

Technical workshop on geospatial population
estimation for selected countries in the Arab
Region

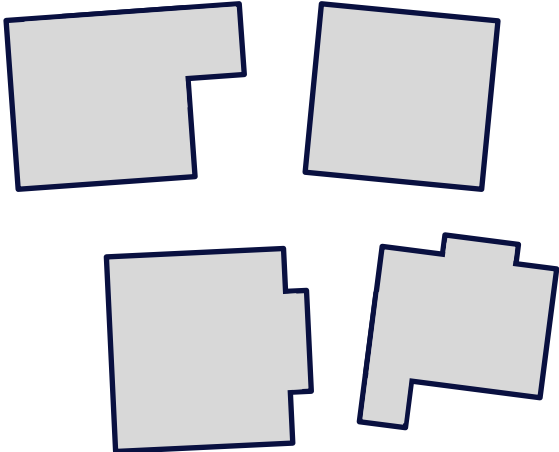
Data for modelling:
Buildings and settlements

WorldPop

Geospatial building/settlement datasets

- Vital datasets for population modelling
- Multiple uses:
 - Identifying unpopulated areas (use as a mask / spatial constraint)
 - To guide collection of enumeration data
 - As a modelling unit
 - As covariates in modelling population

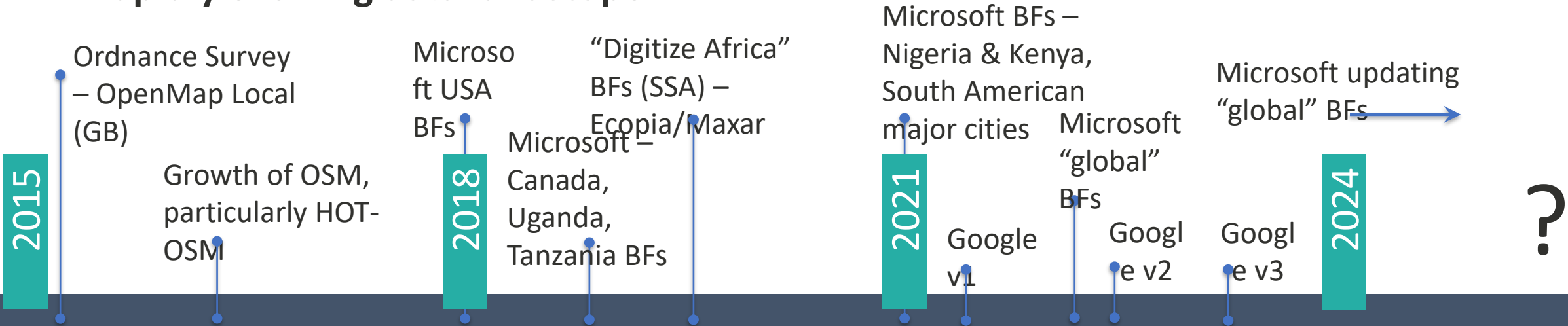
Building footprint data



Main sources:

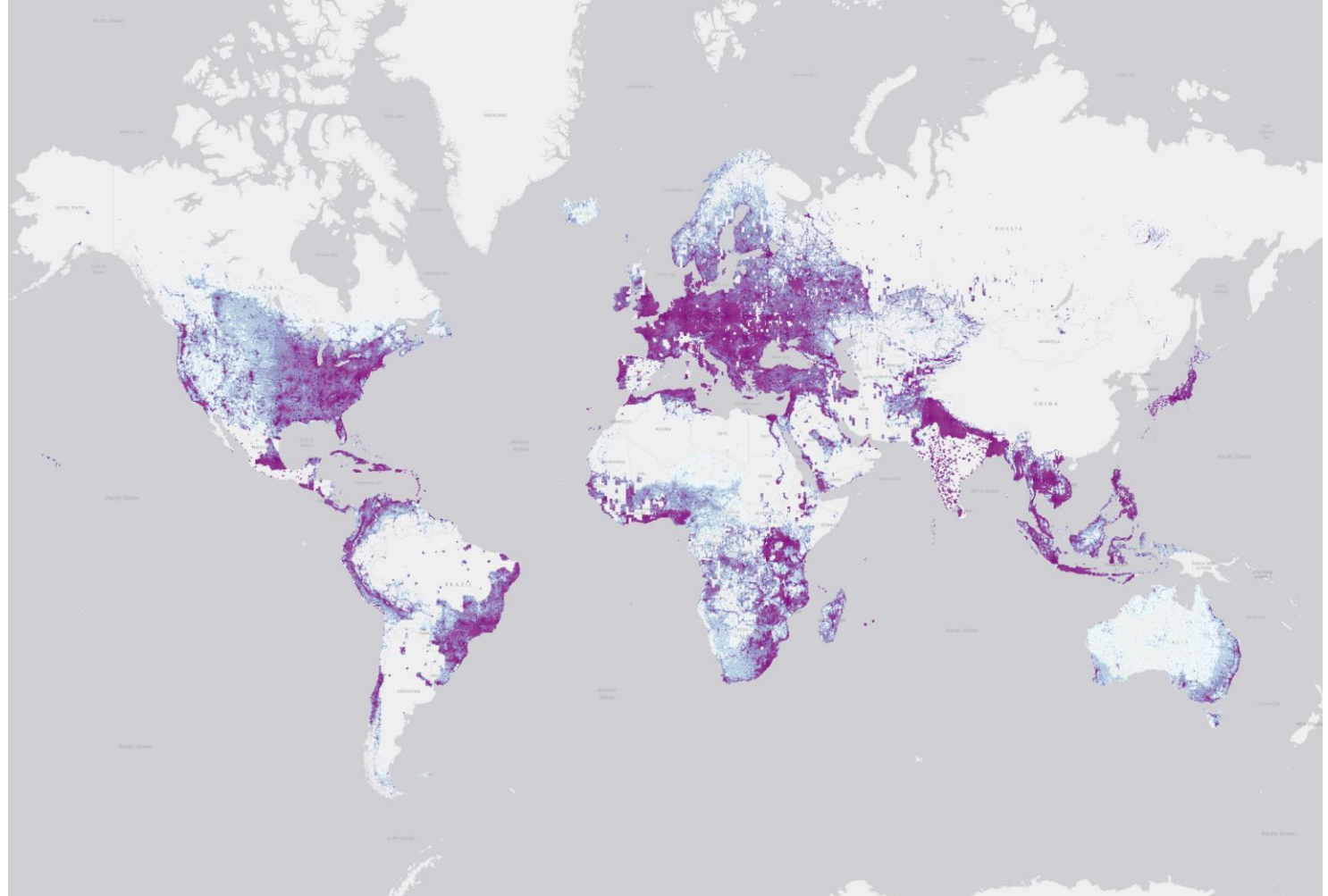
- Authoritative datasets e.g. from national mapping agency
- "Volunteered Geographic Information" initiatives – e.g. OpenStreetMap
- Automated feature extraction from satellite imagery

A rapidly evolving data landscape:



Microsoft building footprints

→ Openly available

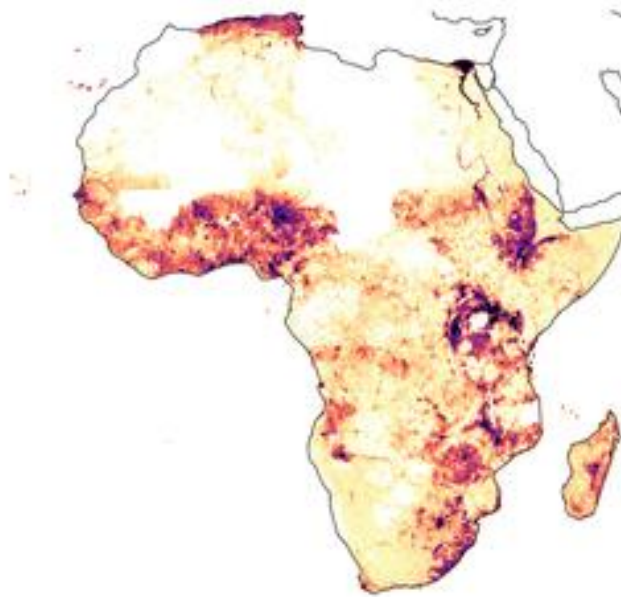
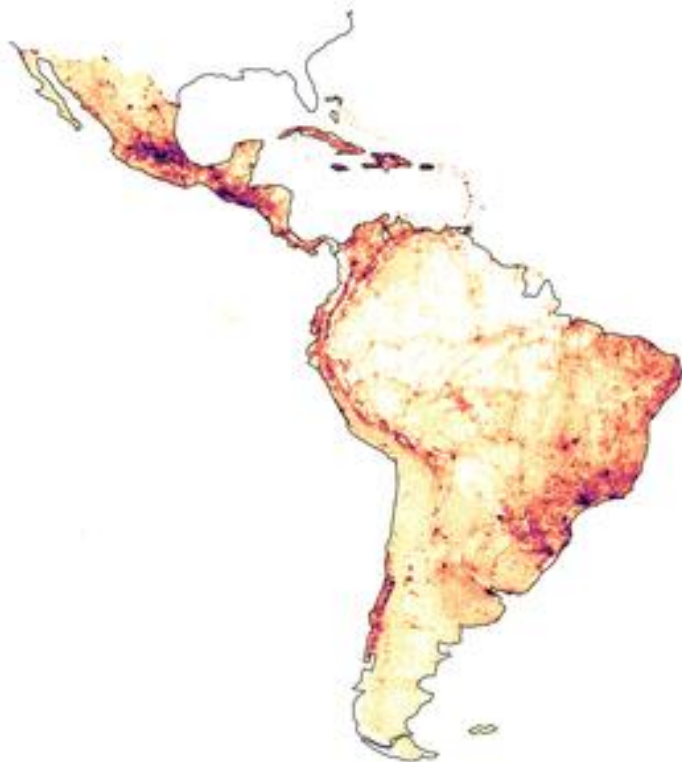


<https://github.com/microsoft/GlobalMLBuildingFootprints>

Google building footprints

→ Openly available

→ New release Sept 19th



sites.research.google/open-buildings/

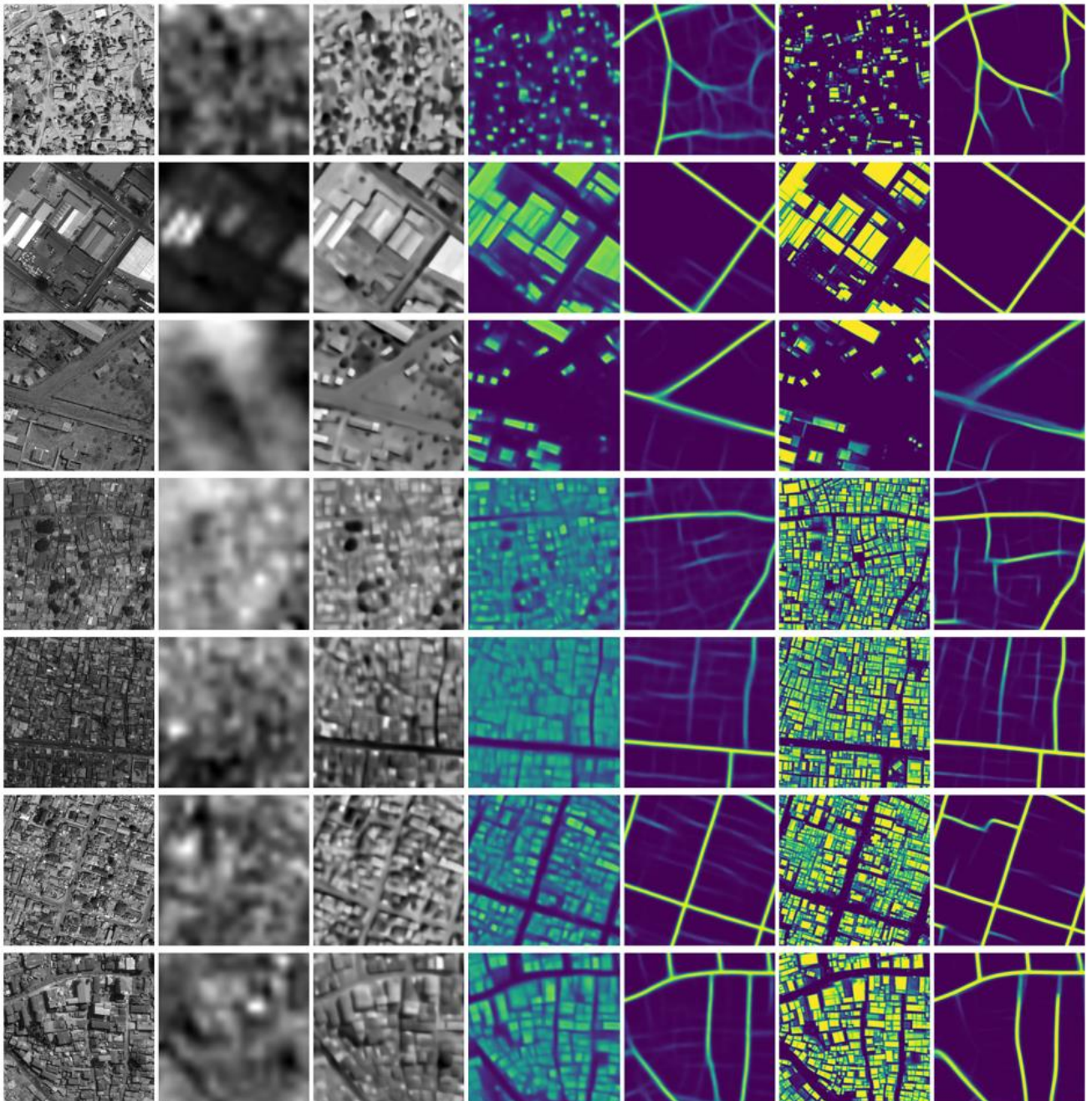
Open Buildings

A dataset of building footprints to support social good applications.

Building footprints are useful for a range of important applications, from population estimation, urban planning and humanitarian response, to environmental and climate science. This large-scale open dataset contains the outlines of buildings derived from high-resolution satellite imagery in order to support these types of uses. The project is based in Ghana, with an initial focus on the continent of Africa and new updates on South Asia



<https://sites.research.google/gr/open-buildings/>



50 cm grayscale Sentinel-2 grayscale Sentinel-2 grayscale super-resolution Building detection Road detection Teacher building detection Teacher road detection

High Resolution Building and Road Segmentation from Sentinel-2 Imagery

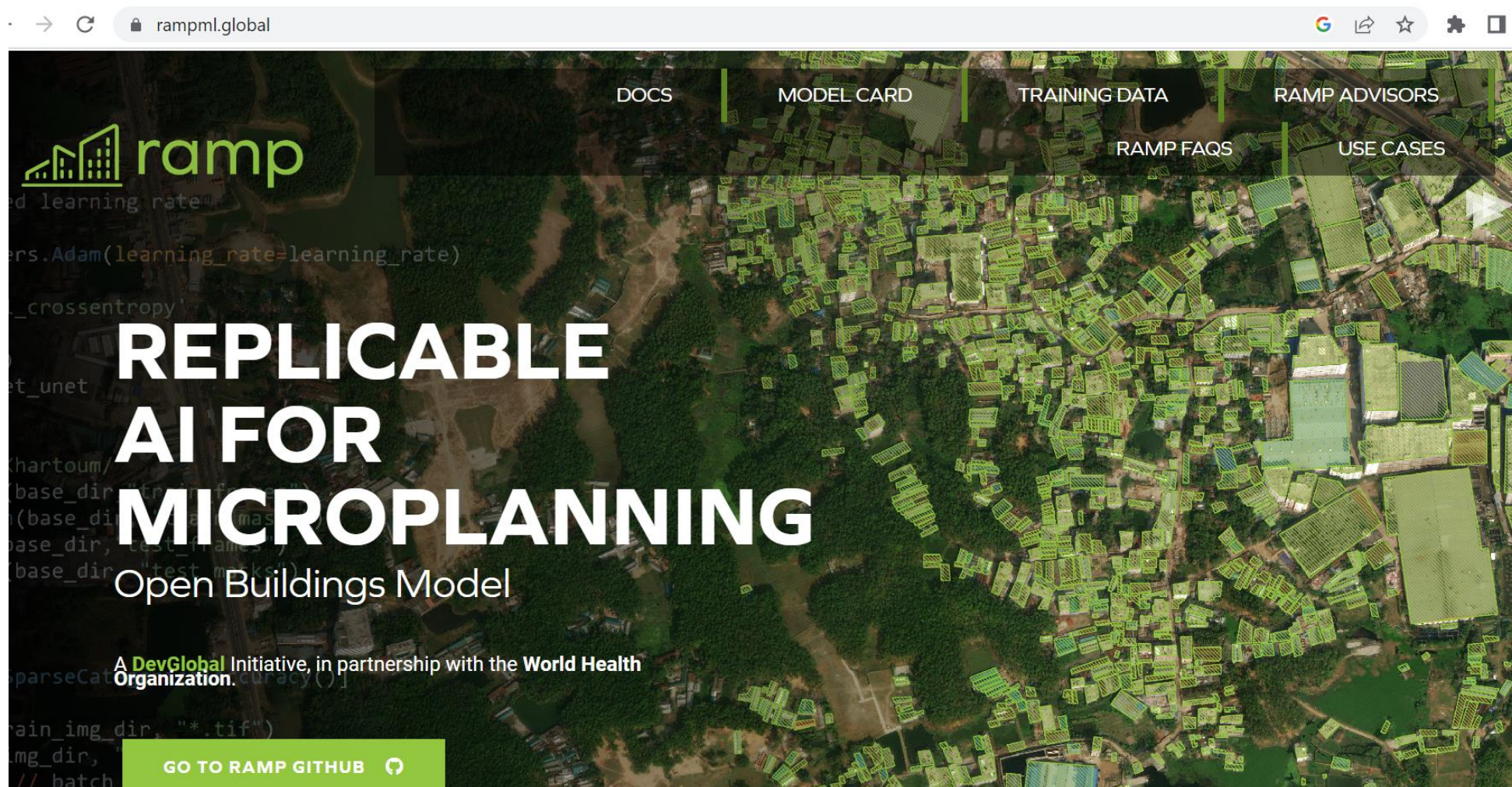
Abdoulaye Diack · Abel Tesfaye Korme · [Abigail Annkah](#) · Emmanuel Asiedu Brempong · Jason Hickey · [John Quinn](#) · Juliana Marcos · Krishna Sapkota · Mohammed Alewi Hassen · [Tomer Shekel](#) · Wojciech Sirko · arXiv, <https://arxiv.org/abs/2310.11622> (2023)



2016-2023 annual datasets of building location and height across most low and middle income countries

<https://research.google/pubs/high-resolution-building-and-road-segmentation-from-sentinel-2-imagery/>

Extracting your own building footprints from imagery




The image shows a browser window displaying the website rampml.global. The page features an aerial photograph of a village with numerous buildings outlined in green, representing the AI-extracted building footprints. The website layout includes a navigation menu with links for DOCS, MODEL CARD, TRAINING DATA, RAMP ADVISORS, RAMP FAQs, and USE CASES. The main heading reads "REPLICABLE AI FOR MICROPLANNING" with the subtitle "Open Buildings Model". At the bottom, it states "A DevGlobal Initiative, in partnership with the World Health Organization." and includes a "GO TO RAMP GITHUB" button.

→ ↻ 🔒 rampml.global

🔍 📄 ⭐ ⚙️ 🗄️

DOCS MODEL CARD TRAINING DATA RAMP ADVISORS
RAMP FAQs USE CASES

 ramp

ed learning rate
rs.Adam(learning_rate=learning_rate)
_crossentropy
et_unet
hartoum/
base_dir
(base_dir, mas
base_dir, test_frames
base_dir, test_masks)

REPLICABLE AI FOR MICROPLANNING

Open Buildings Model

A **DevGlobal** Initiative, in partnership with the **World Health Organization**.

GO TO RAMP GITHUB ↻

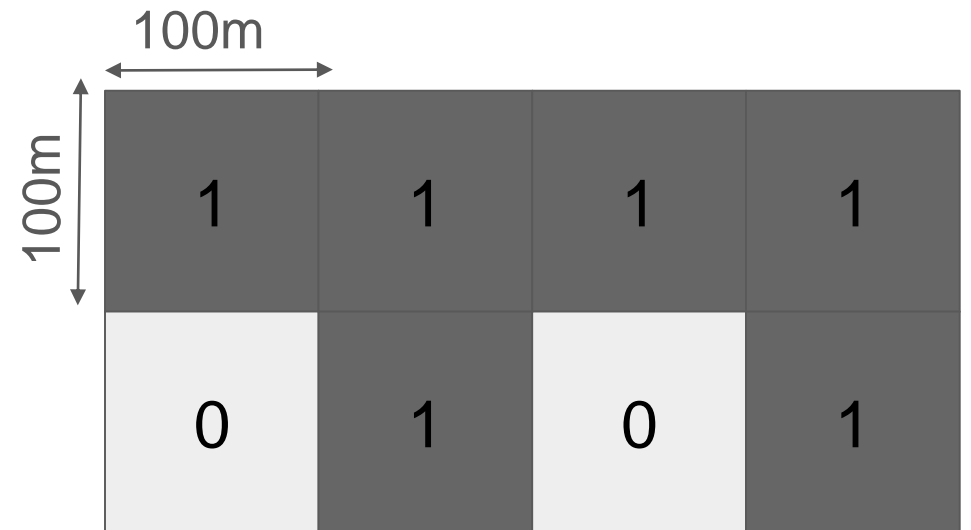
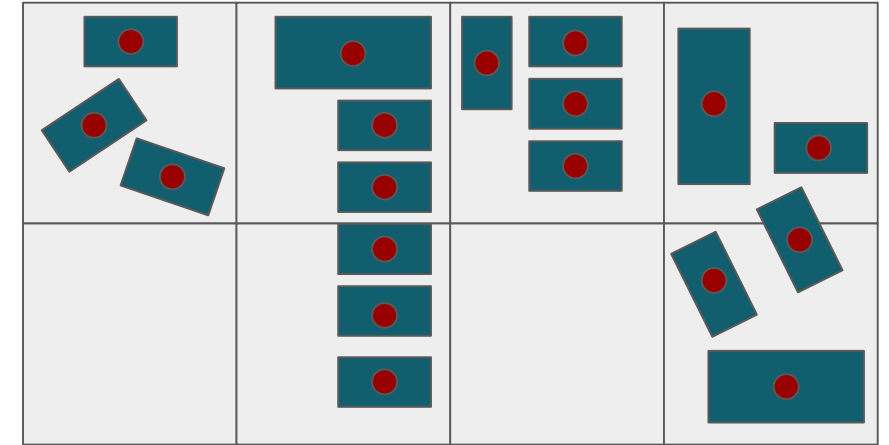
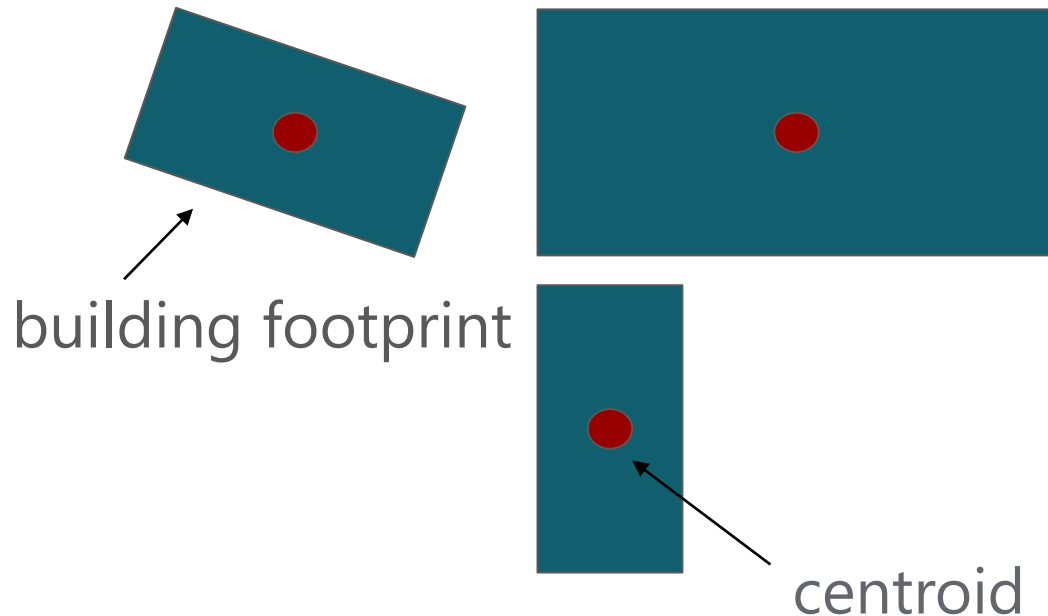
rain_img_dir, (*.tif")
img_dir,
// batch

Building footprint datasets

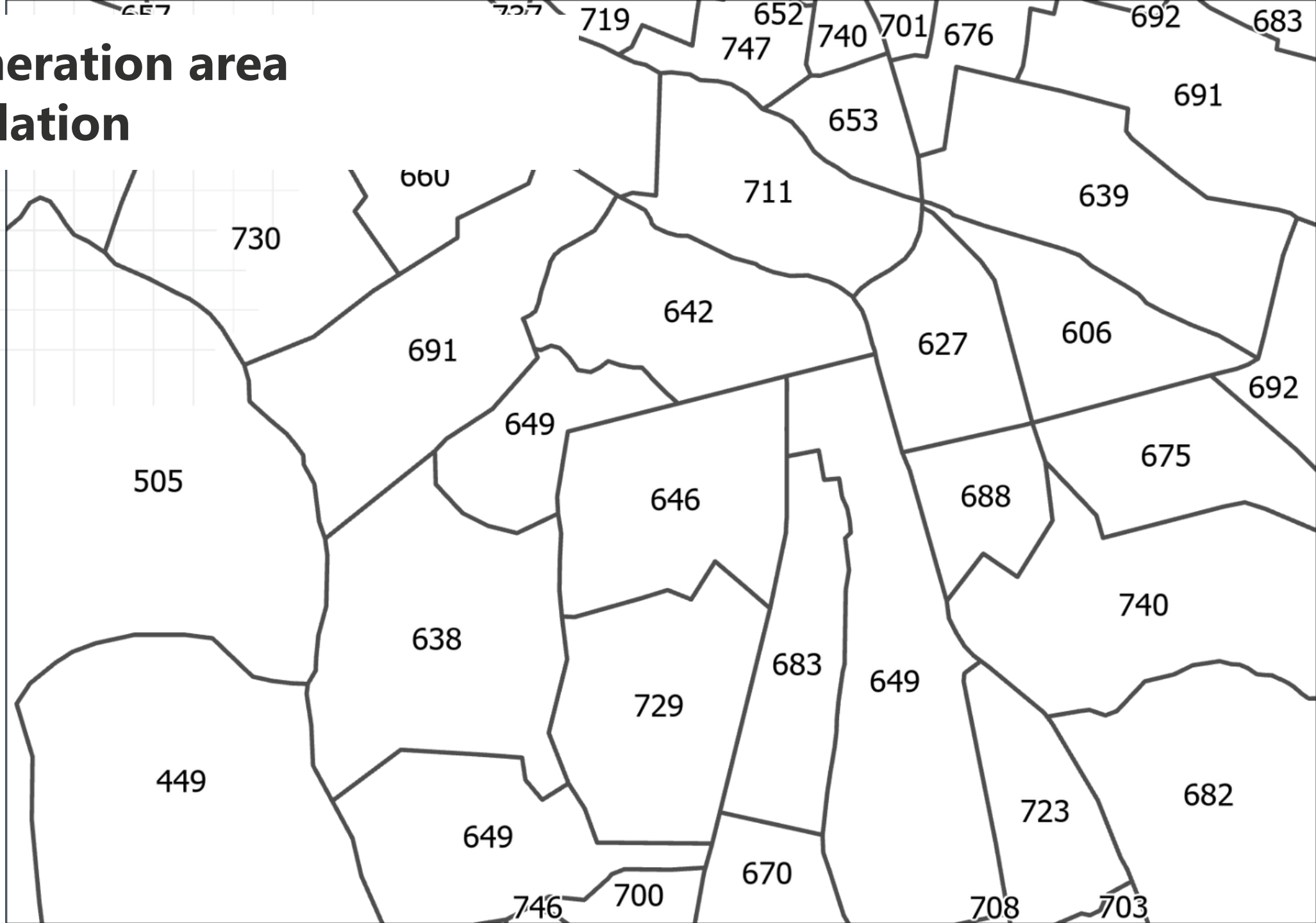
Constraining modelled population estimates

All grid cells with 1 or more buildings are considered to potentially have population

- Based on building footprint centroid



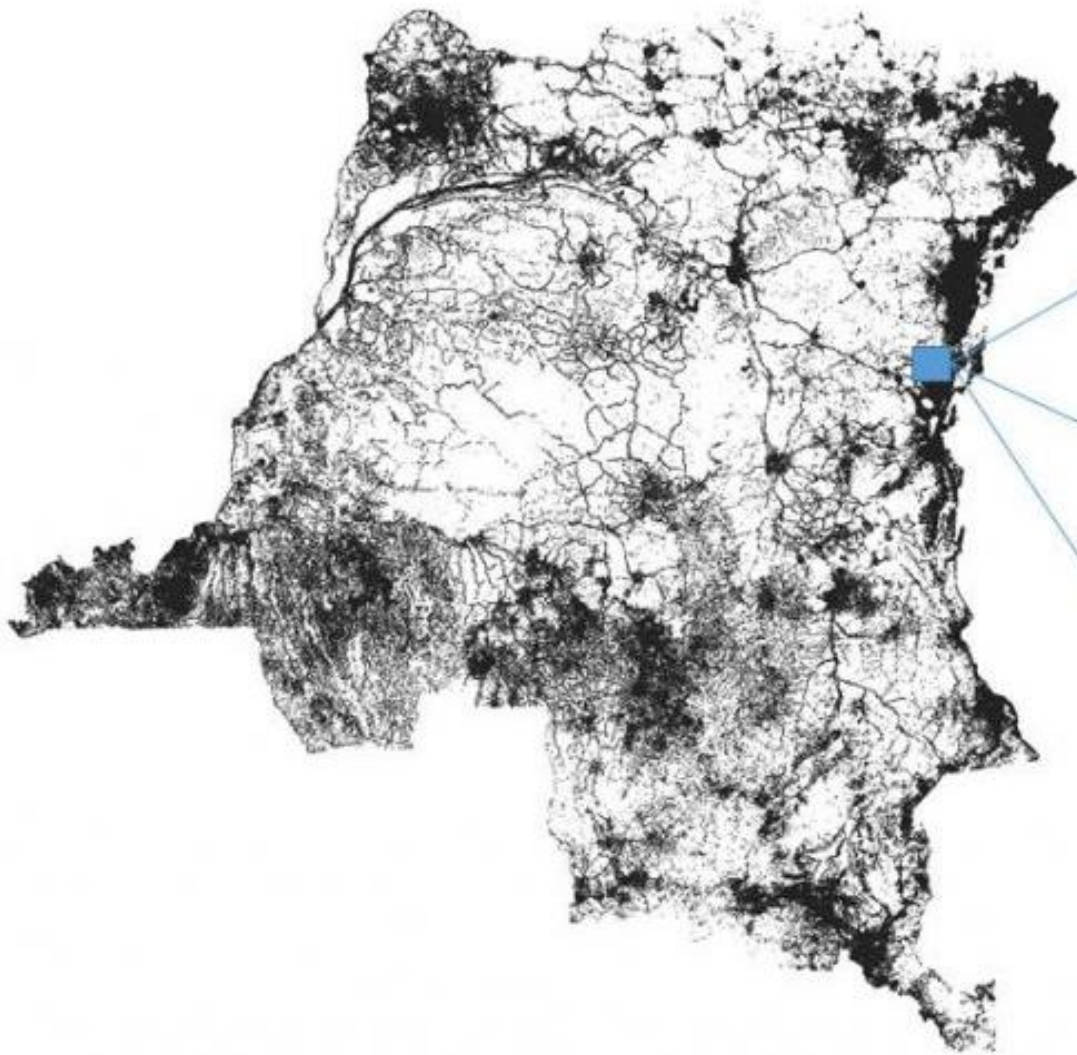
Enumeration area population



Constrain to areas of settlement - e.g. derived from building footprints







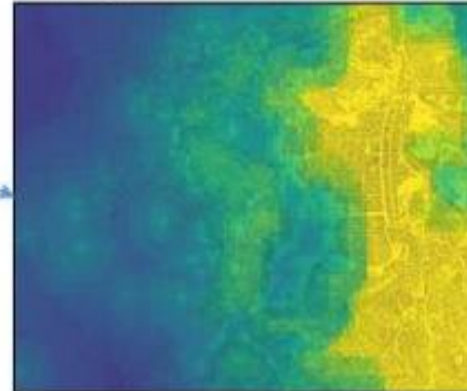
Building footprints (Democratic Republic of the Congo)
Digitize Africa project of Ecopia.AI and Maxar Technologies (2020)

Building footprints

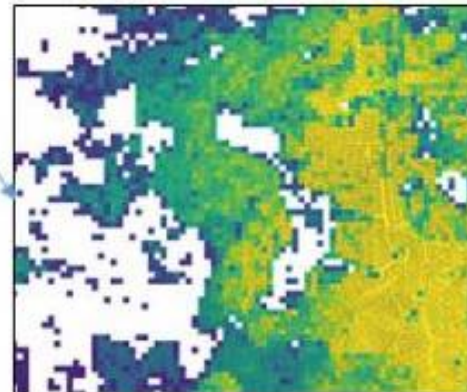


**Building
footprints**

Top-down unconstrained



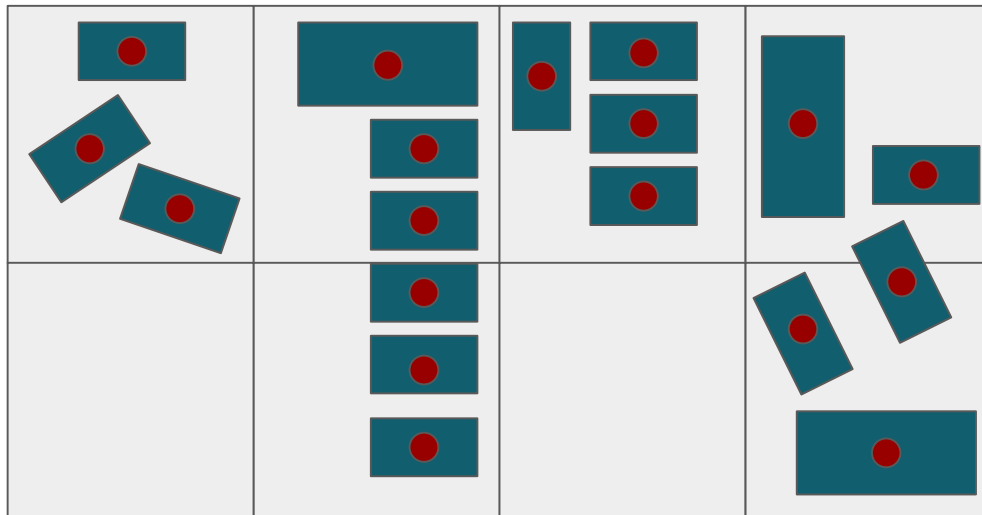
Top-down constrained



Building footprint datasets

Building metrics as covariates

- Deriving metrics from building footprints:
 - Building count
 - Building area (min, max, mean, total, sd)
 - Building perimeter (min, max, mean, total, sd)
 - Count of building vertices (min, max, mean, total, sd)



3	3	4	2
0	3	0	3

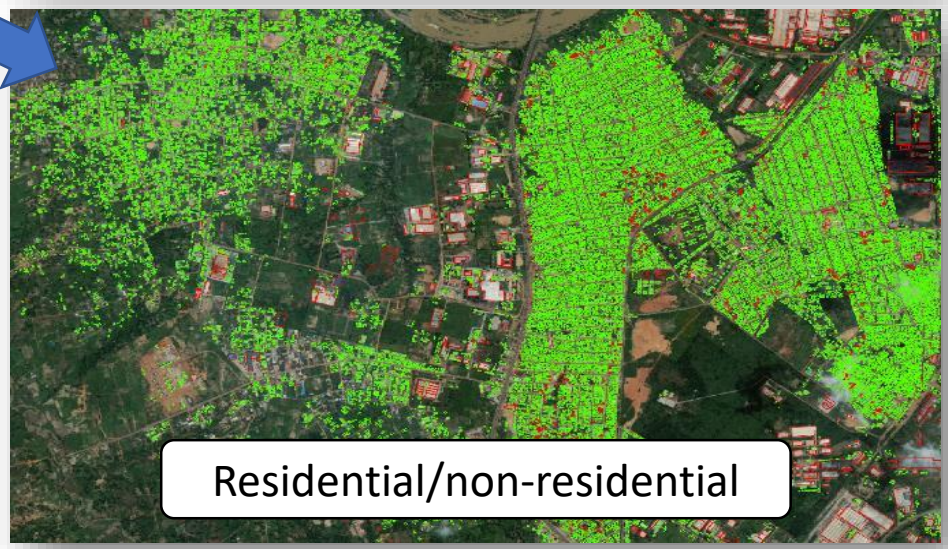
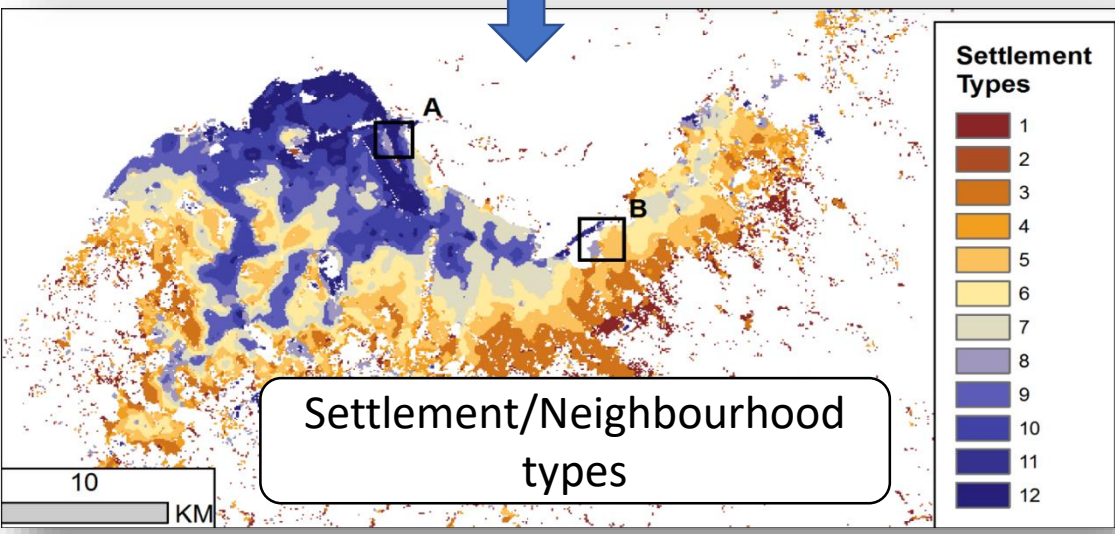
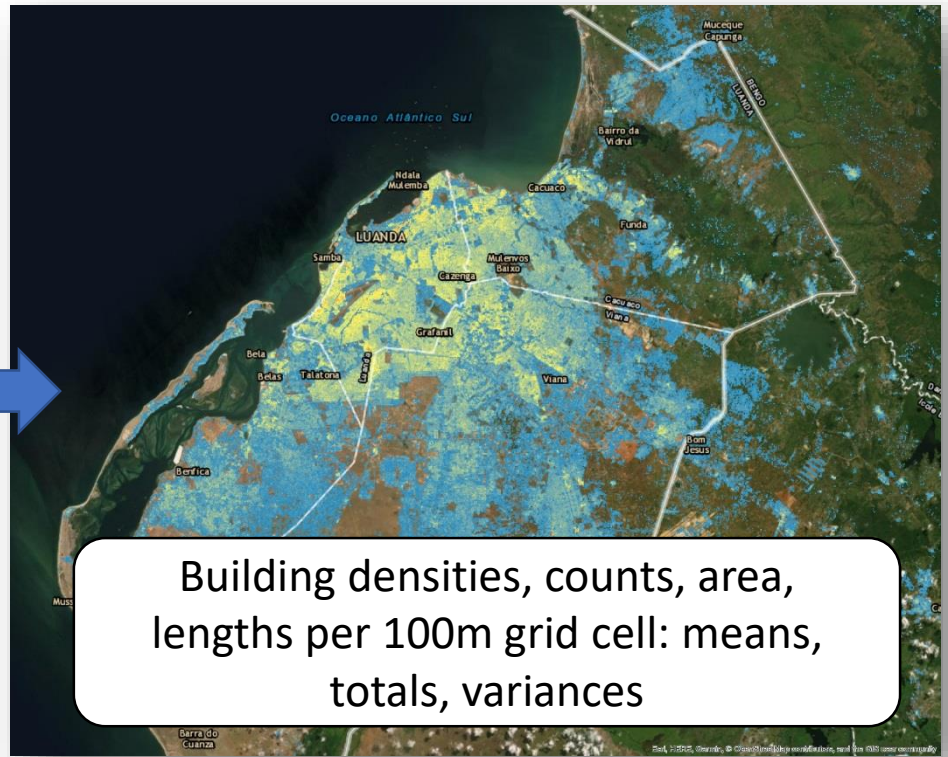
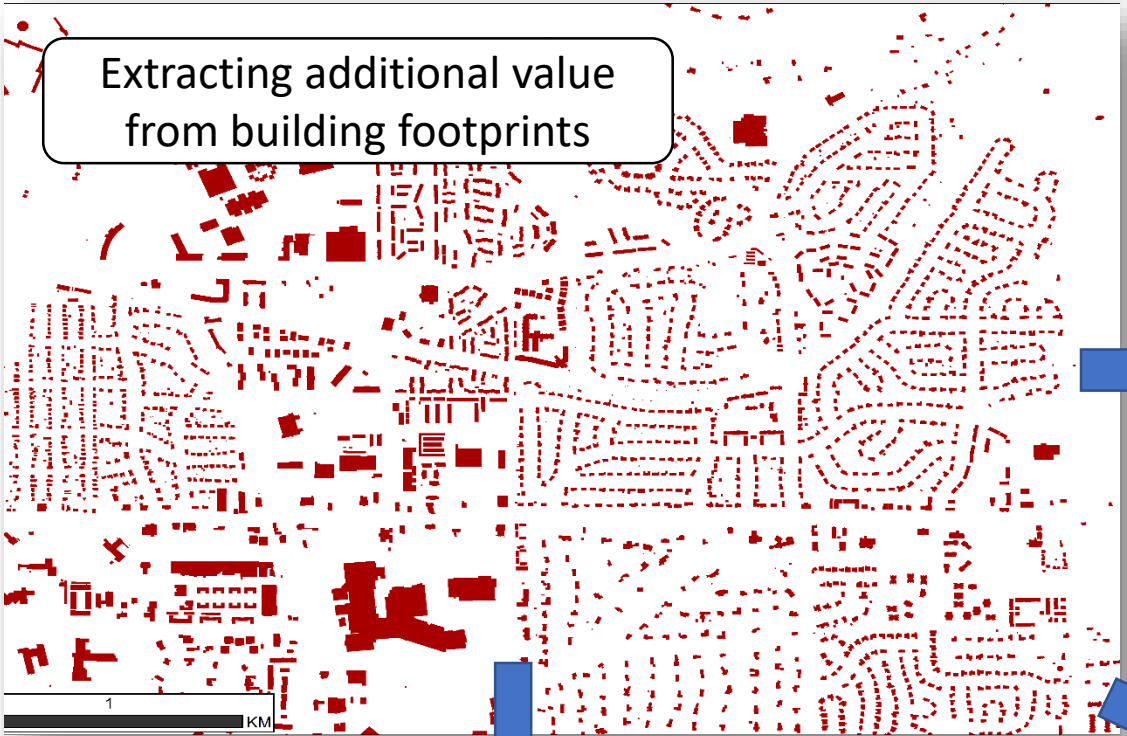
Building
count

2	2.8	2	2.6
0	2	0	2.4

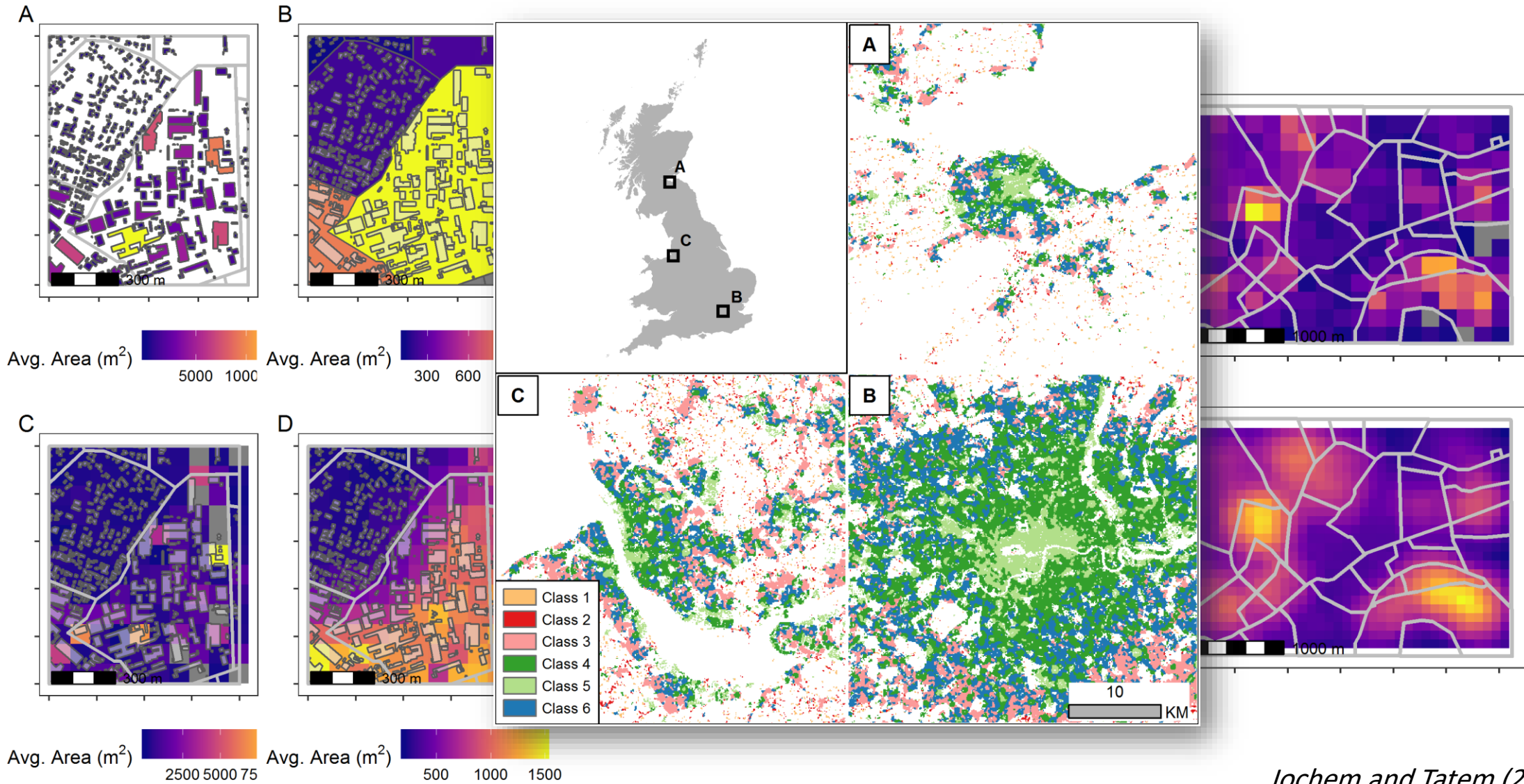
Mean
building
area

4	8	4	8
0	4	0	8

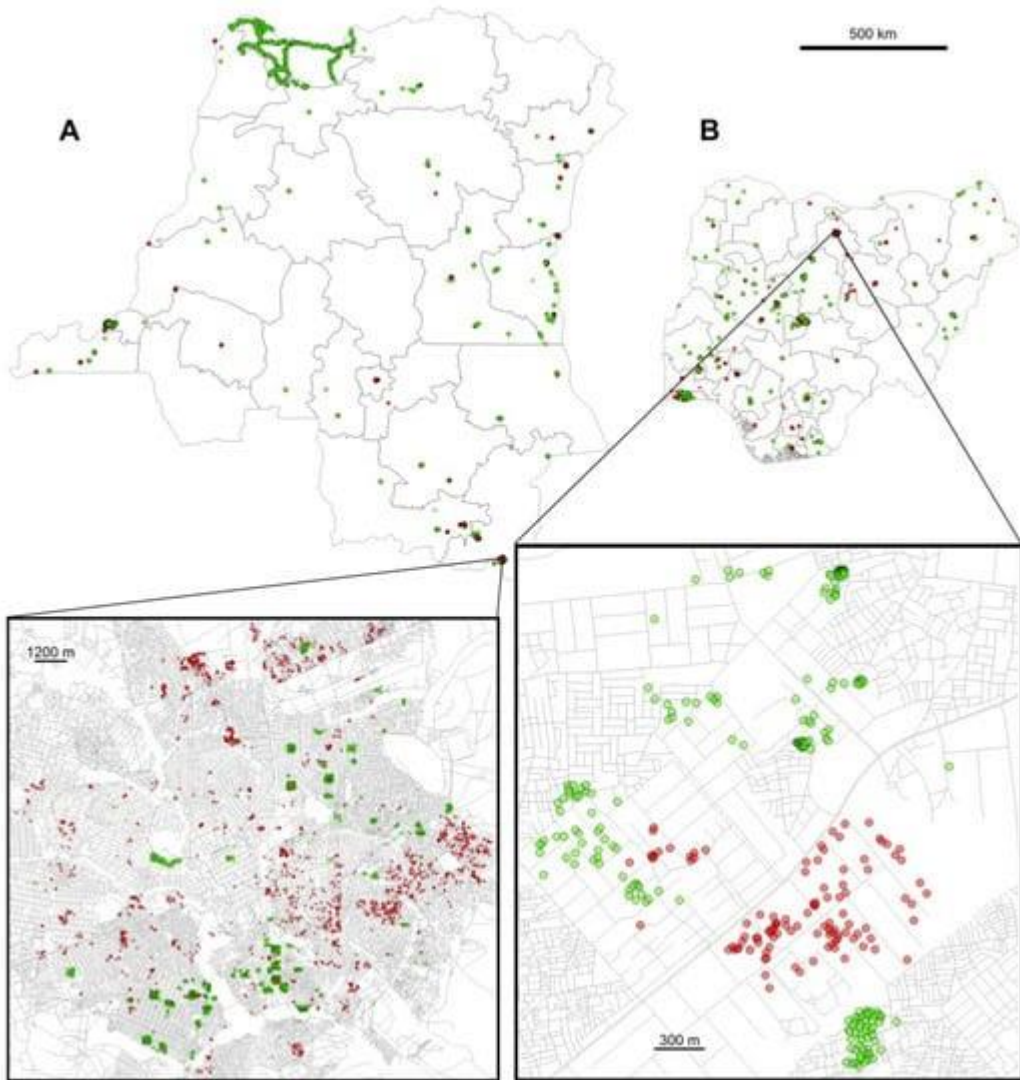
Maximum
building
perimeter



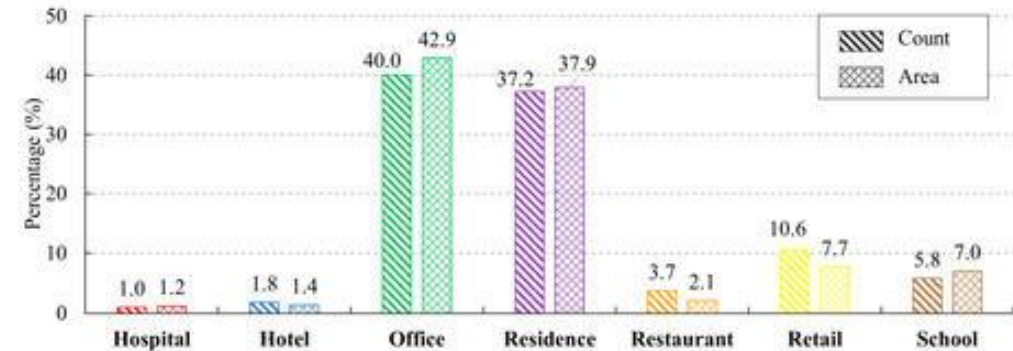
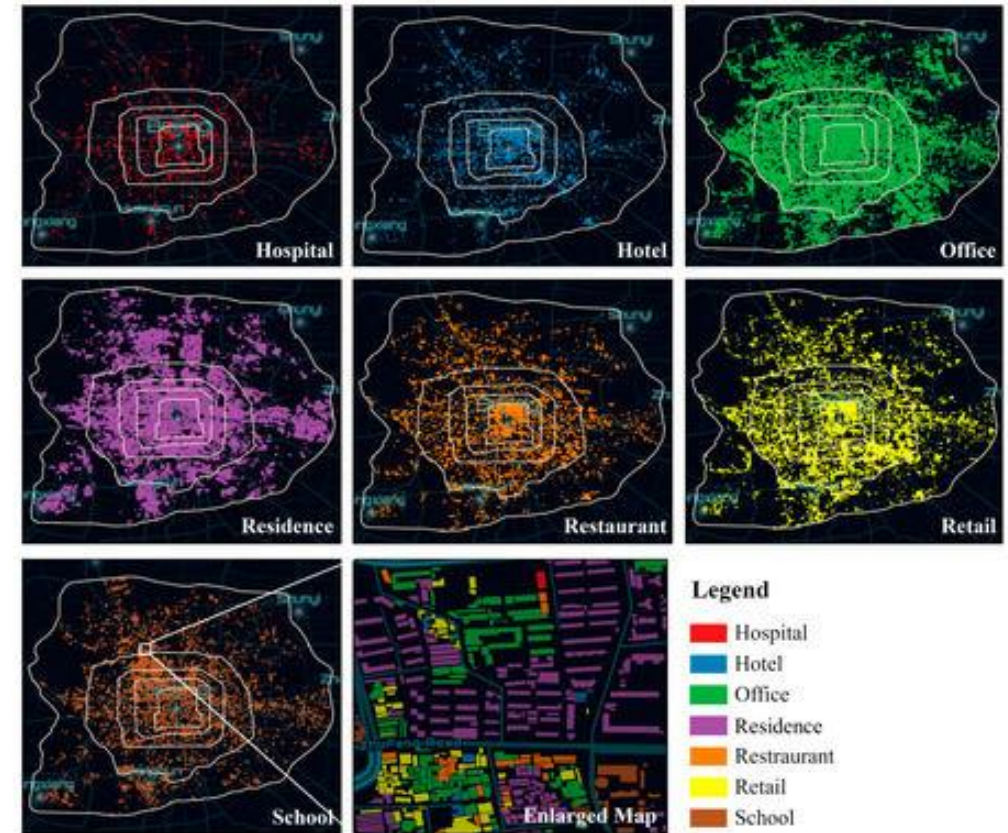
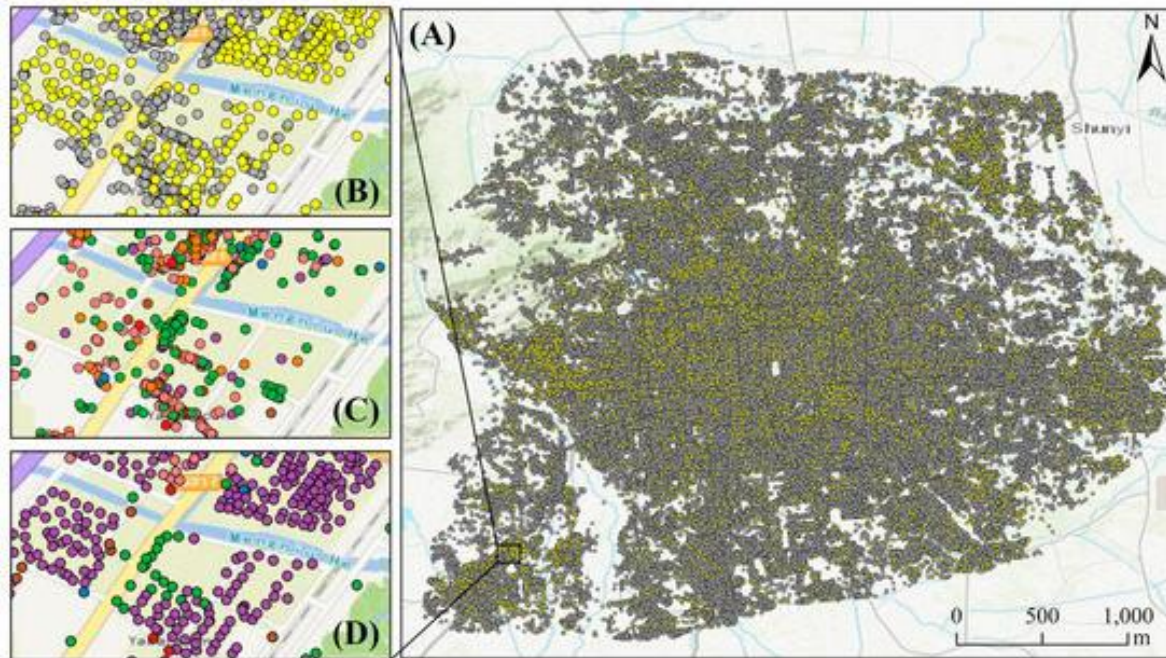
Neighbourhood types, building statistics



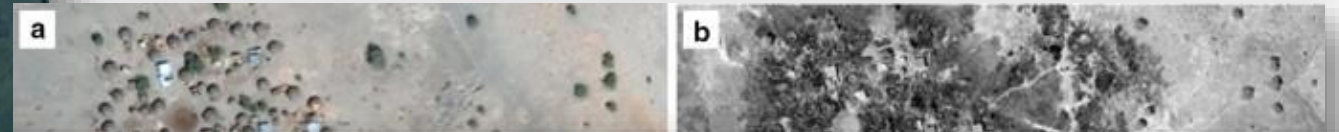
Residential status



Building type



Abandoned settlements



Finding inhabited settlements and tracking vaccination progress: the application of satellite imagery analysis to guide the immunization response to confirmation of previously-undetected, ongoing endemic wild poliovirus transmission in Borno State, Nigeria

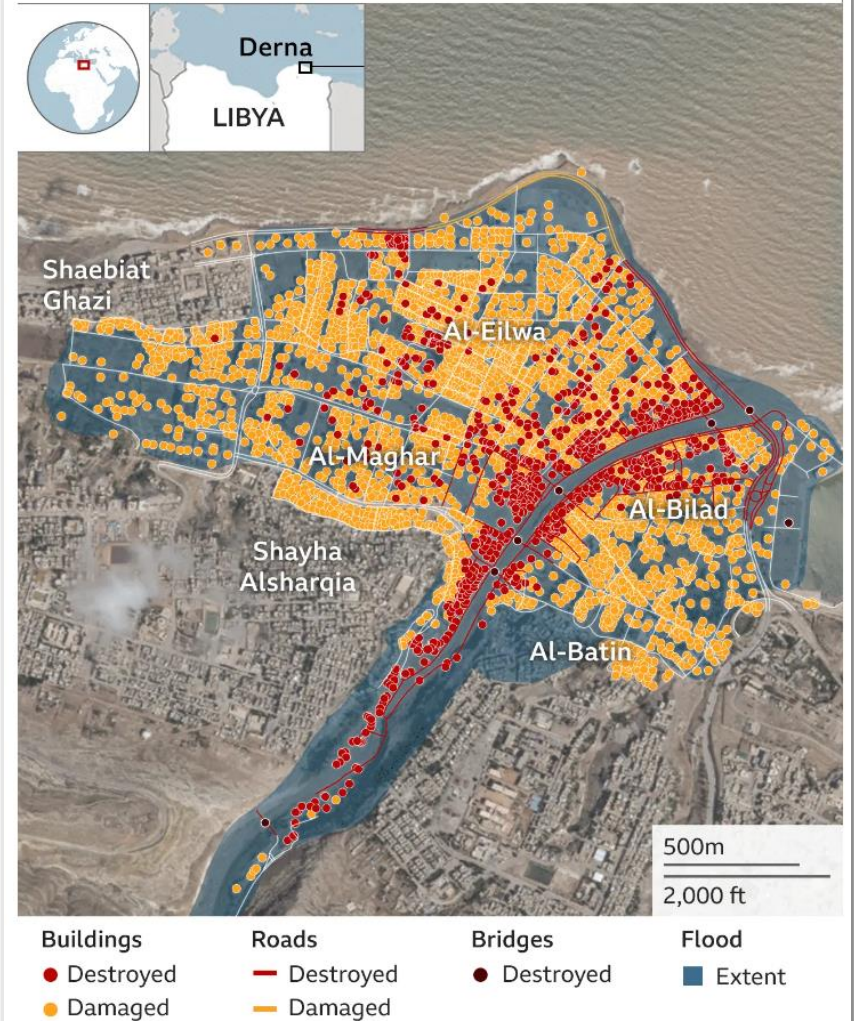
Settlement status data	Security personnel field data		
	True	False	
True	1064	186	PPV = 85.1%
False	70	311	NPV = 81.6%
	Sensitivity = 93.8%	Specificity = 62.6%	Accuracy = 84.3%

PPV positive predictive value, *NPV* negative predictive value

Building damage mapping

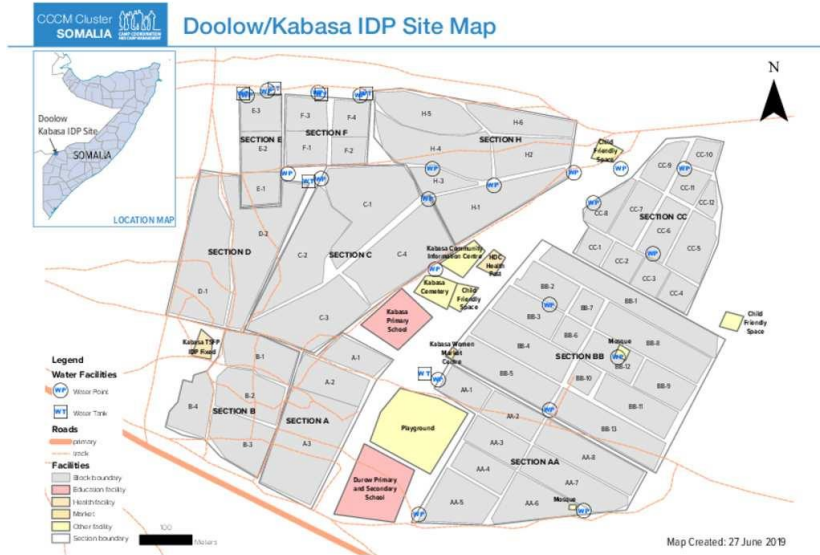
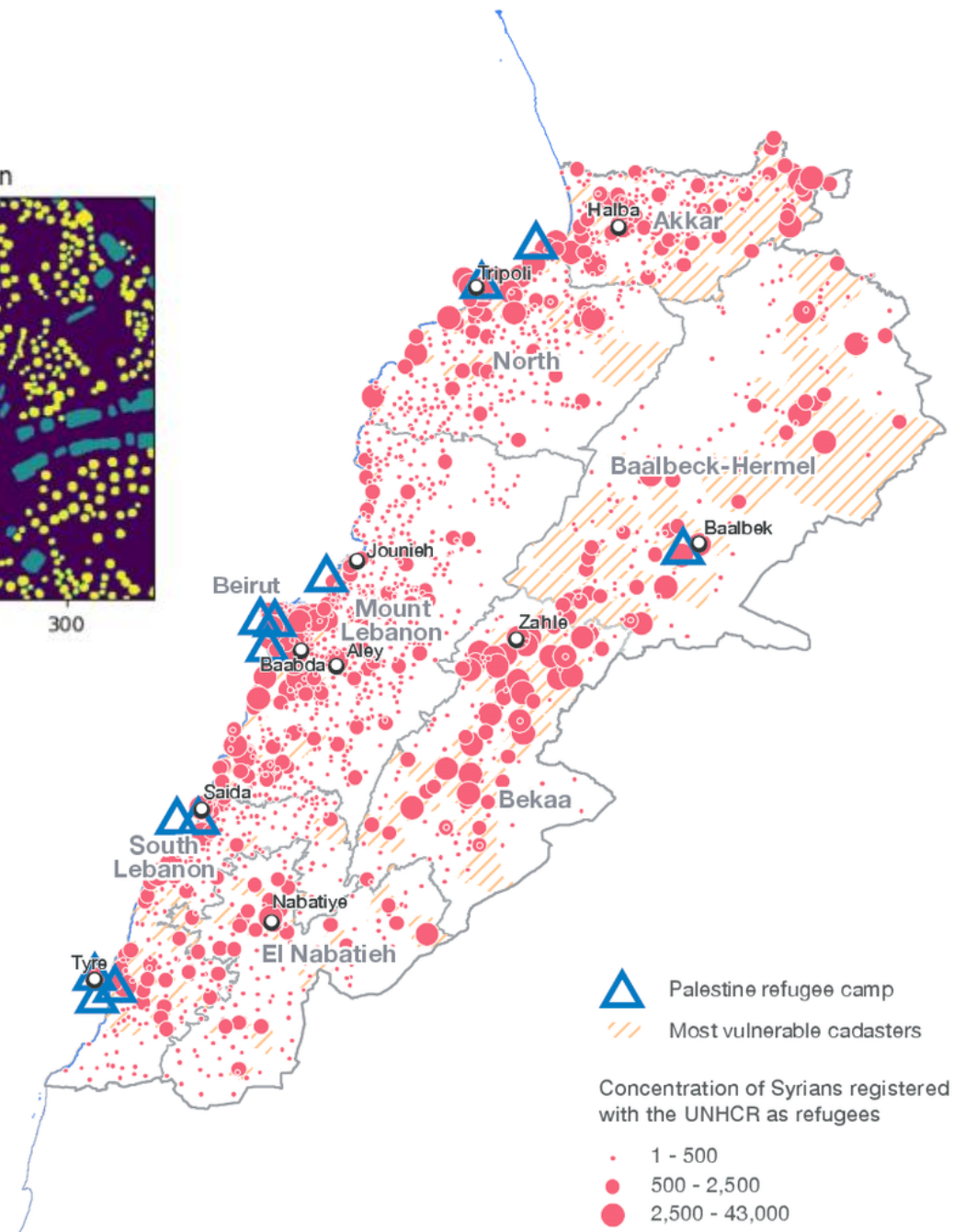
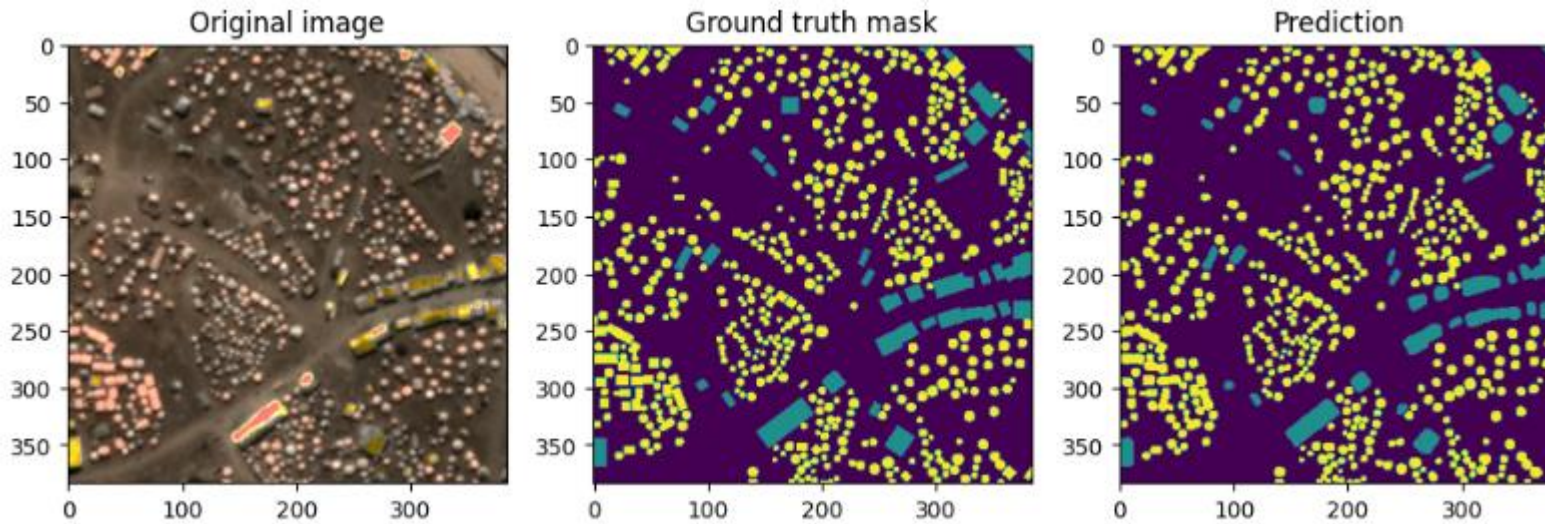


Damage and destruction in Derna

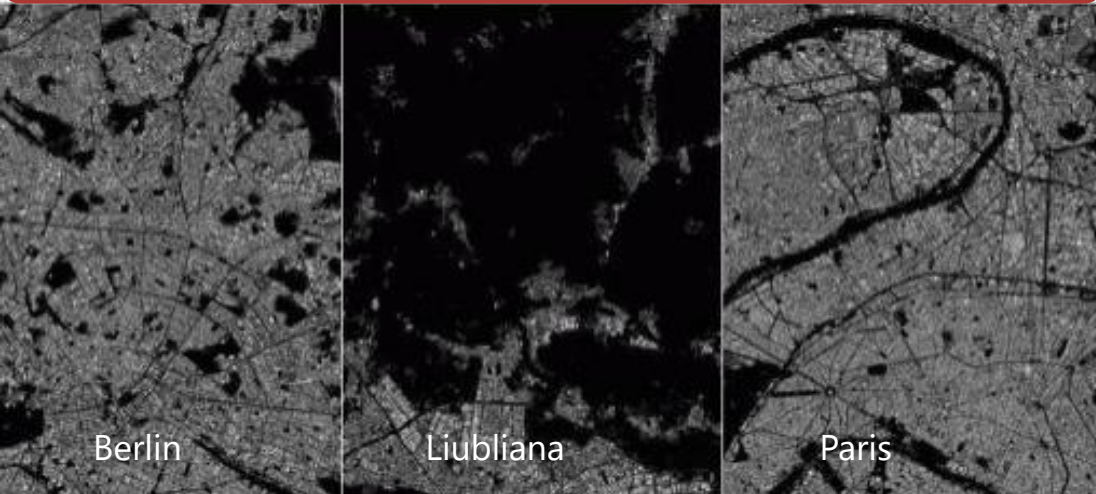


Source: Planet Labs, Copernicus EMS Rapid Mapping, 14 September 2023 **B B C**

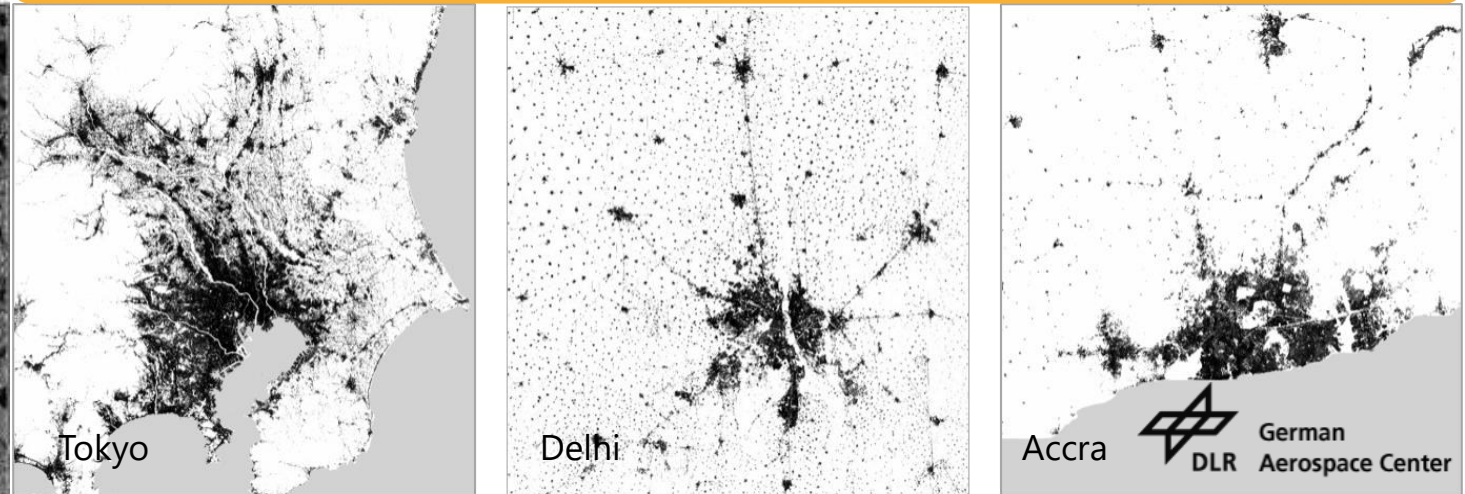
Refugee camp data



Global Human Settlement Layer



World Settlement Footprint

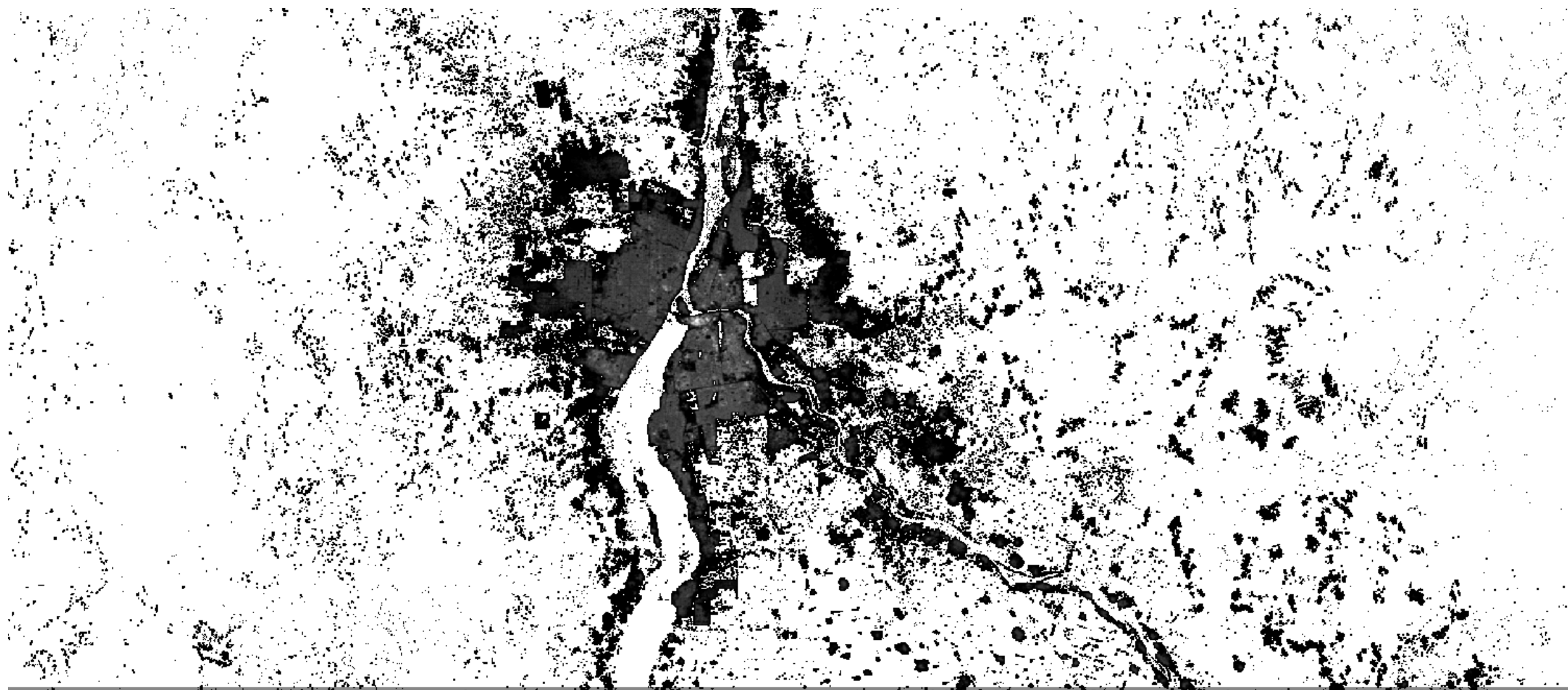


OpenStreetMap



Global open datasets

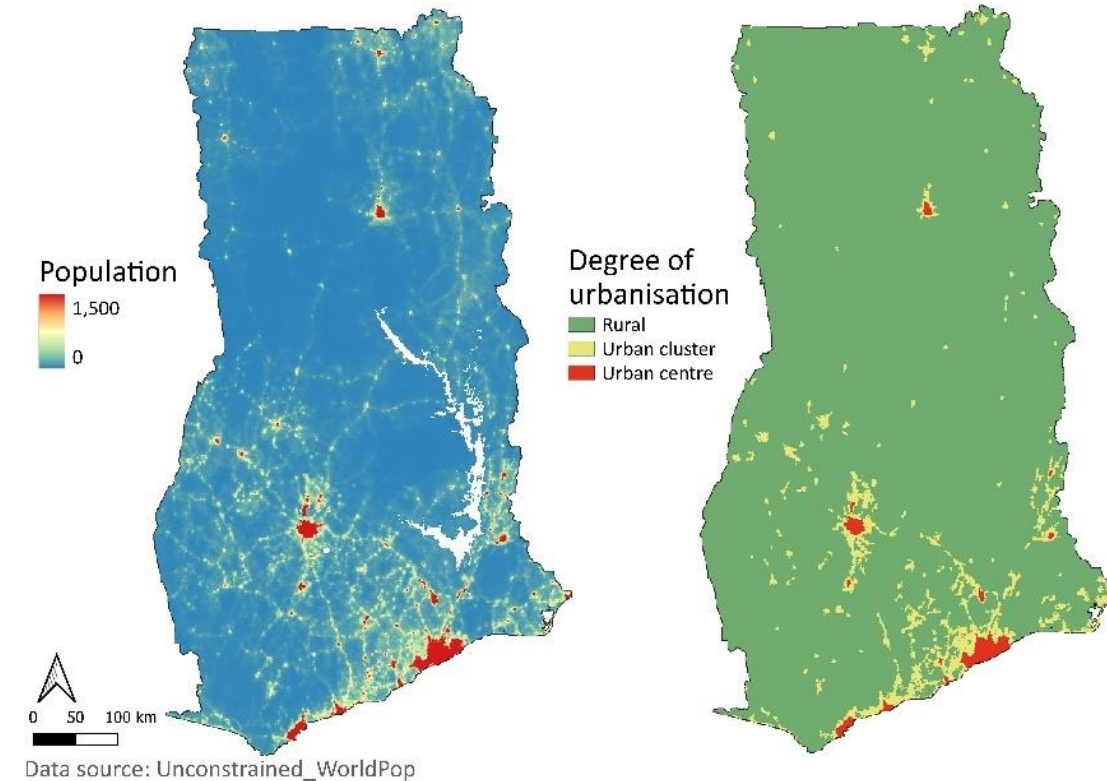
Animation of settlement growth



Khartoum, Sudan 2015

Degree of Urbanisation

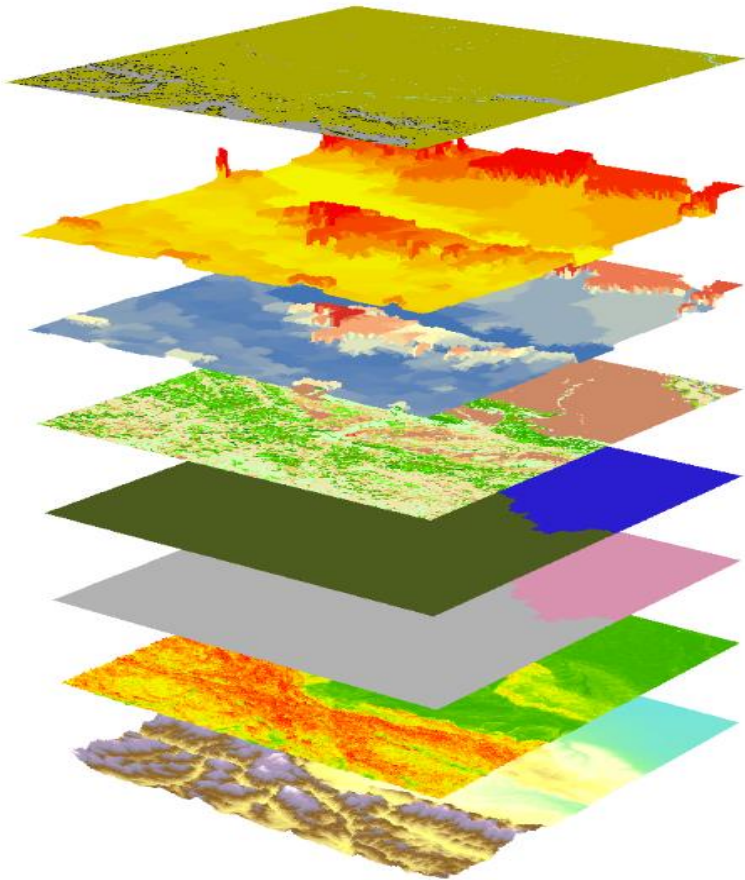
- A settlement classification based on population density, size and contiguity
- An internationally harmonised classification of the urban-rural continuum
- Developed for **international comparison**, endorsed by the United Nations Statistical Commission in March 2020
- It is designed to **complement, not replace**, the national definitions used by statistical offices
- Detailed website with **open source, easy to use tools and documentation**:
<https://ghsl.jrc.ec.europa.eu/degurba.php>



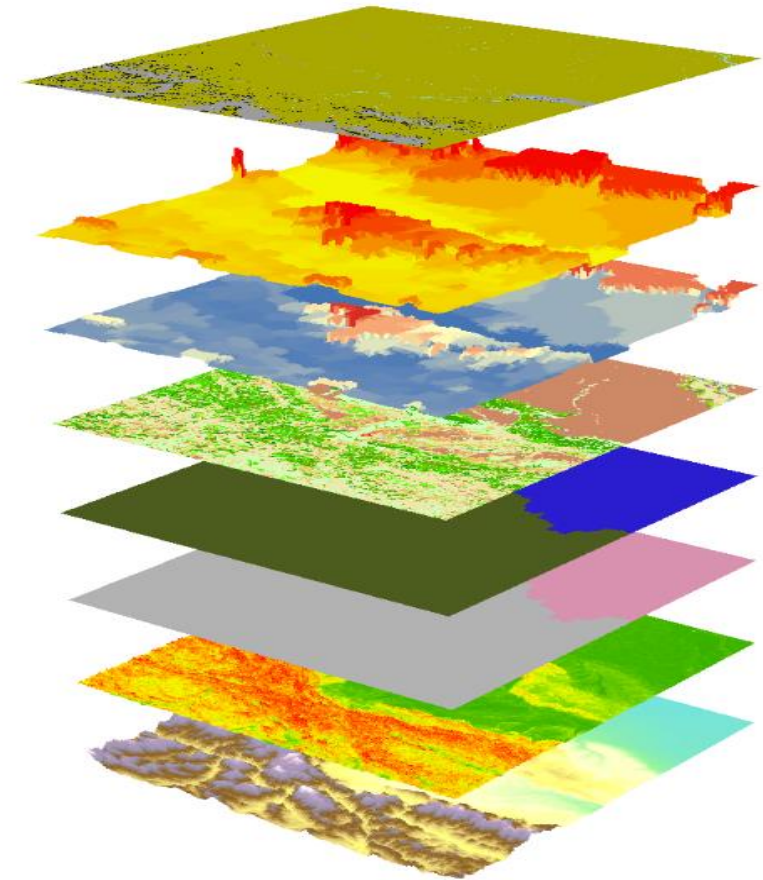
Example Ghana: From population grid to settlement grid.



Capturing the drivers and correlates of demographic variations



Building density/height, remoteness, topography, distance to markets, land cover, infrastructure density, household sizes, ethnicity, religion, livestock densities, climate, waterpoints, building type....and more....!



WorldPop

Geospatial library






BIG EARTH DATA
2019, VOL. 3, NO. 2, 108–139
<https://doi.org/10.1080/20964471.2019.1625151>



DATA ARTICLE

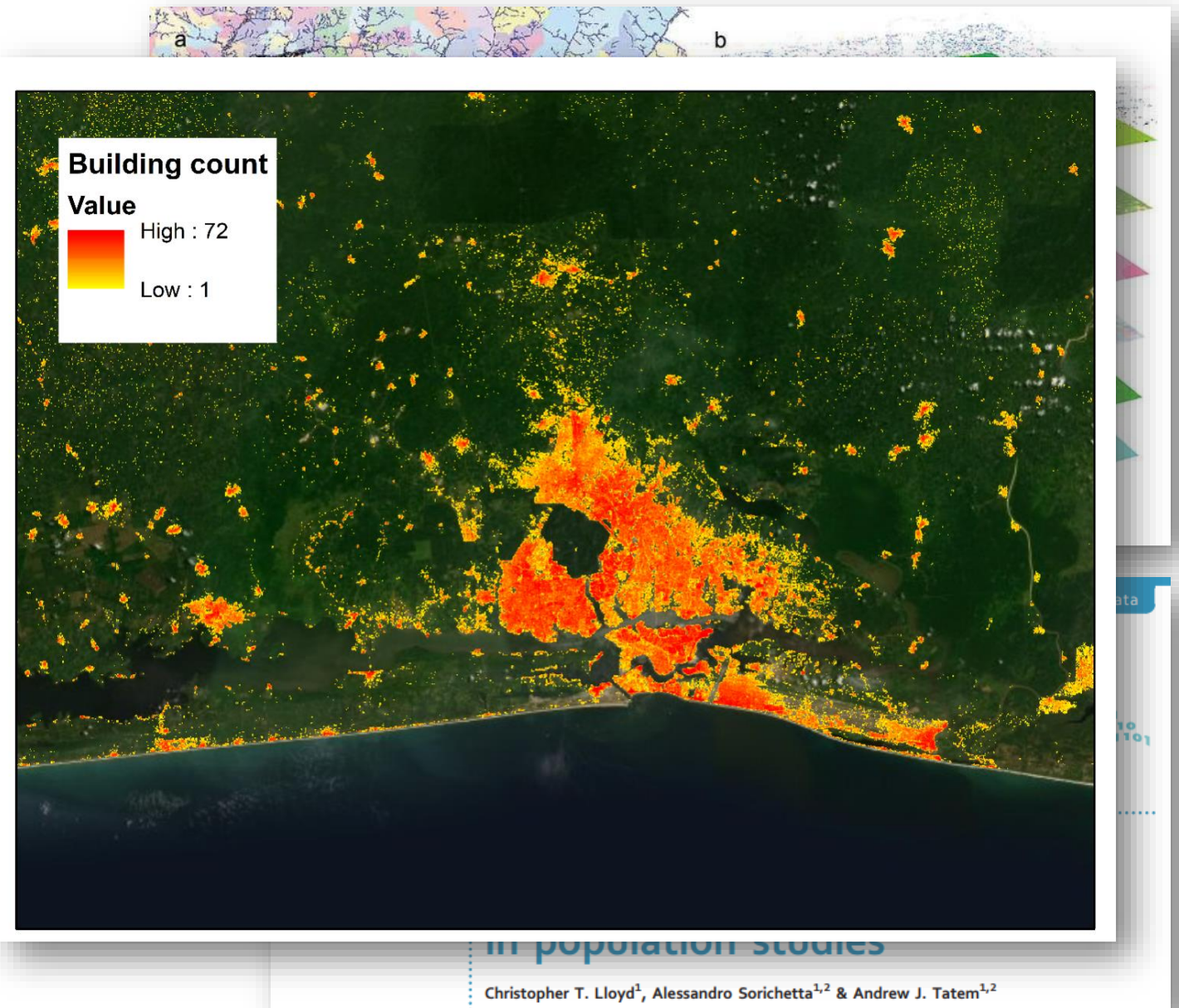


Global spatio-temporally harmonised dataset of high-resolution gridded population distribution

Christopher T. Lloyd ^a, Heather Chamberlain^{a,b}, David Kerr^a, Linda Pistoletti^c, Forrest R. Stevens ^d, Andrea E. Gaughan^d, J. Graeme Hornby ^{a,e}, Kytt MacManus^c, Parmanand Sinha^d, Massimo Alessandro Sorichetta ^a and Andrew J. Tatem ^{a,b}

^aWorldPop, School of Geography and Environmental Science, University of Southampton, UK; ^bFlowminder Foundation, Stockholm, Sweden; ^cCenter for International Earth Science Information Network (CIESIN), Columbia University, Palisades, NY, USA; ^dDepartment of Geography, University of Louisville, Louisville, KY, USA; ^eGeoData, University of Southampton

www.worldpop.org



Questions?

WorldPop