# Monitoring of subsurface processes:
## (1) soil moisture changes during winter
## (2) water flow in buffer zones

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### CHALLENGES:

- Flooding and soil erosion due to rain and snow melt on frozen soils
- Lack of understanding of freeze thaw dynamics in soils
- Damages on crop, water quality and infrastructure

→ Understanding and quantification of freezing and thawing behavior of soil under different winter conditions based on field measurements.

- Efficiency of the buffer zones is often measured by means of surface runoff
- Enhanced infiltration in buffer zones is one of the purposes of establishing buffer zones

→ Getting a feeling of the processes/flows in the subsurface

### RESEARCH QUESTION:

**(1) Can the combination of ERT and FDR/Temperature profiles enhance our understanding of water transport in soils undergoing freezing?**
**(2) Can we quantify the macropore flow/preferential in the subsurface of buffer zones, with the help of infiltration experiment and ERT?**

### EXAMPLE OF EXPERIMENTAL SET-UPS:

<u>"Long- term" monitoring</u>

- 71 m ERT transect, 1 m spacing
- 2 slopes (north and south facing) and a depression

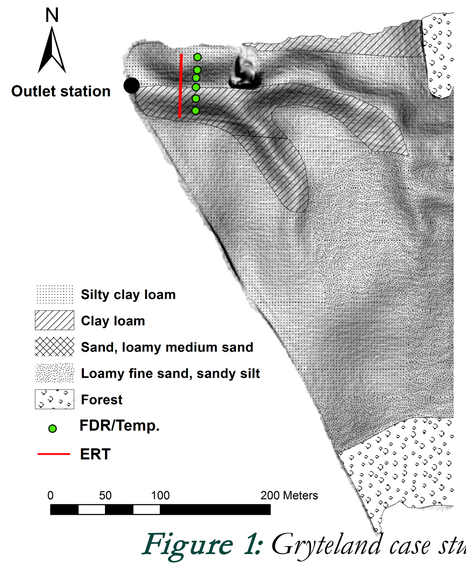



*Figure 1: Gryteland case study*

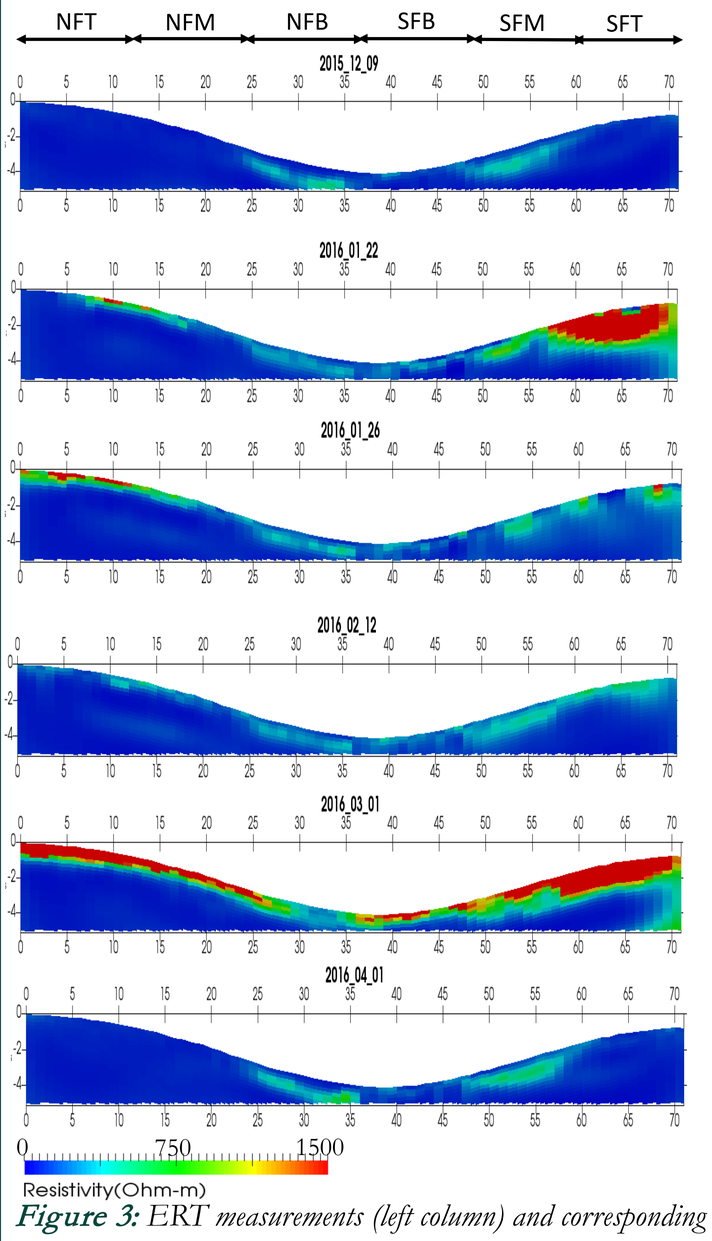
<u>"Short- term" experiment: plume test</u>

- 2 lines 35m, 75cm spacing, parallel to the slope
- 4 lines 12m, 50cm spacing, perpendicular to the slope
- bromide solution + color tracer

*Figure 2: Fruit orchard at Åsbakken, NMBU*

### RESULTS – LONG TERM MONITORING:

**Resistivity:**




**Soil moisture:**

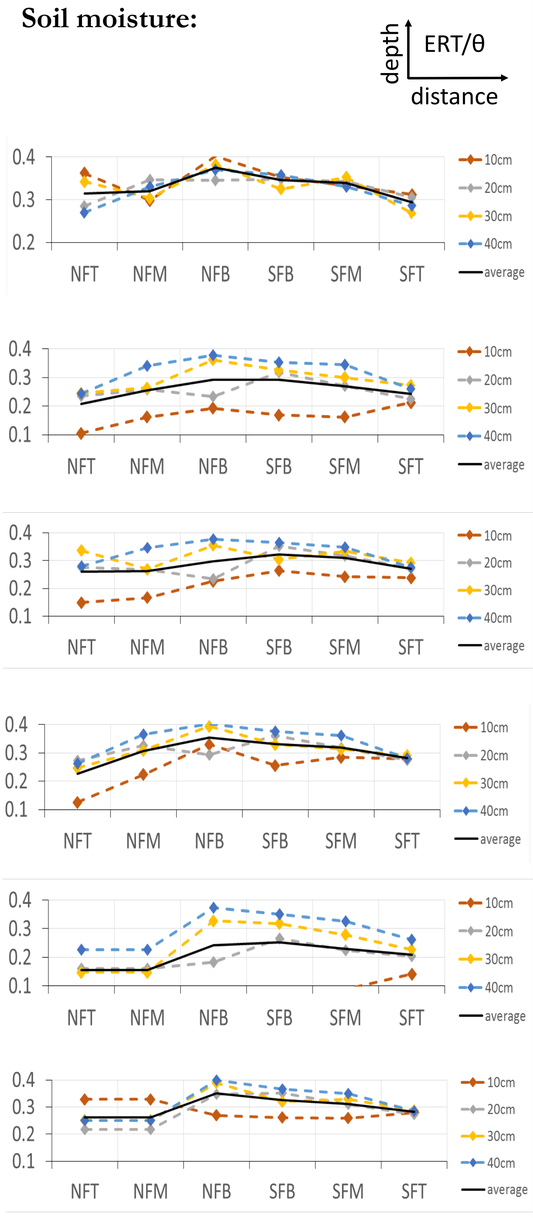
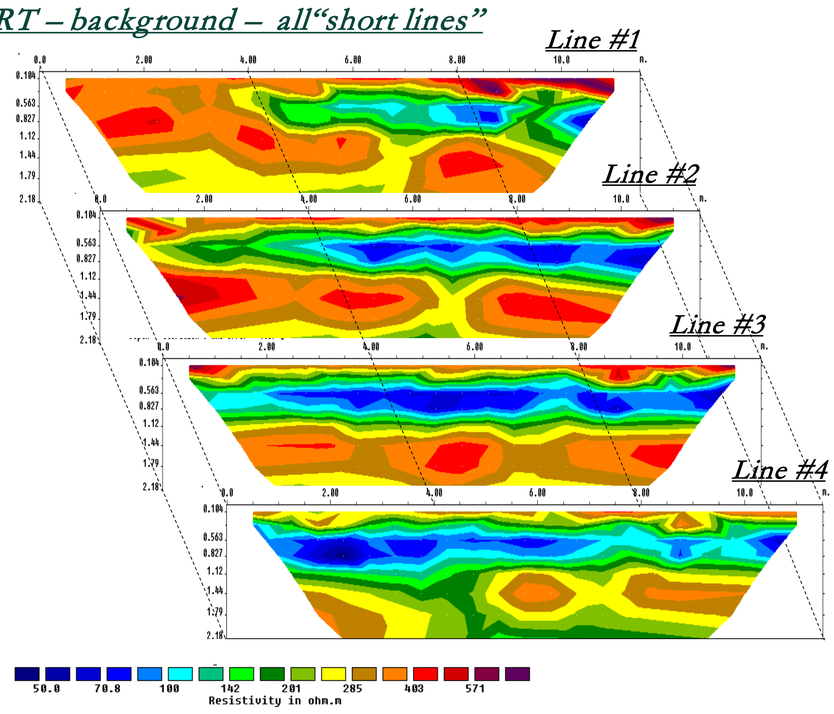



*Figure 3: ERT measurements (left column) and corresponding θ (right column) across monitored transect; NFT – North Facing top, NFM – North Facing Middle, NFB – North Facing Bottom, SFB – South Facing Bottom, SFM – South Facing Middle, SFT – South Facing Top*

### RESULTS – INFILTRATIONS TESTS & PLUME TEST:

*<u>ERT – background – all"short lines"</u>*




*<u>ERT – timelapse – Line#1</u>*

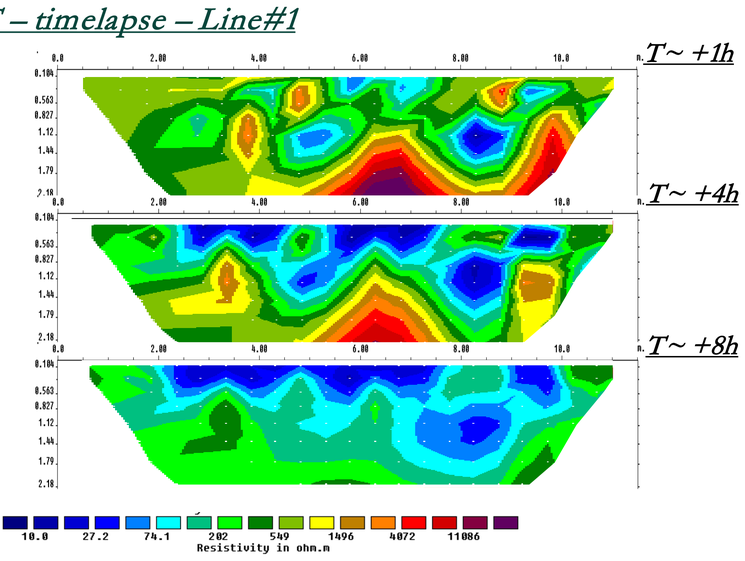
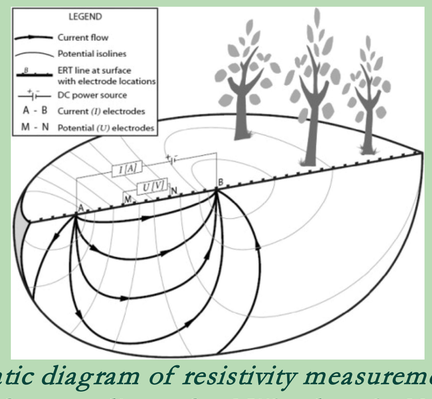



*Figure 4: (left)Very first ERT results, not yet corrected and processed data;(right) Photos from the infiltration experiments within fruit orchard at Åsbakken (NMBU)*

### (1) SOME HIGHLIGHTS :

- ✓ ERT correlates well with FDR and helps reveal spatial subsurface heterogeneities.
- ✓ Soil freezing depth in an undulating terrain varies with slope aspects.
- ✓ Local topography affect soil erosion initiating processes.

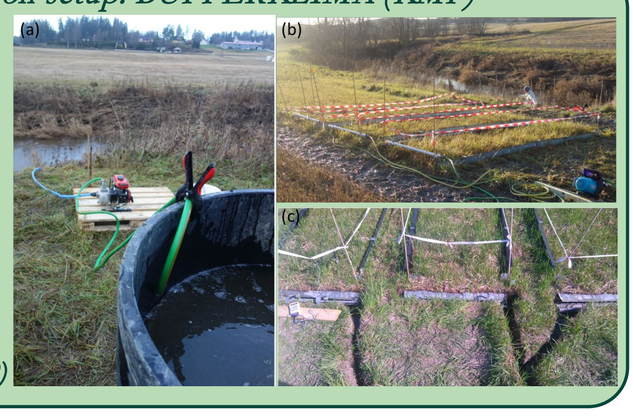



*Schematic diagram of resistivity measurement in a uniform medium after Nijland et al., 2010).*

### (2) SOME HIGHLIGHTS : *Runoff simulation setup. BUFFERKLIMA (KMP)*

| Buffer zones with | Infiltration* ~subsurface flow |
|---|---|
| grass | 60-82% |
| shrubs | 51-80% |
| trees | 100% |

** % of surface runoff that infiltrated into buffer zones*




*Krzeminska et al.2020.NIBIO Rapport 6(30)*

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**<u>Literature:</u>**

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Nijland W., van der Meijde M., Addink E.A., de Jong S.M. Detection of soil moisture and vegetation water abstraction in a Mediterranean natural area using electrical resistivity tomography Catena, 81 (3) (2010), pp. 209-216

Starkloff T. 2017. Winter hydrology and soil erosion processes in an agricultural catchment in Norway, PhD thesis Wageningen University, Wageningen, the Netherlands.