Sentinel-2 image of Cambridge
Taken October 17, 2022

AI-Assisted Conservation Workshop

AI for the Digital Planet(s)

Dr. Hannah Kerner

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Vision: AI for the Digital Planet
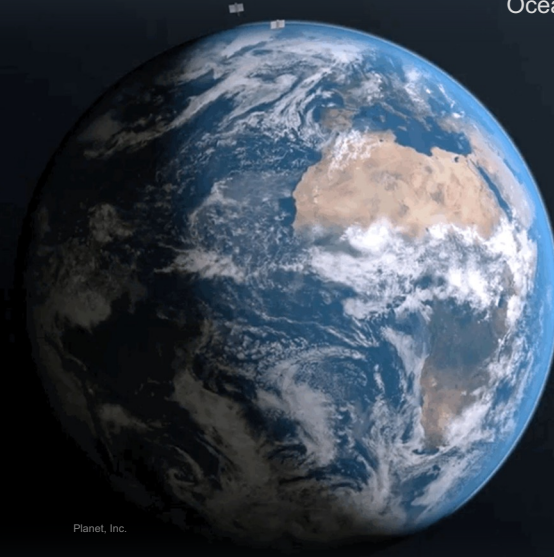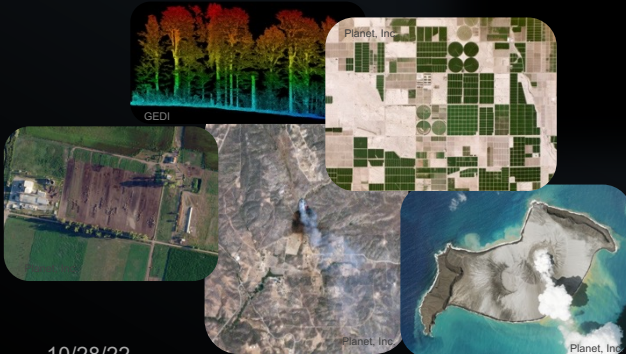

Ocean observations

Webcams and smartphones

Street-level images/videos

In-situ sensors

Satellite/spaceborne observations

Proximal sensors

Use case / stakeholder need

Cina Lawson
Togolese Minister of Post,
Digital Economy
and Technological
Innovation

Need census of smallholder farms in Togo

Hannah Kerner (2022). AI for the Digital Planet.
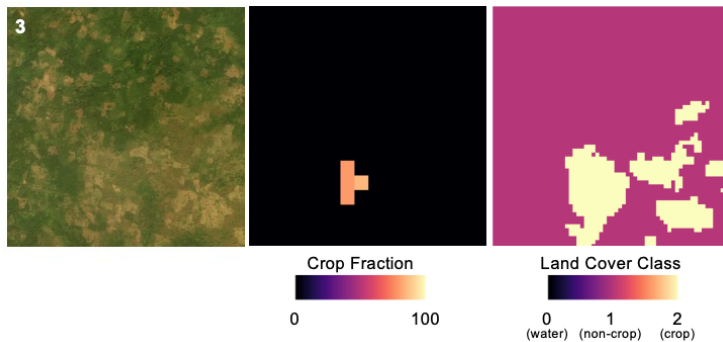
Use case / stakeholder need

→

Existing AI methods insufficient?

Need census of smallholder farms in Togo

Cina Lawson
Togolese Minister of Post, Digital Economy and Technological Innovation

Crop Fraction
0   100

Land Cover Class
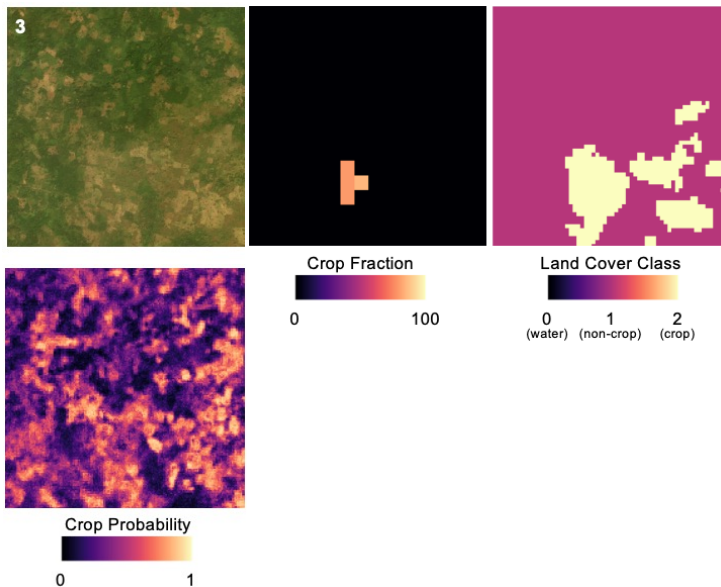0   1   2
(water) (non-crop) (crop)

Use case / stakeholder need

Need census of smallholder farms in Togo

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Existing AI methods insufficient?

Crop Fraction

0   100

Land Cover Class

0   1   2
(water) (non-crop) (crop)

Crop Probability

0   1

Solution

CROP PROBABILITY

0   0.25   0.5   0.75   1

Hannah Kerner (2022). AI for the Digital Planet.

"This map provides unmatched clarity into the nature and distribution of agricultural land nationwide [and helps] provide decisive knowledge being used to design social protection policies aimed at improving the livelihoods of agrarian rural communities."

Deliver
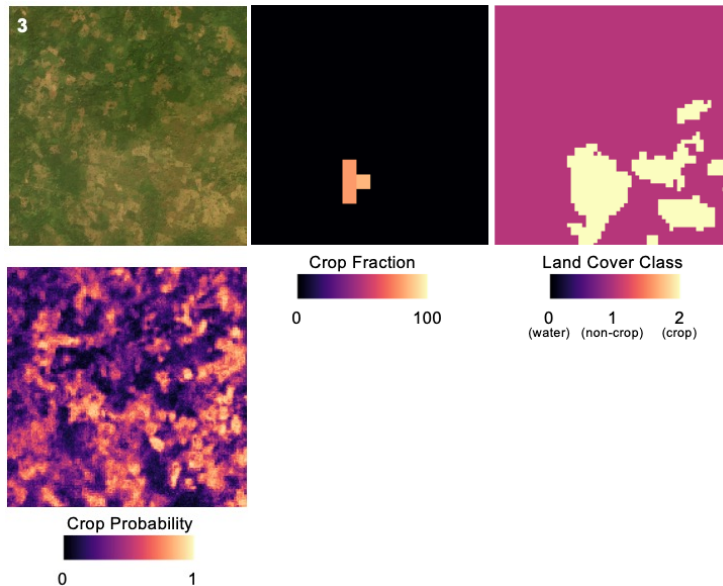
HARVEST

Use case / stakeholder need

Existing AI methods insufficient?

Solution
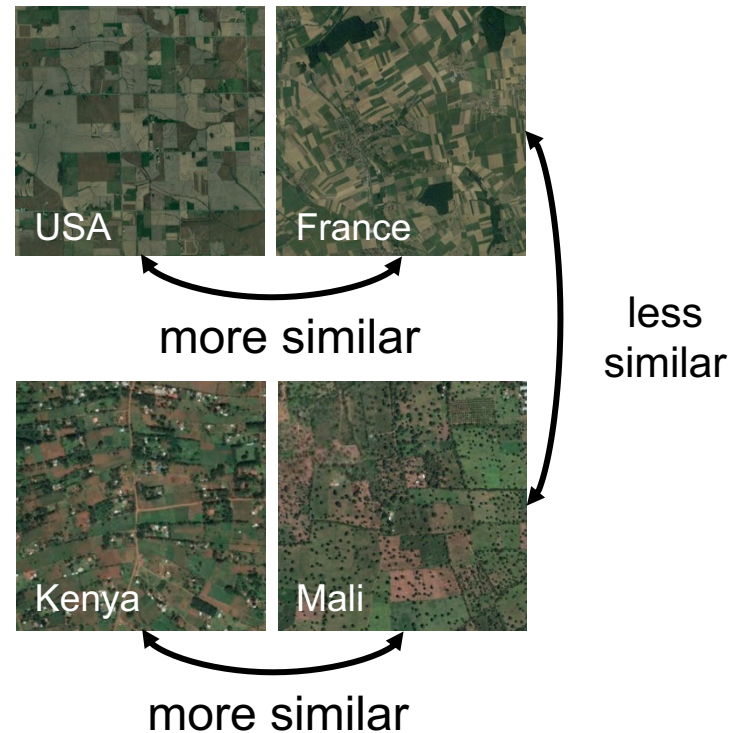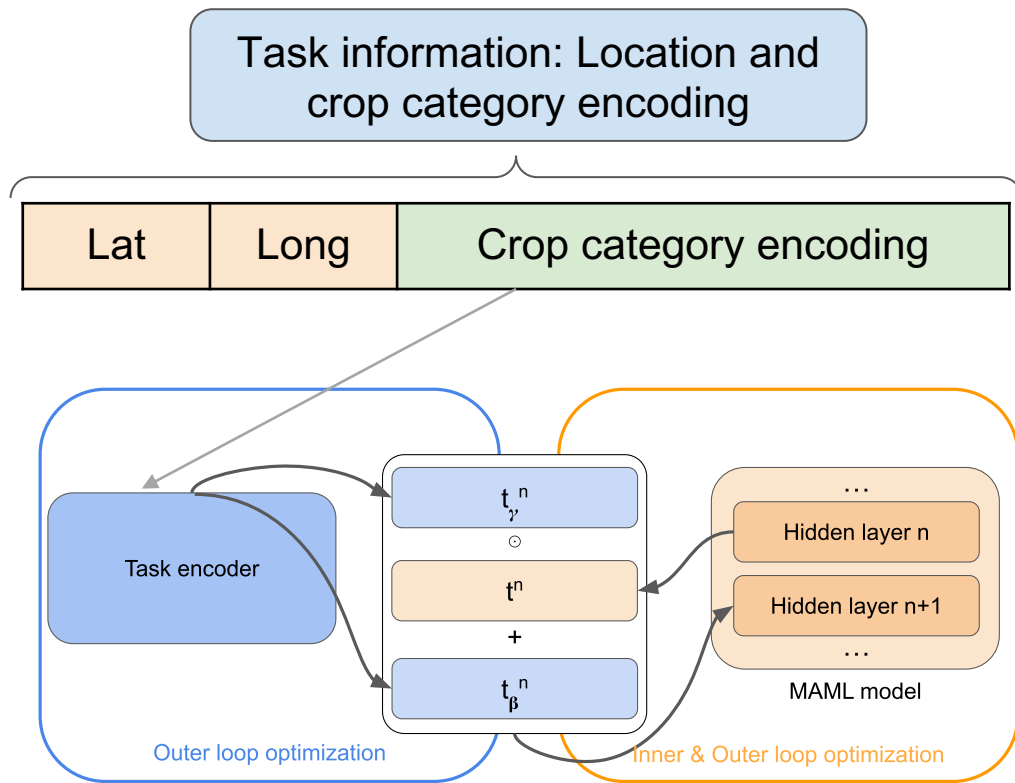
Need census of smallholder farms in Togo

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Crop Fraction
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0   1

CROP PROBABILITY
0   0.25   0.5   0.75   1

Learning from limited labels:
Task-informed meta-learning

Task information: Location and crop category encoding

| Lat | Long | Crop category encoding |

Task encoder

t_γ^n

$\odot$

t^n

$+$

t_β^n

...

Hidden layer n

Hidden layer n+1

...

MAML model

Outer loop optimization

Inner & Outer loop optimization

USA

France

more similar

less similar

Kenya

Mali

more similar

Tseng, G., Kerner, H., Rolnick, D. Under review for *ICLR 2023.*

Scalable geospatial prediction: OpenMapFlow

Rapid map creation with machine learning and earth observation data

openmapflow 0.2.0rc1

`pip install openmapflow==0.2.0rc1`

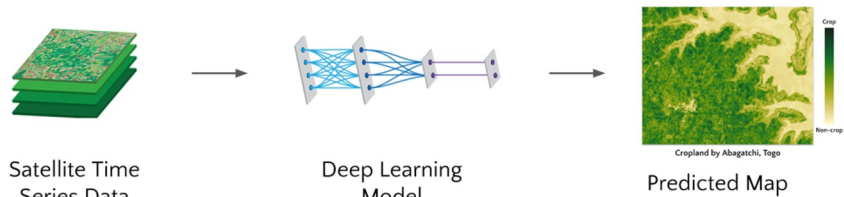Data processing pipeline → ML model training → Rapid map creation

Reduces time and cost

Scalable geospatial prediction:
OpenMapFlow

crop-mask-example 🌍

Satellite Time Series Data → Deep Learning Model → Predicted Map

Cropland by Abagatchi, Togo

Crop / Non-crop

buildings-example 🌍

Satellite Time Series Data → Deep Learning Model → Predicted Map

Buildings by Kampala, Uganda

Buildings / Non-buildings

maize-example 🌍

Satellite Time Series Data → Deep Learning Model → Predicted Map

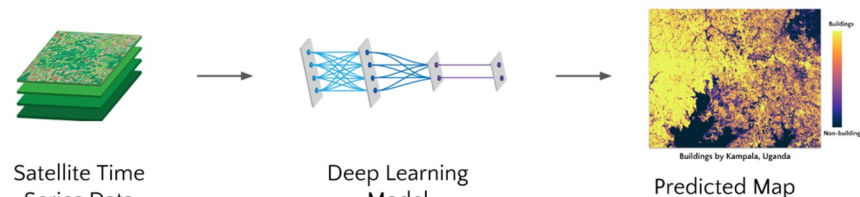Maize in Kakamega County, Kenya

Maize / Non-maize

Table 1: Dense Predictions Time and Cost

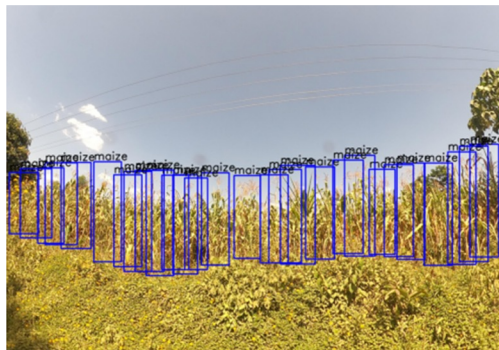| Bounding Box	Area	Input data	Sequential prediction time	Our prediction time	Merging time	Our cost
Rwanda	63,018 km^2	0.331 TB	458 mins	12 mins	7 mins	$9.19
Western Ethiopia	160,036 km^2	1.38 TB	1908 mins	19 mins	40 mins	$42.50
Uganda	375,755 km^2	3.06 TB	4232 mins	39 mins	101 mins	$93.25
	1000 km^2	8.83 GB	12 mins	1 min	<1 min	$0.30
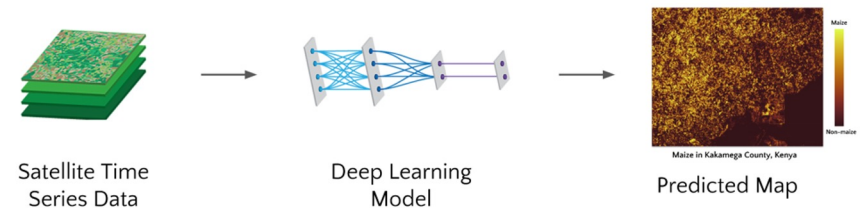
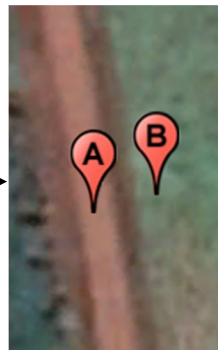Zvonkov, I., Tseng, G., Nakalembe, C., Kerner, H. Under review for *AAAI 2023*.
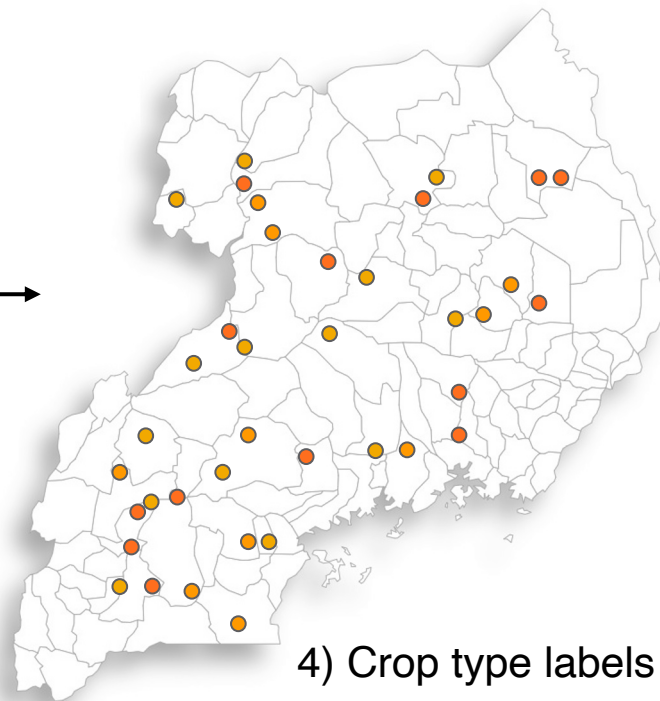
Exponential data collection:
Street2Sat

1) GoPro photos + GPS coordinate

2) Crop type object detection

3) Location offset

4) Crop type labels

Paliyam, M., Nakalembe, C., Liu, K., Nyiawung, R., Kerner, H. (2021). ICLR Tackling Climate Change with AI Workshop.

Incorporating human expertise:
Corrective labeling

Corrective Labeling App - Malawi

This app allows users to add points to where the crop map is wrongly classified. Users can compare the cropland map on the left against the high resolution Sentinel 2 data on the right. The "Add a Marker" icon on the left panel can be selected to start creating the points. To delete a point, click the hand icon to select the specific point and hit the delete button. After picking all the points, users can click the "Get link for downloading points" button to generate a link that can be downloaded as a CSV file. A detailed instruction manual of the App can be found in the link below:

Detailed Instructions

Capacity ~~building~~ boosting