

StatEO

5-7 May 2026 | ESA-ESRIN | Frascati (Rome), Italy

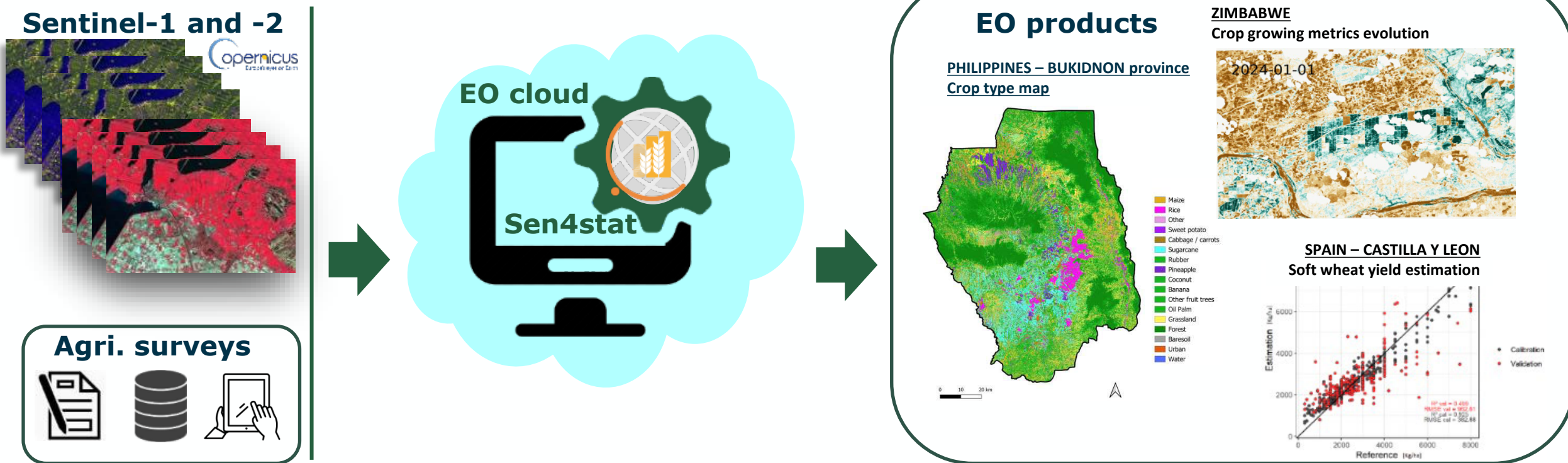
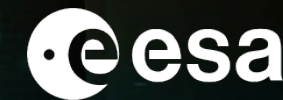


Sen4Stat: leveraging EO data and in-situ surveys for agricultural statistics



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1: UCLouvain, Belgium; 2: FAO

Sen4Stat: coupling EO data and statistical surveys for improved agricultural statistics

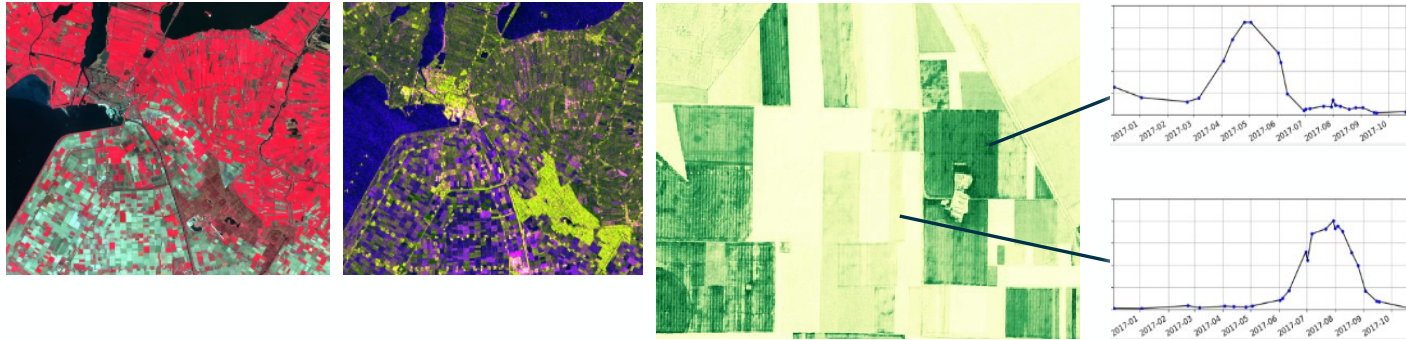


Key EO Impacts

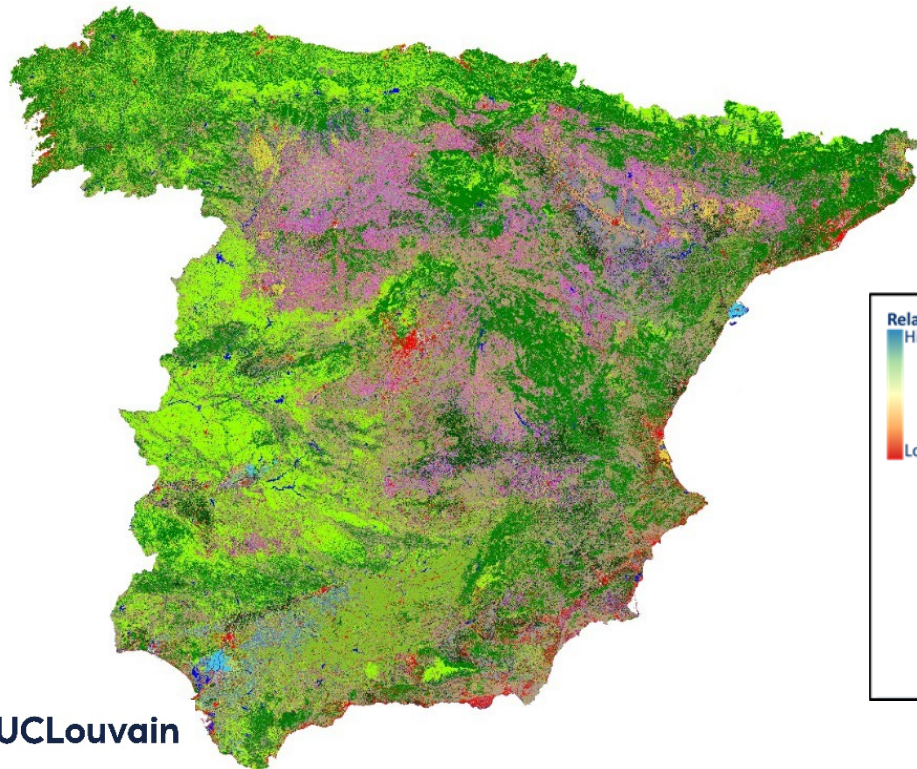
- COST EFFICIENCY
- STAT. GRANULARITY
- STAT. TIMELINESS
- SAMPLING DESIGN
- SURVEY & DATA QA
- DOWNSTREAM APPLICATIONS

UCLouvain 2

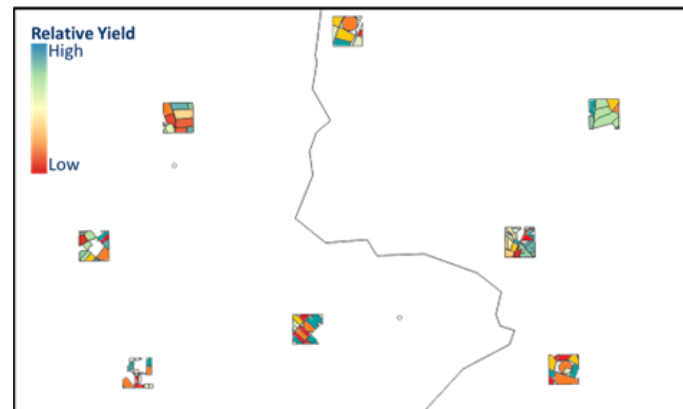
Sen4Stat: an ESA open-source SAR and optical toolbox for operational crop type mapping and monitoring at national scale



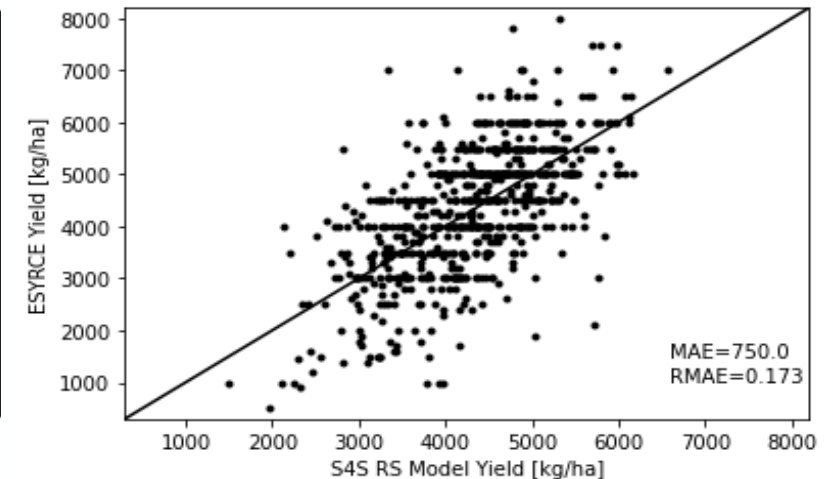
1. Optical 10m cloud free temporal synthesis and SAR temporal synthesis
2. Time series of spectral indices (NDVI, coherence,...) and biophysical variables (LAI, fCover, fAPAR)
3. 10m crop type maps along the season based on in situ dataset and stratification
4. A large set of crop growth conditions metrics
5. Crop yield estimation at various aggregation levels (national, regional, ...)



EO Yield Model



Barley Two Row



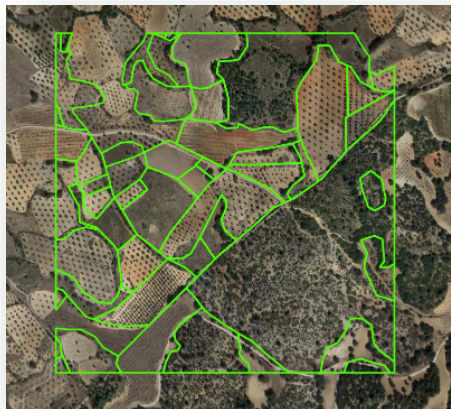
UCLouvain



→ THE EUROPEAN SPACE AGENCY

Sen4Stat: Integrating EO significantly decreases the error for acreage estimates of main crops

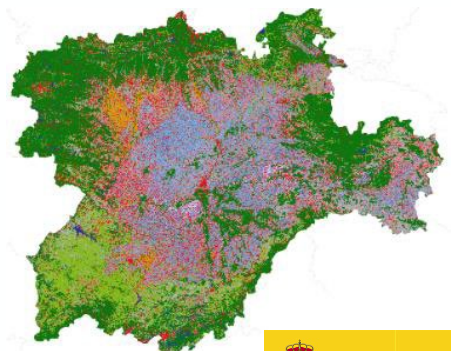
**Integrated list and area
ESYRCE 2020**



Inference



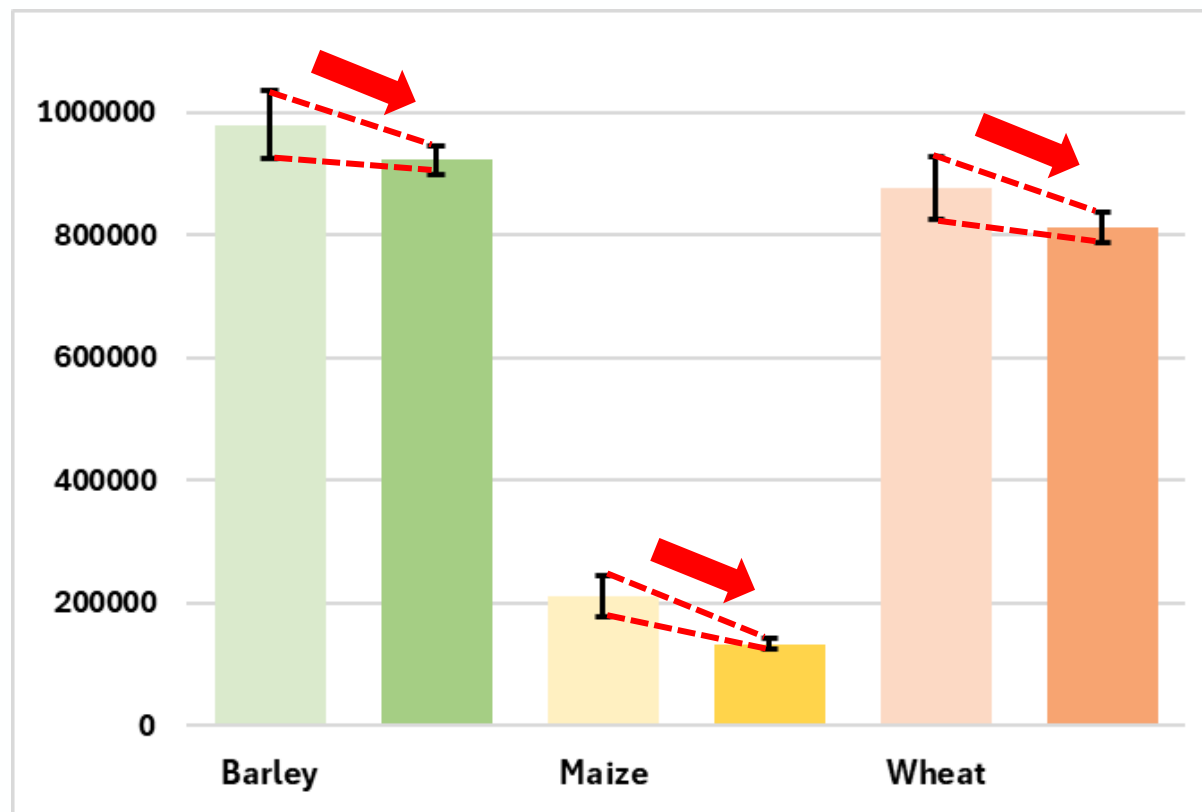
**Crop type map
(OA >85%)**



Reg. Est.



Acreage estimates for 3 main crops in Castilla y Leon (2020)



5,73

16,64

4,36

EO+ESYRCE Relative Efficiency >>> 1

Integrating
EO data
allows
increasing
the
estimation
precision
at **marginal**
cost



Sen4Stat implementation in 6 countries and Sen4Stat feasibility in many more



Collaboration with

- FAO: AGO, ETH, LKA, MDV, MLI, RWA, SEN, SLV, TJK, UGA, ZWE
- PAK, PHL
- ADB: PAK
- CIMMYT: International Maize and Wheat Improvement Center
- WFP: IRQ, LBN
- ETH

E-Stat



Capitalizing and complementing existing NSOs surveys to leverage EO assets

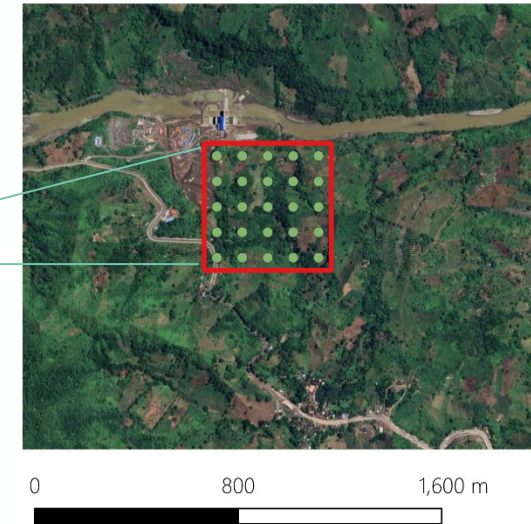
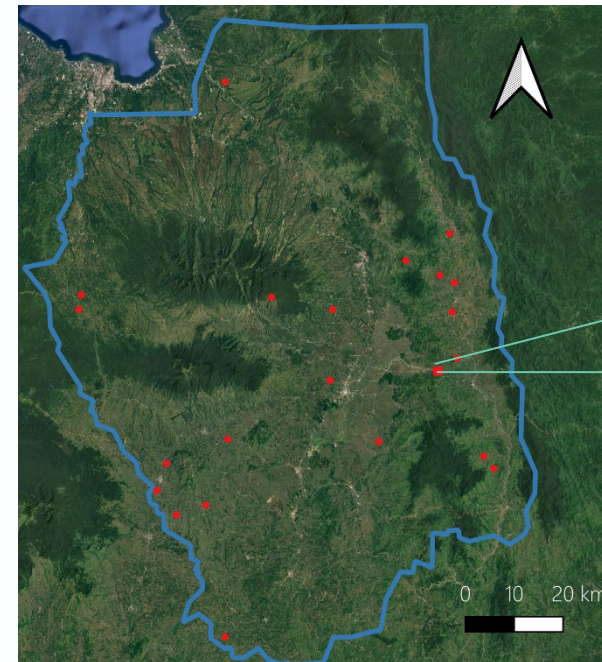
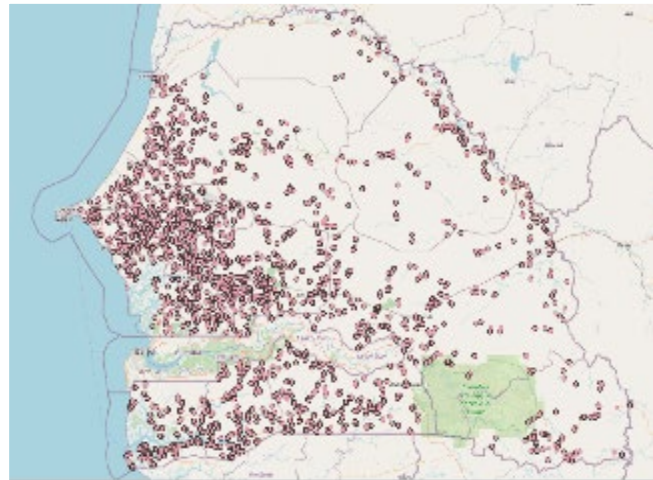
List sampling frame:

Senegal Sen4Stat use case: a small protocol adaptation for enabling operational use of EO data

- ✓ Overall accuracy : 98%
- ✓ Cropland F-Score : 76%
- ✓ Non cropland F-Score : 99%

Area Sampling Frame:

Two-stage stratified design developed by Sen4Stat → cost-efficient area estimates with uncertainties



Sen4Stat
Senegal's National Agricultural Statistics

EOStat
project



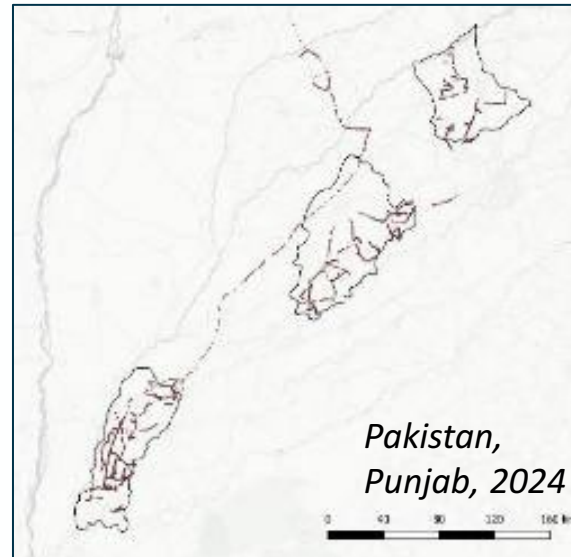
1. Non cropland data for easy classes

Easy non cropland area collected once for all years through visual interpretation of VHR imagery or on existing VHR imagery platforms (Bing map, Google map, etc.)

2. Opportunistic data collection for all other classes

By windshield observation along traveling roads or implemented independently to collect enough samples for each crop type (including minor crops, fallows, etc.)

3. Additional covariates to better interpret EO signal



Within parcel heterogeneity



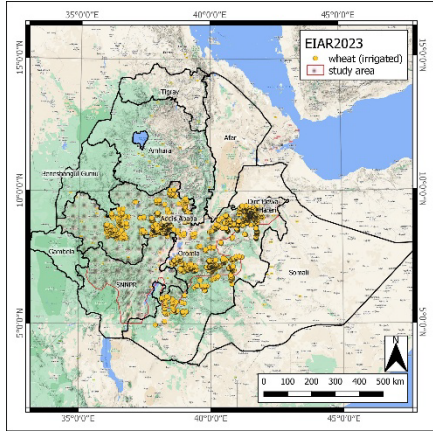
Mixed cropping (groundnut >>> maize)



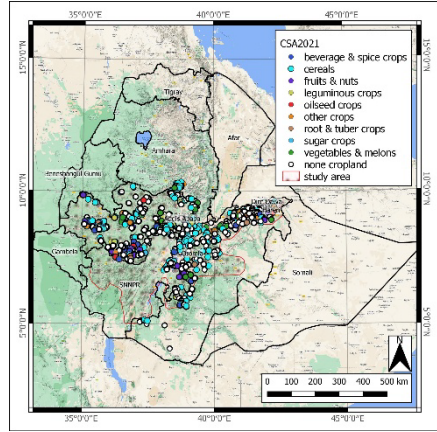
Large in situ georeferenced crop datasets are collected... but most georeferencing are not EO and statistics compatible



Example 2: Great Ethiopian datasets could not be used for Sen4Rust mapping



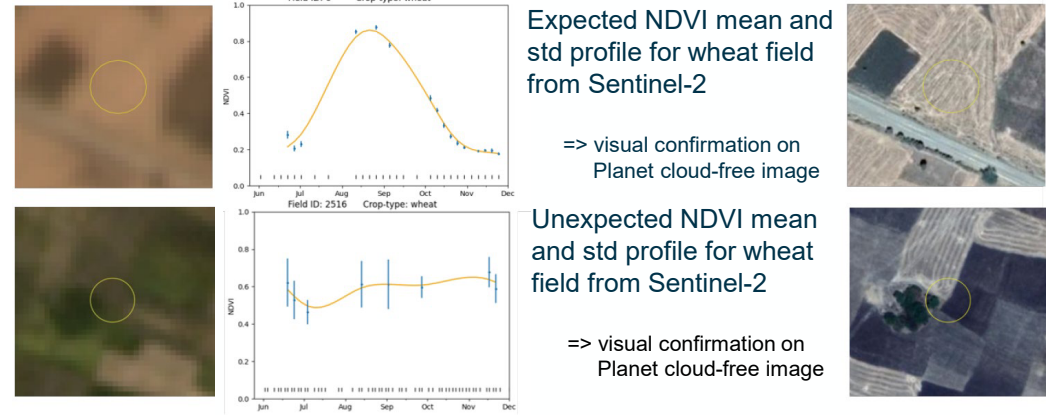
EIAR 2023: 16,278 samples in field clusters of irrigated wheat with GPS coordinates from cluster centroids



CSA 2021: 25,598 samples but GPS locations clustered and multiple crops for single sample



Intensive quality control combining in situ data sources



Expected NDVI mean and std profile for wheat field from Sentinel-2

=> visual confirmation on Planet cloud-free image

Unexpected NDVI mean and std profile for wheat field from Sentinel-2

=> visual confirmation on Planet cloud-free image

Leading to **2,793** harmonized, quality-controlled georeferenced in situ samples over Ethiopia

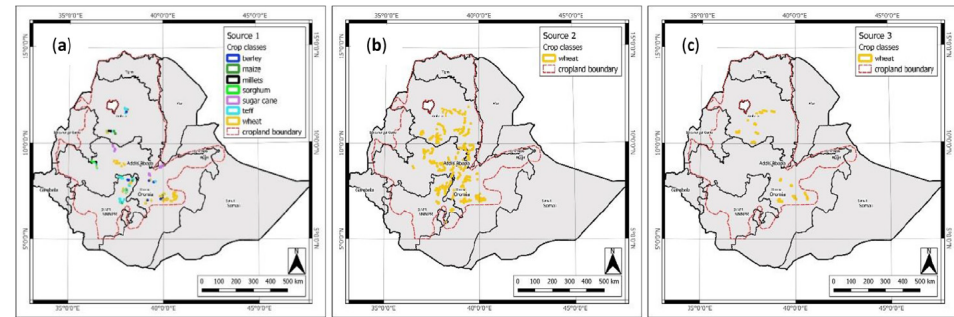


Fig. 2. Location of the source datasets and the distribution of the fields, showing crop classes (a) Source 1 – Ground Data Collection Campaign (GDCC); (b) Source 2 – Wheat Rust Toolbox (WRTB); and (c) Source 3 – Farm Household Survey Database (FHSD).

(Blasch et al. 2024 – *EthCT2020*)

