



# StatEO

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## Comparison and Independent Validation of Global High-resolution Remote Sensing Cropland Extent Products

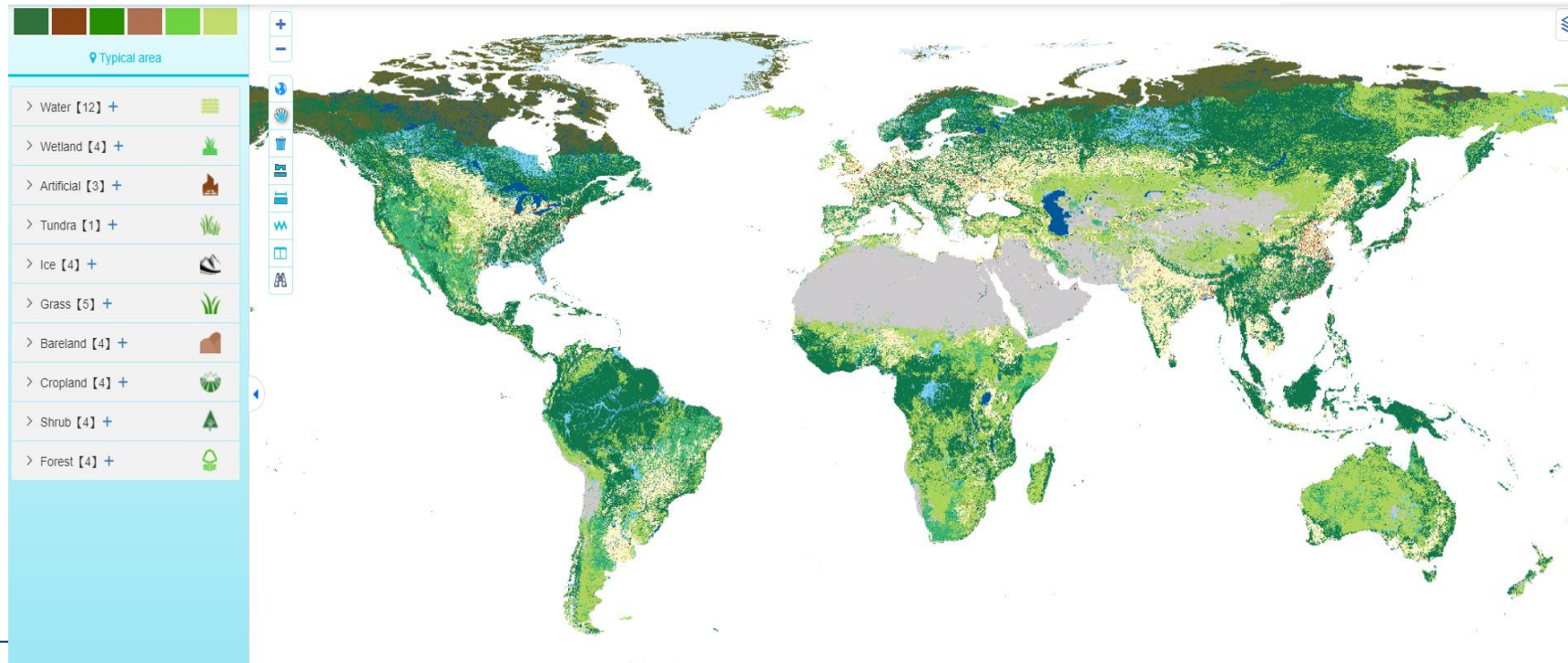
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# Background

- Availability satellite observations with both high temporal and spatial resolution
- Annual cropland extent maps

Product	Provider	Spatial resolution
WorldCover	ESA	10m
ESRI LC	ESRI	10m
FROM-GLC	THU	30m
Globeland30	NGCC	30m
GLC-FCS30	CAS	30m
GLAD	UMD	30m
World Cereal	ESA	10m
...	...	...



# Definitions of Cropland in FAOSTAT

6610	Agricultural land	Land used for cultivation of crops and animal husbandry. The total of areas under "Cropland" and "Permanent meadows and pastures."
<b>6620</b>	<b>Cropland</b>	Land used for cultivation of crops. The total of areas under "Arable land" and "Permanent crops".
6621	Arable land	The total of areas under temporary crops, temporary meadows and pastures, and land with temporary fallow. Arable land does not include land that is potentially cultivable but is not normally cultivated.
6630	Land under temporary crops	Land used for crops with a less-than-one-year growing cycle, which must be newly sown or planted for further production after the harvest. Some crops that remain in the field for more than one year may also be considered as temporary crops e.g., asparagus, strawberries, pineapples, bananas and sugar cane. Multiple-cropped areas are counted only once.
6633	Land under temp. meadows and pastures	Land temporarily cultivated with herbaceous forage crops for mowing or pasture. A period of less than five years is used to differentiate between temporary and permanent meadows and pastures.
6640	Land with temporary fallow	Land that is not seeded for one or more growing seasons. The maximum idle period is usually less than five years. This land may be in the form sown for the exclusive production of green manure. Land remaining fallow for too long may acquire characteristics requiring it to be reclassified, as for instance ?Permanent meadows and pastures? if used for grazing or haying.
6650	Land under permanent crops	Land cultivated with long-term crops which do not have to be replanted for several years (such as cocoa and coffee), land under trees and shrubs producing flowers (such as roses and jasmine), and nurseries (except those for forest trees, which should be classified under "Forestry"). Permanent meadows and pastures are excluded from land under permanent crops.

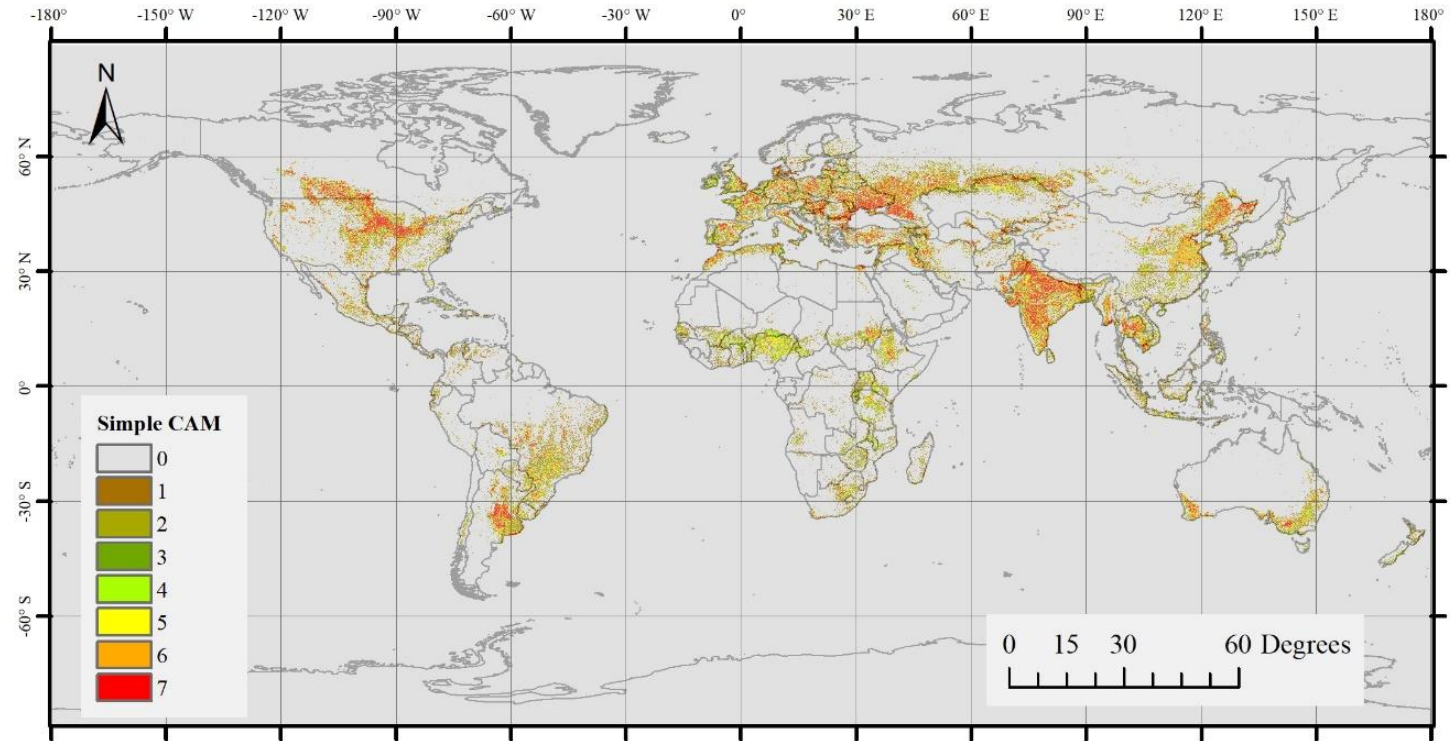
## ➤ Cropland extent comparison

Product	Temporal cropland	Woody crop	Cultivated Pasture	Fallow land	Greenhouse
FROM-GLC	○	×	○	○	○
GLC-FCS30	○	○	×	×	×
Globeland30	○	○	○	×	○
WorldCover	○	×	×	×	×
ESRI LC	○	×	○	○	×
WorldCereal	○	×	×	×	×
GFSAD30	○	○	○	○	×
GLAD	○	×	○	○	×

From the cropland definition, all the seven products include “temporal cropland”

## ➤ Cropland hotspot

- To show the disagreement of the cropland from the five high resolution LC products.
- We define **CAM7 values larger than 1** as potential cropland regions. Among these, **31.89% are identified as cropland by all seven cropland products**

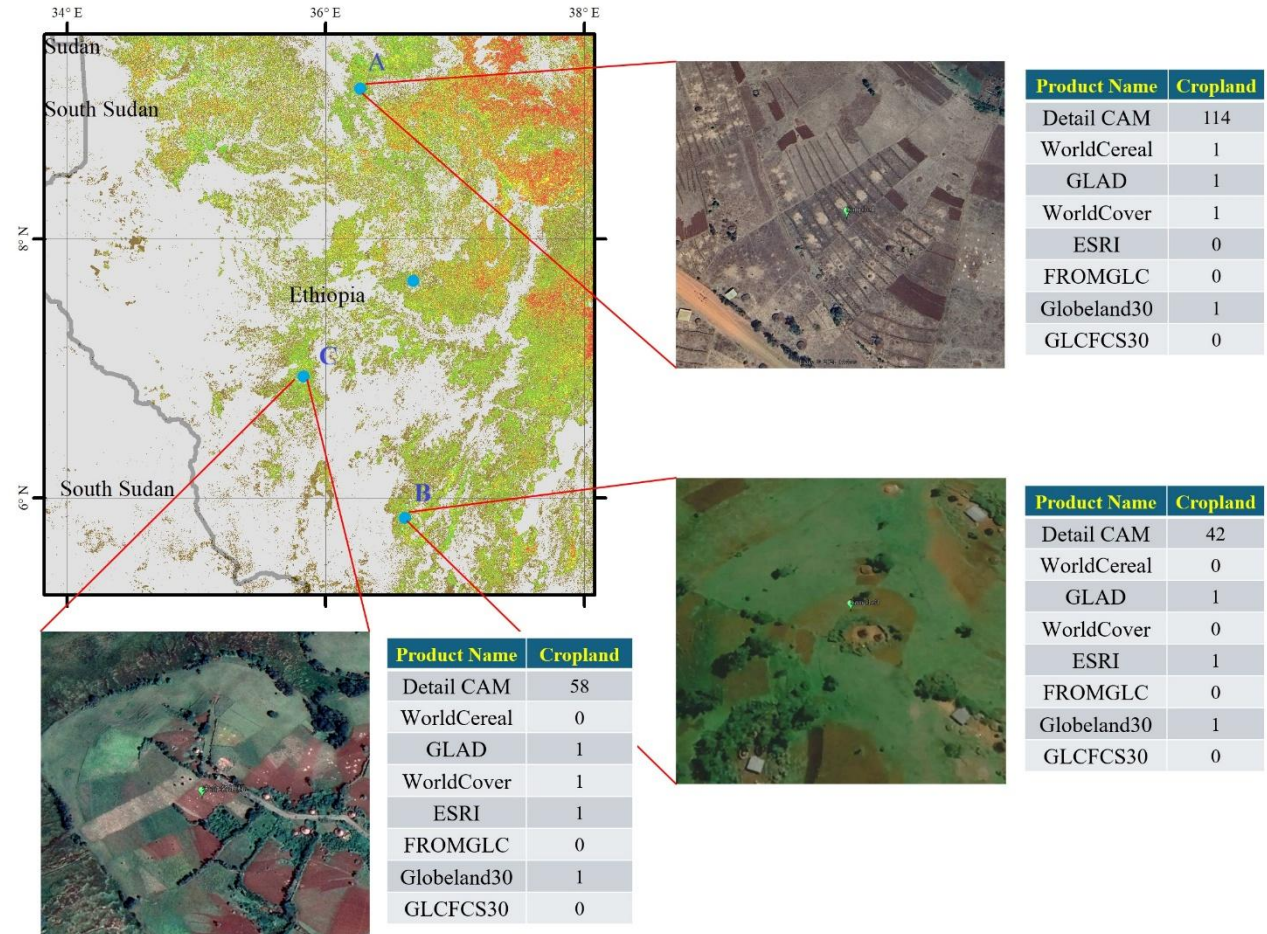


Hao et.al 2025

# Cropland disagreement distributions

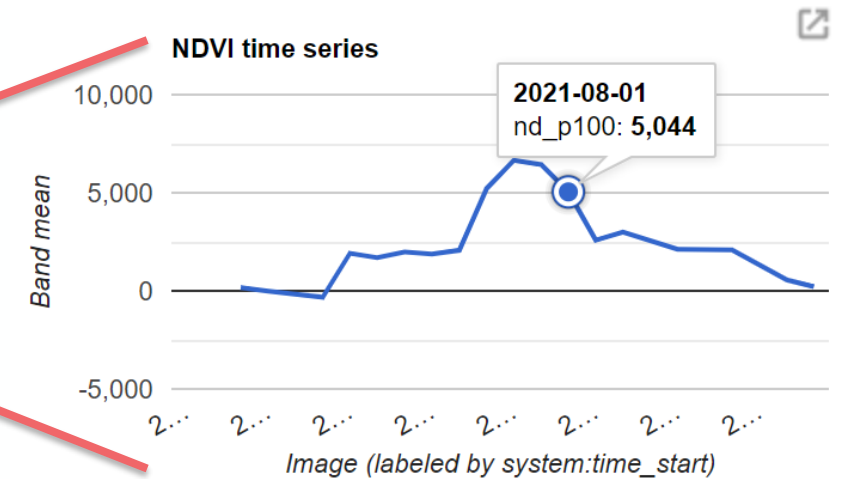
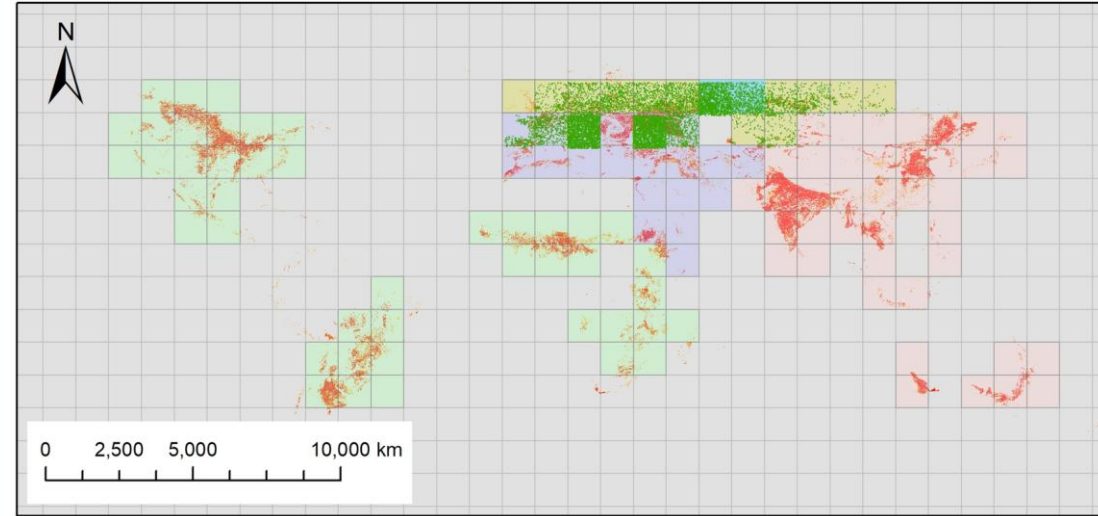
## ➤ One case in Africa showed the use of CAM and comparison of cropland:

- Point A: Temporary Crops, correctly classified by WorldCereal, WorldCover, GLAD and Globeland30.
- Point B: Managed Pasture, should be excluded from WorldCereal, WorldCover and GLCFCS30, just FROMGLC misclassified this pixel.



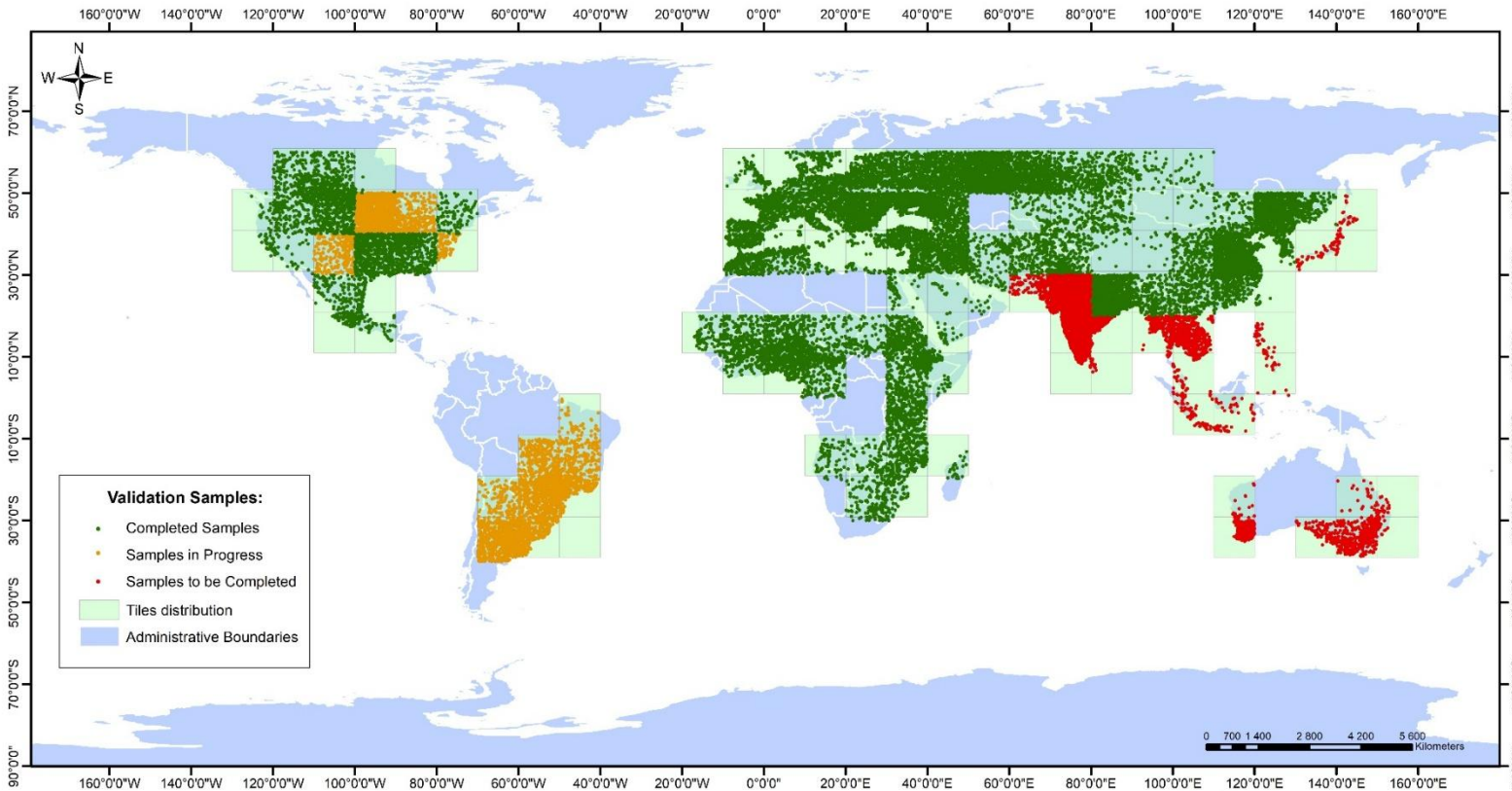
## ➤ Validation Sample Collection

- Definition: Temporary Crops
- Cropland disagreement map of WorldCereal and WorldCover.
- Stratified random sampling
- Collecting ground truth data by visually interpretation of VHR image and NDVI time series



## ➤ Validation Sample Collection

- More than 30,000 samples were collected in total, distributed in all continents

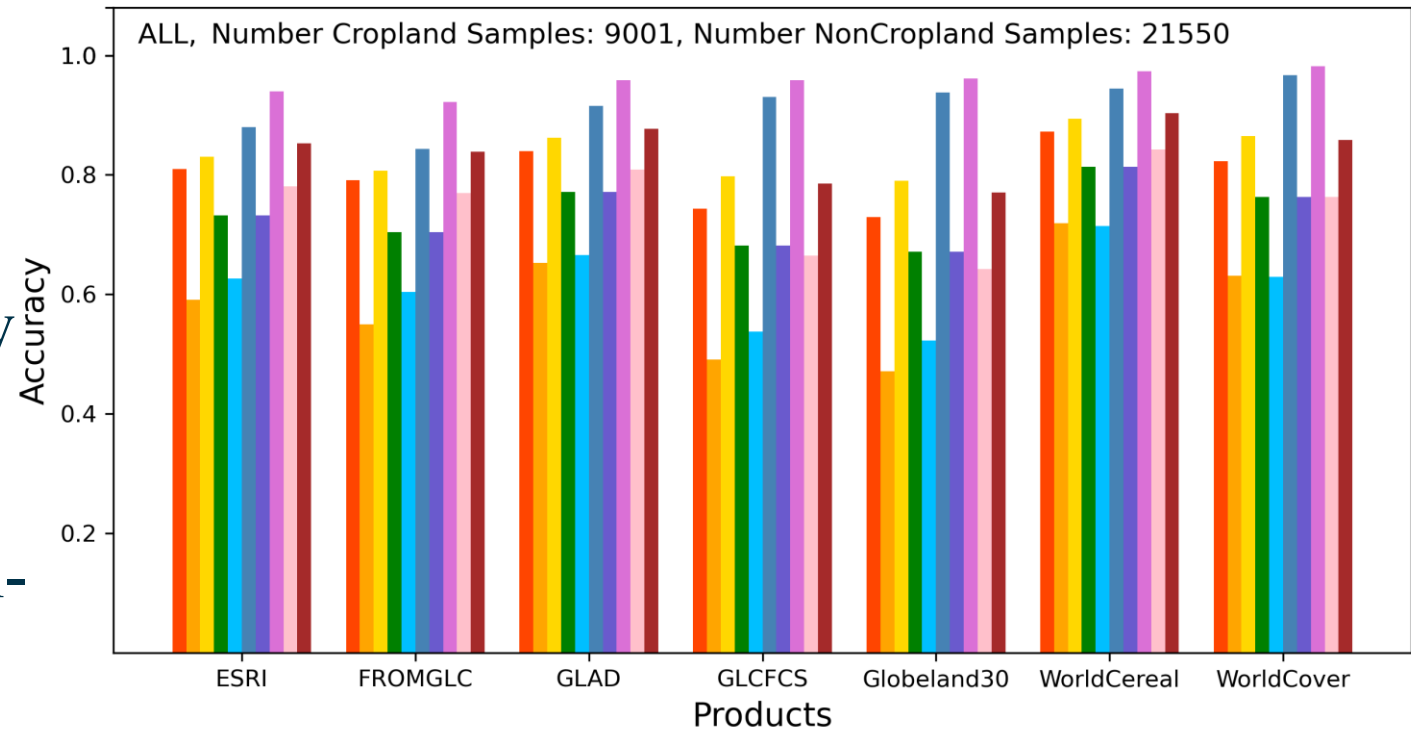
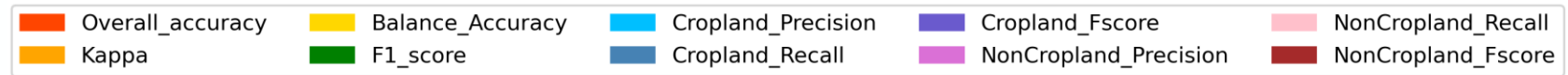


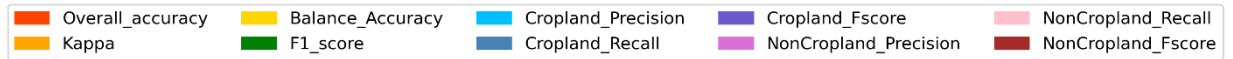
Region	Sample Number
North America	4,338
Latin America	2,658
Europe	7,134
Asia	9,917
Middle East	1,358
Africa	4,275
Oceania	838
<b>Total</b>	<b>30,518</b>

➤ Among the seven input cropland products, **WorldCereal** has the best accuracy (OA = 87.24%).

➤ All products tend to have low Cropland precision and high Non-cropland recall, which indicates that identifying non-cropland as cropland.

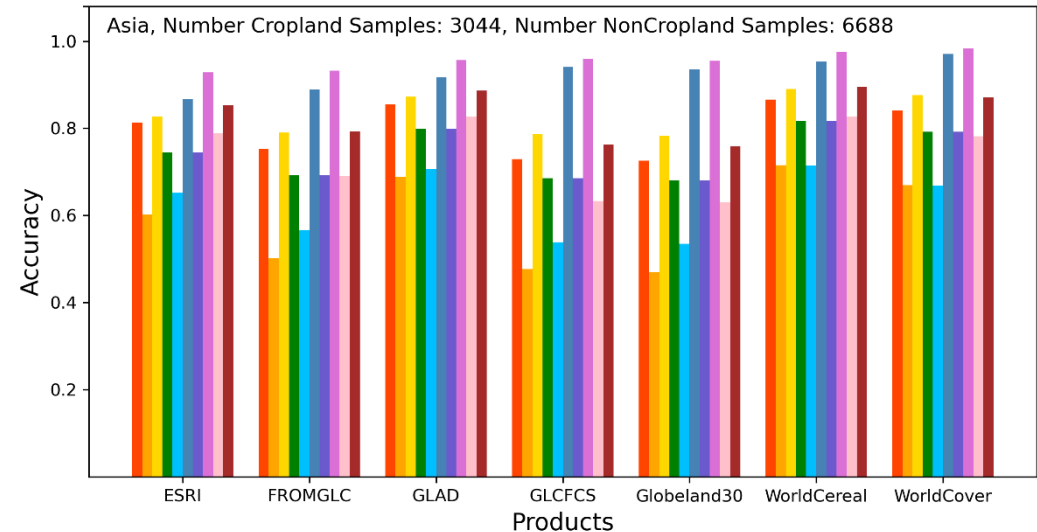
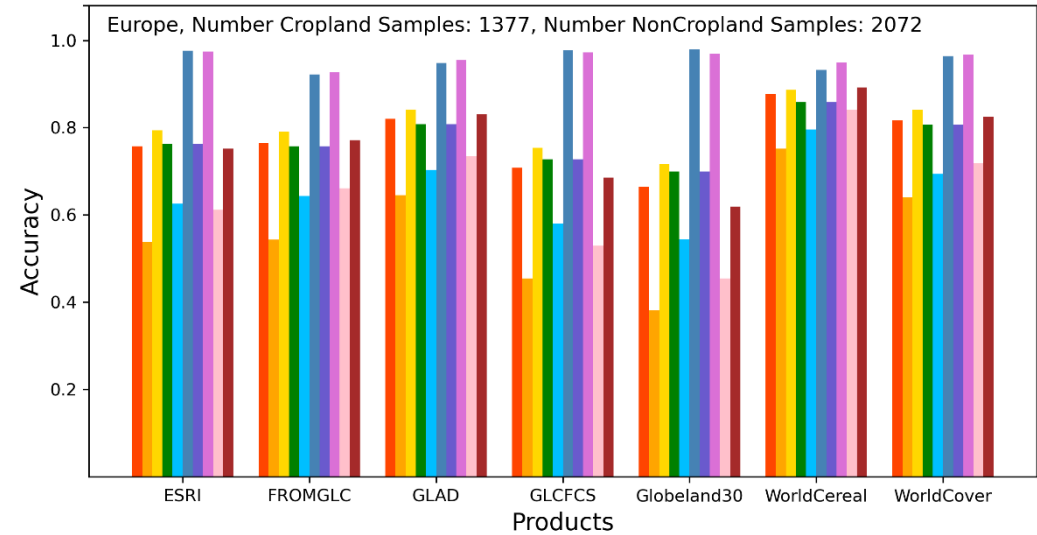
➤ WorldCereal have the smallest different between precision and recall, cropland precision/recall are 0.71/0.94, non-cropland precision/recall are 0.97/0.84.





## ➤ Continental level validation

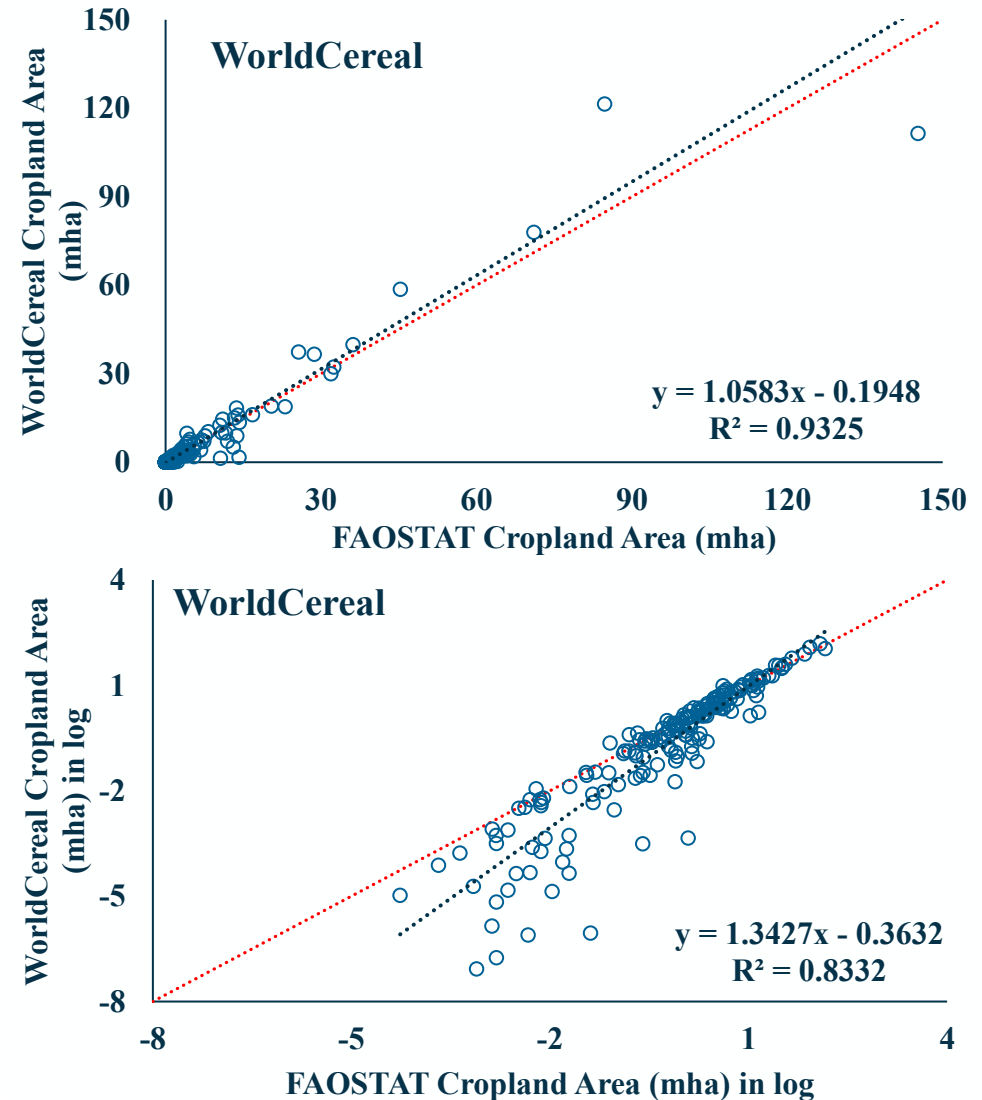
- **WorldCereal** has the highest accuracy in **Asia** (OA=86.63%), **Europe** (OA=87.74%), **North America** (OA = 91.86%), **Latin America** (OA = 93.12%).
- **ESRI** has the highest accuracy in **Africa** (OA = 82.71%).
- **WorldCover** has the best accuracy in **Oceania** (OA = 90.81).



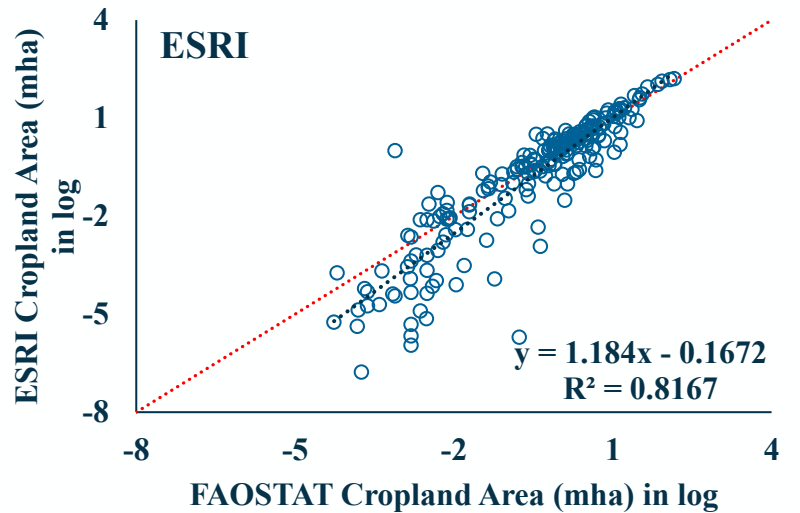
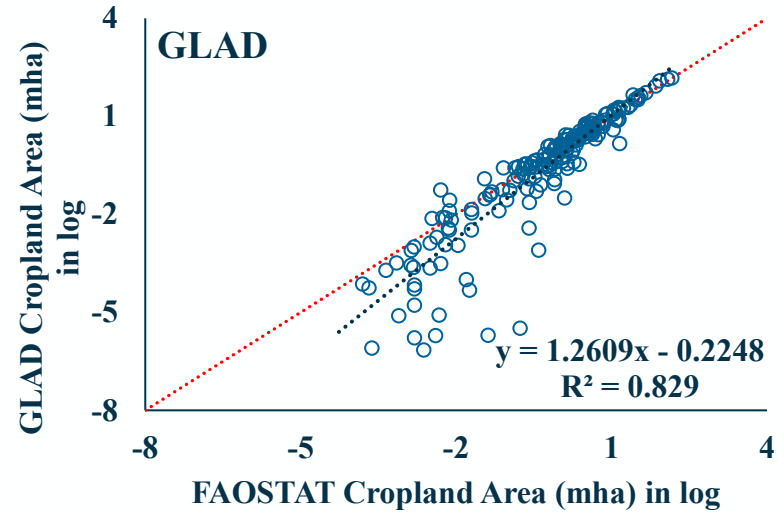
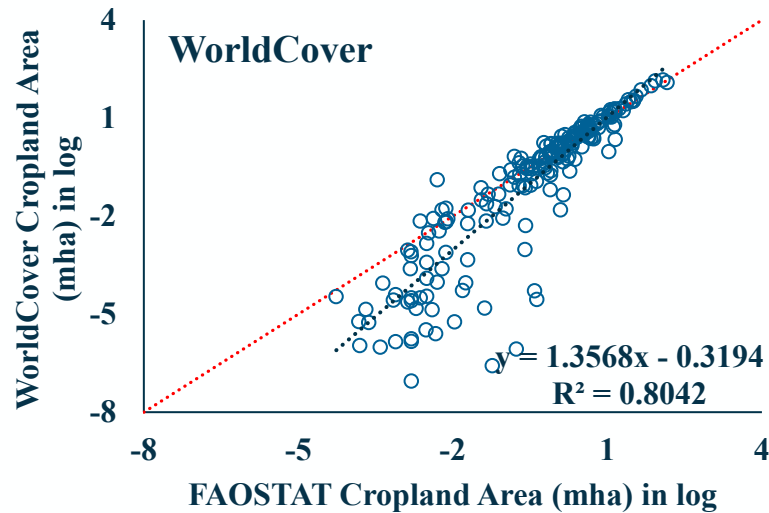
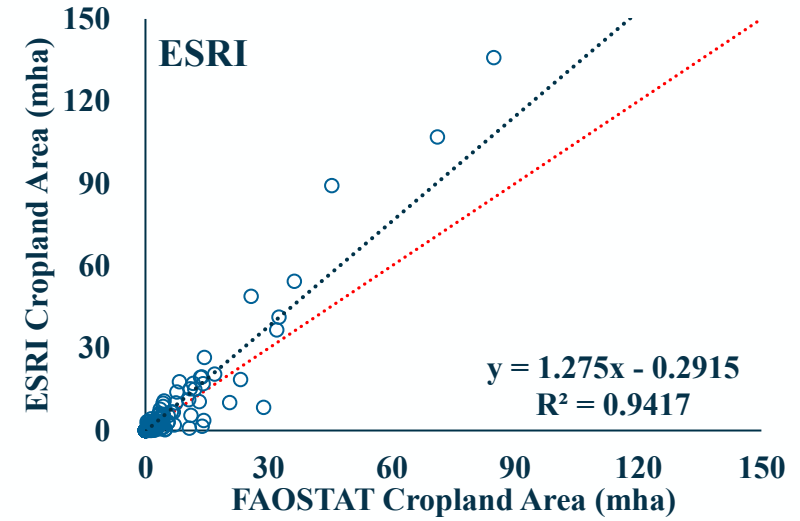
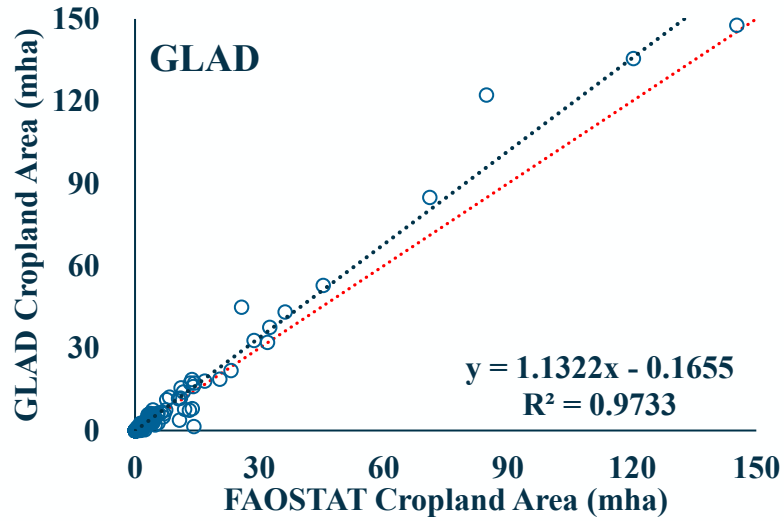
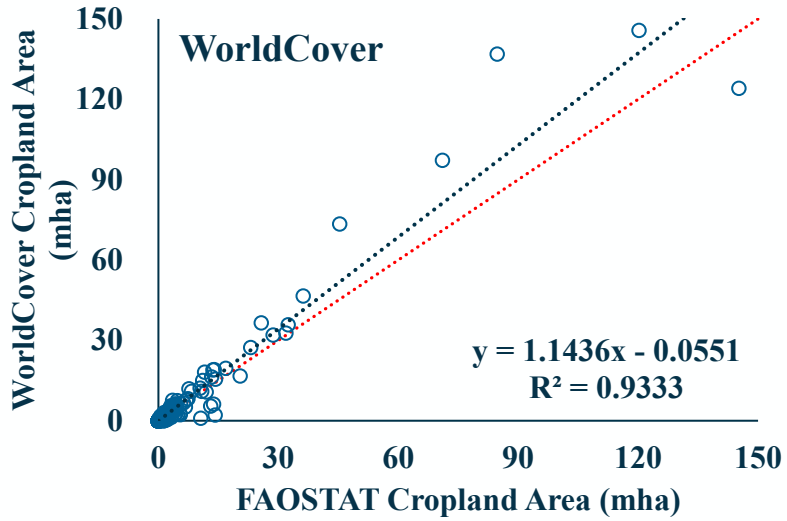


# Cropland validation

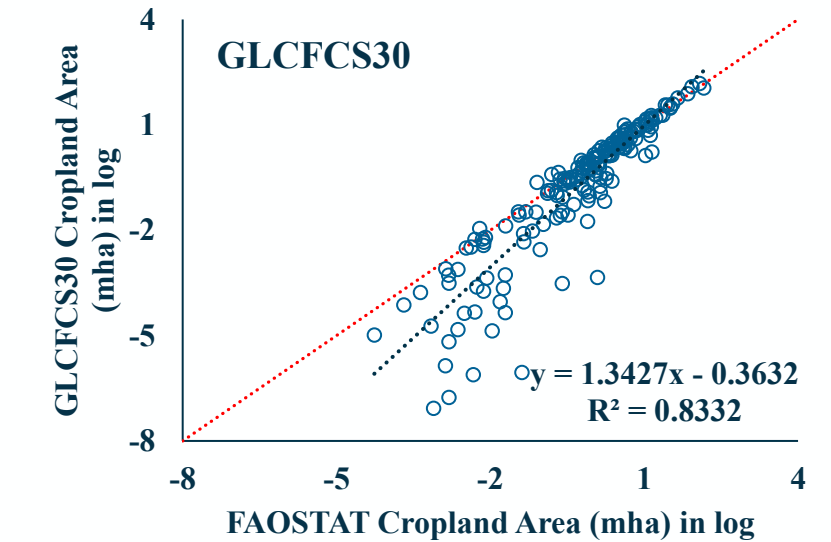
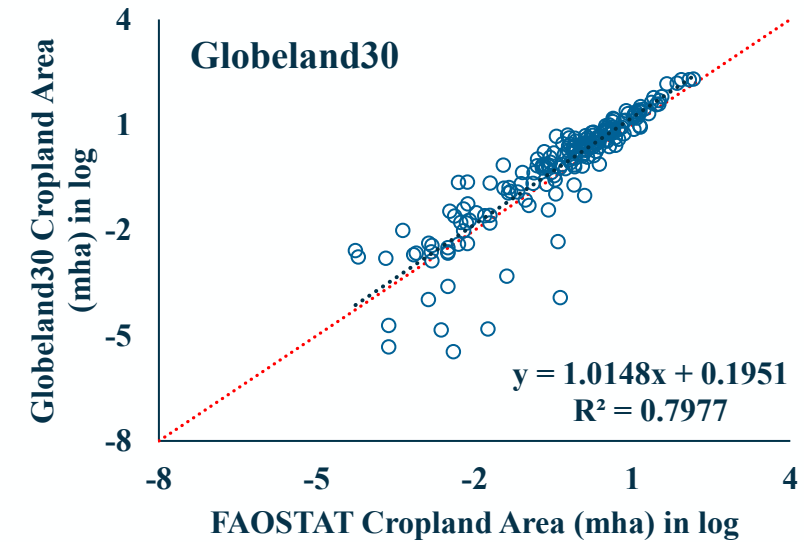
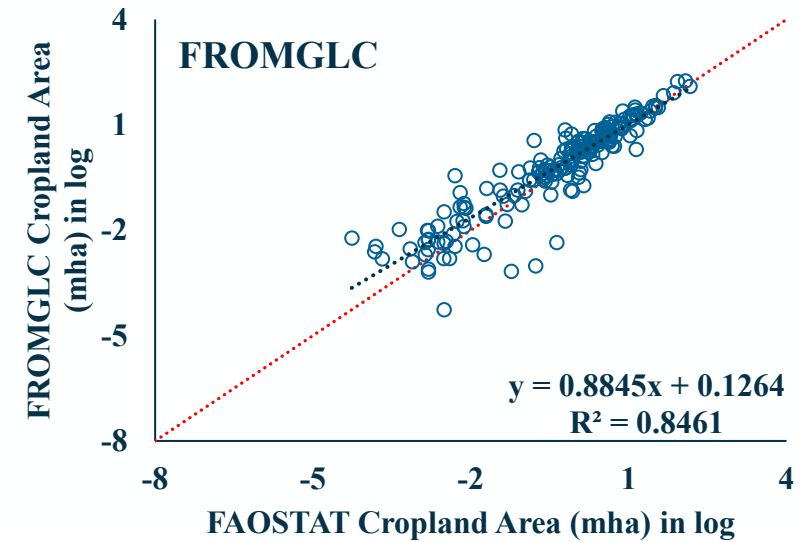
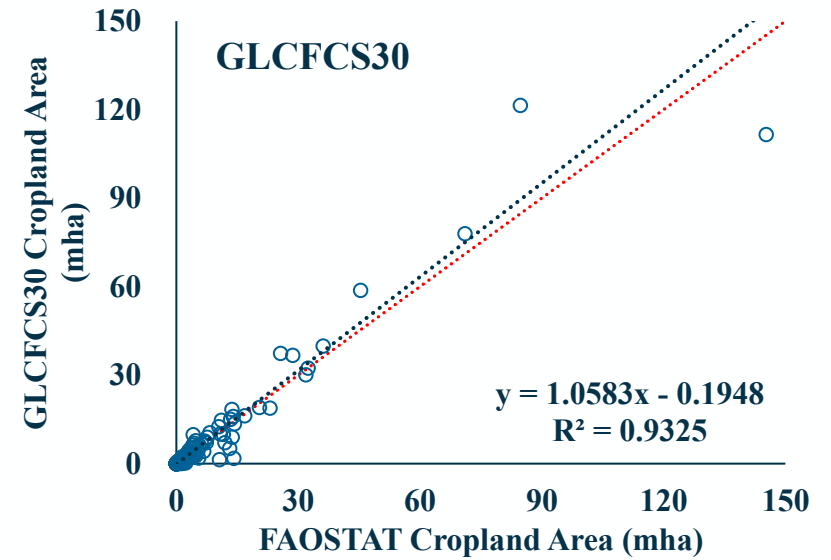
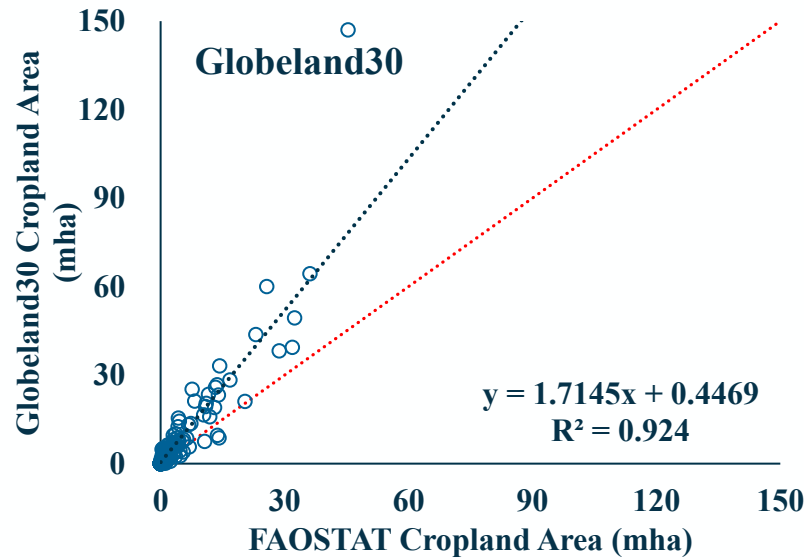
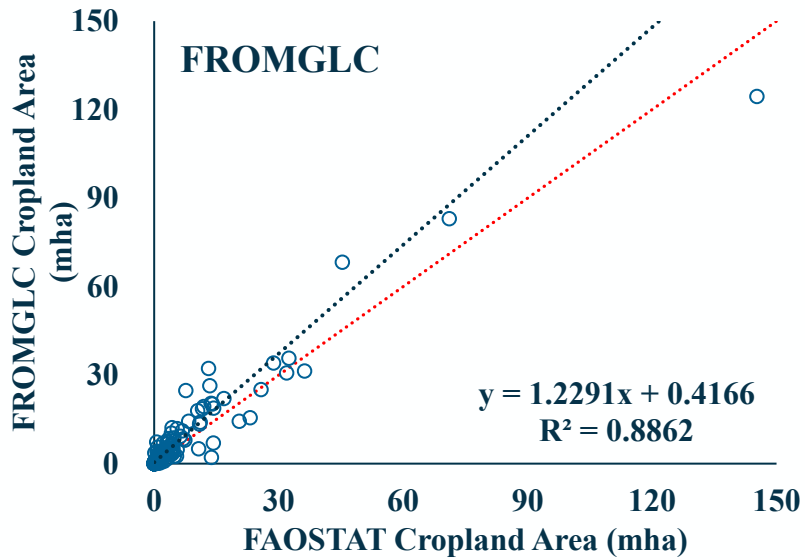
- All the seven cropland products tend to overestimate the cropland area, particularly in the countries with larger territory area
- From the countries with small territory area, fitted line of Globeland30 is the nearest to 1:1 line, and only FROMGLC tend to overestimate cropland area



# Cropland validation



# Cropland validation



- Existing 10-30m resolution cropland extent data have large disagreement, just **31.89%** of potential cropland agreed by all the seven cropland products included in this comparison.
- Validation conducted by independent dataset (with more than 30,000 samples) showed that **WorldCereal have the highest accuracy**. All seven products tend to overestimate cropland area, which may be caused by the broader definition.
- Area comparison with FAOSTAT Temporary Crops showed all products overestimate cropland area for countries with large territory area, for the country with small territory, most cropland products underestimated cropland area.
- We are migrating the validation samples to 2025 and will conduct independent cropland extent map comparison.

# THANK YOU

