k-Means Clustering of geophysical tomographic data for landfill characterization

Ester Piegari\(^1\), Giorgio De Donno\(^2\), and Valeria Paoletti\(^1\)
\(^1\)Dipartimento di Scienze della Terra, dell’Ambiente e delle Risorse, Università degli Studi di Napoli Federico II, Naples, Italy (ester.piegari@unina.it, valeria.paoletti@unina.it)
\(^2\)Dipartimento di Ingegneria Civile Edile e Ambientale, Università di Roma “Sapienza”, Rome, Italy (giorgio.dedonno@uniroma1.it)

The detection and imaging of landfills is a challenging task for geophysical methods because major pitfalls may arise, in such complex areas, from the speculative interpretation of geophysical anomalies as geological or antrophic features. In fact, when we face a multi-layered scenario, with numerous resistive to conductive transitions (that is the case of landfills), the actual shape and position of the anomalies (e.g. due to leachate accumulation) can be biased. The use of electrical resistivity tomography (ERT) in combination with the induced-polarization (IP) method, can help in this sense, even though may be not sufficient to completely remove ambiguities in interpretation of inverted models.

In this work, we present an application of an unsupervised machine learning k-means algorithm to ERT and IP data acquired in two urban waste disposal sites. The aim of the cluster analysis is to reduce the ambiguity on geophysical model interpretation and to improve the accuracy on detection of anomalous zones related to leachate accumulation. Experimental 2D field data were firstly inverted separately for resistivity and chargeability, using a Gauss-Newton algorithm. Then, joint 2D sections were obtained using k-means clustering of electrical resistivity, chargeability and normalized chargeability (chargeability divided by the resistivity) data. The retrieved model sections provide a quantitative integration of distinct geophysical data, which can offer new perspectives for the characterization of leachate distribution in landfills.