Evaluating the evolution of vapor intrusion pathways using electrical resistance tomography in heterogeneously-packed intermediate-scale sand tank tests

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Abstract. Volatilization of organic compounds can produce vapor plumes in the subsurface that can migrate into nearby buildings. Mass transfer of harmful compounds can occur through these subsurface pathways, reducing indoor air quality below minimum air quality standards. This process is known as vapor intrusion (VI). Experimental investigations have shown that the evolution of VI pathways can be affected by surface events such as precipitation or irrigation. We have developed a series of intermediate scale two-dimensional sand tank tests designed to investigate the complex interactions of soil moisture content and VI pathway evolution through a novel application of electrical resistivity tomography (ERT). The purpose of our study is to evaluate the performance of ERT in characterizing the moisture content and lithologic composition of the shallow subsurface under various saturation conditions, thus identifying potential VI pathways. By utilizing a network of moisture and temperature sensors along with well-characterized laboratory sands, we were able to develop two-dimensional moisture and lithologic profiles based on hard analytic data to compare against our observed soft ERT data.
Initial laboratory findings suggest that ERT can distinguish saturated fine sand layers versus course sand layers. However, as the soil water content decreases, the performance of ERT decreases significantly. ERT shows promise as a novel application for site characterization of VI pathways using soft geophysics, however, further studies investigating the limitations of ERT in low-moisture heterogeneous environments is needed. After developing ERT characterization methodologies in the laboratory, our next phase of research will involve up-scaling this method to field conditions.

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