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Ground-penetrating radar for temporal soil moisture variability analysis along a land slope

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Knowledge of temporal surface soil moisture variability is an useful key in agriculture, surface hydrology and meteorology. In that respect, ground-penetrating radar (GPR) is a non-invasive and promising tool for high resolution and large scale characterization. In the case of quantitative analysis, off-ground GPR signal modeling and full-waveform inversion has shown a great potential during the last decade. In this research, we applied GPR in an agricultural field with different hillslopes along a 300 m single transect for more than 6 months. The 200-2000 MHz TEM-horn antenna situated 1.1 m above the ground, connected to a VNA was used as an off-ground frequency domain GPR. The accurate positioning was done using a differential GPS. All the systems were mounted on a 4-wheel vehicle for continuous scanning. Calibration the antenna and using the GPR signal inversion permitted to the ground surface relative dielectric permittivity. Topp's model was used for transformation of the relative dielectric permittivity to the soil moisture. The temporal stability of the field-average soil moisture was computed by indicators based on the relative difference of the soil moisture to the field-average. The results showed a good correlation (-0.754) for temporal stability of soil moisture and slope variability.