Buffer zones with different vegetation cover – the *subsurface* runoff

NIBIO
Norwegian Institute of Bioeconomy Research

ID number: # 169

LuWQ 2025
LuWQ2025, Land Use and Water Quality

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INTRODUCTION

Vegetated buffer zones in agriculture are an important measure for increasing water quality and natural diversity. These zones may be even more important with increasing climate change perspective.

Table 1: Effect of buffer zones with different vegetation (Krzeminska et al, 2020)

Vegeta-tion type	Infiltration	Reduction of		
		SS	TP	TN
	[%]	[%] in the overlandflow		
Grass	60 – 77	85 – 94	74 – 88	76 – 86
Bushes	51 – 80	84 – 93	71 – 85	68 – 84
Trees	100	No overlandflow		

Motivation for further research

Need to investigate: flow-through processes within, and leaching from the subsurface

OBJECTIVE

Our aim herein was to “**look into the subsurface**”, of buffer zones. This is to be able to reflect on the processes influencing water flow through the subsurface, within the buffer zones with different vegetation cover. We aimed at: (1) recognizing the dominant infiltration/waterfront formation patterns, (2) to use geophysical methods, like electrical resistivity tomography (ERT) to assess subsurface water flow and accumulation patterns during simulated rainfall-runoff events.

SITE:

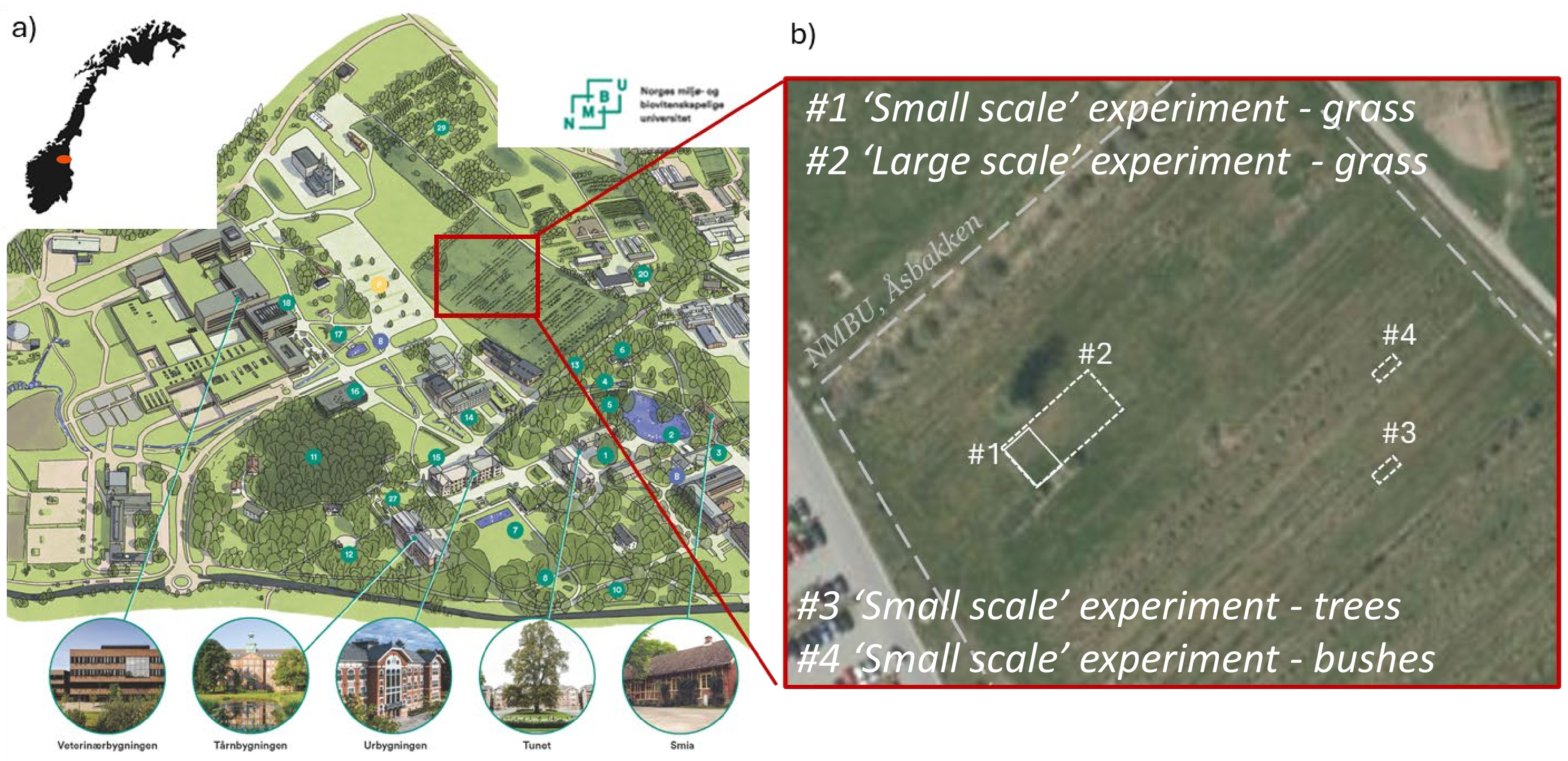

Figure 1: (a) Location of the rainfall simulation experiment within Norway and within NMBU campus. (b) Location of all experiments within the ‘Apple Orchard’ NMBU.

CONCLUSIONS AND HIGHLIGHTS:

Large parts of the surface runoff infiltrate into buffer zones; even up to 100% in case of buffer zones with tree cover. **Most of the water transport occurs through macropores**. In tree covered buffer zones water infiltrates faster and percolates into deeper layers than in grass areas. **Wetting front** in the near surface layers in grass zones moves faster than the wetting front in the deeper layers in the buffers with tree cover.

ERT was able to provide semi-quantitative confirmation of subsurface moisture dynamics that was consistent with measured physical and hydraulic soil properties.

Would you like to know more about this research? The results will be soon publish as NIBIO report

RESULTS – infiltration

- More than 70% of surface water infiltrated into the soil **(Figure 2)**
- Only a small portion of water infiltrated via the soil matrix **(Table 2)**
- Macropore flow was highest in the trees area **(Table 2)**

Figure 2. Small scale experiment in the areas with grass

Table 2: Soil physical characteristics

Characteristics		*grass*	*bushes*	*trees*
Bulk density	g/cm³	0.95	1.24	1.01
Porosity	cm³/cm³	0.64	0.53	0.62
Infiltration – total	cm/day	432	1300	1712
Infiltration – soil matrix	cm/day	27	20	19

Figure 3. Infiltration test: minidisc (soil matrix infiltration) & single ring method with the Beerkan approach (total infiltration)

RESULTS – ERT

‘large scale’ experiment in grass area & ‘small scale’ experiment in trees

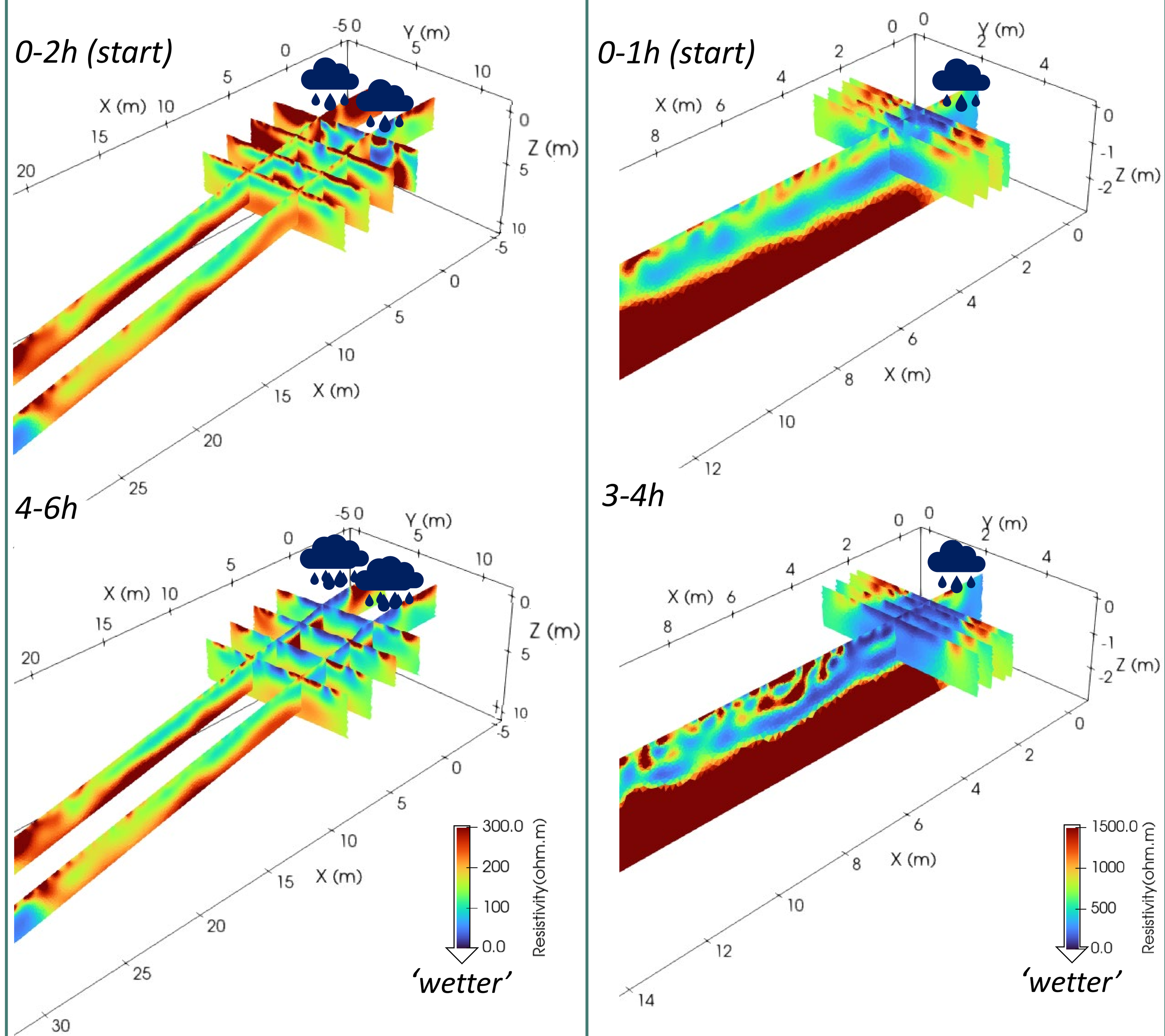

Figure 4. ERT monitoring during the surface runoff simulation (3-6l/min during 5-6h): (left) the grass area and (right) the area with trees. NOTE: different scale for X,Y, and Z dimensions of the plots and for resistivity values.

- There are visible differences in infiltration patterns in areas with different vegetation cover (and different root systems)
- Simulated surface runoff infiltrates ‘faster’ in the tree area
- In the tree area most water percolates into the subsurface **(Figure 4 right)**
- In the area with grass, most water is stored in the near-surface layer and is moving with surface flow **(Figure 4 left)**
- The observed wetting processes **(Figure 4)** are in agreement with measured physical and hydraulic properties of the soil **(Table 2)**

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