic cube, we obtained the estimated inclinations $\hat{I} = -9.58948° \pm 0.00026°$ and $\tilde{I} = -8.86599° \pm 0.00876°$ and declinations $\hat{D} = -164.57023° \pm 0.00049°$ and $\tilde{D} = -167.34047° \pm 0.01028°$. The caret (^) and tilde (~) denote the results computed by using, respectively, the least-squares and robust estimates. These results show the good performance of our method in retrieving the true magnetization direction of the sphere and the cube. The direct comparison between these results shows the robustness of our method in estimating the magnetization of non-spherical sources. The numerical code used to produce these results can be found here.

Specific comments

Interactive comment on Nonlin. Processes Geophys. Discuss., 1, 1465, 2014.