NASA Harvest
Helmets Labeling Crops

Dr. Catherine Nakalembe
Africa Program Director, NASA Harvest

Ivan Zvonkov
Machine Learning Engineer, NASA Harvest

Core Team Members at NASA Harvest

Dr. Catherine Nakalembe
Harvest Africa Program Director

Madhava Paliyam
Harvest ML Researcher

Ivan Zvonkov
Harvest ML Engineer

Dr. Hannah Kerner
Harvest AI Lead

Partners


UNIVERSITY OF
18
56
MARYLAND


WE BUILD FOR THE FUTURE


MAPPING FOR SUSTAINABLE DEVELOPMENT
RCMRD


Mapillary


IIASA


LUTHERAN
WORLD RELIEF


EAGC
EASTERN AFRICA GRAIN COUNCIL


CIMMYT
International Maize and Wheat
Improvement Center

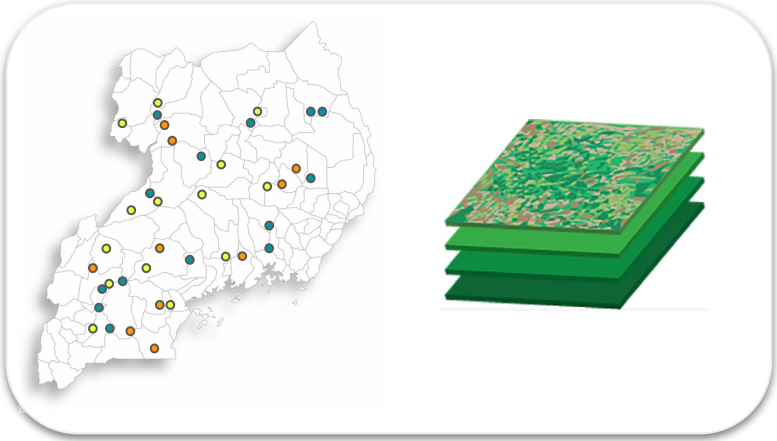

Radiant Earth
Foundation
EARTH IMAGERY FOR IMPACT


SOKOINE UNIVERSITY OF AGRICULTURE
1984
ARDHI NI HAZINA

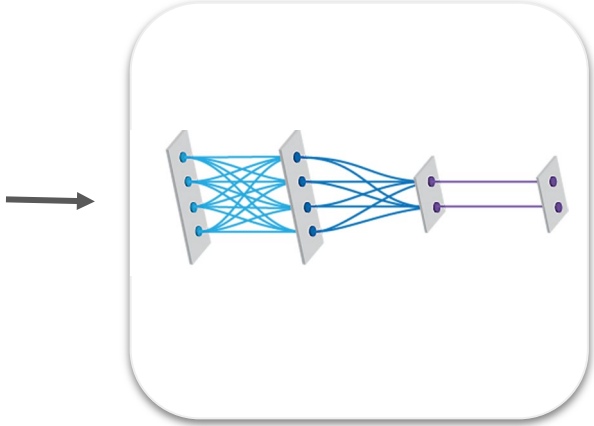

RUFORUM
Capacity Building in Agriculture


HARVEST

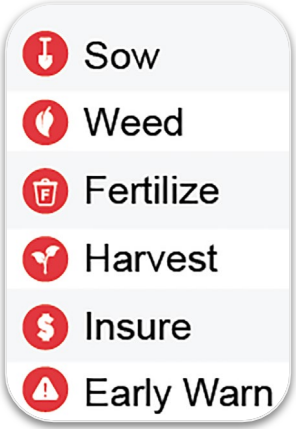
1. **The Challenge**
2. Our idea
3. How it works
4. How it scales
5. Next steps



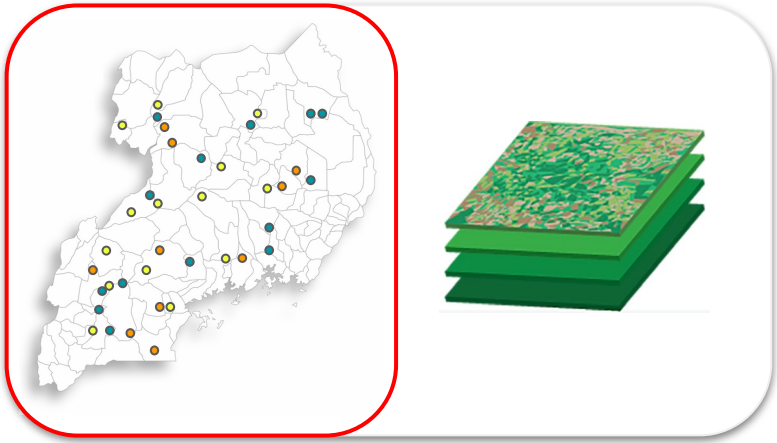
Crop type labels with
Earth observation data



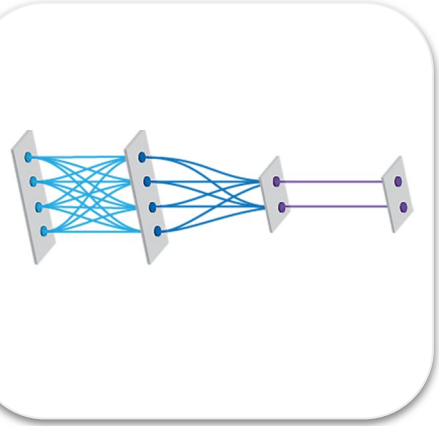
Machine learning



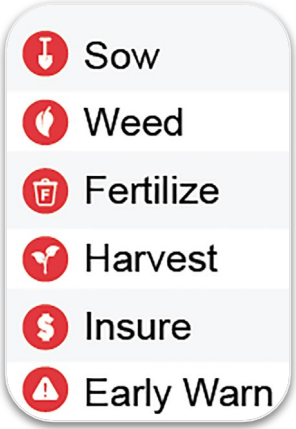
Insights



Crop type labels with
Earth observation data

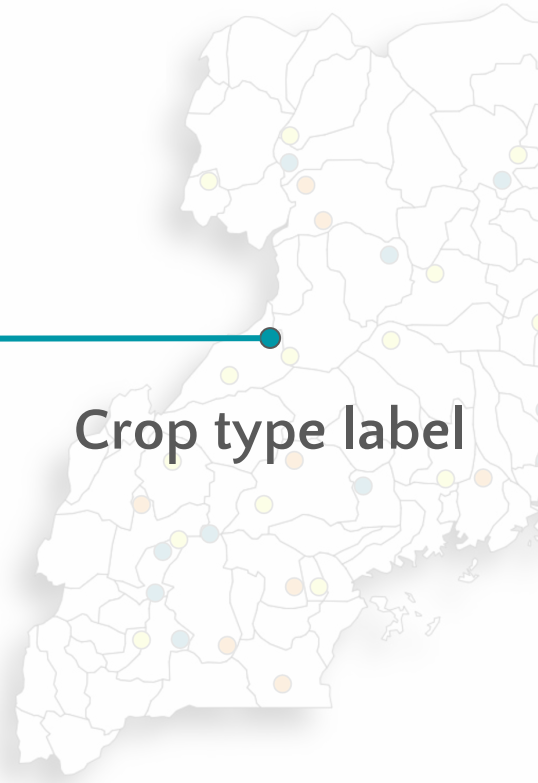


Machine learning



Insights

Traditional data collection is a lot of work

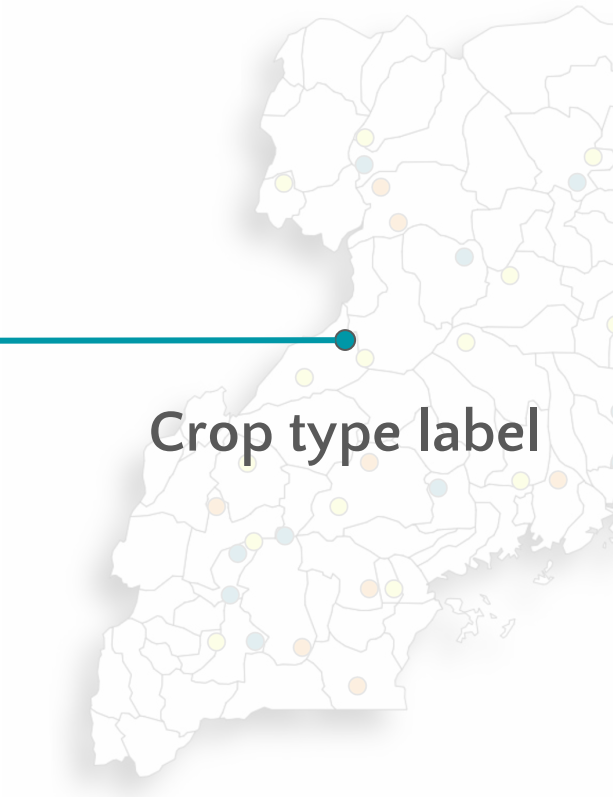


Crop type label

1. The Challenge
2. **Our idea**
3. How it works
4. How it scales
5. Next steps

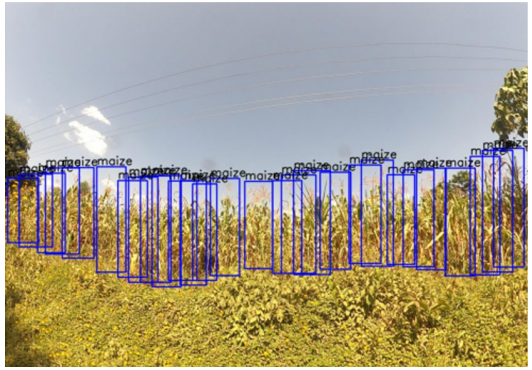
Rapid data collection

Helmets labeling crops

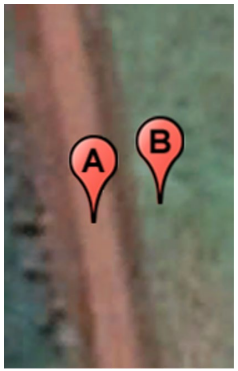


Helmets labeling crops

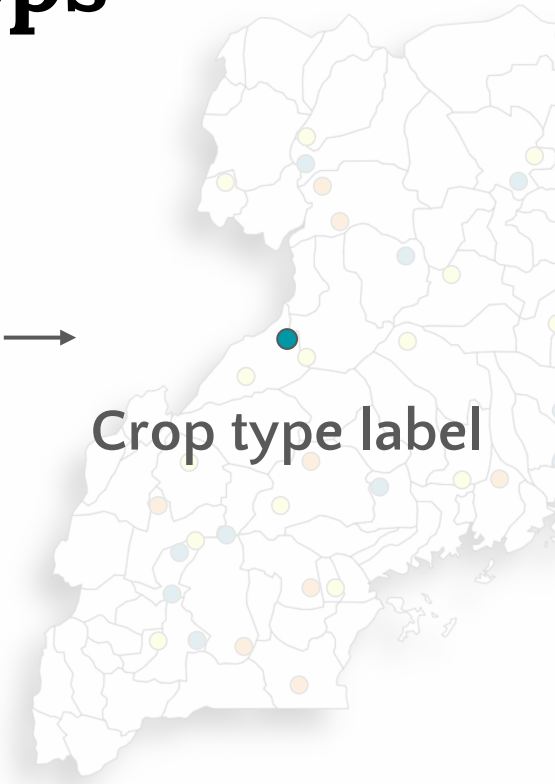
1) GoPro photos with coordinate



2) Crop type object detection

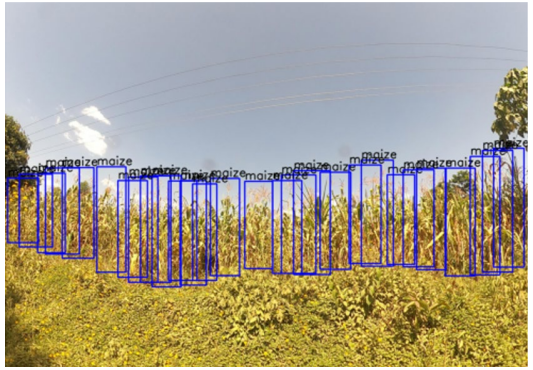


3) Distance offset algorithm

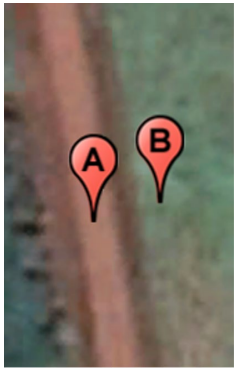


1. The Challenge
2. Our idea
3. **How it works**
4. How it scales
5. Next steps

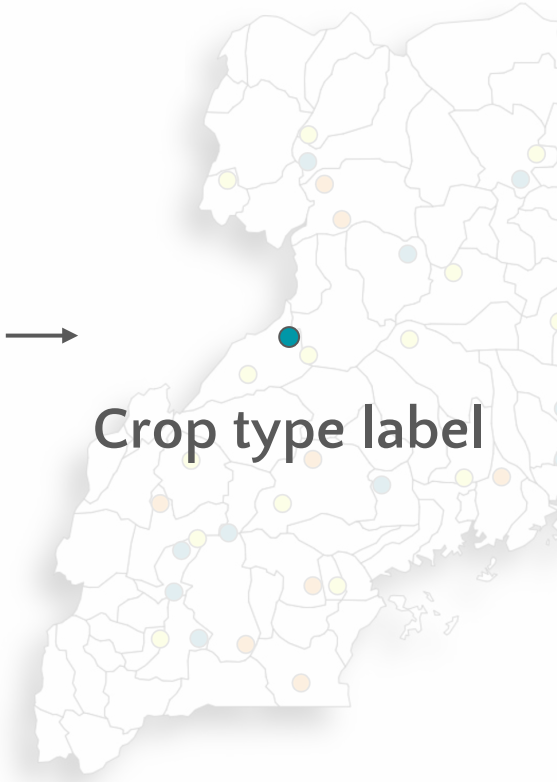
1) GoPro photos with coordinate



2) Crop type object detection



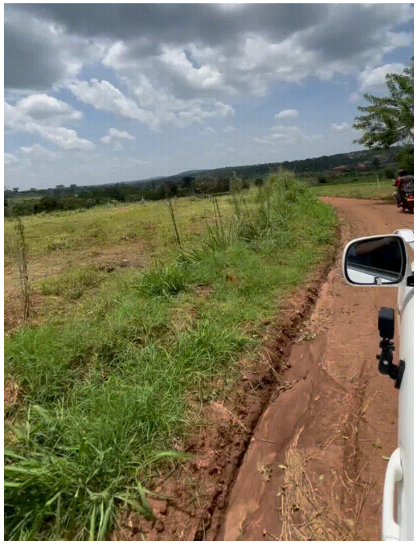
3) Distance offset algorithm



1) GoPro photos with coordinate

Easy setup

Helmet mount



Car mount

1) Partners leading data collection

Makerere University
Collection in Uganda

Sokoine University of Agriculture
Collection in Tanzania

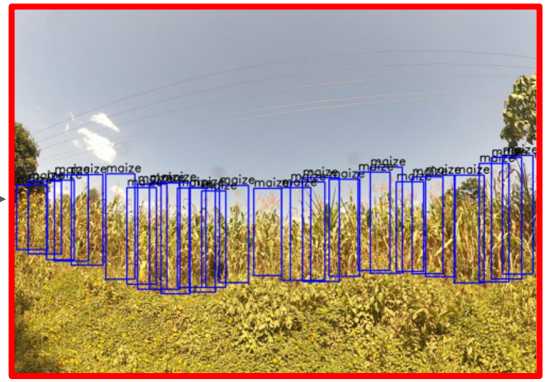
LUTHERAN WORLD RELIEF

Collection in Mali

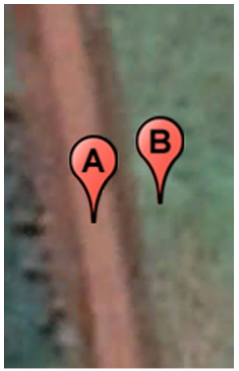
RCMRD

Collection in Kenya and Rwanda

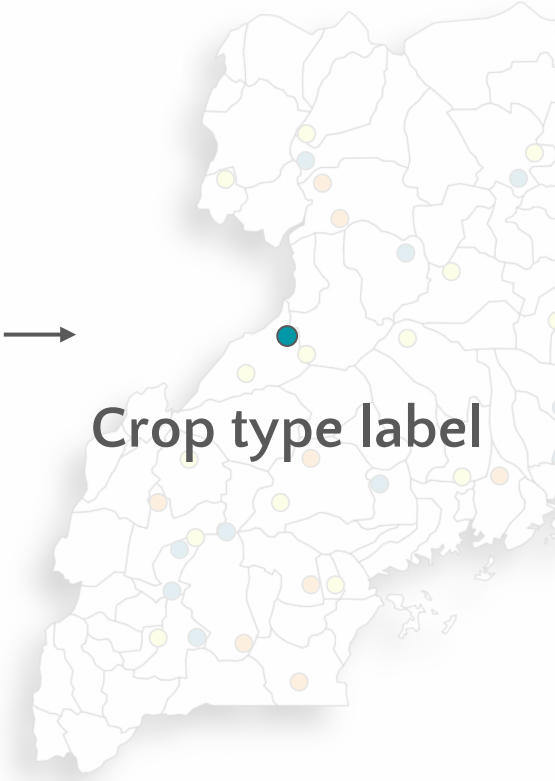
1) GoPro photos with coordinate



2) Crop type object detection

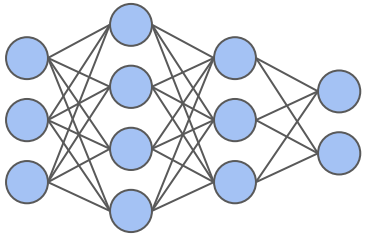


3) Distance offset algorithm

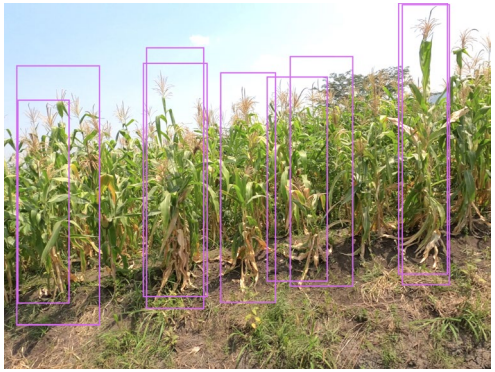


2) Crop type object detection (inference)

Input GoPro photo



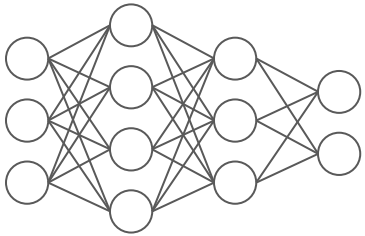
Trained crop type detection model



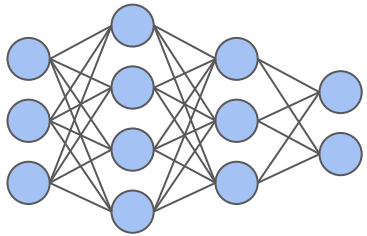
Output crop type bounding boxes predictions

2) Crop type object detection (model training)

Manually labeled bounding boxes



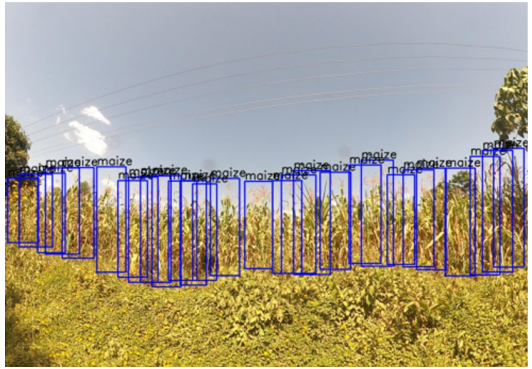
Pretrained YOLO v5 object detection model architecture



Trained crop type detection model

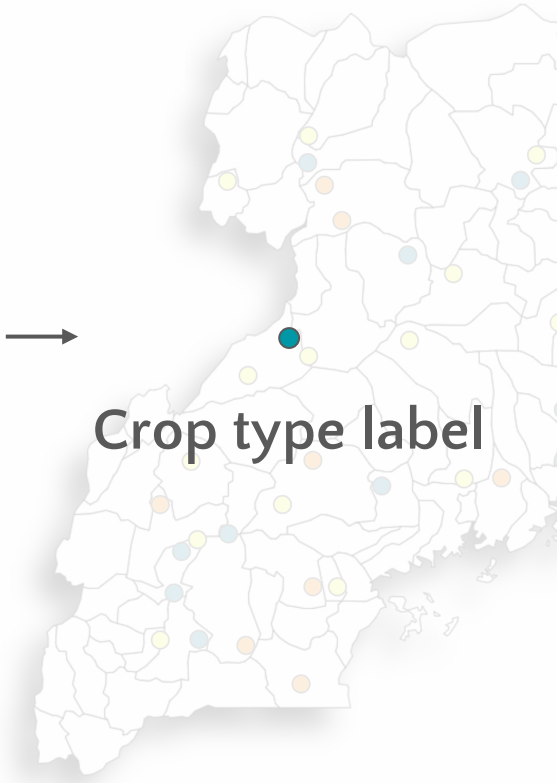
Partners helping with labeling images

1) GoPro photos with coordinate

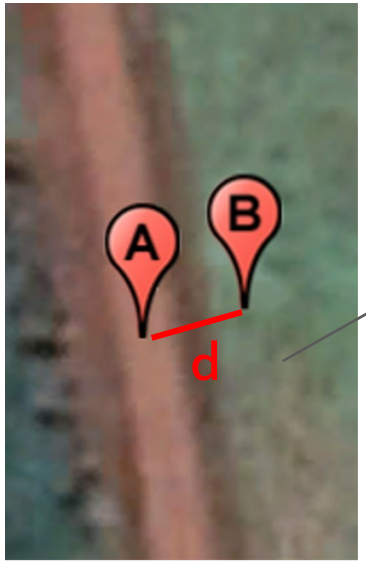


2) Crop type object detection

3) Distance offset algorithm



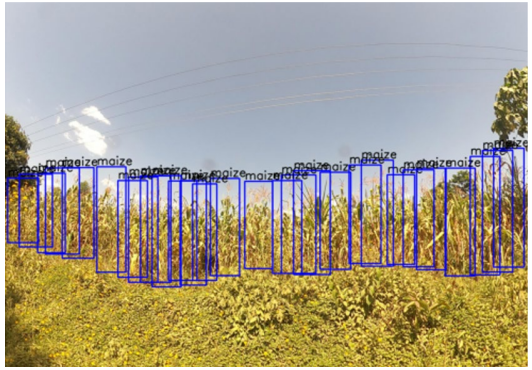
3) Distance offset algorithm



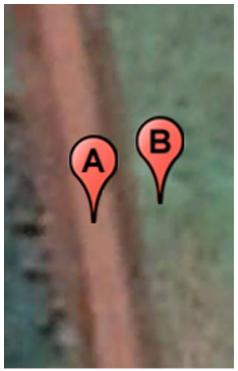
$$d = \frac{(l_{focal} * h_{crop} * h_{image})}{(h_{bbox} * h_{sensor})}$$

- l_focal: focal length of camera
- h_crop: height of crop based on lookup table
- h_image: image height in pixels
- h_bbox: detected bounding box height in pixels
- h_sensor: sensor height obtained from GoPro website

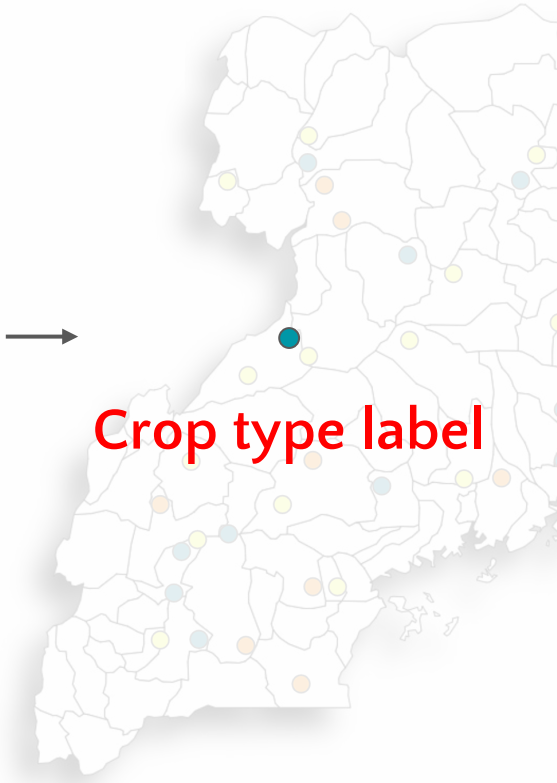
1) GoPro photos with coordinate



2) Crop type object detection

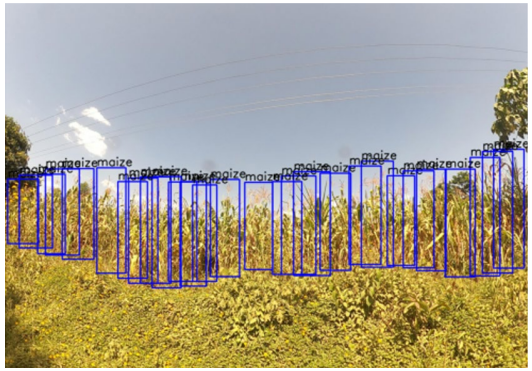


3) Distance offset algorithm

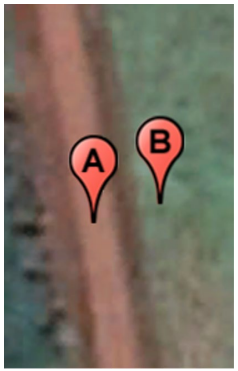


How can we generate 1000s of labels?

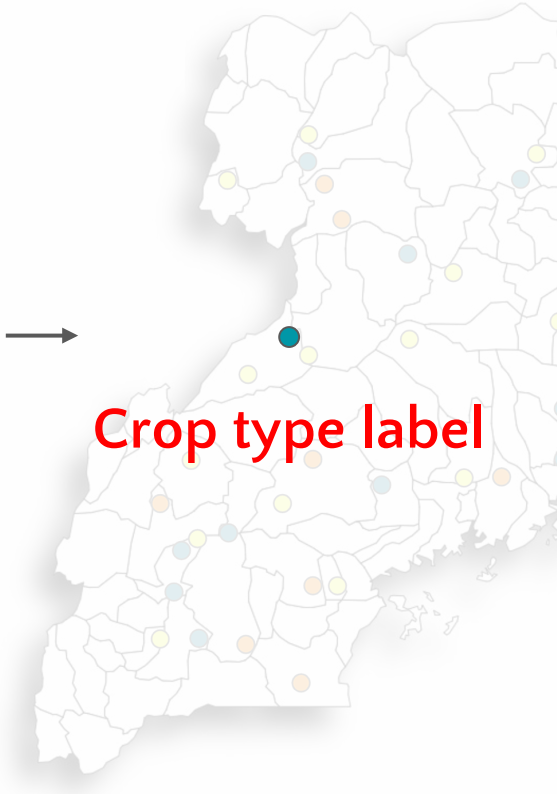
1) GoPro photos with coordinate



2) Crop type object detection

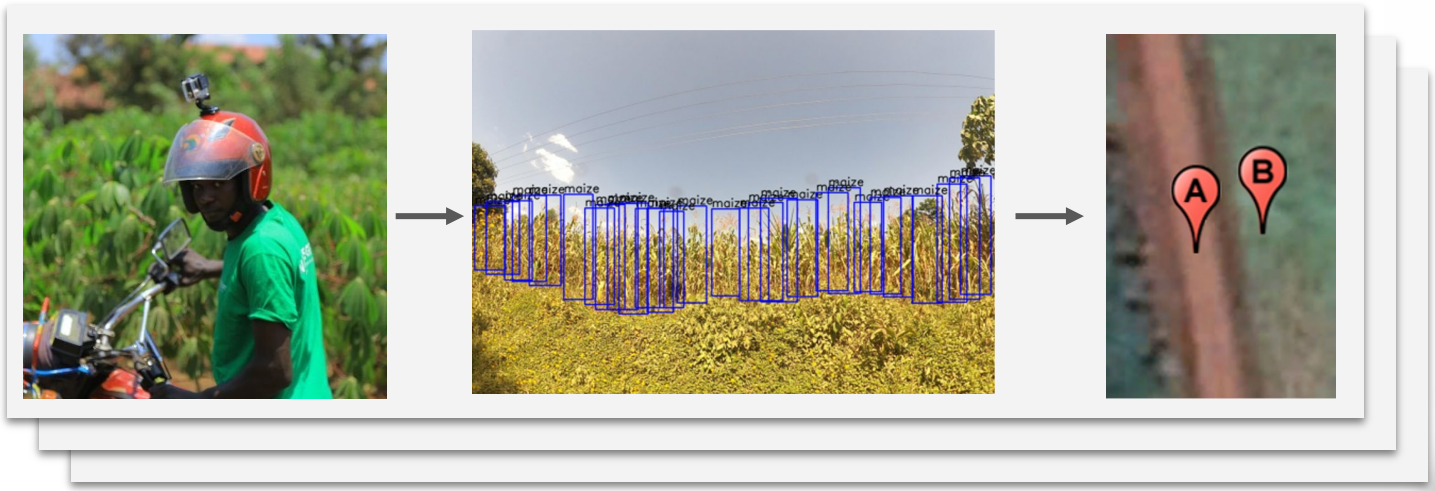


3) Distance offset algorithm



1. The Challenge
2. Our idea
3. How it works
4. **How it scales**
5. Next steps

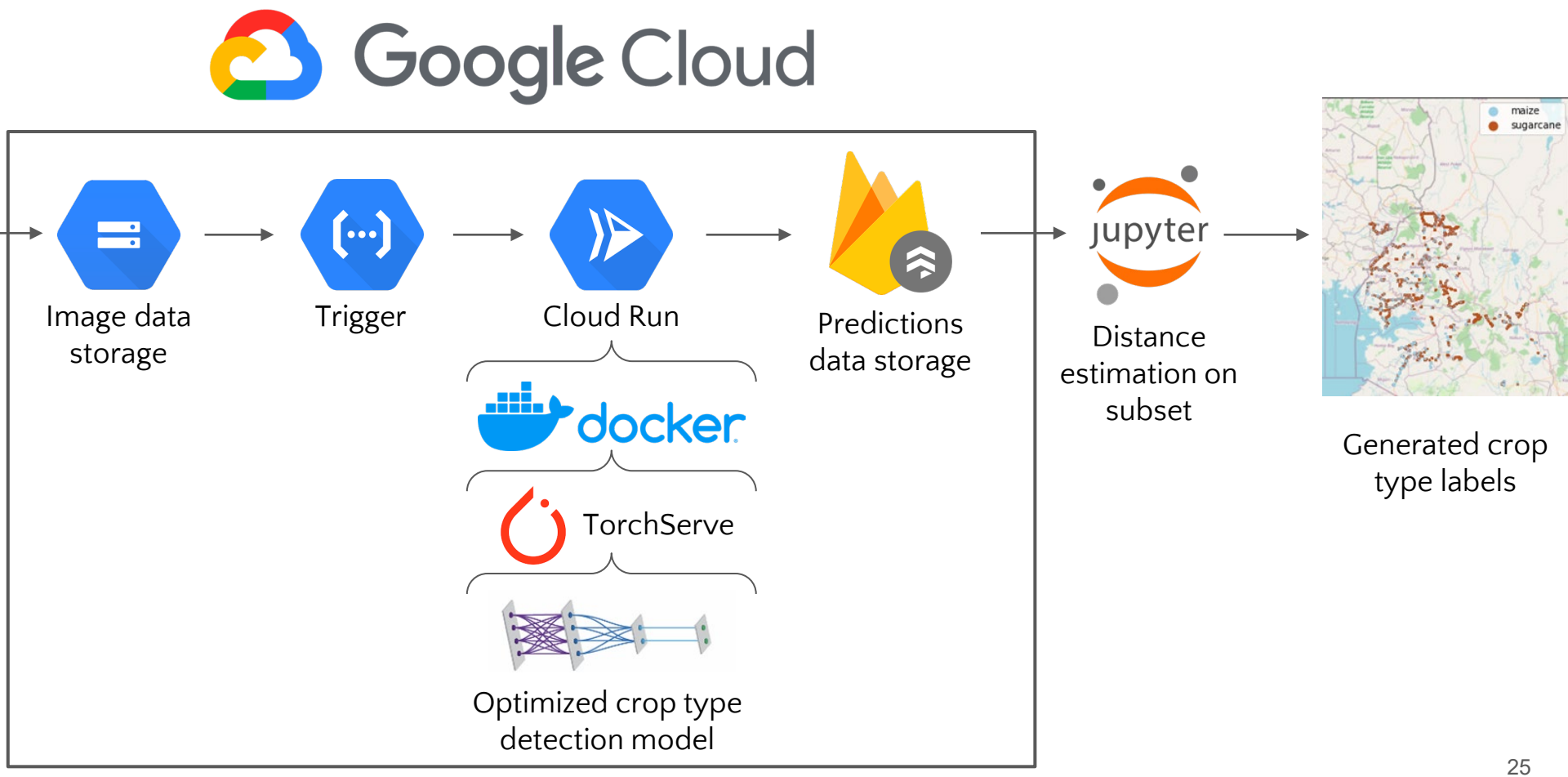
Generating 1000s of labels with a cloud architecture

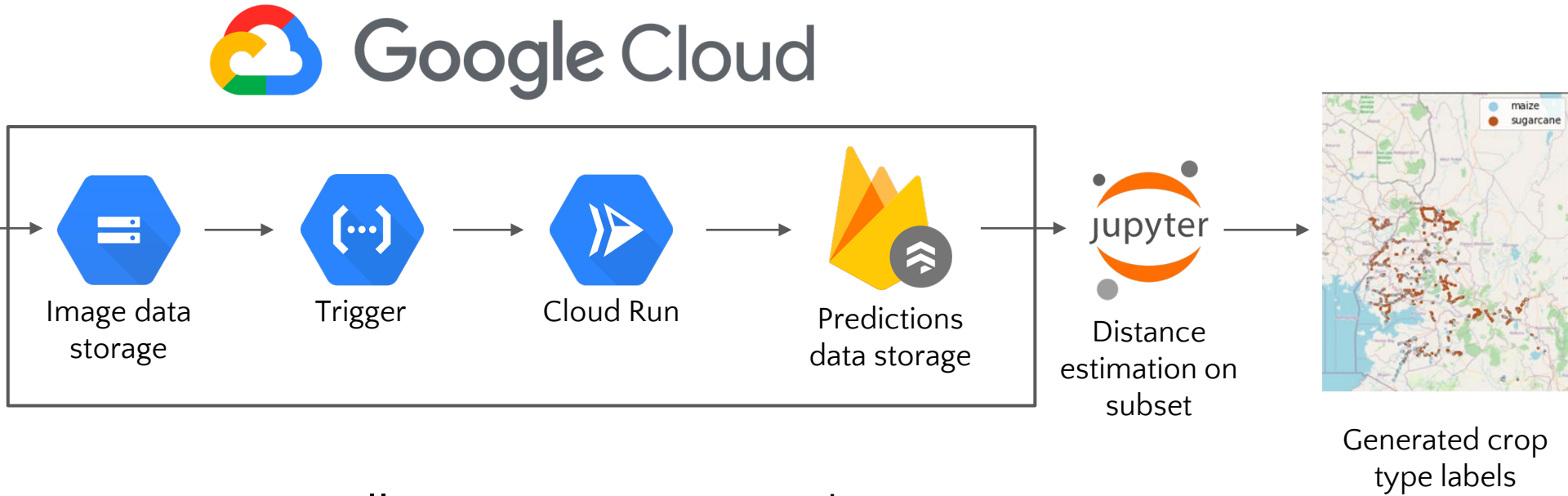


Google Cloud

100x

Crop type labels


Google Cloud
Image data storage
Trigger
Cloud Run
docker
TorchServe
Optimized crop type detection model
Predictions data storage
jupyter
Distance estimation on subset
maize
sugarcane
Generated crop type labels



Over 1 million images processed

1. The Challenge
2. Our idea
3. How it works
4. How it scales
5. **Next steps**

Next Steps

Pilot data collection

HARVEST

LocateIT Limited

RCMRD

RCMRD

LUTHERAN WORLD RELIEF

Next Steps

1. Extensive quality assessment/control
2. Evaluate multiple distance offset algorithms
3. Using generated labels in NASA Harvest's existing workflows
4. Releasing datasets for public use

Contribution

A novel rapid data collection method
for in-situ crop type labels