

Ground Penetrating Radar Attenuation Expressions in Shallow Groundwater Research

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Abstract

The electromagnetic-wave attenuation coefficient determines the overall resolution and effective penetration depth of ground penetrating radar (GPR) surveys. Despite this relevance to the design of proper GPR surveys, the attenuation expressions are rarely used in the applied shallow groundwater research (SGR) literature. This work examines the status of the attenuation expressions in SGR. For this, 73 GPR case studies (in 47 papers), including some information concerning the attenuation variables and parameters, were selected to build a database. From these, 18 cases (in 10 papers) provided attenuation expressions and only 11 cases (in 4 papers) used those expressions. Two types of expressions were identified, physically based global ones that try to solve a broad (but not complete) range of environmental and field technical conditions, and non-global ones adapted for specific geological environments and resolution needed. The database analysis showed that both global and non-global expressions were used exclusively in low-loss media to report an attenuation range of 0.1-21.5 dB m⁻¹ by using common antenna frequencies in the 25-900 MHz range. The range of the attenuation expressions validity in SGR is biased because no surveys in variable-loss heterogeneous media and wider antenna frequency intervals could be compiled. The attenuation database generated seeks to improve the design of GPR surveys in SGR.

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