Kim Schwartz Madsen, Bo Vangsø Iversen and Christen Duus Børgesen
Department of Agroecology, Aarhus University, Tjele, Denmark (km@agro.au.dk)

Tool for predicting identifiability of soil parameters through EMI model ensemble and machine learning.

Intro

- The Electrical conductivity (EC) of the soil is positively correlated with salinity of soil and water, clay- and water content, meaning that different subsurface materials have varying ranges of EC. Electromagnetic induction have seen many uses. In soil mapping and agriculture.
- In this study we seek to create a tool that can predict the conditions where an EMI instrument (figure 1) can infer the thickness and EC of each soil horizon. Furthermore the tool predict the optimal configuration of the EMI instrument.

Methods

- The study investigates a three-layered soil (figure 2) to which we apply two forward model description from EMagPy (McLachlan et al. 2020) to generate an ensemble of model responses.
- The model descriptions include vertical- (VCP), horizontal- (HCP) and perpendicular (PRP) coil positions.
- We use machine learning to identify favorable and unfavorable subsoil conditions for inferring EC and thicknesses of the horizons.
- In addition the optimal instrument configurations for detecting each layer are identified.

Results

- The perpendicular coil positions have the highest rank for inferring the EC and thickness for the A-horizon (figure 3).
- The horizontal coil position ranks highest for inferring EC and thickness for B- and C-horizon.
- The shortest instrument heights ranks the highest in all cases.

Discussion

- So far, the tool can give a solid predictions about the sensor modalities, but further analysis is required before using it to identify the conditions where it is amendable to apply the EMI instrument.

Conclusion

- In most cases the horizontal and perpendicular coil positions are optimal for detecting the electrical conductivity and thickness of layers in the subsurface.

Acknowledgements

- We would like to acknowledge the scientific contributions of Ty Ferre (University of Arizona) & Paul McLachlan and Guillaume Blanchy from Andrew Binley's research group (Lancaster University).

References

- McLachlan, P., Blanchy, G, Binley, A., 2020, EMagPy: open-source standalone software for processing, forward modelling and inversion of electromagnetic induction data, Computers & Geosciences (in review).

Figure 1. A sledge mounted EMI instrument towed by an all terrain vehicle. The tube contains the transmitter (Tx) and reciever (Rx) coils and a GPS is mounted on the sledge.

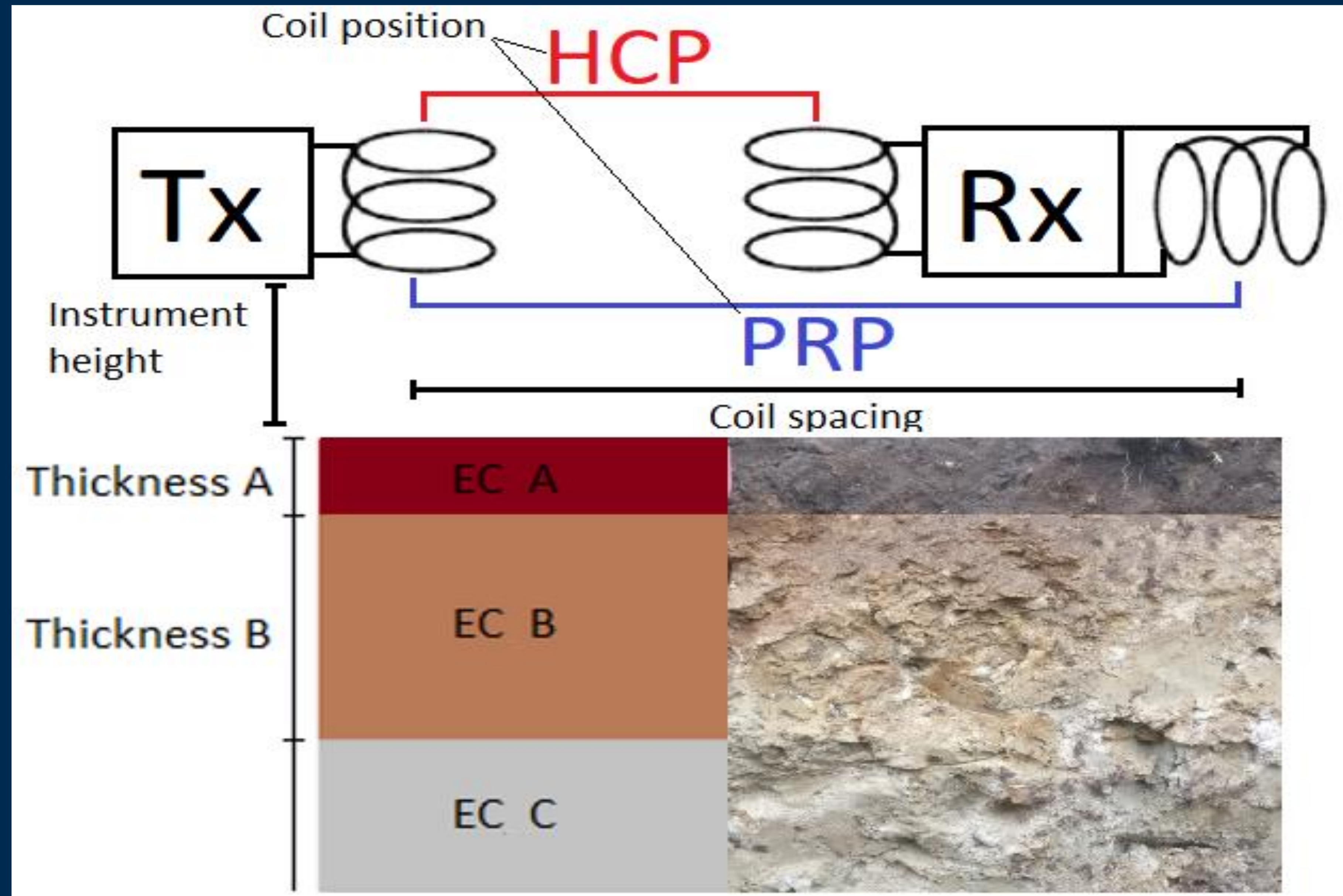

Figure 2. Three-layered soil with the schematic of an EMI instrument situated on the surface. The five soil parameters and three instrumental configurations are labeled.

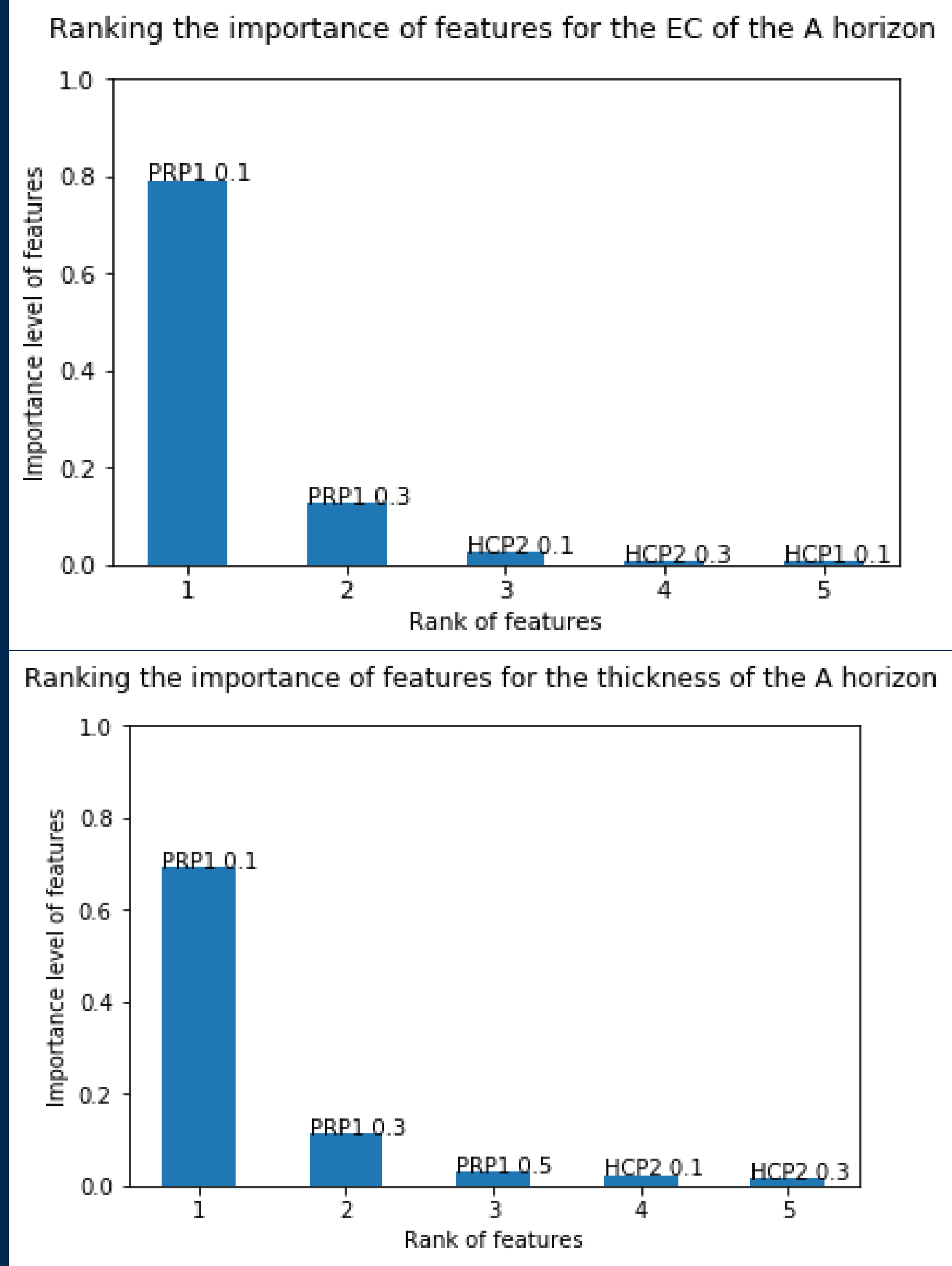

Figure 3. A feature is a combinations of instrumental configurations. Their importance are ranked by machine learning. The labels on each bar refers to the instrument configuration. The labels are a sequence of coil position (VCP, HCP & PRP), coil spacing (1m & 2m) and instrument height (0.1m, 0,3m & 0,5m).

AARHUS UNIVERSITY
DEPARTMENT OF AGROECOLOGY