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The Picture Pile Platform for Rapid Image Classification: Demonstrating the Potential for Citizen Science and SDG Monitoring

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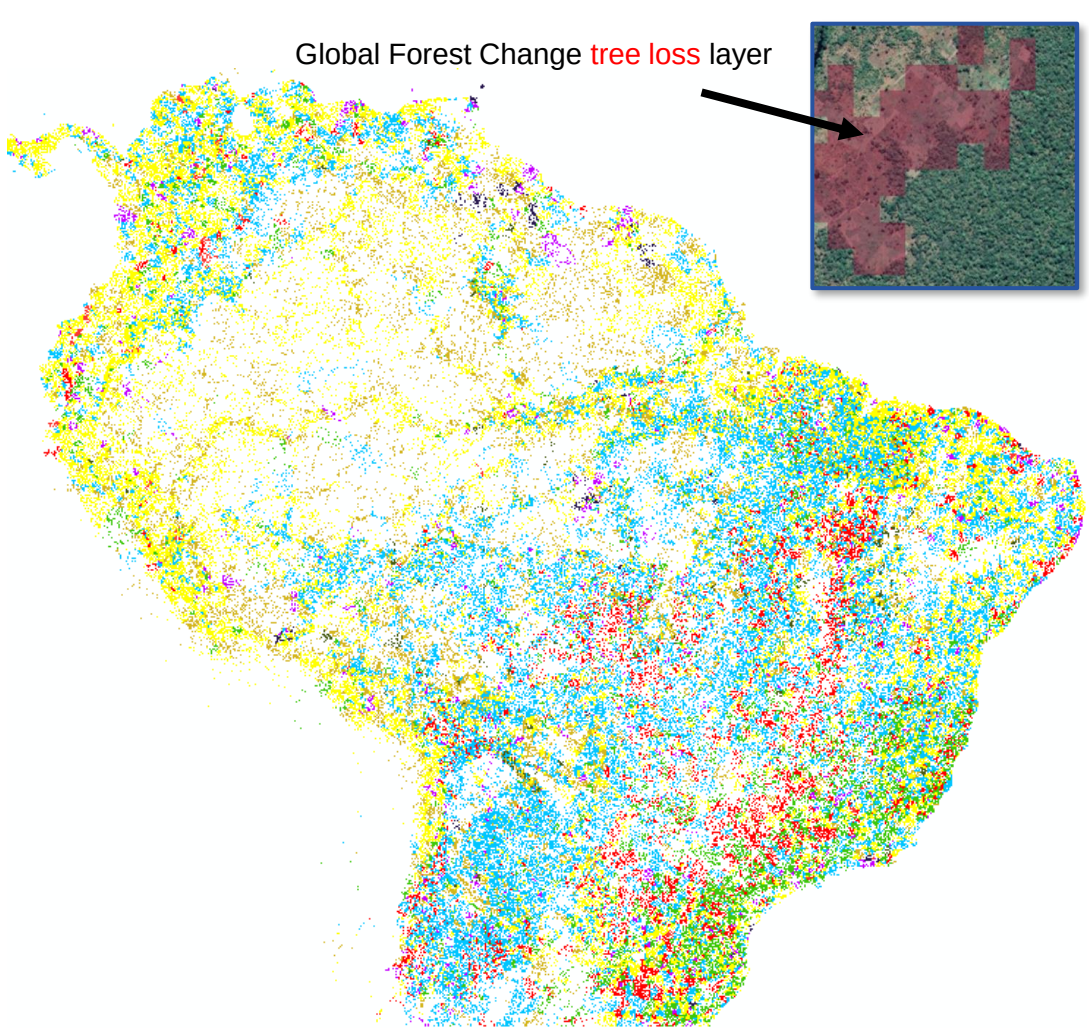
Novel Data Ecosystems for Sustainability (NoDES) Research Group

Advancing Systems Analysis Program

ISRSE39, 24-28 April 2023

Geo-Wiki: Drivers of tropical forest loss campaign



58 participants

400 K+ observations

2 weeks

120 K+ unique locations validated at least 3 times each

- Data published in IIASA-PURE repository: http://pure.iiasa.ac.at/id/eprint/17539/
- Laso Bayas et al. (2022), Scientific Data

Before Picture Pile

- Cropland Capture for rapid image classification

25 weeks

November 2014 — May 2014

3,314
Players

4,648,659
Classifications

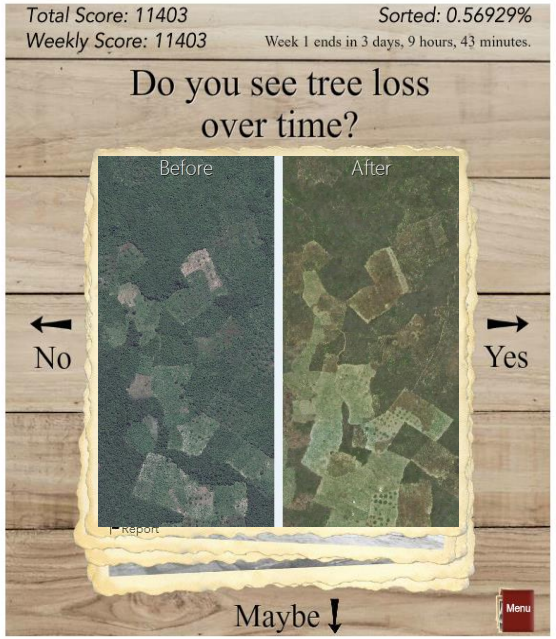
187,673
Unique images

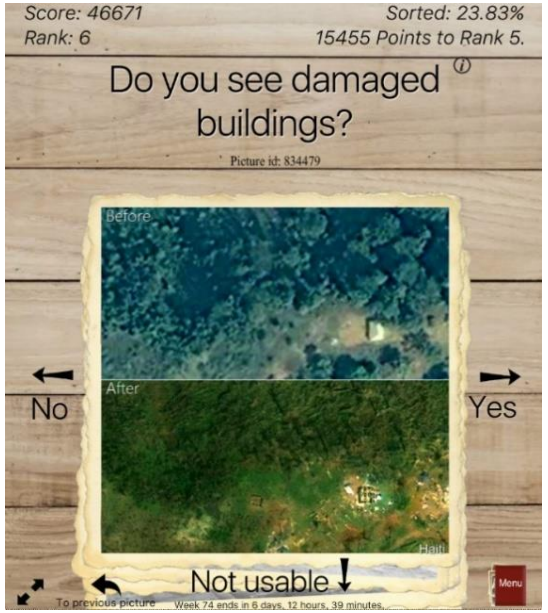
92%
< 2 seconds

→ Leaderboard, weekly and final competition prizes

The Start of Picture Pile

- Generalization of Cropland Capture to any domain
- Pairs of images for change detection
- Wilderness, deforestation, building damage assessment
- Same yes/no/maybe mechanic





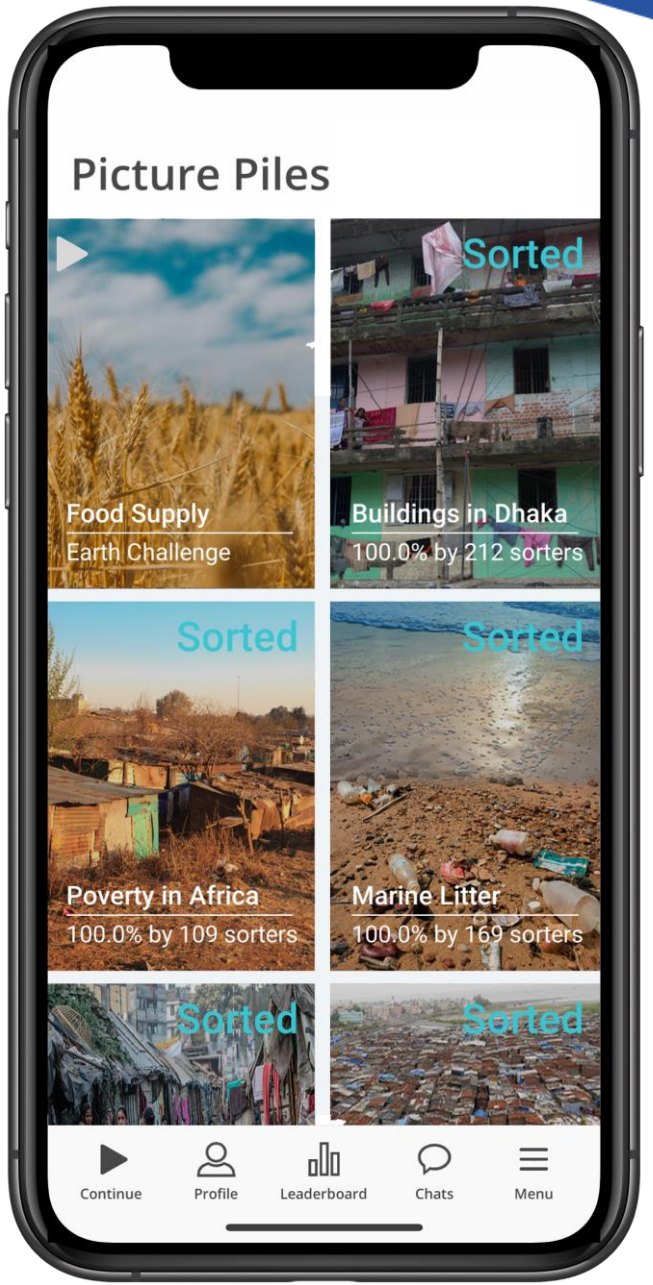
Picture Pile Campaigns

- Since 2014 we have run 16 different Picture Pile crowdsourcing campaigns
- More than 4000 volunteers participated
- More than 11.5 million pictures have been classified

Available on the App Store

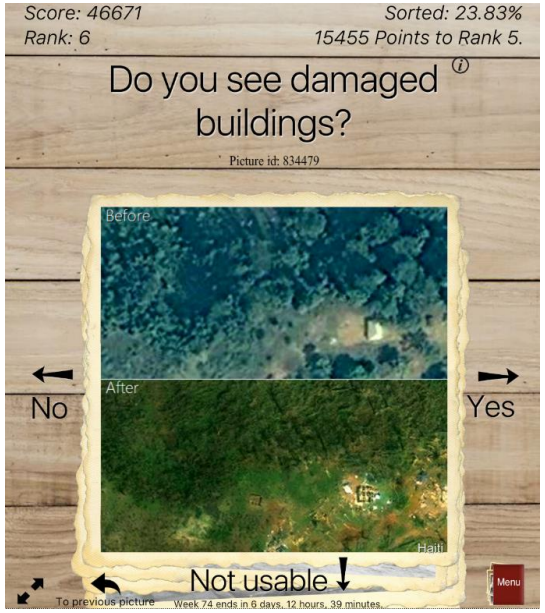
Available on Google Play

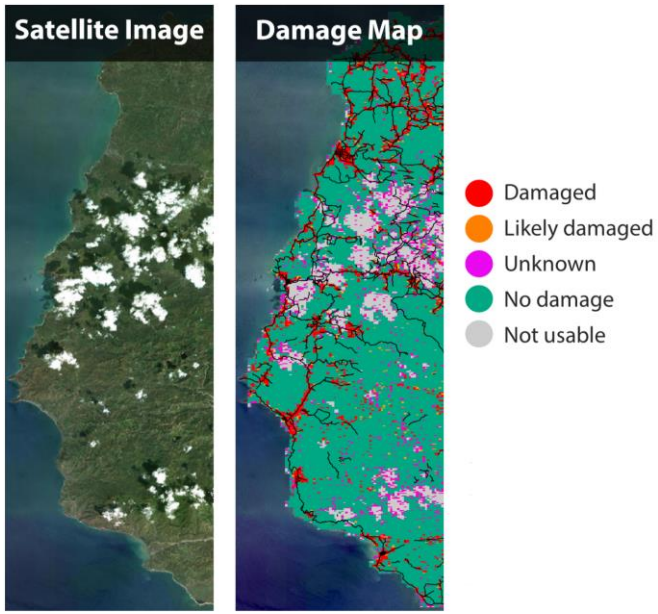
www.picturepile.org

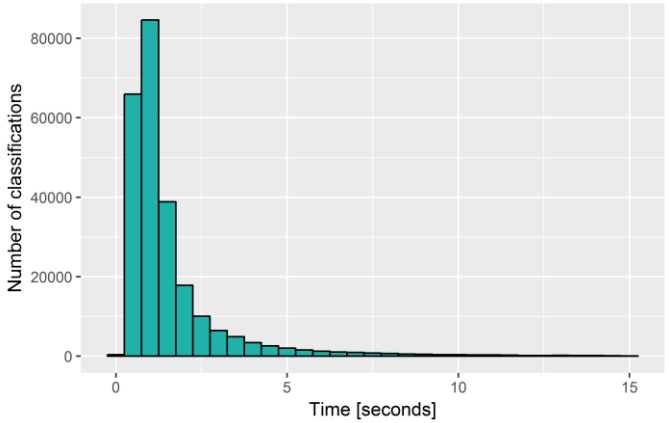


Picture Pile and a humanitarian application

- Picture Pile campaign resulted in 248,997 images classified over a three-week period with 179 volunteers in 122 hours; half the images classified in 5 days
- 1.76 seconds per classification on average
- Only included a small amount of people from HOT's network
- Could classify an entire country like Haiti in 1 to 2 days with thousands of volunteer







Picture Pile Campaigns

Campaign	Location	# of participants	# of validations	# of images	Campaign start date	Campaign available for
Wild landscapes	Global	32	11,937	86,176	2014-12-15	6 months
Deforestation	Tanzania, Indonesia	1360	5,127,697	362,544	2015-07-25	Left open until 2018-09-04
Hurricane Matthew campaign 1	Haiti	344	224,214	37,582	2017-04-28	6 days
Hurricane Matthew campaign 2	Haiti	421	298,323	37,582	2017-05-03	12 days
Cloud detection	Global	149	276,068	27,021	2019-02-28	2 months
Nighttime lights	Global	217	160,338	13,966	2019-03-04	6 months
Urundata land cover campaigns	Indonesia	395	1,373,840	14,221	2019-04-01	4 months
Oil palm plantations	Global	78	56,212	1,649	2019-07-31	1 month
Oil palm plantations Asia	Asia	78	99,618	13,653	2019-08-20	2 months
Poverty (degree of wealth)	Dhaka, Bangladesh	176	60,382	11,300	2019-08-26	6 months
Slums	Dhaka, Bangladesh	74	13,636	30,028	2019-08-27	6 months
Urundata Change Campaigns	Indonesia	195	3,553,315	153,115	2019-08-27	3 months
Marine litter	One beach	105	14,374	1,215	2019-12-13	3 months
Poverty (degree of wealth)	Africa	63	7,888	1,398	2019-12-18	6 months
Poverty (building height)	Dhaka, Bangladesh	181	36,430	12,300	2020-02-06	6 months
Earth Challenge Food Insecurity (crop types) from present	France, Latvia, USA	1292	289,553	45377 out of 70,520	2020-07-28	Ongoing

Source: Fraisl et al. (2022) https://www.sciencedirect.com/science/article/pii/S1462901121003208

Picture Pile and the SDGs

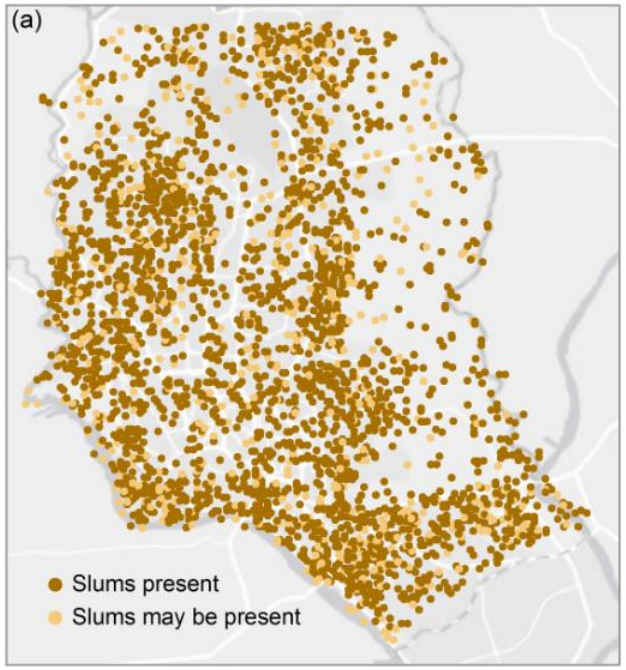
- Found that Picture Pile could contribute to the monitoring of 15 SDG indicators (SDGs 1, 2, 11, 13, 14, 15)
- Direct = data from Picture Pile could contribute to the calculation of the SDG indicators
- Supplementary = data that are useful to contextualize an SDG indicator or target

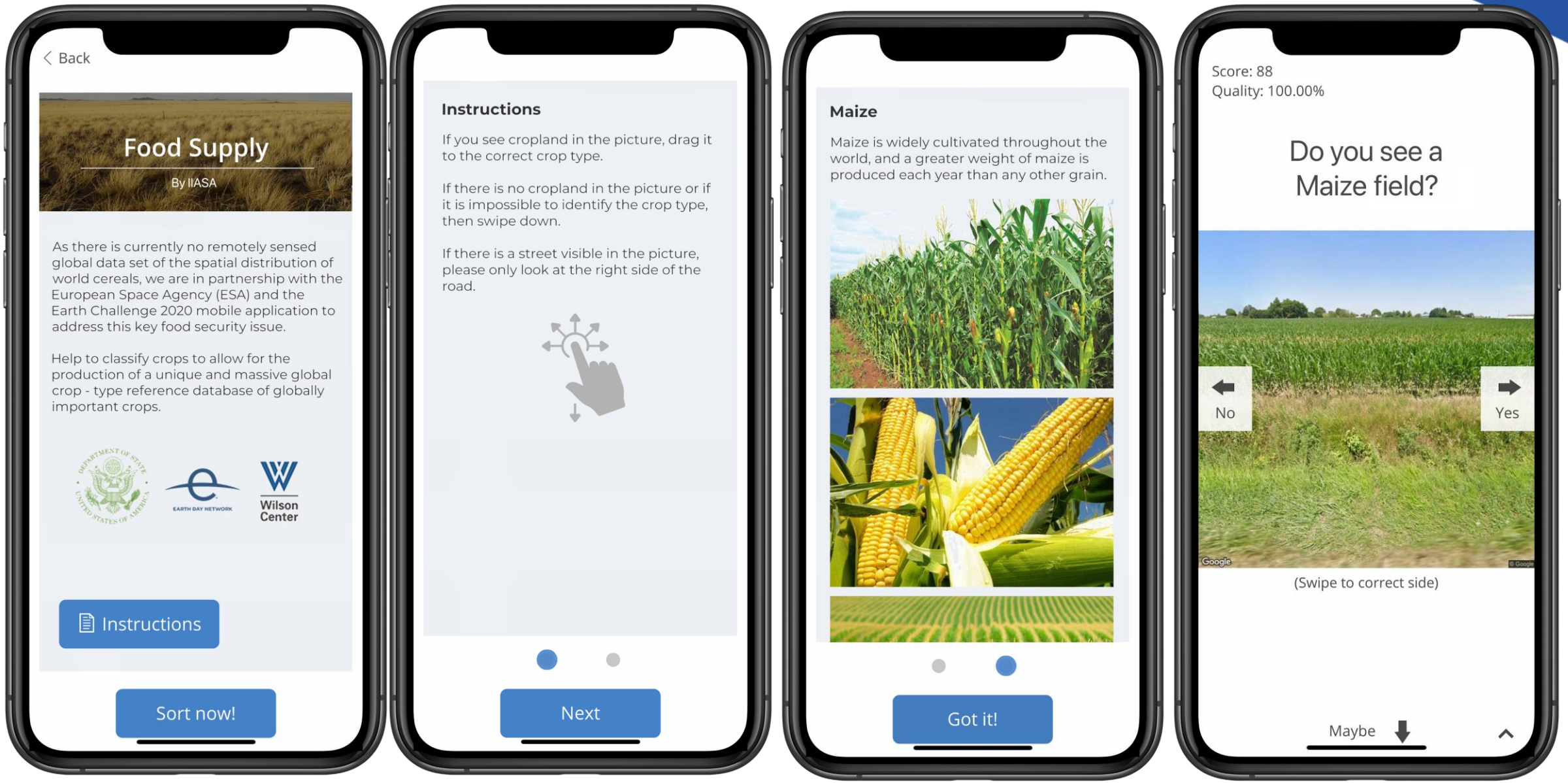
	SDG contribution by indicator	
Campaign	**Direct**	**Supplementary**
Wild landscapes	-	-
Deforestation	15.2.1	-
Hurricane Matthew campaign 1	1.5.2, 11.5.2	1.5.1, 11.5.1, 13.1.1
Hurricane Matthew campaign 2	1.5.2, 11.5.2	1.5.1, 11.5.1, 13.1.1
Cloud detection	-	-
Nighttime lights	11.3.1	1.1.1, 1.2.1, 1.2.2
Urundata land cover campaigns	15.1.1, 15.2.1, 15.4.2	-
Oil palm plantations	15.1.1, 15.2.1, 15.4.2	-
Oil palm plantations Asia	15.1.1, 15.2.1, 15.4.2	-
Poverty (degree of wealth)	11.1.1	1.1.1, 1.2.1, 1.2.2
Slums	11.1.1	-
Urundata Change Campaigns	15.1.1, 15.2.1, 15.4.2	-
Marine litter		14.1.1b
Poverty (degree of wealth)	11.1.1	1.1.1, 1.2.1, 1.2.2
Poverty (building height)	11.1.1	1.1.1, 1.2.1, 1.2.2
Earth Challenge Food Insecurity (crop types)	2.4.1	-

Source: Fraisl et al. (2022) https://www.sciencedirect.com/science/article/pii/S1462901121003208

One example of Picture Pile for SDG 11

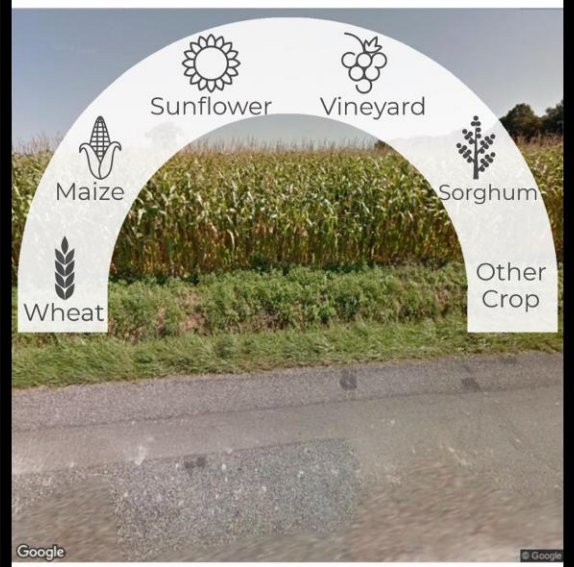
- SDG 11, indicators 11.1.1: Proportion of urban population living in slums, informal settlements or inadequate housing
- Slums have multiple dimensions, but one is about housing durability
- Picture Pile was used to classify images in Dhaka for presence/absence of slums, number of floors, other variables that could be discerned from imagery
- Inputs were used (along with many other features including those from remote sensing) to produce a wall-to-wall map for the city with slum locations




Back
Food Supply
By IIASA
As there is currently no remotely sensed global data set of the spatial distribution of world cereals, we are in partnership with the European Space Agency (ESA) and the Earth Challenge 2020 mobile application to address this key food security issue.
Help to classify crops to allow for the production of a unique and massive global crop - type reference database of globally important crops.
EARTH DAY NETWORK
Wilson Center
Instructions
Sort now!
Instructions
If you see cropland in the picture, drag it to the correct crop type.
If there is no cropland in the picture or if it is impossible to identify the crop type, then swipe down.
If there is a street visible in the picture, please only look at the right side of the road.
Next
Maize
Maize is widely cultivated throughout the world, and a greater weight of maize is produced each year than any other grain.
Got it!
Score: 88
Quality: 100.00%
Do you see a Maize field?
No
Yes
Google
(Swipe to correct side)
Maybe

Score: 21
Quality: 100.00%

What do you see?



(Drag to answer)

Maybe

Back

Hello TobiasTest,

You have sorted 10 pictures in 1 pile. Your quality score is: 100 (8 expert agreements, 1 expert disagreements)

You are on Level 1.

90 pictures until next level

Show username in leaderboard

Save

All piles | Total

17 people have sorted 2556 pictures in total.

Rank	Name	Score
1	user21	537
2	test1	217
3	Test8	187
4	TobiasTest2	182
5	user10	147
6	TobiasTest1	110
7	TestPPP	95
8	anonymous	76
9	Tobias3	46
10	user1	22
11	eeeee	20
12	Test6	20
13	user2	13
14	Test5	11
15	TobiasTest	9
16	TestTobias	7
17	anonymous	4

Back

General Topic

Enter message... Send

Tobias
If there is no plant swipe the image down.

anonymous1
Hi! I have a question regarding this pile. What should I do if there is no plant visible?

Back

Labeling Platforms for AI

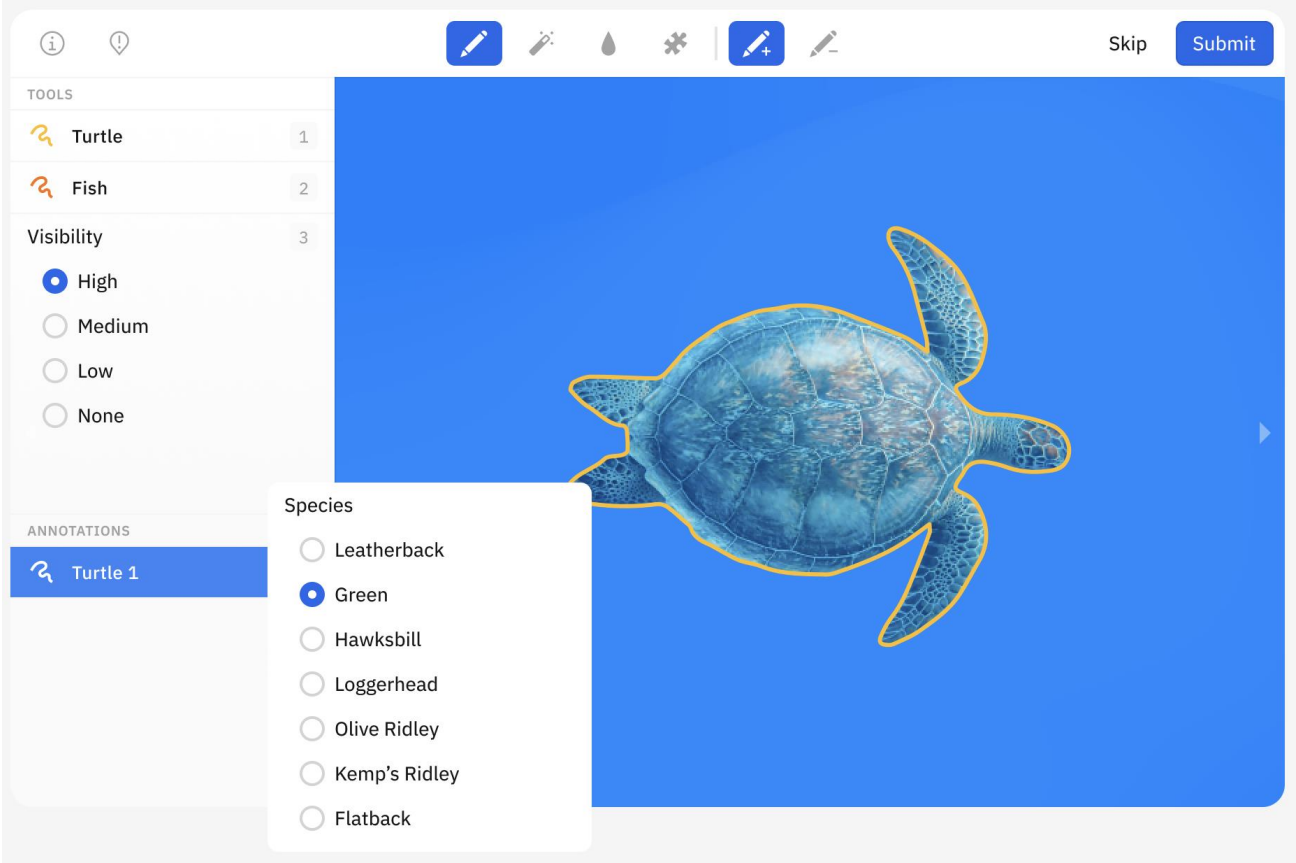
- Already a lot of labeling platforms exist:

Labelbox

V7

CVAT

- Main disadvantages:
  - Annoted datasets not made publicly available
    - ➢ Data can't be used by others
  - Users have to annotate data themselves or limited quality control
  - Often not fair payment
  - Not cross platform



Annotating a turtle in Labelbox

Picture Pile Platform

- Open up Picture Pile that anyone can setup a pile and run their own campaigns for free
- Users can earn money

- Data made freely available on the Picture Pile Data Portal
- Goal is to create a commercially self-sustaining platform

Campaigner

Setup your own pile of images to get classifications

Picture Pile App

Crowd classifies the images using the picture pile mobile app in an intuitive, efficient and engaging way

Data Portal

The image classifications are made publicly available on Data portal

Quality Assurance

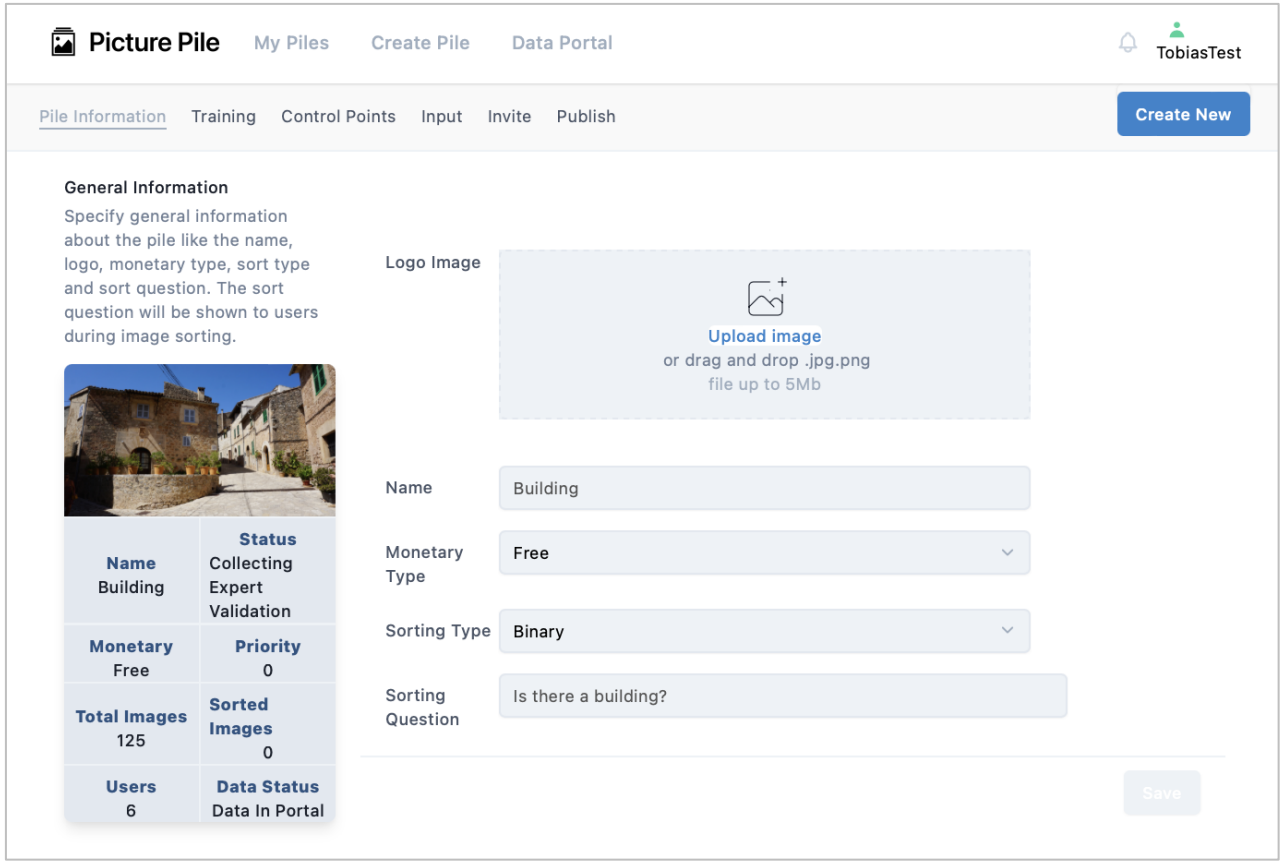
Many quality control mechanism guarantee the quality of data collected.

Free To Use

Its is completely free to setup you own pictures. You can pay the crowd if you don't want to make the collected data public on Data Portal or provide additional incentives for the crowd to do classifications.

Picture Pile Campaigner

- Anyone can setup picture piles and run their own campaigns for free:
  - Upload a pile logo
  - Pile name
  - Pile description
  - Specify sorting type and question
  - Upload images with Picture Pile Uploader tool
- Created piles are sent to Picture Pile Reviewer for checking
- Approved piles are published in the Picture Pile App for the Picture Pile volunteers to classify



Pile Instructions

Add Instructions to the pile to help user with sorting the images.
Higher order instructions will be shown first

Building Markings

Verify Building Markings Order: 0

Logo Image

Upload image(s)
or drag and drop .jpg.png
file up to 5Mb(Max 5 Files)

Title

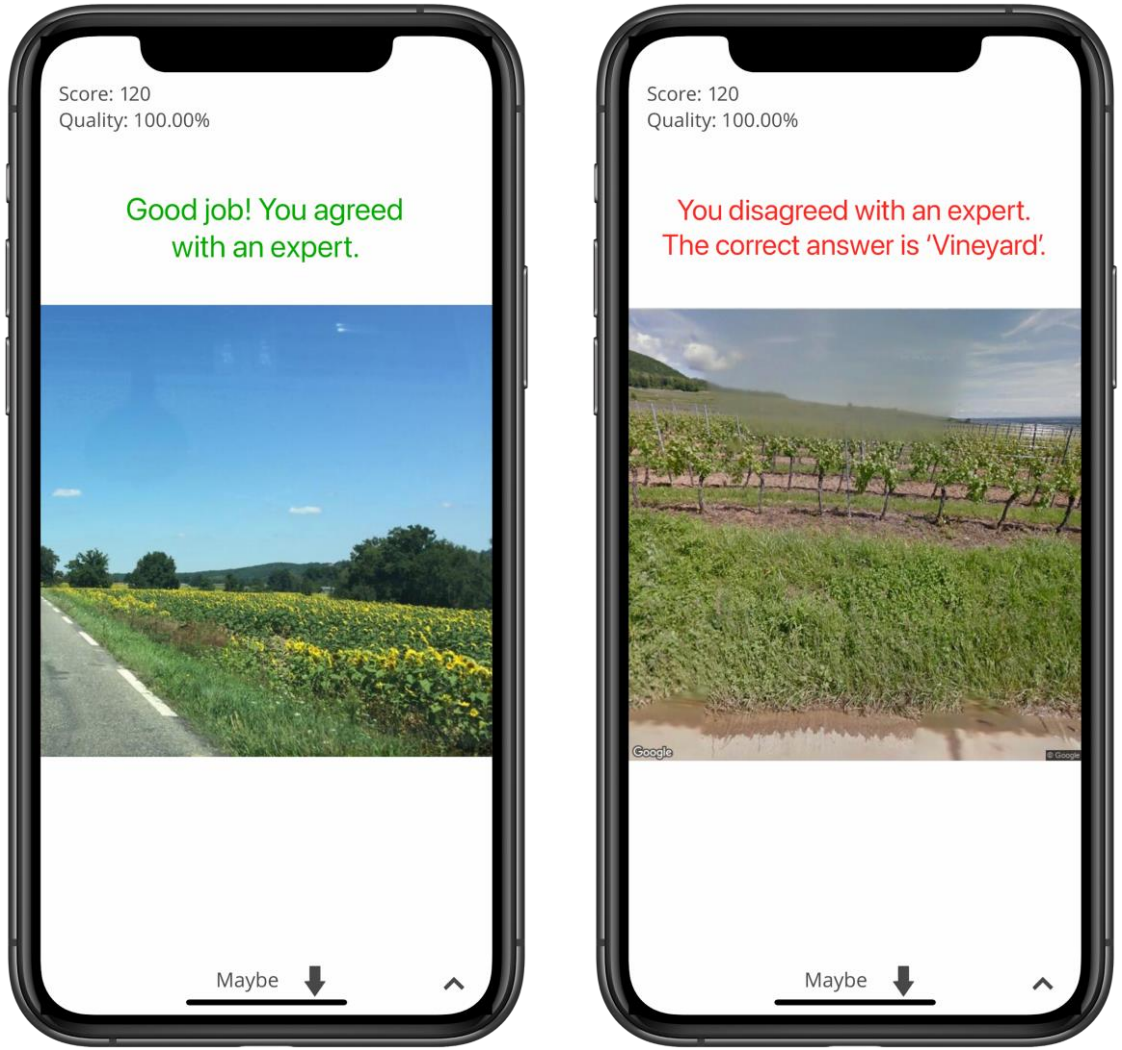
Order 1

Description

Data Quality

Many data control mechanisms:

- Every image is classified multiple times by different users
- Pile creators can invite experts to collect expert classifications to which sorters have to agree:
  - To train the sorters
  - To create a user quality score
- Instruction pages can be added
- Training images can be added



Validation Settings

Specify the sort settings for Expert Validation and Crowd Validation. The Expert Validation settings are used to convert input image as control points. The Crowd Validation Settings are used to complete validations on input images.

Expert Validation

Number of Expert Agreements required to convert image to control point 1

Allowed Expert Disagreements per image 0

1 out of 1 swipes/submissions should match to make the image as control point.

Crowd Validation

Number of Crowd Agreements to complete validation 5

Allowed Crowd Disagreements per image 3

5 out of 8 swipes/submissions should match to make the image as crowd control point, else image gets removed from pile validation

Save

Pile Messages

You can show popup messages to the users when they have reached a certain score during the pile sorting. These messages can be congratulation messages or interesting information to teach the users; like 'Did you know...' etc, to keep them entertained.

Title	Message	Score	
Title of Message	Congratulations on scoring 100	100	Add

Score: 0
Quality: 100.00%

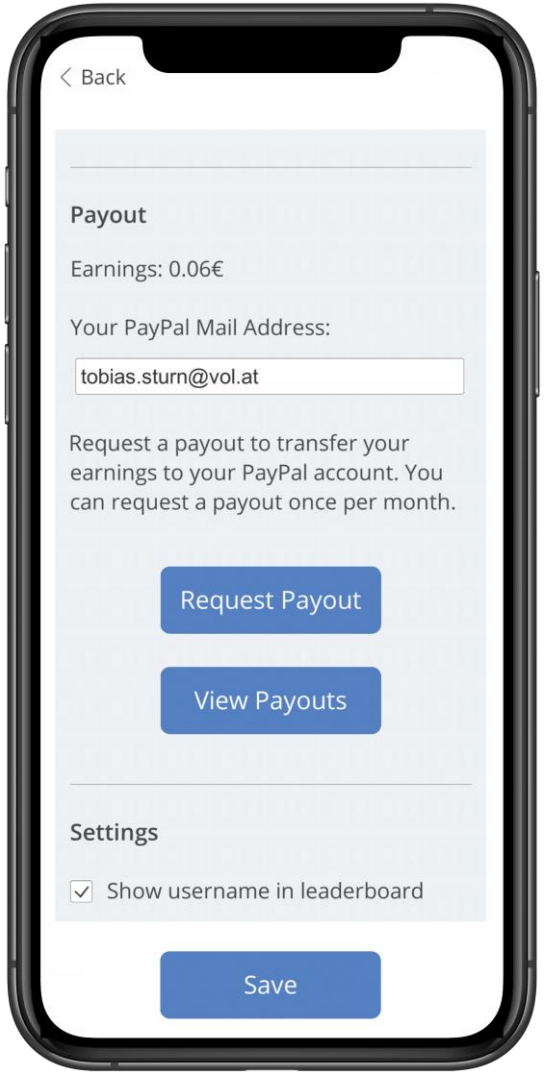
Are the buildings correctly marked?

Maybe

Fair Platform

- Pile creation for free:
  - Data will be made publicly available on the Data Portal for free
- Payment of a fixed price based on pile size:
  - Users earn at least the minimum wage
  - Share paid to the platform to being able to operate it
  - Option to make data collected private (will be made prominently visible in the app)

If piles are free, they should provide enough intrinsic motivations for the sorters to sort



Paid Pile Configuration

Specify the paid pile configuration.

Euros paid per score.

Euros paid per score can be minimum 0.01.

0.01

Minimum Quality score, below which a warning message will be shown.

Value can be between 0.5 and 0.9.

0.9

Maximum Quality score, below which a error message will be shown and no payout will be maid.

Value can be between 0.0 and 0.9 and should be less than Minimum quality score.

0.6

Save

Looking for piles / launch by the end of the summer

- Do you have any piles of images you want sorted?
- Can be very high-resolution satellite imagery
- Can be geotagged photographs
- Can be drone imagery
- Training data collection
- Validation data collection
- Applications for training computer vision algorithms
- Get in touch with us: see@iiasa.ac.at/sturn@iiasa.ac.at

  https://www.geo-wiki.org/apps

land

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Special Issue "Integrating Remote Sensing and Geospatial Big Data for Land Use Mapping and Monitoring"

Guest Editor:

Dr. Myroslava Lesiv
Dr. Linda See
Dr. Dmitry Schepaschenko

Submission Deadline: 16 June 2023

This Special Issue aims to bring together state-of-the-art research in this field. We invite papers on methods and applications that integrate remote sensing with geospatial big data in mapping and monitoring land use, including change detection.

During the last decade, there has been an explosion of data, both from remote sensing and other sources of geospatial data (e.g., citizen science, low-cost sensors, mobile phones), which can benefit the mapping and monitoring of land cover and land use. The opening up of the Landsat archive, the spatial and temporal richness of data now available from Sentinel satellites, and the proliferation of small satellites photographing the Earth provide new opportunities for characterizing the land surface, particularly in relation to land use. By integrating remote sensing with other sources of big geospatial data and machine learning/data fusion, we can create new data sets on land use, e.g., land use management intensity (Dou et al., 2021), forest management (Lesiv et al., 2022), and drivers of tropical deforestation (Laso Bayas et al., 2022), all of which fill significant gaps in land use information.

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Thank you! Questions?

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