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Development of a methodology to constrain hydrodynamic models by time-lapse ERT monitoring: Application to leachate flow into waste landfills

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Leachate recirculation is a key process in the operation of municipal solid waste landfills as bioreactors. To ensure optimal water content distribution, bioreactor operators need tools to design leachate injection systems. Prediction of leachate flow by subsurface flow modelling could provide useful information for the design of such systems. However, hydrodynamic models require additional data to constrain them and to assess hydrodynamic parameters.

Many studies have shown that time-lapse ERT monitoring is a suitable method to study infiltration flow into a porous medium at the field scale. It can provide spatially distributed information which is useful for constraining hydrodynamic models. However, this geophysical method does not allow ERT users to directly measure water content. To avoid the use of empirical petrophysical relationships for the study of infiltration flow by time-lapse ERT, Audebert et al. [2014] developed the MICS ("multiple inversions and clustering strategy") methodology, which is based on a razor-sharp delimitation of the infiltration area on the time-lapse ERT results.

The aim of this study is to propose a new methodology to constrain hydrodynamic models from the infiltration shape delimited by MICS on the ERT results. This methodology could improve the understanding of infiltration flow into porous medium, such as waste landfills.

Time-lapse ERT field data are used to estimate infiltration shape and volume affected by infiltration using MICS. Then the subsurface flow model is run using a wide range of hydrodynamic parameters. Finally, the range of hydrodynamic parameters is constrained to those for which the infiltration shapes obtained by subsurface flow modelling and extracted with MICS are in good agreement.

This methodology is applied to both single and dual continuum hydrodynamic models to compare their ability to reproduce hydrodynamic information obtained with MICS at the field scale and consequently to improve the understanding of leachate flow into waste porous medium. Finally, the constraint methodology has been developed in this study to improve the understanding of leachate flow into the waste porous medium. Future research could be considered in applying this methodology for the study of infiltration into porous medium, such as fractured medium for example.