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Application of Geophysical Methods in the Identification of Contaminated Areas in Urban Environments: Challenges and Perspectives.

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Introduction

The characterization of contaminated areas is a key topic in environmental geophysics, being extremely important for urban planning, risk management and land rehabilitation. Geophysical methods are widely used for due to their ability to provide continuous, non-invasive information about the subsurface, enabling the detection of contamination plumes anomalies. This paper discusses the main geophysical methods employed in environmental studies and focuses the challenges encountered in urban areas. It also proposes integrated approaches and operational strategies to overcome the limitations imposed by these complex environments.

Method and/or Theory

This study aimed to characterize the geophysical signals of the presence of different contaminants using the following methods:

• Electrical resistivity (ERT): this method detects the electrical parameters of the current flow in the subsoil.
• Induced polarization (IP): measures the chargeability of the subsoil through the voltage decay of an induced current.
• Electromagnetic induction electronics (EM): uses electromagnetic induction to study the electrical properties of the subsoil.
• Magnetometry (MAG): analysis of variations in the Earth's magnetic field, focusing on crustal sources where it is possible to assess the presence of underground metallic materials.
• Gamma spectrometry (GAMA): method that measures the concentration of radioactive elements in the soil to identify potentially contaminated areas or areas with a high concentration of radionuclides.
• Ground penetrating radar (GPR): uses radio waves to create images of the subsurface based on the contrast of the subsoil's electrical properties.

Results and Conclusions

Each geophysical method used in environmental studies has specific advantages and limitations that must be considered in relation to the environmental conditions and the objectives of the study. In soil contaminations studies, all geophysical methods indicate that anomalous locations (with contamination) may be related to potential sources in the saturated and unsaturated zones. This identifies the possible presence of contamination in soil and groundwater (plumes). It is therefore also possible to define the points of greatest concentration and the extent to which the contamination plume extends towards the company boundary, in line with the local flow direction. The different methods presented here have different resolutions and investigation scales, enabling classification of the types of contaminants by the geophysical signal employed.

Keywords: contaminated areas, environmental geophysics, geophysical methods, urban environment, contaminants.