

# Assisted Intelligence

How we map with the support of new technologies



**Assisting the mapper**  
with predictions obtained from  
machine learning



to credit: Red Cross

# Motivations

- Uganda and Tanzania are priority areas for HOT
- Provide an open dataset of buildings for the region
- Test and evaluate AI assisted use cases for OSM
- Leverage OSM data for model training

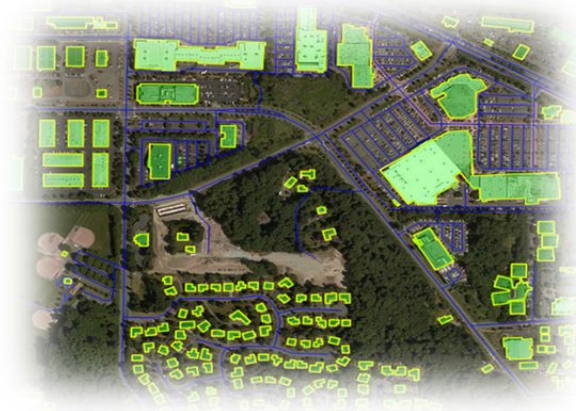
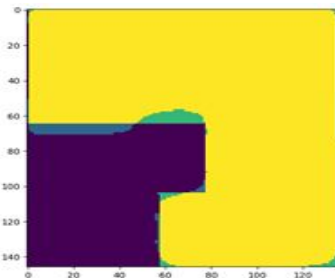
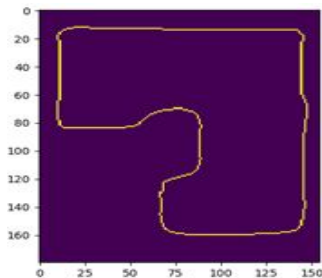
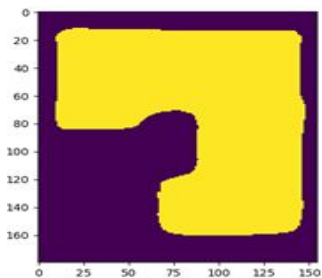
# Buildings blocks of our work

1. Create an open buildings dataset using Machine Learning
2. Connect Machine Learning Models to OpenStreetMap
3. Use predictions for mapping
4. Improve the user experience

1. Create an **open buildings dataset** using ML

# Feature Extraction Basics

Input: RGB aerial imagery -> Output: Vectorized buildings



# Creating Training Data





# Uniqueness of Settlements in Uganda/ Tanzania



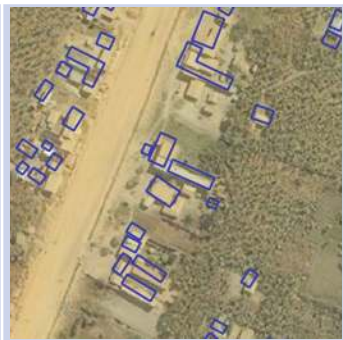
# Challenges when using OSM data

- Model training requires:
  - Good quality labels
  - Corresponding imagery
  - Fully labeled regions

Incomplete data



Offset



Outdated Imagery



Clouds



# Initial output

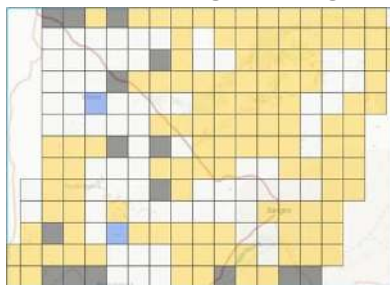


800K Buildings Identified

# Labeling Efforts

Data Curation Effort	Total Labels Generated	Total area [km <sup>2</sup> ]	# Labelers	Days	Labels [per labeler per day]	Area [km <sup>2</sup> per labeler per day]	Output Quality
Create from scratch	31k	44	5	30	206	0.3	Excellent
Fix existing labels	117k	1300	5	10	2400	25	Excellent
Run Binary QC (Y/N)	245k	2680	3	11	7700	80	Good
Filter OSM	129k	1600	1	2	64.5k	800	Unreliable

HOT Tasking Manager



Binary labeling

YES

Label

NO

Label

# Results

- Four iterations
- 800k to **18 million** buildings

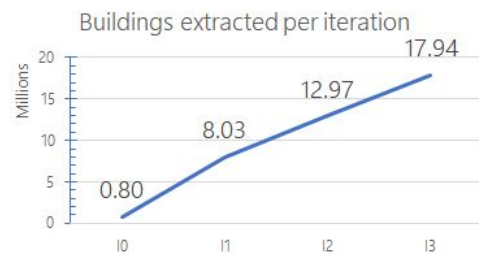
Initial output



Final output



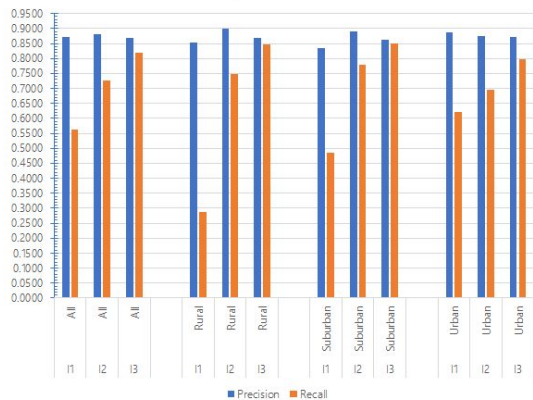
Iteration	DNN Pixel Precision	DNN Pixel Recall	Polygon Precision	Polygon Recall	IoU	Rotation Angle	False Positive Rate
Final	86.8%	81.8%	<b>94.5%</b>	<b>61.8%</b>	68.4%	4.2 deg	1.6%
Initial	87.1%	56.3%	<b>96.7%</b>	<b>37.8%</b>	58.0%	6.0 deg	6.3%



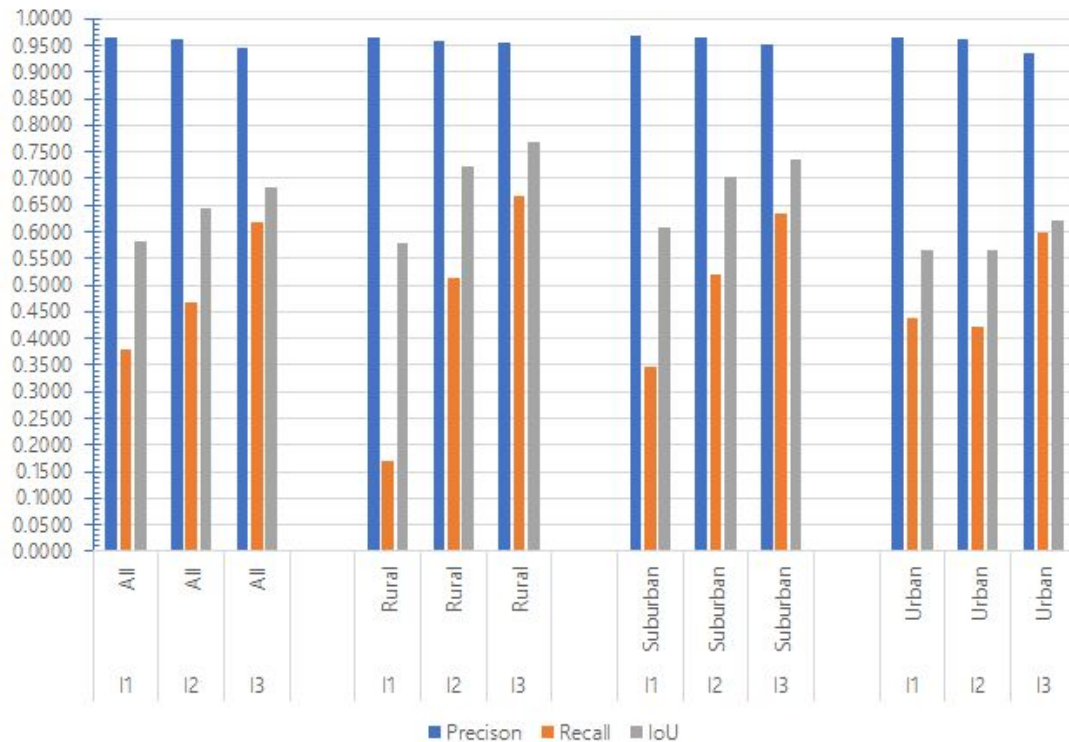
# Results by area type

I1	Low quality urban data	8M
I2	Diverse data	12M
I3	Diverse data + new DNN architecture	18M

DNN pixel metrics

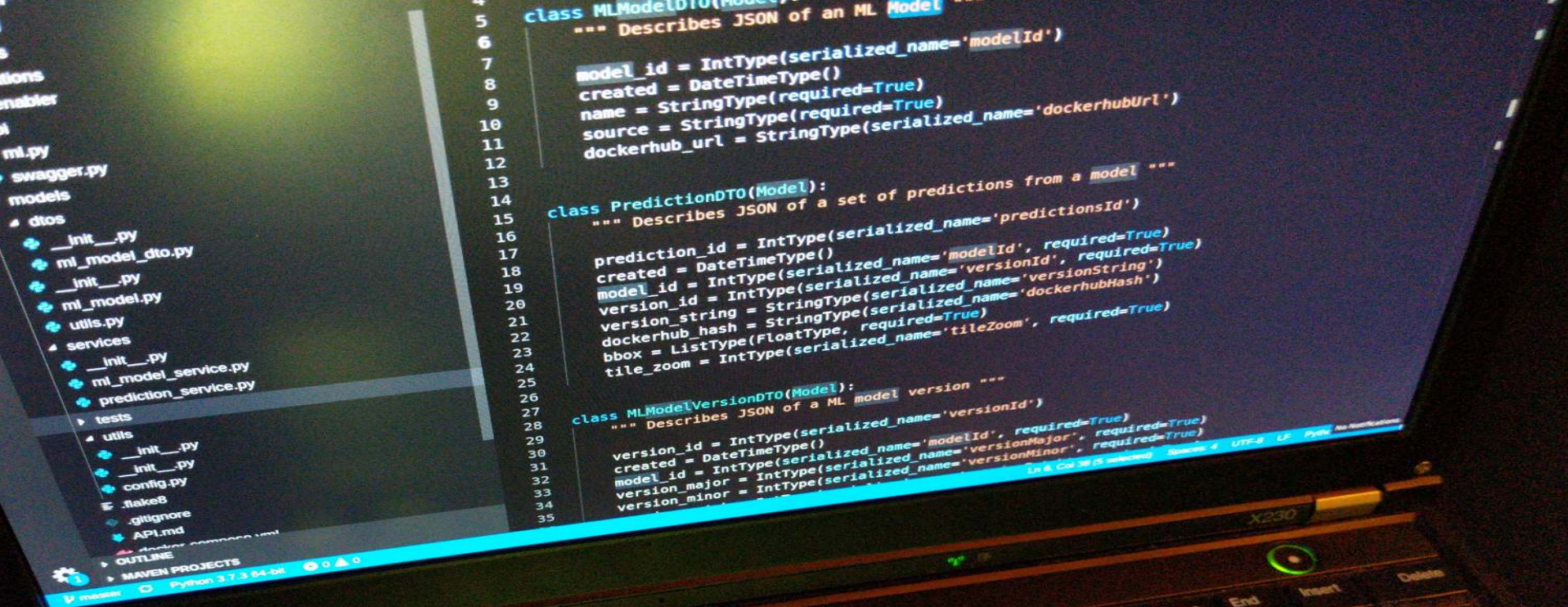


Polygon metrics



18.5k buildings in the set

## 2. Connect Machine Learning Models to OpenStreetMap



```
5 class MLModelDTO(Model):
6     """ Describes JSON of an ML Model """
7
8     model_id = IntType(serialized_name='modelId')
9     created = DateTimeType()
10    name = StringType(required=True)
11    source = StringType(required=True)
12    dockerhub_url = StringType(serialized_name='dockerhubUrl')
13
14
15 class PredictionDTO(Model):
16     """ Describes JSON of a set of predictions from a model """
17
18     prediction_id = IntType(serialized_name='predictionsId')
19     created = DateTimeType()
20     model_id = IntType(serialized_name='modelId', required=True)
21     version_id = IntType(serialized_name='versionId', required=True)
22     version_string = StringType(serialized_name='versionString')
23     dockerhub_hash = StringType(serialized_name='dockerhubHash')
24     bbox = ListType(FloatType, required=True)
25     tile_zoom = IntType(serialized_name='tileZoom', required=True)
26
27
28 class MLModelVersionDTO(Model):
29     """ Describes JSON of a ML model version """
30
31     version_id = IntType(serialized_name='versionId', required=True)
32     created = DateTimeType()
33     model_id = IntType(serialized_name='modelId', required=True)
34     version_major = IntType(serialized_name='versionMajor', required=True)
35     version_minor = IntType(serialized_name='versionMinor', required=True)
```

ml-enabler

<https://github.com/hotosm/ml-enabler>



# ml-enabler

Integrate **many models**

Support **different schematics**

Aggregate and **augment** data

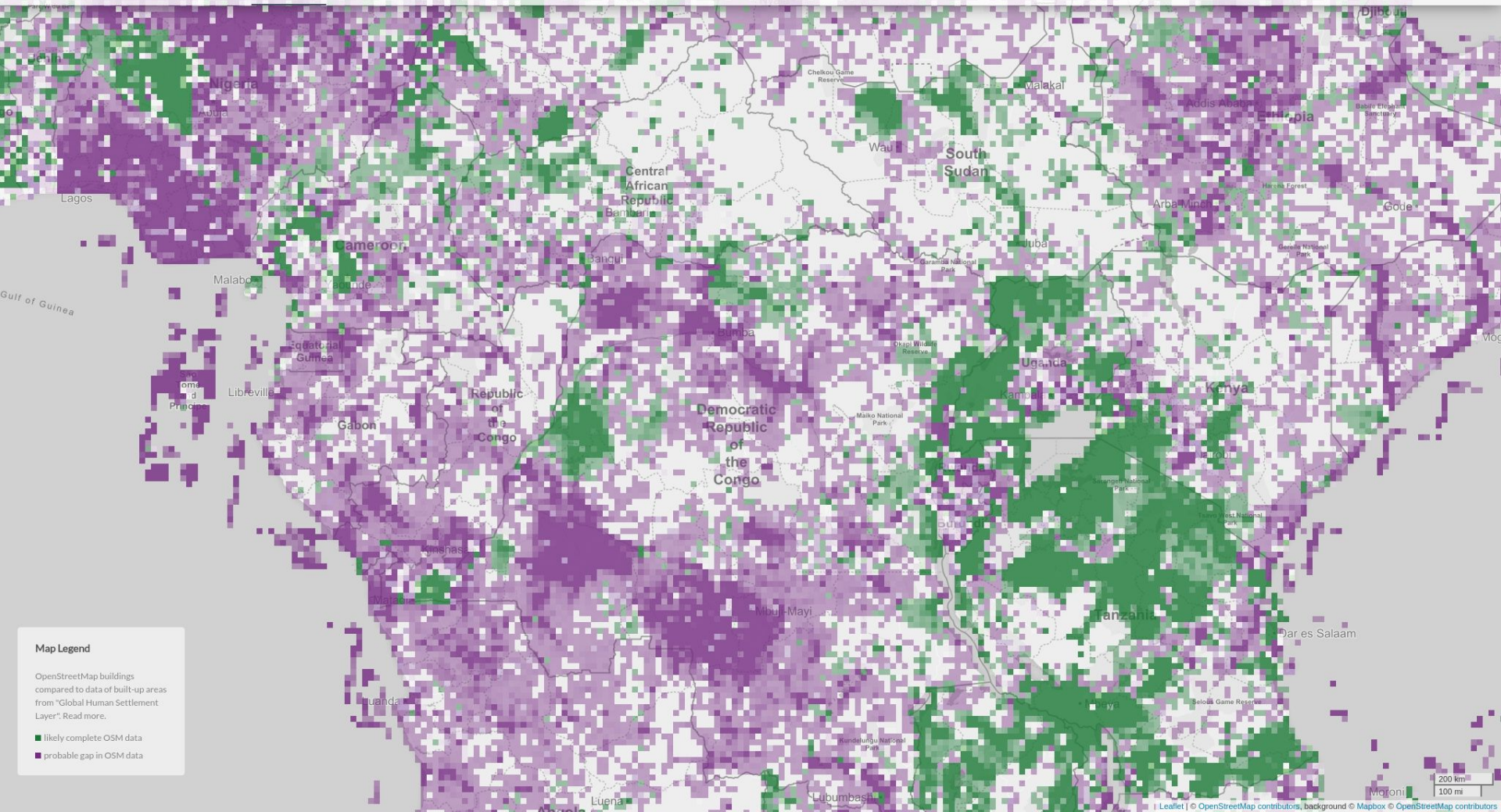
Provide one **consistent API** for consumers

Microsoft Buildings (Open Data)

Looking Glass (Free Software)

**... your model and your application!**

### 3. Use of predictions for mapping

**Map Legend**

OpenStreetMap buildings compared to data of built-up areas from "Global Human Settlement Layer". Read more.

- █ likely complete OSM data
- █ probable gap in OSM data



HIGH

3 - Active Mappers

## #5305 - Guatemala, Las Cruces - National Malaria Program

SHARE

EDIT PROJECT

Download: Aoi as [.geojson](#), Tasks as [.geojson](#), [.osm](#), [.gpx](#)

Update/Validation Project

Author: **HOT** Requesting Org: **Clinton Health Access Initiative**

This project is to review, update and complete the basemap (buildings and roads) in Parcelamiento Las Cruces, Escuintla, Guatemala. Whereas most of the buildings and roads have been mapped, there remains some which are not mapped and several misaligned. Your mapping contribution will help prevent the suffering and loss of life the disease malaria causes.

Clinton Health Access Initiative is supporting the National Malaria program in Guatemala to eliminate malaria by 2020. HOT will be conducting field mapping exercises to add details to remotely mapped buildings starting October 2018.



STEP 1

STEP 2

STEP 3

STEP 4

STEP 5

### Step 3: Set Task Sizes

General task size:

LARGER

SMALLER

Split a specific area into smaller tasks by drawing an area or point or use ML

SPLIT (ML)

SPLIT (POLYGON)

SPLIT (POINT)

RESET

A new project will be created with 36 tasks.

The size of each task is approximately 5.98 km<sup>2</sup>.

NEXT

BACK TO PREVIOUS

MULLEN

Add layer

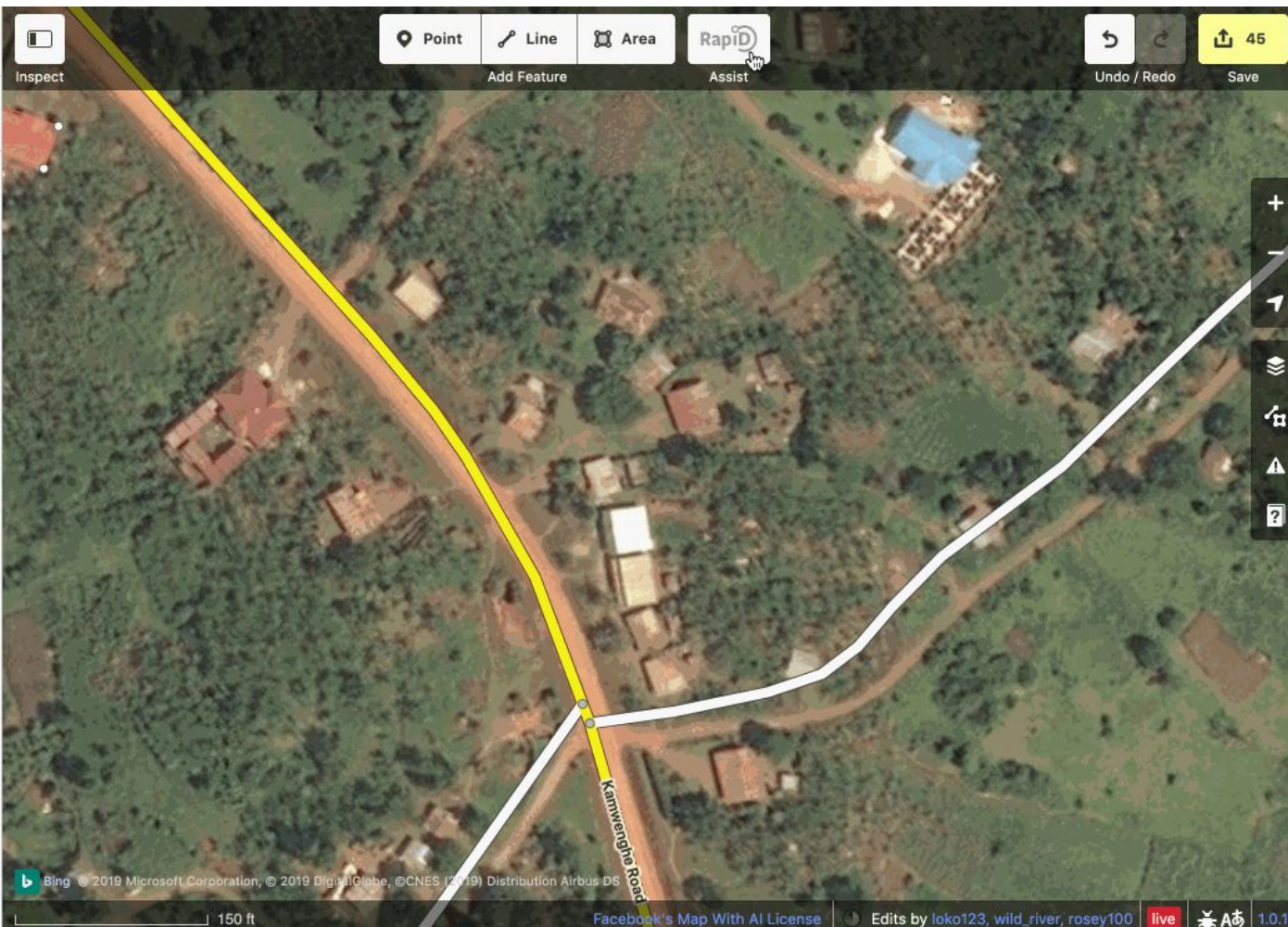
1 km

Toggle the Area of Interest of existing projects

© OpenStreetMap contributors

Search features

Search



Bing © 2019 Microsoft Corporation, © 2019 DigitalGlobe, ©CNES (2019) Distribution Airbus DS

150 ft

Facebook's Map With AI License

Edits by ioko123\_wild\_river\_rosey100

live

Accessibility icons

1.0.1





4. Improve the user experience

## Map a Task for People in Need

Join coordinated humanitarian mapping projects by taking a task and mapping a part of the world in OpenStreetMap, the free and editable map of the world. Communities, organizations and governments worldwide have used OpenStreetMap to address local development challenges and aid disaster response. You can join thousands of other mappers on OpenStreetMap and support these communities in need.

START MAPPING

228

Mappers Online

2,051,519

Tasks Mapped

Mapping our world together

hotasm.org [↗](#)

 Tasking Manager

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# MAP A TASK FOR PEOPLE IN NEED

Join a global community that is helping to put the world's most vulnerable people and places on the map towards humanitarian aid and sustainable development.

Start mapping

Join the community

inVision

38K

Buildings Mapped

952

Roads Mapped (Km)

45K

Total Map Edits

156K

Community Mappers

146

Mappers Online



# Challenges, ideas and next steps

- Feedback loop
- Domain switching to scale
- OSM data for model training
- Access to imagery with corresponding training dataset
- Continue conversations around helpful applications of AI in mapping

# Resources

Check it out: Assisted Tasking Manager: <https://tasks-assisted.hotosm.org/>

Learn more about the project:

Project page: <https://www.hotosm.org/projects/ai-assisted-humanitarian-mapping/>

Bing Maps Blog: <https://blogs.bing.com/maps>

Learn more about Machine Learning and OpenStreetMap:

OSM Wiki page: [https://wiki.openstreetmap.org/wiki/Machine\\_Learning](https://wiki.openstreetmap.org/wiki/Machine_Learning)

OSM mailing list: <https://lists.openstreetmap.org/listinfo/machine-learning>

Questions?