Streamlining data preparation for crop modelling research

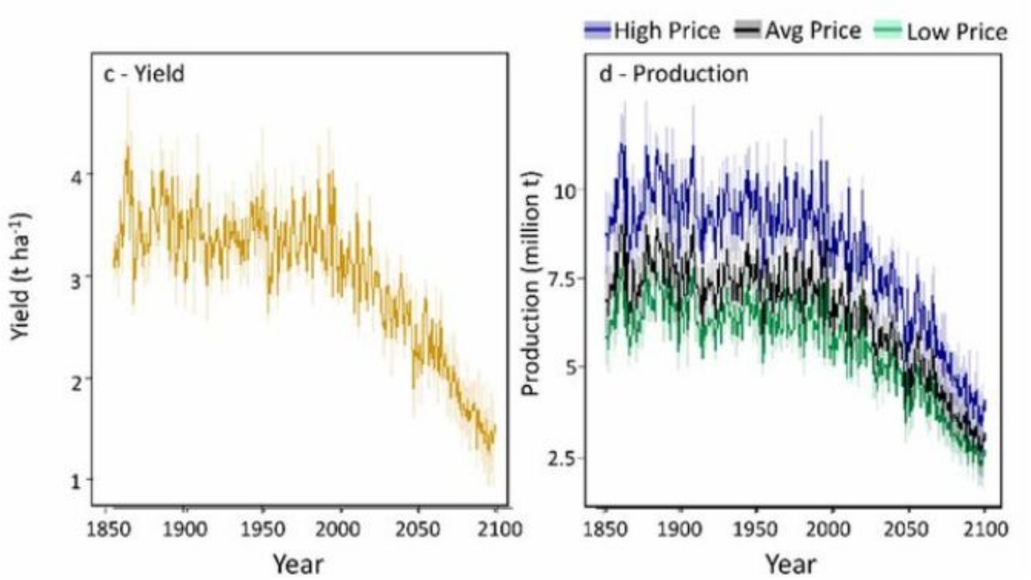
Benjamin Leroy - Technische Universität München

Sebastian Burkhard, Patrick Noack, Senthold Asseng, Joseph Gitahi, Marija Knezevic, David Gackstetter, Andreas Donaubauer, Muhammad Arslan, Giada Matheisen

January 2026

What are crop models?

- Mathematical algorithms that simulate how plants grow and respond to environmental changes and cultivation methods.
  - → *How do wheat yields respond to rising temperatures?*
  - → *How can agronomic practices mitigate the predicted effects of climate change?*
- Process-based models explicitly represent the underlying processes that control plant growth (e.g., photosynthesis, respiration, nutrient uptake...).



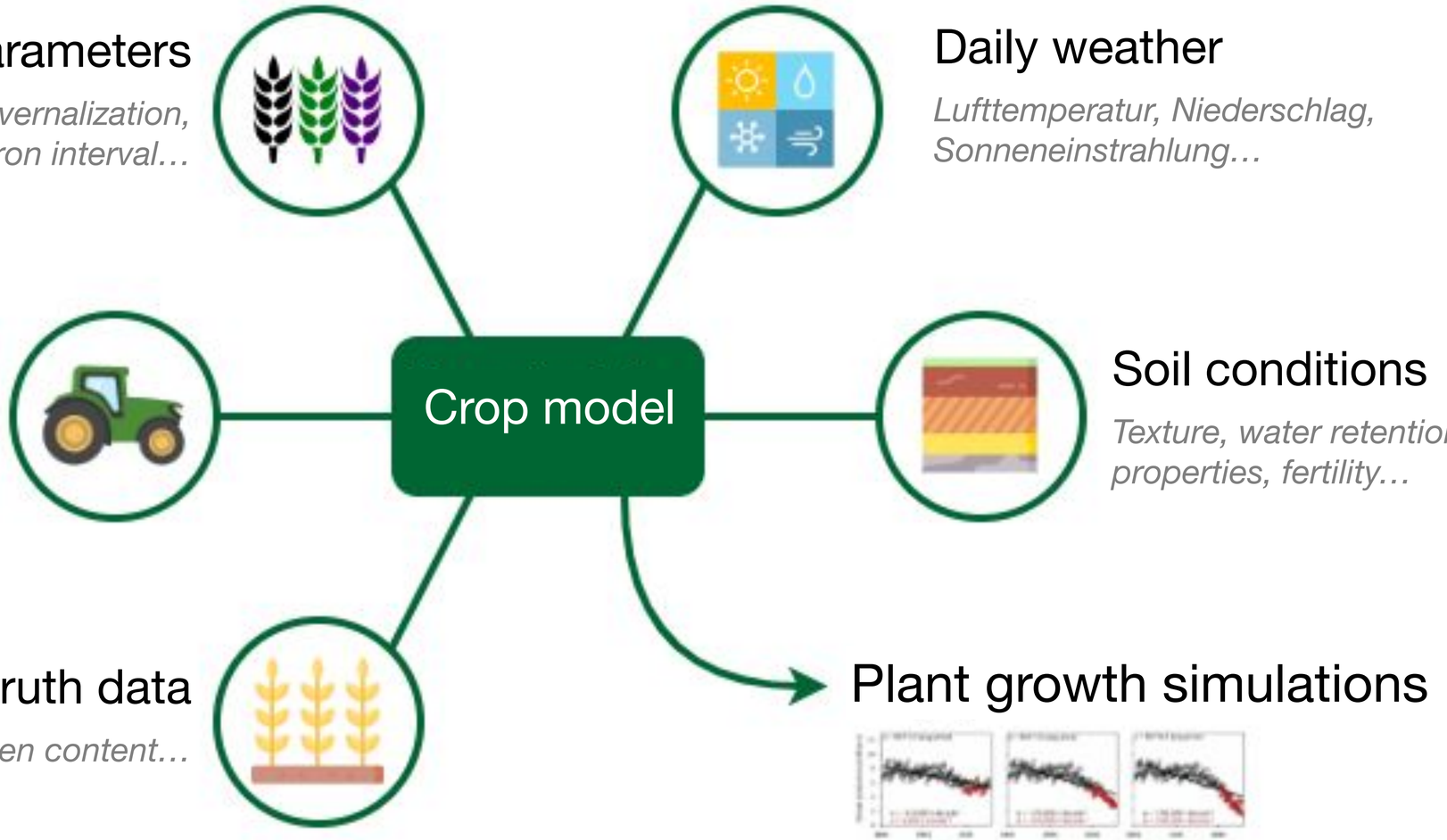
One Earth
CellPress

Primer

Crop models for future food systems

Rogério de S. Nóia-Júnior,[1] Alex C. Ruane,[2] Ioannis N. Athanasiadis,[3] Frank Ewert,[4,5] Matthew Tom Harrison,[6] Jonas Jägermeyr,[2,7,8] Pierre Martre,[1] Christoph Müller,[8] Taru Palosuo,[9] Montserrat Salmerón,[10] Heidi Webber,[4,11] Dilys Sefakor Maccarthy,[12] and Senthold Asseng[13,*]

Data requirements



Sensor data and crop models

Sensors and drones enable continuous monitoring of plant growth, plant health, and weather conditions

⟶ Facilitating the validation and calibration of crop models for improved forecasting.

⟶ Enabling predictive analytics for crop management: disease outbreaks, yield forecasts, short-term decision support, etc.

Data management challenges

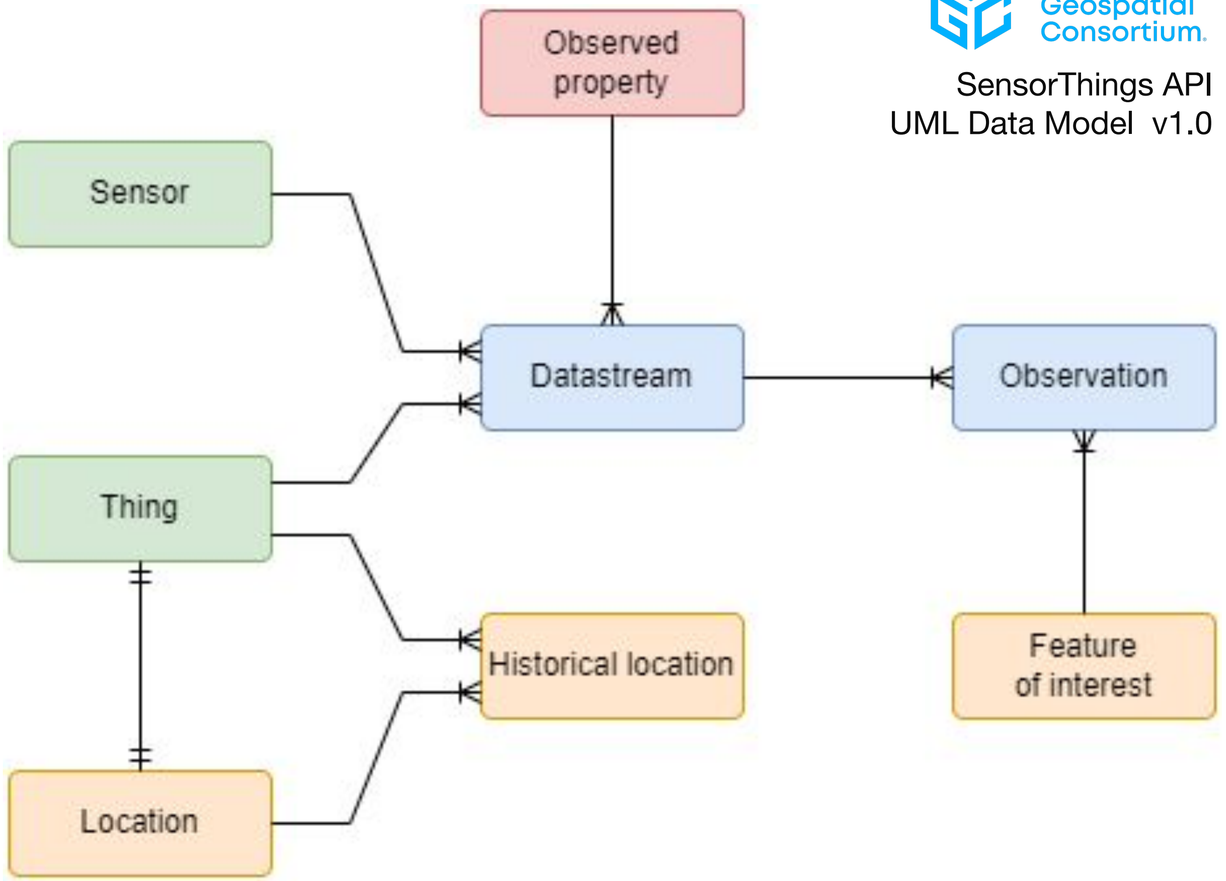
⟶ Automated data flows are required.

⟶ Large volumes of heterogeneous data must be made fully interoperable.

Metadata standards

(Meta)data models define:

- Terminology
- Semantic links
- Formats (e.g. date and time)
- Units



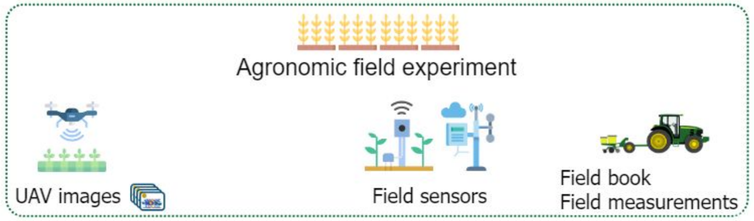
SensorThings API
UML Data Model v1.0

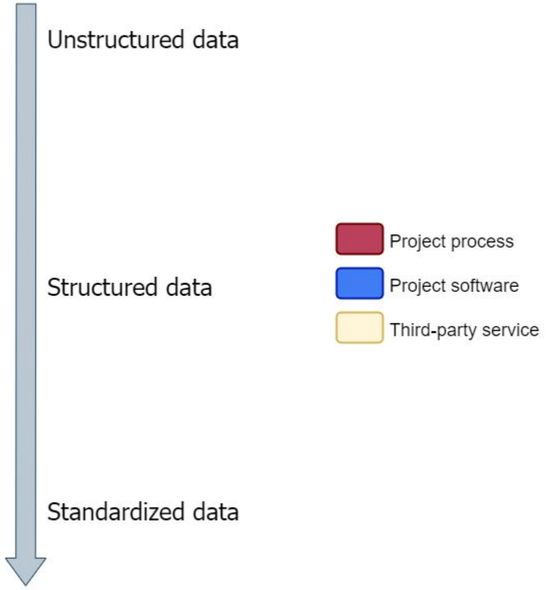
Proof-of-Concept-Experiment

- Wheat fertilization trial in Triesdorf
- IoT soil temperature and moisture sensors and weather stations
- Crop monitoring with drones: high-resolution vegetation indices (NDVI, EVI)
- Integrated crop management, yields, and soil profiles
- Data enrichment with secondary sources: ISRIC SoilGrids, NASA Power

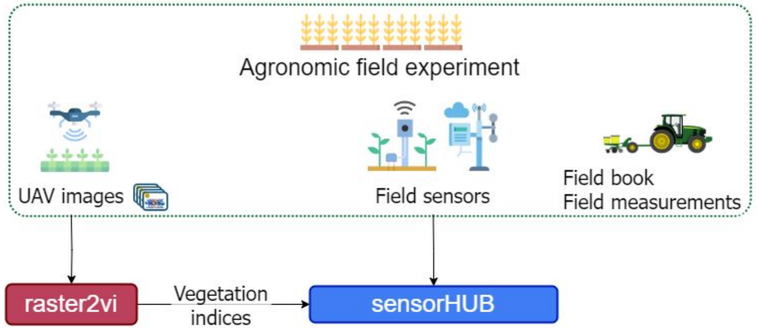
Sebastian Burkhart

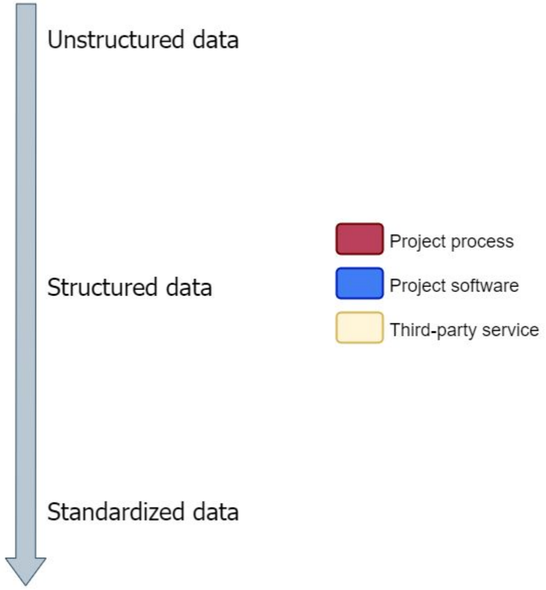
Data integration workflow



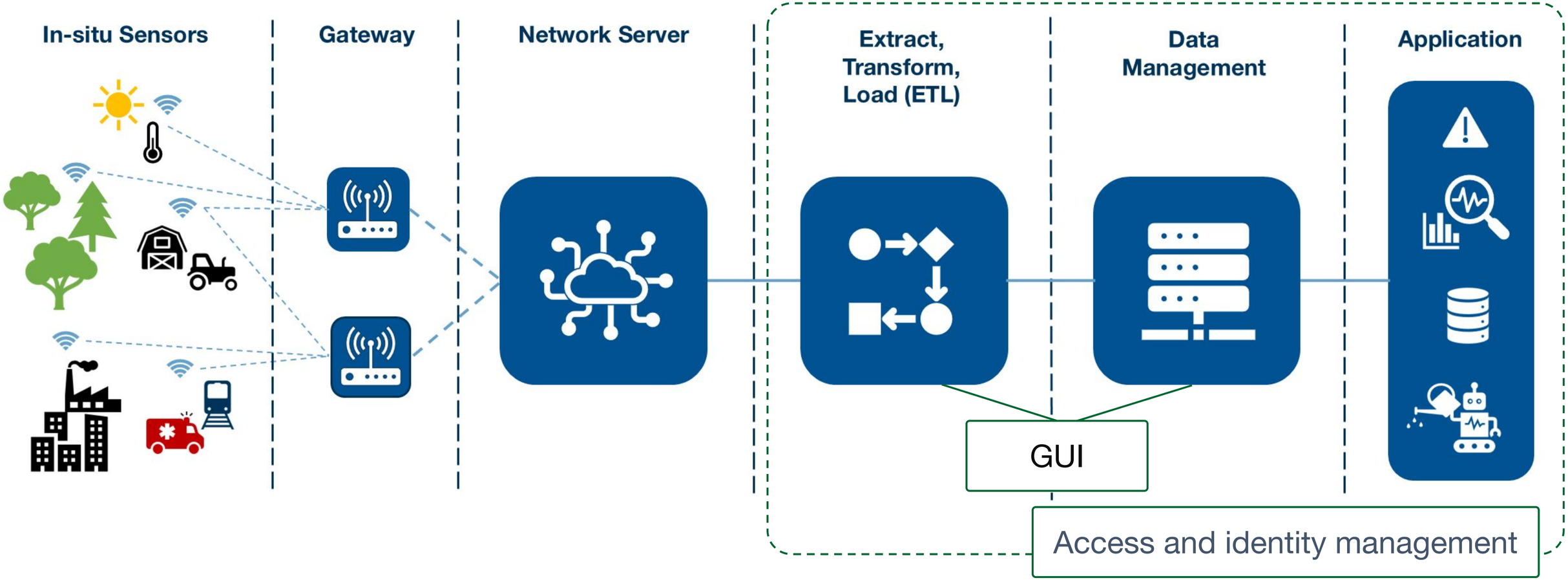


Data integration workflow

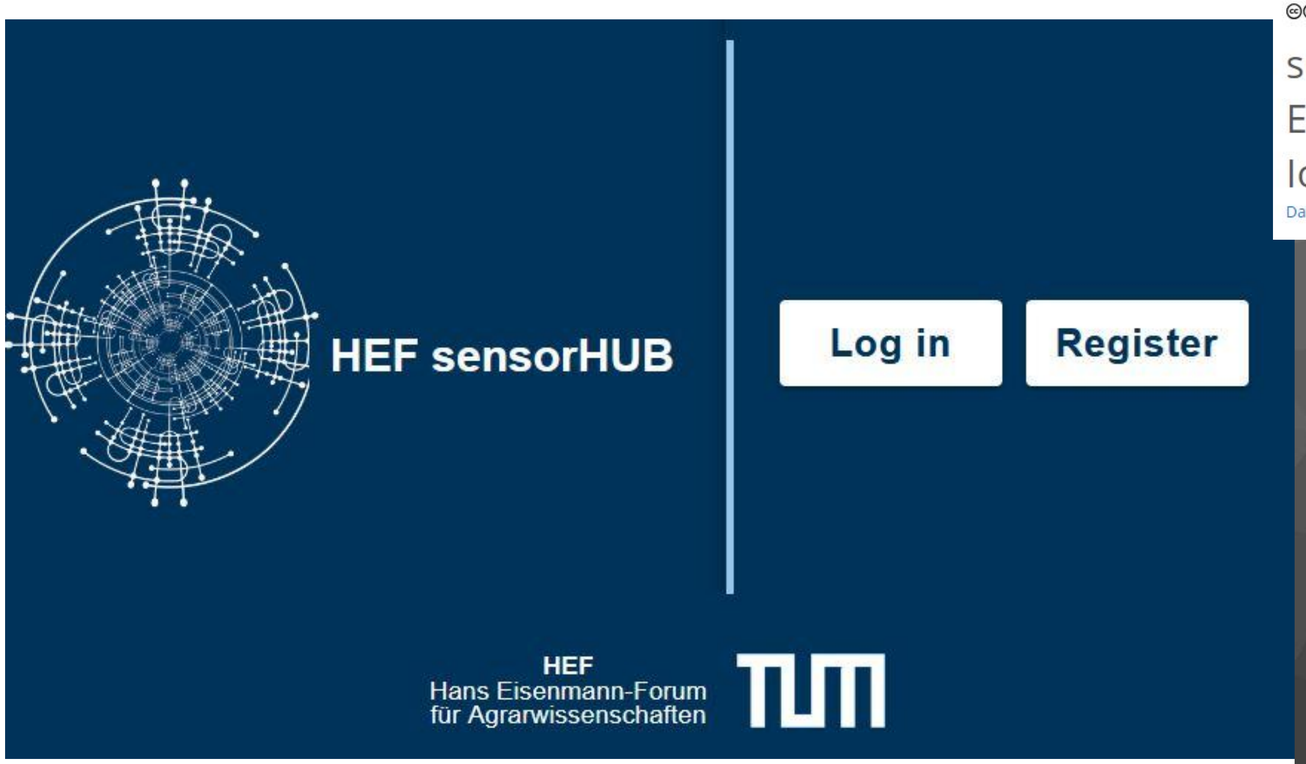




sensorHUB


In-situ Sensors
Gateway
Network Server
Extract, Transform, Load (ETL)
Data Management
Application
GUI
Access and identity management

sensorHUB Webanwendung



https://doi.org/10.5194/isprs-archives-XLVIII-4-2024-197-2024
© Author(s) 2024. This work is distributed under
the Creative Commons Attribution 4.0 License.

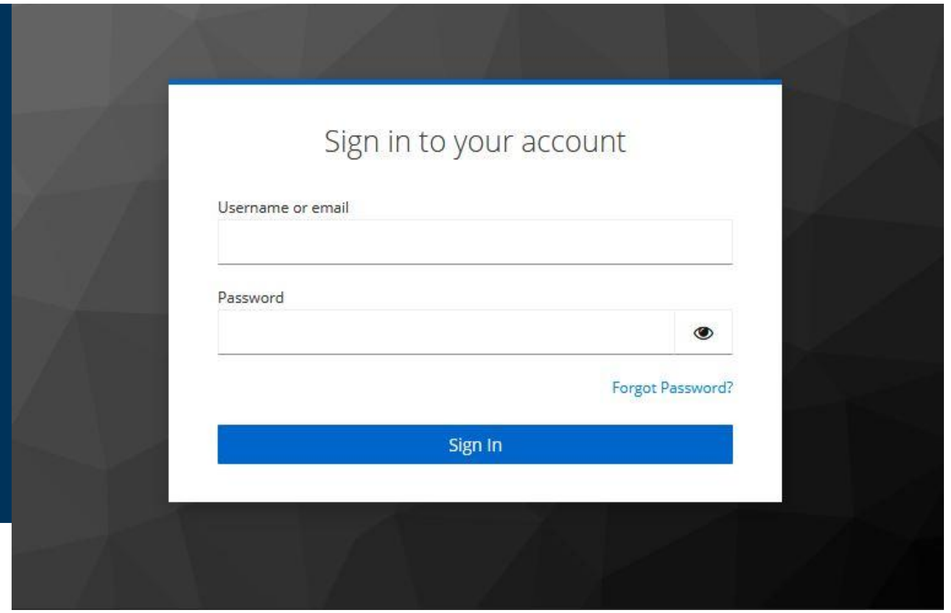
Articles | Volume XLVIII-4-2024

Article | Metrics | Related articles

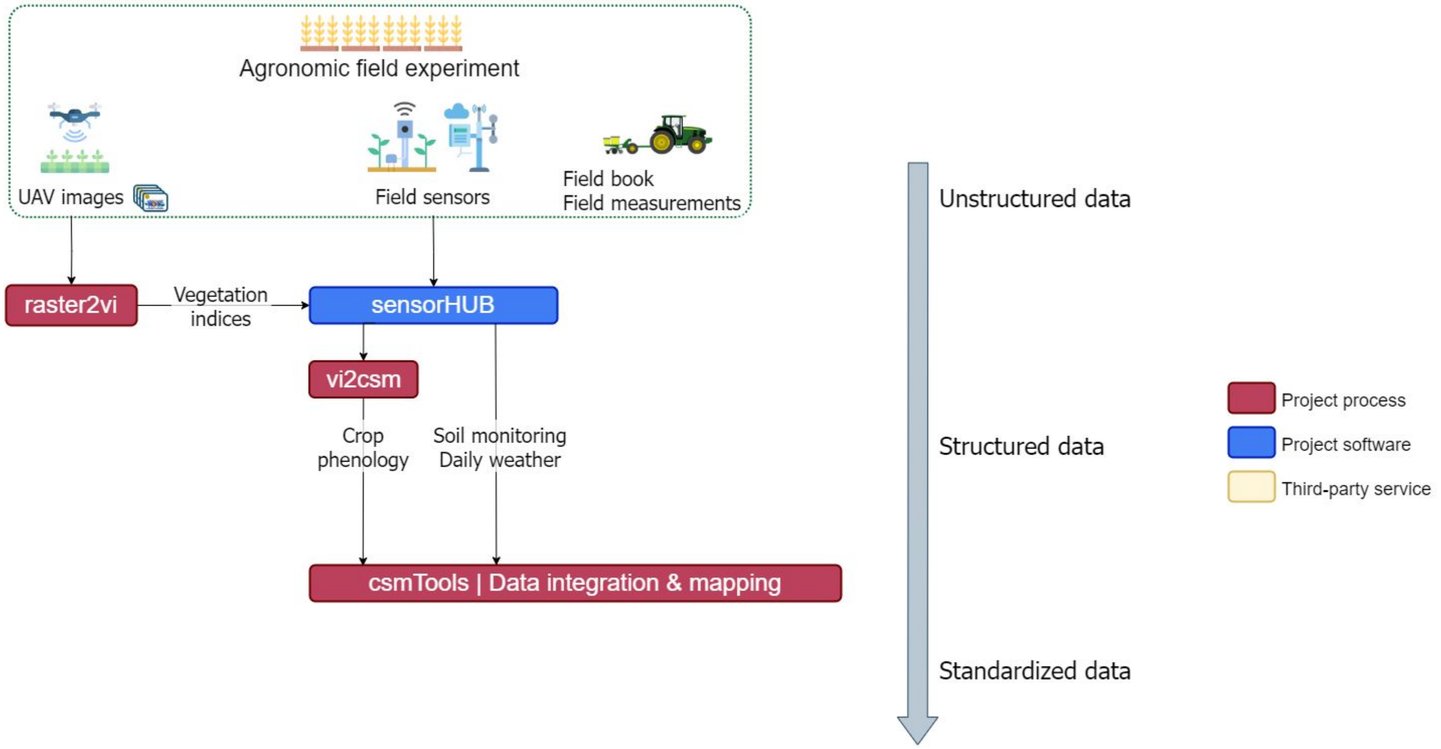
21 Oct 2024

sensorHUB – a Novel, Open-source Software Stack for Enhanced Accessibility and Secure Interoperability in IoT Project Management

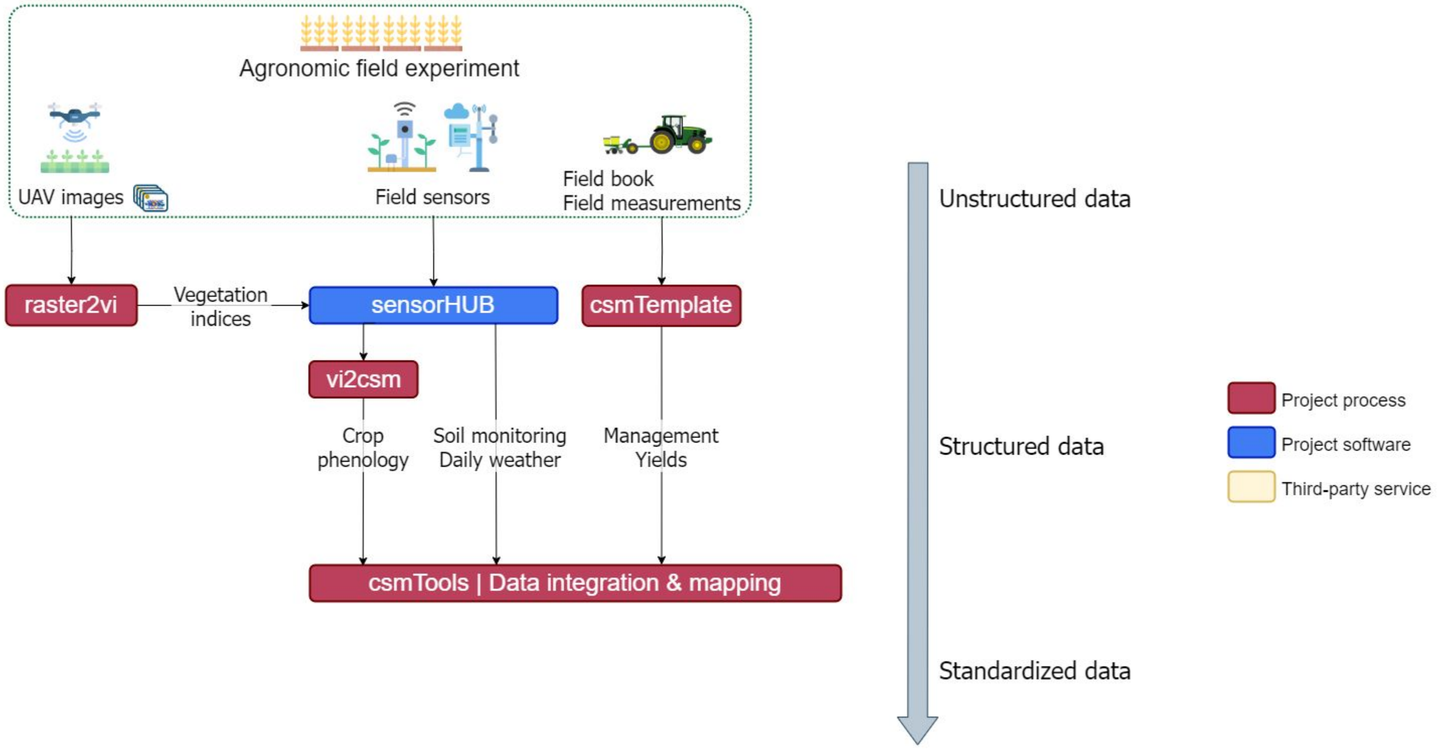
David Gackstetter, Parid Varoshi, and Senthold Asseng



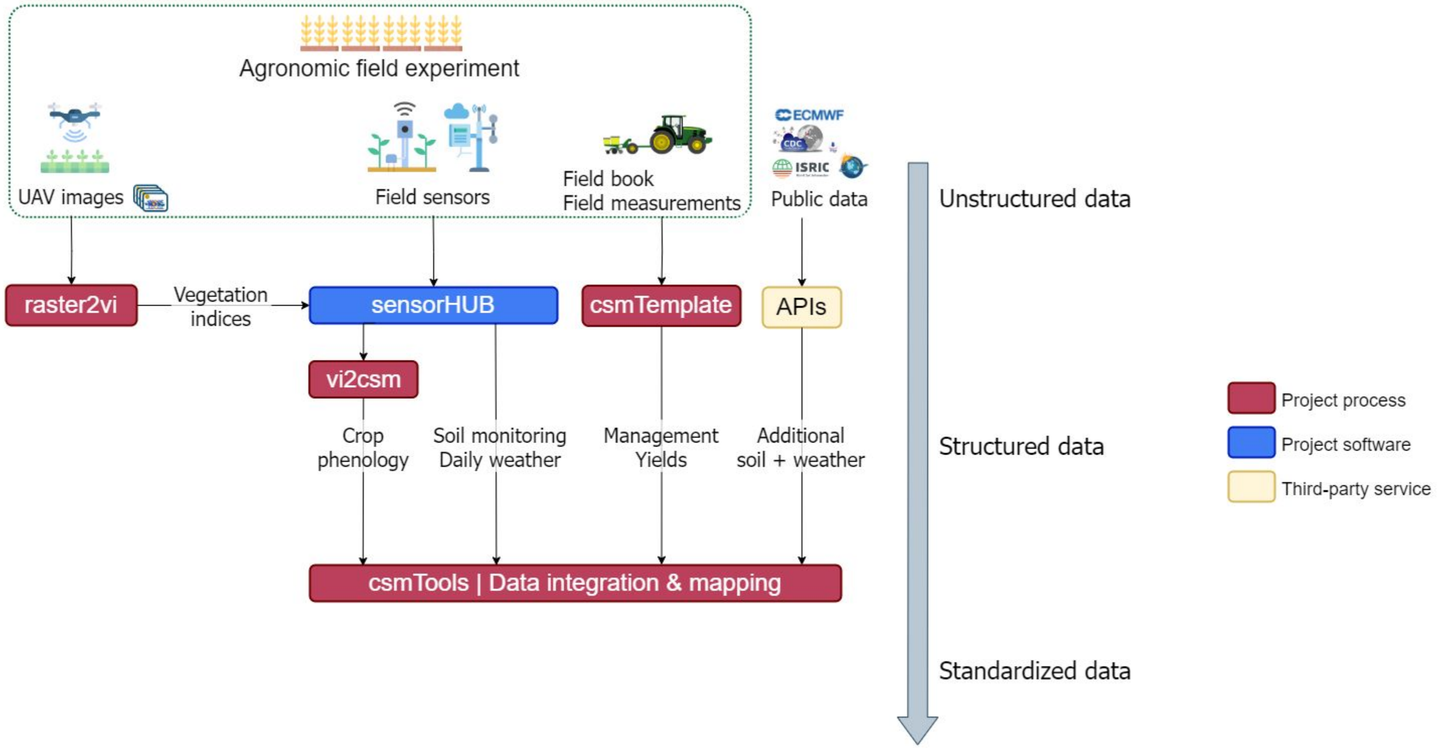
Data integration workflow



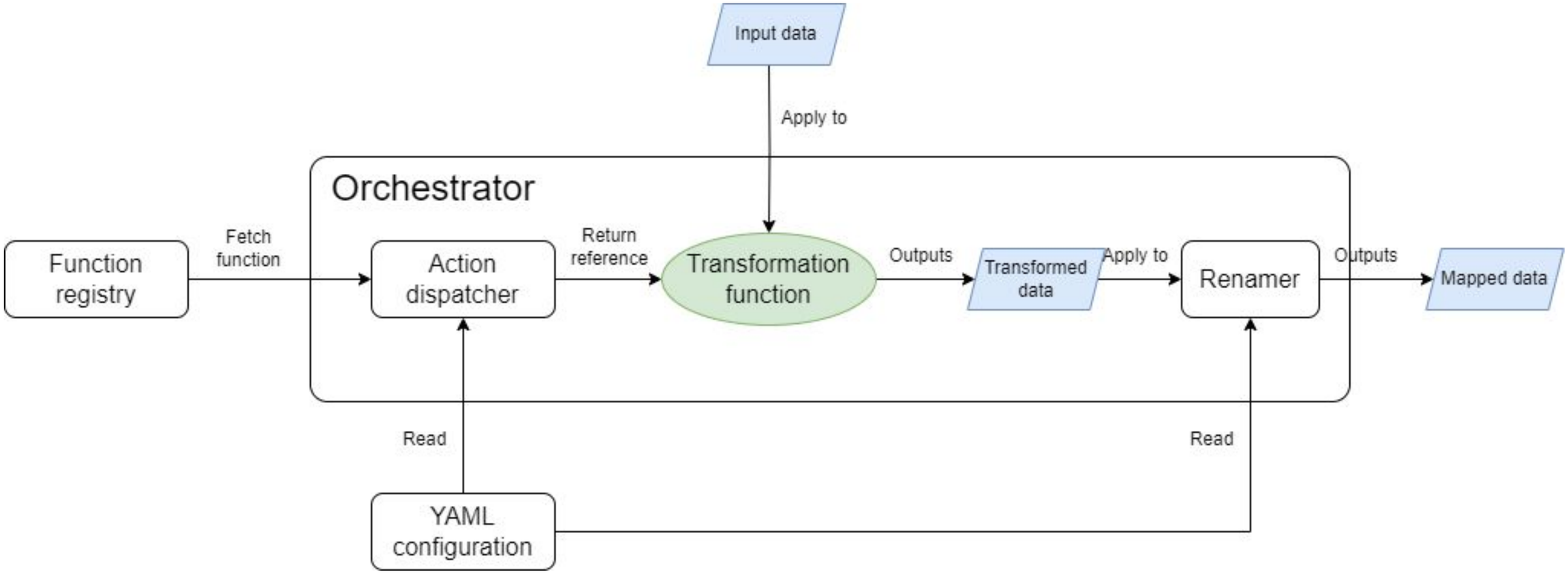
Data integration workflow



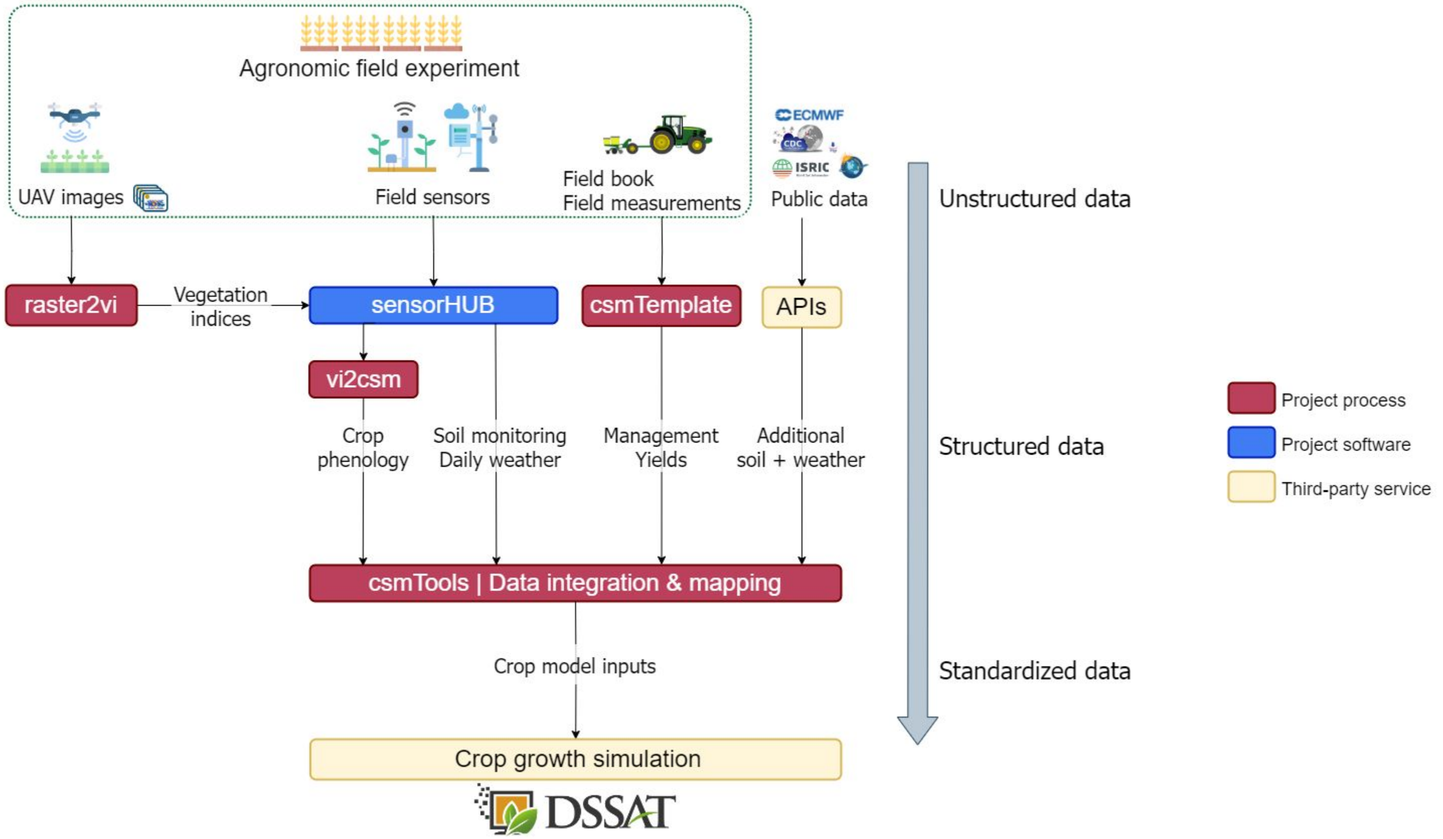
Data integration workflow



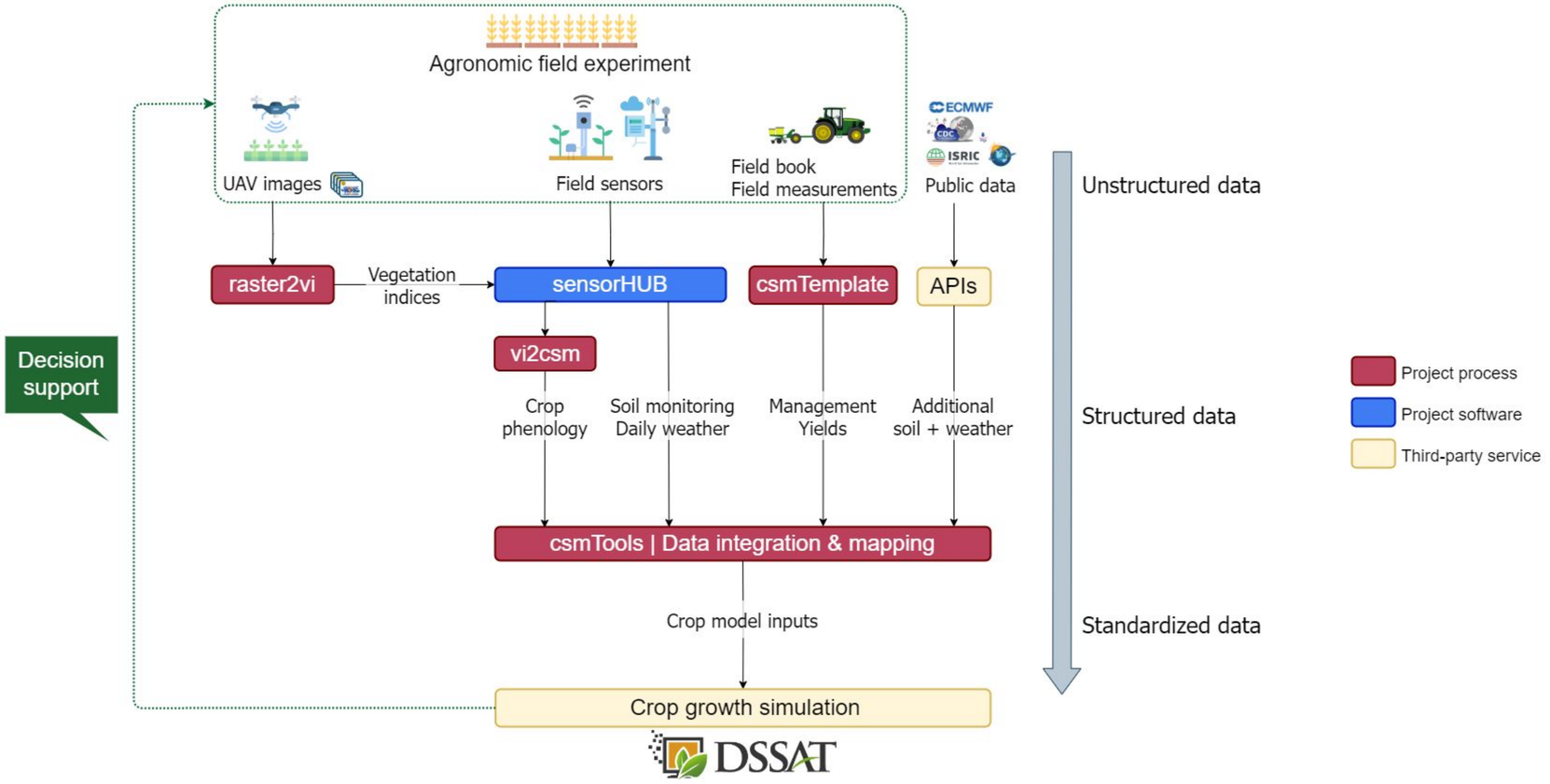
Data mapping engine



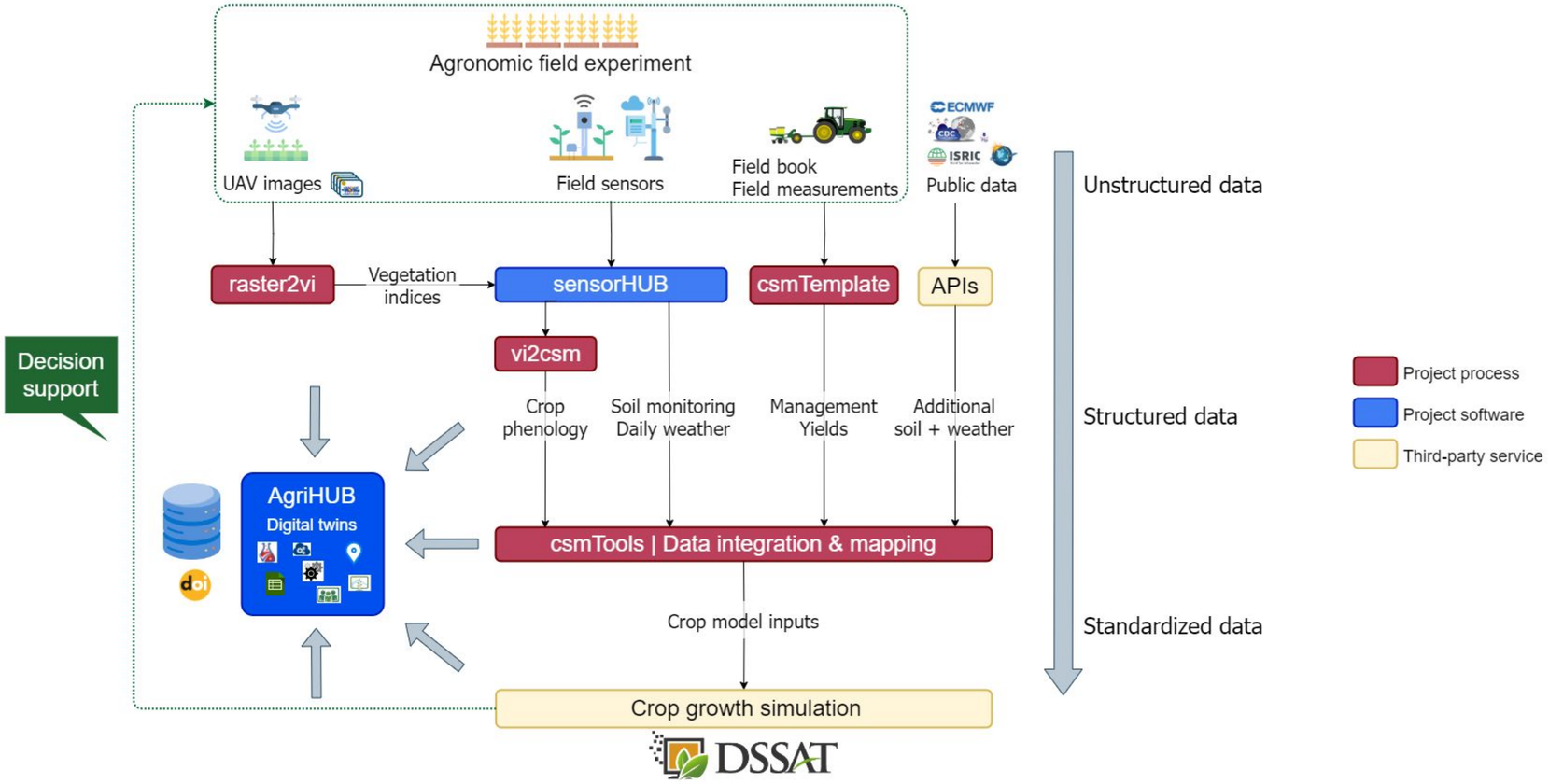
Data integration workflow



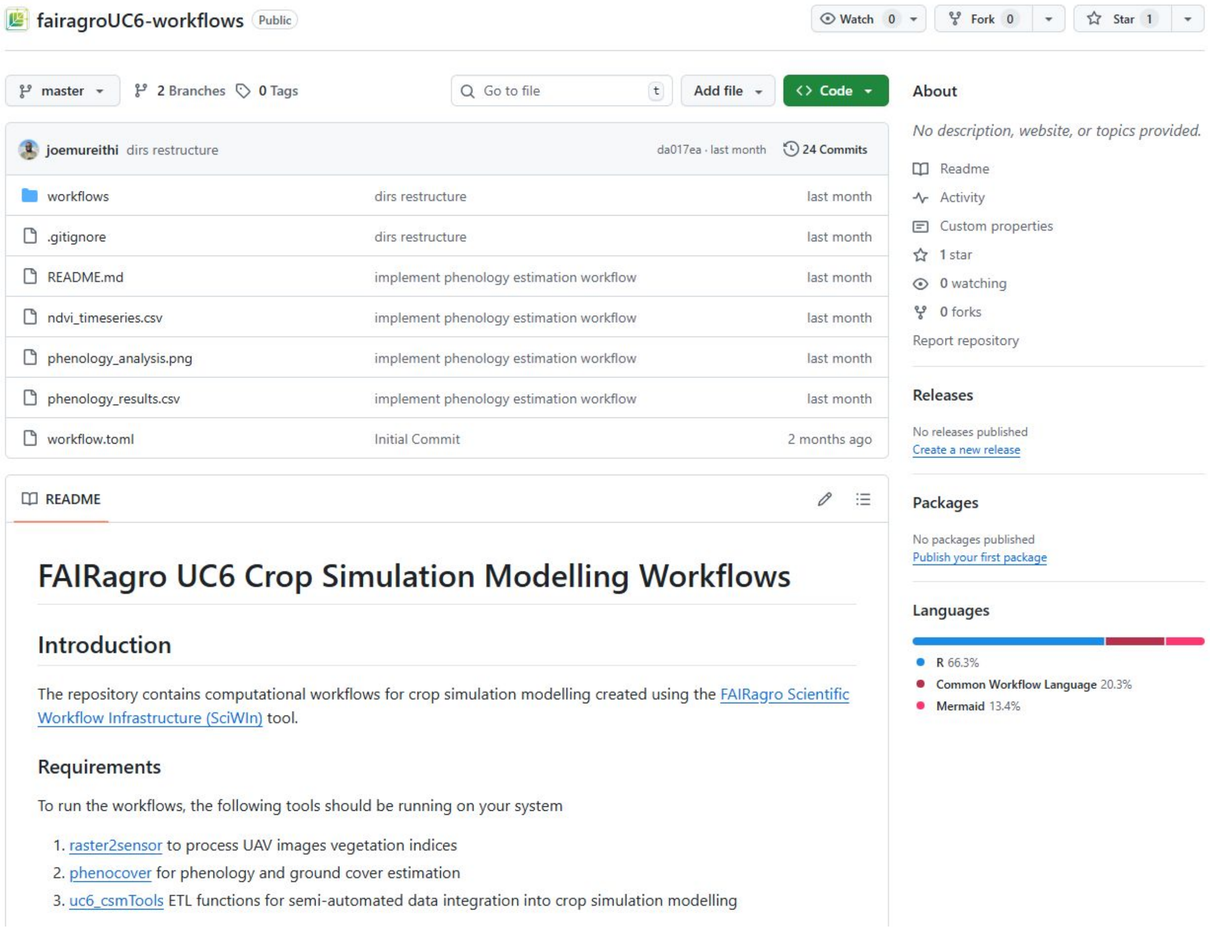
Data integration workflow



Data integration workflow



SciWIn workflow



https://github.com/fairagro/fairagroUC6-workflows

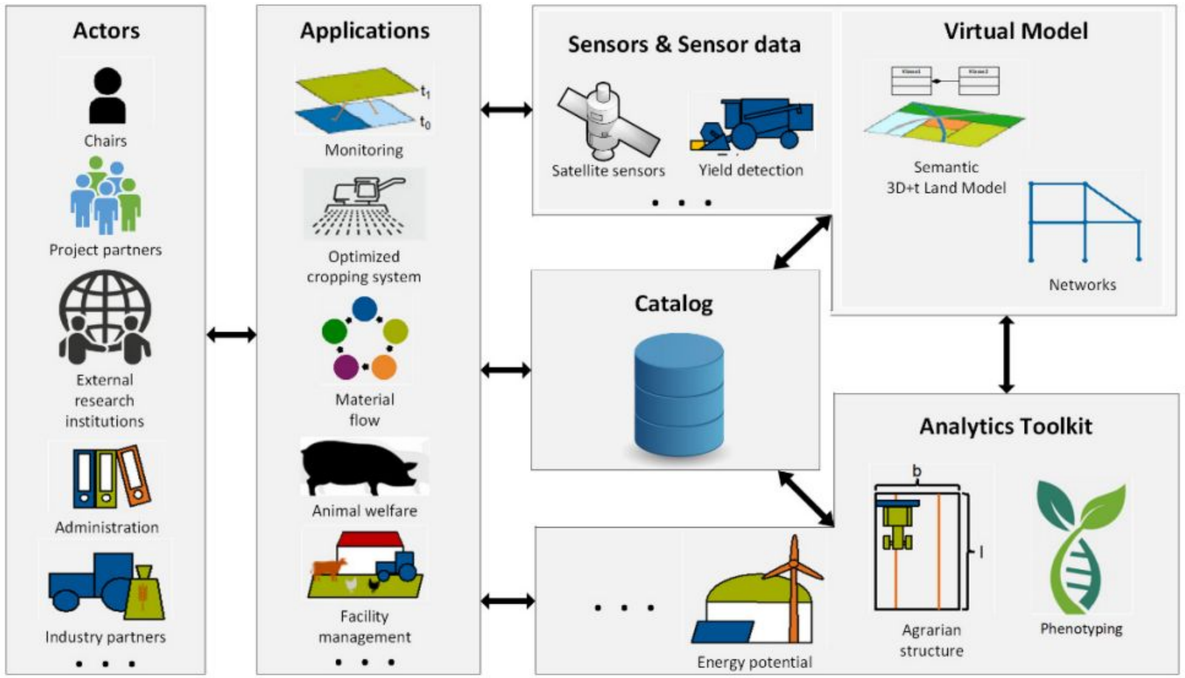
- Runs!
- Allows combining Python and R components (full workflow run)
- Should be optimized with further work with SciWIn team

  → Running the different R commands as separate workflow required a command-line interface

  → Running the demo script with hard-coded arguments easier but less user control

SRADI - Smart Rural Area Data Infrastructure

Objective: foster the availability and harmonization of specialized agricultural data across stakeholders



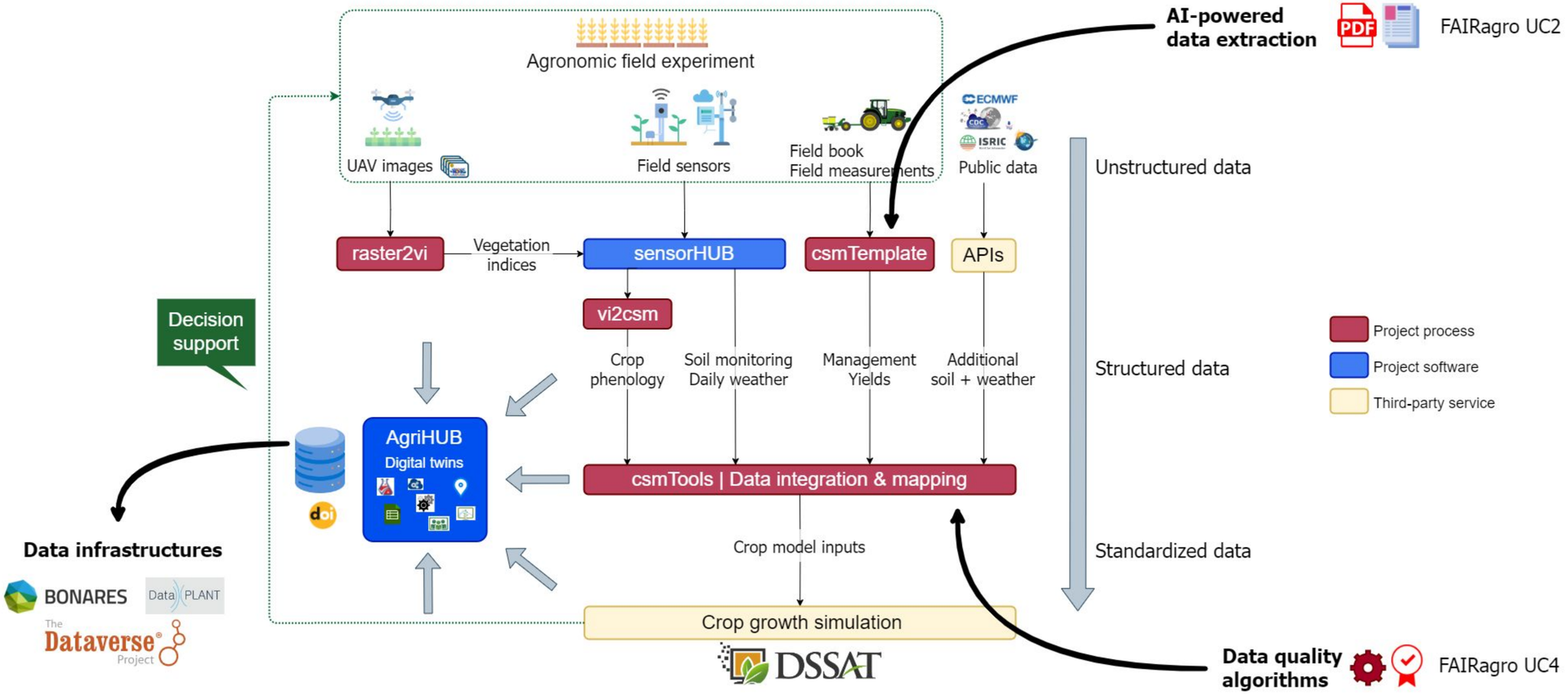
→ Links actors, applications to digital twins of distributed information resources

→ The AgriHub catalogue registers all digital twins and their relationships

→ Builds upon established international standards (DCAT, OGC, ISO…)

→ Handles various resource types: projects, actors, data, devices, web applications/services, software, landscape objects, animals…

Modularität und Skalierbarkeit



WEIHENSTEPHAN · TRIESDORF
University of Applied Sciences

FAIRagro

Thank you for your attention