



## **Subsurface imaging of flood embankment erosional-piping collapse using a combined MASW and ERI approach**

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In recent years, non-destructive investigations and management of civil engineering structures is increasingly improving, and assessments are now supported by national and international standards. However, the literature on the applicability of different geophysical techniques to the problem of levee and river embankment monitoring is still limited. Accurate flood levee embankment stability assessment is critically important because embankments and earth dams are subject to water infiltration and internal erosion, which may lead to mechanical weakness and breaching. This study includes a 2D analysis of the instability of an earthen levee, using multichannel analysis of surface waves (MASW) and electrical resistivity imaging (ERI), along with direct observations of the site engineering geology and geomorphology. Both the modeled  $V_s$  and  $\Omega$  indicate a horizontally-layered subsurface with rapid vertical transitions in both stiffness and conductivity. This conclusion is supported by a covariance analysis of  $V_s$  and  $\Omega$  at varying depths and chainages along the levee. Together with a geomorphic assessment, this indicates that the structure is being destabilized by water infiltration, which is causing erosional-piping, leading to surface subsidence. While the key reason for applying various types of geophysical methods to embankment stability assessment is to undertake a safety examination of the embankment, a secondary reason is to compare and contrast the efficacy of the geophysical methods. To this end, it was found that the integration of covariance analysis of 2D geophysical datasets, alongside sedimentary and topographic data, can help the rapid location of anomalous zones in sub-levee soils between geotechnical boreholes.