AI for Good Discovery Series

20 January 2026, 16:00 – 17:00 CET

Mapping Connectivity for Saving Lives

An Introduction to the Early Warning Connectivity Map (EWCM)

Vanessa Gray, Head, Climate Change and Emergency Telecommunication Division, ITU
Sharell Maureen Sherman, Liberia Telecommunications Authority (LTA)
Caleb Robinson, Principal Research Scientist, Microsoft AI for Good Lab
Paul Hamilton, GIS Expert, Climate Change and Emergency Telecommunication Division, ITU

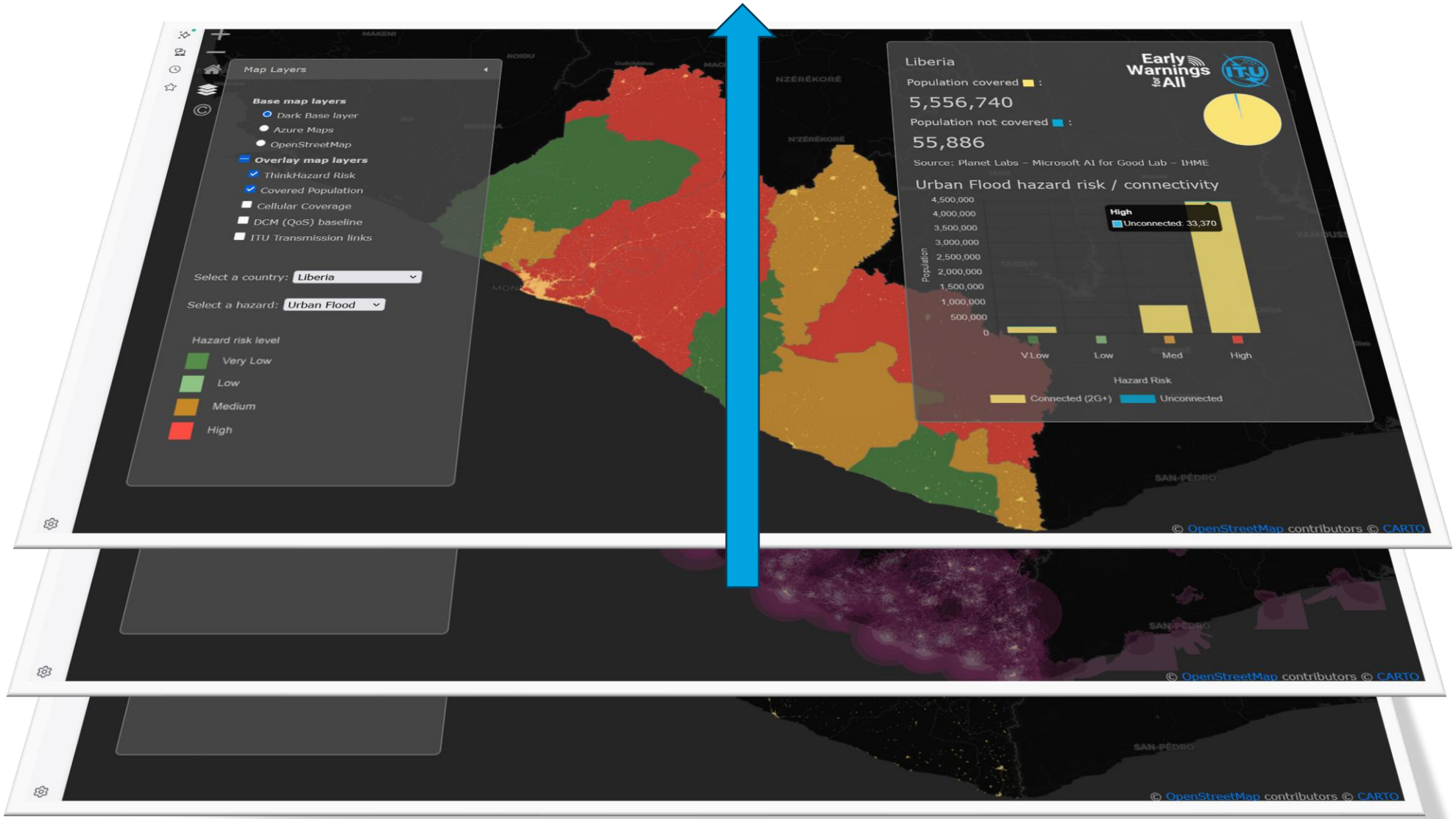
Early Warning Connectivity Map (EWCM)

Identify **connectivity coldspots** where people are at risk of natural hazards but cannot receive early warning messages because they live in places beyond the reach of fixed broadband, 2G and 3G+ networks

Hazard datasets

Connectivity and coverage datasets

Population density dataset




Microsoft
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IHME
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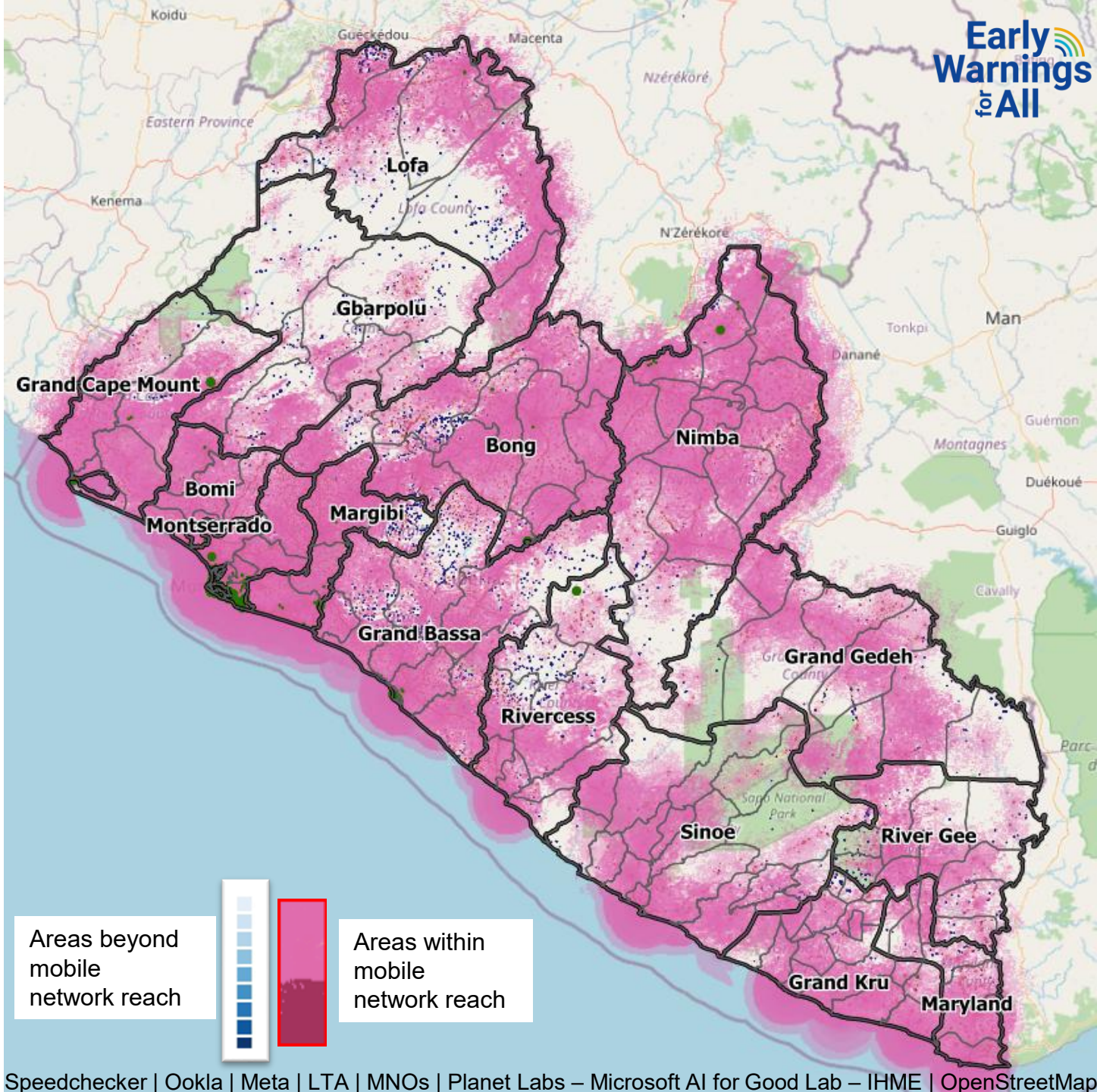
AI for Good Impact

The spill-over effect of the EW4All data

Sharell Maureen Sherman

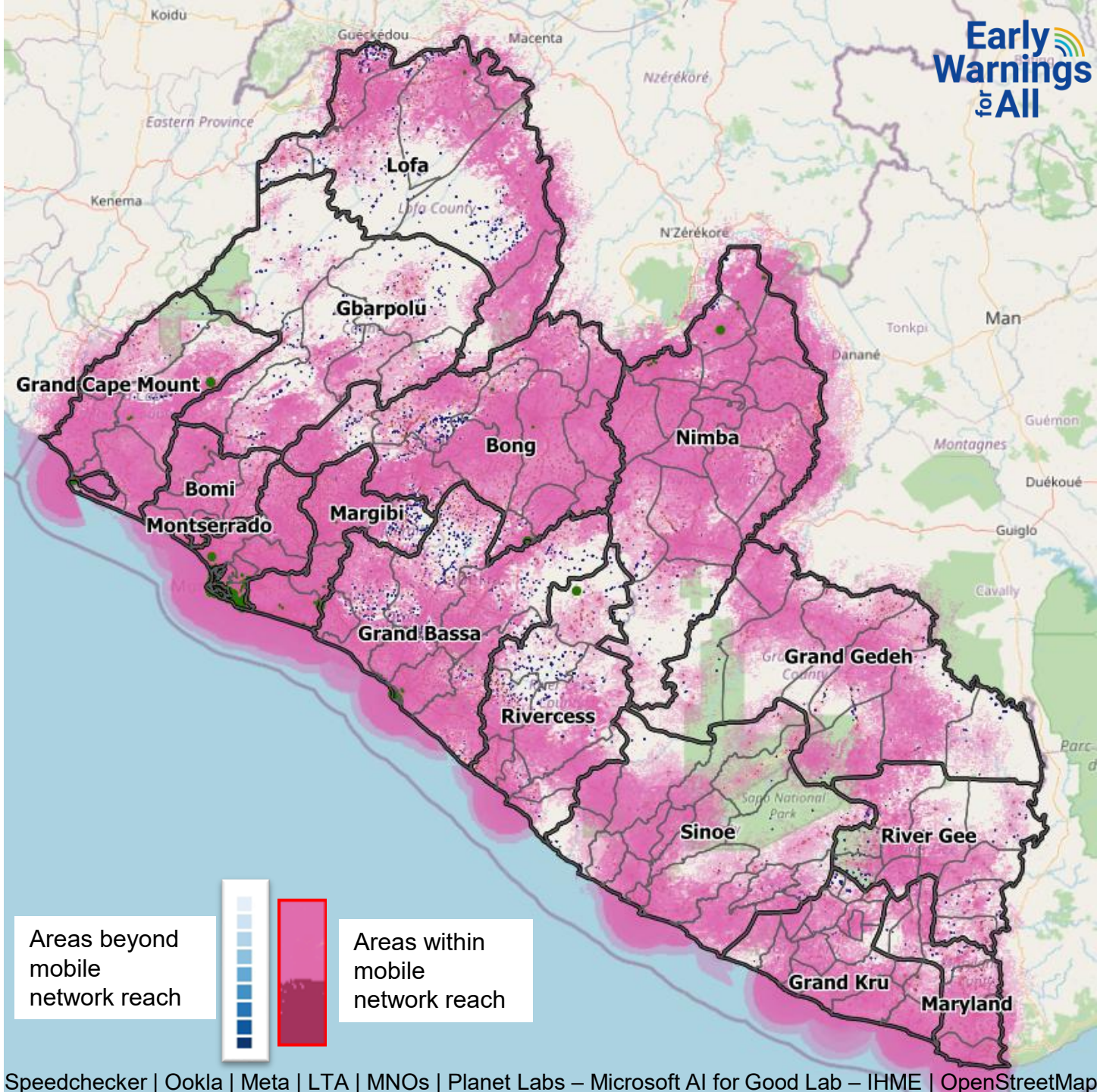
FOCAL POINT FOR TELECOM/ ICT DATA- LIBERIA TELECOMMUNICATIONS AUTHORITY/LTA



Liberia is one of the countries in West Africa selected to be part of the ITU EW4ALL project which focuses on effective early warning in disaster management.

- The project in Liberia is still in the initial phase. Most recently, last year December 2025, there was a workshop held by ITU for relevant stakeholders in disaster management. Participants were taken through the CAP Alert Training (Common Alerting Protocol) and the road map for Liberia highlighted included- the need to develop a National Emergency Telecom Plan, stakeholder mapping and governance to mention a few.

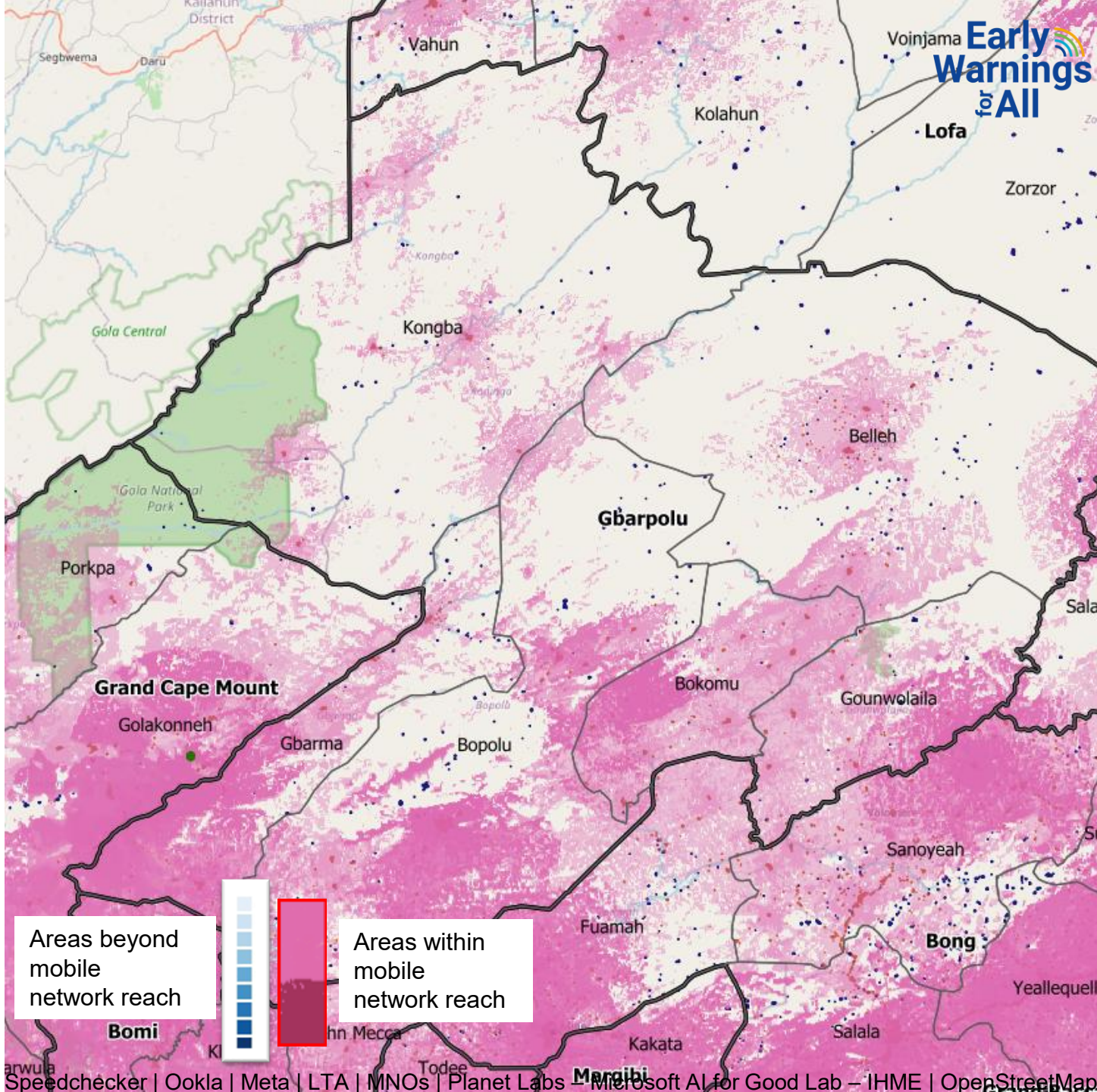
- Through the ITU EW4ALL project, the Early Warning Connectivity Map has been completed as part of the connectivity assessment for effective cell broadcast. The data provides information on places where people can't receive early warning messages and people exposed to medium and high-risk floods for example. This evidence is relevant for government prioritizing resilience and network expansion.



Exhibit/Example: Coverage in Districts in Gbarpolu County

- **Data shows : Coverage is critically needed in Belleh, Kongba, Bopolu, Gounwolaila and Gbarma.** These areas seem to have more people living in places beyond the reach of cellular networks/Offline.
- **Ground truth exercise** for verification and drive tests would therefore need to be carried out in order to take decisions regarding improvement of coverage in these districts.

County	2G	3G	4G	Offline/ No coverage
Gbarpolu	**85.3%**	**28.9%**	**34.6%**	**14.4%**
Belleh	66.6%	0.1%	0.0%	33.3%
Bokomu	99.3%	5.7%	11.4%	0.7%
Bopolu	84.3%	55.1%	70.5%	15.2%
Gbarma	94.2%	52.5%	44.6%	5.8%
Gounwolaila	85.5%	5.7%	10.9%	13.3%
Kongba	81.2%	0.0%	0.0%	18.8%

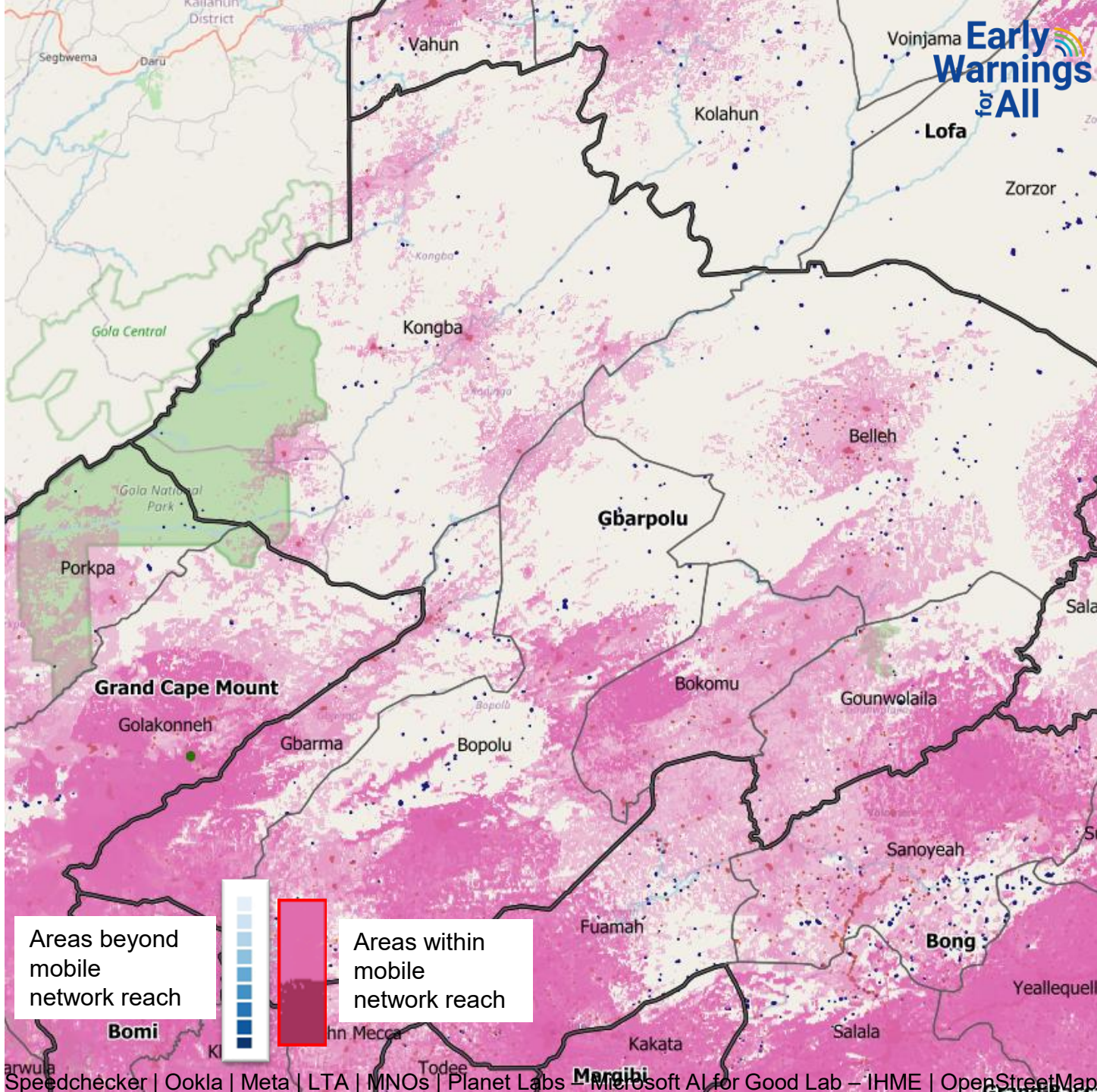


The Spill-over Effect/ Impact

- For Liberia, the data from the EW4All map has generated wider benefits beyond disaster early warning. Although the primary purpose of the EW4ALL data/tool is to support timely and accurate early warnings that help protect lives and property, the data and analytics developed for EW4ALL is also supporting improvements in other areas like:

- **Public service delivery.** E.g. Universal Access strategies: EW4ALL data showed that there are approx.. 73 districts spanning 11 of 15 counties where coverage gaps are most severe. These communities are as usual - non-economically viable areas/sparsely populated/hard to reach areas.

- **ICT infrastructure planning:** The EW4ALL data has assisted in identifying challenges not caused by the lack of coverage in communities, which is the usual assumption. For instance, poor electricity, poor quality of service and capacity issues in many communities. This has added to the need for better improvement on energy, QoS and capacity in communities



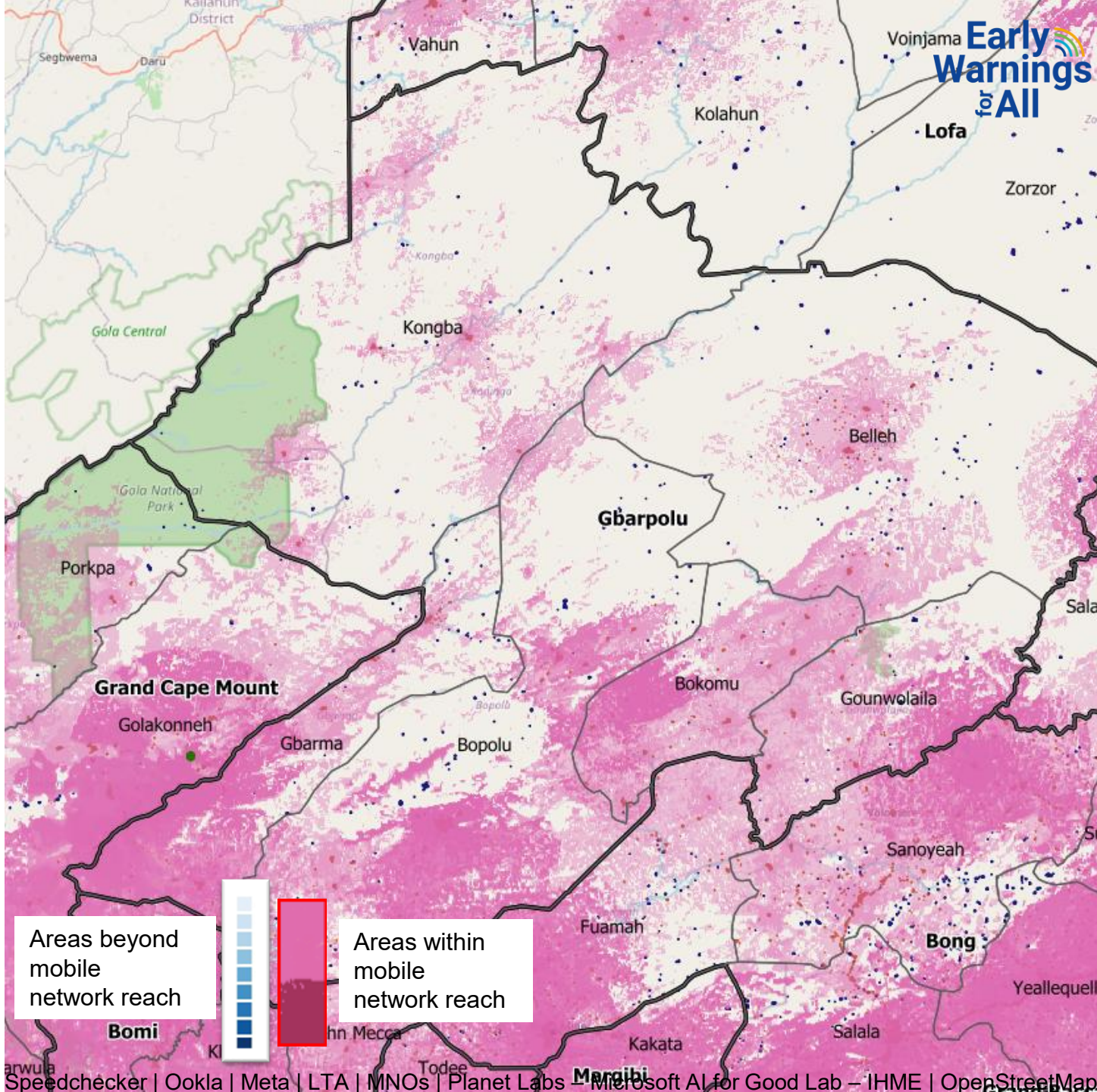
The Spill-over Effect/ Impact

Data from EW4ALL also supports:

- Institutional coordination and collaboration: Externally, EW4ALL data has assisted our current collaboration with other projects e.g. the ITU GIGA school connectivity.
- Internally, it has led to improvement in internal coordination between staff of the engineering, universal access and data divisions within the agency, on infrastructure initiatives for instance.
- It is expected that there would be Institutional coordination with the meteorological authority and other disaster management agencies, promoting interoperability between sectors as the EW4ALL project advances in Liberia.

FUN FACT:

- It may seem very simplistic but the EW4ALL maps generated a lot of excitement. The maps have been highly effective in communicating results. Key stakeholders were pleased to see pictorials of the extent of national coverage, pictorials of cold spots. Many could relate to the visuals instead of just figures which was the case in the past.

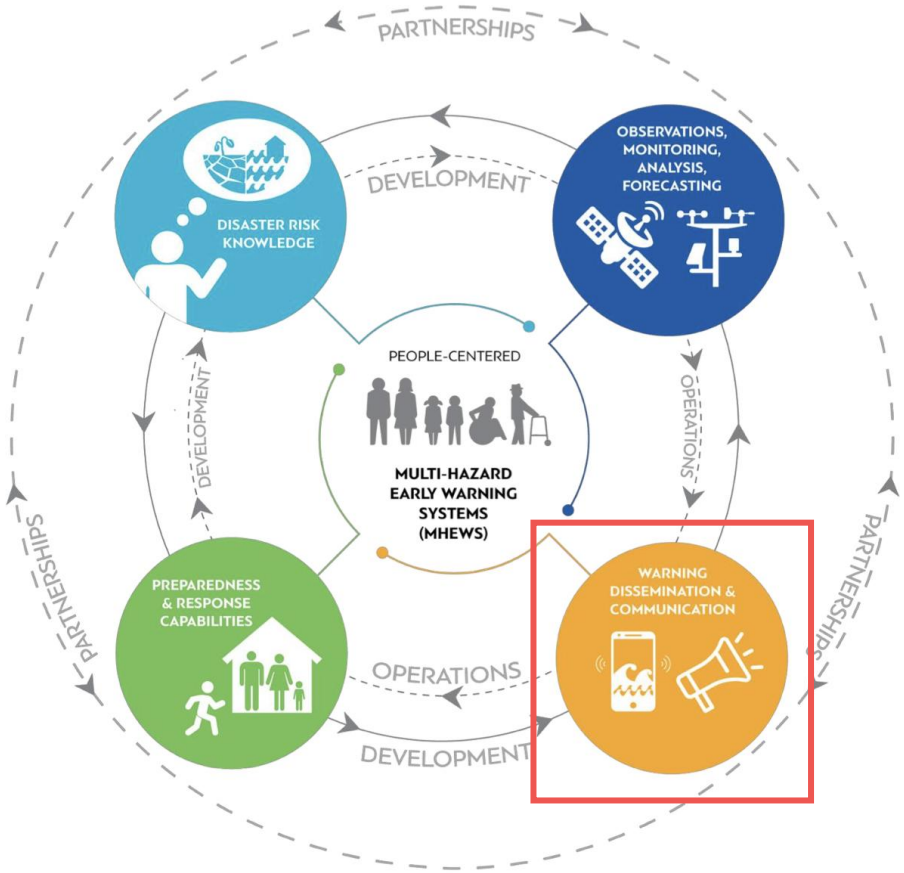


UN Early Warning for All (EW4All) Initiative

Under the UN Secretary-General's Early Warnings for All initiative (EW4All),

ITU is working to ensure early warnings reach people at risk…

…by identifying connectivity gaps, hazards and vulnerable populations



FOUR pillars of EW4All initiative, ITU leads Pillar 3: Warning Dissemination and Communication

Population beyond the reach of mobile networks

97.9%
of the world population is covered by mobile network

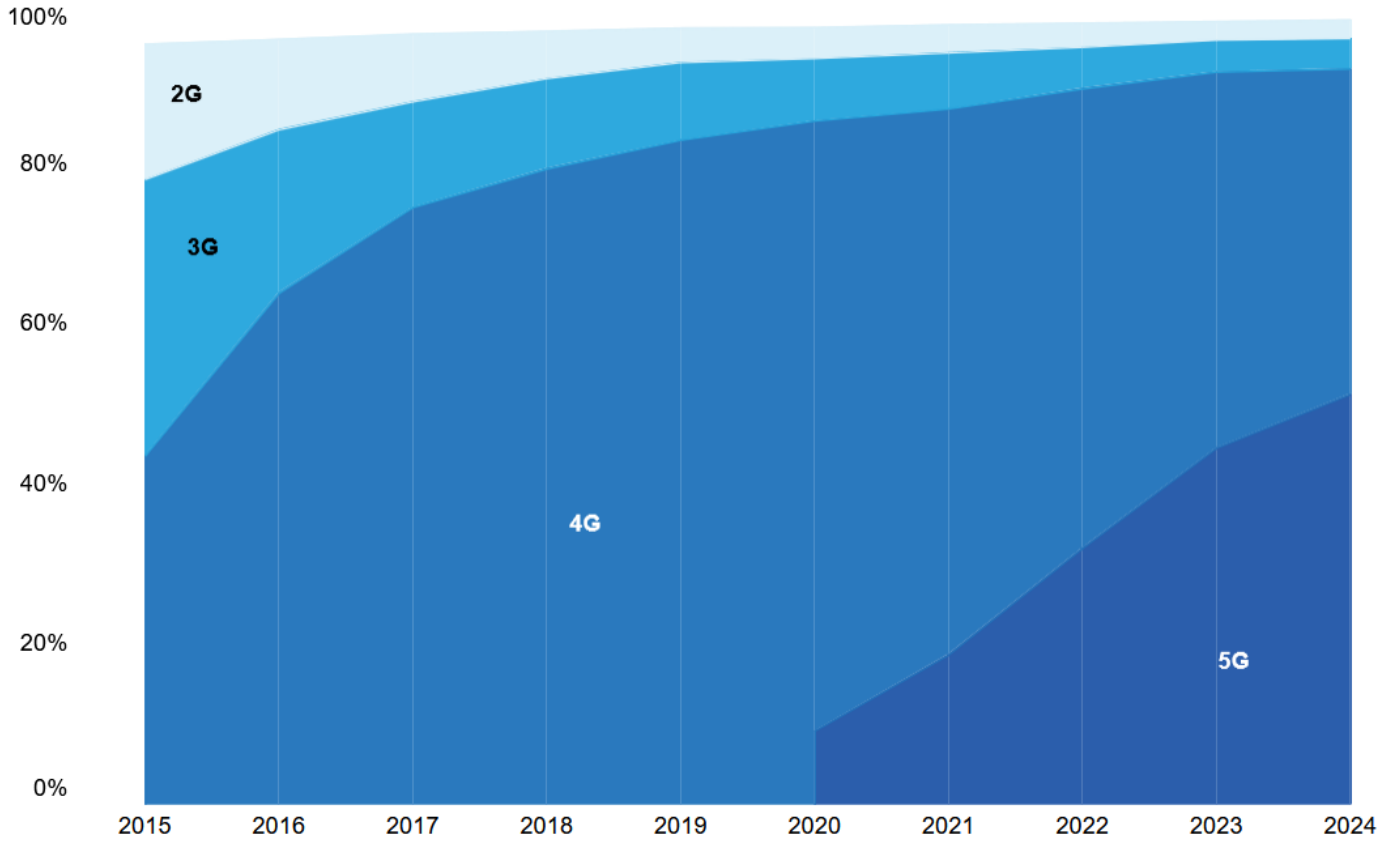
173 million (2.1%)
people beyond reach of 2G+ coverage

362 million (4.4%)
people beyond reach of 3G+ coverage

4 in 5
people own a mobile phone

yet, around 140 countries
have no inclusive mobile early warning systems

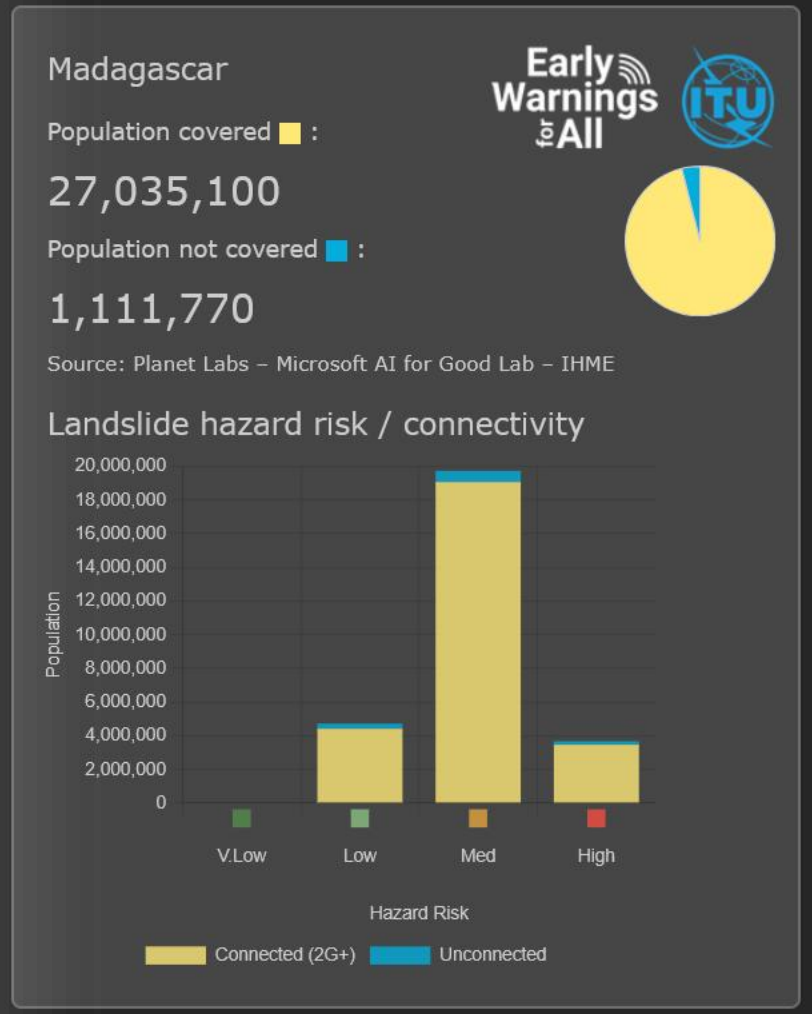
Population coverage by type of mobile network, 2015-2024



Note: The values for 2G, 3G and 4G networks show the incremental percentage of the population that is not covered by a more advanced technology network (e.g. in 2024, 96 per cent of the world population is covered by at least a 3G or above network, with 4 per cent having only 3G, 41 per cent having 4G, and 51 per cent having 5G). There are insufficient data to produce estimates for 5G coverage prior to 2020.

Development of the Early Warning Connectivity Map (EWCM)

to see where and how many people are within coverage, and where connectivity ‘coldspots’ leave populations unreachable by mobile alerts



Disclaimer: The designations employed and the presentation of material on this map do not imply the expression of any opinion whatsoever on the part of ITU and of the Secretariat of the ITU concerning the legal status of the country, territory, city or area or its authorities, or concerning the delimitation of its frontiers or boundaries.

Early Warning Connectivity Map (EWCM)

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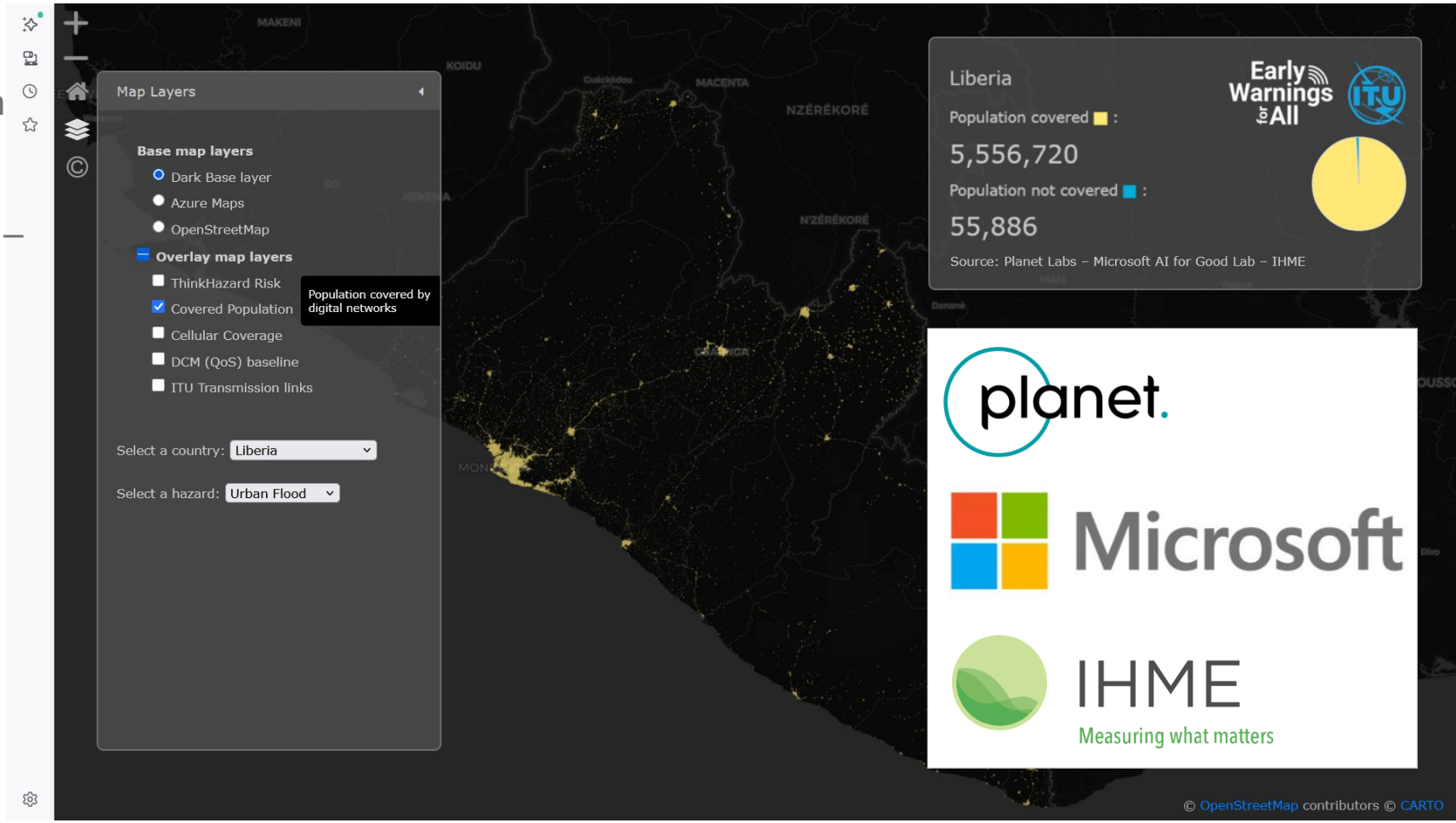

Planet Labs – Microsoft AI for Good Lab – IHME | OpenStreetMap | © CARTO

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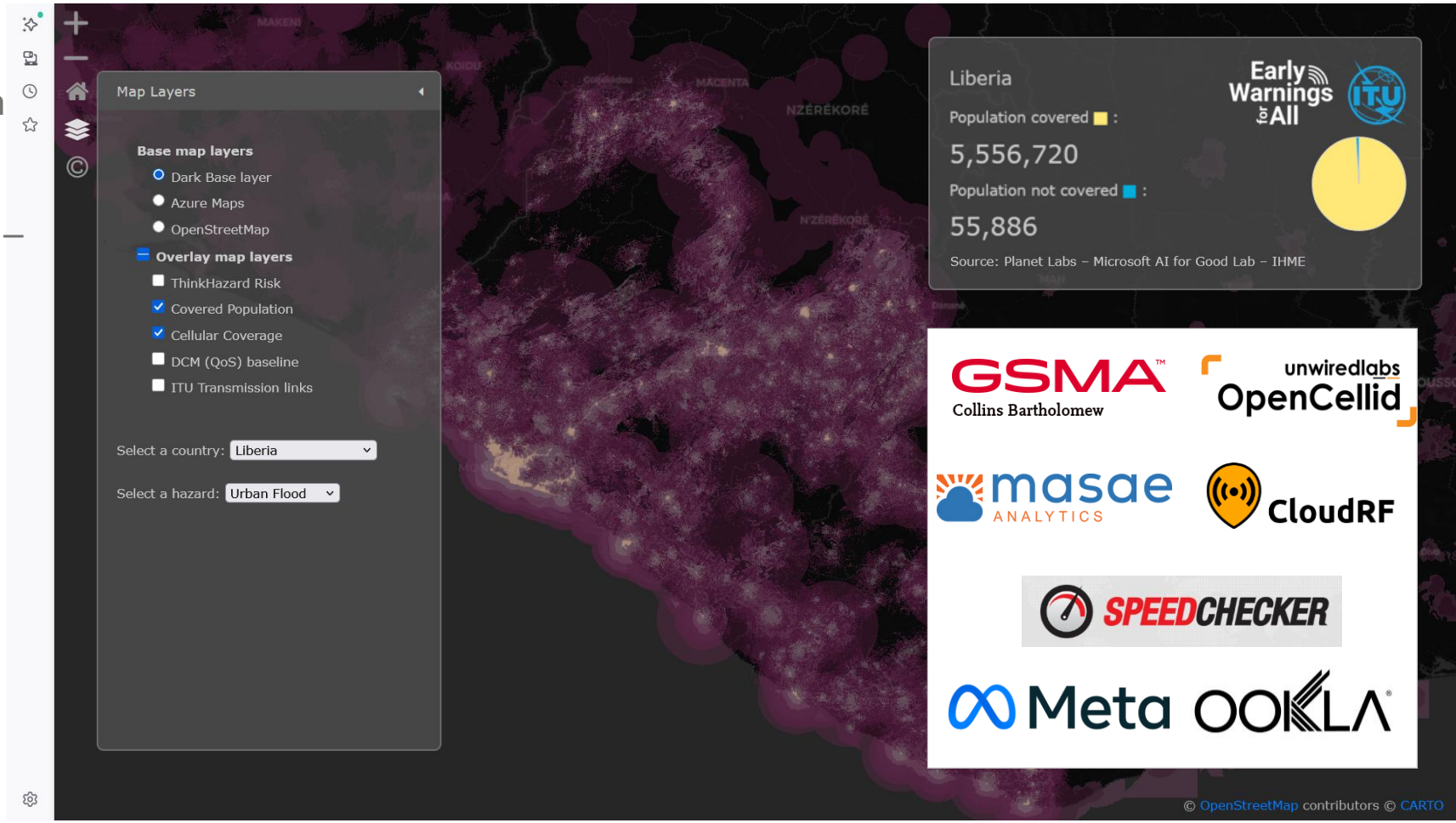

Speedchecker | Ookla | Meta | LTA | MNOs | Planet Labs – Microsoft AI for Good Lab – IHME | OpenStreetMap | © CARTO

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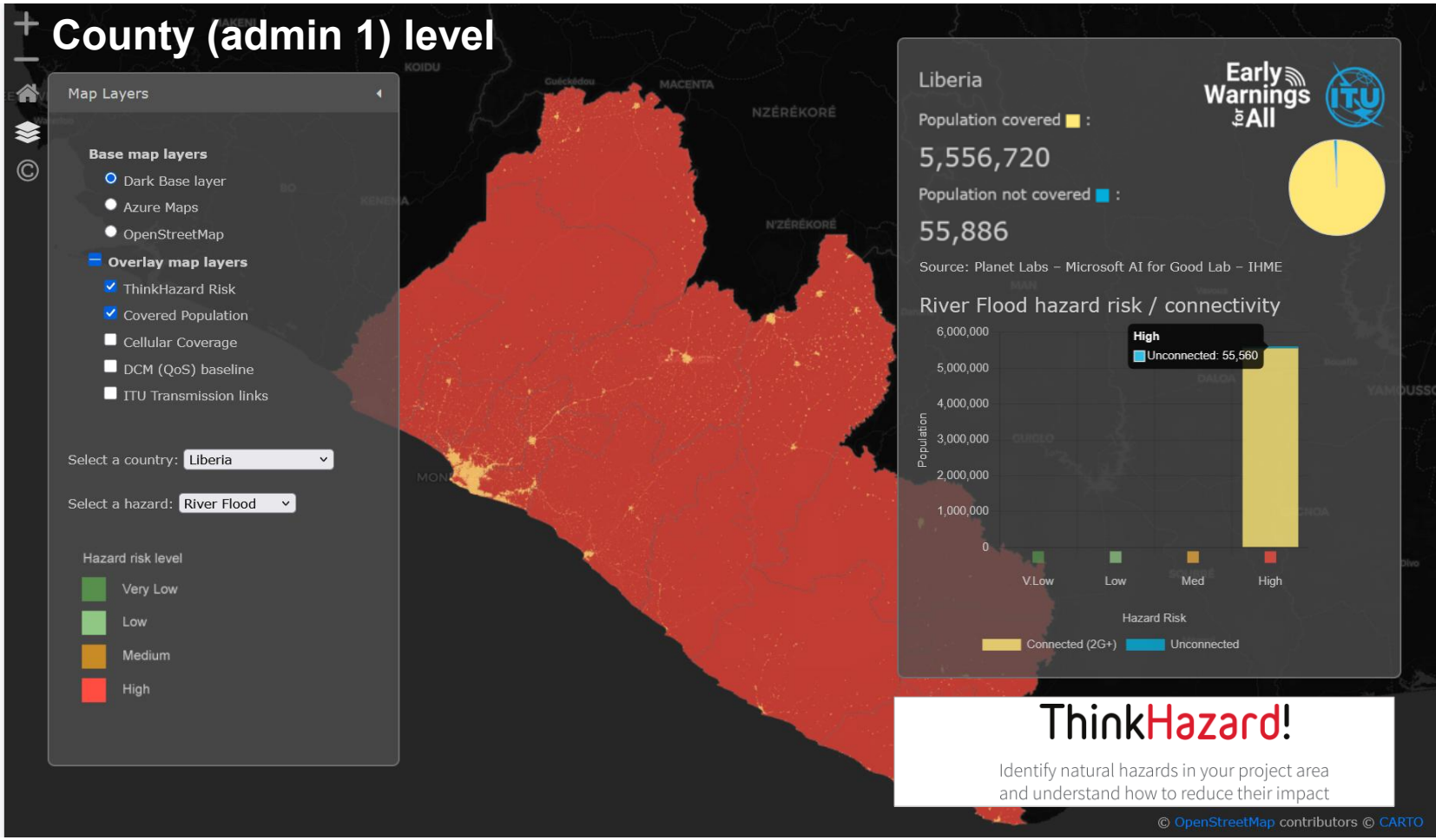

ThinkHazard! | Planet Labs – Microsoft AI for Good Lab – IHME | OpenStreetMap | © CARTO

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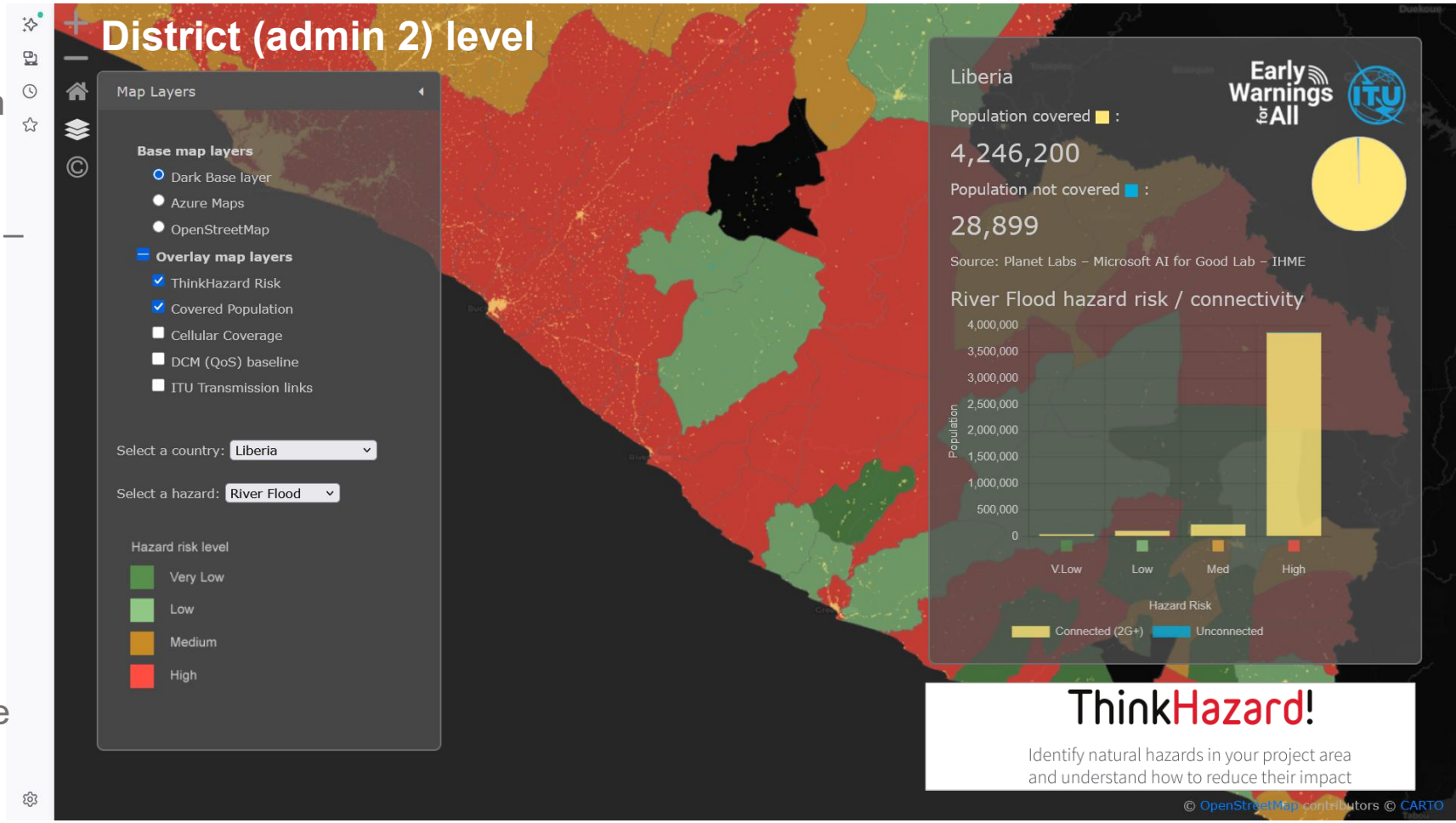

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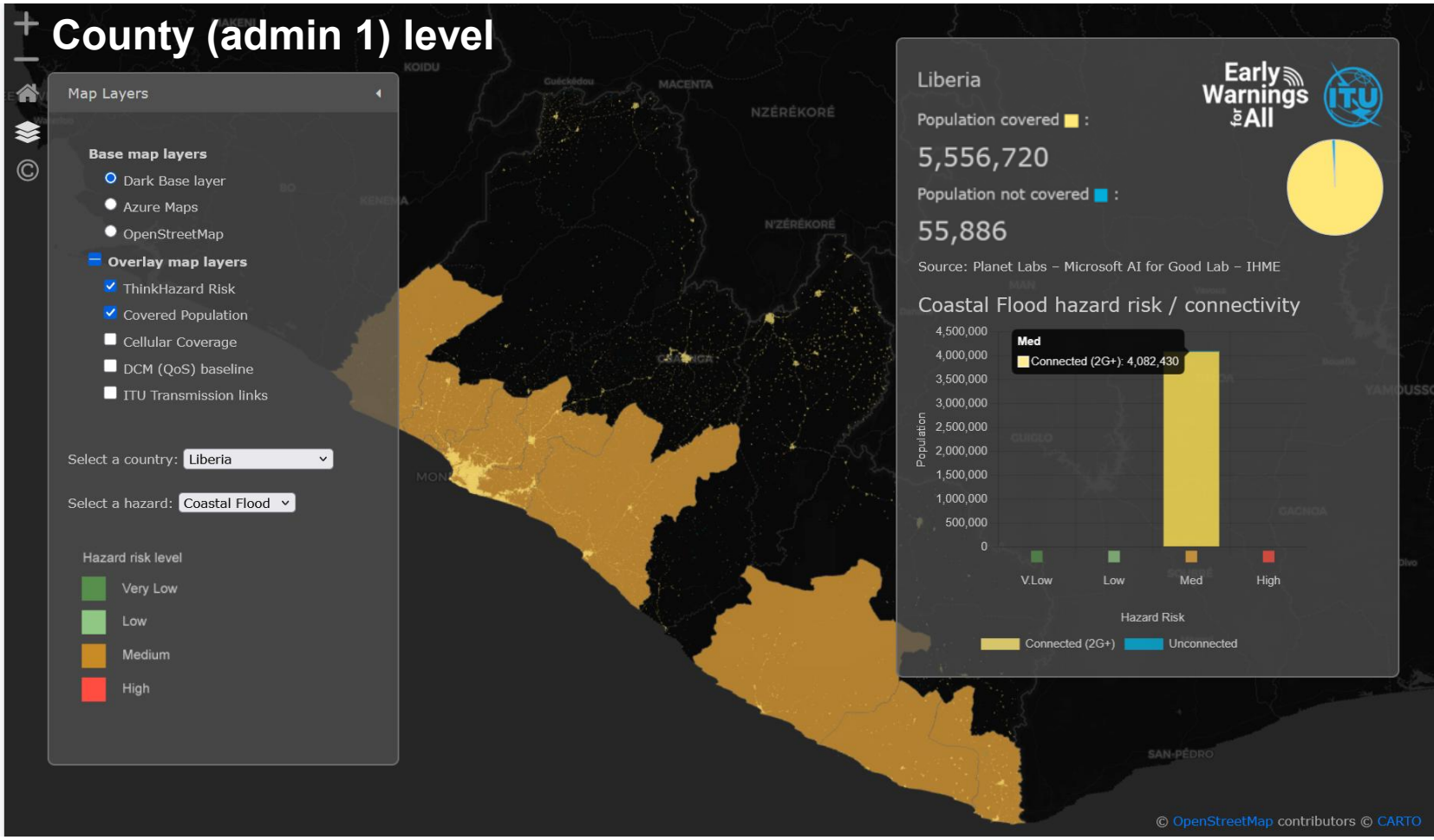

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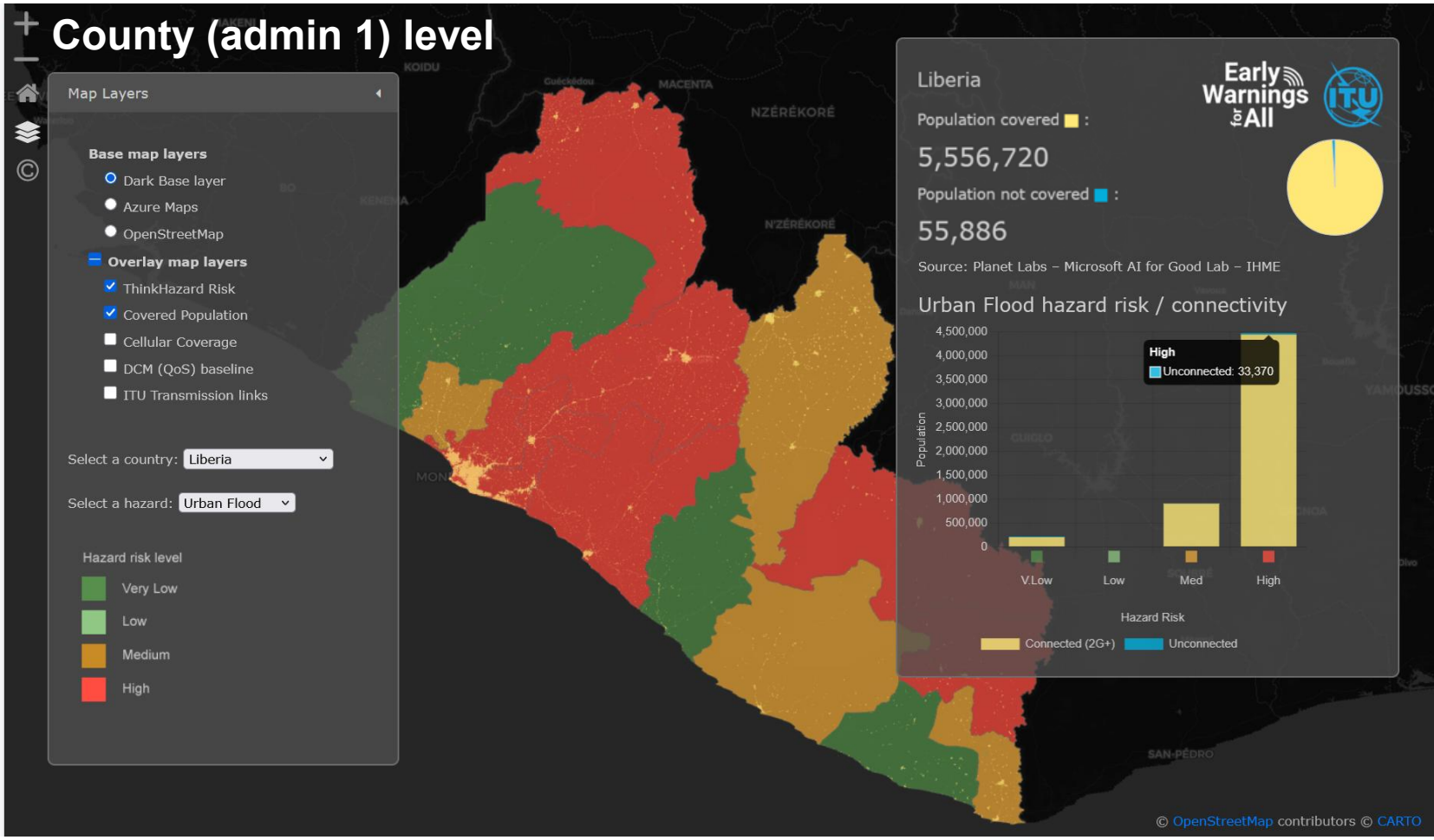
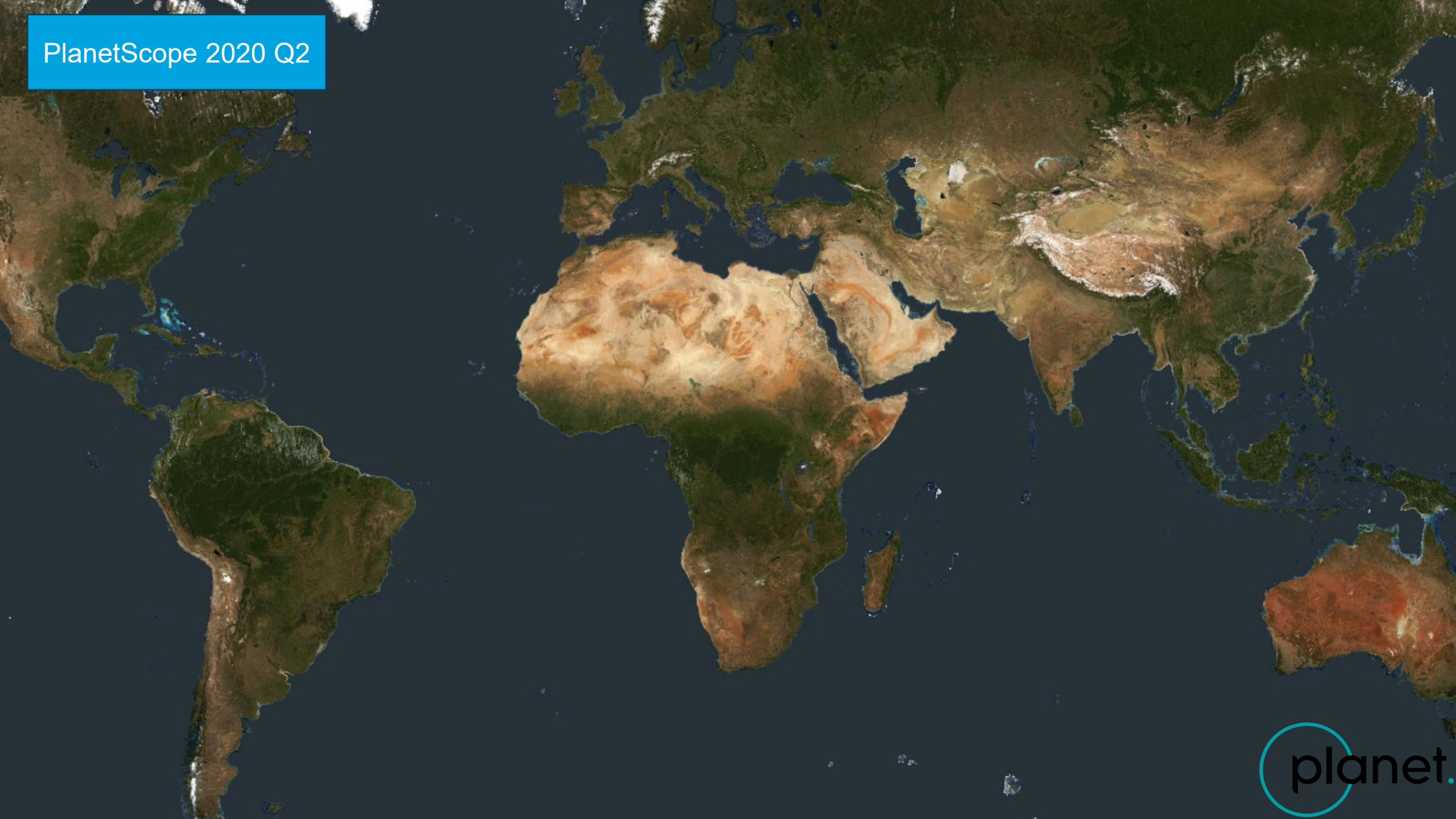


ThinkHazard! | Planet Labs – Microsoft AI for Good Lab – IHME | OpenStreetMap | © CARTO

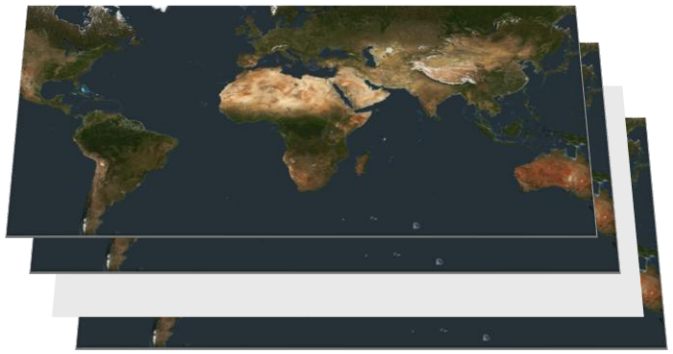
Global Building Density and Height


PlanetScope 2020 Q2
planet.


PlanetScope 2025 Q2
planet.

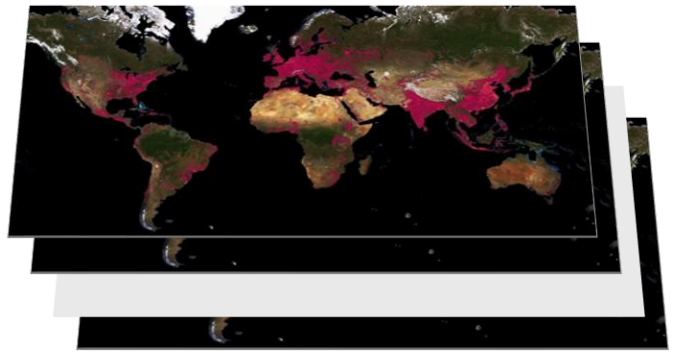
Step 1 – Generate gridded building products

Microsoft | AI for Good Lab



Quarterly satellite imagery

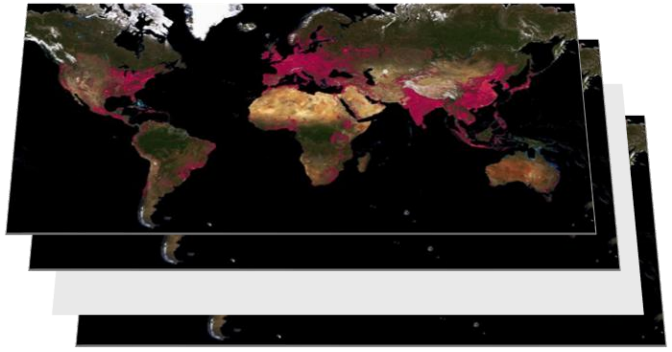
AI Model



Quarterly building density and height

Step 2 – Generate gridded population

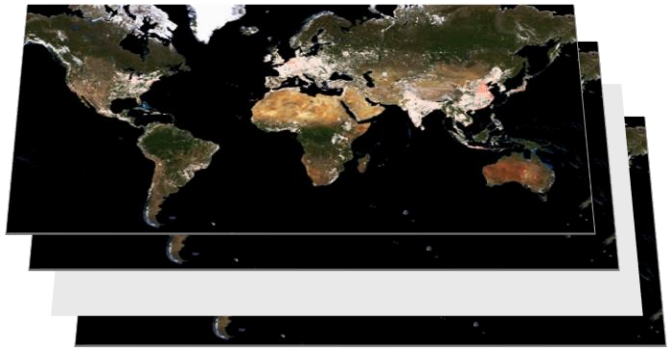
Institute for Health Metrics and Evaluation



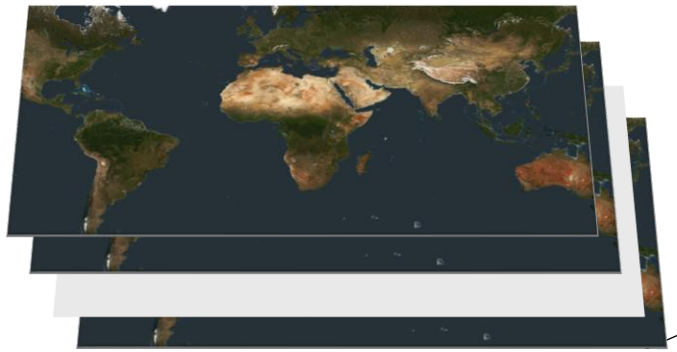
Quarterly building density and height

High-resolution quarterly population projections

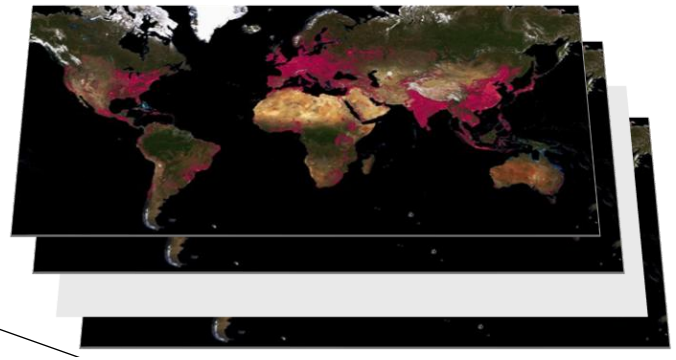
Gridded covariates



Quarterly population



AI Model



Quarterly satellite imagery

Quarterly building density and height

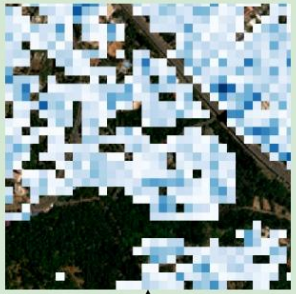
PlanetScope Basemaps / Overture Maps

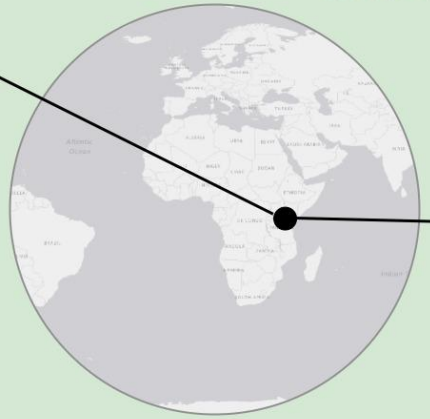
Regression Segmentation Model

Building Density Predictions

Loss

Building Density Labels



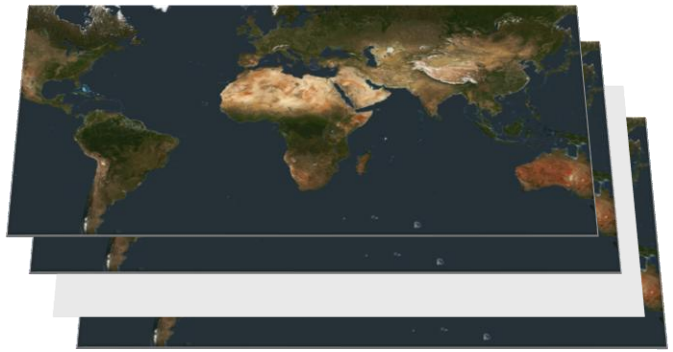


Biased sampling of training points

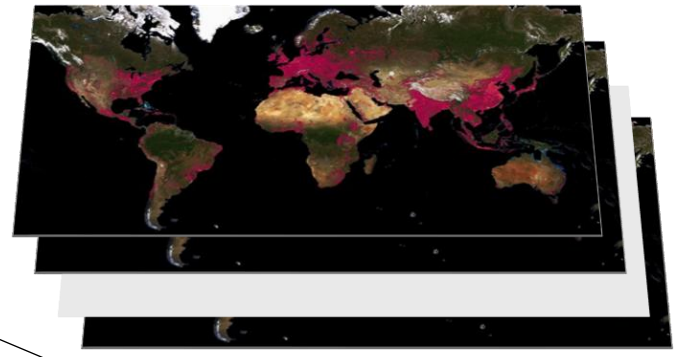
Google Buildings

Generate Weak Density Labels

Training

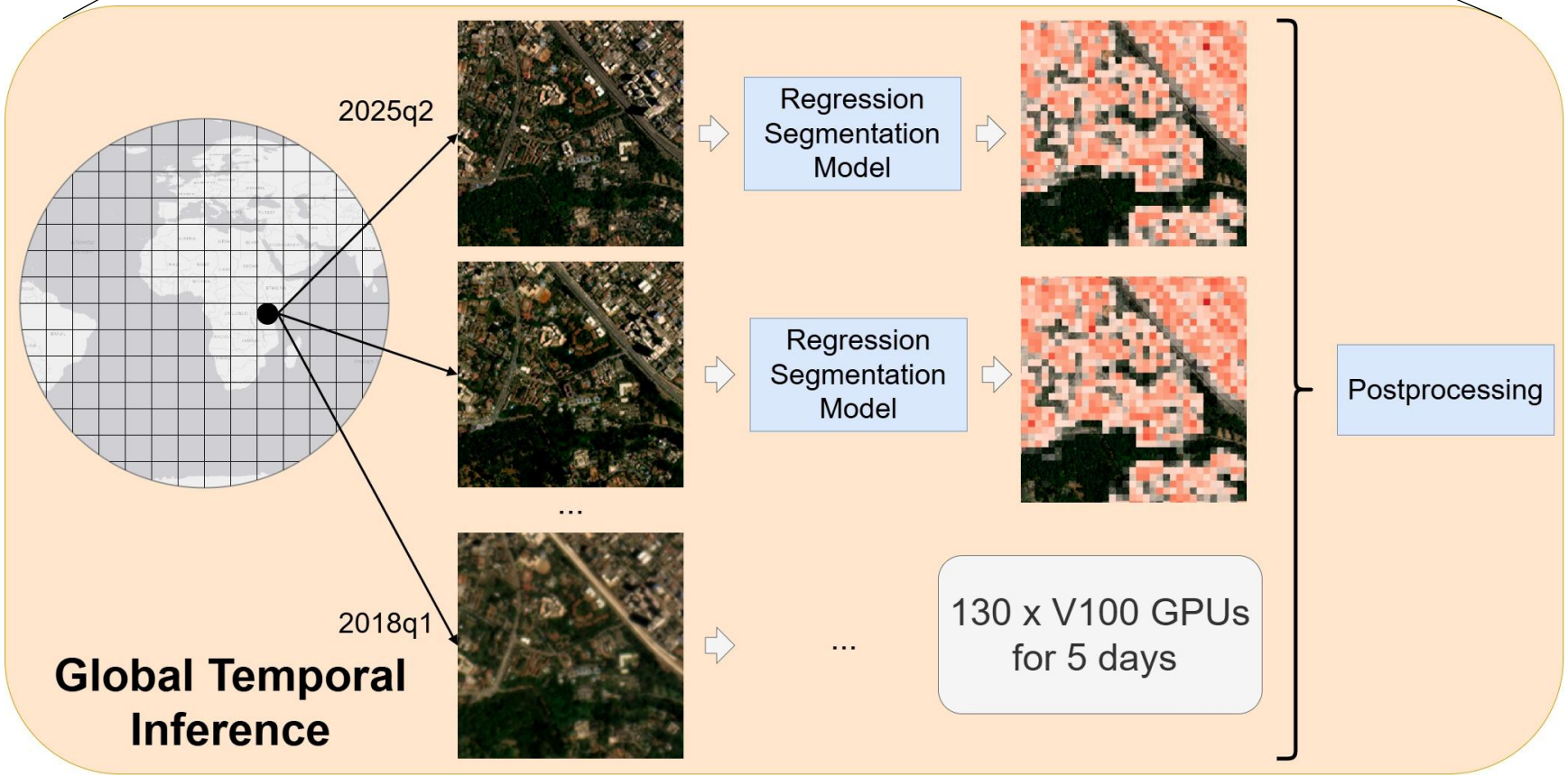


AI Model

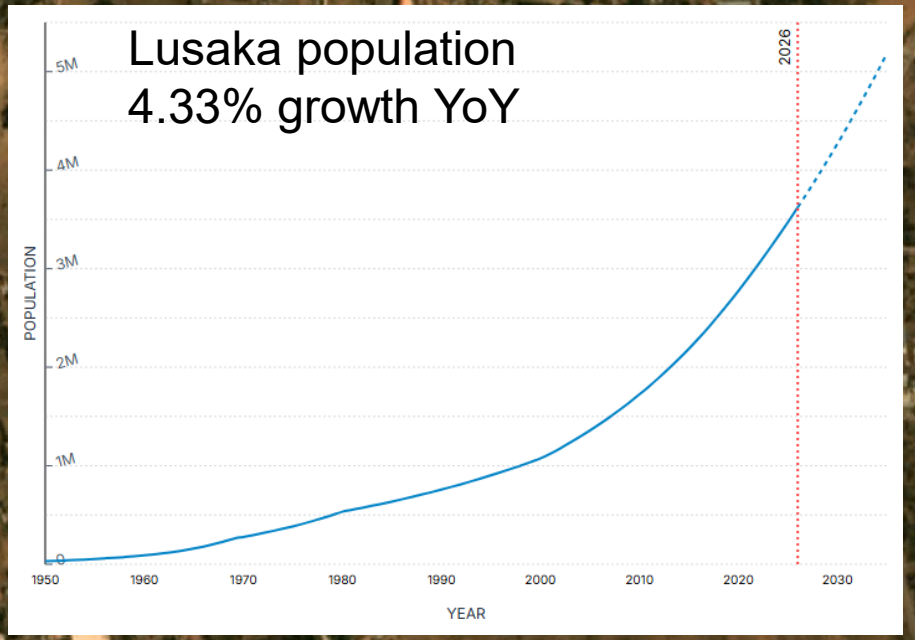


Quarterly satellite imagery

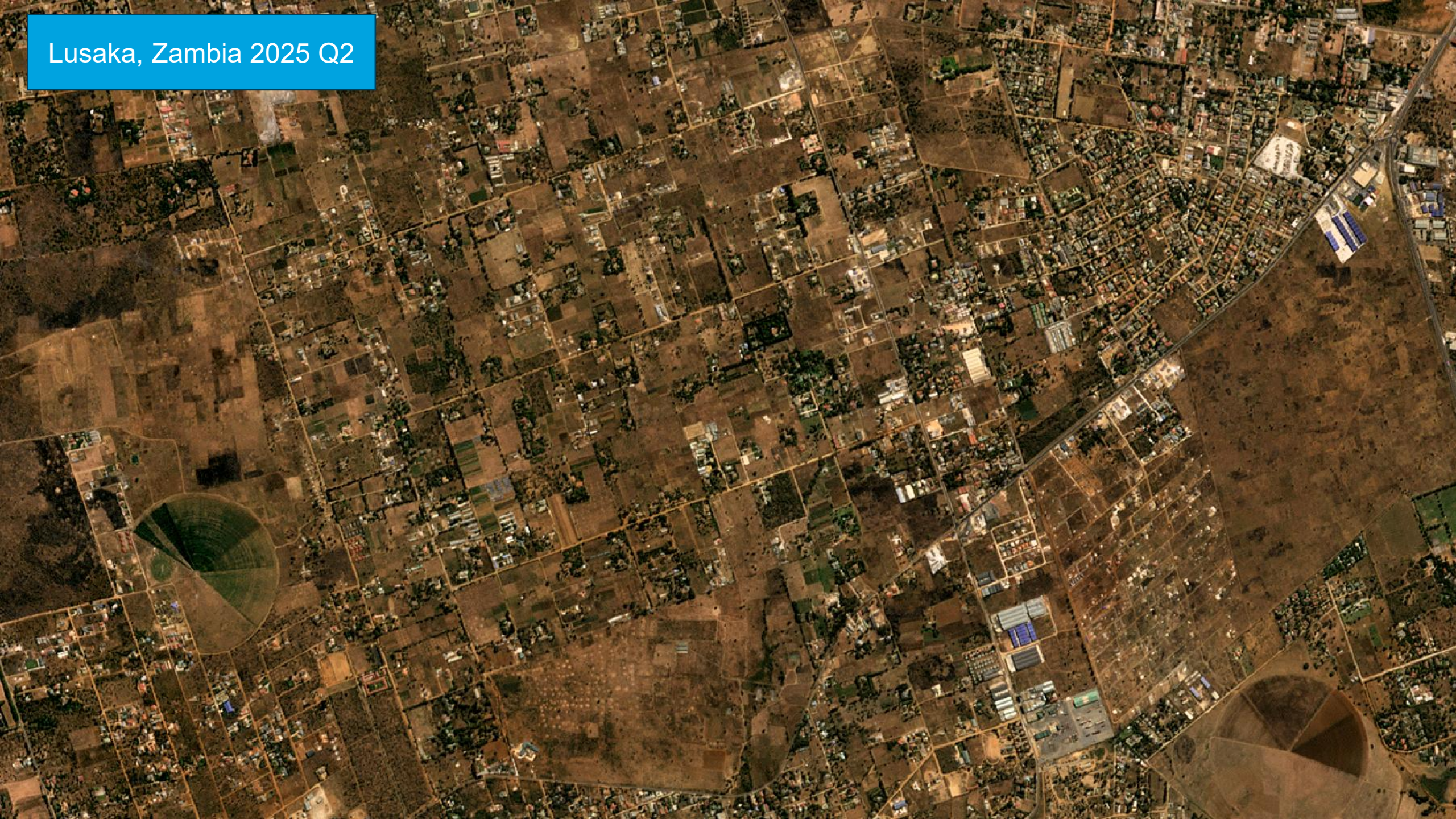
Quarterly building density and height

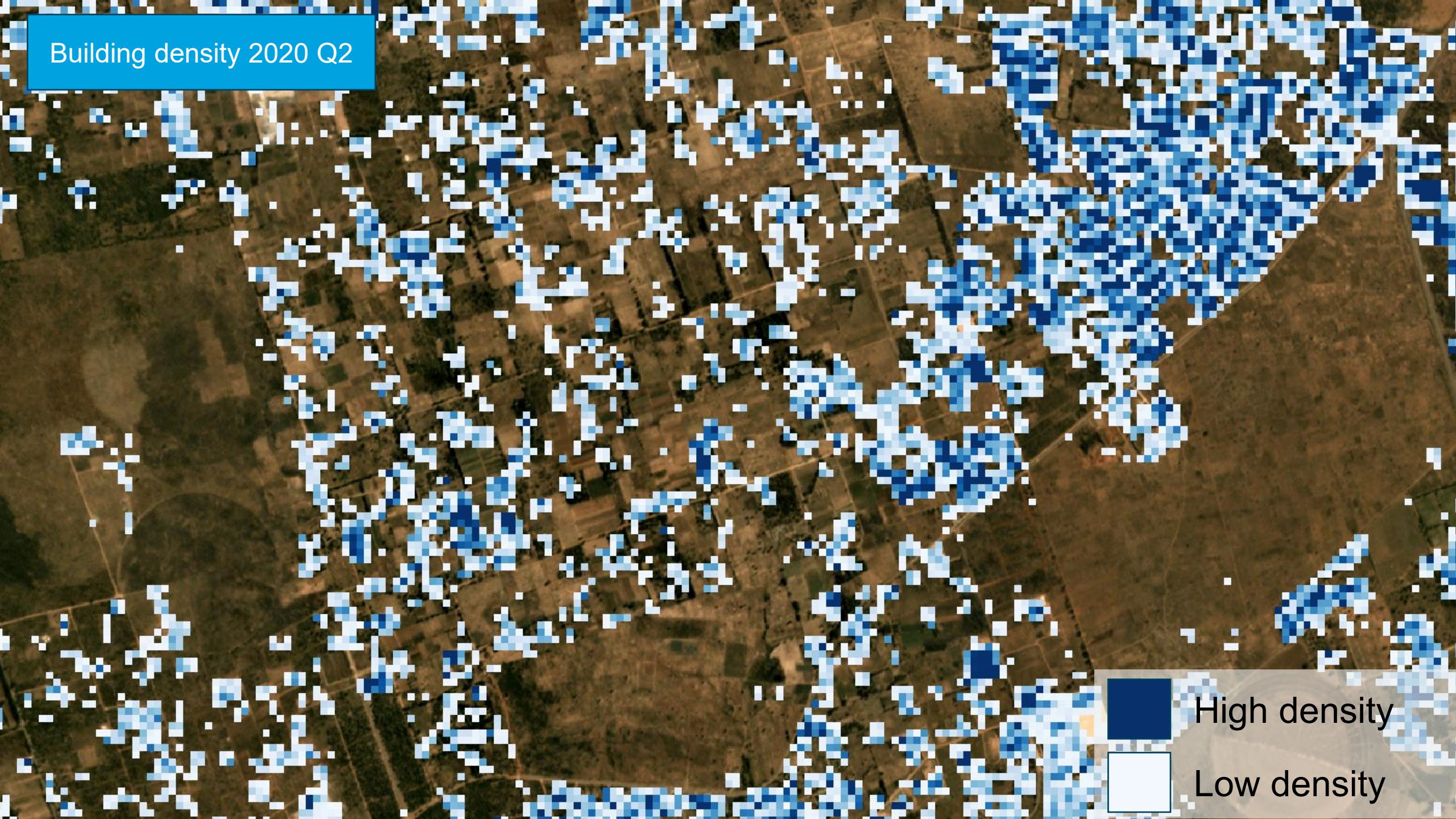


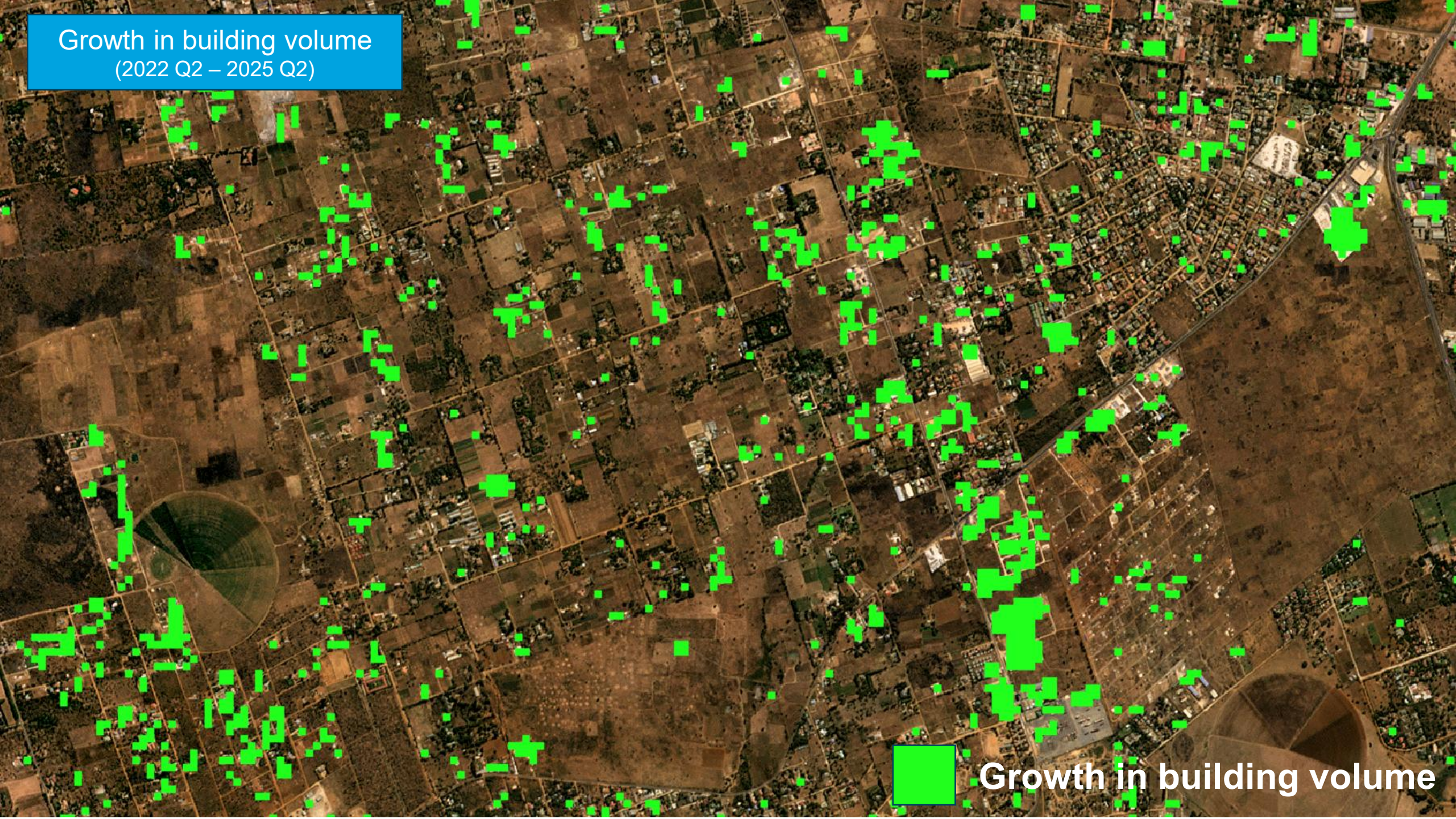
Lusaka, Zambia 2020 Q2



Source: https://worldpopulationreview.com/


Lusaka, Zambia 2025 Q2


Building density 2020 Q2
High density
Low density


Growth in building volume
(2022 Q2 – 2025 Q2)
Growth in building volume

Open Source https://github.com/microsoft/buildings
Paper https://arxiv.org/abs/2511.12104

TEMPO: Global Temporal Building Density and Height Estimation from Satellite Imagery

Tammy Glazer*[1], Gilles Q. Hacheme*[1], Akram Zaytar*[1], Luana Marotti[1], Amy Michaels[1], Girmaw Abebe Tadesse[1], Kevin White[1], Rahul Dodhia[1], Andrew Zolli[2], Inbal Becker-Reshef[1], Juan M. Lavista Ferres[1], and Caleb Robinson[1]

[1]Microsoft AI for Good Research Lab, Redmond, WA, USA
[2]Planet Labs PBC, San Francisco, CA, USA

Abstract

We present TEMPO, a global, temporally resolved dataset of building density and height derived from high-resolution satellite imagery using deep learning models. We pair building footprint and height data from existing datasets with quarterly PlanetScope basemap satellite images to train a multi-task deep learning model that predicts building density and building height at a 37.6-meter per pixel resolution. We apply this model to global PlanetScope basemaps from Q1 2018 through Q2 2025 to create global, temporal maps of building density and height. We validate these maps by comparing against existing building footprint datasets. Our estimates achieve an F1 score between 85% and 88% on different hand-labeled subsets, and are temporally stable, with a 0.96 five-year trend-consistency score. TEMPO captures quarterly changes in built settlements at a fraction of the computational cost of comparable approaches, unlocking large-scale monitoring of development patterns and climate impacts essential for global resilience and adaptation efforts.

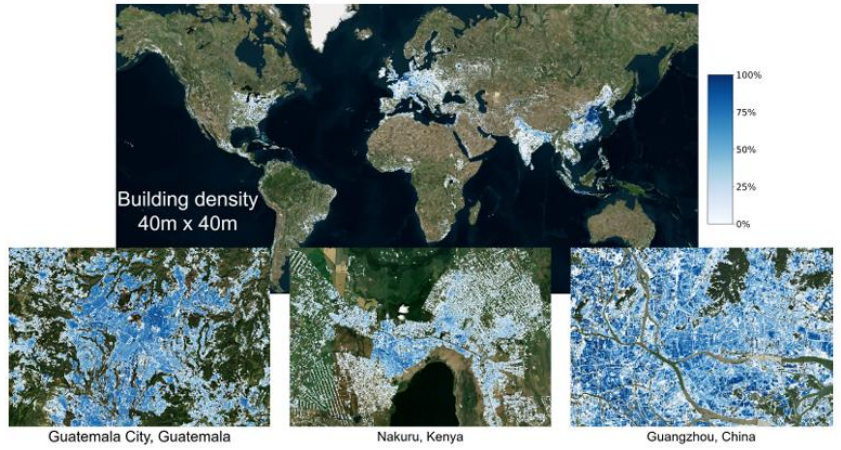


Figure 1: Estimated global building density for Q2 2025.

Early Warning Connectivity Map (EWCM)

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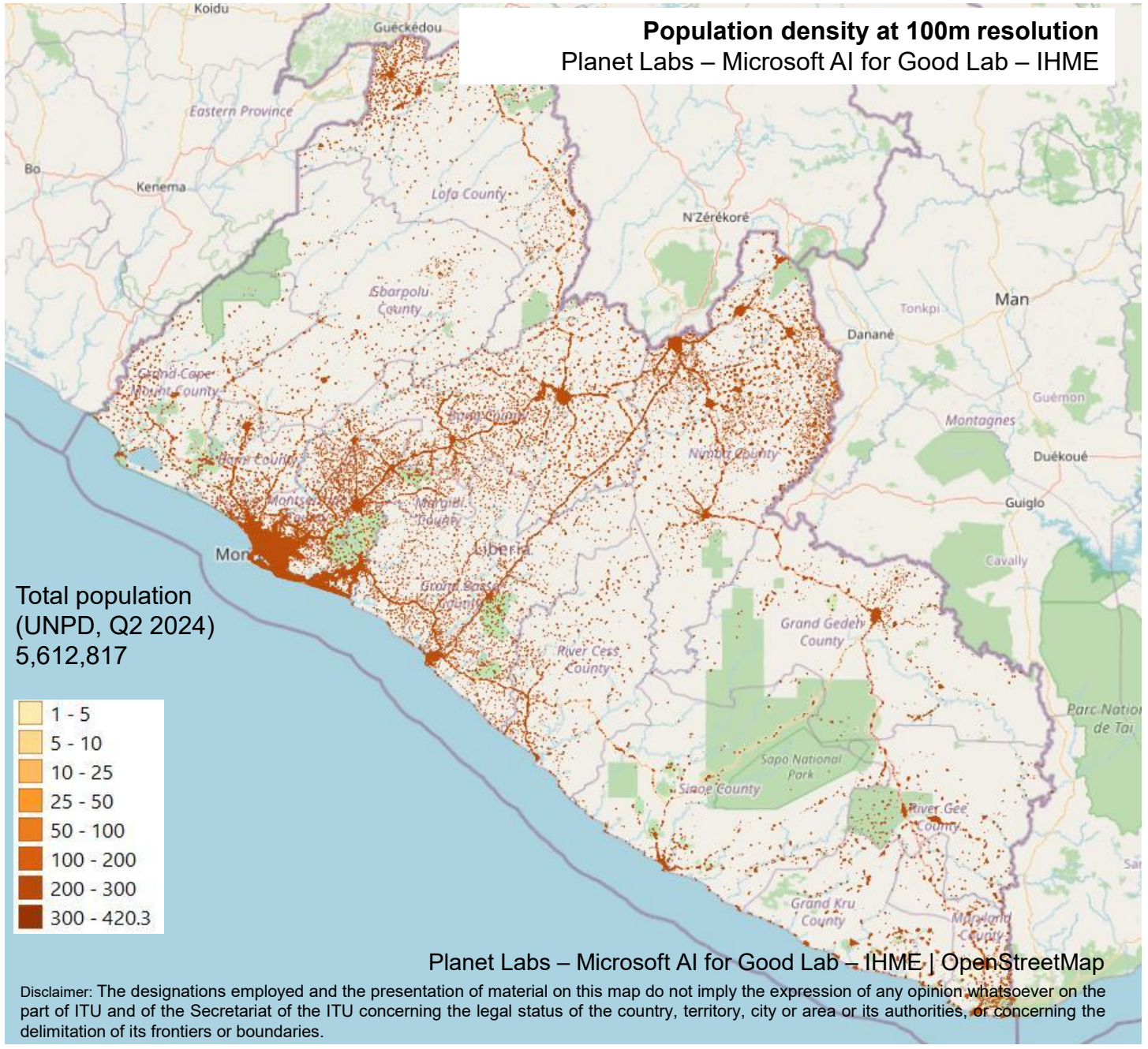

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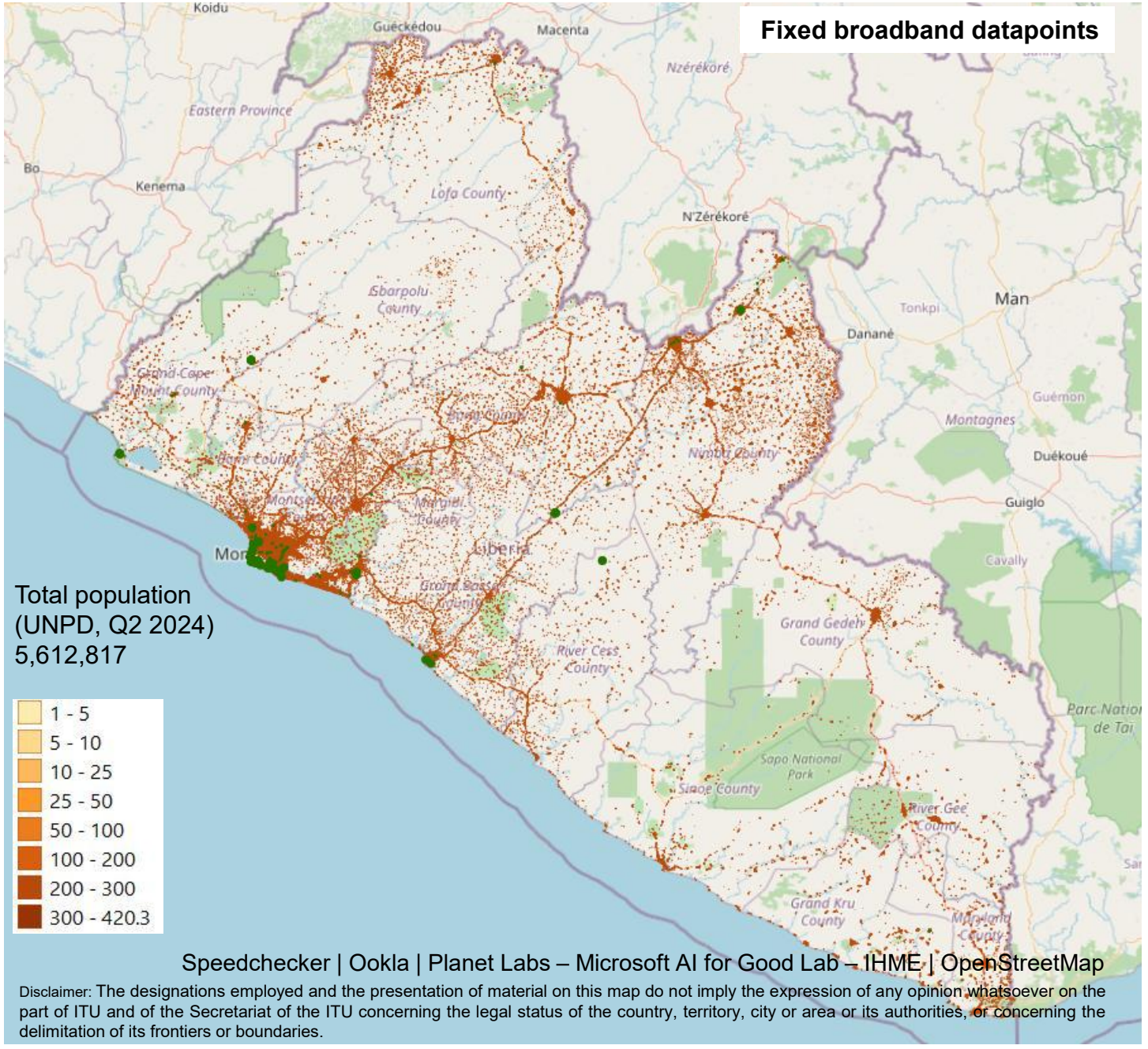

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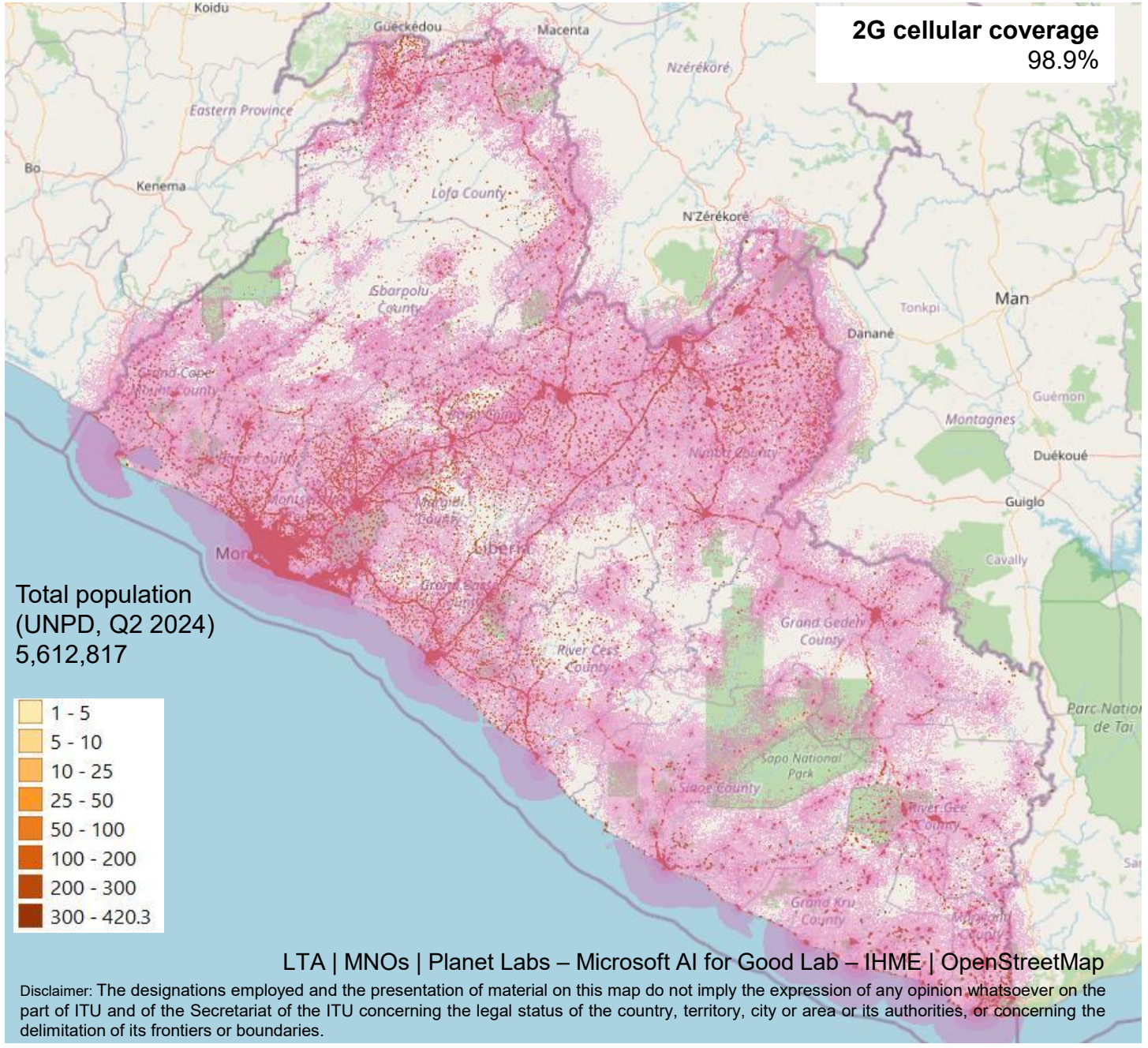

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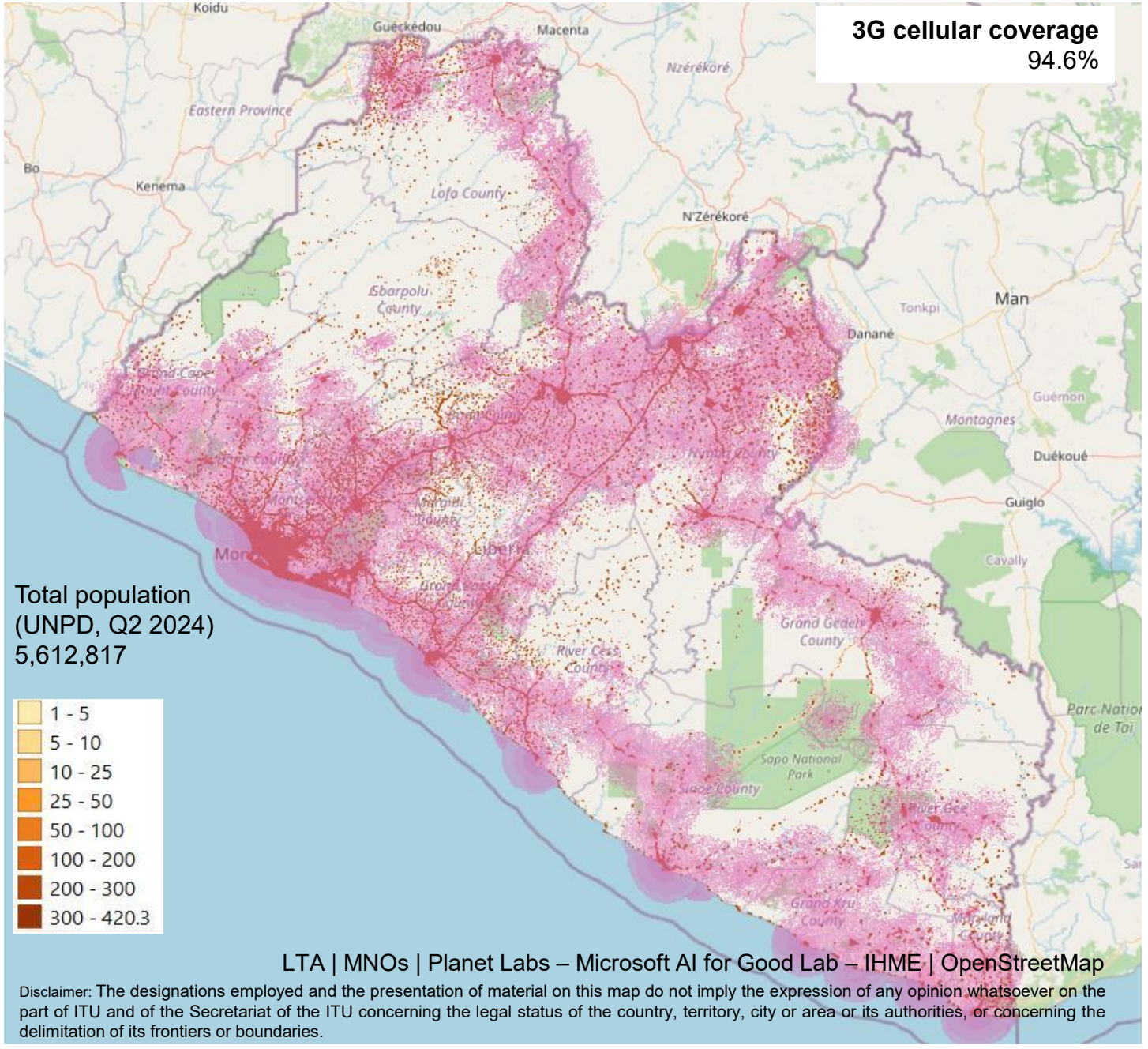

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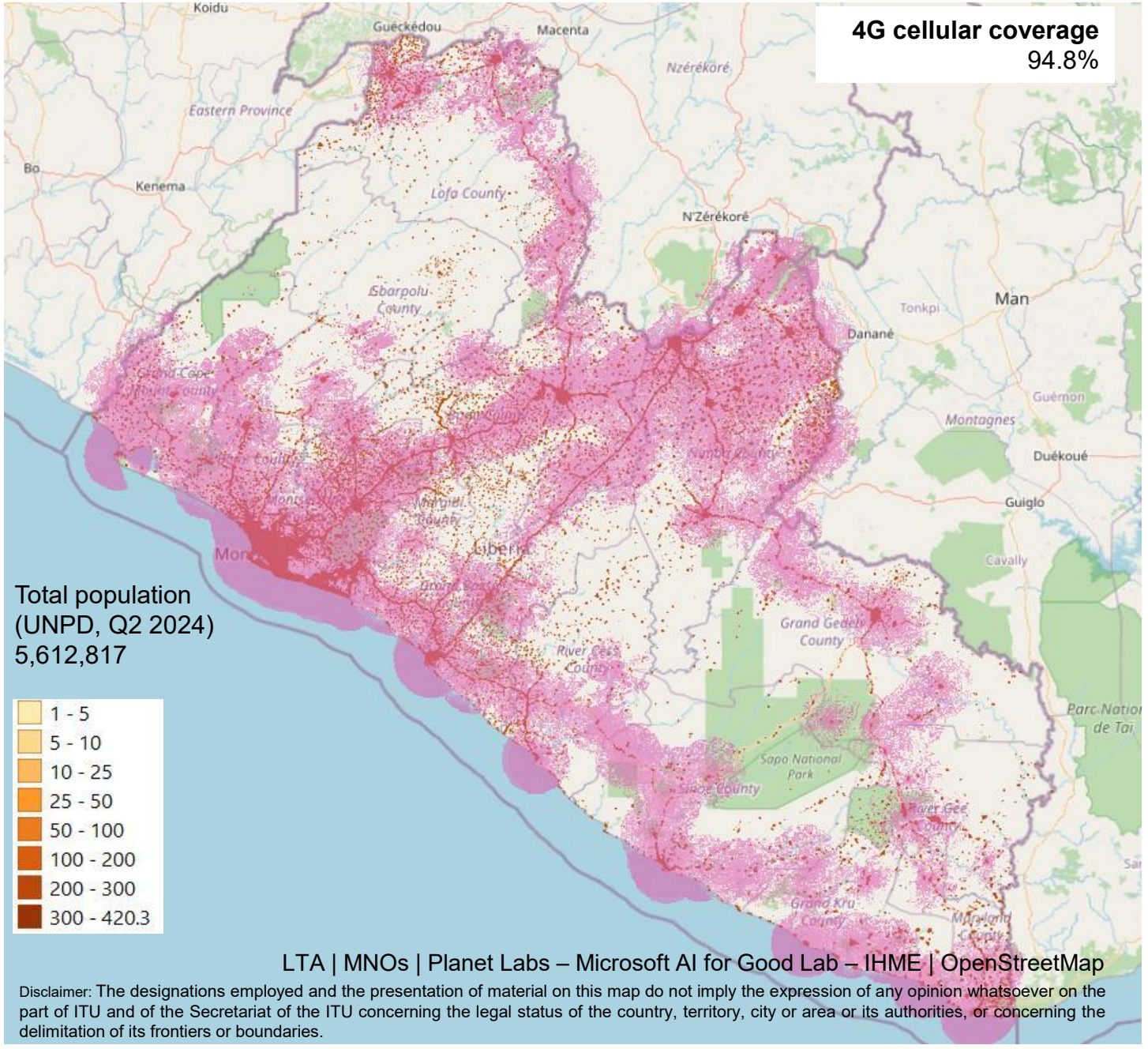

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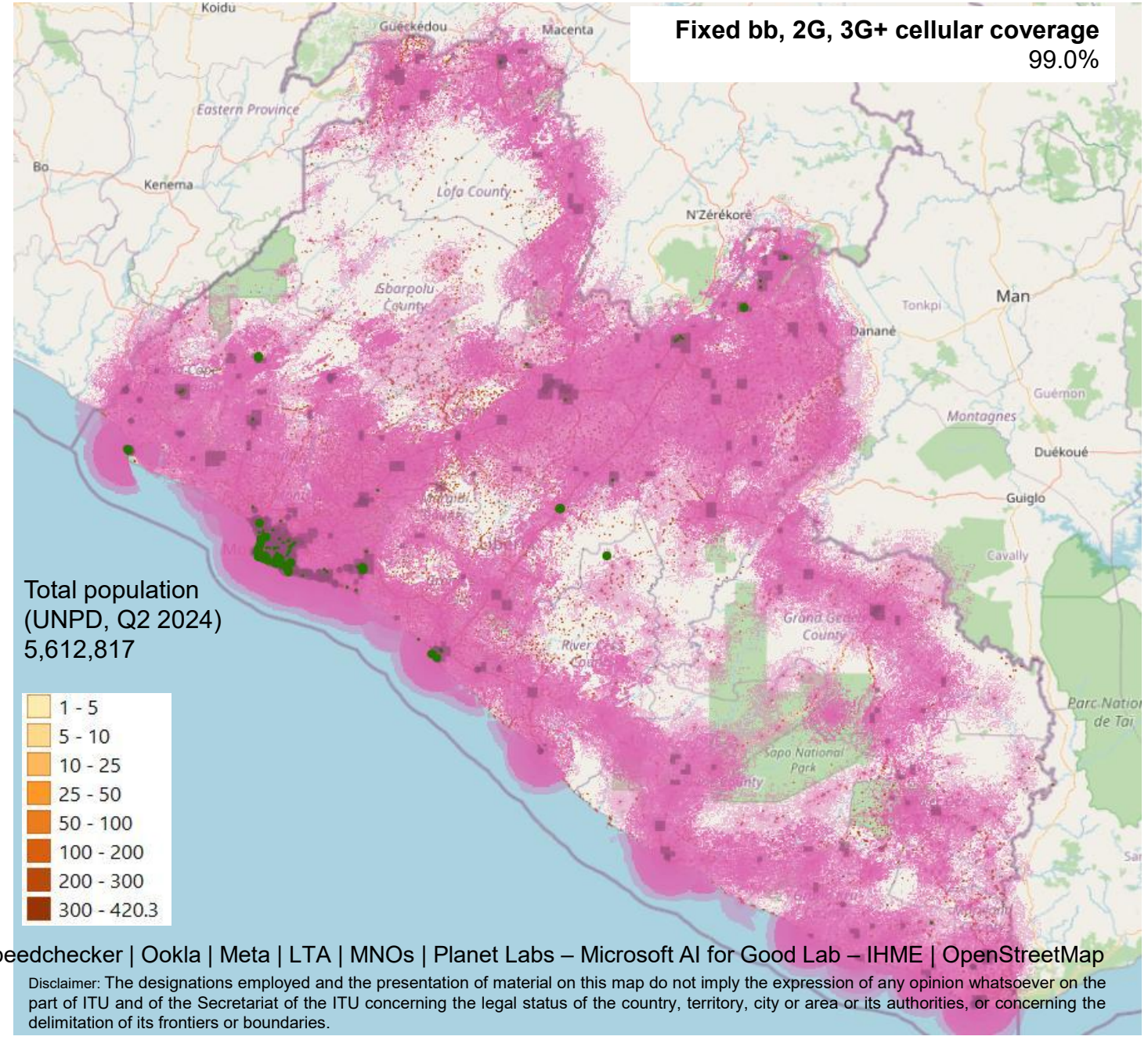

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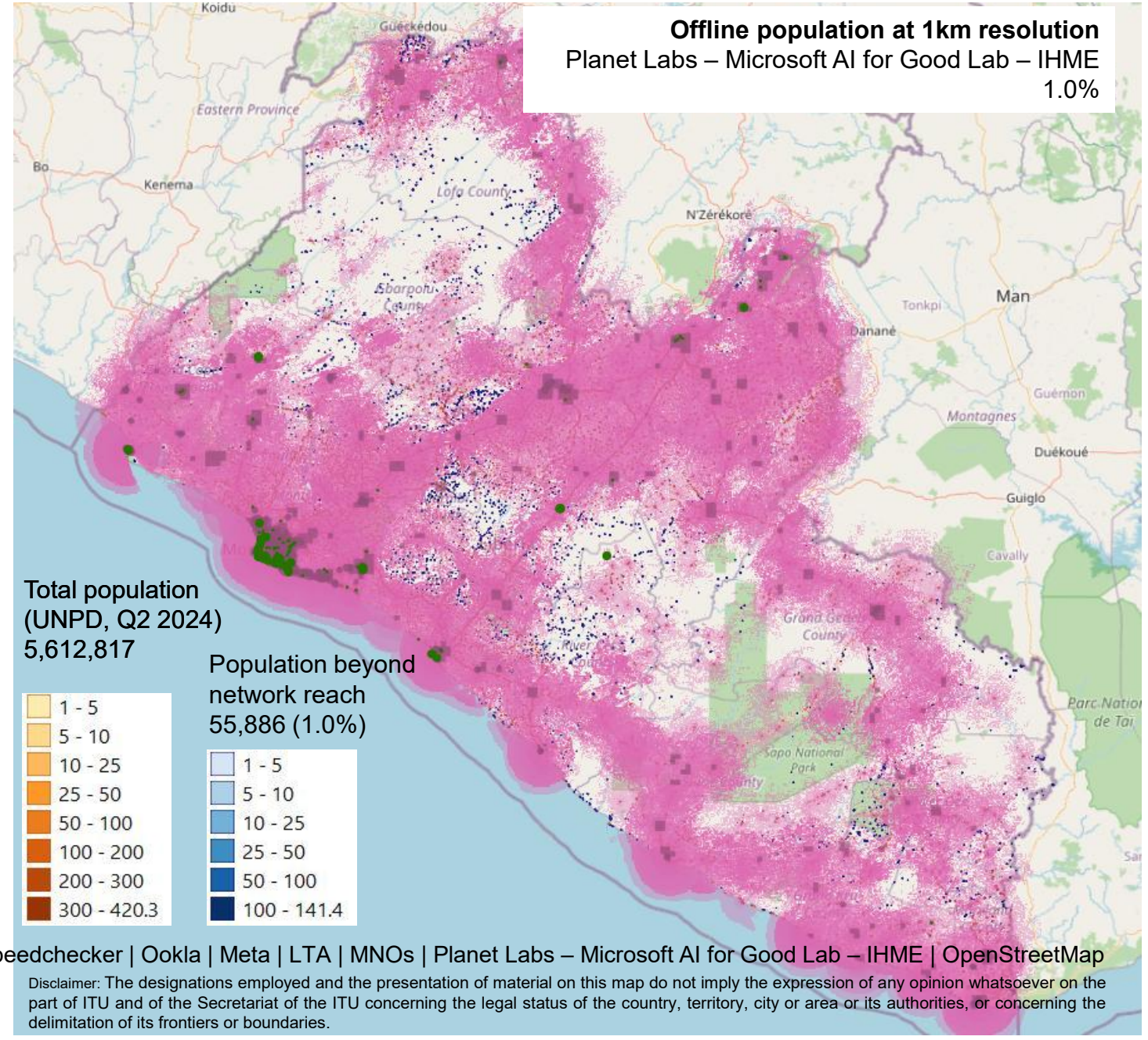

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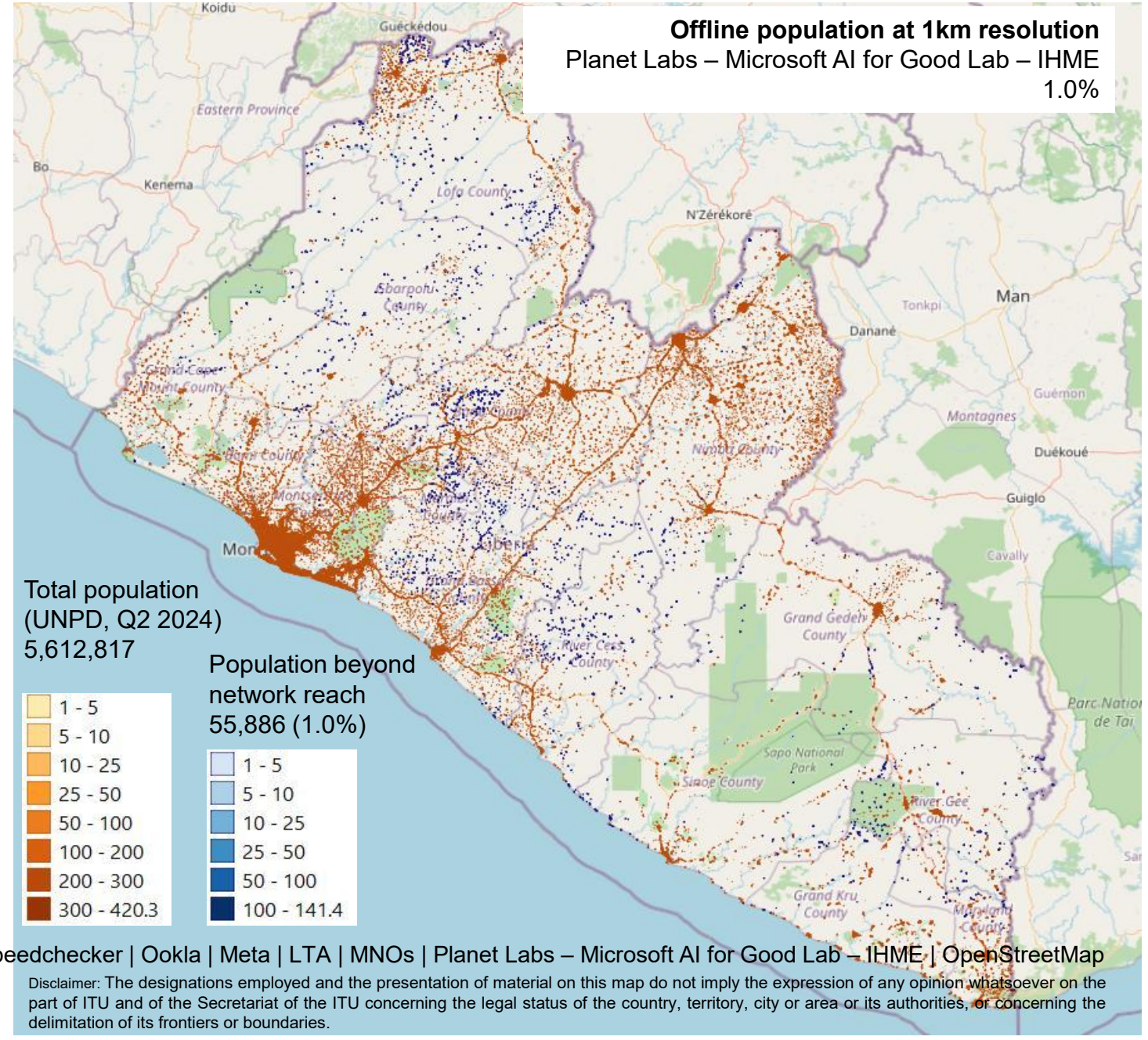
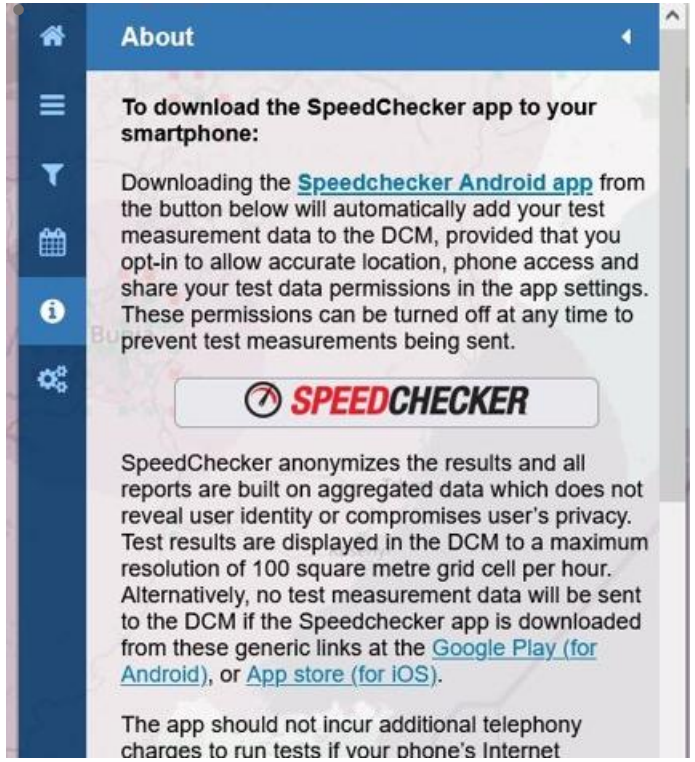
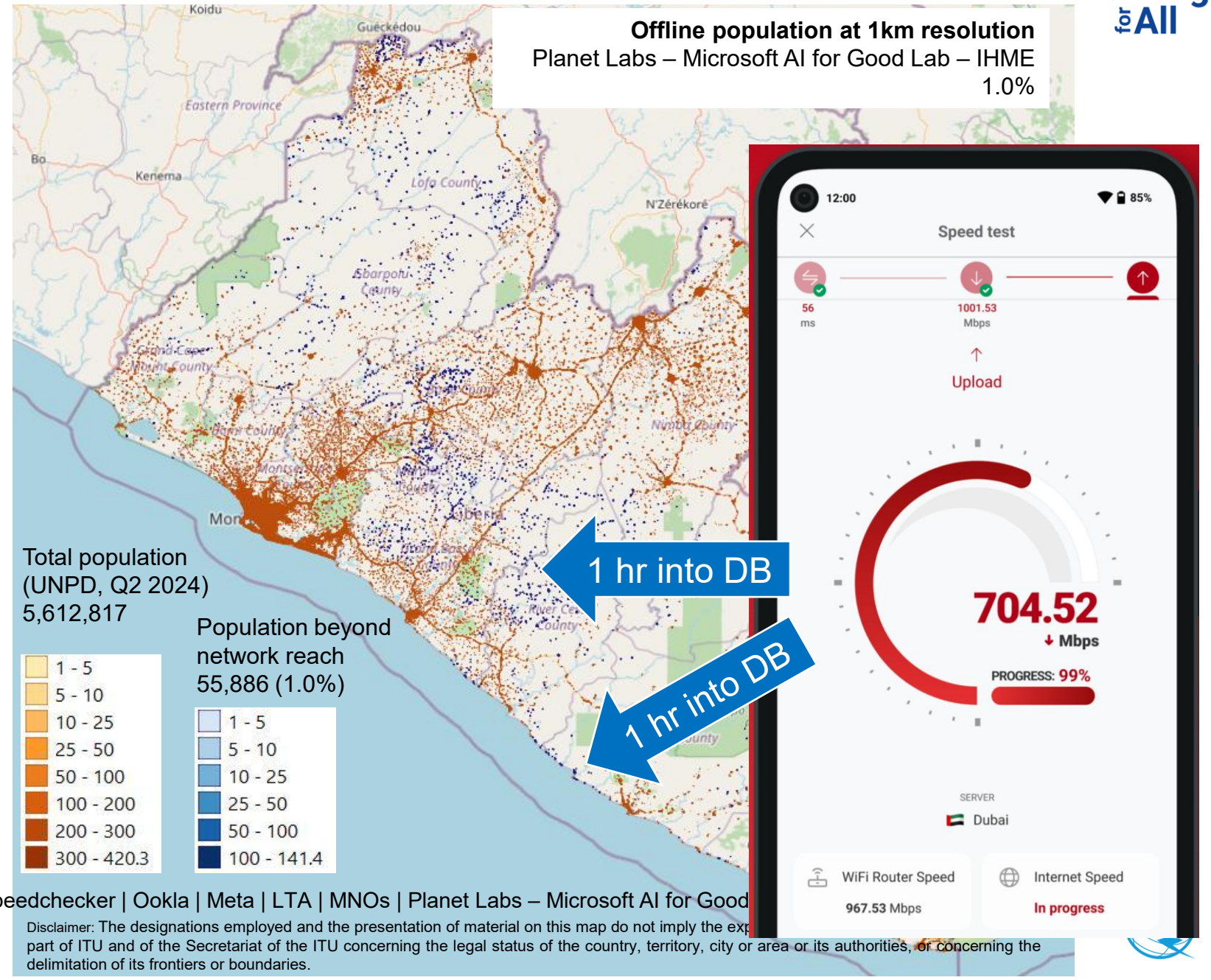


Speedchecker Android App

- Field test real-time connectivity measurements
- Download the Android app from the Speedchecker button on https://dcm.itu.int or from https://broadbandspeedchecker.page.link/Tbeh





Speedchecker Android App

- An LTA team led by Alfred Toomey conducted a pilot mobile coverage field test using the Speedchecker Android app in Sinoe county from 15 - 18 December 2025.

- The results were received into the ITU database within one hour and showed download speeds of up to 7 Mbps in towns with good coverage near to cell sites.

- In some towns, you only get a little access when you are on the road, but when you are off the road or indoors, you lose network as a result of poor service. Other towns had absolutely no coverage.

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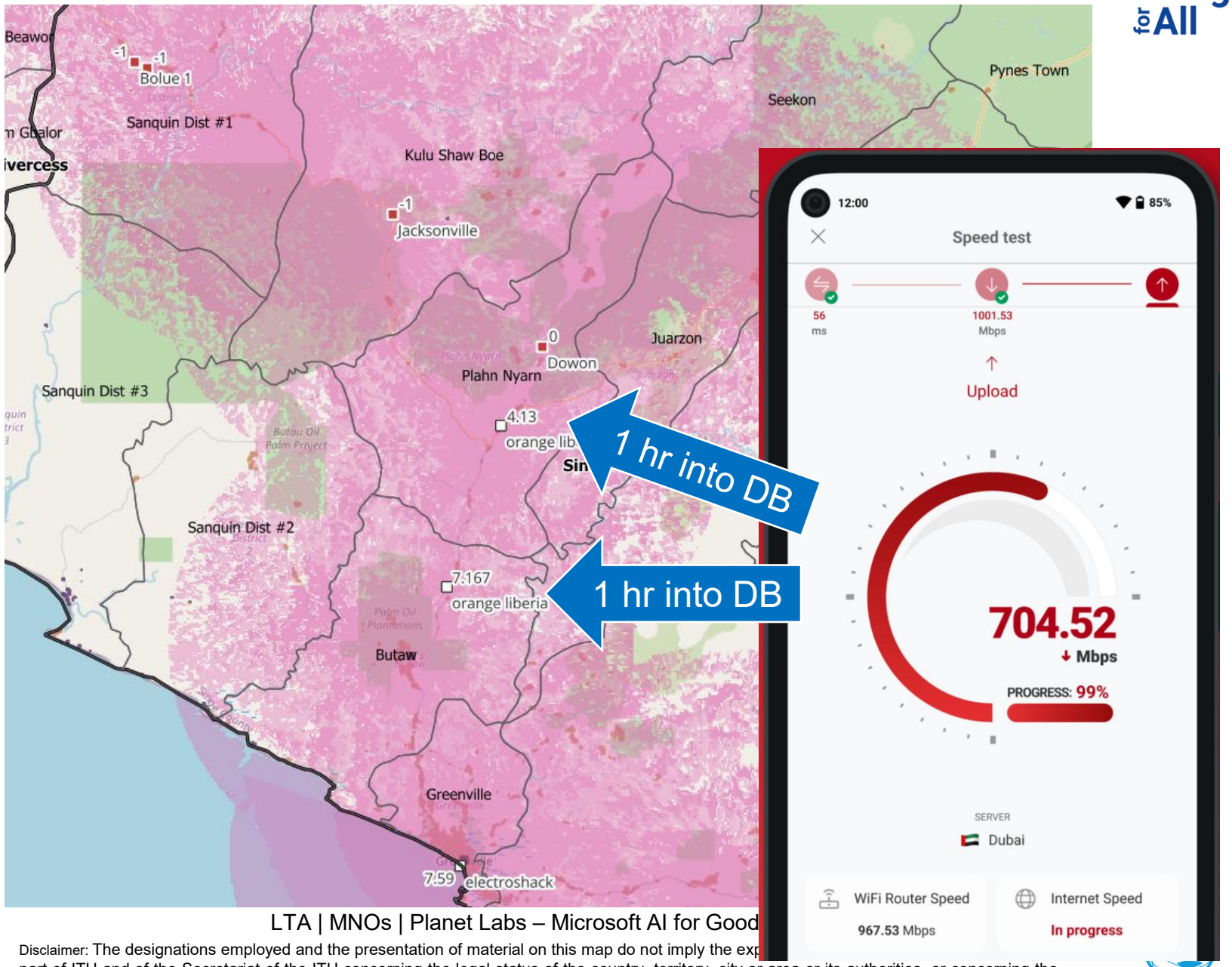

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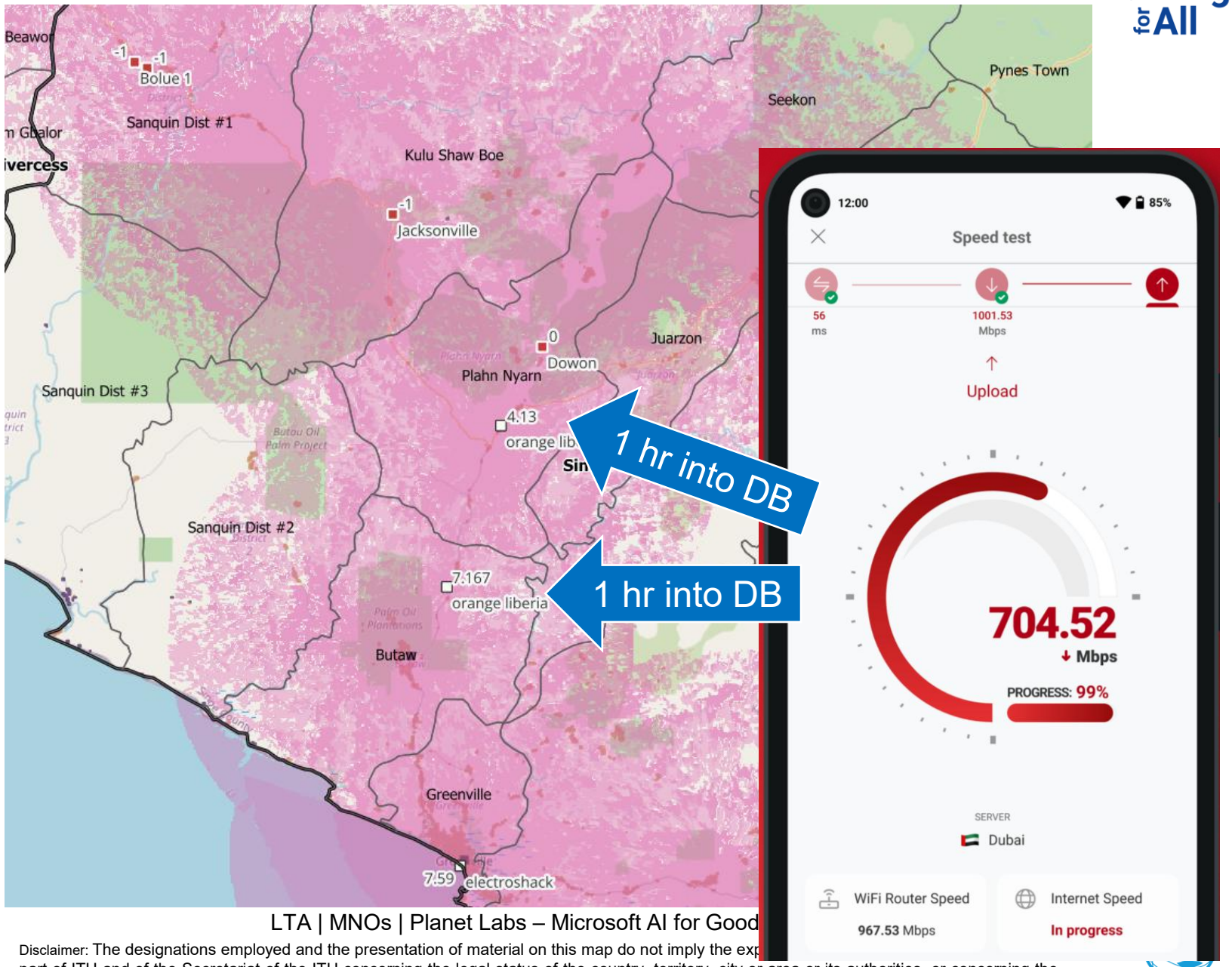
Speedchecker Android App

- This side of the country is experiencing heavy downpours of rainfall which is causing problems for smaller vehicles as ours.
- Due to heavy rains and river floods, most of the identified areas are not accessible.
- The only road that leads to those towns and villages is cut, and the only available means to go through is by a fishing boat, ideally, which is not safe for us.
- We were expected back to Monrovia today, but lots of heavy duty trucks have got stuck in the mud, and there's no detour to use.



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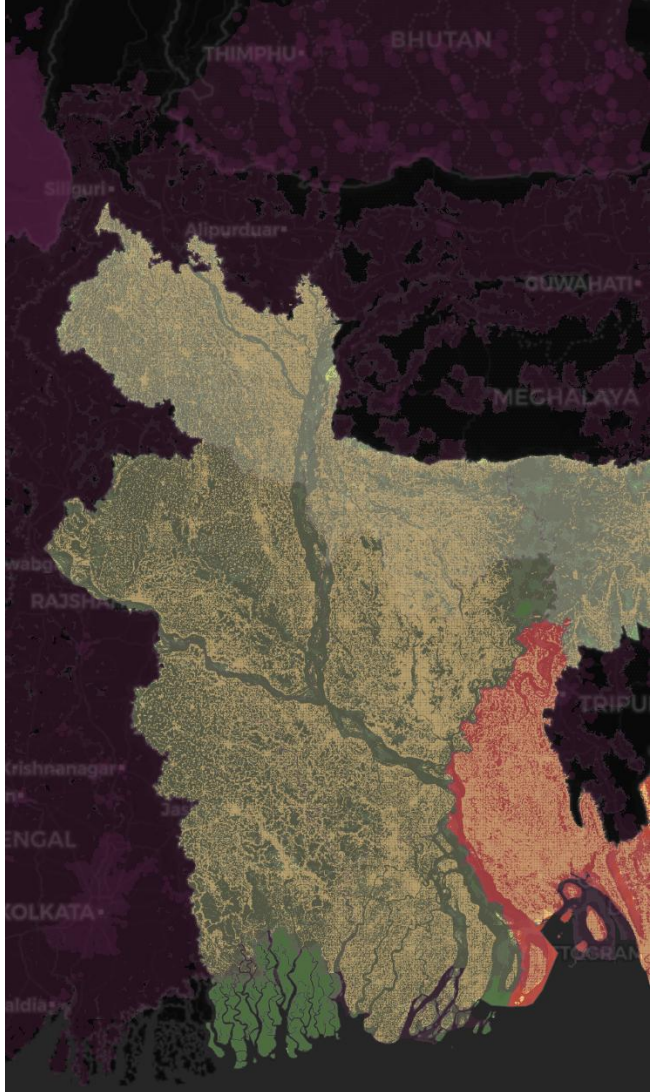
Disclaimer: The designations employed and the presentation of material on this map do not imply the exp
part of ITU and of the Secretariat of the ITU concerning the legal status of the country, territory, city or area or its authorities, or concerning the delimitation of its frontiers or boundaries.

Disclaimers

The EWCM 'near-live' connectivity map layer is **based on the Disaster Connectivity Map (DCM)** which uses multiple sources for network infrastructure, cellular coverage and connectivity measurements. These sources include the ITU Transmission Map, GSMA and CollinsBartholomew Ltd cellular coverage maps, Opencellid, Meta for Good, Measurement Lab (M-Lab), netBravo, Ookla for Good, and Speedchecker. The infrastructure and coverage data has been validated by ITU Member States and supplied by Mobile Network Operators, and is then augmented with updated and real-time crowd-sourced connectivity data from a number of data sources.

A number of ground truth tests have been carried out to compare results to connectivity levels observed on the ground, including by first responders. The connectivity levels, availability and gaps displayed in the map reflect the availability of these data sources and may in certain cases not provide the full connectivity picture. To further improve the quality and reliability of the map, engagement is ongoing with different partners to identify new data sources and AI applications that could be used to further improve the quality and reliability of the data. Member States, Mobile Network Operators, and partners are invited to review, validate, and help improve the results.

Learn more:
https://www.itu.int/en/ITU-D/Emergency-Telecommunications/Pages/Early-Warnings-for-All-Initiative.aspx
www.dcm.itu.int



Thank you