Monitoring internal erosion in embankment dams using 3D Electrical Resistivity Tomography: Älvkarleby test embankment dam

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One major risk threatening embankment dam integrity is internal erosion of the core. Occurring internal erosion progresses inside the dam structure, but it is difficult to detect with conventional methods. Electrical Resistivity Tomography (ERT) is a potential-based method that can sense the interior of the dam. Leaking zones are typically reflected by larger variations in temperature and total dissolved solids (TDS). Such variations in the reservoir water create resistivity variations inside the dam as the water seeps through the dam body. This study aims to evaluate the capability of ERT as a complementary monitoring technique for discovering unwanted processes such as internal erosion. A test embankment dam with some simulated defects incorporated inside the core and fine filter in Älvkarleby, Sweden has been constructed with the purpose of assessing different monitoring systems including ERT. Buried electrodes and a measurement sequence of around 11'000 data points on a daily basis have been used since around two years ago. The collected data were inverted using a 3D time-lapse inversion model implemented in the pyGIMLI/pyBERT package. The inversion model was partly successful in finding the locations of 3 out of 6 defects. The defects made of crushed rock (Defect 2 & 3) and concrete (Defect 4) in the core were discovered except for the crushed rock zone at the abutment (Defect 5). The defect in the fine filter and a defect made of wood (Defect 1) in the core were not detected. Unintentional anomalous zones, that at least in one case can be associated with other sensor installations, were also detected.

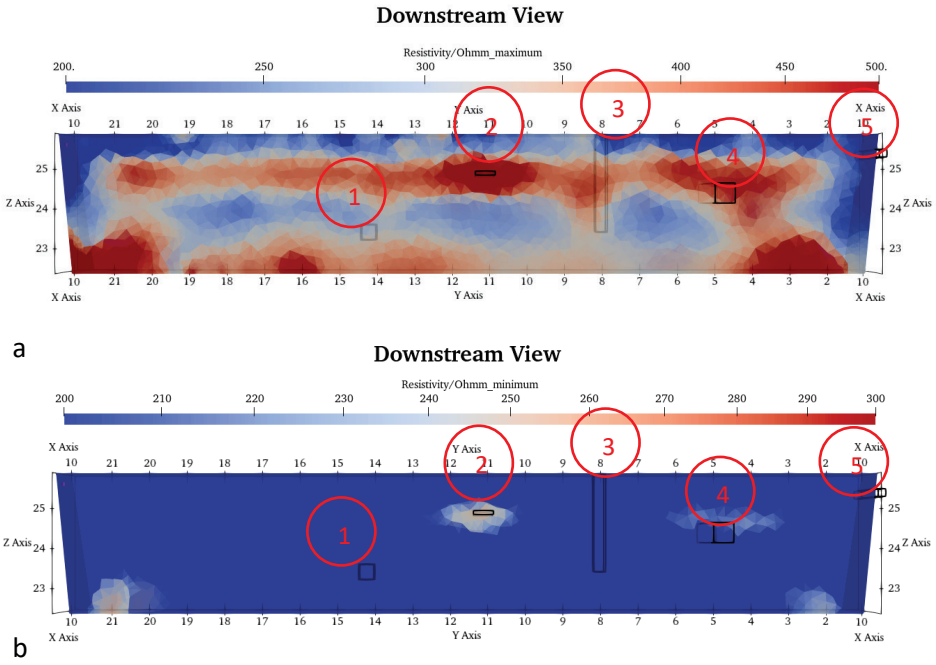

Figure: a) The maximum value of the inverted resistivity through the whole period (from 2019-12-12 to 2022-01-28) for weekly basis data sets; b) The minimum value of the inverted resistivity through the whole period (from 2019-12-12 to 2022-01-28) for weekly basis data sets.