Geophysical Research Abstracts
Vol. 21, EGU2019-2634, 2019
EGU General Assembly 2019

UXO Detection by Multiscale Potential Field Methods

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The choice of an effective interpretative methodology in terms of management costs, timing, reliability, safety and efficiency is a key issue for the identification of Unexploded Ordnance (UXO). We present a study aimed at the identification and characterization of buried UXO in Rohoznik-Studienka, Slovakia, by a multiscale analysis on high-resolution magnetic data. The area is located close to a former army shooting range and is characterized by several buried UXO.
When a UXO hits the ground but does not explode, the impact causes a re-organization of the magnetic domains within the armature (shock demagnetization). Due to shock demagnetization the object gets a remanent magnetization oriented in the direction of the actual Earth magnetic field. Furthermore, the elongated shape of the UXO of Studienka causes their anomalies to be oriented along the longitudinal axis of the projectiles.
Our multiscale analysis was performed through methods such as Depth from Extreme Points (DEXP) and the Multi-ridge method. The upward continuation employed by these two methods allowed reducing the influence of the high-frequency noise related to non-UXO buried iron objects. Also, the use of high-order derivatives in the multiscale approach decreased interference effects related to close-by sources and avoided any pre-filtering.
For our analyses we employed a structural index value of 2.5, which was estimated through the Derivative Euler Deconvolution algorithm.
Both depth-estimation methods proved to be effective and rapid with respect to more expensive methods such as inversion. Our analysis revealed average depths for the analyzed UXOs matching rather well with what was found by subsequent excavations, with a maximum discrepancy of a few centimeters.