Modelling of the Earth's lithosphere using satellite data

By

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Summary

The current work makes use of the geometrical configuration of the two lower-altitude Swarm satellites (Swarm A and C), moving side by side with a longitudinal distance of 1.4°, to estimate a two-dimensional (2D) model of the lithospheric magnetic anomaly field over Egypt using gradient data. It processed 8 years (from January 2014 to August 2021) of magnetic data recorded by this constellation. The gradient in both the north–south and the east–west directions have been inverted using the weighted damping least-squares fit technique to estimate the best model coefficients of the 2D model. The best model coefficients have been obtained under the expansion of the Legendre polynomial from degree $n = 7$ to $n = 56$. Results showed that the gradient data is smother and less noisy than the observed data. Also, it showed that the gradient of the field in the north–south direction is always much smoother than the gradient of the east–west direction conditions. The noise in the east–west direction is attributed to the different environmental surrounding both satellites. The modeled field always showed smoother variations than the observed data, even for the horizontal components (B_x and B_y). Finally, the Total Horizontal Gradient (THG) has calculated to determine the lithospheric boundaries and the edges of magnetic sources for mapping the subsurface geological structures. The thesis is organized in six chapters: Chapter 1 gives basic information about the solar activity, the geomagnetic activity, and the main sources of the earth magnetic field, in addition to external sources. Chapter 2 shows the definition of the lithosphere, satellites and the magnetic anomaly field, satellites geomagnetic measurement, and the contribution of the magnetic field of the Earth. Chapter 3 gives information and examples about the external magnetic, global and local magnetic field models. It explains the inverse theory and shows how to using the data to create a model. Chapter 4 presents the data set and the selection criteria. Chapter 5 shows a theoretical discussion of the modelling techniques. Chapter 6 presents the results of the observed gradient data, weighted and non-weighted method in addition the THG.