



**Humanitarian  
OpenStreetMap  
Team**



# **How can we use remote sensing technology to assess exposure to natural hazards?**

METEOR : Modelling Exposure Through Earth Observation Routines

So what is **exposure**?











Kathmandu, Nepal

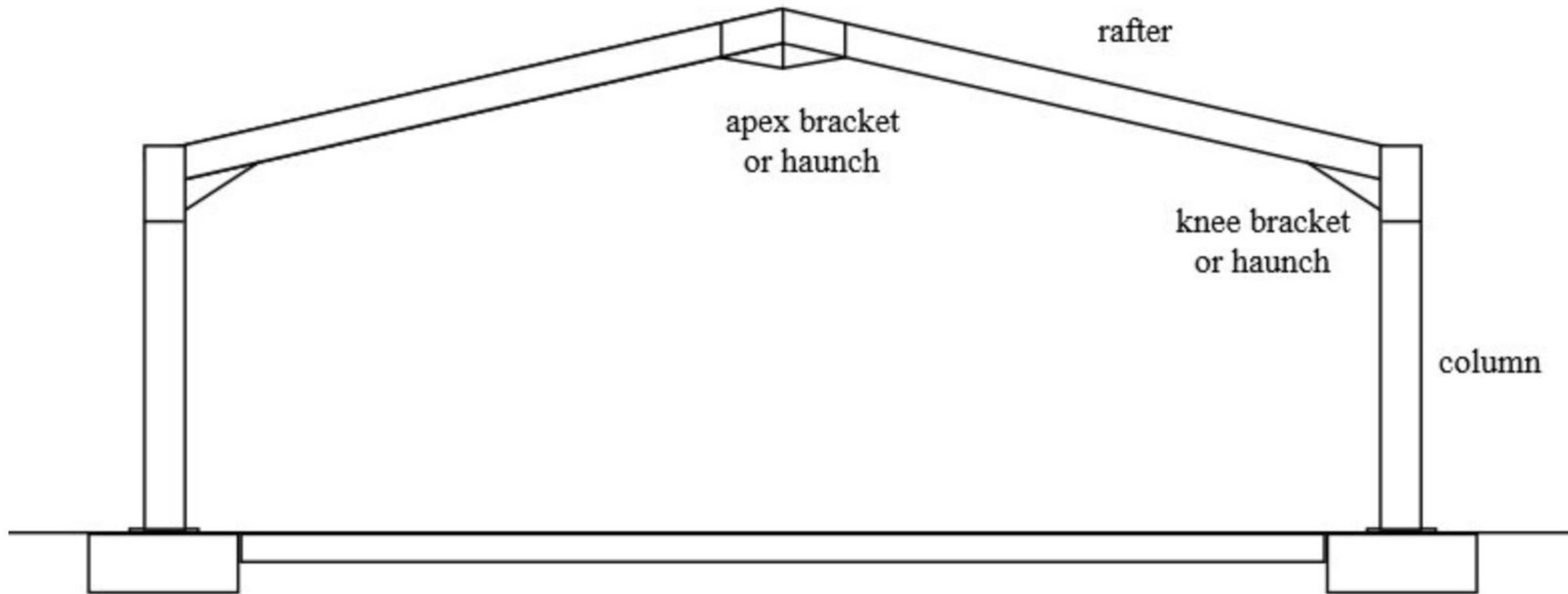


Dar es Salaam, Tanzania

**Detailed structural information?**







British  
Geological  
Survey

ImageCat

Global  
Earthquake  
Model

**Hazard** x **Exposure** x **Vulnerability**

RISK





How does **OSM** fit into this?



# Exposure

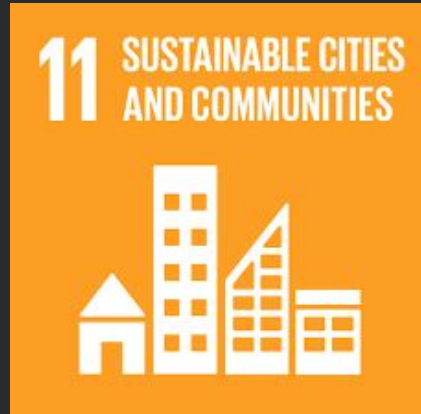
Level 1 : Global

Level 2 : Country

Level 3 : Sub-National

Level 4 : Aggregated Building

Level 5 : Building Specific



To reduce the number of deaths and the number of people affected by disasters



To strengthen resilience and adaptive capacity to natural disasters



Deliver exposure data for 46 of the least developed ODA countries

Create open protocols to develop critical exposure information from EO data

Capacity-building of local decision makers to apply data and assess hazard exposure





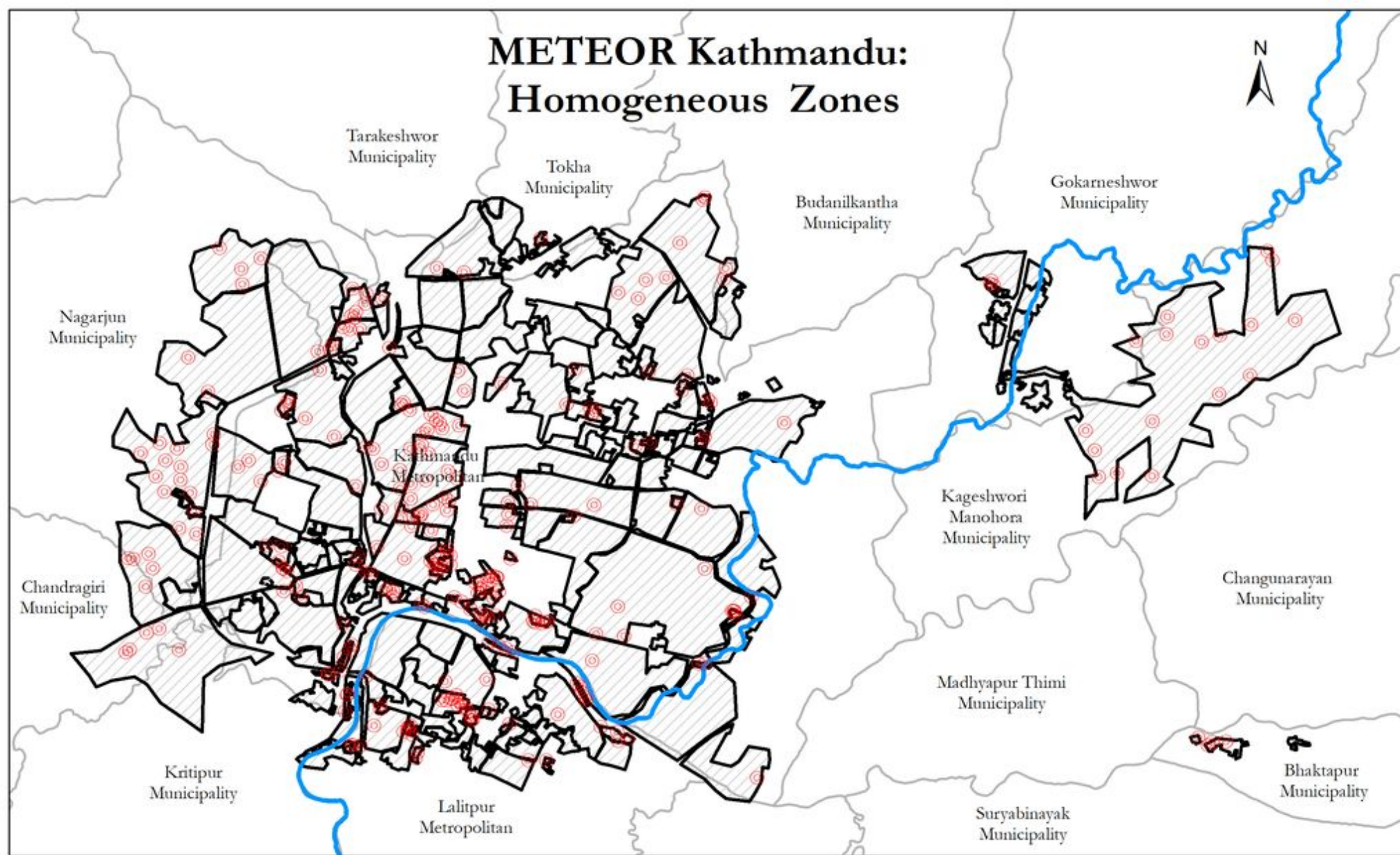
# Kathmandu Living Labs





Gaurav Thapa

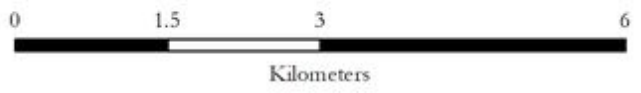
[gaurav.thapa@kathmandulivinglabs.org](mailto:gaurav.thapa@kathmandulivinglabs.org)



# Survey Area



-  Field Survey Location
-  Administrative Boundary
-  Homogeneous Zones
-  Bagmati River

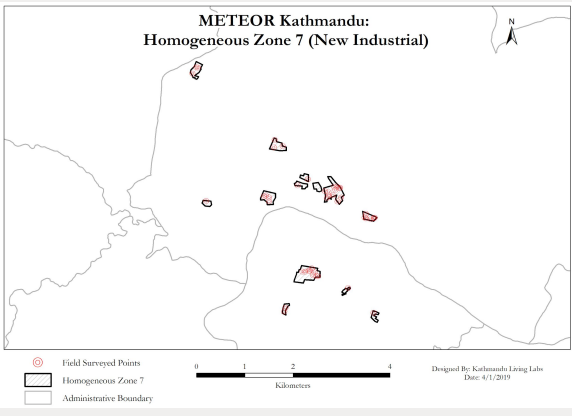
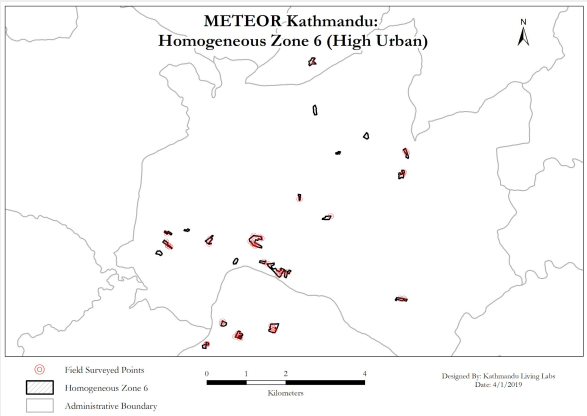
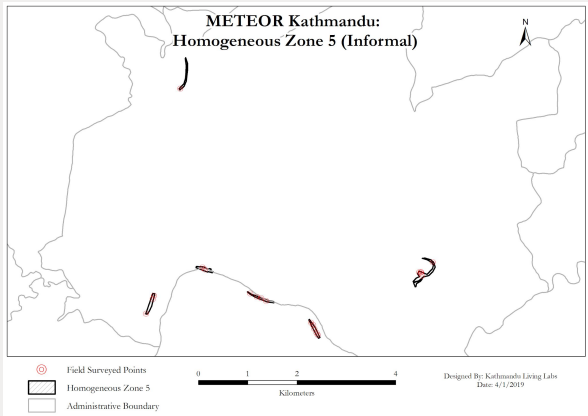
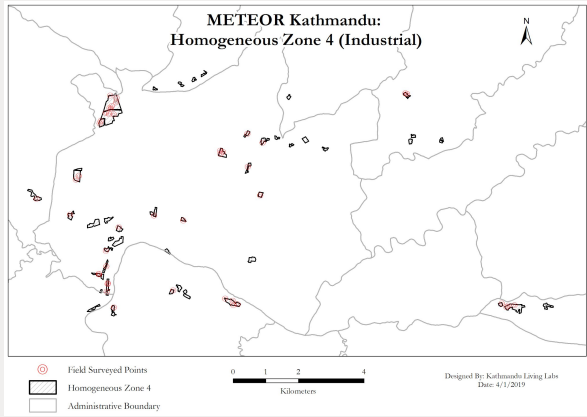
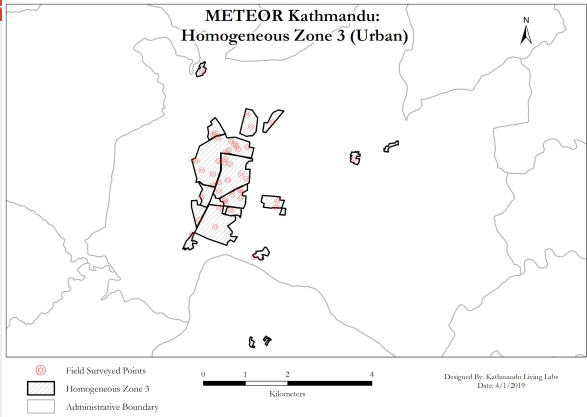
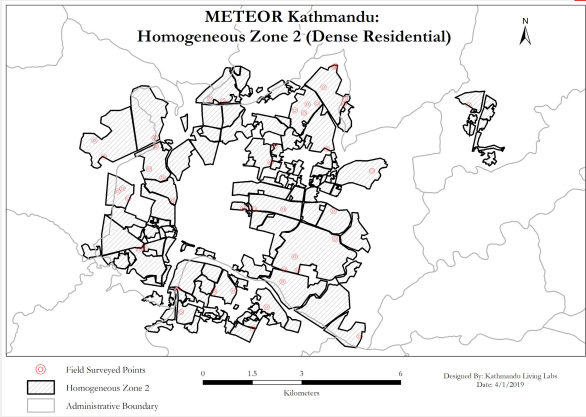
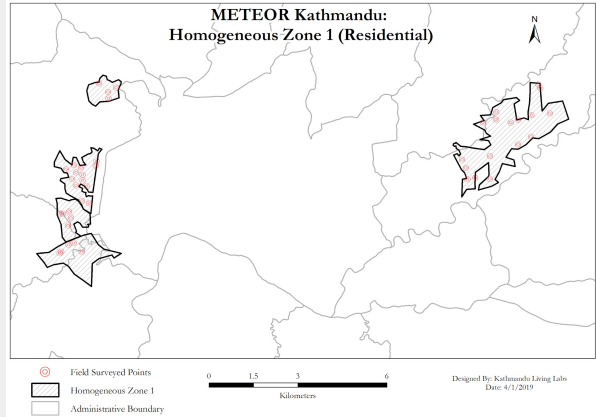


Designed By:





# Homogenous Zones/Development Patterns



# Building Systems and Materials

<b>building:lateral:system</b>	<b>building:lateral:material</b>
moment_resisting_frame	concrete_reinforced
masonry_wall	brick
braced_frame	steel
hybrid	earth
dual_system (frame wall)	mixed
confined_masonry	bamboo
others	wood
shear_wall	steel-concrete_composite
First floor rcc second masonry (brick)	stone



# Building Materials



# Building Systems











**TATA**

Spiral Trading Pvt. Ltd.

**TATA MOTORS**

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MOTORS

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NEXON



















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**SUNDARBAN EDUCATIONAL  
CHILD CARE CENTRE**  
Kathmandu, Nepal  
Phone: 01-4312128  
Montessori Based  
Pre-School

A child miseducated is a  
child lost

Small text on the left wall, possibly a notice or sign.

Small text on the wall above the chalkboards.

Green chalkboard with some text written on it.



Green chalkboard with some text written on it.



Whiteboard with a drawing of Nepal and some text written on it.





# Results of Remote Mapping

Homogeneous Zones	Building Count		
	Before	After	Increase
1 Residential	8,909	16,564	46%
2 Dense Residential	71,310	104,945	32%
3 Urban	8,829	10,671	17%
4 Industrial	1,274	2,259	43%
5 Informal	175	752	77%
6 High Urban	595	749	21%
7 New Industrial	510	675	24%
<b>Total</b>	<b>91,602</b>	<b>136,615</b>	<b>33%</b>



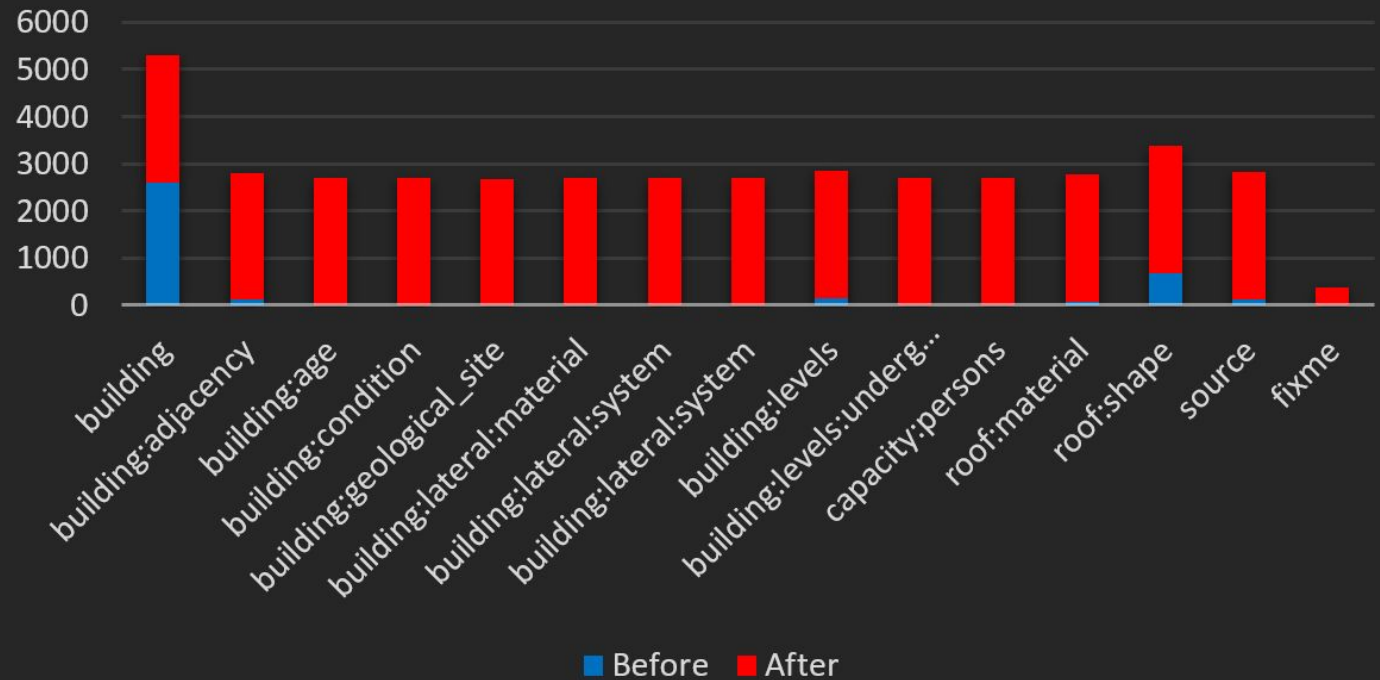
# Results

At the end of the field work a total of 2,701 buildings were surveyed. Some of these buildings had pre-existing attribute information following the tags identified from the data model such as `building`, `building:adjacency`, `building:levels`, `roof:material` and `roof:shape`, while the other tags were not present at all. The below table shows how the information uploaded through this project has added the tags outlined in the data model to this pre-existing information.



Tags	Before	After	% change
building	2589	2701	4.1
building:adjacency	118	2694	95.6
building:age	0	2689	n/a
building:condition	0	2701	n/a
building:geological_site	0	2682	n/a
building:lateral:material	0	2701	n/a
building:lateral:system	0	2701	n/a
building:lateral:system	0	2701	n/a
building:levels	146	2701	94.6
building:levels:underground	0	2694	n/a
capacity:persons	0	2701	n/a
roof:material	65	2701	n/a
roof:shape	685	2701	n/a
source	119	2701	95.6
fixme	0	366	n/a

## Survey Results



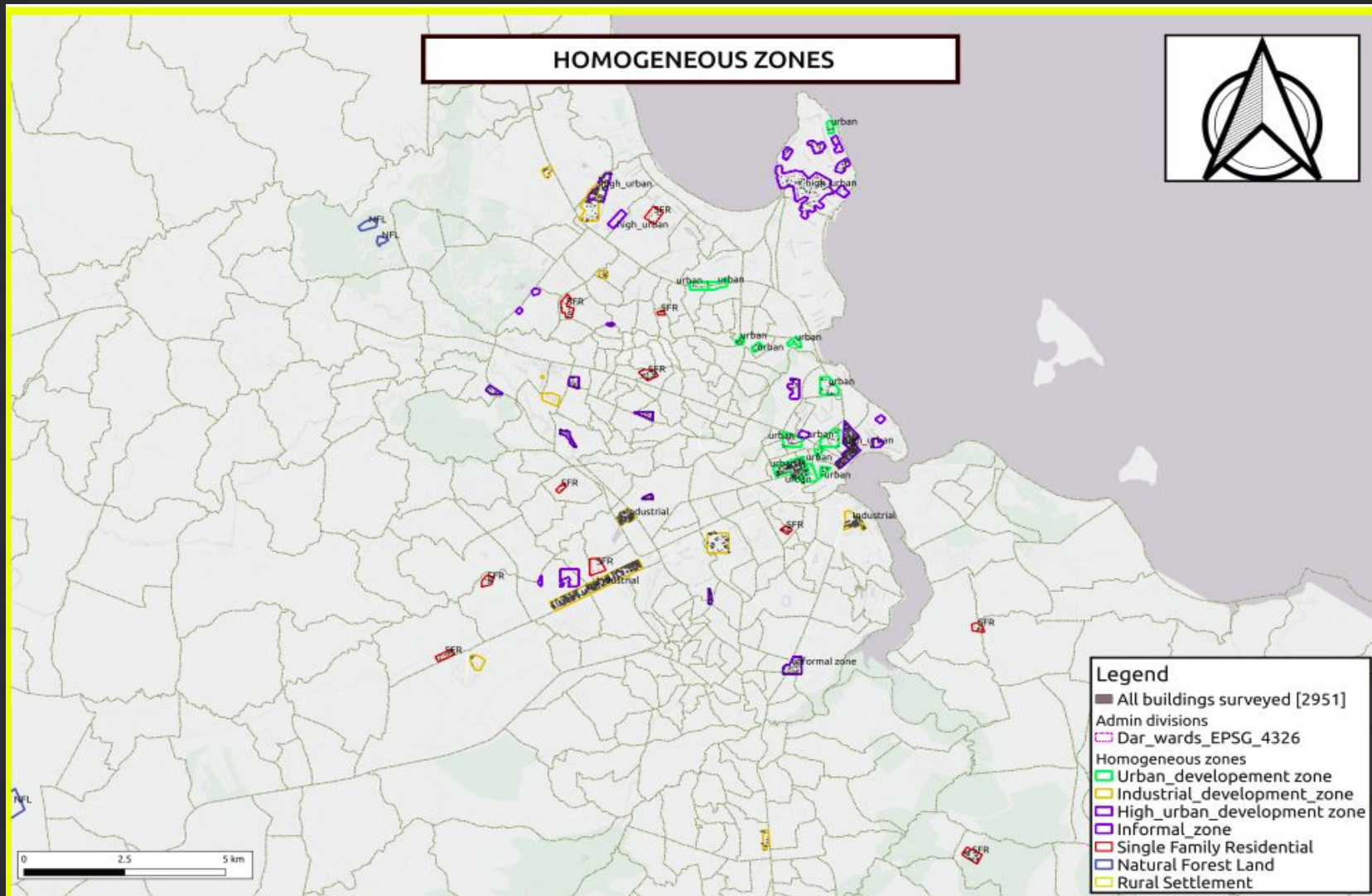


# HOT TANZANI





# DATA COLLECTION IN DAR ES SALAAM



## METHODOLOGIES

### ❖ REMOTE DIGITIZATION

- **As a pre-field activity, building datasets is crucial as it supports the data collection process once field survey is to be conducted. Most parts of Dar es Salaam and Pwani were already digitized using either Bing or DigitalGlobe aerial imageries, there was a need to update and re-digitize most of the misaligned buildings using high-resolution imagery, drone Imagery from COWI with resolution of 10cm. This is an important process as it determines the level of quality of data to be collected in the field**



## Tasking Manager & Josm

The tasks were created from homogeneous zones sampled in different areas such as planned, unplanned, scattered and less populated areas. Using QGIS software, homogeneous zones were split into multiple polygons for task creation in [GeoJSON](#) format. The GeoJSON created for the multiple polygons was used to create an Area of Interest (AoI) in the tasking manager for projects.

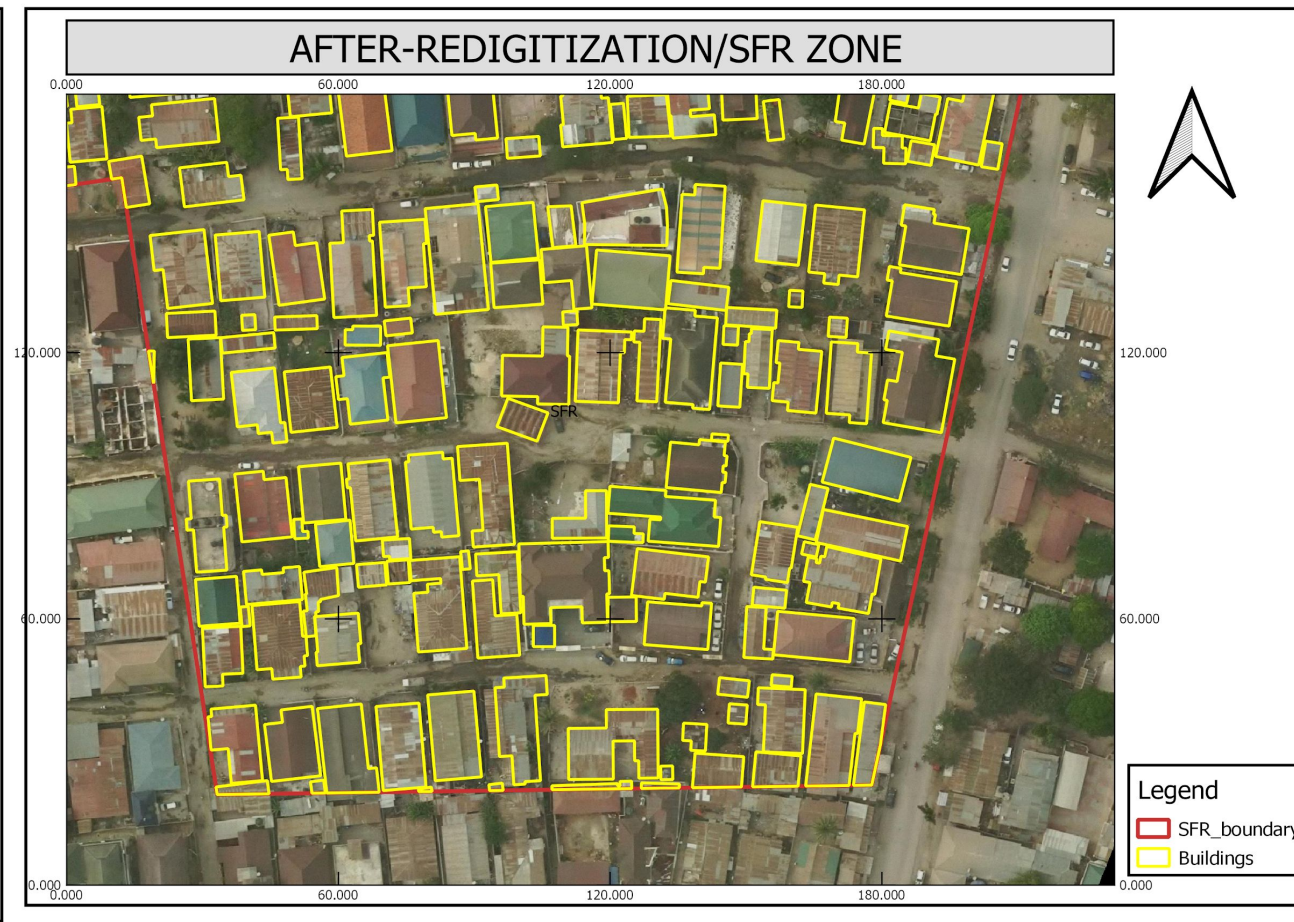
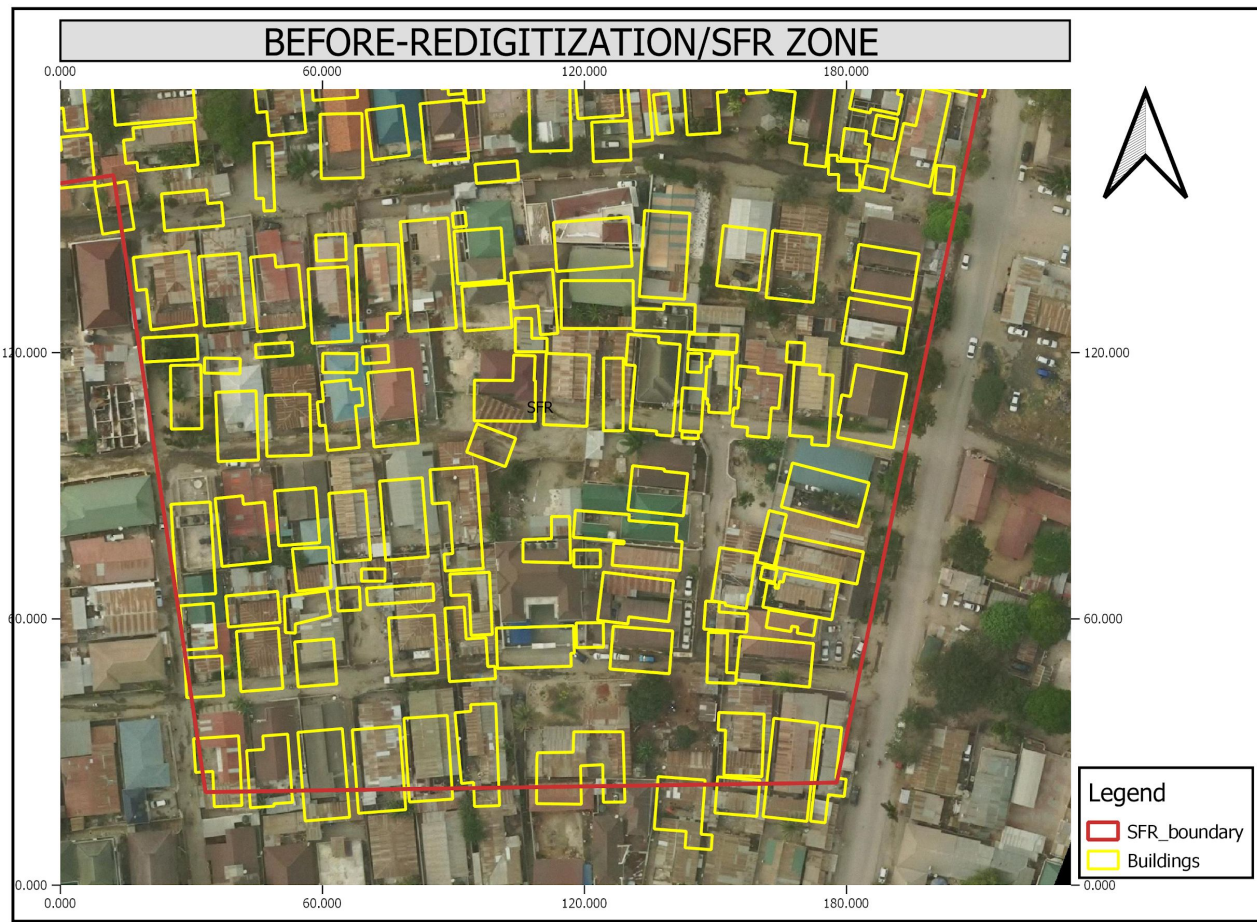
# JOSM

The team used Java OpenStreetMap Editor (JOSM) to trace buildings and for initial quality checks before uploading data on OSM. Tracing buildings was easier because a high 6cm COWI resolution imagery provided by the Ministry of Lands, Housing and Human Settlements was used.

Throughout this activity, the mapping team was able to trace and fix existing errors of 9038 buildings in all zones.



# Buildings in homogenous zones before and after Digitization





# Digitization Results:

Homogeneous Zones	Building Count		
	Before	After	Difference
1 High Urban Development (HURBAN)	331	443	112
2 Industrial Development	418	489	71
3 Natural Forest Land	0	0	0
4 Rural Settlement	790	1767	977
5 Single Family Residential (SFR)	3939	4923	988
7 Informal zone	3287	3893	606
8 Urban Development	1167	1416	249
<b>Total</b>	<b>9932</b>	<b>12931</b>	<b>2999</b>





# TOOLS USED: OPENDATAKIT



[OpenDataKit](#) is a free mobile application that used in geospatial data collection.

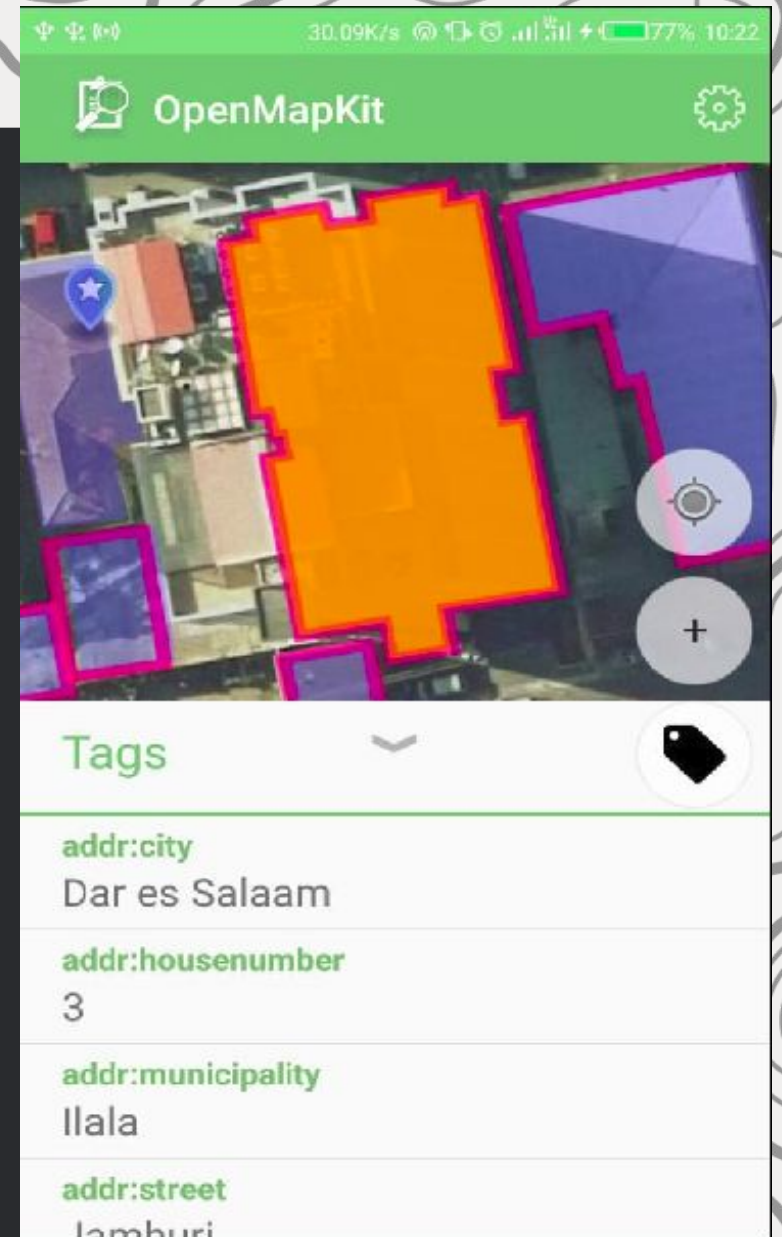
The application is integrated to the server that has questionnaire forms, it is very user friendly, can be used to fill, edit, send and more functions to the required form/questionnaire.

The questionnaire forms can be created in different ways, some by using online builder [in](#) while others developed from scratch in excel some basic and worksheet found within <http://xlsform.org/en/>

# OMK

[OpenMapKit](https://openmapkit.org/) is an extension of OpenDataKit allowing users to create professional quality mobile data collection surveys for field data collection

- OMK is free and open-source.
- It provides a way to record and submit information in the field based on OpenStreetMap.
- <https://openmapkit.org/>





**meteor\_dsm**

Total submissions: 40

[ODK Data](#)
[OSM Data](#)
  
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Start	End	Username	Submission Time	Image	Download
Feb 18, 2019 8:30 AM	Feb 18, 2019 8:39 AM	Hawa Magongo	Feb 18, 2019 6:56 PM	<a href="#">Download image</a>	<a href="#">OSM File</a>
Feb 18, 2019 8:13 AM	Feb 18, 2019 8:18 PM	Neema Elias	Feb 18, 2019 8:32 PM	<a href="#">Download image</a>	<a href="#">OSM File</a>
Feb 18, 2019 7:58 AM	Feb 18, 2019 8:18 AM	Mwasaka	Feb 18, 2019 6:53 PM	<a href="#">Download image</a>	<a href="#">OSM File</a>
Feb 18, 2019 9:06 AM	Feb 18, 2019 9:12 AM	Josephine A. Tinuga	Feb 18, 2019 11:11 AM	<a href="#">Download image</a>	<a href="#">OSM File</a>
Feb 18, 2019 8:26 AM	Feb 18, 2019 8:32 AM	Josephine A. Tinuga	Feb 18, 2019 11:08 AM	<a href="#">Download image</a>	<a href="#">OSM File</a>
Feb 18, 2019 8:49 AM	Feb 18, 2019 8:55 AM	Josephine A. Tinuga	Feb 18, 2019 11:11 AM	<a href="#">Download image</a>	<a href="#">OSM File</a>
Feb 18, 2019 8:13 AM	Feb 18, 2019 8:18 AM	Josephine A. Tinuga	Feb 18, 2019 11:08 AM	<a href="#">Download image</a>	<a href="#">OSM File</a>
Feb 18, 2019 8:39 AM	Feb 18, 2019 8:43 AM	Hawa Magongo	Feb 18, 2019 6:57 PM	<a href="#">Download image</a>	<a href="#">OSM File</a>
Feb 18, 2019 8:04 AM	Feb 18, 2019 8:18 PM	Neema Elias	Feb 18, 2019 8:30 PM	<a href="#">Download image</a>	<a href="#">OSM File</a>
Feb 18, 2019 8:09 AM	Feb 18, 2019 8:14 AM	Ibrahim Alphonce	Feb 18, 2019 6:21 PM	<a href="#">Download image</a>	<a href="#">OSM File</a>
Feb 18, 2019 7:48 AM	Feb 18, 2019 7:58 AM	Mwasaka	Feb 18, 2019 6:53 PM	<a href="#">Download image</a>	<a href="#">OSM File</a>
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Feb 18, 2019 7:08 AM	Feb 18, 2019 8:01 AM	Gloria Elevan	Feb 18, 2019 7:06 PM	<a href="#">Download image</a>	<a href="#">OSM File</a>
Feb 18, 2019 7:48 AM	Feb 18, 2019 8:09 AM	Hawa Magongo	Feb 18, 2019 6:54 PM	<a href="#">Download image</a>	<a href="#">OSM File</a>
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Feb 18, 2019 8:00 AM	Feb 18, 2019 8:09 AM	Ibrahim Alphonce	Feb 18, 2019 6:20 PM	<a href="#">Download image</a>	<a href="#">OSM File</a>
Feb 18, 2019 8:14 AM	Feb 18, 2019 8:26 AM	Rashid Idd	Feb 18, 2019 6:59 PM	<a href="#">Download image</a>	<a href="#">OSM File</a>



### meteor\_dsm

Total submissions: 40

ODK Data OSM Data

Manage

From To

YYYY-MM-DD

YYYY-MM-DD

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Choose an item...

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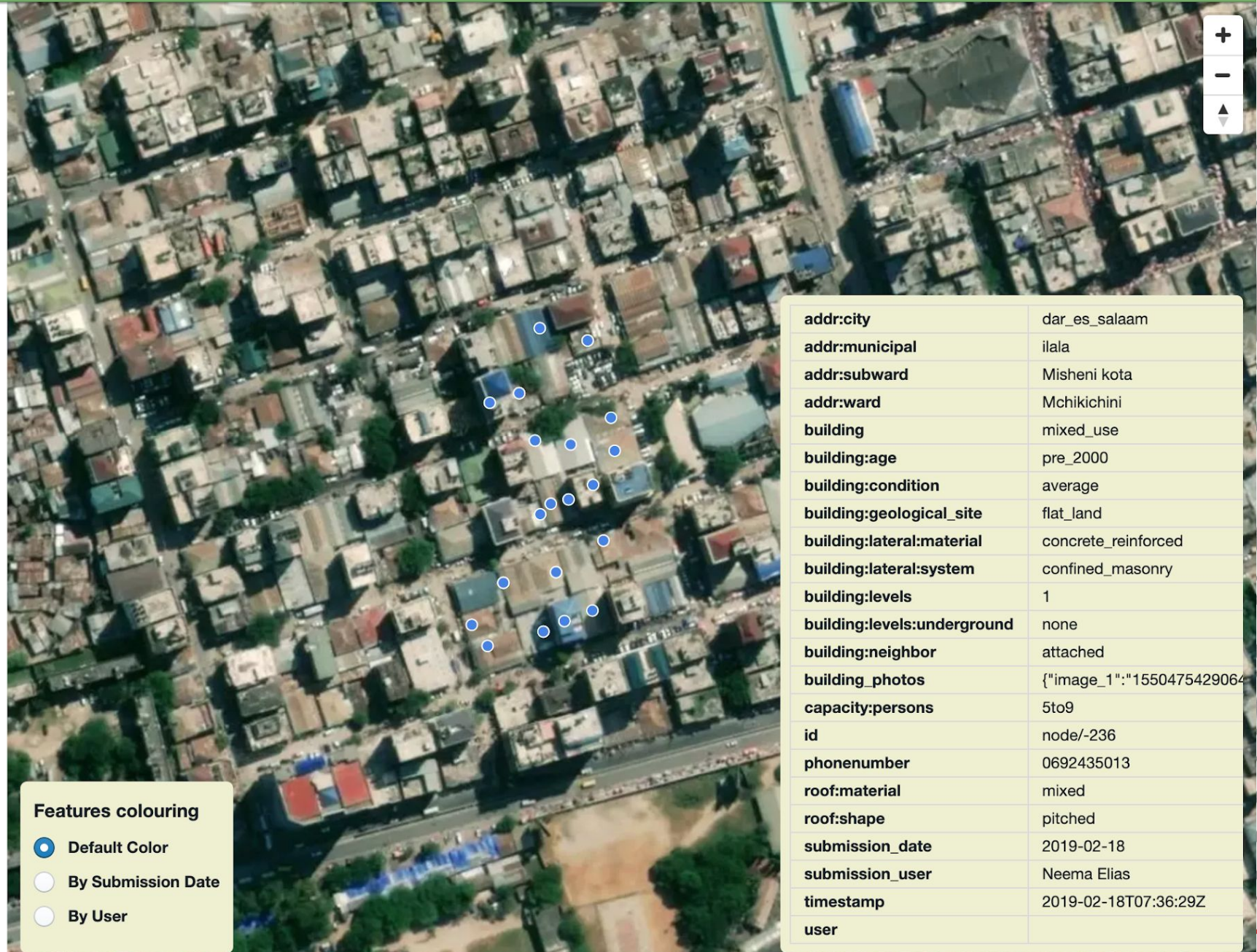
Page Size

200

Page

1

Switch to Table view



#### Features colouring

- Default Color
- By Submission Date
- By User

addr:city	dar_es_salaam
addr:municipal	ilala
addr:subward	Misheni kota
addr:ward	Mchikichini
building	mixed_use
building:age	pre_2000
building:condition	average
building:geological_site	flat_land
building:lateral:material	concrete_reinforced
building:lateral:system	confined_masonry
building:levels	1
building:levels:underground	none
building:neighbor	attached
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capacity:persons	5to9
id	node/-236
phonenumber	0692435013
roof:material	mixed
roof:shape	pitched
submission_date	2019-02-18
submission_user	Neema Elias
timestamp	2019-02-18T07:36:29Z
user	



## Map Campaigner

Is a monitoring tool created to manage field activities to check and review the status of the ongoing and completed field mapping campaigns. Since the zones were scattered, the campaigns were created following priority of the zones. The following is an example of the map campaigns created to check the completeness of attributes collected in the field after the data was uploaded to OSM:

## Meteor/Dar es Salaam/High-Urban-Development-Zone\_1

● Inactive

*Buildings*

Started : 18 Feb 2019 Ends : 18 Mar 2019

Modelling Exposure Through Earth Observation Routines[METEOR], is the project aim to cover building taxonomy around selected homogeneous zones. The project will help to improve the understanding of the distribution and character of building and infrastructure's exposure to natural hazards. This High Urban Development zone in Dar es Salaam consists all of the buildings available in high urban area, so the project will capture the full details of the buildings for the selected zone

Campaign Manager : [kombe1207](#) , [Nuru\\_Kalulunga](#) , [dorica\\_mugusi](#) , [William Perry Evans](#) , [nsmith](#) , [mataharimhairi](#) Creator : [kombe1207](#) Map: Default

Participate

 OpenMapKit

 Maps.me

Share



Features Collected

230

Users Engaged

0

Areas Covered

0%



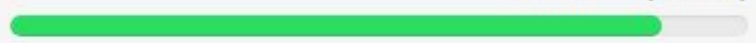
# Feature details

## Buildings

- building
- building:lateral:material
- building:lateral:system
- building:levels
- building:levels:underground
- building:age
- building:condition
- building:neighbor
- building:geological\_site
- capacity:persons
- roof:shape
- roof:material
- source

## Attribute Completeness

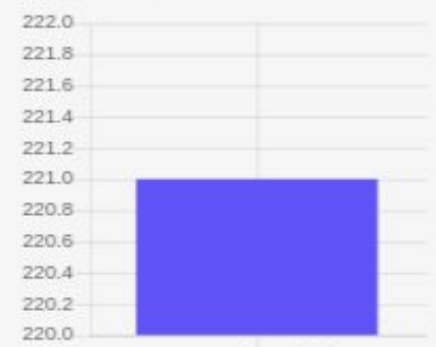
203/230 (88.3%)



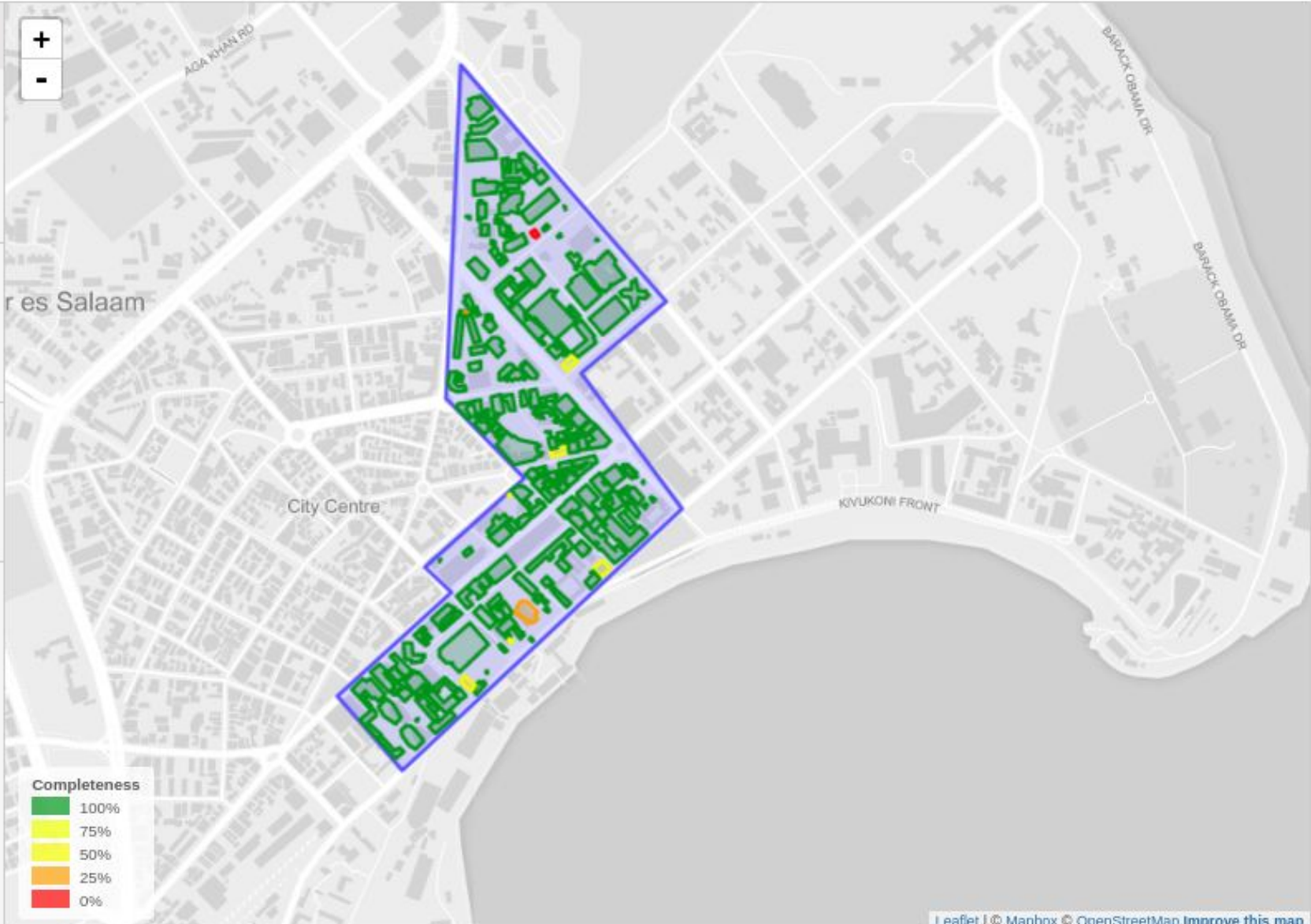
## Features Checked

230

## Buildings by type



METEOR Dar es Salaam Field Survey 2019



## RESULTS

At the end of the field work, a total of 2951 buildings were surveyed. Some of these buildings had pre-existing attributes information following the tags identified from the data model such as building, building:age, building:levels, and building:material while other tags were not present at all.



Tags	Before	After			
			building :levels	1461	2951
building	1548	2951	building:neighbor	0	2951
building:age	206	2951	capacity:persons	0	2951
building:condition	105	2951	building:geological_site	0	2951
building:lateral:material	0	2951	roof:shape	0	2951
building:lateral:system	0	2951	roof:material	222	2951
building:levels:underground	0	2951	source	0	2951
building :levels	1461	2951			

## Summary of Building Data Collected

<b>Homogeneous zones</b>	<b>Buildings count</b>
High urban	584
Urban development	505
Industrial	423
Single-family residential	467
Rural settlement	434
Informal settlement	538
<b>Total buildings</b>	<b>2951</b>



## Lessons learned

- **Constant updating of collected data:** Some of the data may be very dynamic, for example, damage and demolishing can change over a day, building uses and structures change over time.
- **Fieldwork eclipse data cleaning and analysis:** In some activities, we underestimated the resources needed and time allocation to conduct specific activities.
- **Chosen sample:** the sample chosen in some place tend to be lower in number than other zones

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# Thank you!

Mhairi O'Hara

 @hotosm

Gaurav Thapa

 @KTMLivingLabs

Emanuel Kombe

 @RamaniHuria

