

# Monitoring Temperate Forest Soil Moisture Dynamics Using Ground-Penetrating Radar



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## Introduction

Ground-penetrating radar (GPR) methodologies for evaluating soil moisture dynamics are still being developed. In this project, time-lapse GPR data was collected before and after a heavy rain event and used to generate two-dimensional soil profiles. Feature comparisons of these images along with time-domain reflectometry (TDR) measurements were used to evaluate changes in soil moisture conditions during the sampling period.

## Methods

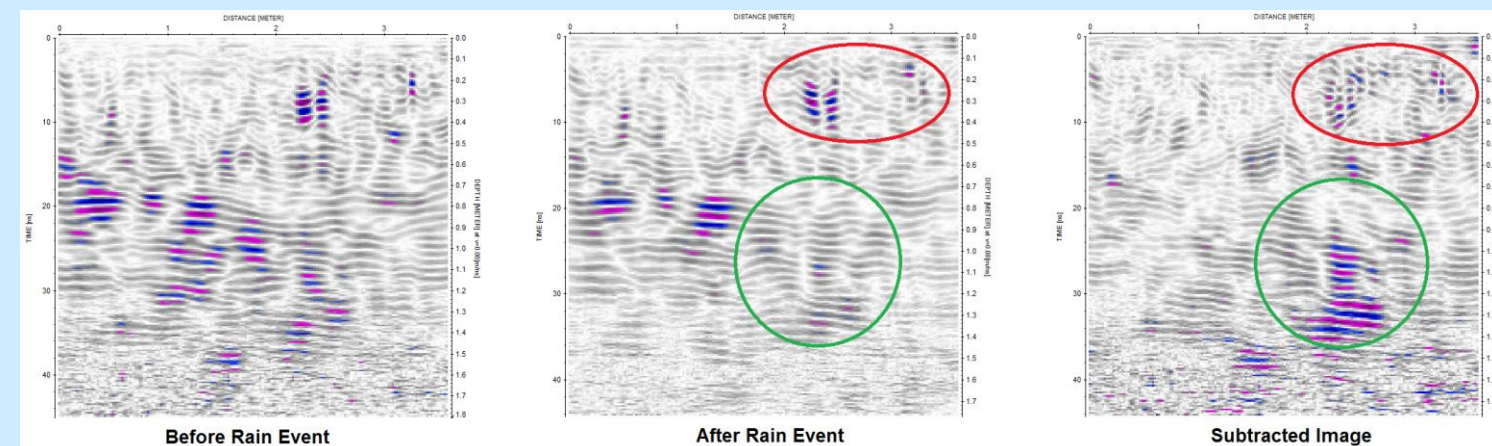
A 500-Mhz bistatic set of GPR transducers was configured with a wheel-mounted odometer to survey the test site. Collected data was processed to remove surface reflections and background noise while augmenting return from subsurface features.



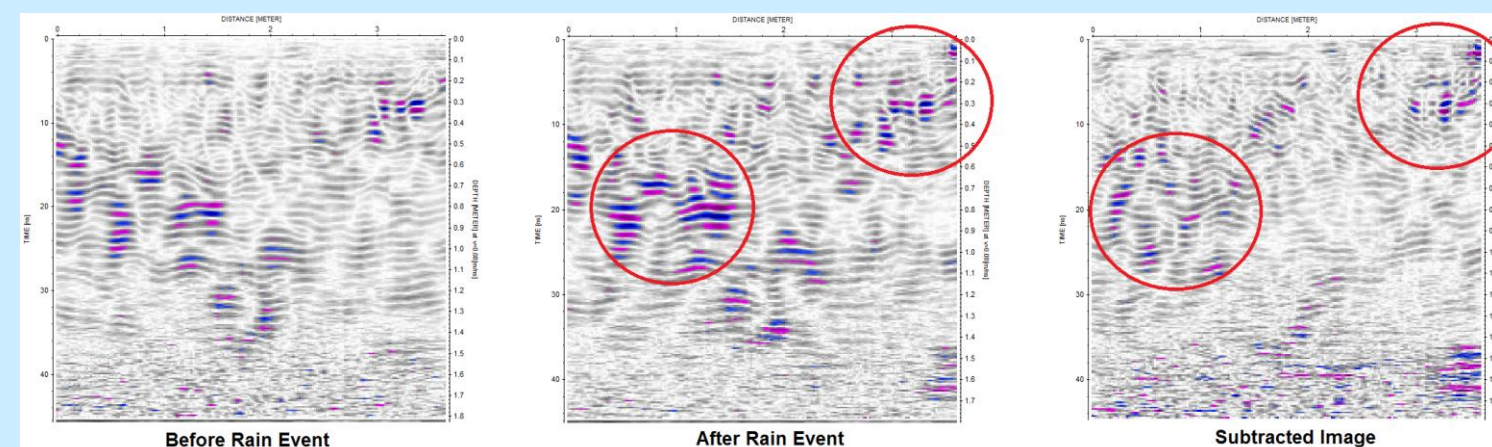
## Results

The images in each sequence below were recorded approximately 24 hours apart, separated by a heavy rainfall event. The transects shown provide a sample of profiles representing the entire span of the test grid. Physical features of each profile sequence (i.e. soil layering, root networks, rocks) were minimized by subtracting the before and after images, allowing the impact of the introduced soil moisture to be emphasized.

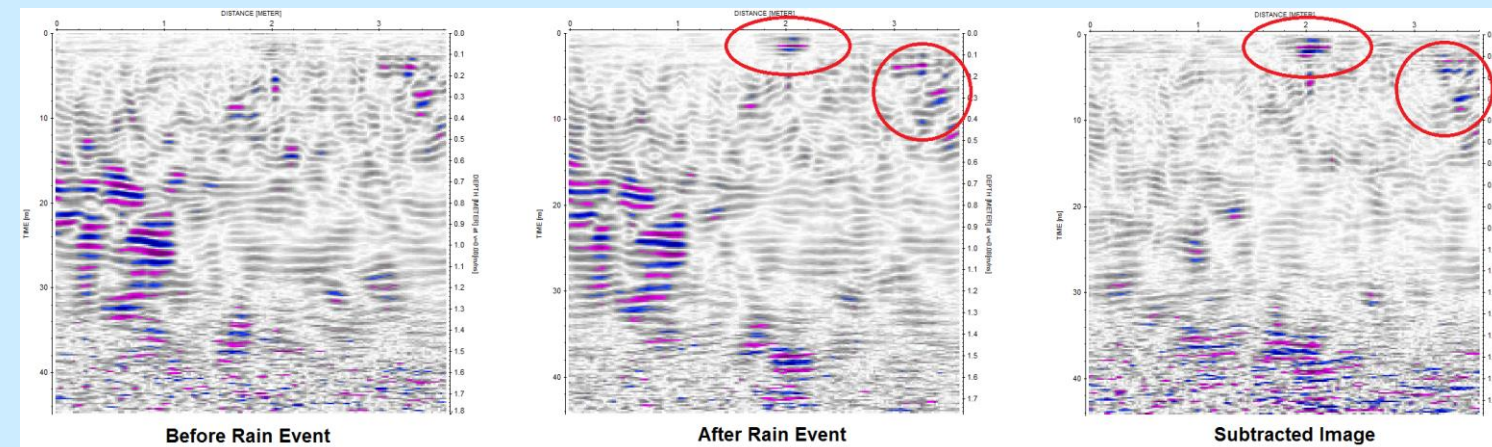
### Transect 2



### Transect 7



### Transect 12



## Discussion

As illustrated in each sequence, an increase in reflection intensity can consistently be observed within the top 40 cm of the soil surface after the rainfall. This response in each GPR profile corresponds with increased soil moisture measurements using TDR.

Average Soil Moisture Percentage			
Depth	Before Rain	After Rain	Differential
10 cm	21.83	24.51	+2.68
20 cm	25.13	27.56	+2.43
40 cm	24.46	26.78	+2.32
60 cm	26.38	25.46	-0.92
80 cm	25.86	26.40	+0.54

In contrast, data from both GPR and TDR indicate that moisture dynamics in deeper layers of subsoil are more persistent and driven by factors other than surface moisture events. Ongoing research into lateral flow networks, macropore structures, and other subsoil features continues in an effort to more fully understand these influences.

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