LEVee ASSessmenT in the Sacramento Delta using SEISMIC and electrical Resistivity Methods

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A levee in the Sacramento Delta, California, USA, was surveyed using seismic surface wave and electrical resistivity methods. The levee surrounds an island and prevents it from flooding. A layer of peat ~ 5 meters thick was the native, surficial, soil unit prior to construction of the levee. The goal of this work was to develop tools for assessing levee vulnerability based on geophysical properties such as seismic S-wave velocity, an effective proxy for stiffness. One of the basic products is a 2D velocity profile, oriented parallel to the levee, which provides information on spatial variability in both the vertical and horizontal directions.

Three separate segments of the levee with distinct characteristics, each ~ 1000 meters long, were selected for study. At one location, the levee was built across a natural tidal channel. At another, the levee is adjacent to a cut made in the early 20th century and the underlying peat is unusually thick. The final location is at the site of a breach and major repair of the levee. Coincident seismic and electrical resistivity surveys were conducted at the three locations.

Seismic surface wave surveys were carried out using both active and passive methods. Active surveys were conducted along the top and base of the levee using a 24-channel land streamer and 40 kg impact source. Passive surveys were performed along the base of the levee using nodal (cableless) seismographs with 2 Hz phones. Data from the different surveys were merged to extend the depth range. S-wave velocity profiles through the levee body reveal a decrease in S-wave velocity at the base of the levee due to the presence of peat. The levee body consists of fill that is stiffer than the underlying peat and organic clay. Lateral variations in S-wave velocity of the levee body along the length of the levee may be summarized using time-averaged velocity to the base of the levee, typically ~ 3 meters deep.

Electrical resistivity surveys were performed using a towed capacitively-coupled dipole system with four receivers. Resistivity surveys were conducted at both the top and base of the levee at same locations as the seismic surveys.