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地中レーダを用いた地中灌漑における土中水分の非破壊計測
Non-destructive measurement of soil water content under sub-surface irrigation using ground penetrating radar

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In 2010, there are more than 6.9 billion people in the world. The world population has been quadrupling for the past 100 years. It is indispensable to increase foods product to this population increase. In arid regions where solar energy is abundant, the high production is expected if the water resource can be secured enough.

In the arid regions high-performance irrigation systems are necessary to reduce to amount of water used in agriculture. Among common irrigation systems, subsurface irrigation is known to increase the water use efficiency dramatically by decreasing the water loss from the ground surface. For effective design and management of these systems, non-destructive methods to observe changes in water contents in soils need to be developed. Ground penetrating radar (GPR), one of the geophysical methods for subsurface measurement, has been used to observe subsurface water contents non-destructively using electromagnetic waves.

The main objective of this study was to measure the soil water content distribution under subsurface irrigation using GPR. In this study, experiments were conducted using a lysimeter (1.2m x 0.6m x 0.8m) filled with river sands. An irrigation pipe was placed at a depth of 20 cm to supply water at a given head for one hour. A GPR system (1 GHz central frequency) used for subsurface environment measurement. GPR profiling data were collected a) every five minutes for an hour while irrigating and, b) 1, 2, 3, 4, and 23 hours after irrigation was ceased. For the ground truth, we measured water content using gravimetric sampling at before irrigation and 23 hours after irrigation.

As a result of the GPR measurement, before the irrigation, average water content was 0.018 to the depth of irrigation pipe and 0.013 to the bottom. After 23hours the irrigation, water content was 0.038 and 0.033 in the same zone respectively. Compared with sampling data, both were corresponding. Immediately after the irrigation, the electromagnetic wave velocity to the irrigation pipe was slower than other time. It is reflected that was higher water content. And after irrigation, GPR measurements were able to show the movement of water infiltration front by the change the position of reflected wave.

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