

Estimation of Wetting Front Depth using Time-Lapse Multi-Offset Gathers Obtained from Array Antenna GPR

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A surface array ground penetrating radar (GPR) system was used to estimate the wetting front depth during an infiltration experiment conducted at an experimental field near Tottori Sand Dune, Japan. The array GPR system used in this study consists with 10 transmitting antennas (Tx) and 11 receiving antennas (Rx) aligned horizontally and scans 110 different antenna combinations in less than 1.5 seconds. Common-offset gather (COG) and common mid-point data (CMP) were reconstructed from the time-lapse multi-offset gather (MOG) collected during the infiltration experiment. During the measurement, the array antenna position was fixed to ensure data reproducibility. There have been few studies that used CMP data collected from the array GPR system for further velocity analysis. In this study, electromagnetic (EM) wave velocity structure was estimated from the reconstructed CMP data every 1 minute by fitting the hyperbola equation. Using the estimated EM wave velocity, the depth to the wetting front was computed. The estimated wetting front arrival time agree well with the time when the sudden increase in the soil dielectric constant measured independently with a soil moisture sensor was observed at the depth below 20 cm. This study demonstrates that the array GPR system is capable of tracking the depth to the continuously moving wettingfront.

Keywords: Ground penetrating radar, EM wave velocity