Three-dimensional inversion of magnetic resonance sounding (mrs) for groundwater detection

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For this paper, we consider the resulting 3-D inversion using inversion modeling, which is motivated by developing theory and the recent application of the Magnetic Resonance Sounding (MRS) technique in detecting and mapping of subsurface groundwater. MRS is a non-invasive method which directly detects the groundwater's existence from surface measurements. A pulse current, at a proper frequency, is transmitted into a loop. After hydrogen atoms of water molecules in the subsurface are energized by pulses of alternative currents, the magnetic resonance field is produced by the H protons is measured within the same loop. Generally, MRS has two observable factors: initial amplitude and decay time. The aim of three-dimensional inversion is to extract the information, i.e., the value and distribution of two physical parameters of the subsurface conditions: water content and subsurface properties (pore and grain size). Additionally, we present a general formulation for inverting the initial amplitude and decay time of the MRS data to recover a 3-D distribution of groundwater. The forward problem was solved using an integral equation method in the spatial domain. An improved Levenberg-Marquardt strategy was employed to solve the inverse problem. Two synthetic examples are illustrated to determine the basic functionality of the inversion algorithm. The real data results show applicability and relevance in larger-scale field examples.