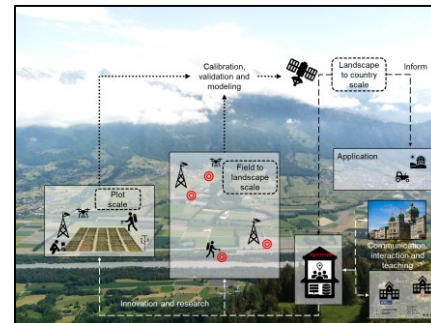
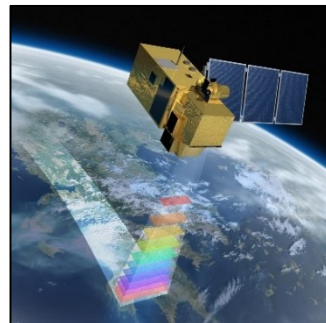
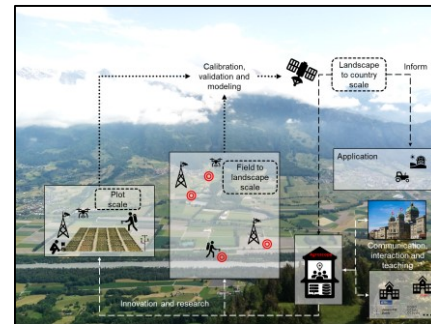
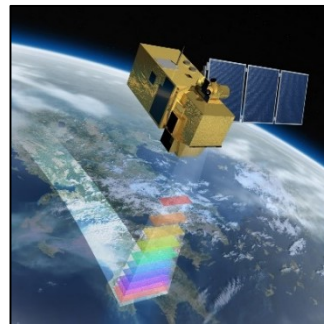




Remote sensing to solve agroecological challenges

Helge Aasen, Lukas Graf, Gregor Perich, Frank Liebisch



Remote sensing to solve agroecological challenges

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- Agroscope remote sensing team
- Agroscope remote sensing platform
- Spatial Data Science for agroecological applications

Agroecology

... is the study of relationships between plants, animals, people, and their environment - and the balance between these relationships in the context of farming.

(adapted from soilassociation.org)



Remote sensing in the context of agroecology

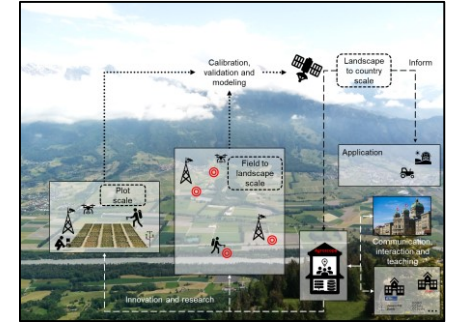
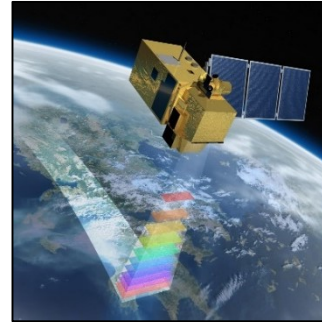
Mapping and monitoring

- **land use** and its **change**
- Impact of **climate change** on the agricultural systems
- Impact of **agricultural practices**
- Investigate **ecophysiological processes**

...

(Rhine valley, Switzerland)

Agroscope Remote Sensing Team



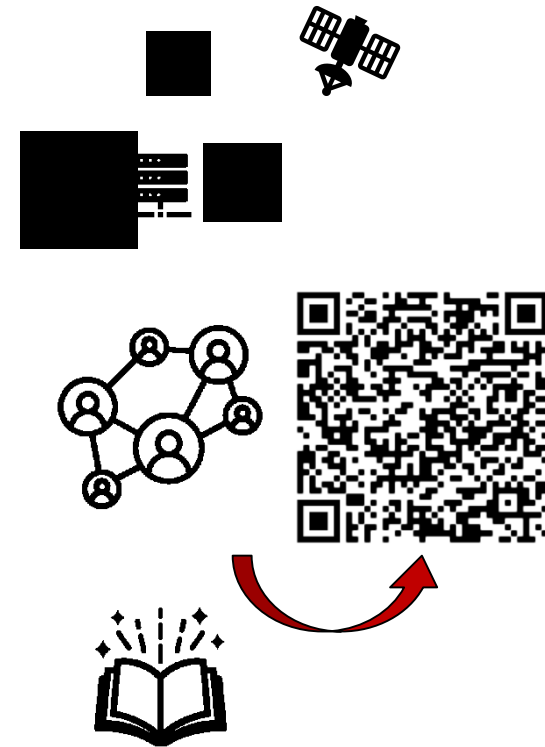
- **Founded end of 2021**
- **Competence centre for remote sensing in an agroecological context**
- **Works across spatial and temporal scales**
- **Bridges the gap between research and application**
- **Integrates across Agroscope divisions and beyond**

Agroscope Remote Sensing Platform Concept

- Build remote sensing infrastructure
(hardware, software, algorithms, protocols)
 - Implemented in python
 - Currently on premises
- Develop a remote sensing user network
 - Symposium: Remote Sensing for AgroEcology

- Compile, enhance and secure remote sensing knowledge

- Link to *GeoWissensPlattform (GWP)*



Implementation: AgriSatPy

In-house developed Python 3.x package to handle (any kind of) raster data using an object-oriented programming interface

- Easy data visualization, manipulation and conversion (geopandas, xarray, numpy, hdf5, ...)
- Light-weight Python API

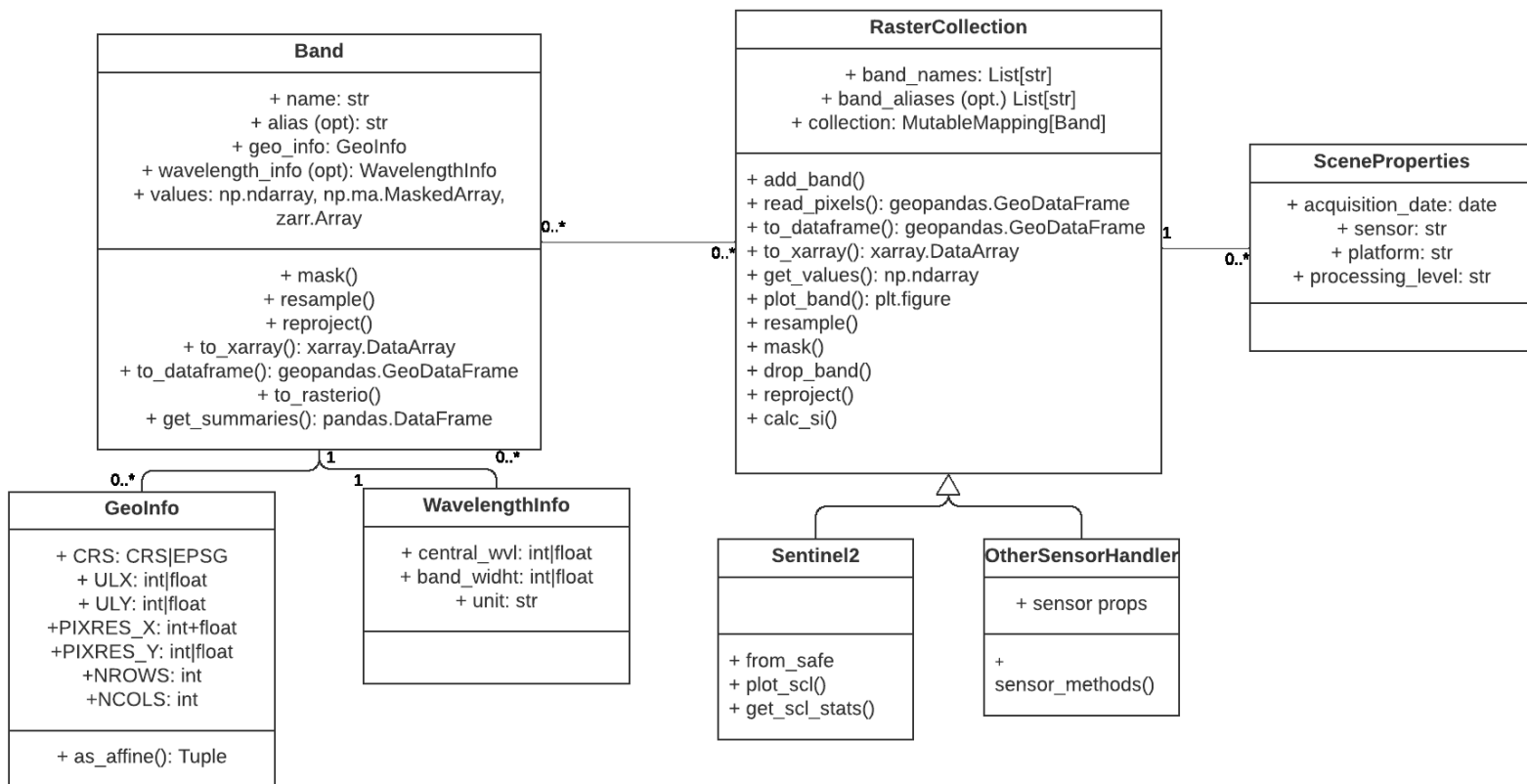
Special capabilities for handling Sentinel-2 data (*.SAFE datasets)

- Fetching data from CREODIAS
- Satellite-metadata base (PostgreSQL + PostGIS)
- Cross-tile extraction of (multi-year) Sentinel-2 data in a Google-Earth-Engine like approach

Implementation: AgriSatPy

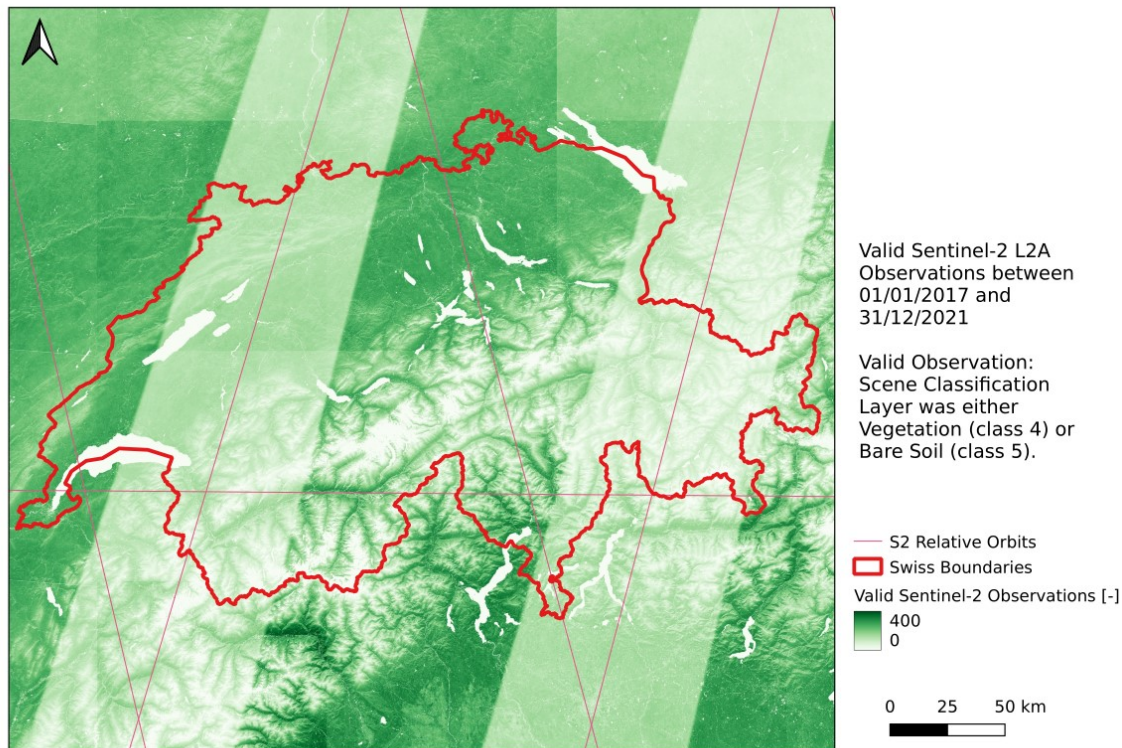
AgriSatPy Core UML

Lukas Gref | March 7, 2022



Implementation: AgriSatPy

- Country-wide Sentinel-2 data availability



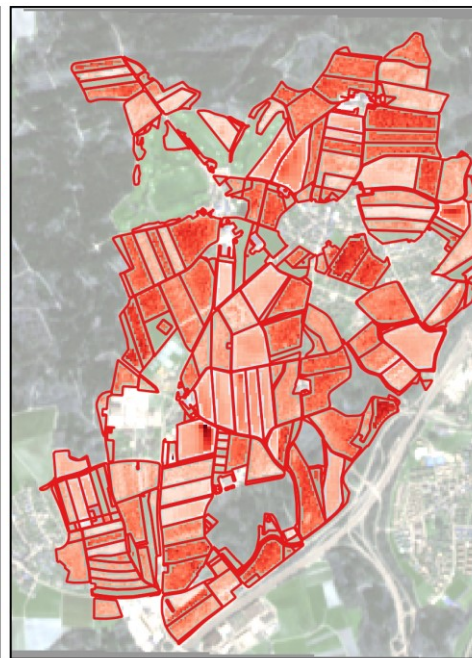
Biophysical trait estimation

GPR estimated LAI

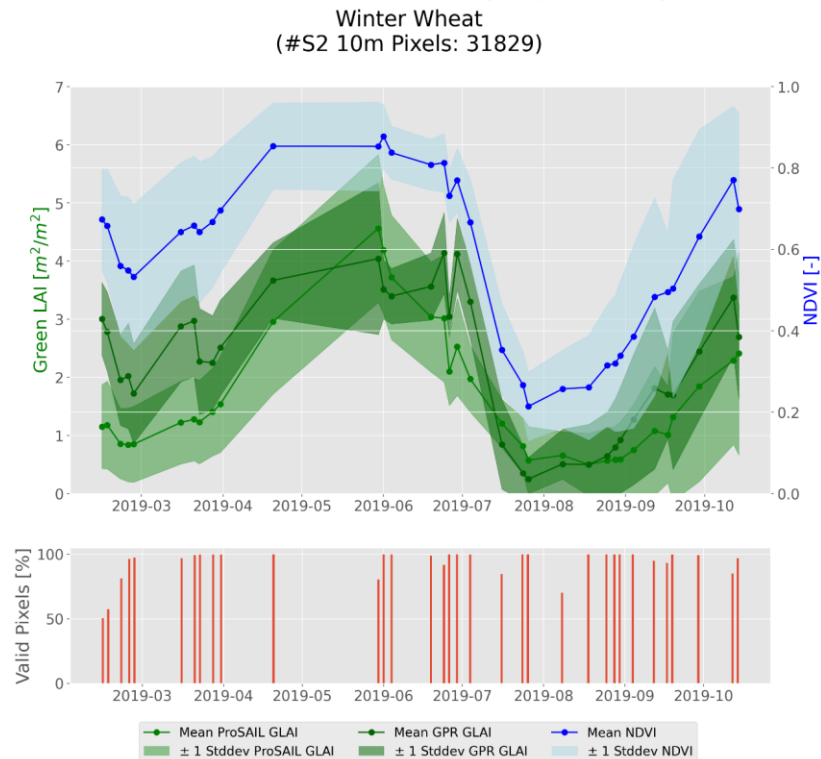
GPR derived uncertainty



low high



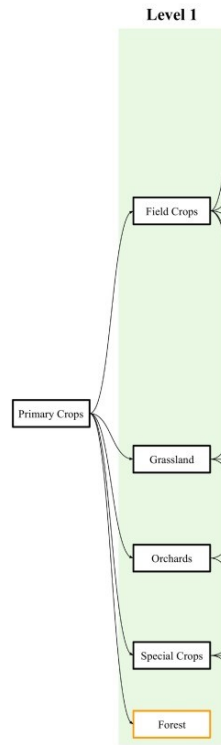
low high



- Physically based radiative transfer models (Spart)
- Machine learning (Gaussian Process Regression)
- Biomass, LAI, Cab, protein, phenology, soil parameter ...

(PhenomEn project, Lukas Graf)

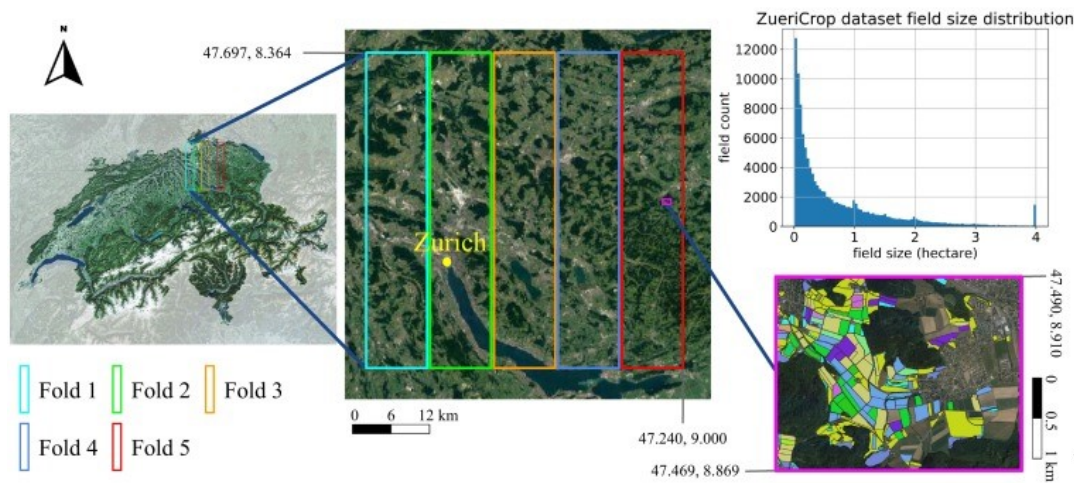
Crop mapping from image time series: Deep learning with multi-scale label hierarchies



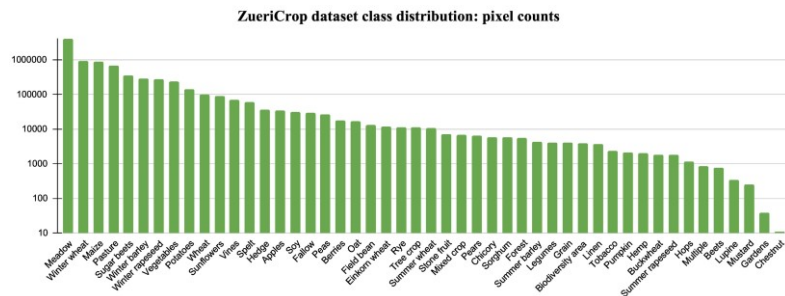
Turkoglu, M.O., D'Aronco, S., Perich, G., Liebisch, F., Streit, C., Schindler, K., Wegner, J.D., 2021. Crop mapping from image time series: Deep learning with multi-scale label hierarchies. <https://doi.org/10.1016/j.rse.2021.112603>

Crop mapping from image time series: Deep learning with multi-scale label hierarchies

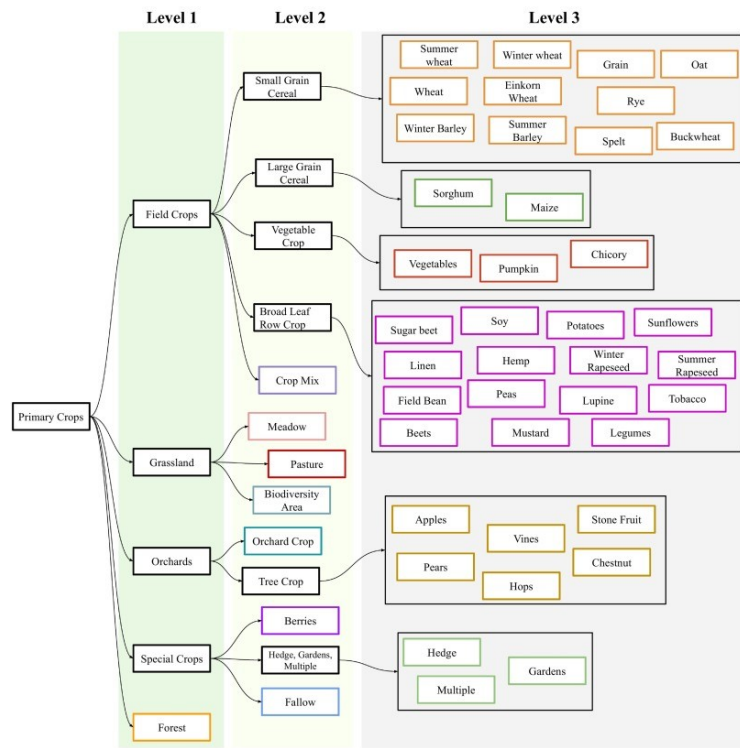
ZueriCrop dataset 2019



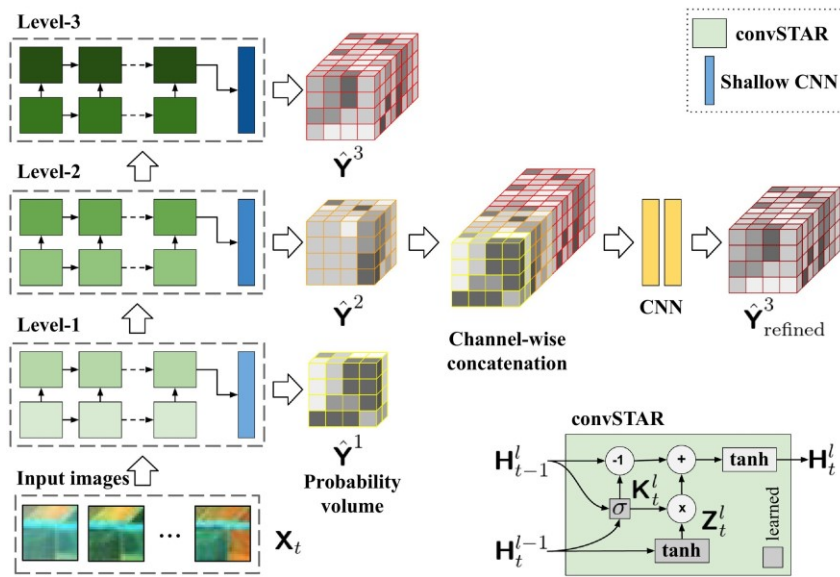
- 116,000 field instances
- field border polygons
- dominant crop label
- 48 crop classes
- provided by FOAG
- 71 Sentinel-2 level-2A Scenes



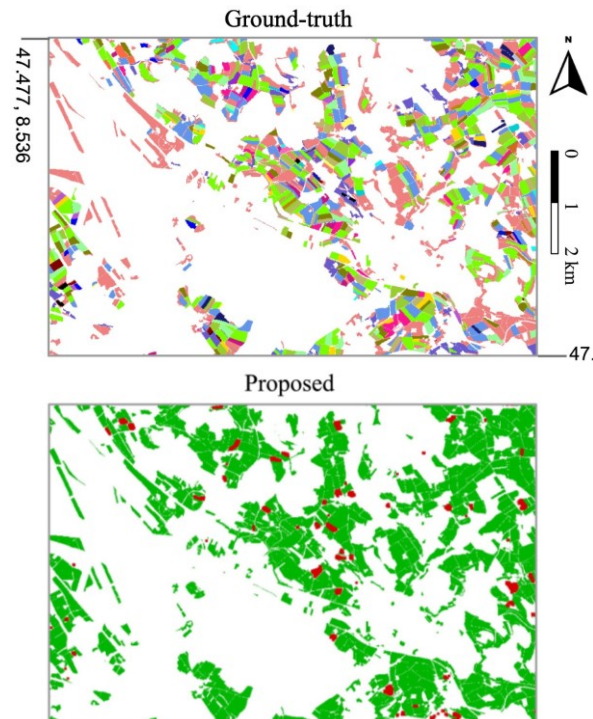
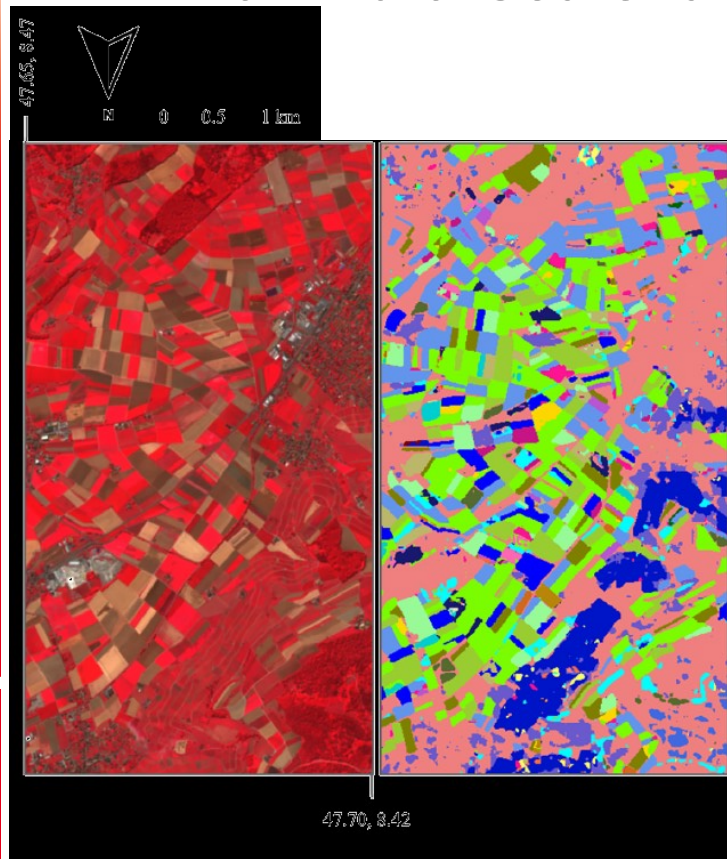
Crop mapping from image time series: Deep learning with multi-scale label hierarchies



Multi-stage, convolutional STAR network (ms-convSTAR)



Crop mapping from image time series: Deep learning with multi-scale label hierarchies



Prototype results

C., Schindler, K., Wegner, J.D., 2021. Crop mapping from image time series: Deep learning with multi-scale label hierarchies. <https://doi.org/10.1016/j.rse.2021.112603>

Conclusion

- Resolution and revisit frequency of current and upcoming satellite platforms have huge potential
- Spatial Data Science is needed to unlock it
 - Data organization (storage and databases)
 - Data interpretation (machine (deep) learning together with domain experts)
 - (Interpreted) Data publishing and access
- Main ingredients for success
 - Motivated and well educated people
 - Data accessibility (training data)
 - Interaction with stakeholders
 - Funding



Thanks for the attention

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Agroscope gutes Essen, gesunde Umwelt
www.agroscope.admin.ch



AgroEcological Remote Sensing Network