Title: Trustworthy Intelligent Soil Mapping

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Abstract:
On many farms, the smallest management unit is conventionally the field. There, measures of fertilization, tillage or harvest are usually performed uniformly. However, within a field, a high spatial variability in soil properties can exist due to the underlying geology or landuse history of the site. A uniform management such as fertilization then leads to an over-fertilization of one part of the field, which results in a waste of resources and environmental pollution. On other parts of the field, on the other hand, the yield potential is still not exploited. Site-specific management enables the application doses to be specifically adapted to these small-scale differences in demand. Therefore, however, a high-resolution mapping of the spatial variability of soil characteristics is important. This high resolution of soil data cannot be achieved through costly and time-consuming laboratory analyzes alone. Soil mapping with sensors is a comparatively quick and cost-efficient alternative.

Since no soil sensor can precisely detect all agriculturally relevant soil characteristics, the data of a variety of complementary sensor systems have to be combined, fused, and applied in modelling - in order to increase the prediction quality and robustness of the resulting soil parameter maps. In this PhD topic different artificial intelligence and data science approaches are applied, in particular complex data modelling and machine learning, as well as tested to best tackle the following research questions:

- How to deal with different spatial resolution and coverage, data complexity and mapping dates?
- How to deal with and quantify uncertainty in the predictions (probabilistic models)?
- How can we develop robust probabilistic Machine Learning (ML) methods?
- To what extent can we provide robust explanations for the models / maps?
- How can we include aspects of interpretability into the ML models?
- Which data preprocessing and ML methods are most effective?

Desired skills of the applicant:

- Very good knowledge of a programming language (e.g. R, Python)
- Experience with data science methods (e.g. machine learning, probabilistic modeling)
- Experience working with geographical data (Geographic Information System)
- Interest in agronomy, soil science and/or soil mapping
- Proven skills in writing academic texts in English

References:

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