EVALUATION OF MISSISSIPPI RIVER VALLEY LEVEE CLAY BLANKET THICKNESS USING CLUSTER ANALYSIS ON AIRBORNE ELECTROMAGNETIC DATA

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The U.S. Geological Survey (USGS), in cooperation with the U.S. Army Corps of Engineers, contracted an airborne electromagnetic (AEM) survey of select levee reaches along the Mississippi and Arkansas Rivers to map the thickness of the surficial, fine-grained blanket that underlies the levees. The levee reaches surveyed extend from Cape Girardeau, Missouri to south of Baton Rouge, Louisiana on the Mississippi River and from Pine Bluff, Arkansas to Beulah, Mississippi on the Arkansas River. This natural “clay blanket” deposit is typically comprised of clay, silt, and silty sand backswamp or floodplain deposits and is important to levee integrity by controlling underseepage of river water during high water events. For Mississippi River Valley levees, clay blanket thicknesses of less than 6 m generally require impervious berms to be constructed up to 91 m outward from the landside toe. The survey was flown along three profiles paralleling the levee centerline for a total of 5,896 line-kilometers. AEM data were acquired with the Resolve frequency-domain instrument measuring six frequencies (400 to 140,000 Hz) of in-phase and quadrature data. We ran a laterally constrained inversion with a model spacing of 10-m along flightlines. We determined that assigning resistivity value thresholds to create a blanket thickness isopach map would not capture many of the nuances in the resistivity structure that may have engineering importance. To provide a product for geotechnical engineers with potentially limited experience with resistivity data interpretation, we developed a GIS-based reconnaissance tool for visualizing spatial variability of resistivity structures using a commercially available *k-means* clustering algorithm. We identified an optimum number of cluster classes that defined the upper 15 m resistivity structures (coincident with the maximum depth of cone penetrometer tests) and allowed for grouping into four categories based on the surface layer characteristic: (1) thick fine-grained, (2) thin fine-grained, (3) thin coarse-grained, and (4) thick/very coarse-grained. We developed geospatial layers that link the depth-dependent mapped cluster class and profile section images, allowing areas with a thinner clay blanket to be identified and enable follow-up geotechnical evaluations.