OST
Ostschweizer Fachhochschule

Institut für Intelligente Systeme und Smart Farming

Institutsvorstellung

ISF | Institut für Intelligente Systeme und Smart Farming

Wer bin ich?

Kurze Vorstellung

- Promoviert in **Hannover**, an der Leibnitz Universität: Pflanzenerkennung aus 3D Punktewolken
- Berufliche Entwicklung:
  - **Leica Geosystems AG** (Heerbrugg)
  - **ZHAW**, Zürcher Hochschule für Angewandte Wissenschaften
  - **HKA**, Hochschule Karlsruhe
  - **HSR**, Hochschule Rapperswil
  - **OST** – Ostschweizer Fachhochschule

Quelle: https://www.behance.net/gallery/75068381/My-big-Atlas-of-the-Switzerland-Auzou-6-years-old?moduleId=436419105&action=moodboard

Die Präsentation

- Das ISF – Team
- Entstehung vom ISF
- Intelligente Systeme in der Landwirtschaft: Ideen aus Vergangenheit…
- Woran arbeiten wir jetzt?
- Was bringt die Zukunft?

Das Team

Das ISF – Team

Vorstellung Team ISF

Dejan Šeatović		Head of Institute
Luis Meier		Mechatronics & Robotics Engineer
Marco Morf		Data Science Engineer
Dominic Diedenhofen		Mechatronics & Robotics Engineer
Robin Ehrensperger		Mechatronics Engineer
Anna Pietak		Electrical Engineer
Jonas Scholz		Mechanical Engineer
Alexander Meier		Mechanical Engineer
ANYmal		ANYbotics Robot

Die Chronologie des ISF

Projektskizze Innovationsforum — 2020/01 - 2020/11

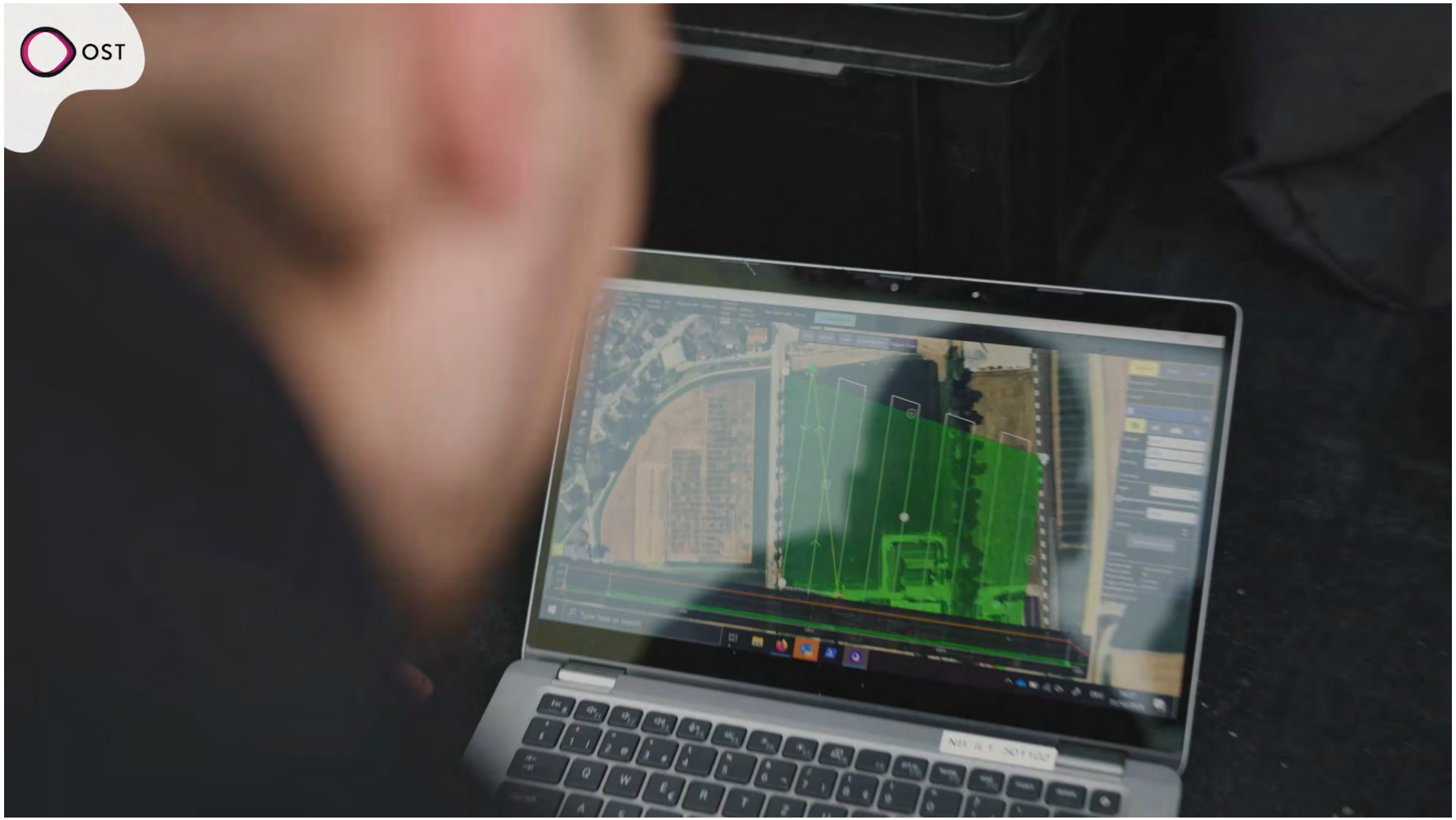
Ideenentwicklung OST Tänikon — 2020/12 - 2022/02

Living Lab Phase I — 2022/12 - 2023/05

Living Lab Phase II — 2023/09 - 2024/12

Rumex Detection

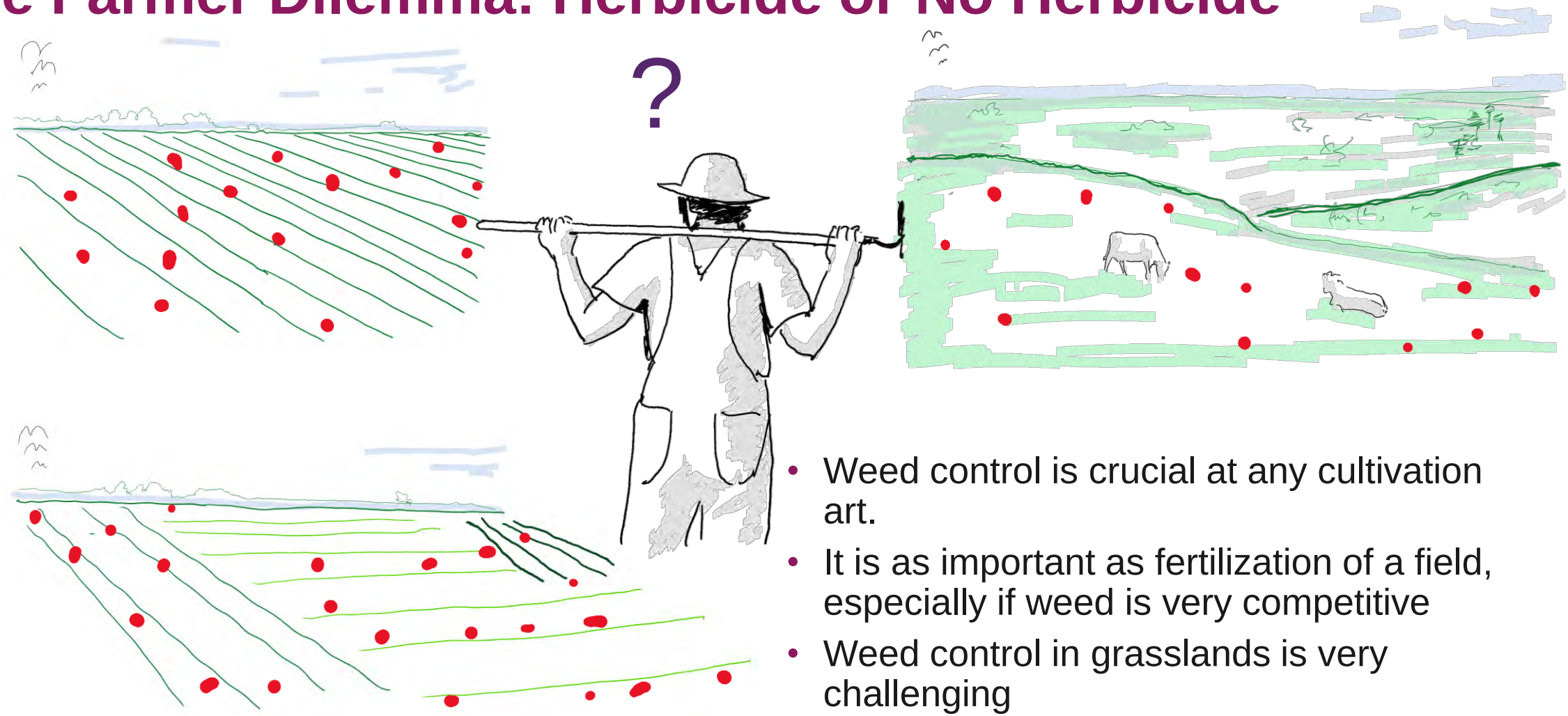
fenaco Sunrise HUAWEI Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra



Towards Autonomous Field Systems and Smart Farming

Weed detection and treatment

The Farmer Dilemma: Herbicide or No Herbicide

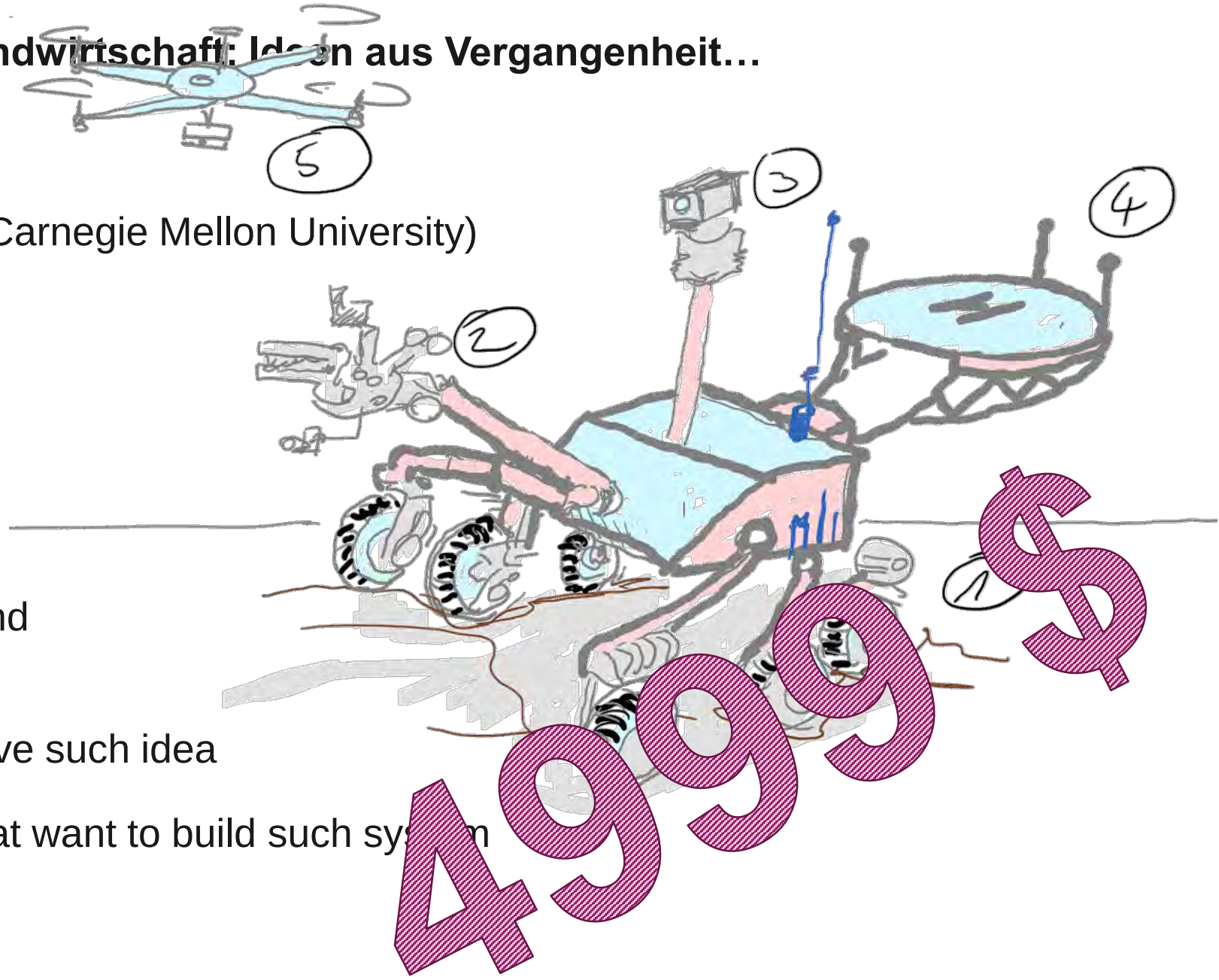


- Weed control is crucial at any cultivation art.
- It is as important as fertilization of a field, especially if weed is very competitive
- Weed control in grasslands is very challenging

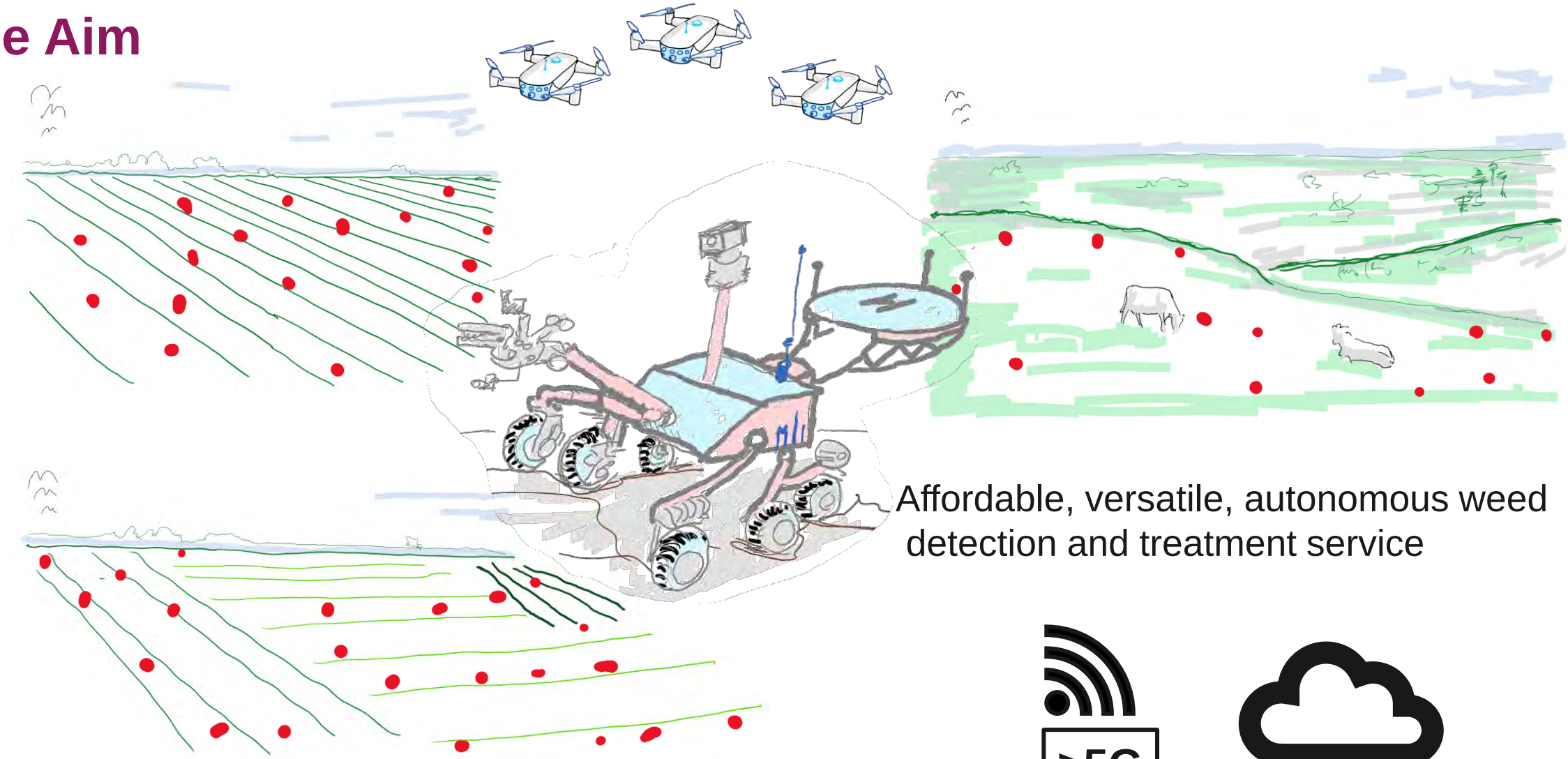
The Idea

1. UGV – A carrier (Design by Carnegie Mellon University) a UGV inspiration
2. Manipulator
3. Ground sensing systems
4. A UAV – Landing platform
5. A UAV for remote sensing and reconnaissance

- We are certainly not first to have such idea
- We are probably first group that want to build such system for 5000 $US

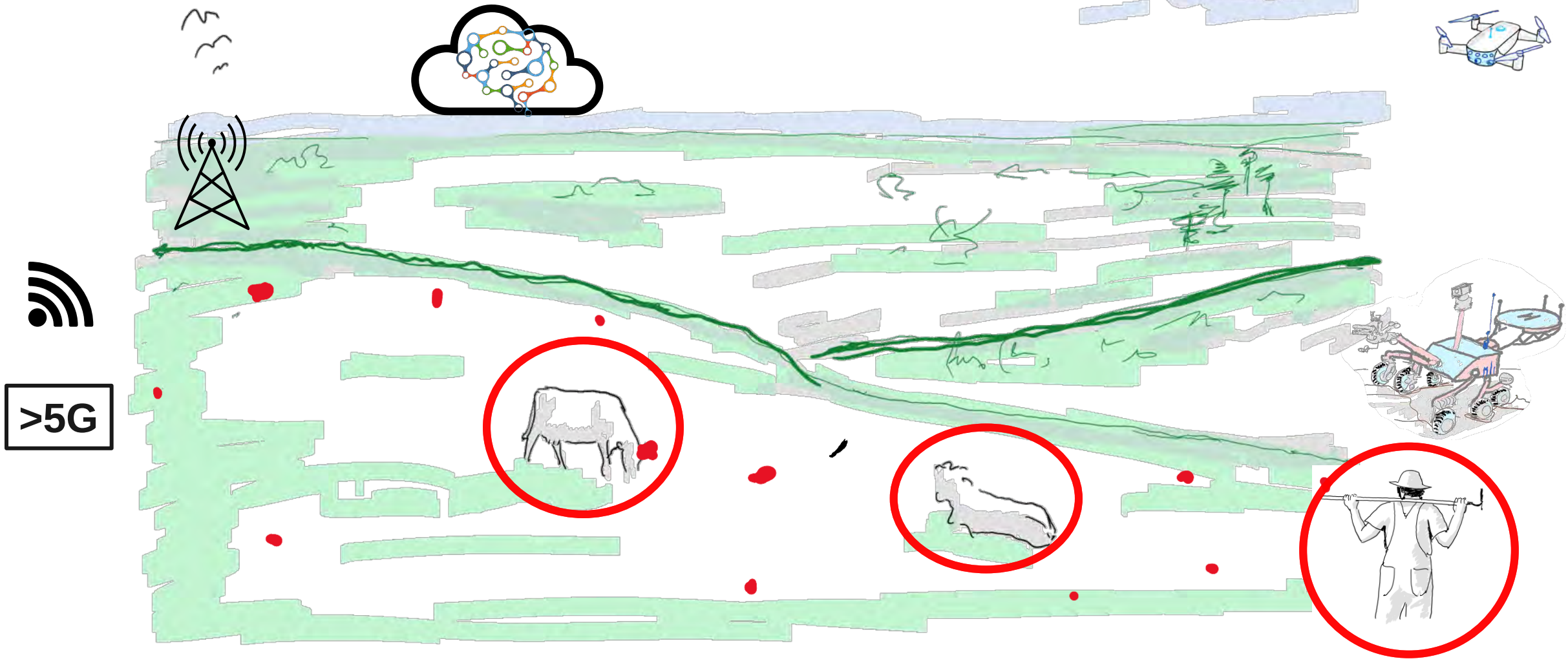


The Aim



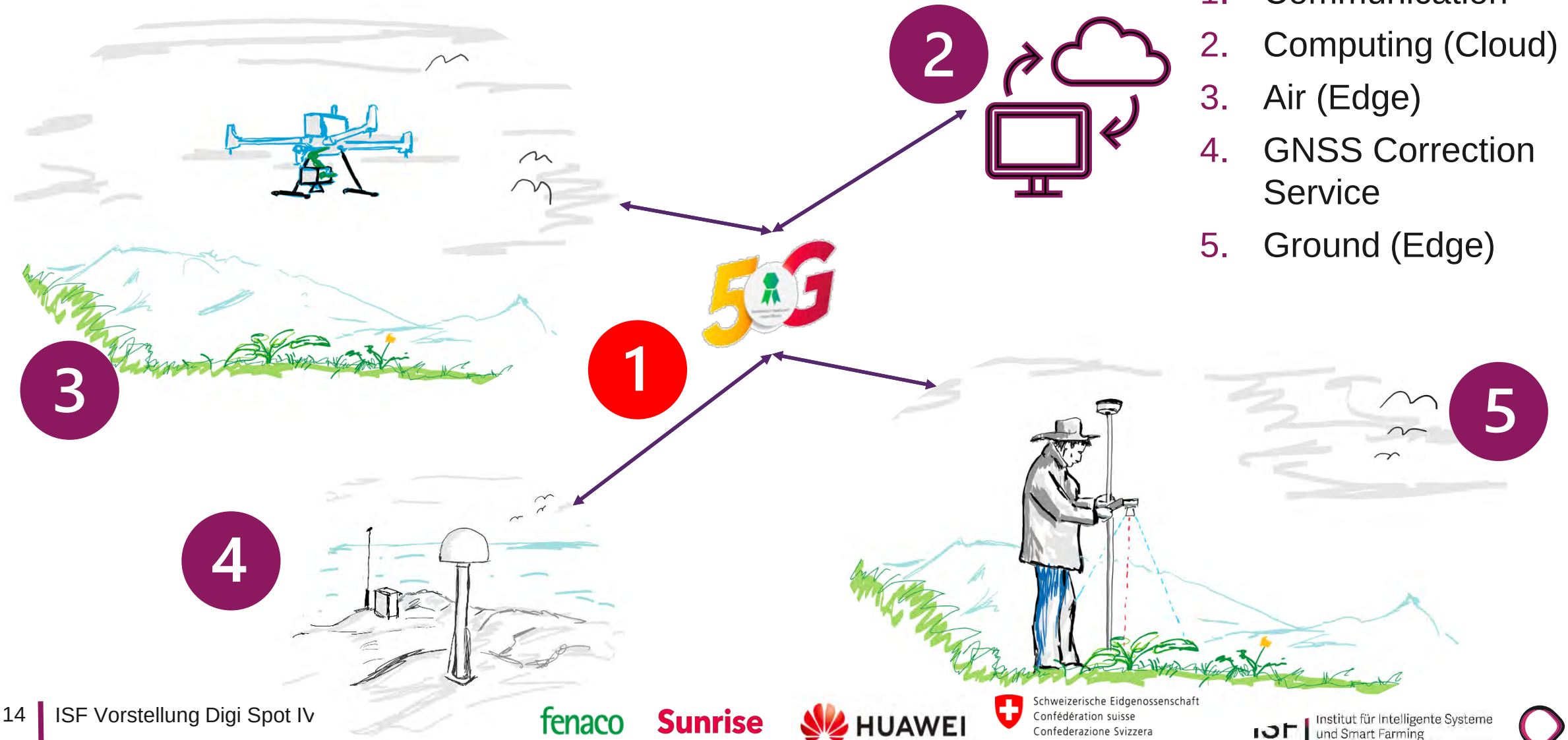
Affordable, versatile, autonomous weed detection and treatment service

Weed Detection and Treatment in Grasslands



Intelligente Systeme in der Landwirtschaft: Ideen aus Vergangenheit…

Broad Leaved Control: 120.476 IP-EE



Segments:

1. Communication
2. Computing (Cloud)
3. Air (Edge)
4. GNSS Correction Service
5. Ground (Edge)

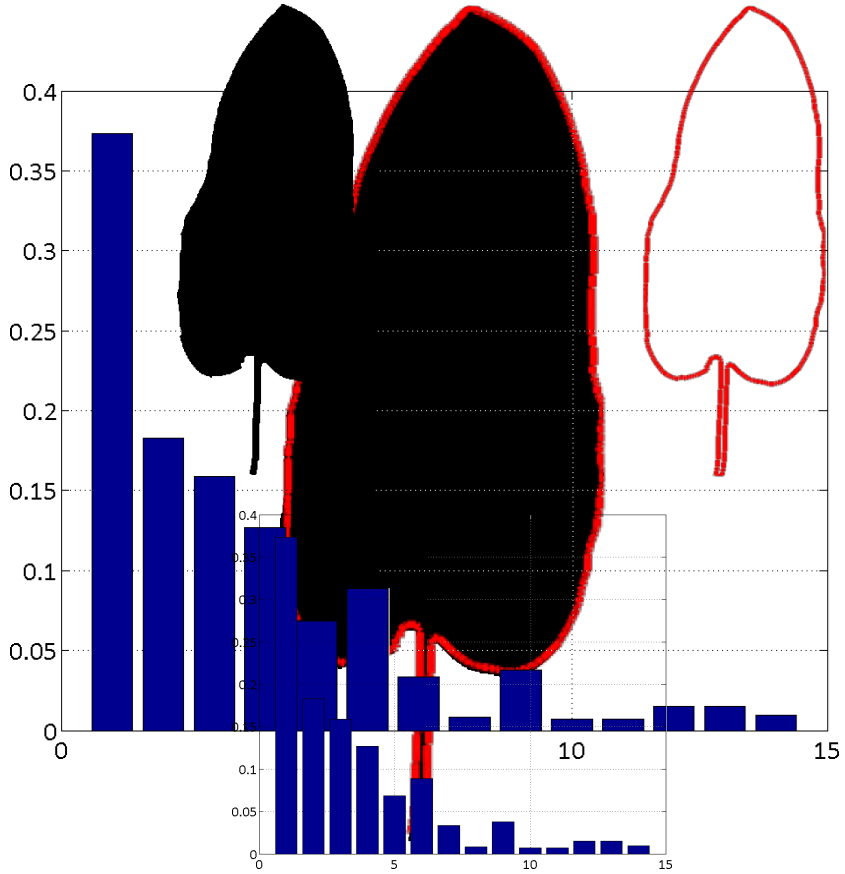
fenaco Sunrise HUAWEI Schweizerische Eidgenossenschaft Confédération suisse Confederazione Svizzera Confederaziun svizra ISF Institut für Intelligente Systeme und Smart Farming OST

Komponenten einer Vision

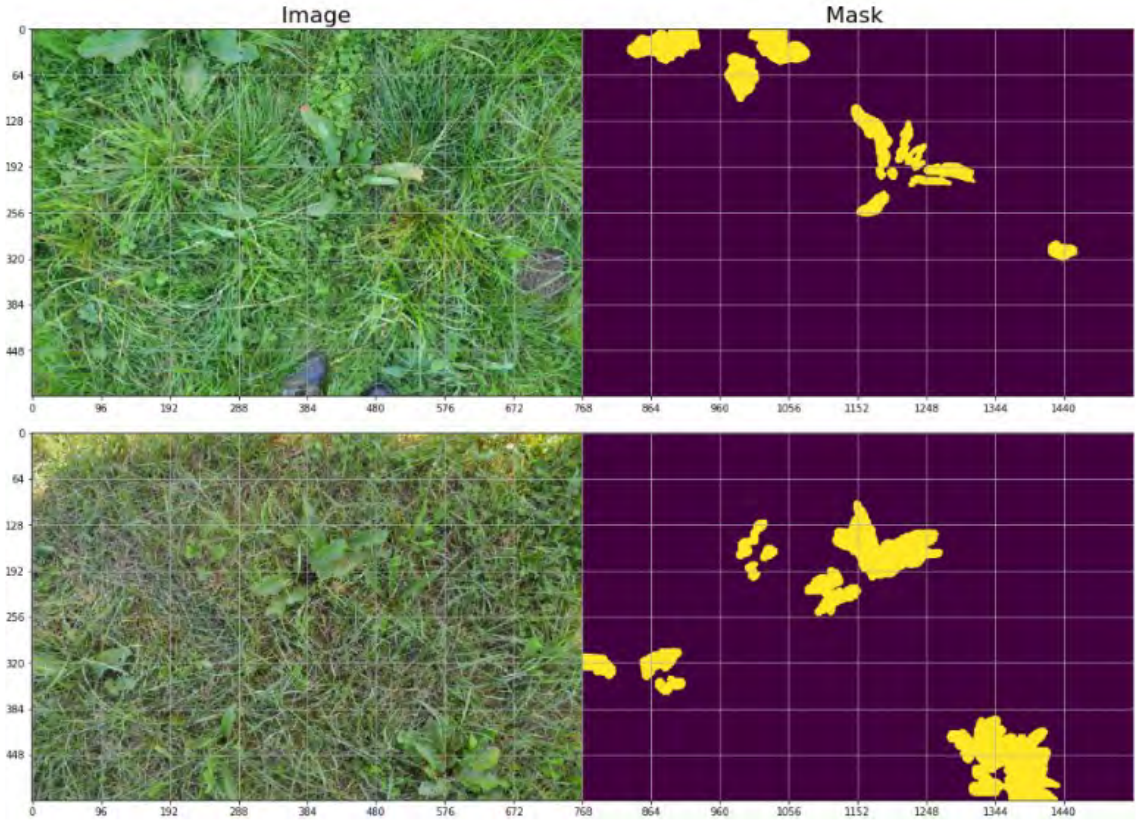
Weed Detection

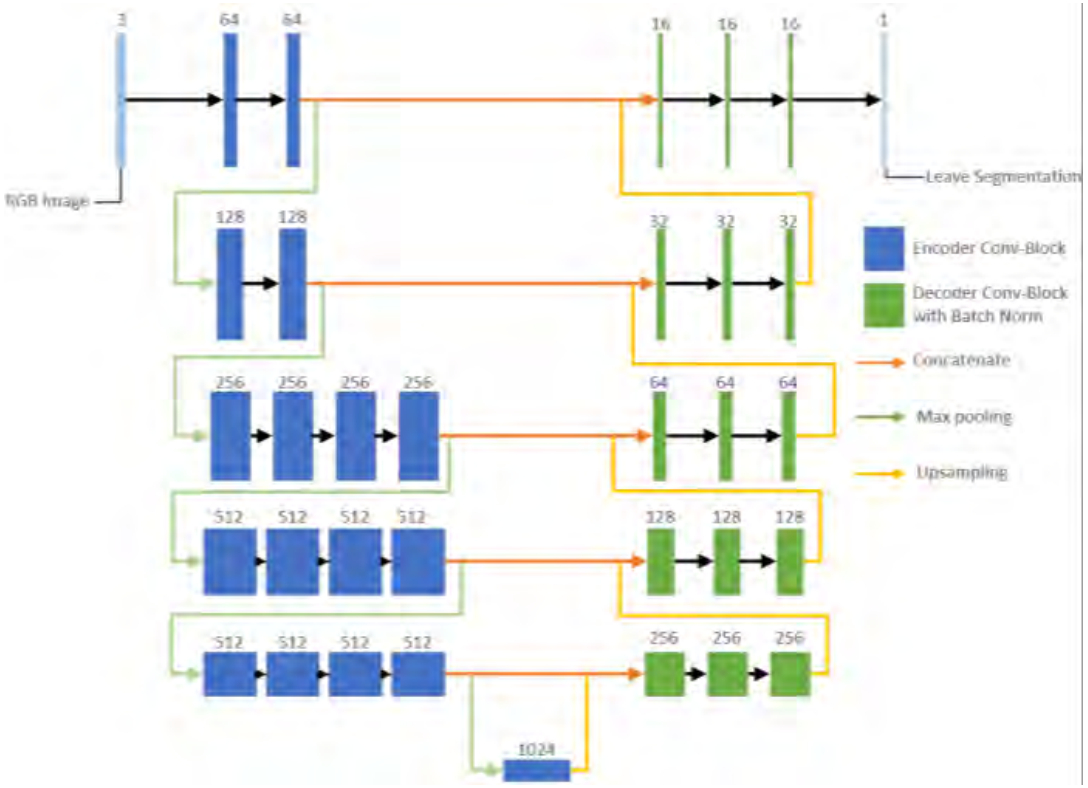
The Machine View of Weed Control

Maschinenvision, die Herausforderung.



U-Net Based Segmentation Algorithm Detects 95% of Plants





Weed detection

- A real time plant root detection has been developed
- In non-optimized state, the system processes 4 frames per second
- A deep-stream solution will increase the processing rate to 20 frames per second
- Plant roots are not visible in any images
- The root location is 3 cm accurate

Root Detection: Detect Unseen Features

DJI-Zenmuse P1

Orthomosiaic

Detail

Sony Alpha 6000

One Shot

Detail

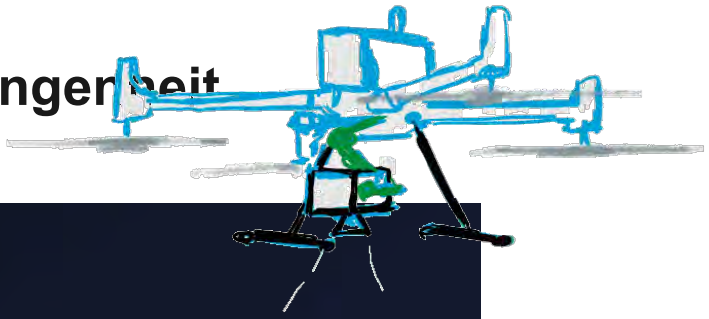
Mavic Mini iso 100, 1/500 exp, 0.5 m/s

Detail

Detail

The Challenge: Balance the Economy and Data Quality

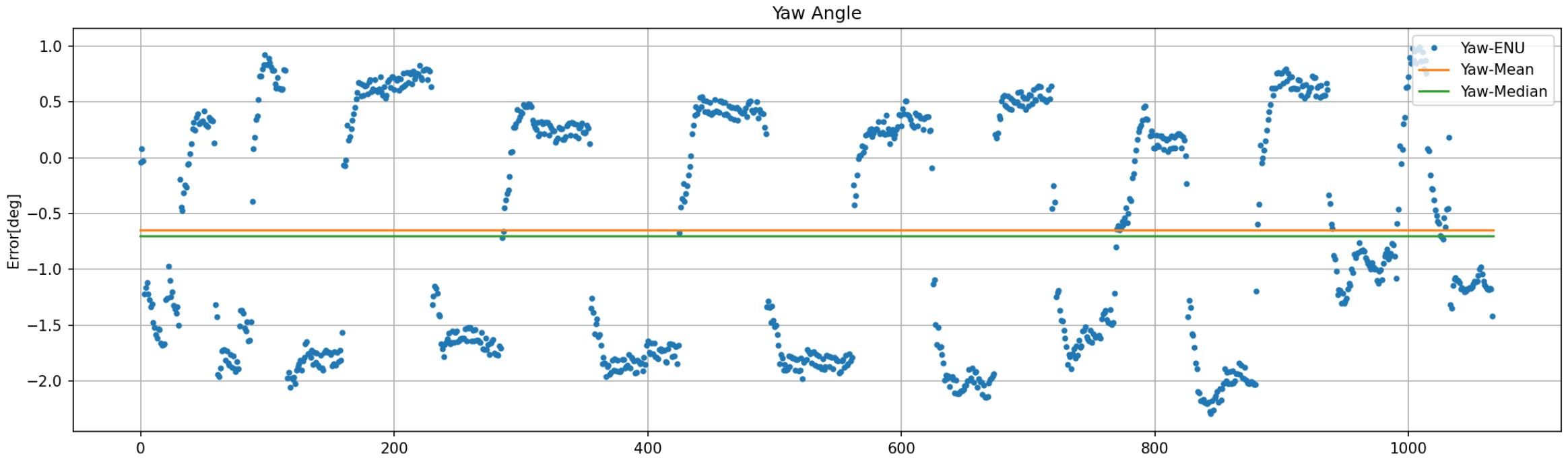
Intelligente Systeme in der Landwirtschaft: Resultate aus Vergangenheit



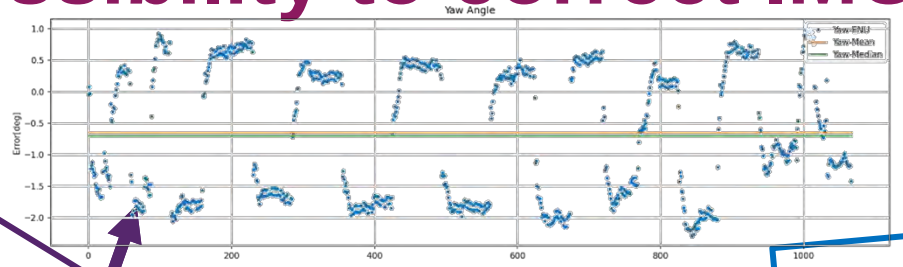
5G

fenaco Sunrise HUAWEI Schweizerische Eidgenossenschaft Confédération suisse Confederazione Svizzera Confederaziun svizra ISF Institut für Intelligente Systeme und Smart Farming OST

Orientation Analysis Using Commercial Software

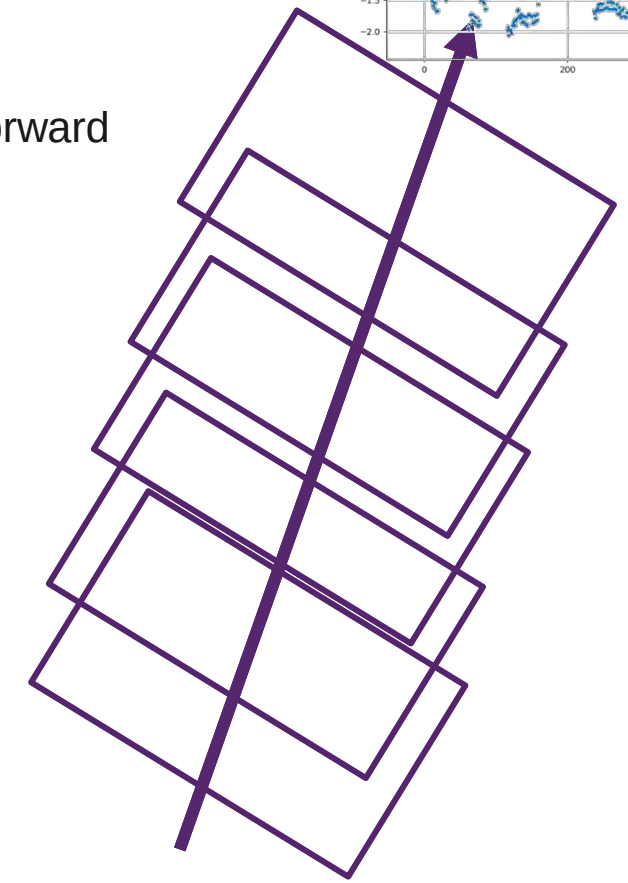


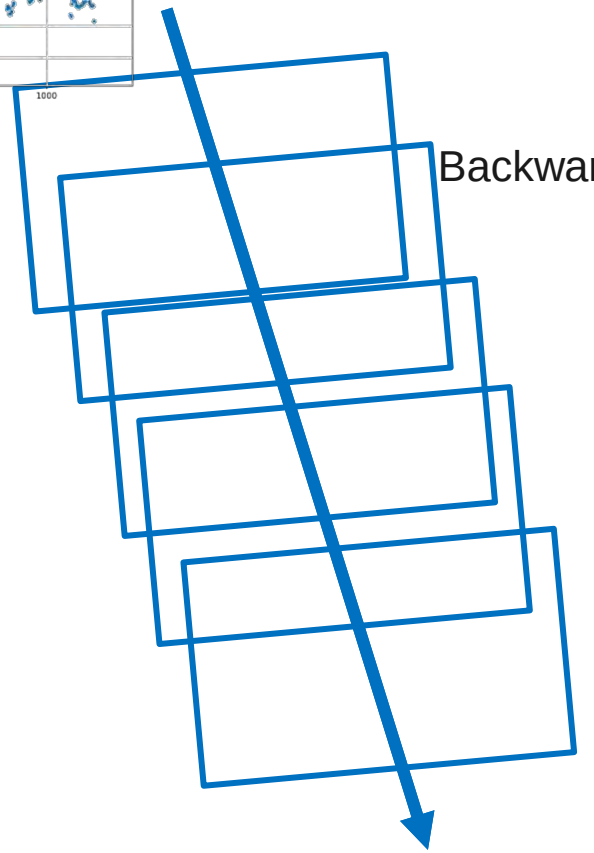
UAV has no possibility to correct IMU drift.



Forward

Backward





IMU error and it's effect on flight path and stripe orientation

Example Session “Härepünt“

Flight facts:

- Images: 2048
- Single image resolution: 48 Mpx
- Data volume for the session: ~51 GiB
- Fllight time: ~40 minutes
- Approximate area: 22 000 m^2

Processing facts:

- Image matching time: 20’ 23”
- Image alignment time: 20’ 45”
- **Complete processing time: 1h 23’ 17”**
- **Covered area: 21 960** m^2
- **Average** camera location error: ~3 cm
- **Average** object location error on the ground: ~3 cm

Image Alignment Result

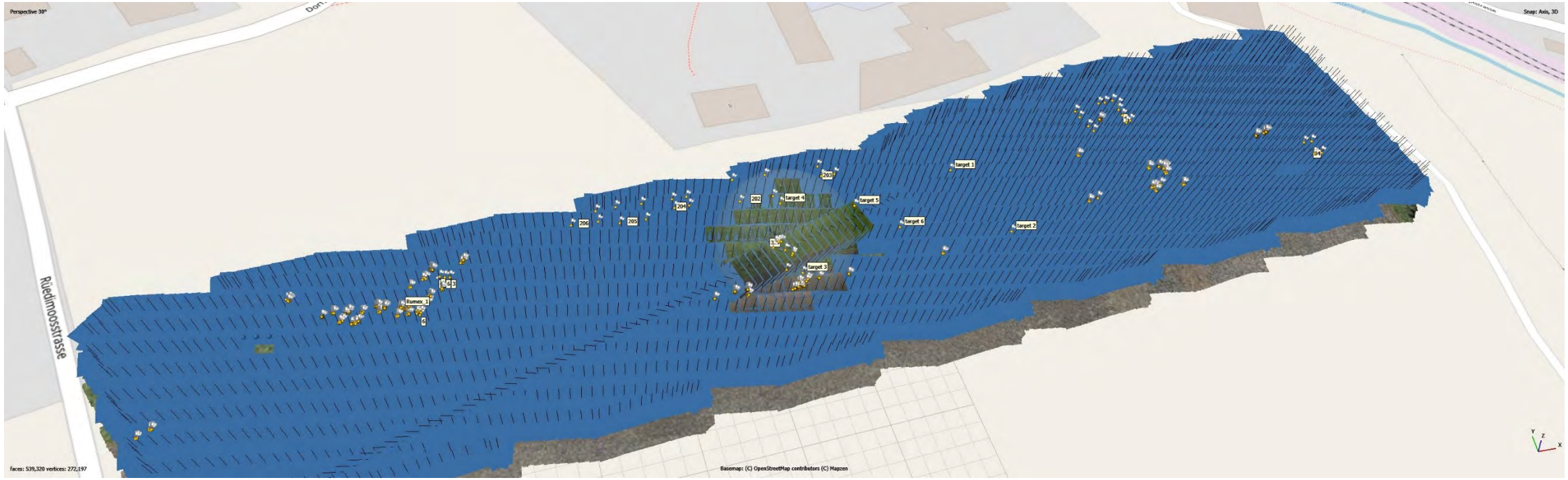
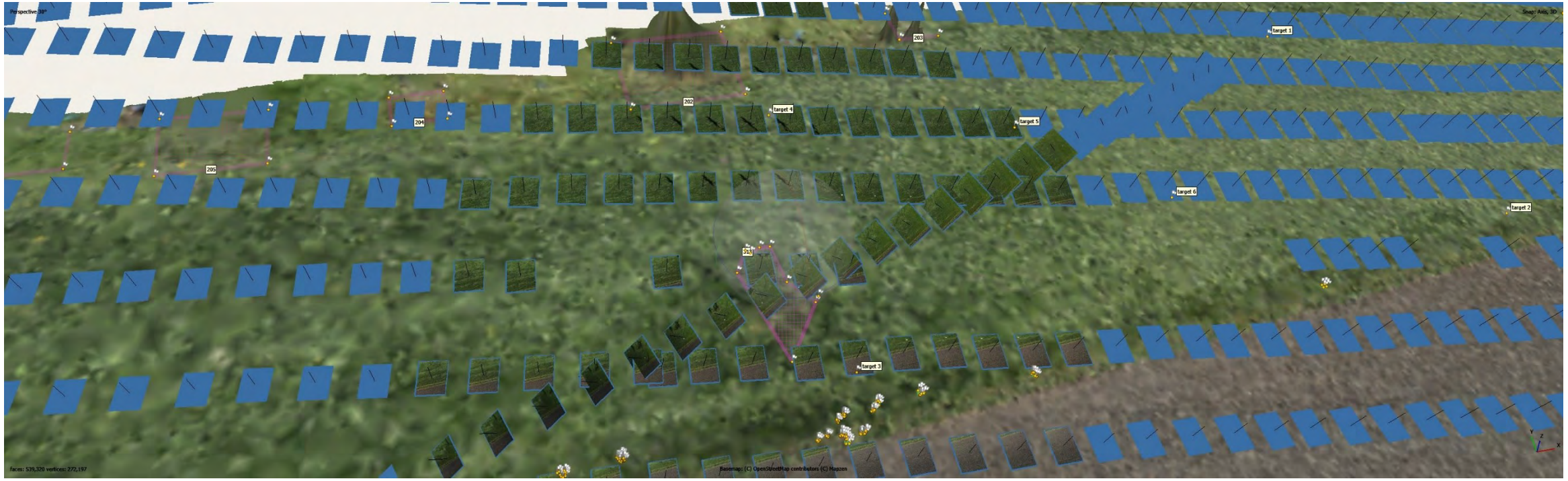
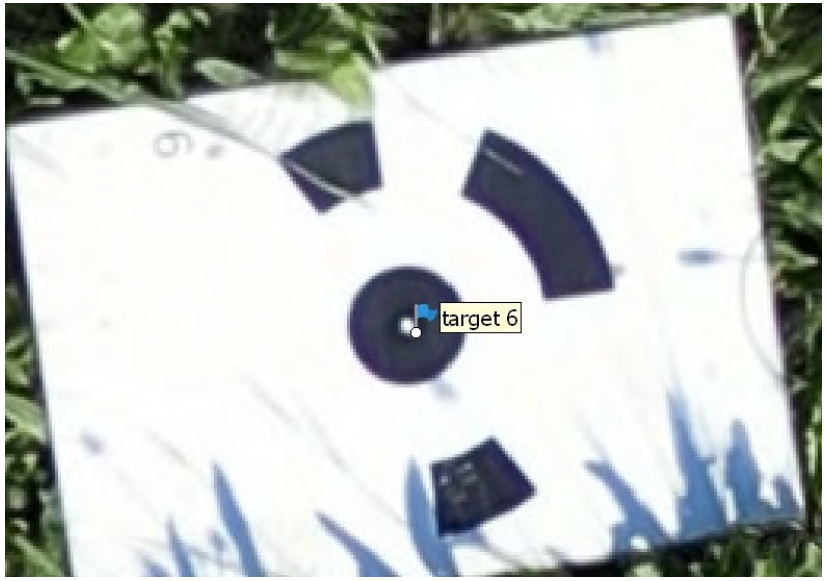


Image Alignment Result (Zoom)





Detection results

Plants are detected in all oriented images…

Look at the image seamline!

“Perfect” meadow map is created and provided to an user

Image “stitching” is almost perfect
Seamlines are almost invisible in orthomosaic

Woran arbeiten wir jetzt?

Woran arbeiten wir jetzt?

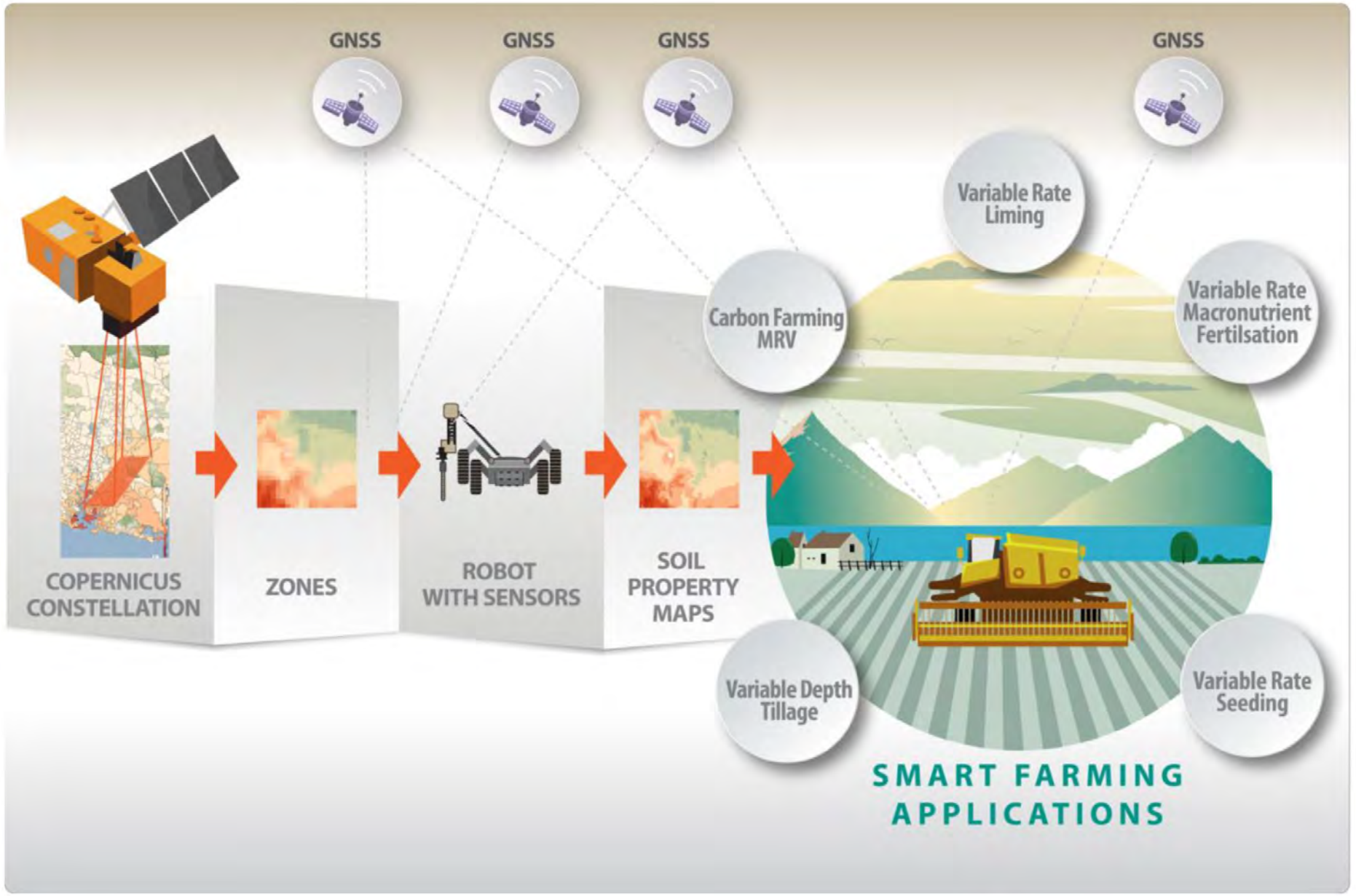
OFA – Erweiterbare Trägerplatform

SQAT

SOIL QUALITY ANALYSIS TOOL

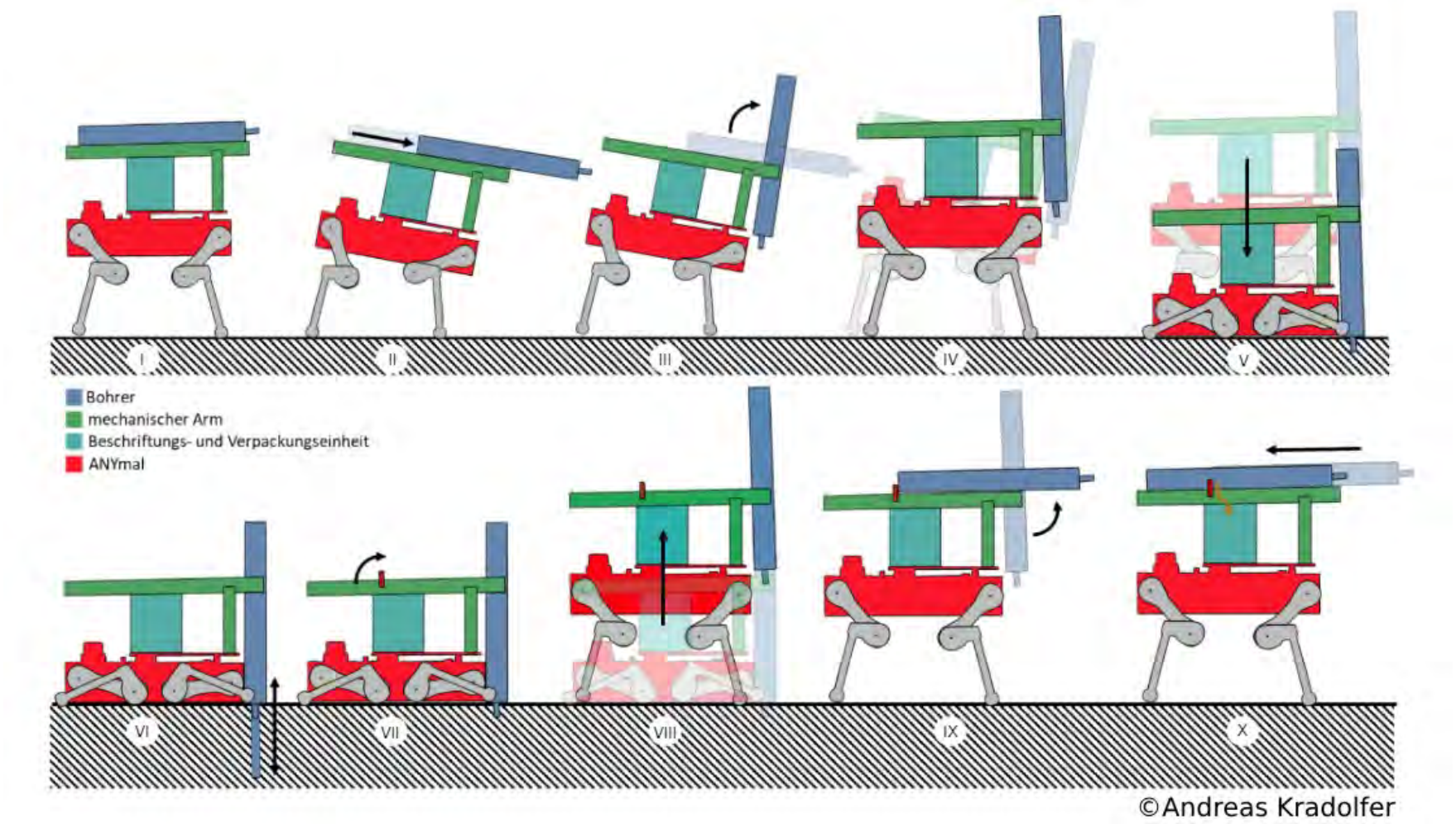
SQAT

Coordinator ABE


GNSS
GNSS
GNSS
GNSS
COPERNICUS CONSTELLATION
ZONES
ROBOT WITH SENSORS
SOIL PROPERTY MAPS
Carbon Farming MRV
Variable Rate Liming
Variable Rate Macronutrient Fertilsation
Variable Depth Tillage
Variable Rate Seeding
SMART FARMING APPLICATIONS

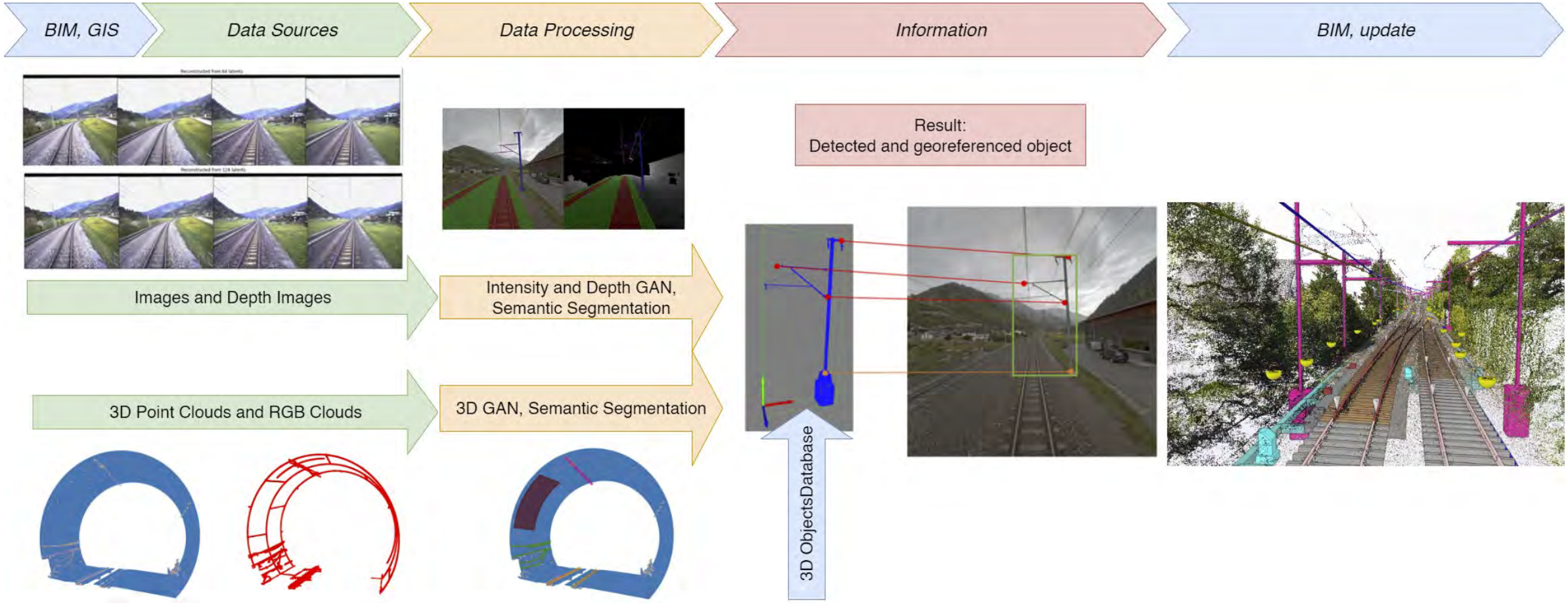
Woran arbeiten wir jetzt?

SQAT



Woran arbeiten wir jetzt?

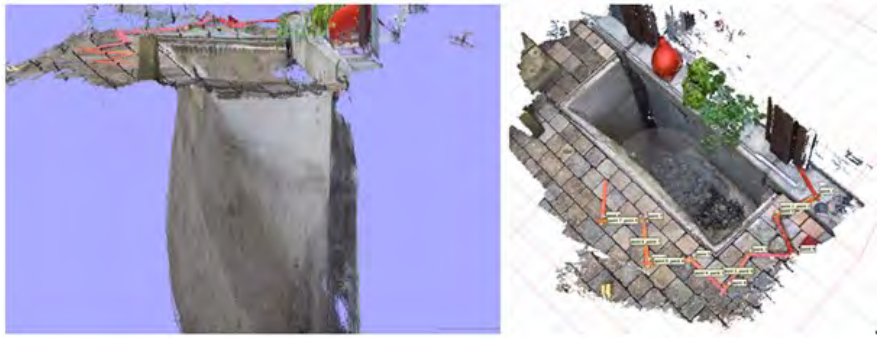
ARTEMIS

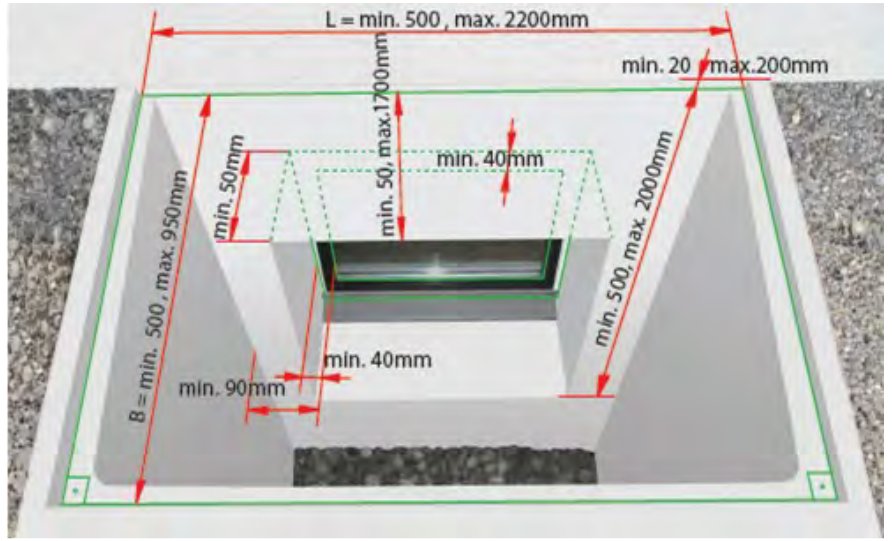


Heliobus®
The daylight company

Enlightening

- Automatische Generierung von Konstruktionsplänen für Lichtführungen
- Selbstständige Erfassung der Lichtschachtdaten durch Kunden

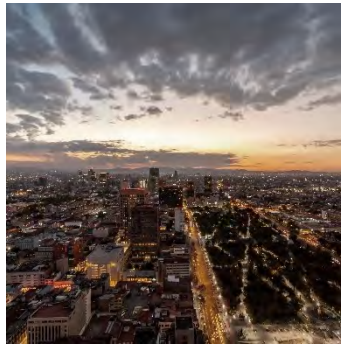




Wo geht die Reise hin?

Es gibt zahlreiche Herausforderungen in der Landwirtschaft

26% der globalen **Gesamttreibhausgas** Emissionen entsteht durch Nahrungproduktion



50% der global bewohnbaren **Wohnfläche** wird für Nahrungsproduktion beansprucht

70% des global verwendeten **Trinkwassers** wird für Pflanzenanbau genutzt

Es müssen **neun Milliarden Menschen** nachhaltig **ernährt** werden

Dafür werden **Lösungen** auch für den Bodenseeraum **benötigt**

Quelle: https://ourworldindata.org/environmental-impacts-of-food

Klarheit über Langzeitexperimente und Vergleiche!

- Praxistaugliche Live-Experimente in der gesamten Farm-To-Food Kette
  - Langzeiteinsatz und Evaluation kommerzieller Geräte, Software und Methoden, Datenerfassung und Deutung, KI
  - Unabhängige, gründliche Analyse der Nahrungsproduktion, -verpackung und -distribution, Best-Practices
  - Förderung nachhaltiger Prozesse in der gesamten Versorgungskette
  - Daten in hoher Zeit- und Ortsauflösung
- Förderung der Digitalisierung in der Farm-To-Food Kette durch ausgewiesene Praxisbeispiele

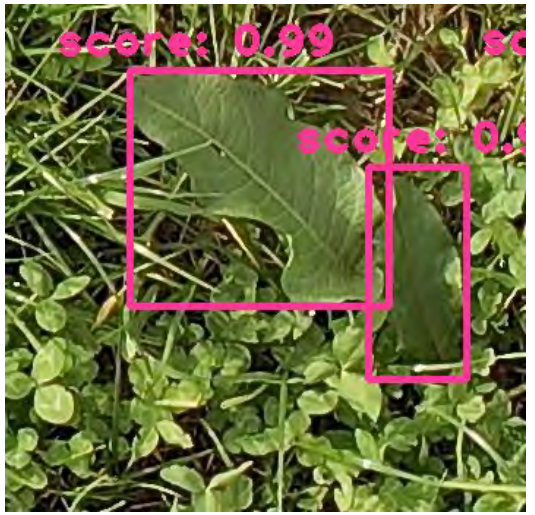
Digital Farmer: The Number 5

Q & A

Die Vorstellung ISF

The ISF Presentation

Training the AI for detection task



CVAT

Meta AI