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AI supported Digital Farming

Dr. Rainer Cramer

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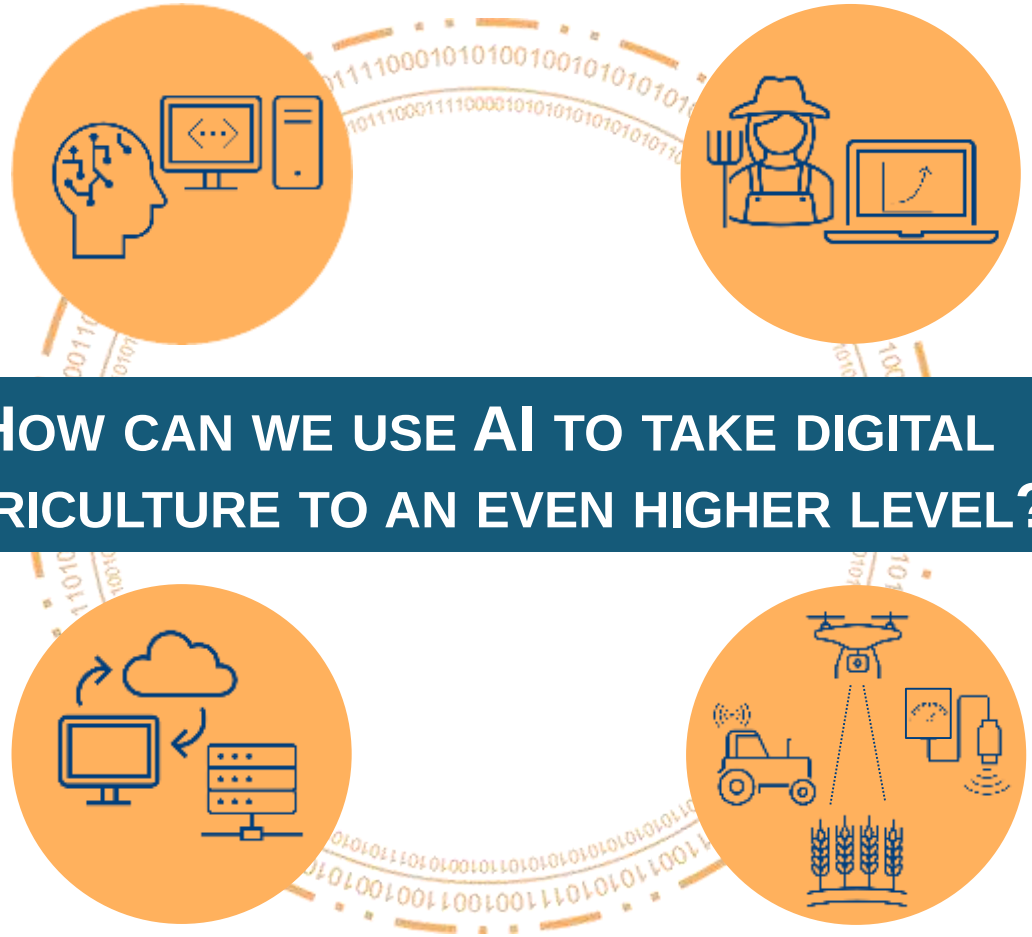
DIGITAL FARMING

DATA AS THE BASIS FOR ACTION

- Data collecting / generating units
  - Machines, sensors, drones etc.
- Data infrastructure
  - Cloud computing, white space, server etc.
- Data analysis

Data describing the current state is used as the basis for decisions or actions



HOW CAN WE USE AI TO TAKE DIGITAL AGRICULTURE TO AN EVEN HIGHER LEVEL?

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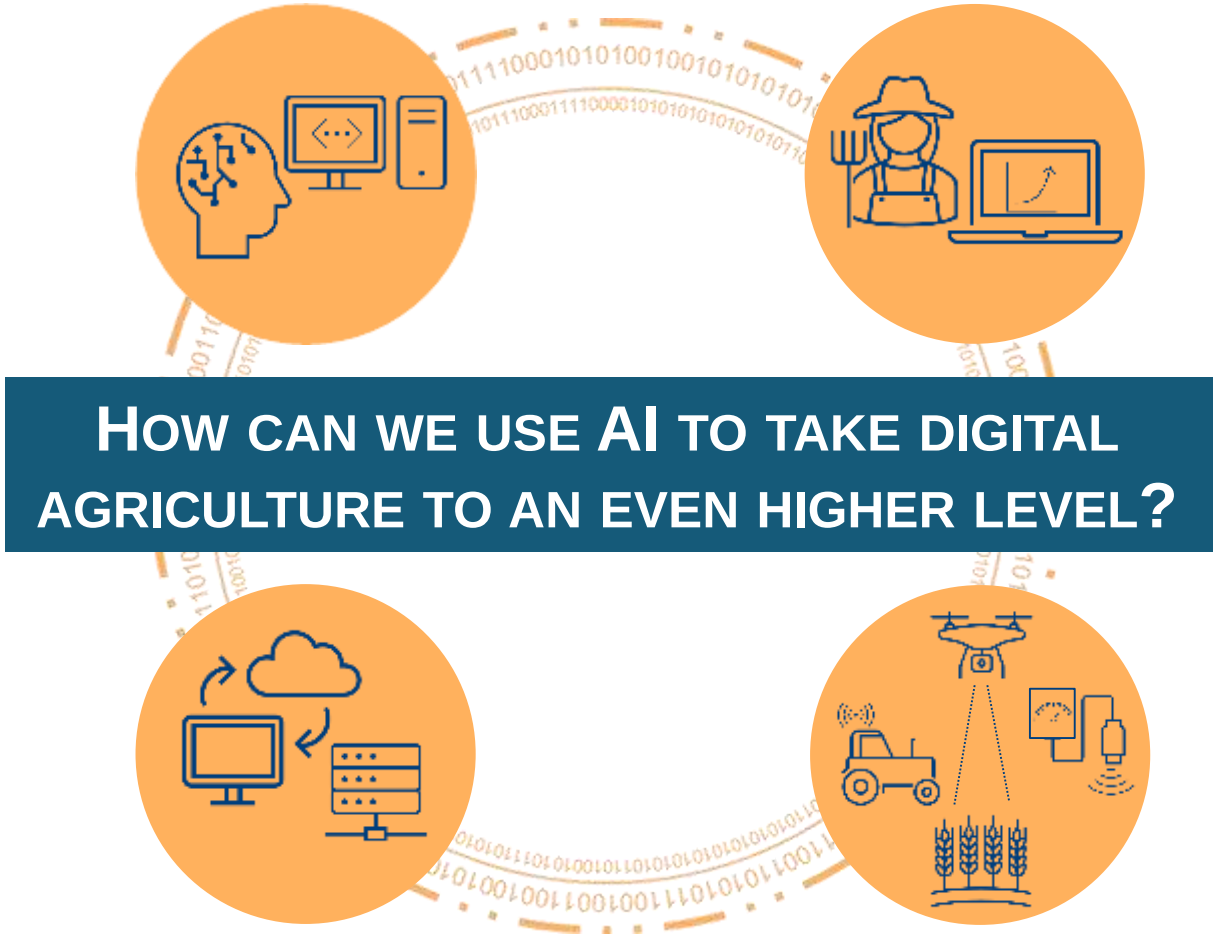
AI IN DIGITAL FARMING

OVERVIEW

INSIGHTS AND PREDICTIONS

- As basis for action
- Support and improve decision making
  - making better informed strategic and operative decisions
- Increased efficiency and food security
- Coupling higher productivity and reduced environmental fate
  - Optimize pesticide and fertilizer use



Detecting crop damage with data from drones

An accurate and efficient method for field area evaluation

Detecting crop damage

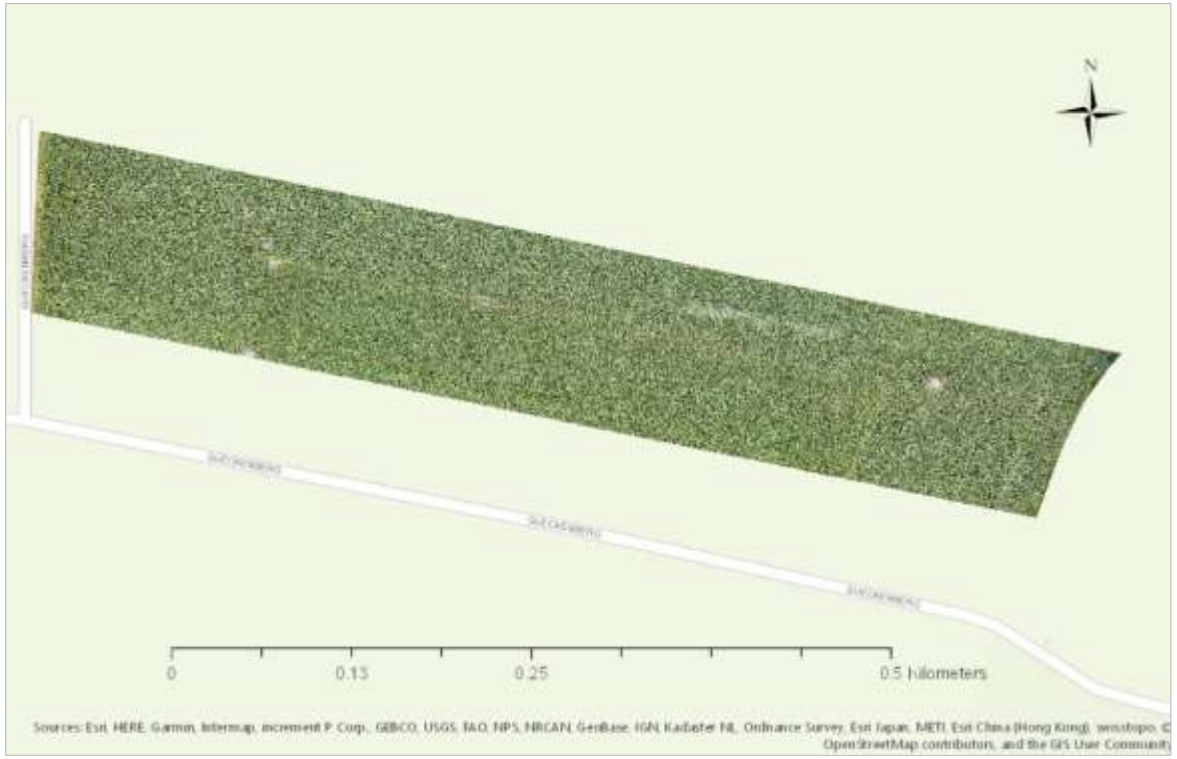
Identification and measurement of areas with geodata from drones

Project Goal

Examine the crop damage and bare soil areas of a corn field

Data

Geodata consisting of point clouds and multiple 4-band images



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Detecting crop damage

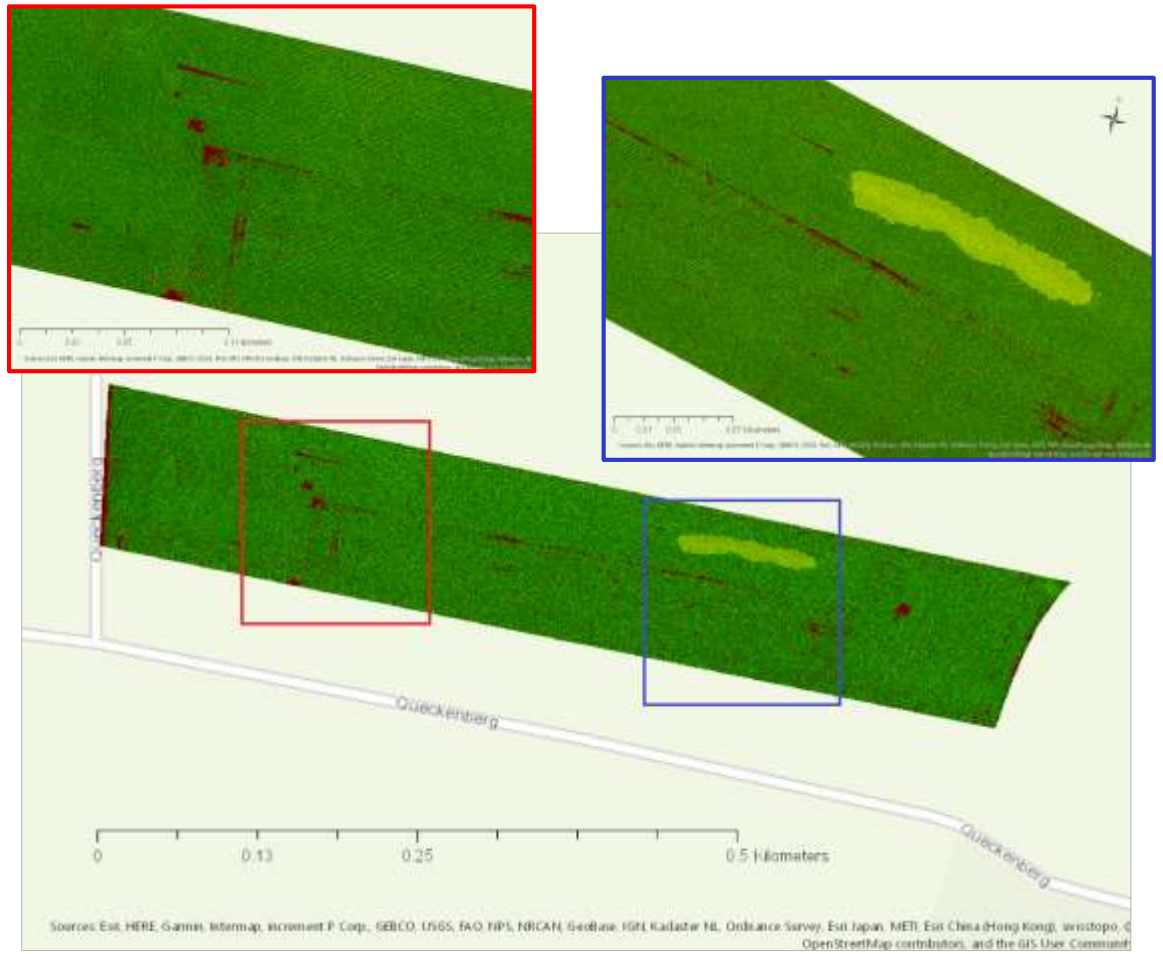
Identification and measurement of the areas with geodata from drones

Approach

- Preprocessing
  - mosaicking, georeferencing and radiometric corrections
- Supervised and unsupervised classification

Project Outcome

- Automatised detection of damaged (0.69%) and bare areas (5.51%)



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USING OF EXPLAINABLE ARTIFICIAL INTELLIGENCE

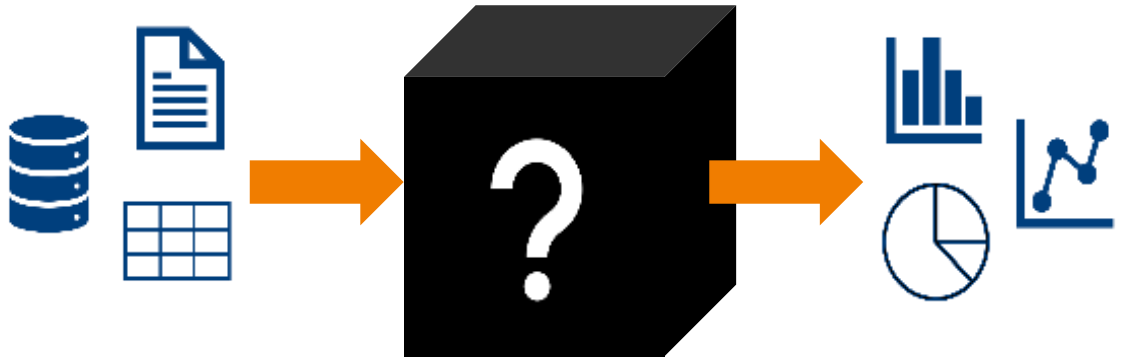
EXPLAINABLE ARTIFICIAL INTELLIGENCE FOR TRIAL FIELD ANALYSIS

USING OF EXPLAINABLE ARTIFICIAL INTELLIGENCE

EXPLAINABLE AI FOR TRIAL FIELD ANALYSIS

PROJECT GOAL

Develop a transparent and data-driven framework to interpret a model numerically and graphically



Blackbox

FEATURE IMPORTANCE

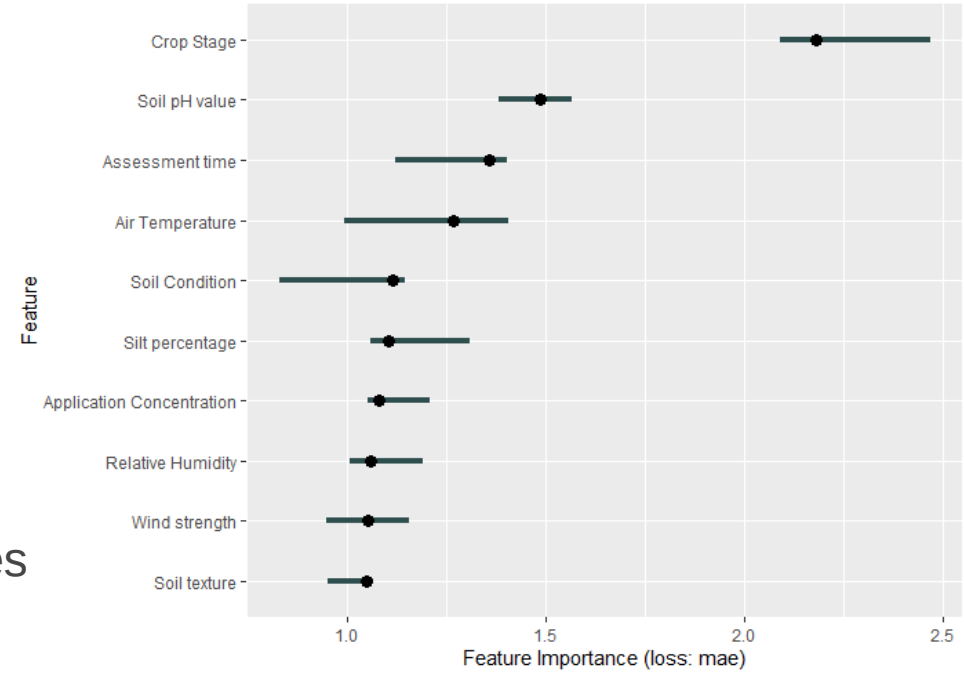
USING OF EXPLAINABLE AI

Basis: Model using various environmental factors to predict the efficacy of an herbicide application based on historical spray data

What environmental factors have the greatest effect on herbicide efficacy?

Permutation feature importance index

- Additional insights from model
- Can be applied to almost all model types
- With confidence intervals



USING OF EXPLAINABLE ARTIFICIAL INTELLIGENCE

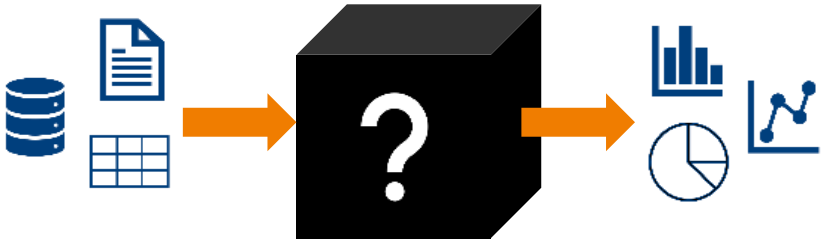
EXPLAINABLE AI FOR TRIAL FIELD ANALYSIS

PROJECT GOAL

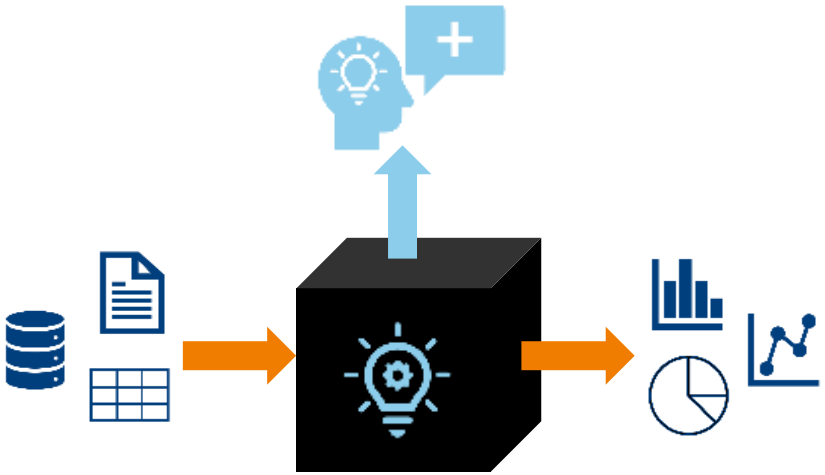
Develop a transparent and data-driven framework to interpret a model numerically and graphically

PROJECT OUTCOME

The framework provides more valuable insights within the analysis process than traditional statistical methods and can identify patterns as well as interactions, which potentially improve agricultural practice



Blackbox



How do new corn hybrids perform?

Predicting the corn yield of a new corn hybrid based on historical yield data and the genetic composition

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Predicting yield of new corn hybrids

How do new corn hybrids perform at a new location?

Project Goal

Predicting the corn yield of new hybrids based on historical yield data of other hybrids and the genetic composition

Identify which new combinations of corn hybrid varieties might be promising

Data

Information from 2001 to 2016 on a variety of hybrids, their yield and location.

Furthermore, genetic markers of all hybrids

Historical data on yield and genetic composition

New corn hybrids

PREDICTING YIELD OF NEW CORN HYBRIDS

HOW DO NEW CORN HYBRIDS PERFORM AT A NEW LOCATION?

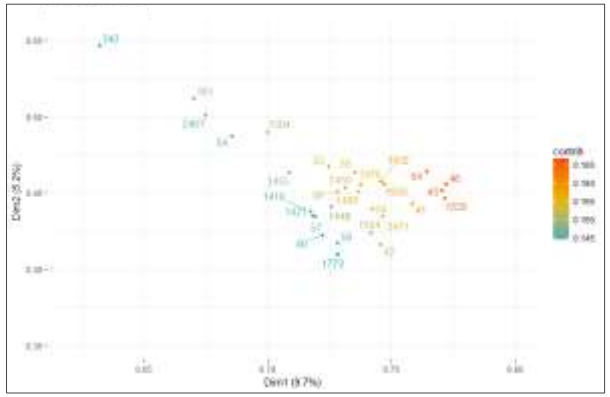
APPROACH

- Data preparation:
  - Dimension reduction
  - Weather prediction
- We tested different model types for predicting the yield of the new hybrids

PROJECT OUTCOME

- Best predictive quality was achieved with a Random Forest model (86% accuracy)
- Identified those gene markers that explained most of the yield variation

Data matrix with 3 million data points
→ Multiple correspondence analysis (MCA) to cluster the genetic markers



Weather model:

$$W_1(S,t) = X_\beta(S,t)\beta + z(t)1_S + \delta w(S) + \rho\vartheta(S,t) + \varepsilon(S,t)$$

Conclusion

Conclusion

How can we use AI to take digital agriculture to an even higher level?

AI can …

… automatically and accurately help to identify and measure specific areas in the field

… provide more valuable insights than traditional statistical methods and identify patterns as well as interactions

… predict yields on a site-specific basis, even before the plants are growing

Thank you

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