

# **Deep Learning for mapping urban areas: challenges and opportunities**

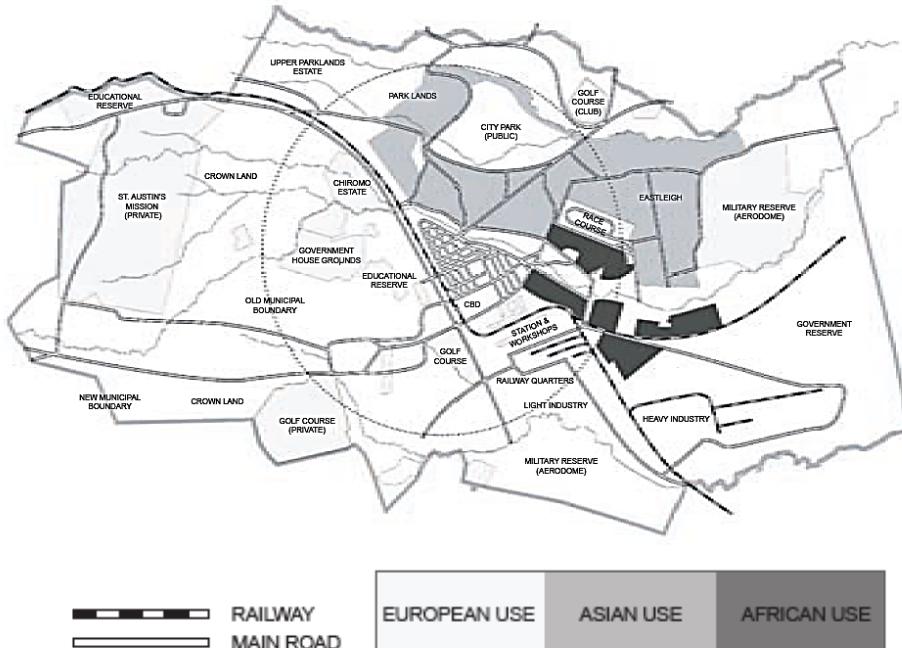
## **AI4COPERNICUS 2022**

Applications of deep learning using case-studies of data from  
Central Africa.

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# Urbanization in Sub-Saharan Africa (SSA)



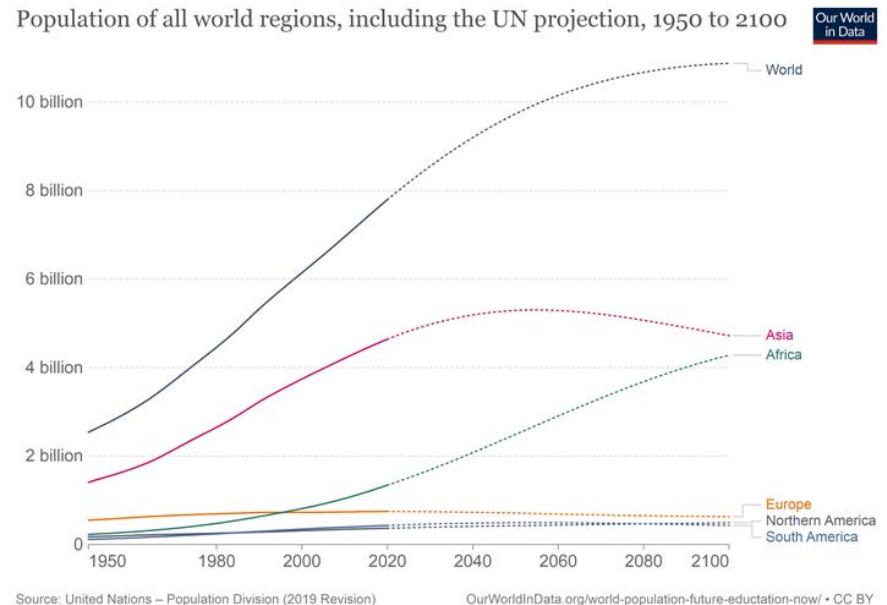
1927 Nairobi plan. Source  
ETH studio Basel



Nairobi, 2020. Source: Google Earth ©

# Urbanization trends

- Due to rapid population growth rate, 22% of world population be residing in Africa by 2050 in Africa
- Increasingly, more people are settling in Urban areas in SSA affecting infrastructure, demand for housing, environmental degradation
- People are also increasingly settling in areas that are vulnerable to natural disasters such as floods and landslides
- Urbanisation studies are needed to support urban planning and management, environmental monitoring and health campaigns.

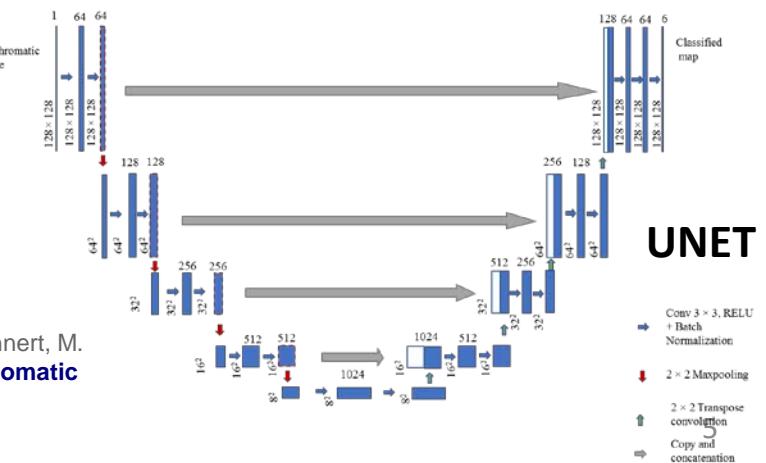
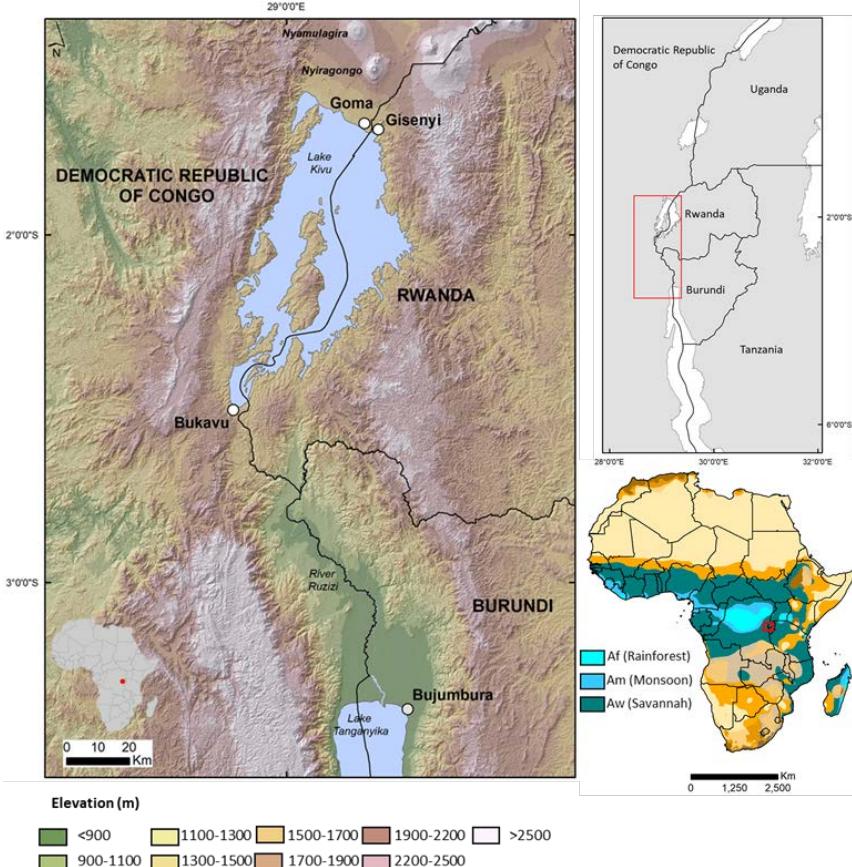


UN population division, 2019 revision. Chart sourced from <https://ourworldindata.org/world-population-growth>

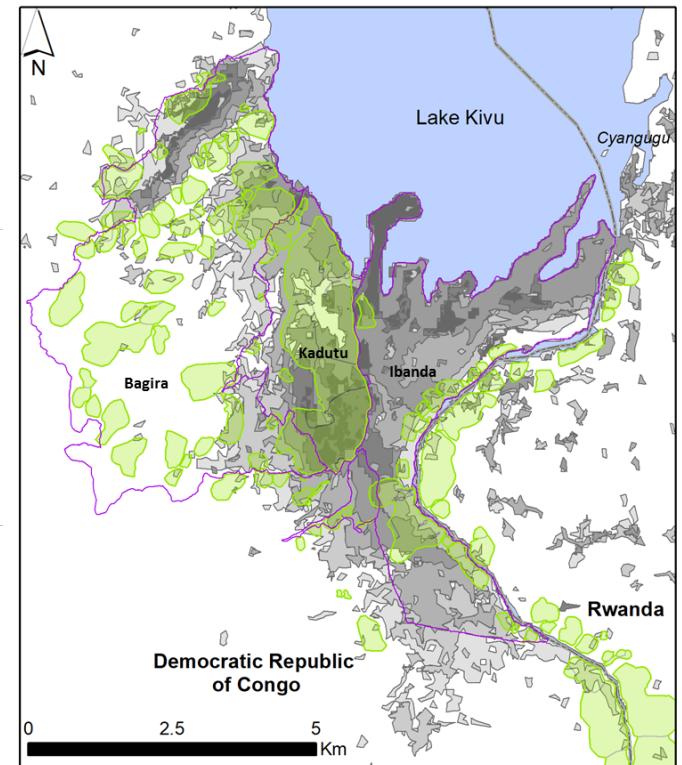
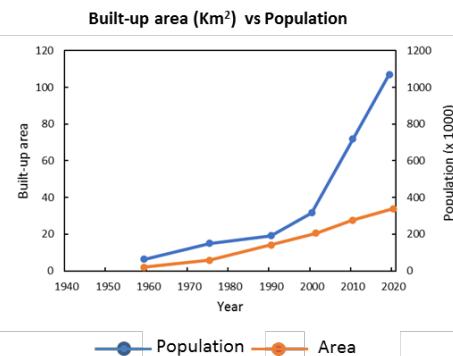
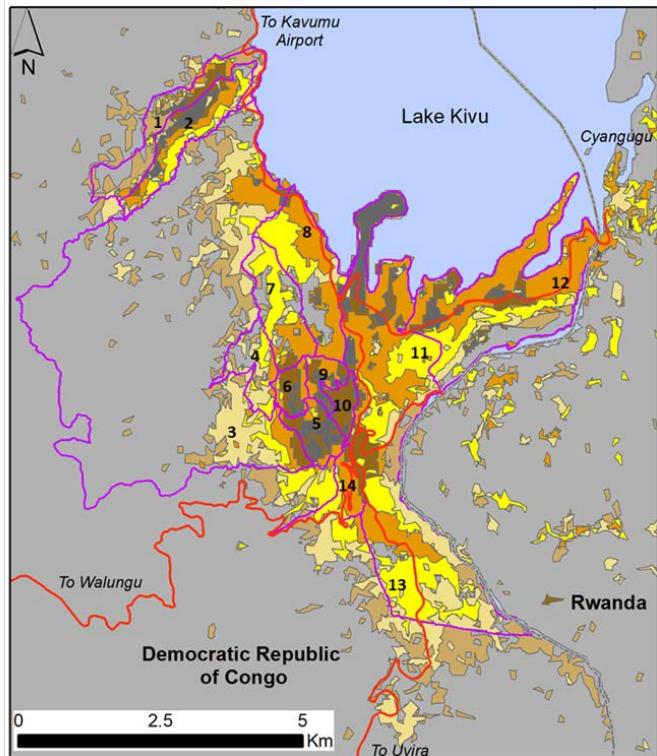
# Elements of the Talk

- Mapping urban areas in Sub-Saharan Africa (SSA)
  - Long-term mapping: baseline maps from historical panchromatic orthomosaic
  - Recent mapping: recent sub-metric resolution RGB imagery
- Challenges and opportunities
  - Urban fabric
  - Training data

# Long-term mapping: Historical baseline



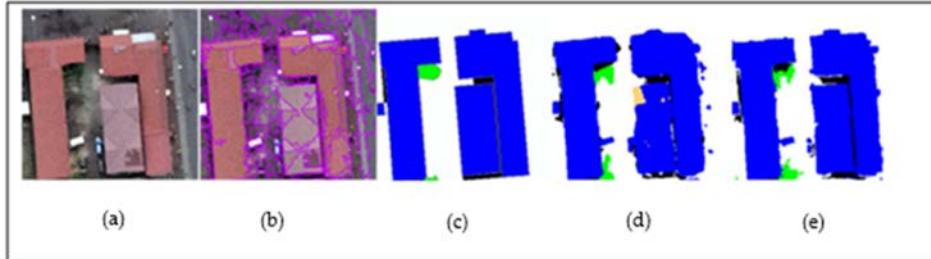
# Bukavu, DRC



a) Multitemporal built-up area growth Bukavu, DRC

b) Location of geohazards compared to built-up areas in Bukavu, DRC

# Recent Landcover : sub-metric images (Goma, DRC)



• Mboga, N., Georganos, S., Grippa, T., Lennert, M., Vanhuysse, S., Wolff, E. **Fully Convolutional Networks and Geographic Object-Based Image Analysis for the Classification of VHR Imagery**. *Remote Sens.* 2019, 11, 597. doi: <https://doi.org/10.3390/rs11050597>.

Legend

BD	VG	BS	IS	SH
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Goma, DRC



Bukavu, DRC



Vaihingen, Germany

# Global buildings mapping initiatives

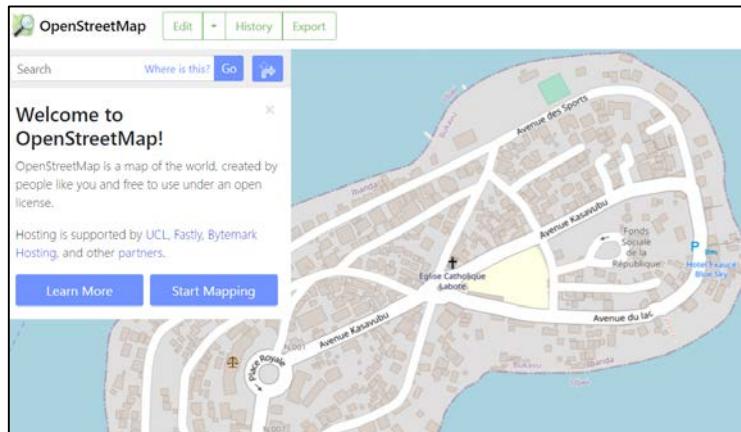
## ☞ What does the data include?

17,942,345 building footprint polygon geometries in Uganda and Tanzania in GeoJSON data here:

Country	Number of Buildings	Unzipped MB
Uganda	6,928,078	1339
Tanzania	11,014,267	2202

## Microsoft ai buildings

(<https://github.com/microsoft/Uganda-Tanzania-Building-Footprints>)



## OpenStreetMap

(<https://www.openstreetmap.org/search?query=bukavu#map=13/-2.5107/28.8434>)

## Explore

Zoom or search to explore, and click on building outlines to see metadata.  
Alternatively, [look at the data in Earth Engine](#).



**OpenBuildings**  
(<https://sites.research.google/open-buildings/#explore>)



Home About

## Data

You can download OpenStreetMap (OSM) data for any wards mapped by Ramani Huria for Dar es Salaam through this page. The OSM data in this page will be updated every time a ward is fully mapped. We provide two kinds of data formats that you can download, one in shp format (OSM data) and .pdf format for already designed maps. To download the data, you can choose which ward you would like in the list below grouped under three districts of Kinondoni, Ilala and Temeke.

You can download OpenStreetMap data for Dar es Salaam [here](#).

- Atlas
- General Map
- Drainage Map
- Drone Imagery

**Community initiatives**  
(<https://ramanihuria.org/en/ilala/>)

# Challenges & Opportunities

- Difficult urban fabric creates need for tailored AI-based solutions
- Data quality of historical panchromatic photographs/orthomosaics
  - See HIATUS project (<https://anr.fr/Project-ANR-18-CE23-0025>)
- Need smart ways to reduce effort in generating labelled data <sup>(1,2)</sup>

1. Mboga,N., D'Aronco, S., Grippa, T., Pelletier, C., Georganos, S., Vanhuysse, S., Wolff, E., Smets, B., Dewitte, O., Lennert, M., and Wegner, JD (2021) Domain adaptation for semantic segmentation of historical panchromatic orthomosaics in Central Africa. ISPRS International journal of Geo-Information. 10(8),523

2. Mboga, N. O., Georganos, S., Grippa, T., Lennert, M., Vanhuysse, S., & Wolff, E. (2019). Weakly supervised fully convolutional networks using OBIA classification output. In Proceedings of the 2019 Joint Urban Remote Sensing Event (JURSE) conference IEEE. doi:10.1109/JURSE.2019.8809000

# References/Links

- For more information contact  
[Nicholus.Mboga@uantwerp.be](mailto:Nicholus.Mboga@uantwerp.be)
- Project website:  
<http://pasteca.africamuseum.be/papers>