

Using a novel electrical measurement approach to measure the effects of liming on rooting parameters in German beech forests

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Please note: the presenter of this study will only be able to join discussions at 09:15 am



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Background:

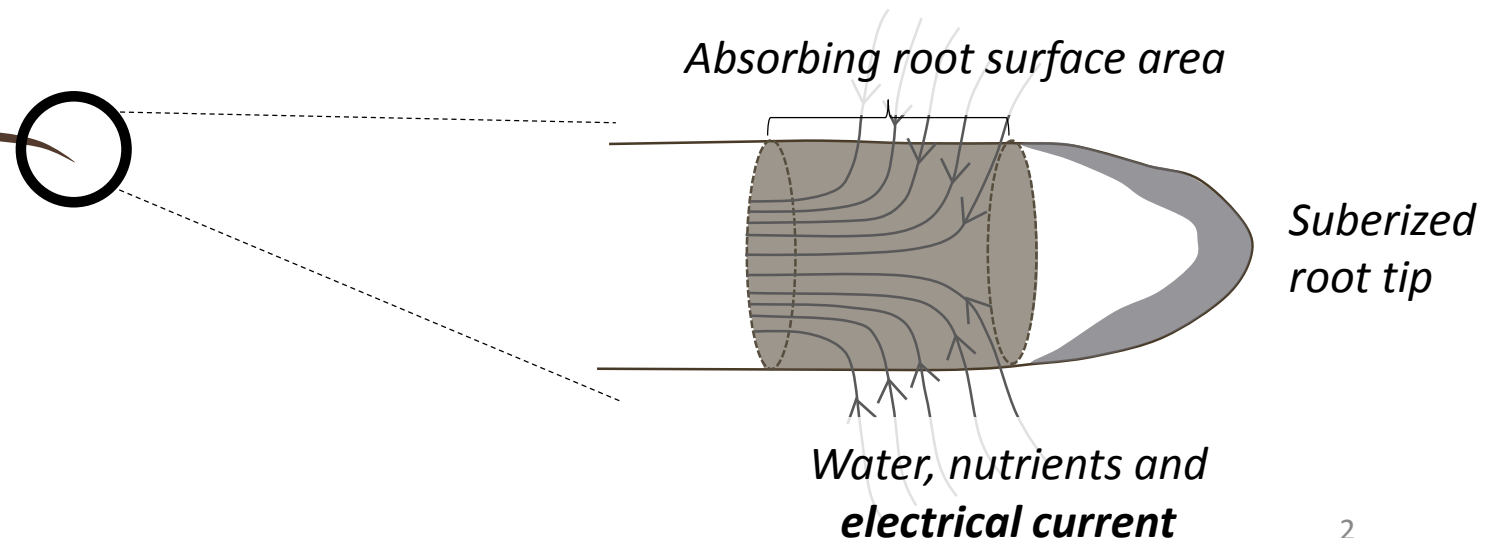
- Hundreds of thousands of hectares have been limed in German forests in the last three decades to mitigate the effects of soil acidification
- Yet little is known on liming impacts on belowground carbon

Study objective:

- To quantify the effects of liming on tree rooting behavior in beech forests
- To evaluate the feasibility of non-destructive electrical measurement approaches to quantify tree root systems *in situ*

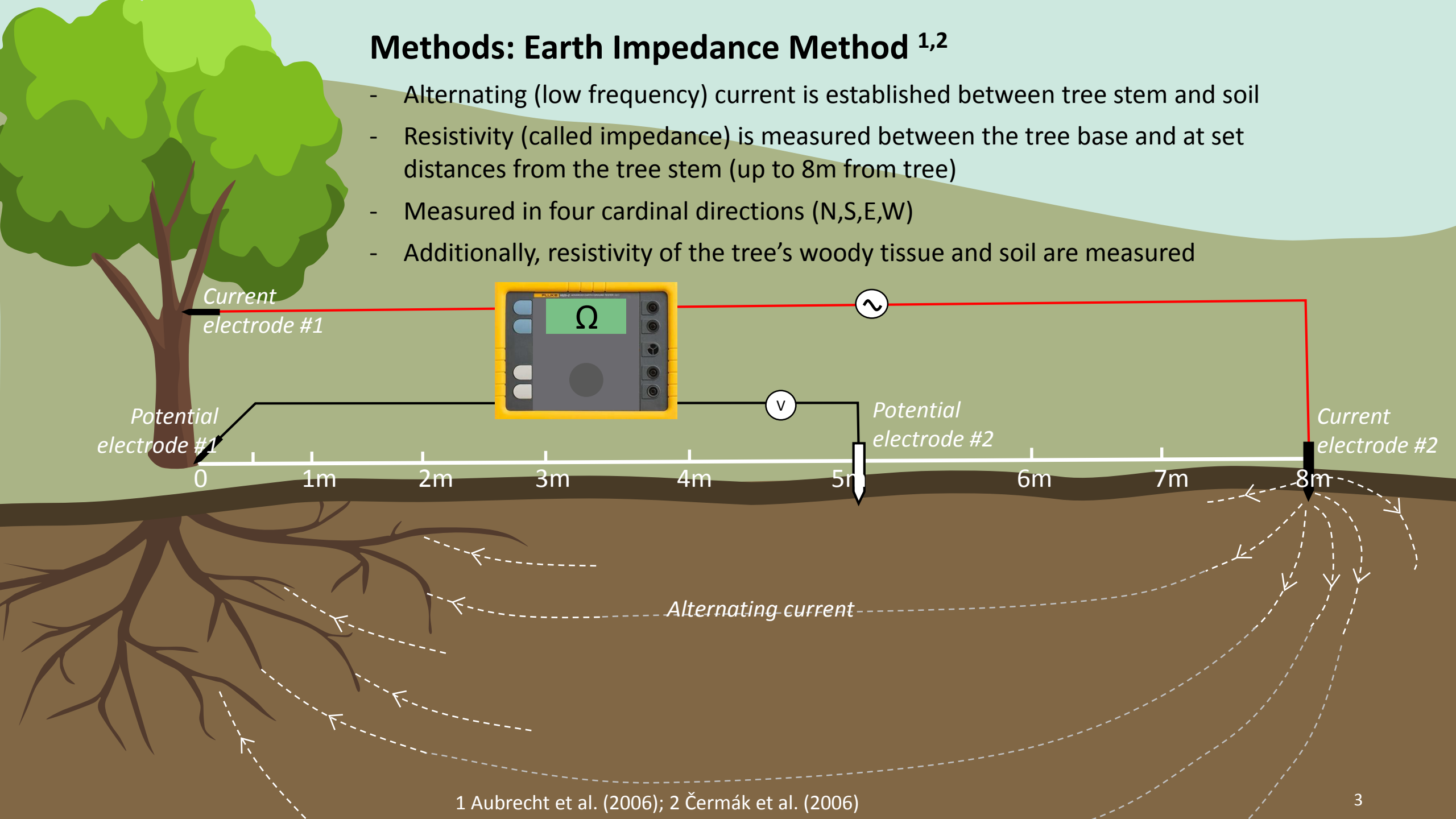
Approach:

- We tested an electrical measurement approach to measure rooting parameters
 - specifically we quantified the absorptive root surface area (ARSA)
 - this is where water and nutrients are absorbed on the root surface



Methods: Earth Impedance Method ^{1,2}

- Alternating (low frequency) current is established between tree stem and soil
- Resistivity (called impedance) is measured between the tree base and at set distances from the tree stem (up to 8m from tree)
- Measured in four cardinal directions (N,S,E,W)
- Additionally, resistivity of the tree's woody tissue and soil are measured



Methods: Impressions of the field setup



Impedance measurement of the soil medium (Wenner Method)



Impedance measurement within the stem of the tree

Methods: Study design

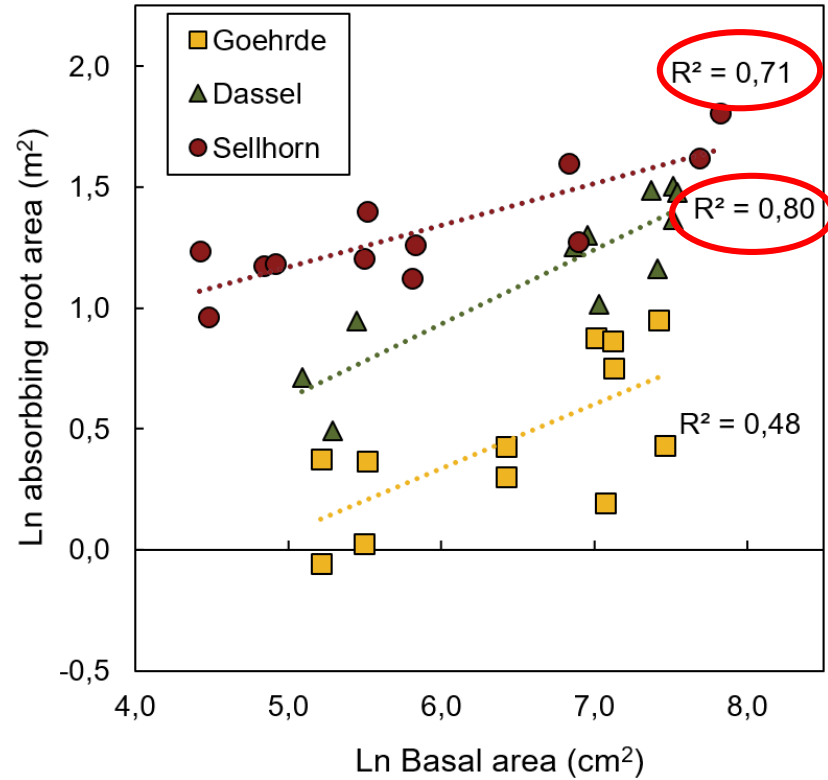


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- Conducted at 3 mature beech forest sites across northern Germany (called Sellhorn, Dassel, Goehrde)
- Each experiment site consists of adjacent limed and control plots
- Limed with a total of 8 t/ha with CaCO_3 (in 1981 and 1993)
- 6 tree pairs were measured at each site (in total = 12 trees / site)
 - A tree pair were similar size (based on DBH) - where one tree was in the limed plot and the other in the control plot
 - Both trees were measured on the same day (when soil moisture conditions were similar)

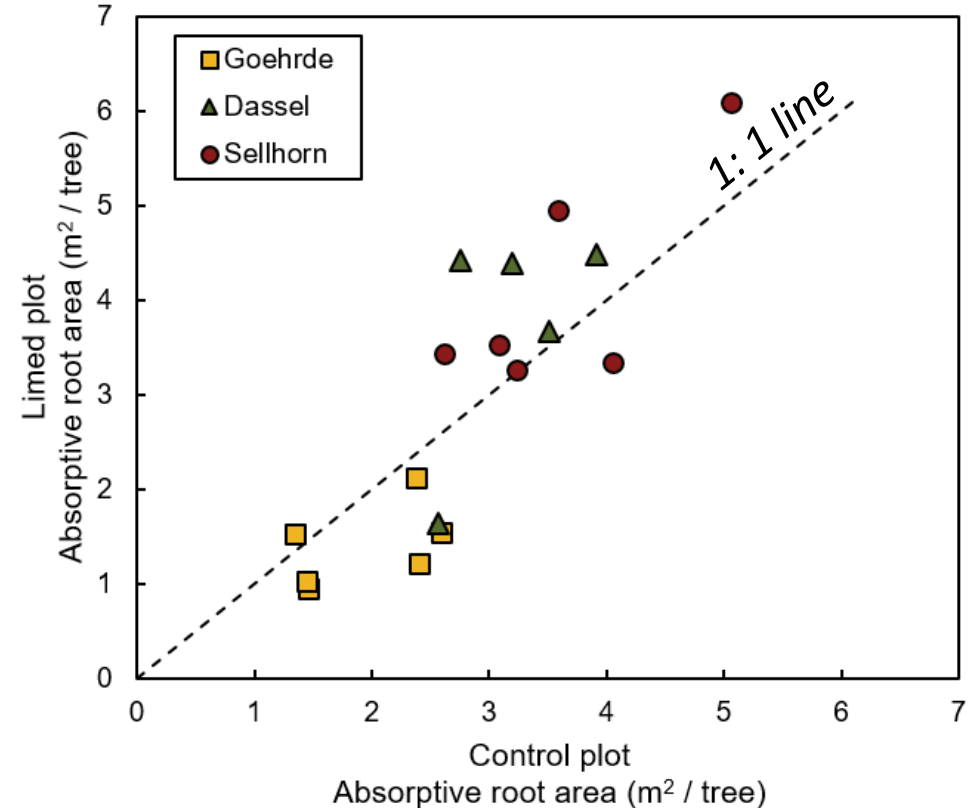
Results: key findings (#1)

Absorptive root area vs. basal area



- Close correlation between tree size and the absorbing root area for two sites
- Poor correlation at Goehrde likely due to thick organic layer

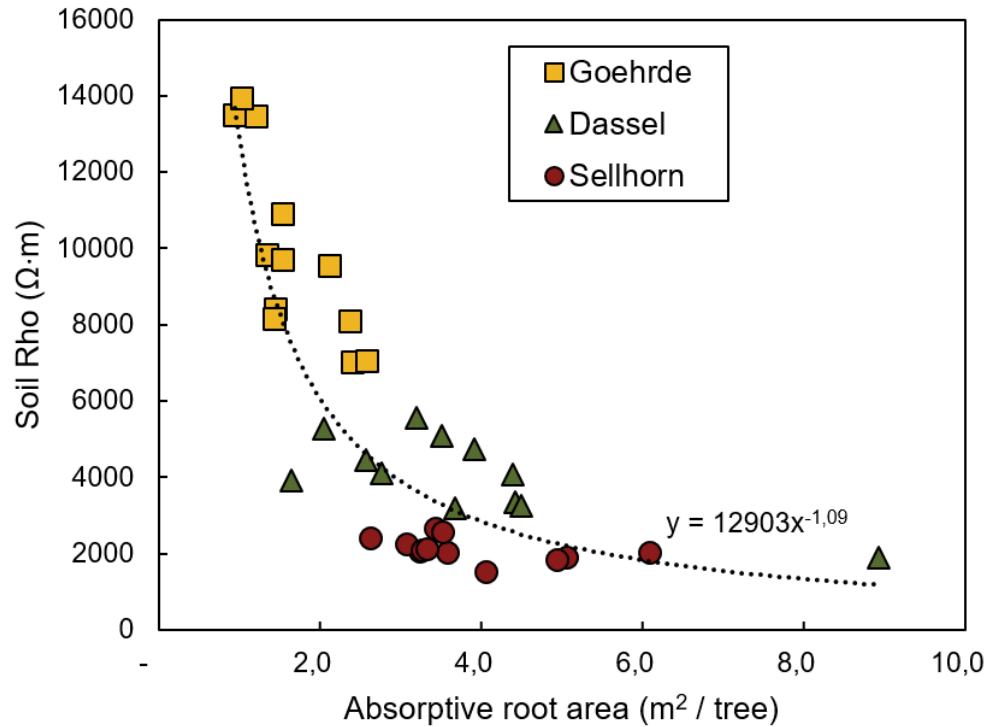
Liming effects on absorptive root area



- No significant difference in absorptive root area between control and limed plots

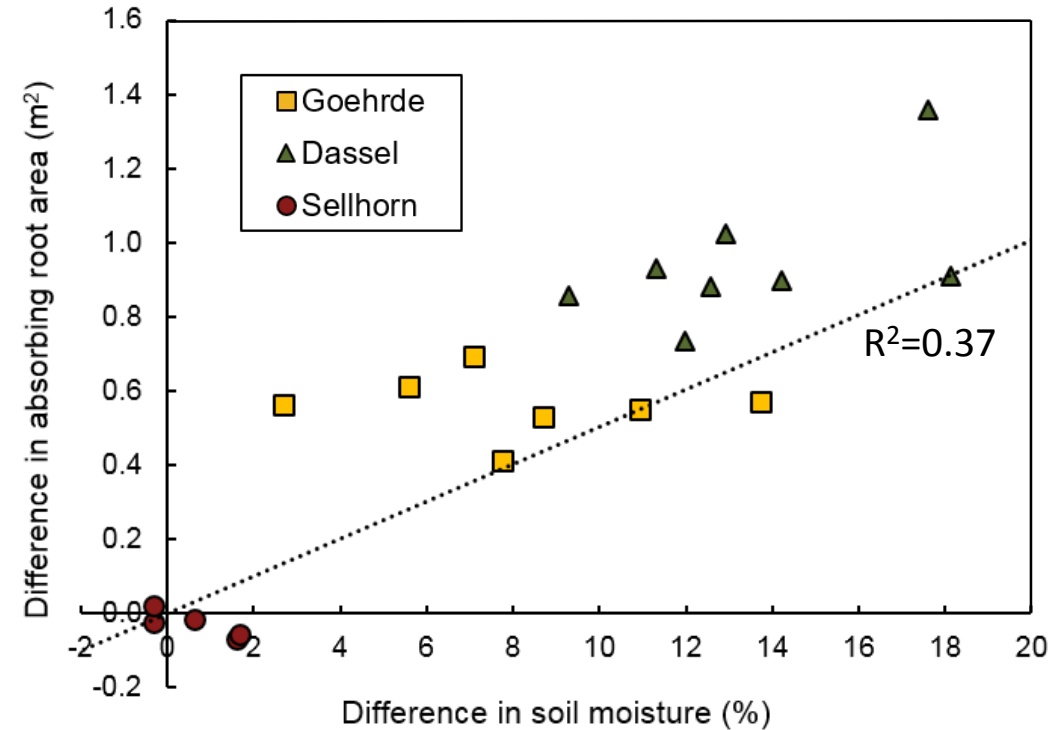
Results: key findings (#2)

Soil resistivity vs absorptive surface root area (ARSA)



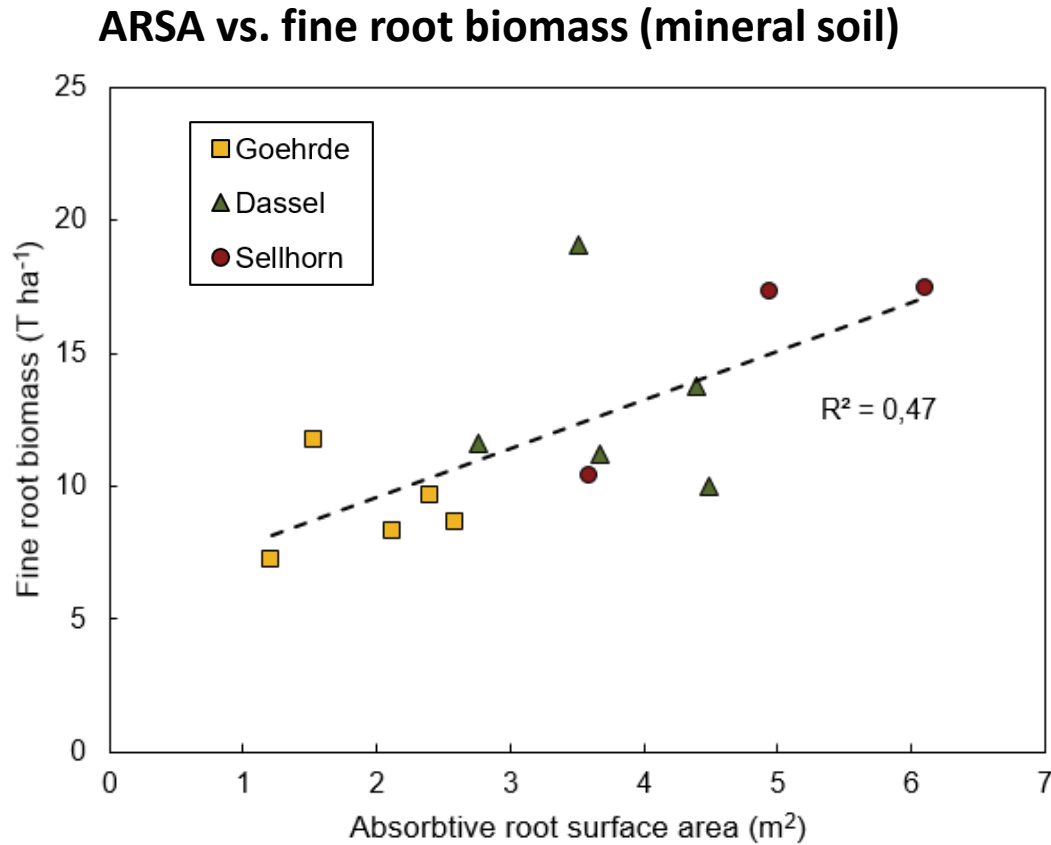
- The electrical resistivity is strongly affected by soil moisture, texture, stones content, organic matter and accordingly impacts the calculated ARSA

Moisture effects on ASRA



- Soil moisture has a strong influence on the absorptive surface root area measurements (*here the same trees were measured under both wet and dry conditions*)

Results: key findings (#3)



- Significant positive correlation between ARSA and fine root biomass in the mineral soil (roots washed out from undisturbed soil cores)

Take-home messages:

Earth Impedance Method:

- Is a non-destructive, rapid tool that can accurately estimate tree root size in situ
- Nevertheless, method still prone to variables that effect electrical conductivity, such as:
 - soil moisture
 - thickness and makeup of the organic horizons

Impacts of liming on root absorptive surface area:

- No significant differences between limed and control plots
- This suggests that despite improved soil pH conditions the tree root systems in limed plots remain relatively constant in size and capacity to take up nutrients and water