DETECTION OF SOIL PIPES USING REFRACTION SEISMICS

Md Abdus Samad, Leti T. Wodajo, Parsa Bakhtiari Rad, Md Lal Mamud, Craig J. Hickey, National Center for Physical Acoustics (NCPA), University of Mississippi, MS, USA

Soil erosion is considered a great challenge for soil management and its impact on agri-food production. Although surface processes of soil erosion (wind, water, ice and snow) are well discussed, the role of subsurface processes (internal soil pipes) are often underestimated. The primary reason being a lack of information or direct observations of soil pipes. In this study, the feasibility of using P and S wave seismic refraction information to identify soil pipes is discussed. Seismic wave velocity measurements depend on the ratio of elastic moduli to the density of the soil. In theory, the S wave velocity of a soil pipe should be zero since fluids have zero shear modulus. For an air-filled soil pipe the expected P wave velocity is approximately 340 m/s. Two seismic surveys were conducted in a small area of the Goodwin Creek experimental site that is characterized by extensive soil pipes. The study consisted of two survey lines located between gully windows and oriented perpendicular to the maximum slope of the ground. Each line consisted of 32 3C geophones at a spacing of 40cm for a profile length of 12.4. The source (small hammer) locations were located off the ends of the line and in between each geophone. The processing was carried out using Rayfract 4.01. A smooth average filter with a width of 8 milliseconds was used to remove the distortion of the first arrival due to airwaves. A total of 1056 arrival times for all shot-receiver combinations were used. The velocity tomograms were generated using the wavepath eikonal traveltime (WET) inversion at 62.5 Hz with the new wave path-dependent velocity smoothing algorithm (Chen & Zelt, 2017). Individual soil pipes were not detected using this approach. However, P wave and S wave velocity tomograms show three distinct velocity zones. Invasive cone penetrologger measurements were conducted along both survey lines. The low velocity of P and S wave from the refraction survey coincide with low penetration resistance of cone penetrologger. The low velocity layer was identified as the soil pipe affected zone.

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