1D MODELLING AND INVERSION OF FREQUENCY-DOMAIN ELECTROMAGNETIC (FDEM) DATA AT A FORMER COAL TAR REFINERY

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Modern multi-offset FDEM devices enable apparent electrical conductivity-depth soundings and the application of fast 1D inversion techniques to extract quantitative information about modelled soil layers. Understanding the contribution of electromagnetic induction (EMI) devices accuracy, orientation, acquisition mode and the 1D inversion limits at noisy urban sites is a key step for estimating contaminated volumes using additional geophysical data. To develop a measurement protocol, we conducted a bi-oriented and bimodal (vertical coplanar - VCP - and horizontal coplanar coils - HCP) FDEM survey at a former coal tar refinery site at the Ile Lacroix Island at Rouen, France. Borehole log analysis, Time Domain Reflectometry (TDR) measurements of electrical conductivity on soil samples, groundwater (GW) electrical conductivity probes (Figure A), and an Electrical Resistivity Tomography (ERT) survey (Figure B) helped to design a three-layer (urban fill, aquifer layer and clay) model for the 1D EMI inversion (Figure C). The 1D inversion results (only VCP in-line and broadside presented) show a global correlation between Total Hydrocarbon level (THC) and electrical conductivity (σ_1) of the modelled fill layer (Figure C). The contaminated area is clearly discriminated following the French standards ([THC] < 500mg/kg). The failure of the 1D inversion (data residual>2 for an error bar of 10%) and the apparent anisotropy suggest the presence of 3D structures (hatched zones on Figure C). Moreover, the in-phase ratio imaged possible metallic structures in the East portion of the site (not shown here). A principal component analysis of EMI data versus THC levels is in progress to summarize the data spatial correlation and decouple the clay layer and GW level effects. The summarized factors will integrate a geostatistical framework to evaluate the contribution of EMI data for a better contaminated volume estimation.