The Fermi Function performance in geomagnetic data inversion

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We present a method for inversion of geomagnetic data for 3-D source's magnetization modeling based on a generalization of the well known Fermi Distribution Function. This procedure does not need any preliminary information besides the definition of the prismatic volume containing the source involved in the calculation. Every additional knowledge about the depth and the dimension of the source or its average magnetization can be introduced as modeling initial conditions, locking the corresponding parameters. The working volume is divided into an array composed of a fixed number of prismatic cells imposed by the user, generally larger than the available number of sampled field points. We avoid the algebraic non-uniqueness problem by considering an over-determined system, in which the magnetization is described by an appropriate 11-parameter distribution function. We suppose that demagnetization effects are negligible, but our algorithm is able in working also in the case of remanent magnetization.

The maximization of the likelihood function is obtained through a Levenberg-Marqardt algorithm for non-linear fit, using a FORTRAN 77 code running under a Linux OS on a desktop PC. We test the algorithm on some synthetic examples, and finally we model an off-shore anomaly surveyed at NW of Elba Island. The result of Capraia-Elba geomagnetic anomaly shows a deep body characterized by structure, orientation and magnetization of the same kind of the structural ophiolitic line of Elba Island – Levanto – Ottone – Varzi basal rocks.

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