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Ground-based quantitative electromagnetic induction measurements and inversions show that patterns in airborne hyperspectral data are caused by subsoil structures

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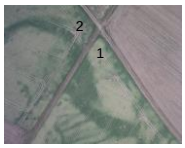
Motivation

Here, **paleo-river channels buried at ~ 1 m depth** cause soil water storage differences controlling crop growth.



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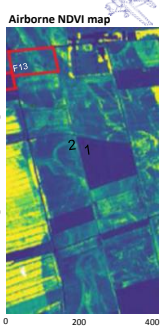
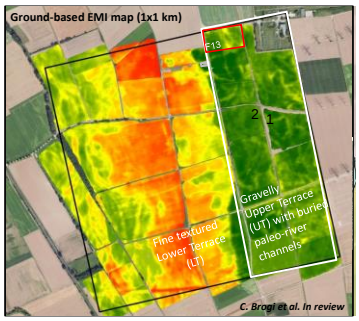
Motivation

Airborne NDVI map



Ground-based EMI map (1x1 km)



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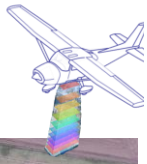
M&M: Combining ground-based EMI and airborne hyperspectral data

HyPlant dual channel hyperspectral spectrometer (D2, Maria Matveeva, U.Rascher, etal.)

→ Sun-induced fluoresence, i.e, photosynthesis measure



Ground-based EMI measurements (B6, Christian von Hebel, J. van der Kruk, etal.)

ECa of 3+6 = 9 depth ranges of investigation (**DOI**)

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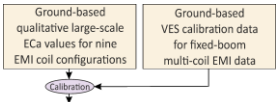
M&M: Work flow for combined ground-based and airborne data analysis



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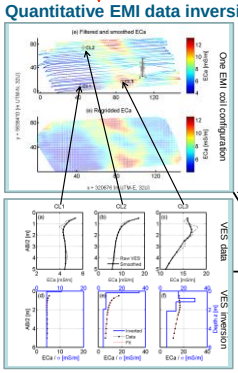
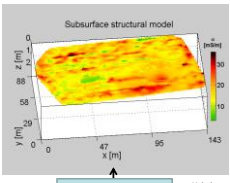
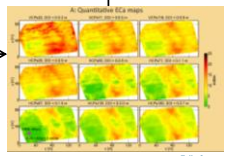
Quantitative EMI data inversion procedure





Quasi-3D inversion — von Hebel etal, 2014



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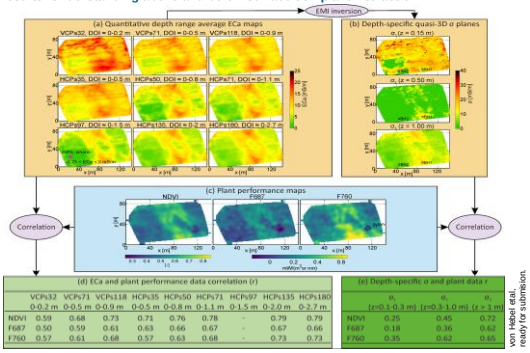
Results: Understanding above and below surface soil-plant interaction



(d) ECa and plant performance data correlation (r)

	VCPs32 0-0.2 m	VCPs71 0-0.5 m	VCPs118 0-0.9 m	HCPs35 0-0.5 m	HCPs50 0-0.8 m	HCPs71 0-1.1 m	HCPs97 0-1.5 m	HCPs135 0-2.0 m	HCPs180 0-2.7 m
NDVI	0.59	0.68	0.73	0.71	0.76	0.78	-	0.79	0.79
F687	0.50	0.59	0.61	0.63	0.66	0.67	-	0.67	0.66
F760	0.57	0.61	0.68	0.57	0.63	0.68	-	0.73	0.73

(e) Depth-specific σ and plant data r

	σ_a (z=0.1-0.3 m)	σ_a (z=0.3-1.0 m)	σ_a (z > 1 m)
NDVI	0.25	0.45	0.72
F687	0.18	0.36	0.62
F760	0.35	0.62	0.65

von Hebel etal. ready for submission.

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Summary and conclusions

- ✓ Buried paleo-river channel material provides vital plant resources.
  - ➢ Photosynthetically more active plants compared to early senescent plants growing at the surrounding coarser soil.
- ✓ Distinct soil texture <-> water holding capacity differences reflected in sun-induced fluorescence (F).
  - ➢ F can contain information about the soil moisture status.
- ✓ Quantitative multi-coil EMI data and inversions obtain top and subsoil structures.
  - ➢ Geophysical data can improve e.g., plant modeling tools for description of above and below surface processes.

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References

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  - **Calibration and large-scale inversion of multi-configuration electromagnetic induction data for vadose zone characterization**, von Hebel, C. Schriften des Forschungszentrum Jülich, Reihe Energy & Environment, 361, D 82 (Diss. RWTH Aachen University, 2016)
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  - **Three-dimensional imaging of subsurface structural patterns using quantitative large-scale multiconfiguration electromagnetic induction data**, von Hebel, C., Rudolph, S., Mester, A., Huisman, J. A., Kumbhar, P., Vereecken, H., van der Kruk, J., Water Resources Research, 2014, 50
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  - **Electromagnetic induction calibration using apparent electrical conductivity modelling based on electrical resistivity tomography**, Lavoué, F., van der Kruk, J., Rings, J., Andre, F., Moghadas, D., Huisman, J. A., Lambot, S., Weihermüller, L., Vanderborght, J., Vereecken, H., Near Surface Geophysics, 2010, 8(6)