

Use case 5: Non-invasive phenotyping with autonomous robots

About us

We are the shoot dynamics group at the IGB-2: plant sciences at the Research Center Jülich.



Lars Grygosch

PhD student at the Institute for Bio- and Geosciences at Forschungszentrum Jülich, with a background in astrophysics. He has experience in data analysis from simulating black holes and working as a data scientist.



Ireneusz Kleppert

Research associate at Forschungszentrum Jülich. During his master's degree in physical geography at the University of Cologne, he specialized in remote sensing and geoinformatics.



Uwe Rascher

Leader of the Shoot Dynamics working group at the Institute for Bio- and Geosciences at Forschungszentrum Jülich and professor for quantitative plant physiology at the Rheinische Friedrich-Wilhelms-Universität Bonn. Leader of use case 5.

What we do?

Our overall objective is „to improve our scientific (biological) understanding of plant shoot functioning and dynamic shoot traits from the leaf to the canopy, which will provide the basis to optimize plant production. Our special focus is on understanding of the regulatory properties of photosynthesis, the mechanisms of leaf and canopy water content and transpiration as well as the dynamics in shoot architecture in crops.”

Non-invasive field phenotyping

Phenotyping of plants under real-life scenarios on external fields enables us to gather information under realistic conditions. This includes natural sources of variety such as light exposure, weather and soil nutrients. Our sensor systems also allow measurements without changing, harming, or destroying the plants during the process.

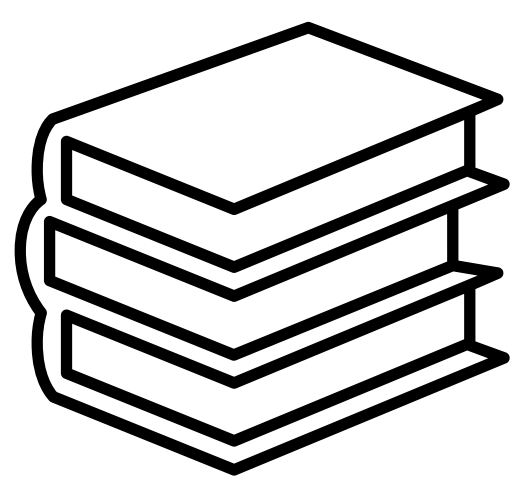
Proximal and remote sensing

Remote sensing is usually defined as measuring radiation emitted or reflected by an object over an undefined distance. In literature, remote sensing is often referred to as proximal sensing when performed closer to individual plants. In use case 5, we work with all the different scales, from measurements of single leaves to plant canopies up to the field level.

Machine learning

Machine learning and data science are important segments of use case 5. As all our data are digital and some are even measured automatically by robots, we must work on our data organization to enable smooth communication between different systems. At the same time machine learning is an important and promising method to create input data (e.g., fluorescence signal from simulations/models) as well as for data analysis.

Products and activities



TA 3

Vocabulary for ontology

We provided a vocabulary list with common names for traits in the domain of field phenotyping and created a list of remote sensing categories for metadata standards.



TA 2

Reduced dataset

We took part in a training course on research data management, where we introduced the basics of data organization. In addition, we provided a reduced exemplary dataset for the practical part of the training.



TA 3

Small example dataset

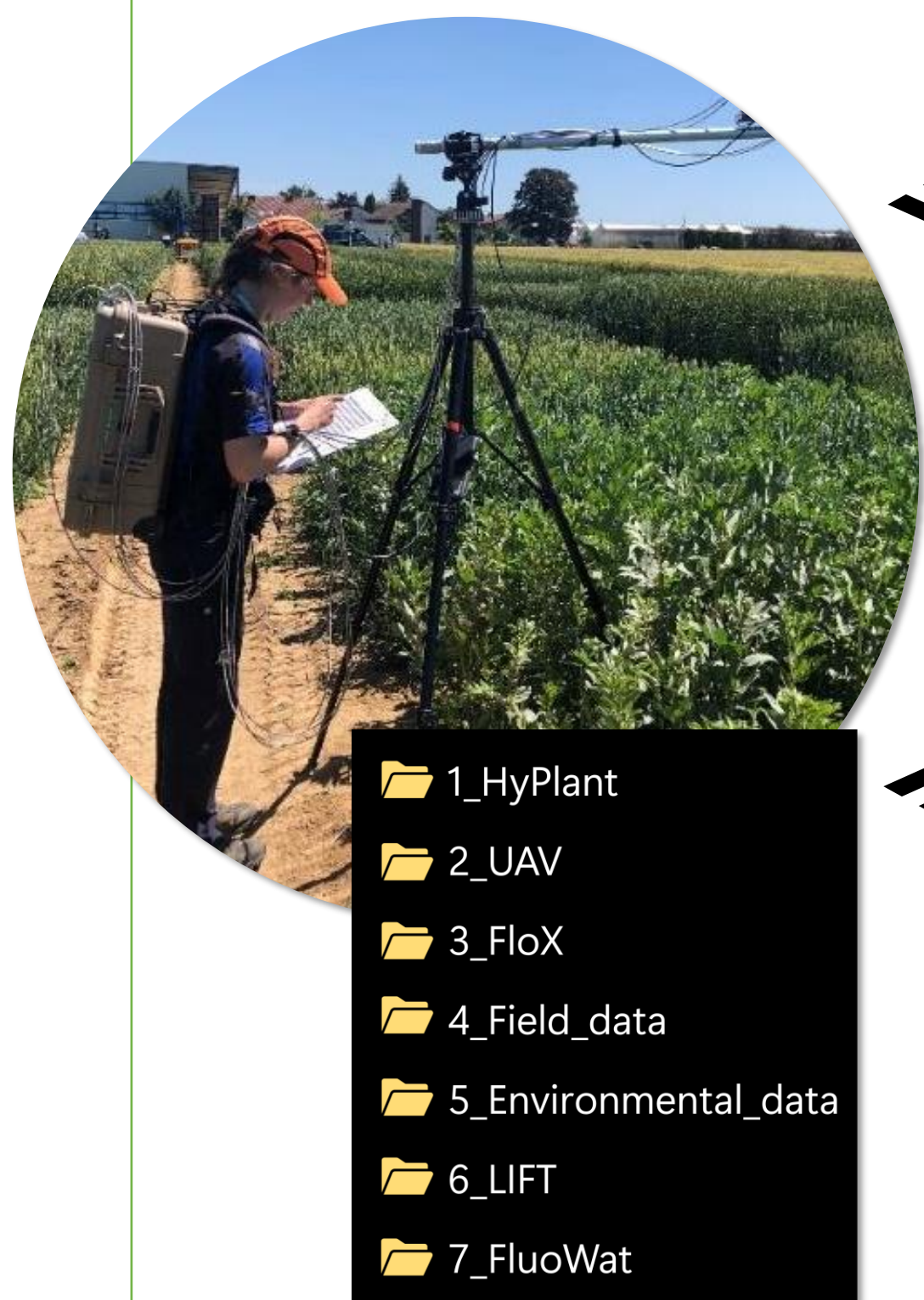
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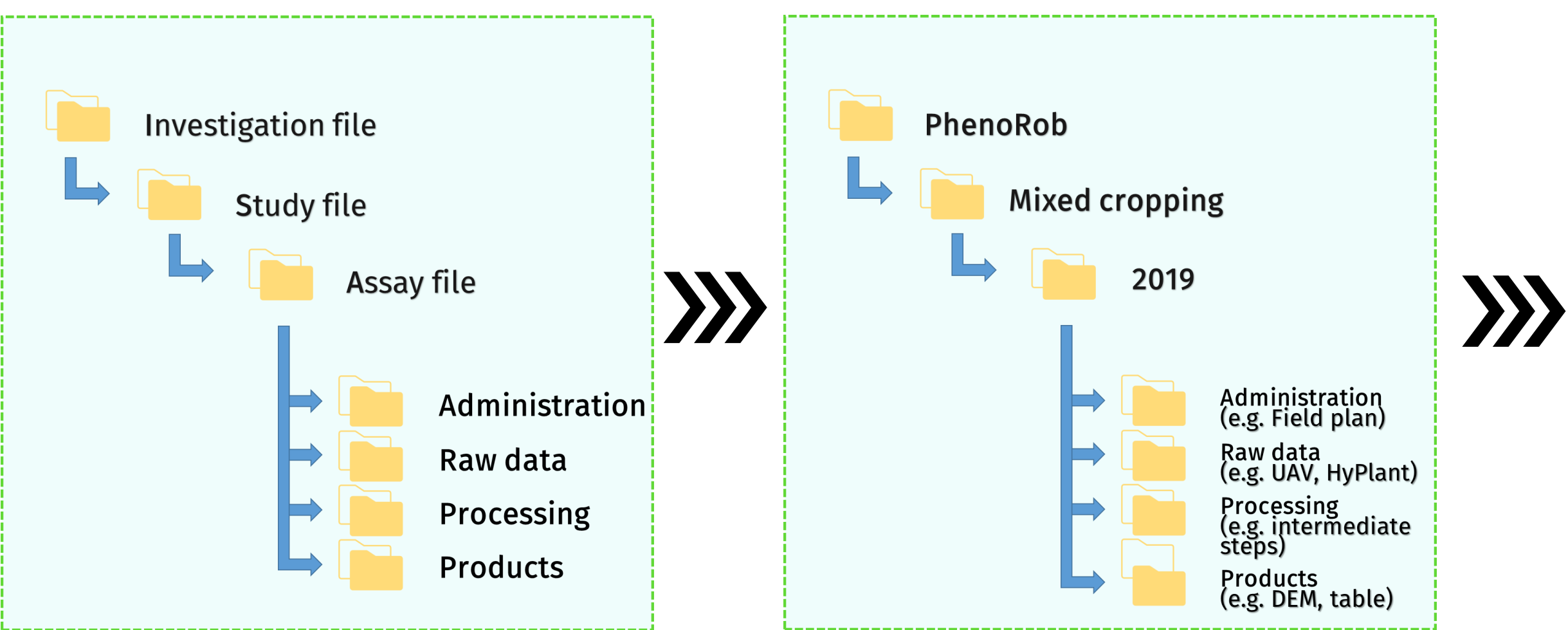
TA 4

Advanced example dataset

We provided an advanced version of a dataset, which will be published as part of a benchmark dataset for non-invasive field phenotyping, to the ARC workshop by TA4 and DataPLANT. During the workshop, we introduced the audience to the data and TA 4 used it to demonstrate the ARCitest tool.

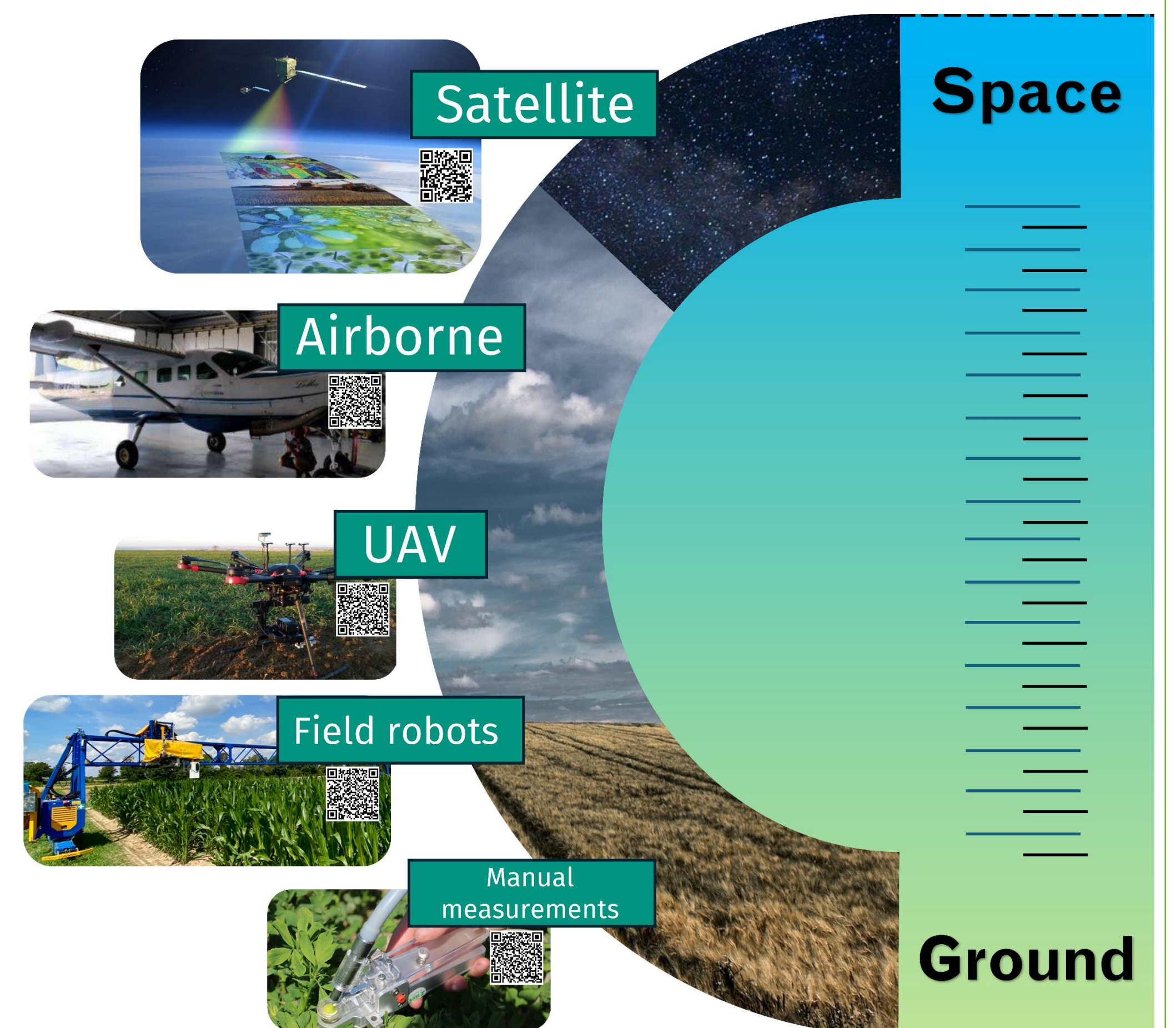


Mixed cropping experiment. Source: Julie Krämer.



ISA-based data structure

We created a data organization based on the ISA metadata standard with the goal of achieving a flexible and effective structure.



Selection of sensor systems across different scales. Sources: European space agency, Forschungszentrum Jülich, Pixabay (Modified)

Plans

- Our goal is to fully publish a benchmark dataset that closely represents the multifaceted domain of field phenotyping. To achieve this, we will combine existing published data with newly published datasets.
- Create templates for data documentation.
- Create a guideline for data producers and data publishers.



Think Tank Digitalisierung



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