GEOMaize

Using Earth Observation for Maize Yield Estimation in Ghana

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Scientific Background and Objectives

Agriculture drives Ghana's economy; maize is a key food and cash crop

- Maize accounts for % of Ghana's agricultural GDP and is a staple food

Huge yield gap:

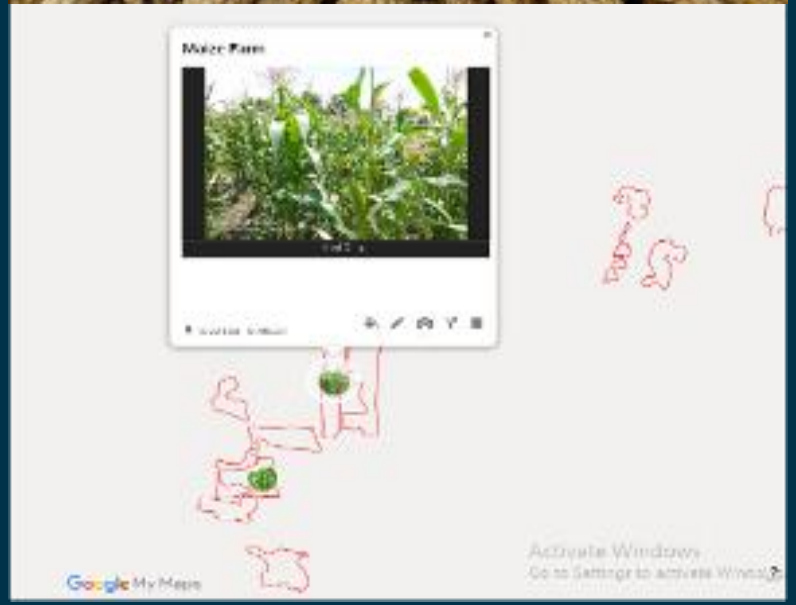
- Weather variability
- Soil conditions
- Farming practice diversity

Yield estimation is difficult due to Current methods:

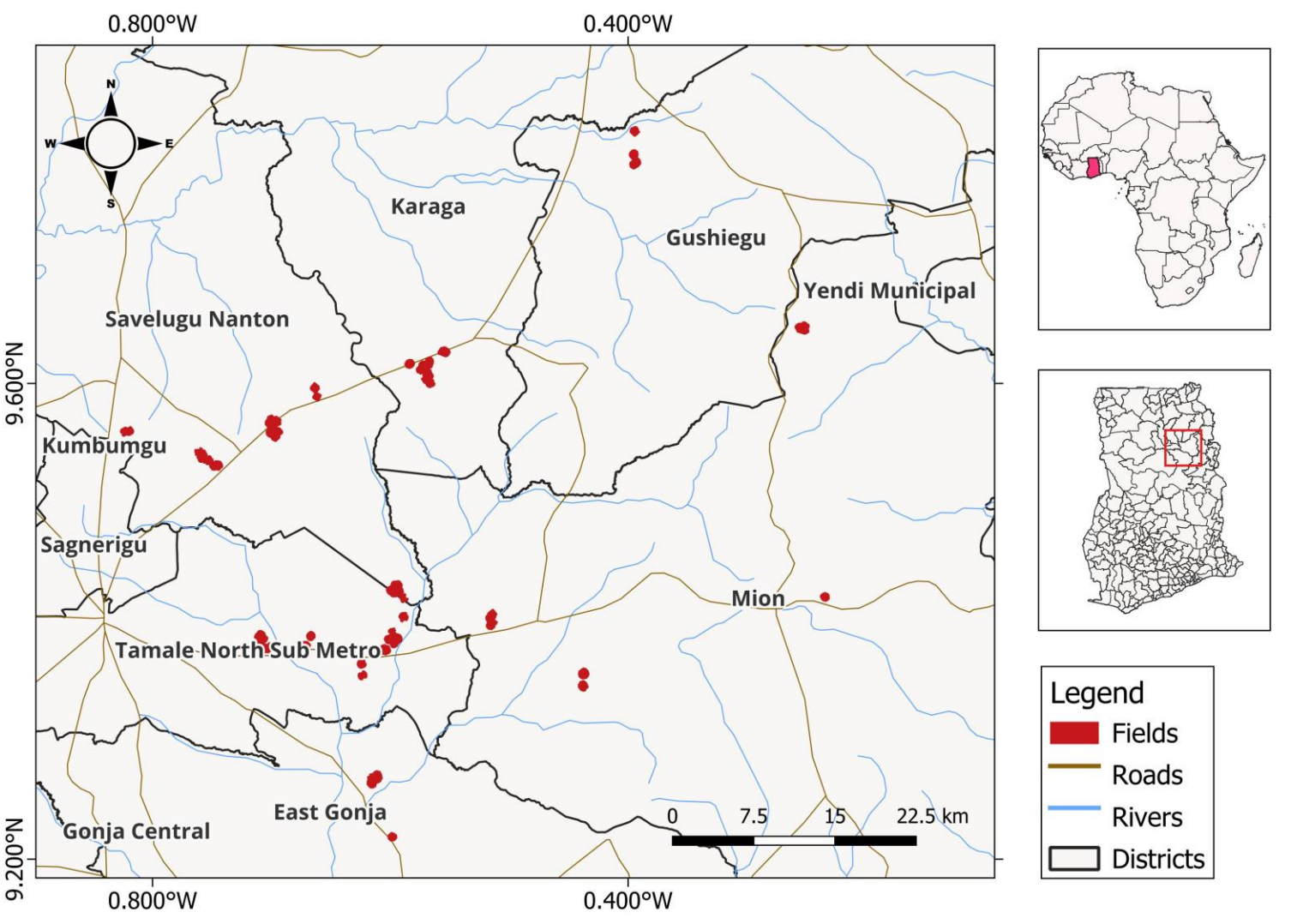
- Manual surveys
- Costly
- Often imprecise

Accurate yield prediction (at the end of the season) is crucial for:

- Policymaking
- Resource management
- Food security
- Supply chain stability



Study Area



Region: Northern Ghana

Districts:

- Karaga
- Nanton
- Mion
- Savelugu
- Tamale
- Yendi

Field data collection

Yield (maize)				
Year	2021	2022	2023	2025
Data points	45	43	40	30

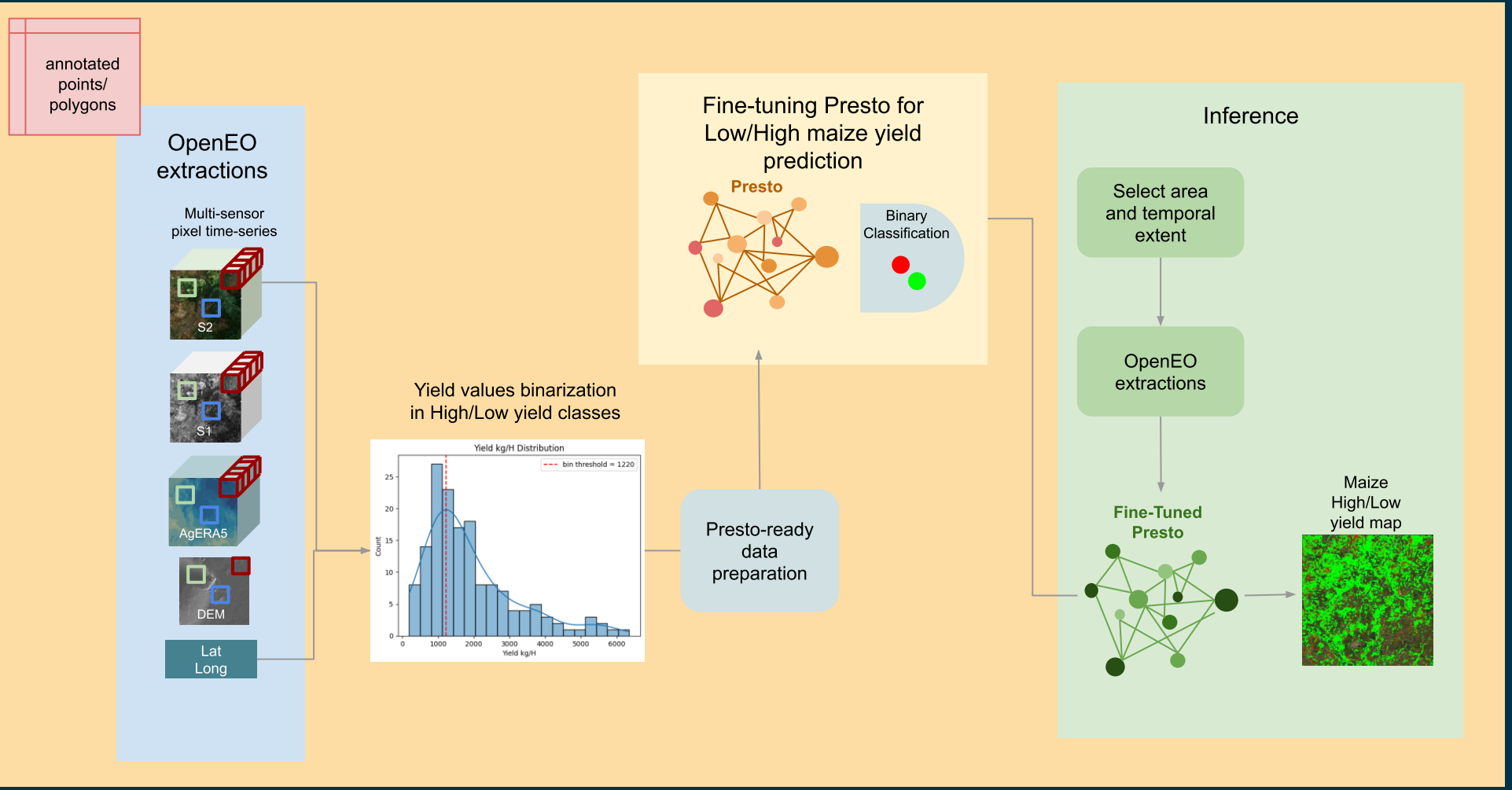
Crop Type 2021				
Crop type	Maize	Rice	Groundnut	Others
Data points	202	50	71	38

Crop Type 2025				
Crop type	Maize	Rice	Groundnut	Others
Data points	52	33	18	27

Yield data collection through quadrant-based crop cuts

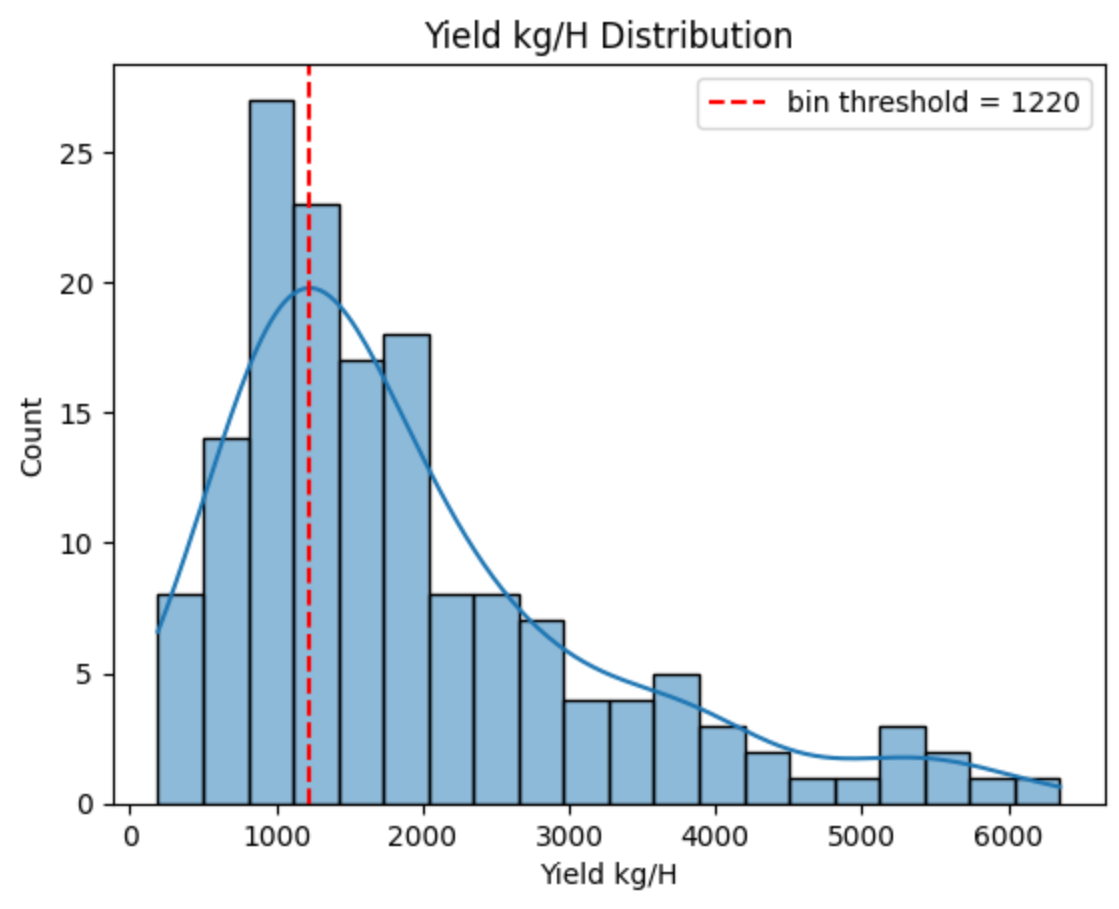
Crop type data collection through GeoQuest app

Methodology



- Original **regression** task needs more and cleaner data
- **Binary** low vs high yield classification as a revised methodology
- **WorldCereal** as a maize masking prior for a final yield regime map

Methodology

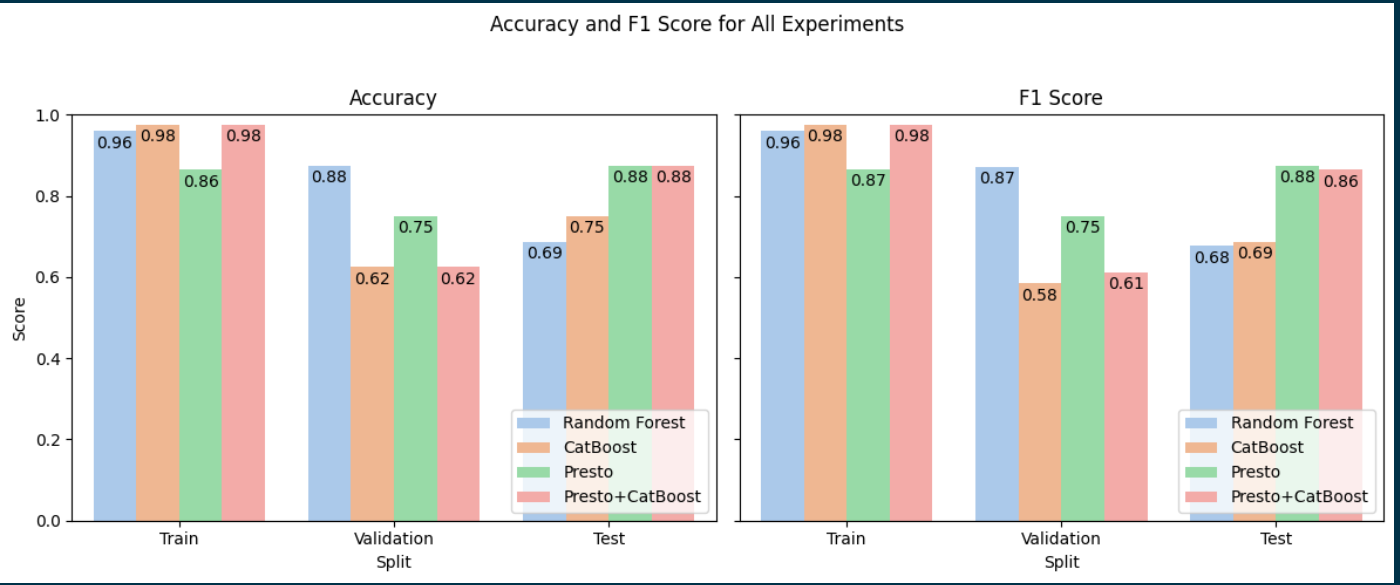


Based on the available observations in the ground data and expert evaluation, **1220 kg/ha** is chosen as the threshold to distinguish low vs high yield regime

Results

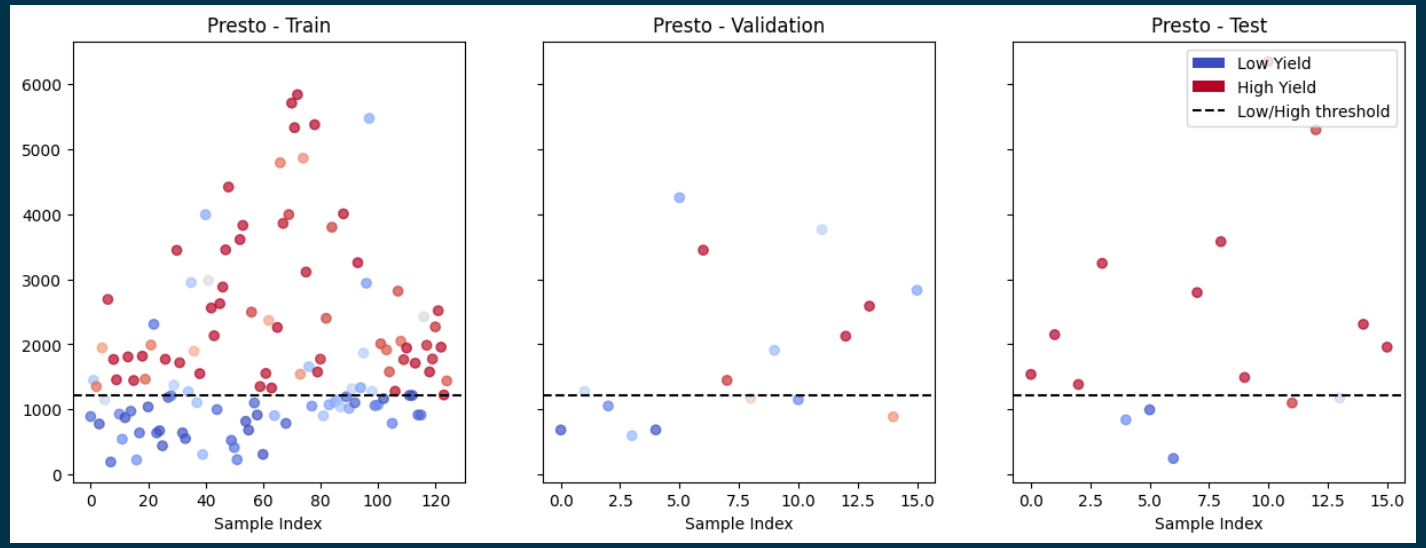
- Comparison of **traditional models** vs **geospatial foundation model**
- Performance on binary task for independent **test** set indicates degree of **overfitting**
- Foundation model (**Presto**) does not overfit compared to other approaches

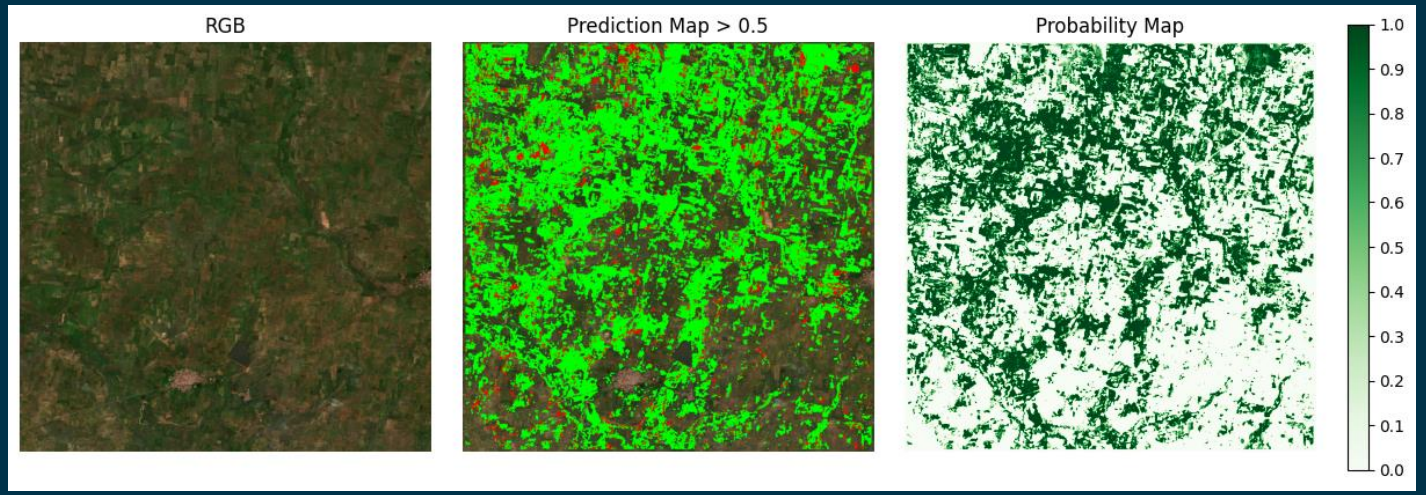
Model	Train vs Test	Gap
Random Forest	0.96 vs 0.69	-0.27 (severe overfitting)
Catboost	0.98 vs 0.75	-0.23 (moderate overfitting)
Presto	0.86 vs 0.88	+0.02 (no overfitting)
Presto + Catboost	0.98 vs 0.88	-0.10 (mild overfitting)



Results

- The model detects most low-yield fields correctly, flags some high-yield fields wrongly
- Final model was integrated in fully-cloud based workflow running **openEO** on **CDSE**
- Output binary yield map masked by a **2025 maize** map produced using the **locally trained WorldCereal system**
- Map for this region mostly shows high-yield regime





Future Work

- **More ground data** is needed to improve the method
- **Reducing aggressive cloud masking** could give more input signal to the model
- **Small correlated datasets** used in this project, so the results are just laying initial foundation for future work
- From binary yield regime **towards yield regression** once more and cleaner data available
- Large-scale tests and evaluation of the results

Cloudy growing season suffers from too aggressive cloud masking

Layout for social media posts

Can EO science 🛰️ deliver reliable national-scale 🌾 yield estimates under smallholder, cloudy, diverse conditions? #GEOMAIZE (EO AFRICA) explores this via foundation models + collaboration. Learn more: https://geoglam.org/from-partnership-to-practice-advancing-yield-intelligence-and-food-security-through-geomaize/ #EO4Society

🧐 ...is it feasible to translate EO science 🛰️ into an operational yield 🌾 estimation system that performs reliably under smallholder 👩🏾 , cloud-affected, and diverse agricultural conditions, while producing outputs suitable for decision-making 👨🏾‍⚖️ at the national level...?

This is what the EO AFRICA R&D Facility collaborative research project hashtag#GEOMAIZE is about. An effective combination of foundation models, progress sharing, and knowledge exchange. An initiative of the Ghana Space Science and Technology Institute and VITO Remote Sensing funded by European Space Agency - ESA through the hashtag#EOAFRICA initiative and supported by GEOGLAM (Group on Earth Observations Global Agricultural Monitoring).

Learn more about this amazing project at https://lnkd.in/e7QDnJYC

Kristof Van Tricht, Kofi Asare
#EO4Society