# Topic 3g - Informal Settlement Mapping

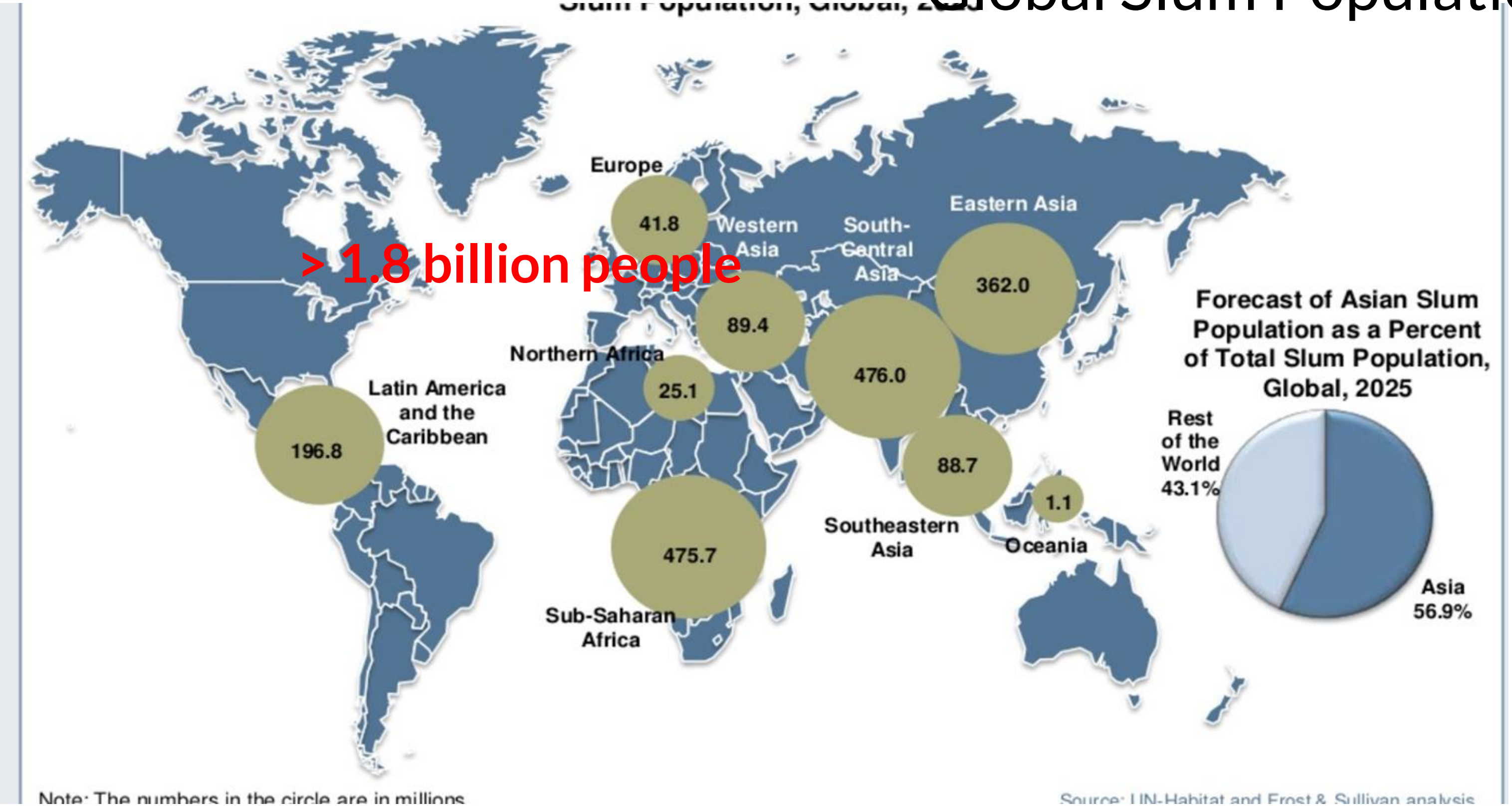
Bradley Gram-Hansen, FDL Slides

# Over Half of the World's Population Lives in Absolute Poverty

People live in **densely populated**, **unplanned** and **unstructured settlements**

This leads to huge **economic and social inequalities**

# Global Slum Population **2025**


Europe
41.8
Western Asia
South-Central Asia
Eastern Asia
362.0
89.4
476.0
Northern Africa
25.1
Latin America and the Caribbean
196.8
88.7
1.1
Southeastern Asia
Oceania
475.7
Sub-Saharan Africa
Forecast of Asian Slum Population as a Percent of Total Slum Population, Global, 2025
Rest of the World 43.1%
Asia 56.9%

Note: The numbers in the circle are in millions

Source: UN-Habitat and Frost & Sullivan analysis

**> 1.8 billion people**

*Source: UN-Habitat and Frost & Sullivan Analysis*

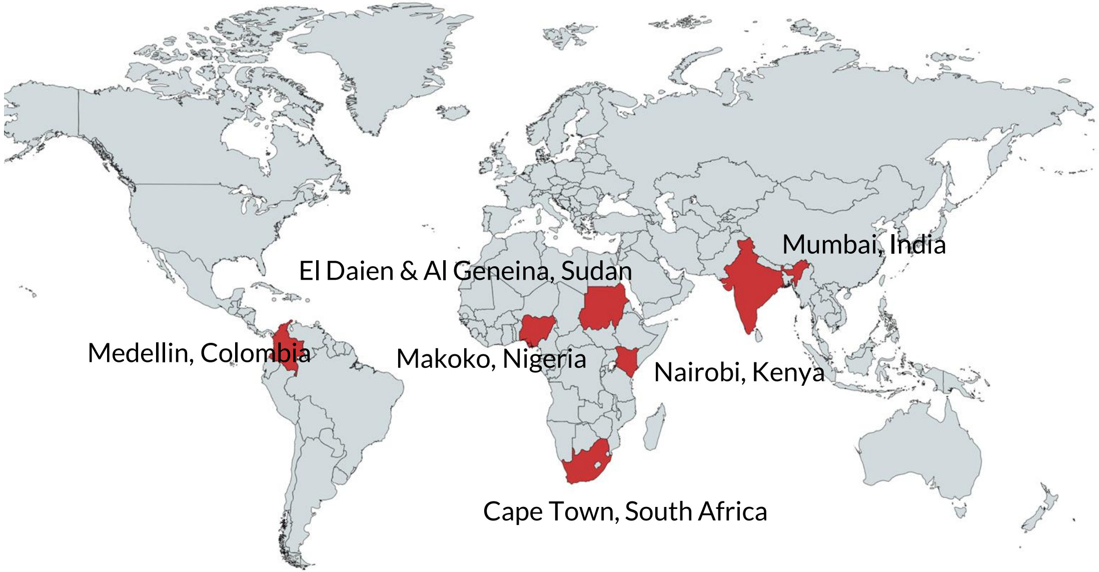
# Our Goal

# Enhancing Socio-economic Well Being

- Prediction
  - NGOs
    - Provide economic Aid
    - Provide social Aid
  - Local Governments
    - Develop Infrastructure
    - Economic Planning

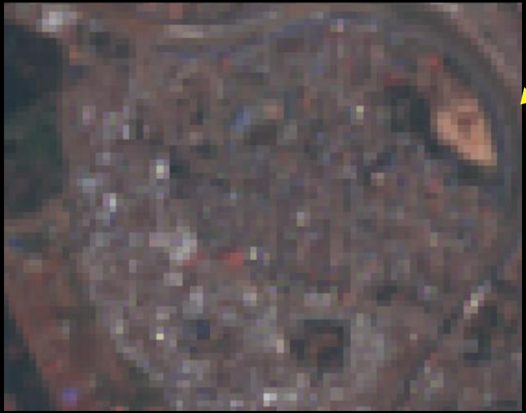
# Case Study

# Informal Settlements Addressed in the Study

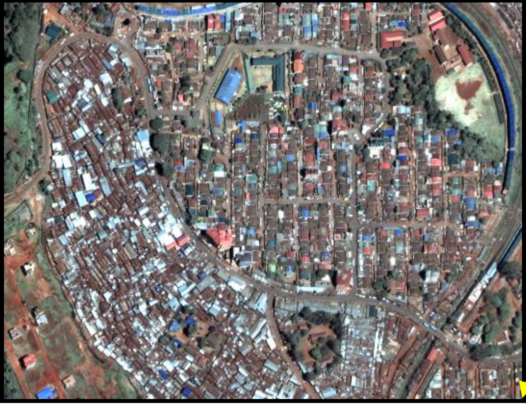

Mumbai, India
El Daien & Al Geneina, Sudan
Medellin, Colombia
Makoko, Nigeria
Nairobi, Kenya
Cape Town, South Africa

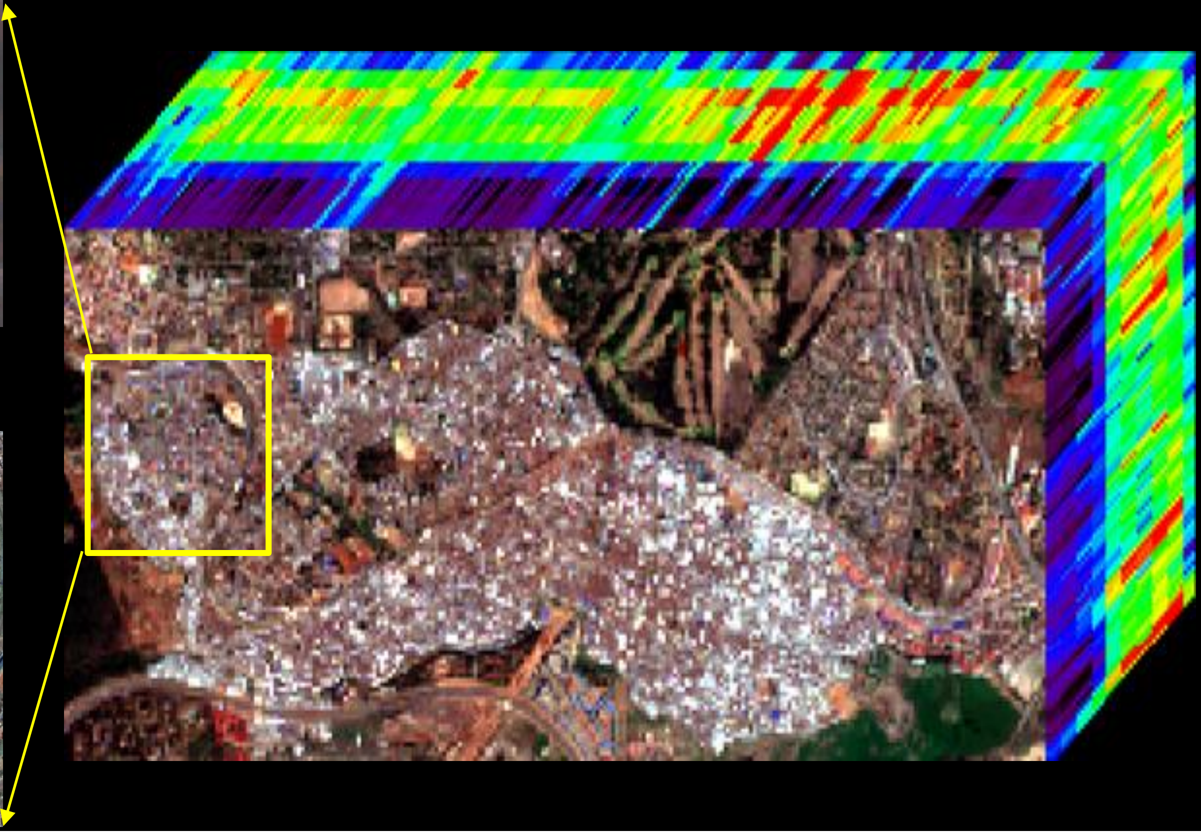
# Data Used

# Different Types of Optical Images

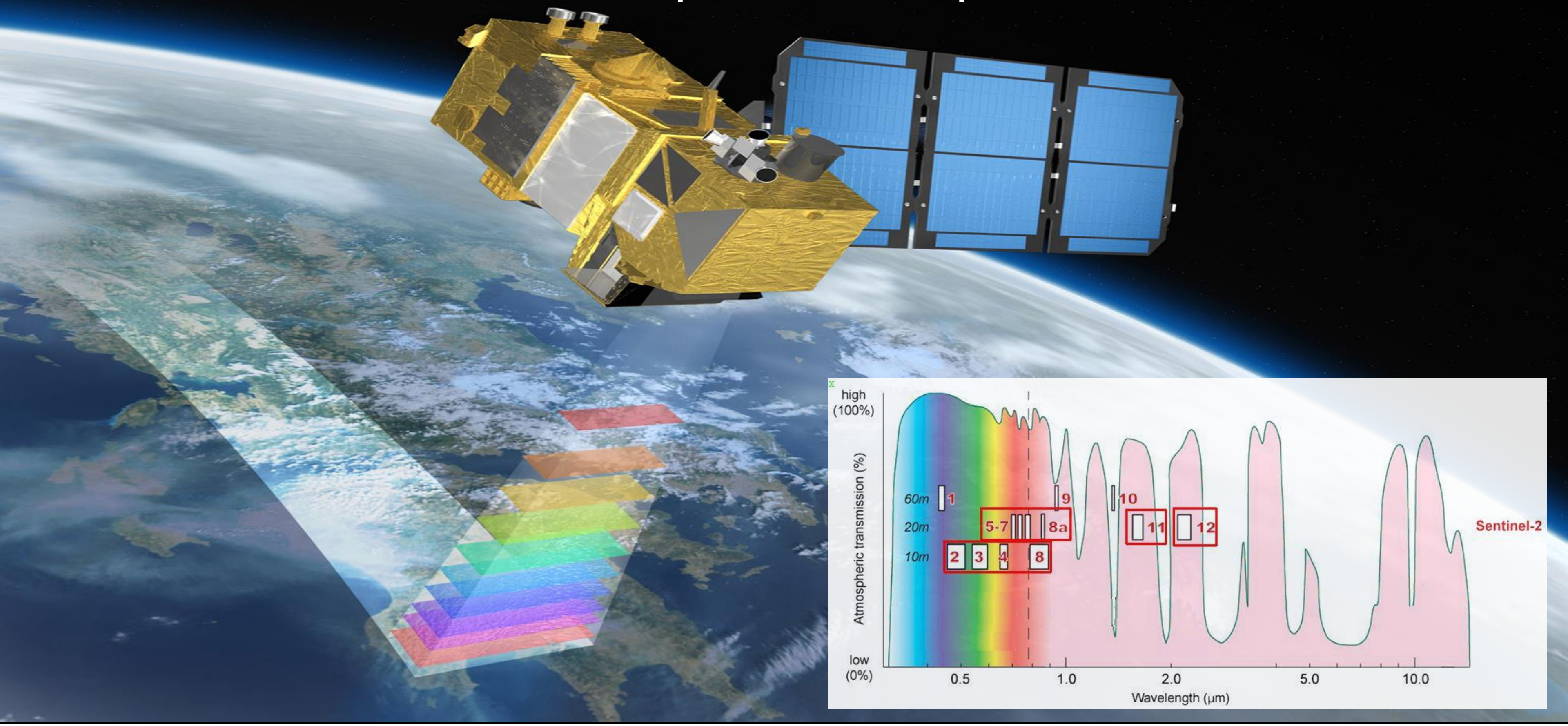


Sentinel 2 (10 & 20 m/pixel)



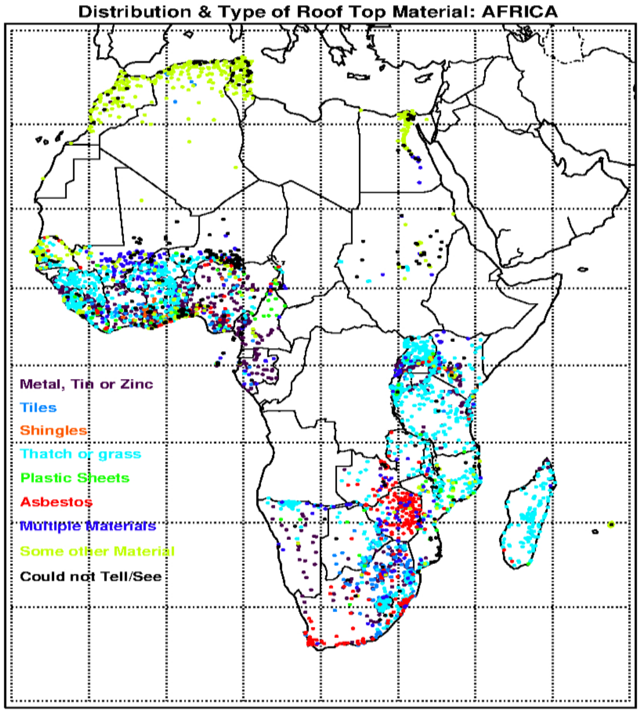


# **Sentinel 2:** (10 & 20 meters/pixel) Multispectral Data


high
(100%)
low
(0%)
Atmospheric transmission (%)
60m
20m
10m
1
9
10
5-7
8a
11
12
2
3
4
8
Sentinel-2
0.5
1.0
2.0
5.0
10.0
Wavelength (µm)

# Ground Truth

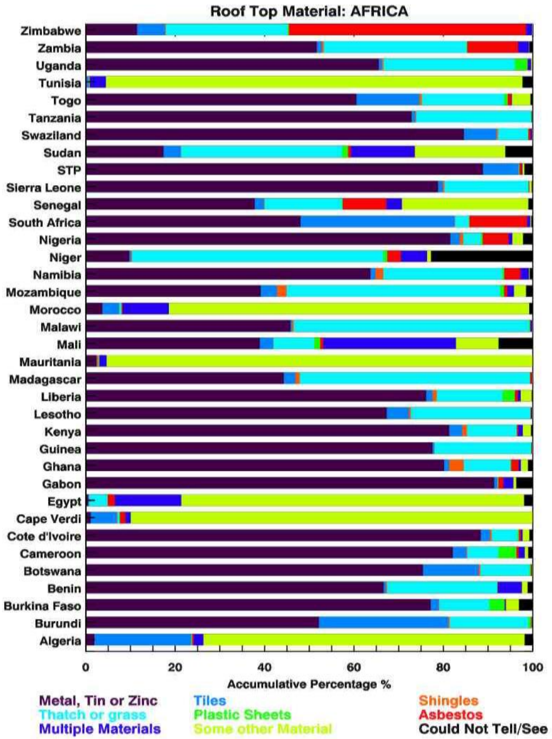
# Types of Roof Materials over Africa


Distribution & Type of Roof Top Material: AFRICA
Metal, Tin or Zinc
Tiles
Shingles
Thatch or grass
Plastic Sheets
Asbestos
Multiple Materials
Some other Material
Could not Tell/See

Source: Afrobarometer - AID data

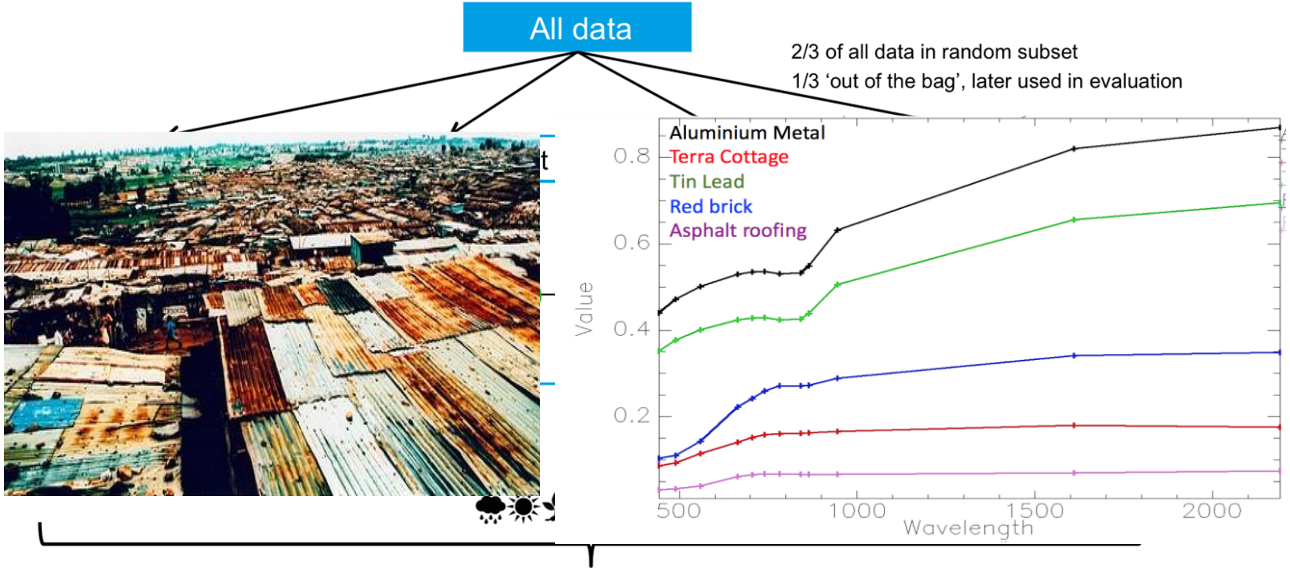
Tin roof

Thatch roof



# The Spectral Model : How does it all work?

# Canonical Correlation Forests


All data
Aluminium Metal
Terra Cottage
Tin Lead
Red brick
Asphalt roofing
Value
0.8
0.6
0.4
0.2
500
1000
1500
2000
Wavelength

2/3 of all data in random subset
1/3 ‘out of the bag’, later used in evaluation

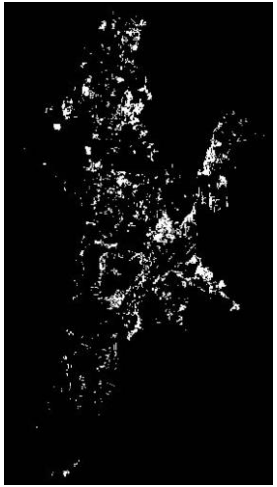
**AVERAGE**

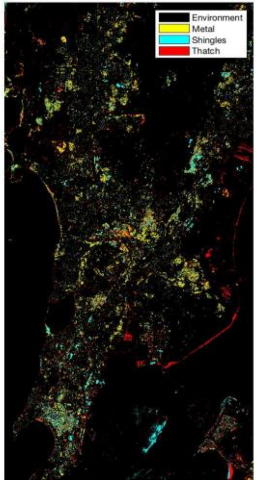
> find the set of predictor variables that produce the strongest classification model

# Mapping Informal Settlements using Low-resolution Satellite Imagery (Gram-Hansen et al, AAAI 2019)

*Take a big humanitarian problem + freely available, frequently updated low-res satellite imagery + interpretable Machine Learning = Generate maps of informal settlements for NGOs.*

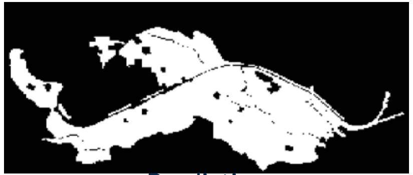
Mumbai Sentinel-2

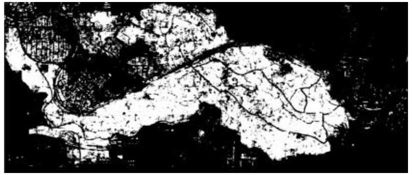

Ground Truth



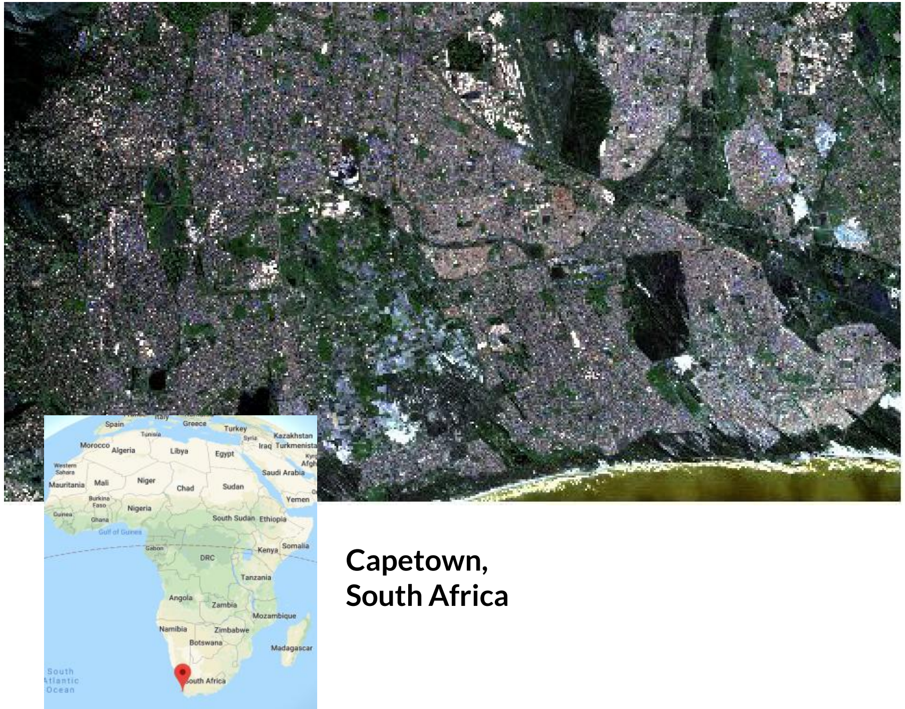
Prediction

Sentinel-2 Kibera

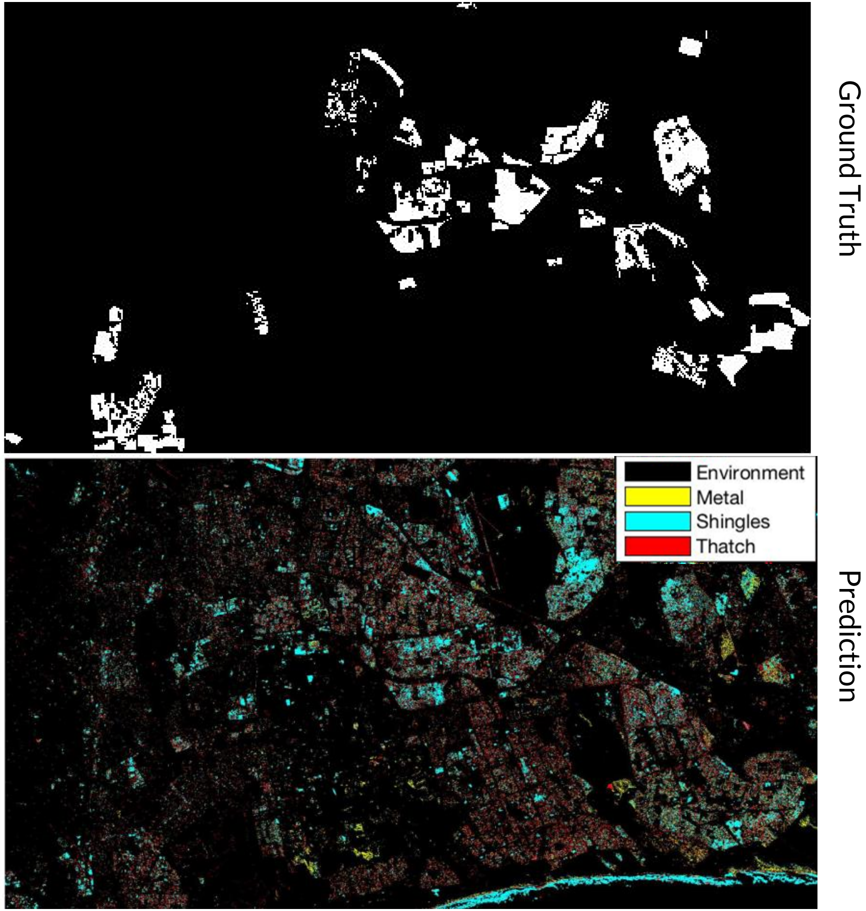

Ground Truth


Prediction

## Sentinel-2


Spain
Italy
Greece
Turkey
Tunisia
Morocco
Algeria
Libya
Egypt
Syria
Iraq
Kazakhstan
Turkmenista
Western Sahara
Saudi Arabia
Mauritania
Mali
Niger
Chad
Sudan
Yemen
Burkina Faso
Nigeria
Guinea
Ghana
Gulf of Guinea
South Sudan
Ethiopia
Gabon
Kenya
Somalia
DRC
Tanzania
Angola
Zambia
Mozambique
Namibia
Zimbabwe
Botswana
Madagascar
South Atlantic Ocean
South Africa

**Capetown, South Africa**


Ground Truth
Environment
Metal
Shingles
Thatch
Prediction

# Thanks to our partners

NVIDIA

esa

DigitalGlobe

FDL
EUROPE

UNIVERSITY OF
OXFORD

unicef

CATAPULT
Satellite Applications

AFRO
BAROMETER
LET THE PEOPLE HAVE A SAY

MEEO
Meteorological Environmental
Earth Observation

EARTH OBSERVATION

# Support well-being of people in informal settlements