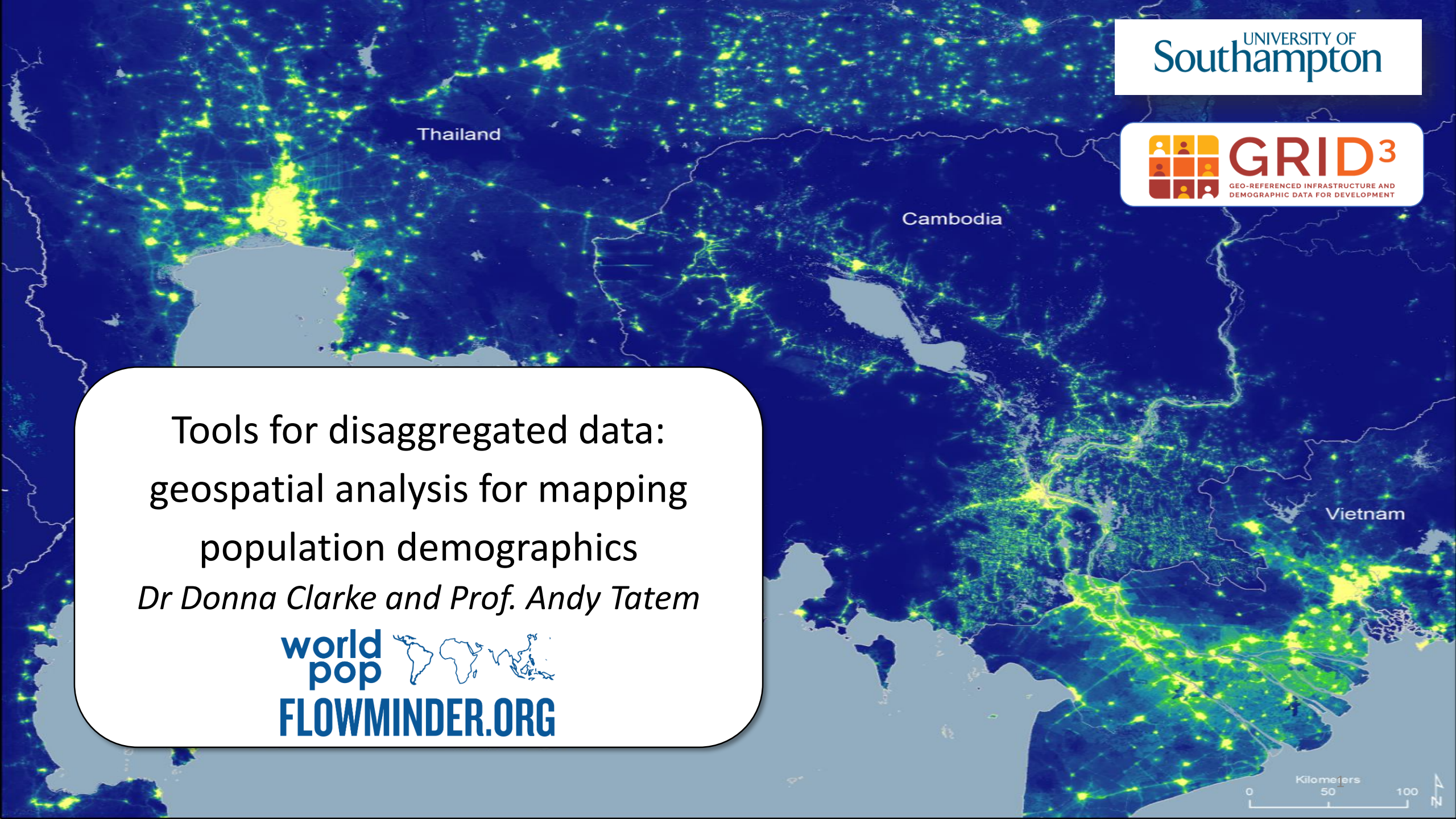


UNIVERSITY OF Southampton

GRID3
GEO-REFERENCED INFRASTRUCTURE AND DEMOGRAPHIC DATA FOR DEVELOPMENT

Tools for disaggregated data: geospatial analysis for mapping population demographics

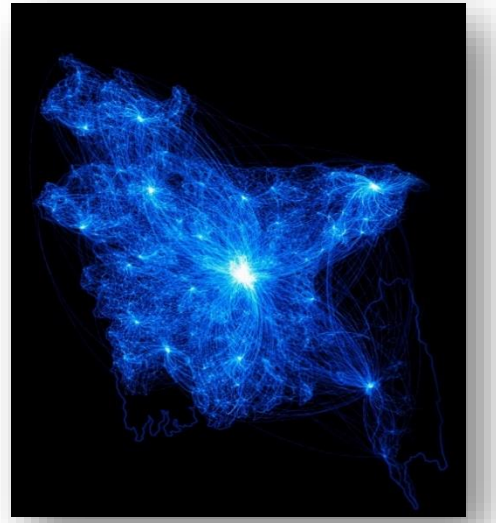
Dr Donna Clarke and Prof. Andy Tatem

worldpop

FLOWMINDER.ORG

worldpop FLOWMINDER.ORG DATA-POP ALLIANCE HARVARD HUMANITARIAN INITIATIVE mit media lab FLOWMINDER.ORG UNIVERSITY OF Southampton

- **WorldPop**: Research program focused on methods for improving the demographic evidence base in low/middle income countries
- **Flowminder**: Non-profit foundation working with data providers and international/government agencies to operationalize and scale research in support of vulnerable populations and sustainable development
- Open data, open methods
- 60+ researchers, data scientists, PhD students, support staff based primarily in Southampton



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UNITED NATIONS FOUNDATION
ADB Asian Development Bank
IDB Inter-American Development Bank
THE WORLD BANK Working for a World Free of Poverty

GOAL 1 TARGETS

1.1

By 2030, eradicate extreme poverty for all people everywhere, currently measured as people living on less than $1.25 a day

1.2

By 2030, reduce at least by half the proportion of men, women and children of all ages living in poverty in all its dimensions according to national definitions

1.3

Implement nationally appropriate social protection systems and measures for all, including floors, and by 2030 achieve substantial coverage of the poor and the vulnerable

1.4

By 2030, ensure that all men and women, in particular the poor and the vulnerable, have equal rights to economic resources, as well as access to basic services, ownership and control over land and other forms of property, inheritance, natural resources, appropriate new technology and financial services, including microfinance

1.5

By 2030, build the resilience of the poor and those in vulnerable situations and reduce their exposure and vulnerability to climate-related extreme events and other economic, social and environmental shocks and disasters

1.a

Ensure significant mobilization of resources from a variety of sources, including through enhanced development cooperation, in order to provide adequate and predictable means for developing countries, in particular least developed countries, to implement programmes and policies to end poverty in all its dimensions

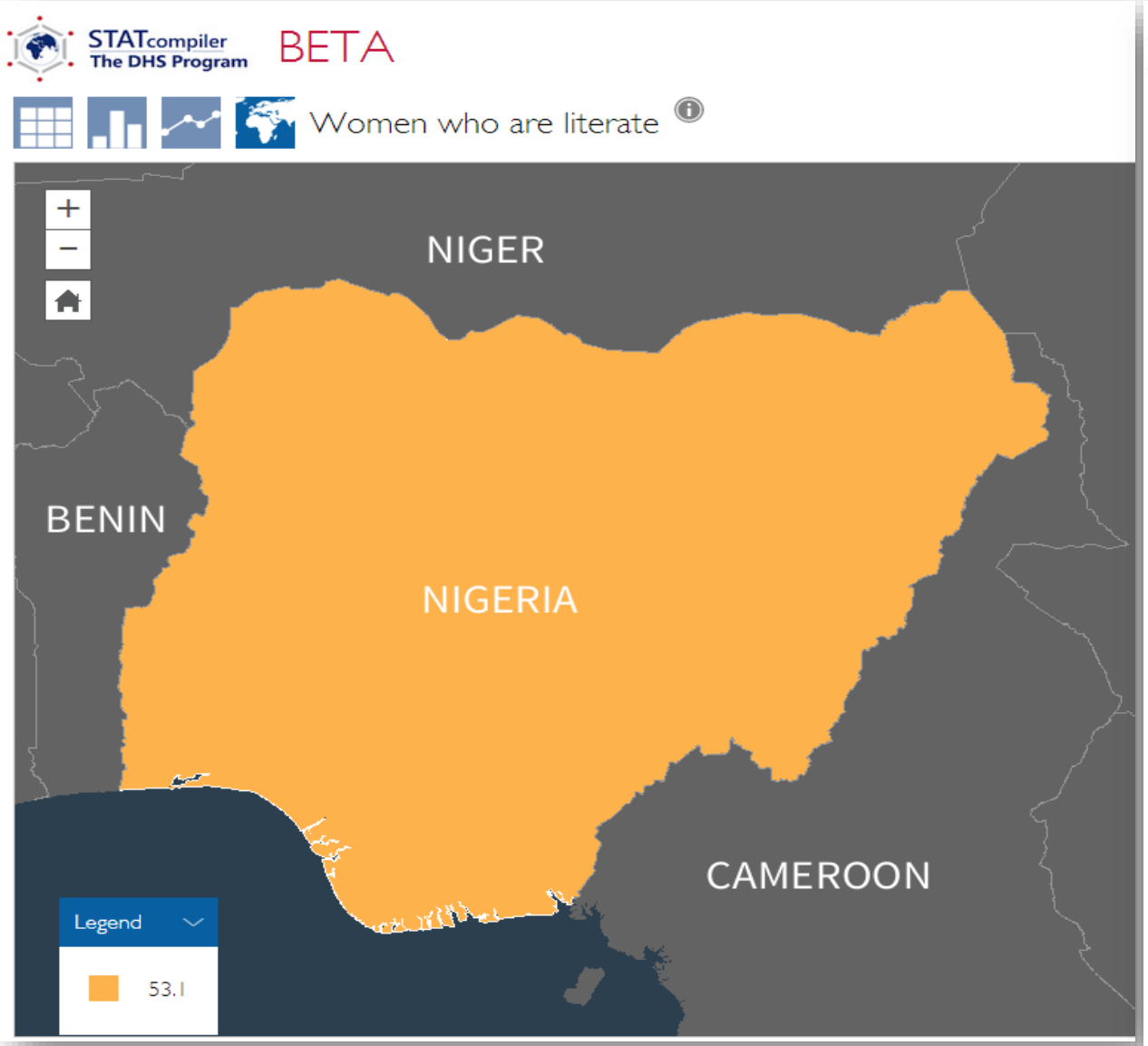
1.b

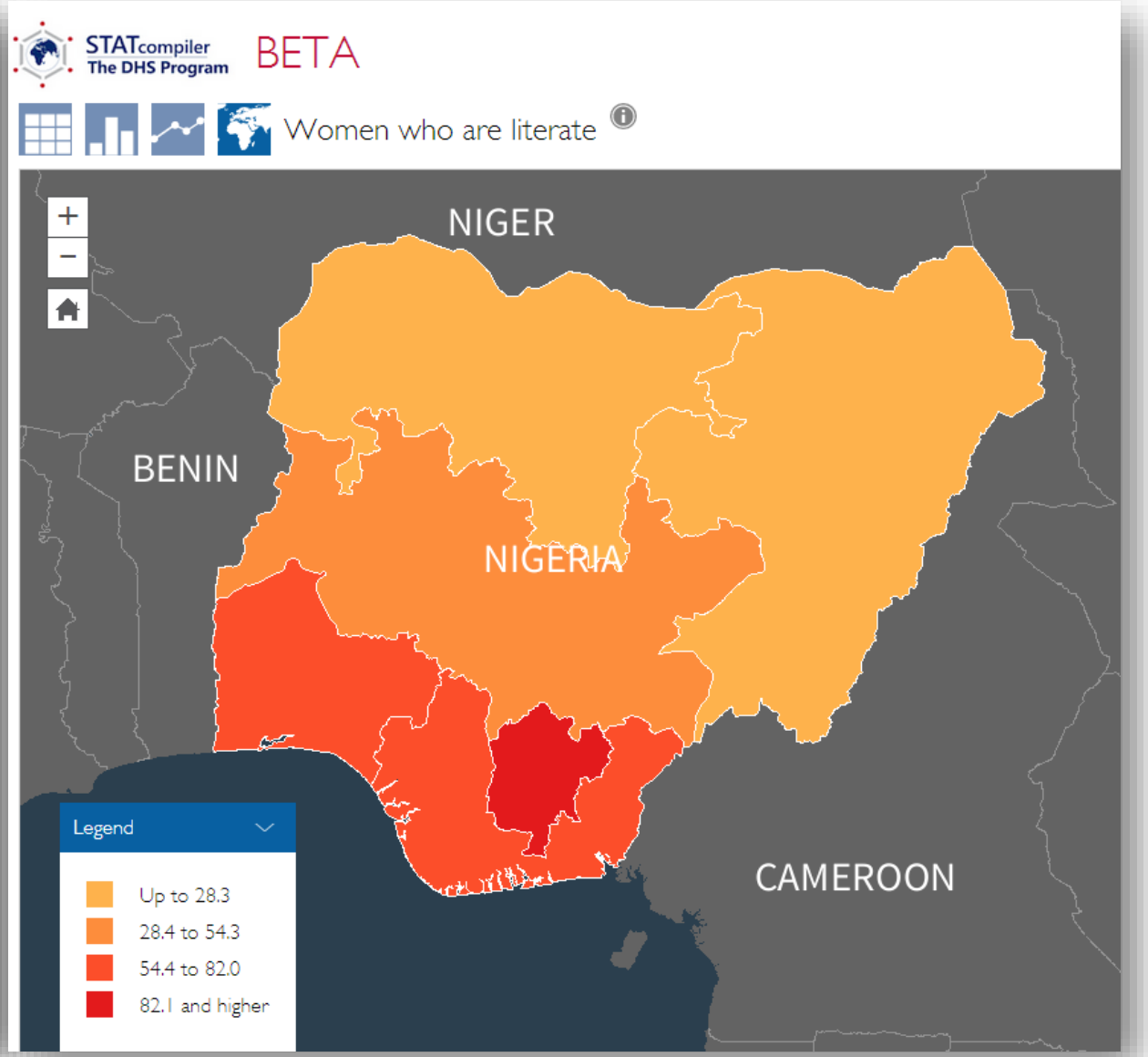
Create sound policy frameworks at the national, regional and international levels, based on pro-poor and gender-sensitive development strategies, to support accelerated investment in poverty eradication actions

2015-2030: 17 goals, 169 targets

“Everywhere”

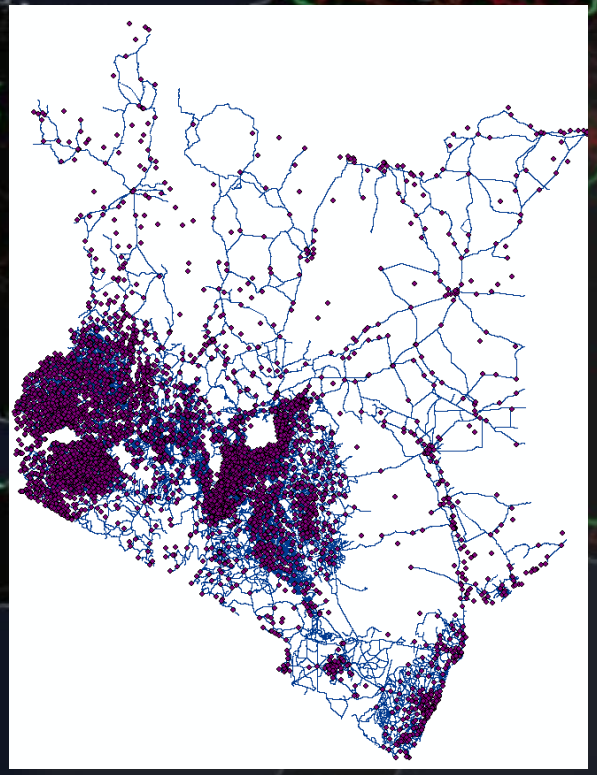
Women who are literate in Nigeria

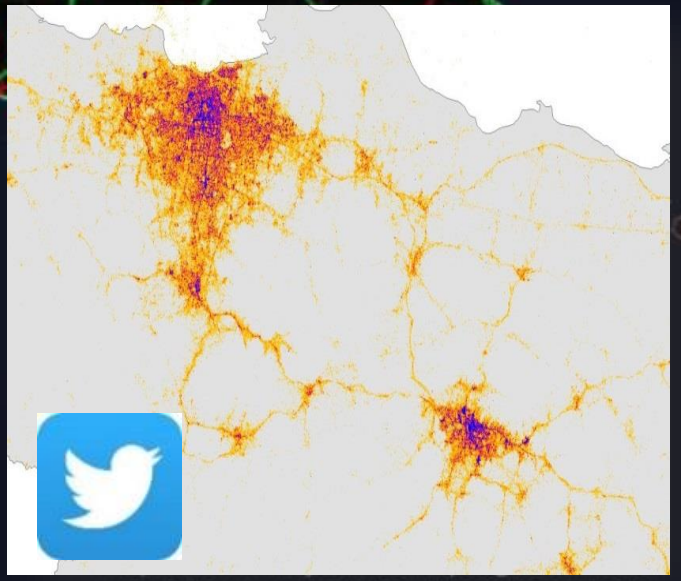




How can we produce subnational data?

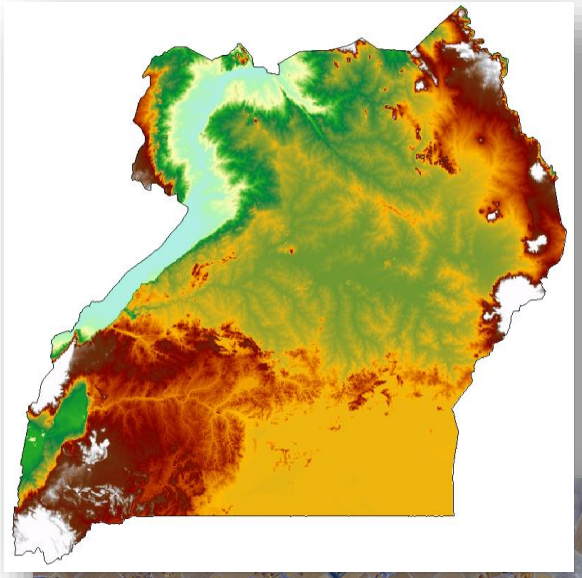
Geographic Information System (GIS) Data

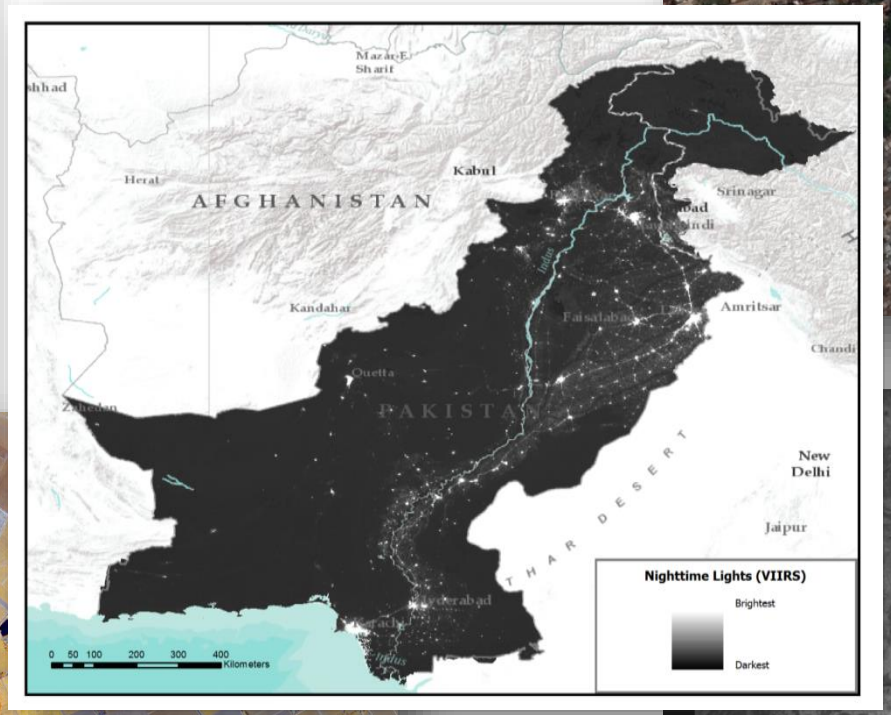


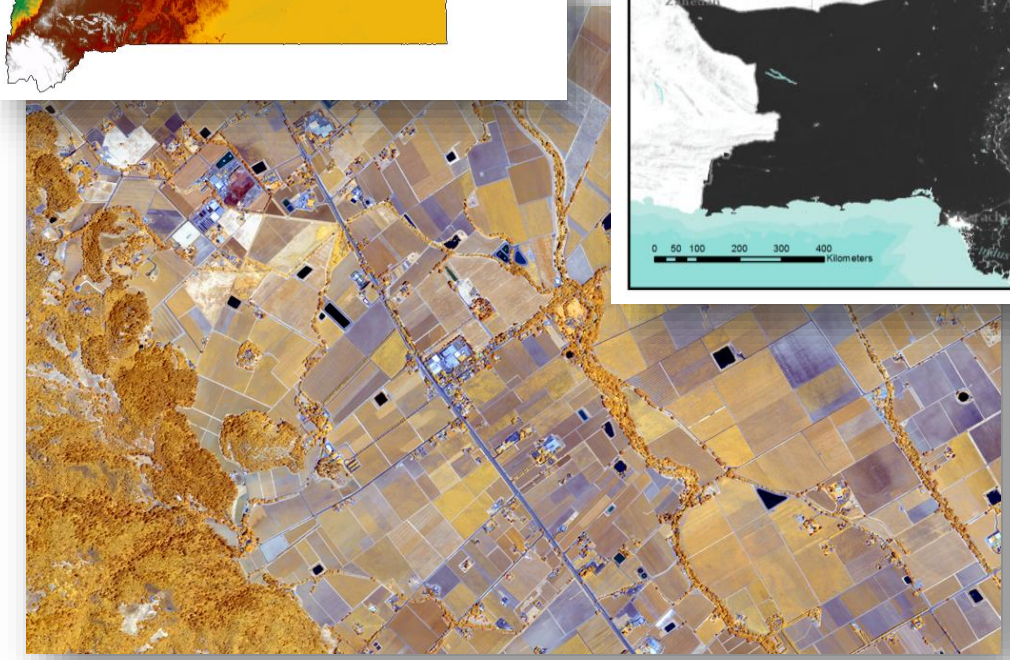


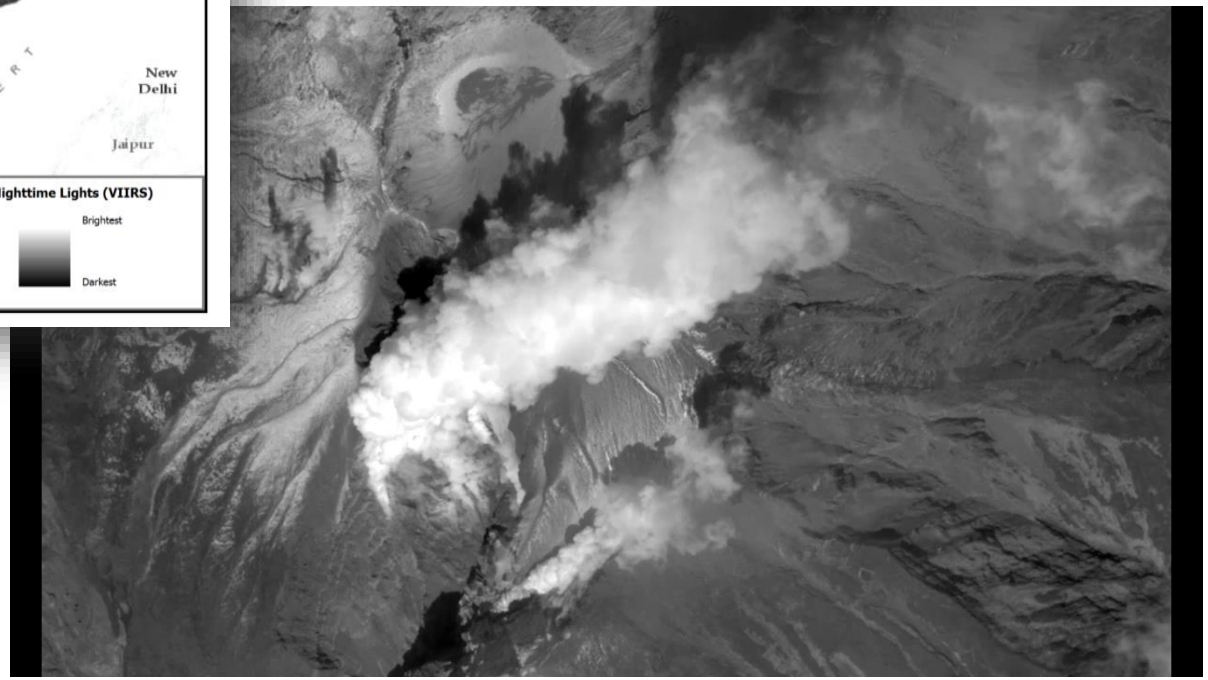
9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 January 2010

Satellite imagery

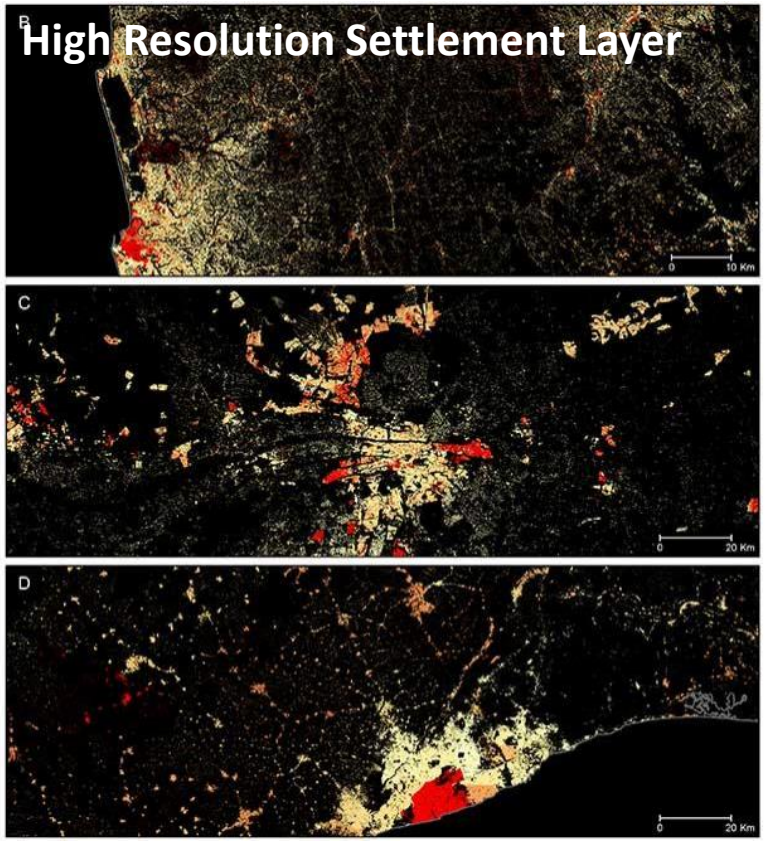


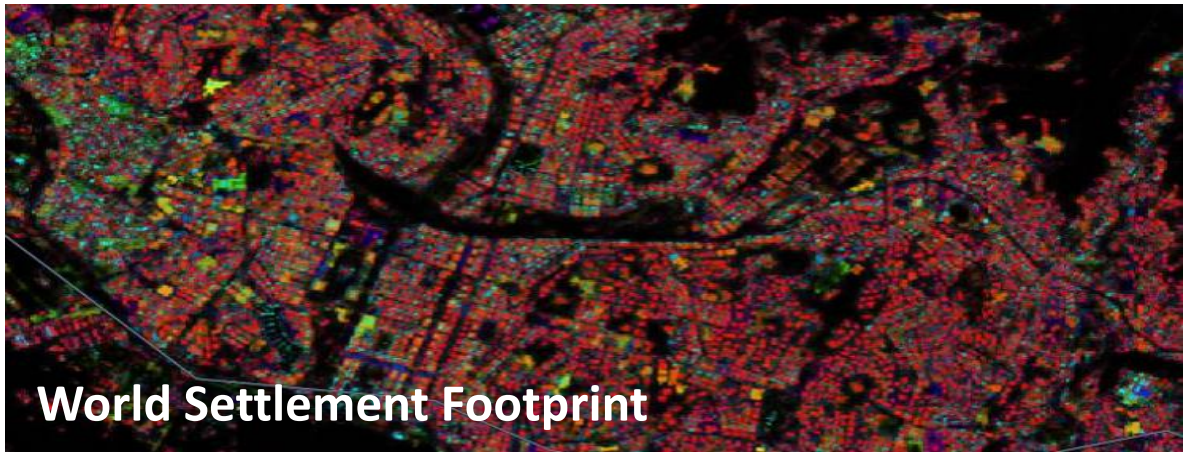






High Resolution Built-Up/Settlement Datasets





DLR

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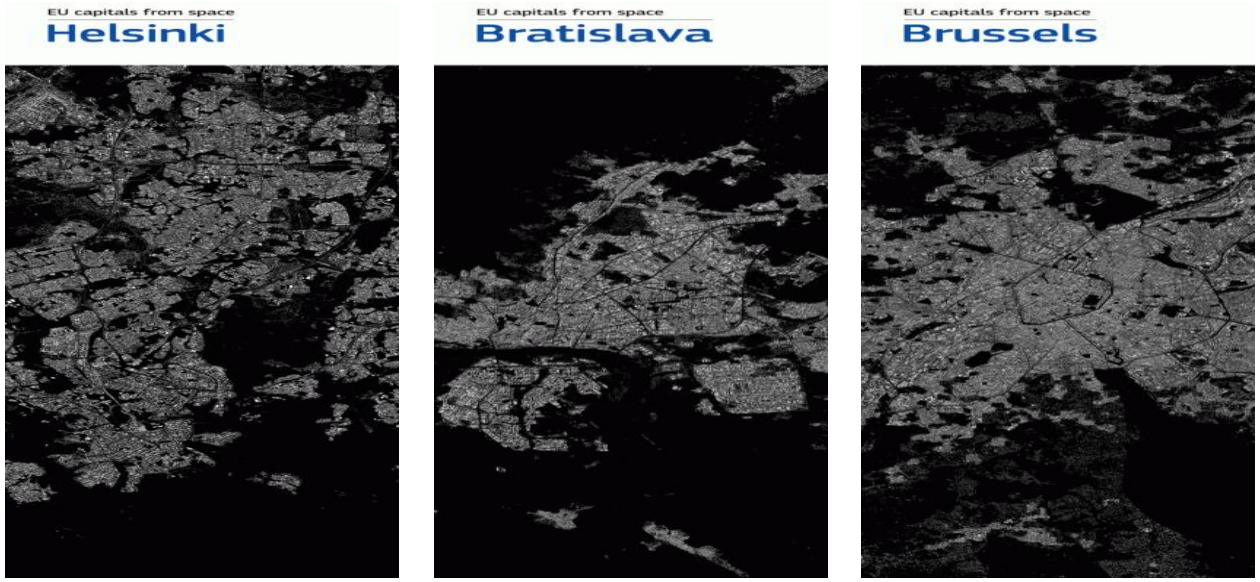
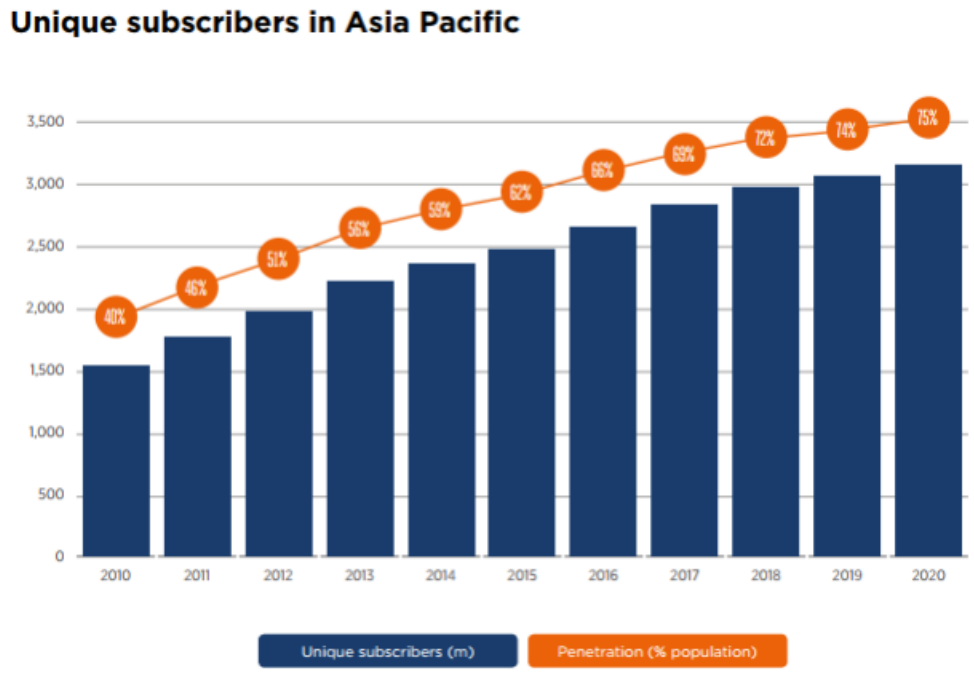
European Commission

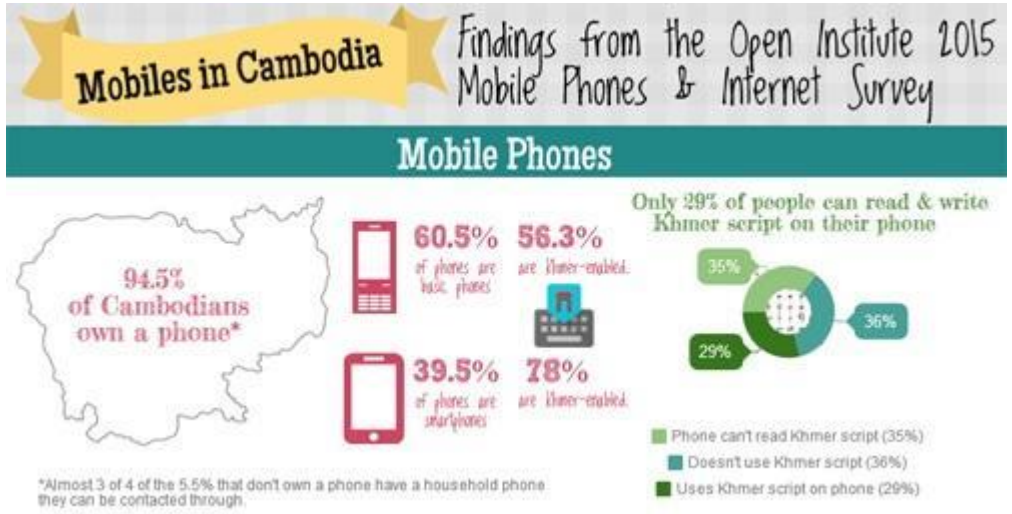


Global Human Settlement Layer

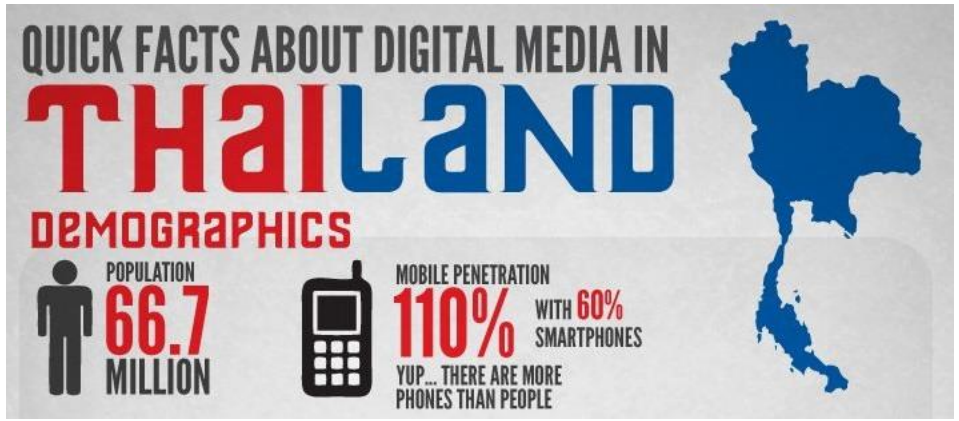
Mobile phone call detail records (CDRs)



Source: GSMA The mobile economy Asia Pacific 2017
https://www.gsmaintelligence.com/research/?file=336a9db2ab3ed95bc70e62bf7e867855&download



Source: Open Institute and the Asia Foundation 2015
http://www.chamnanmuon.com/2015/11/mobile-phones-internet-cambodia-2015.html



Source: Nielsen. The digital media habits and attitues of South East Asian Consumers 2011
https://wiki.smu.edu.sg/digitalmediaasia/Digital_Media_in_Thailand

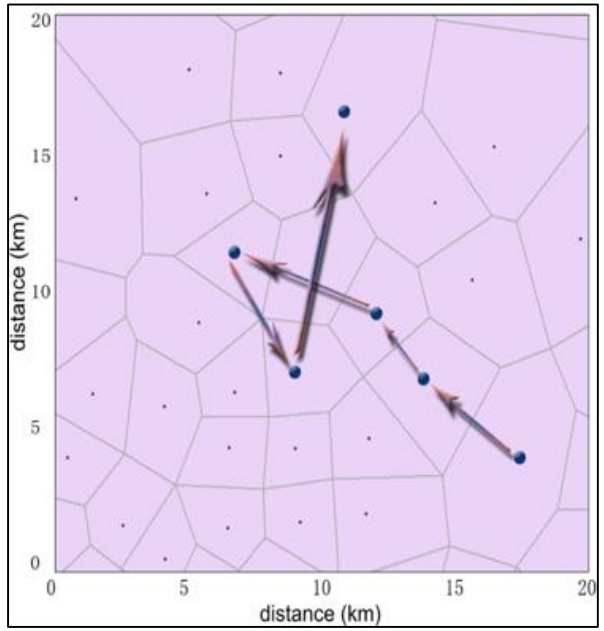
Mobile phone call detail records (CDRs)

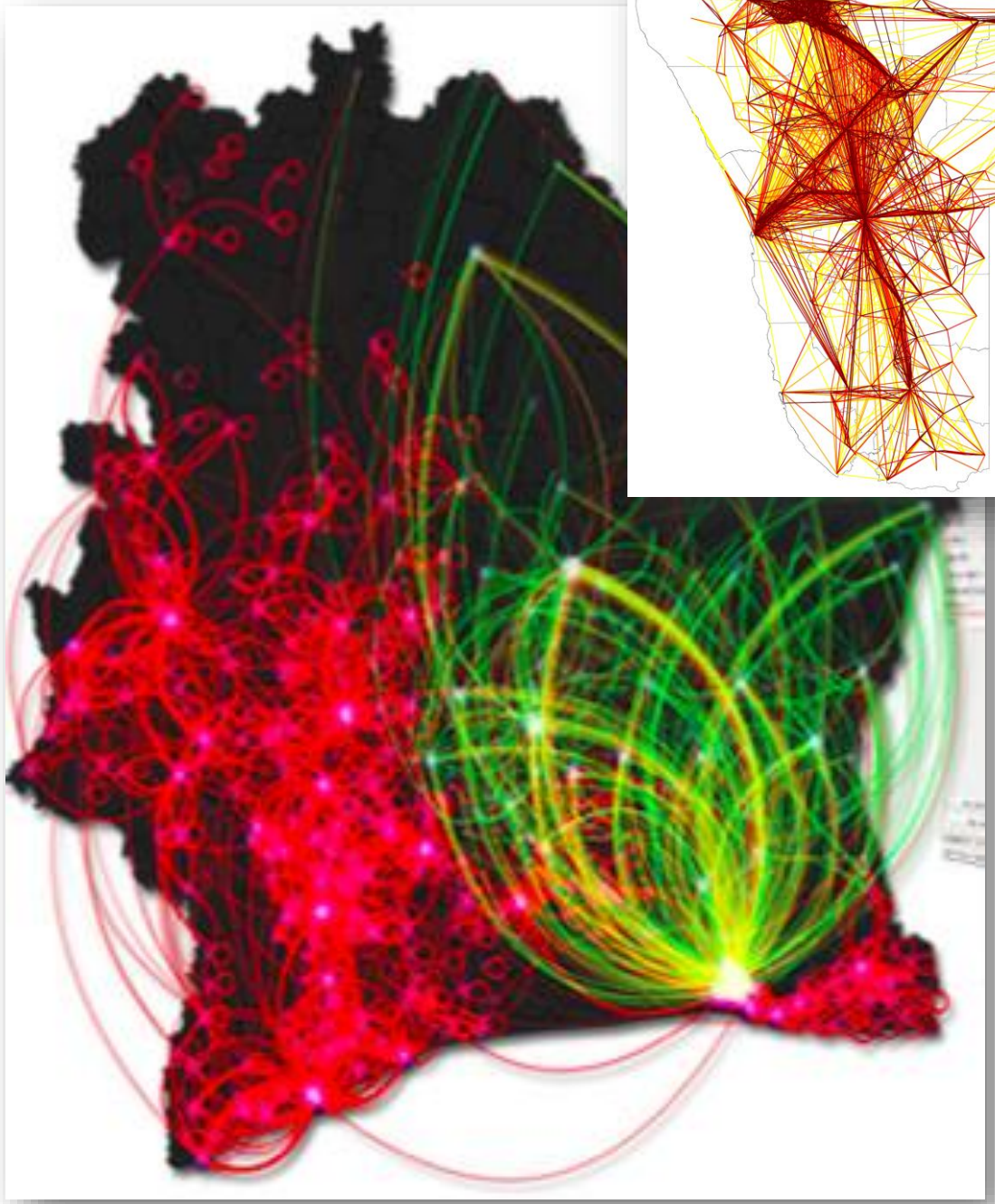
User makes a call from location X

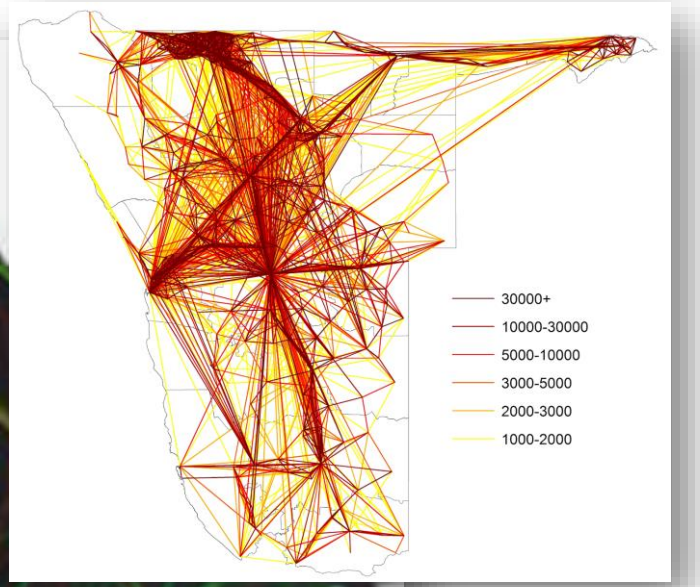
Call routed through nearest tower

Network operator records time and tower of call for billing

User travels to Y and makes a call







Mobility: Changing densities, flows, seasonal/permanent migration

Social networks: Number of contacts, calling patterns

Consumption: Credit purchase frequencies, top-up amounts

Protecting confidentiality

-Aggregate summaries

-Regulator approval

-Raw data never leaves operator

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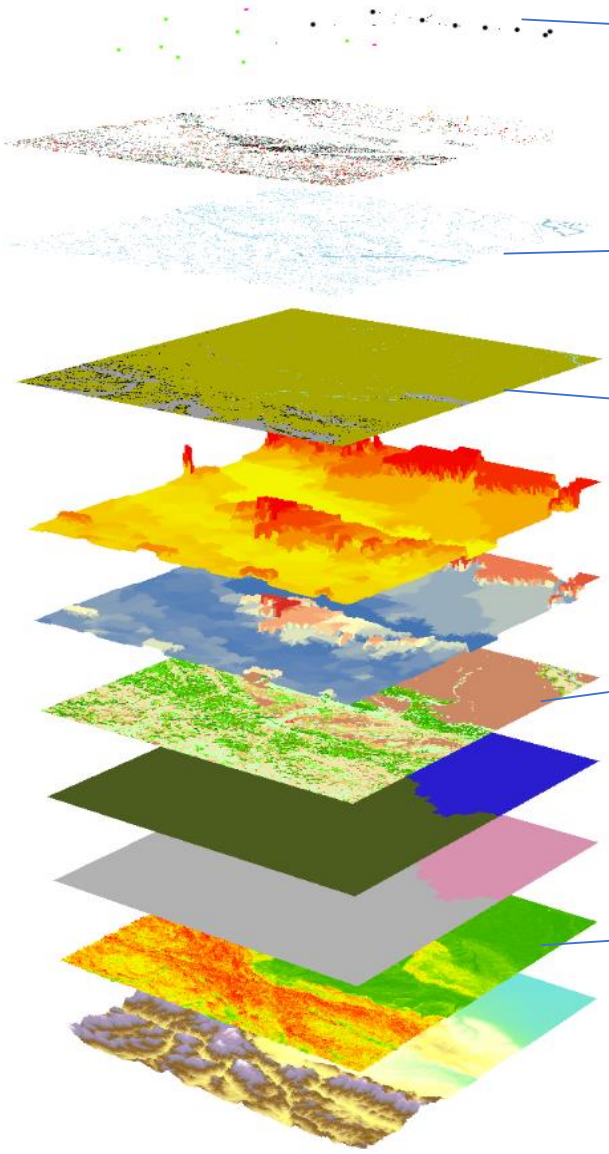
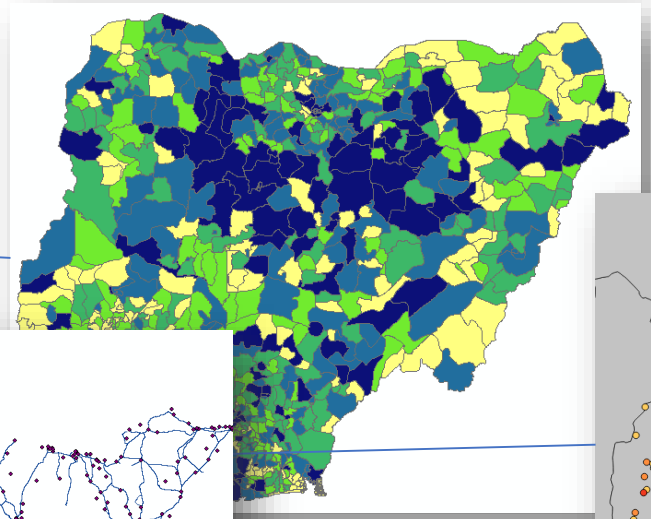
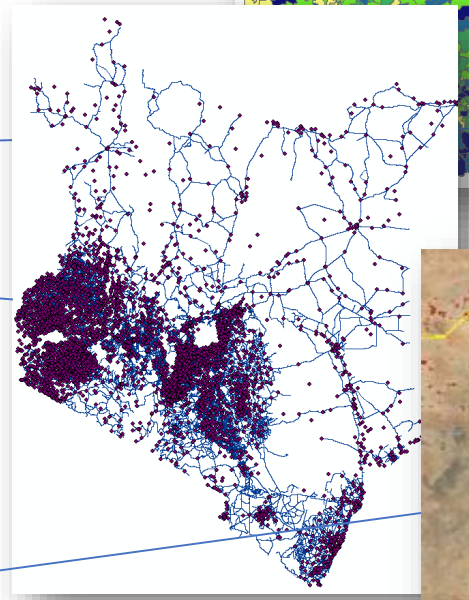
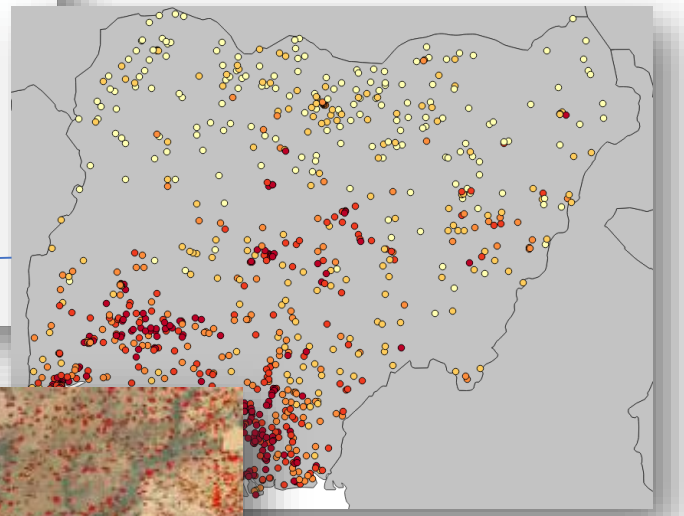
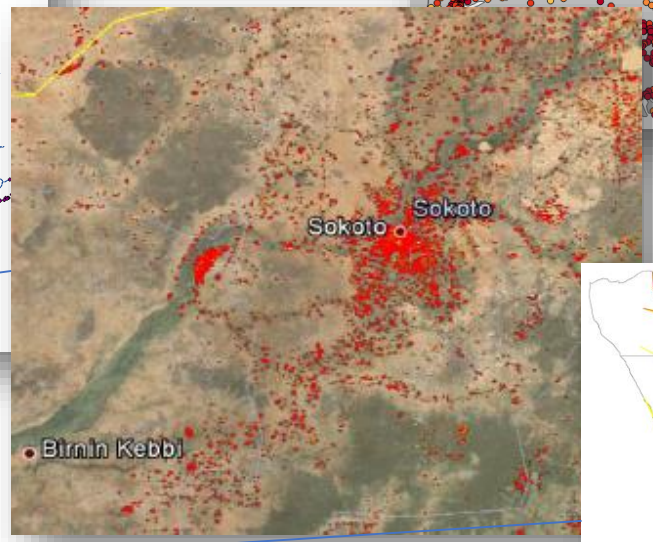
Data integration

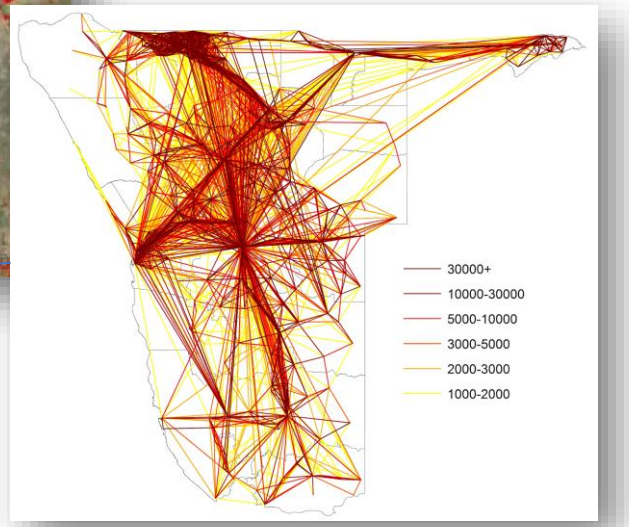


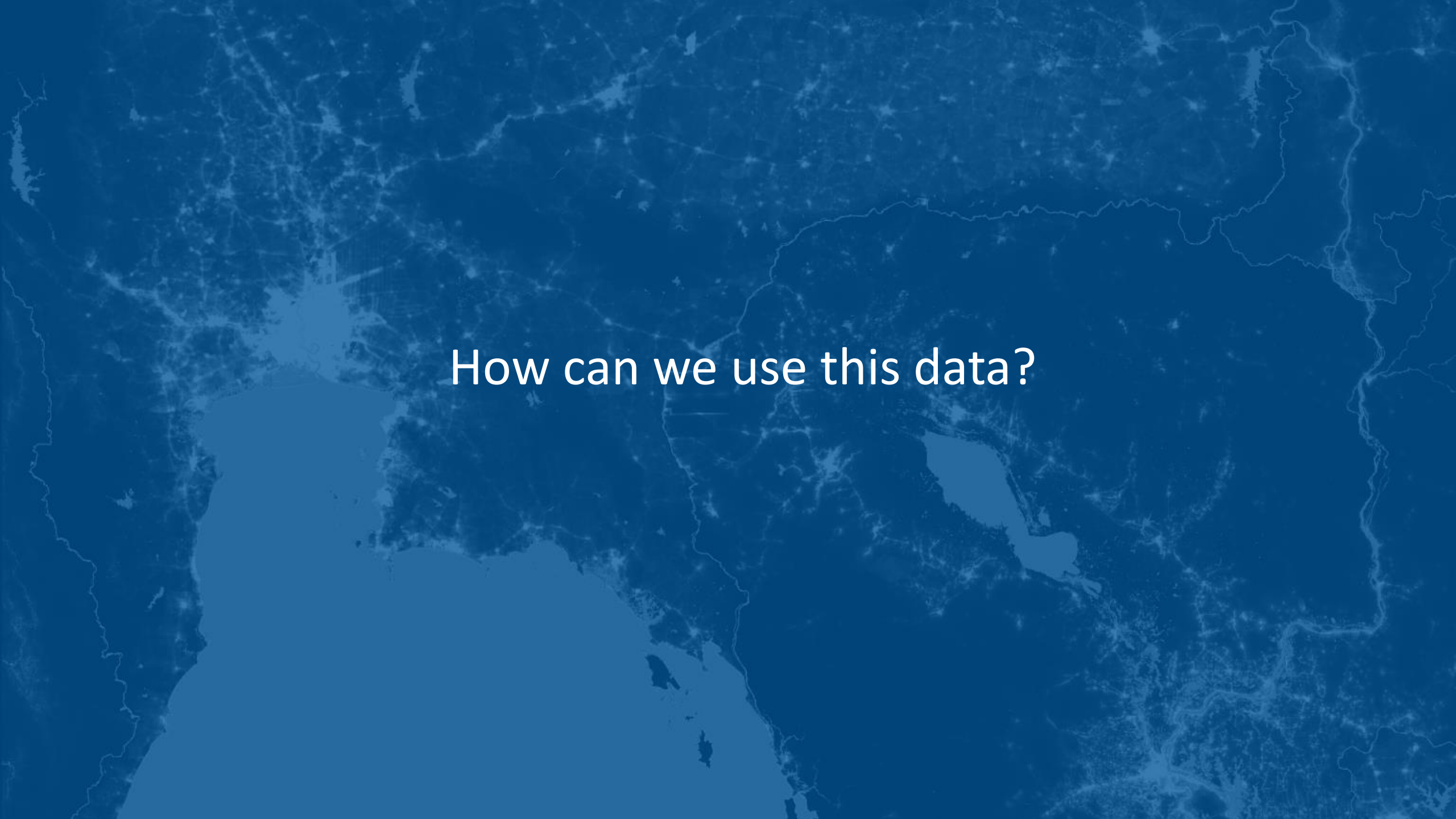






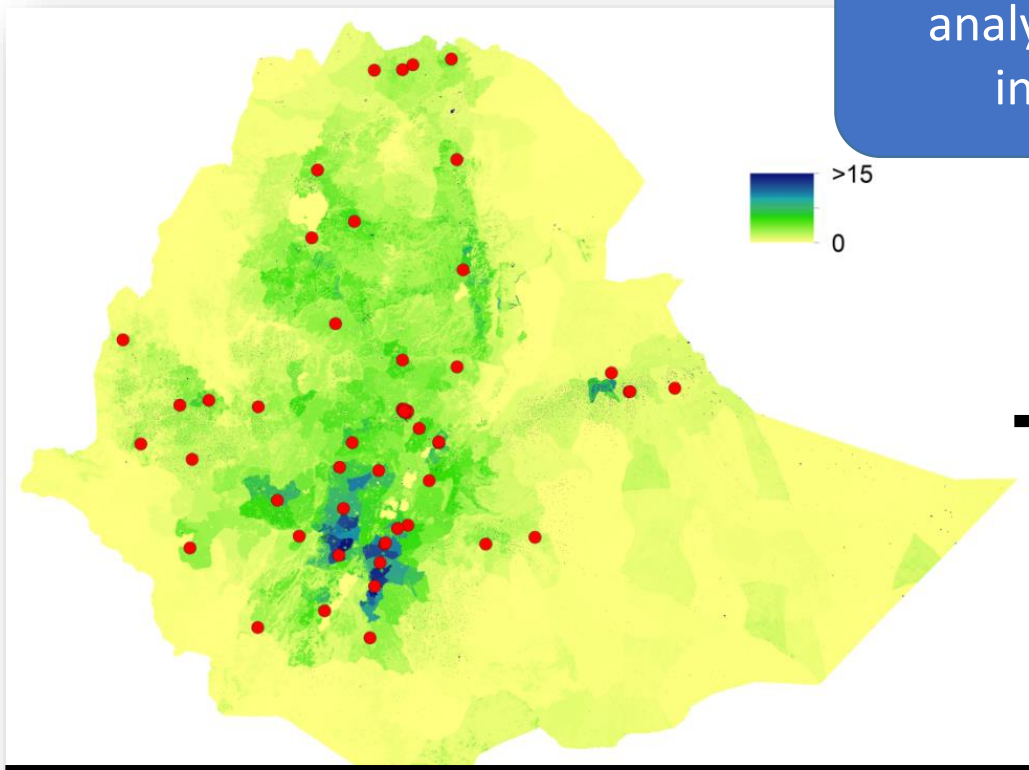




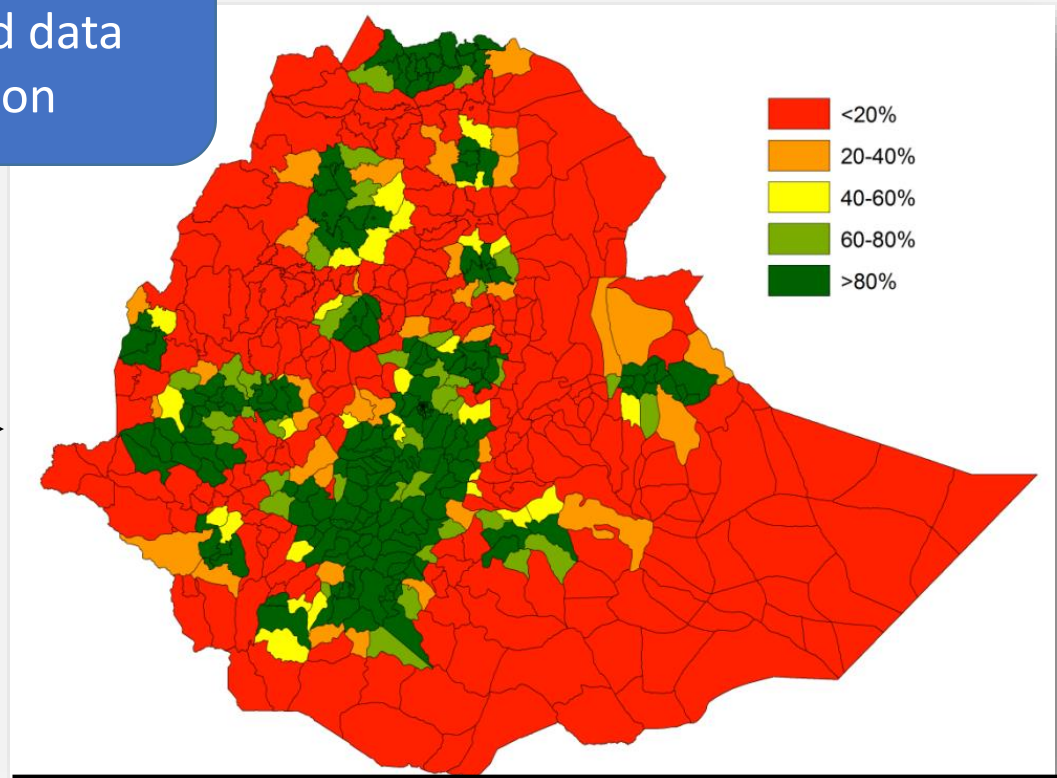

How can we use this data?

Gridded population data

Grids: flexibility in analysis and data integration



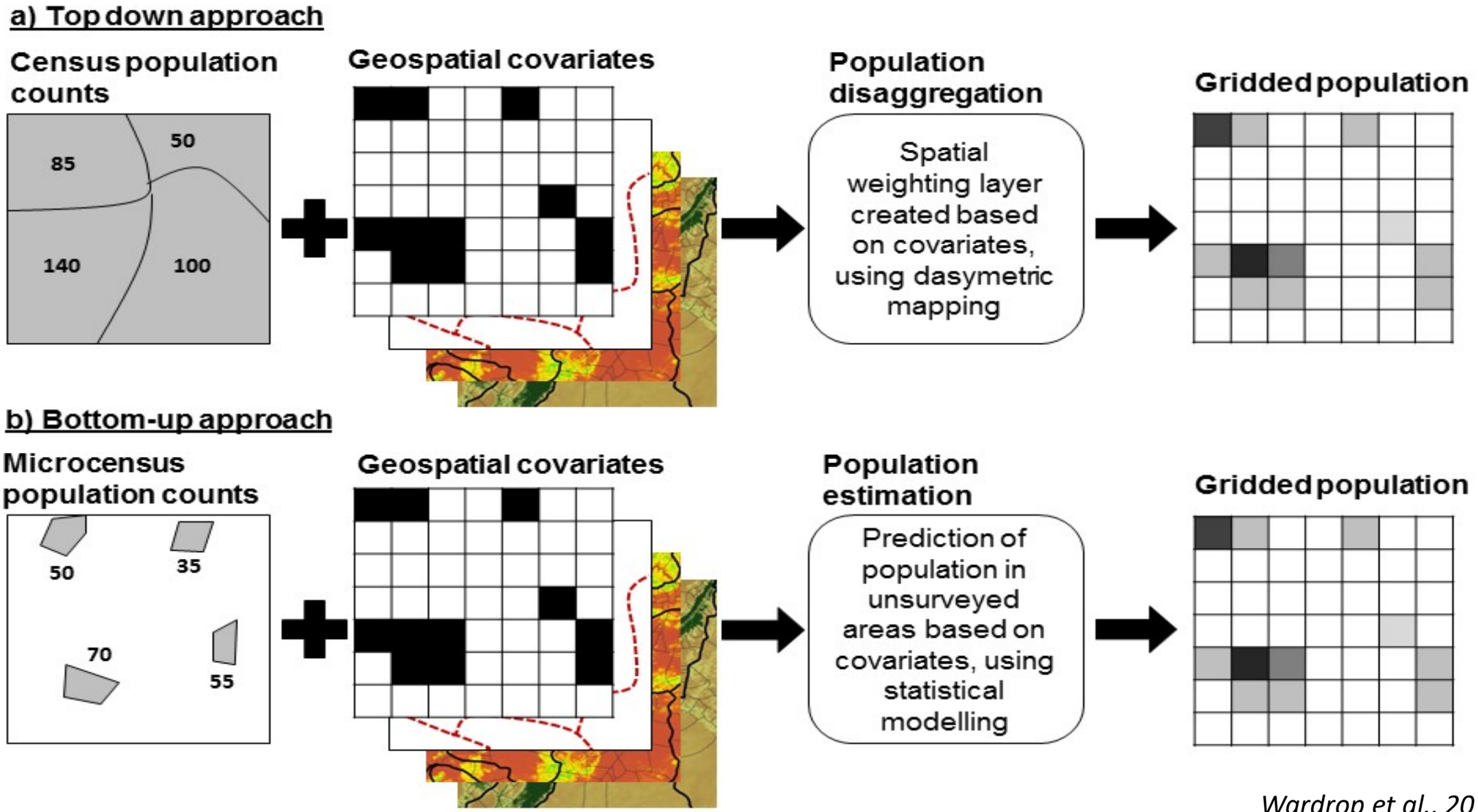
Comprehensive Emergency Obstetric and Neonatal Care (CEmONC) Facilities overlaid on grid of women of childbearing age



Percentage of women of childbearing age per woreda within 50km of a CEmONC

population totals

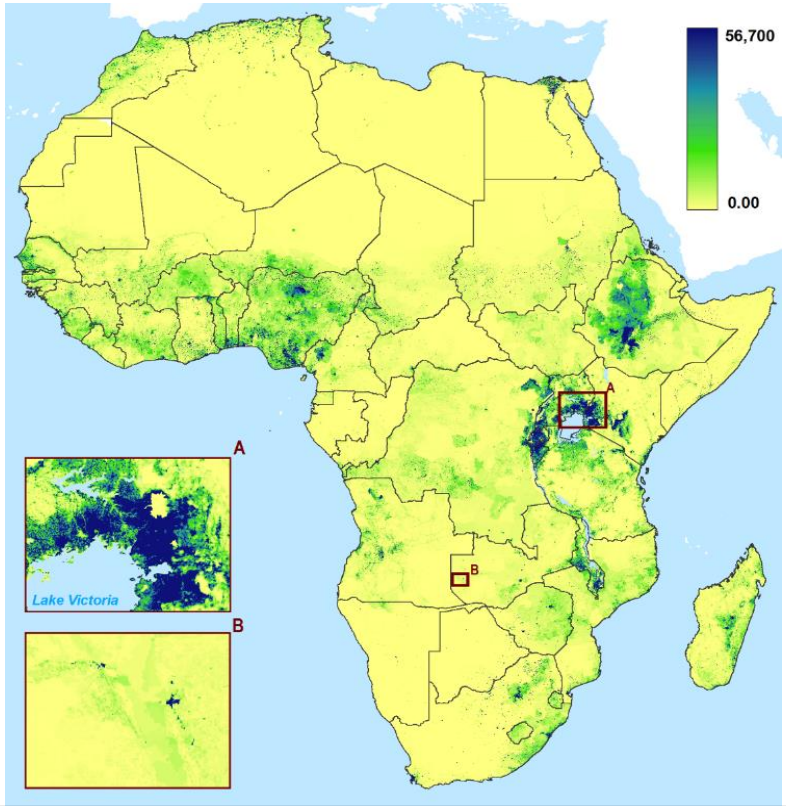
Top-Down Vs Bottom-Up Approach



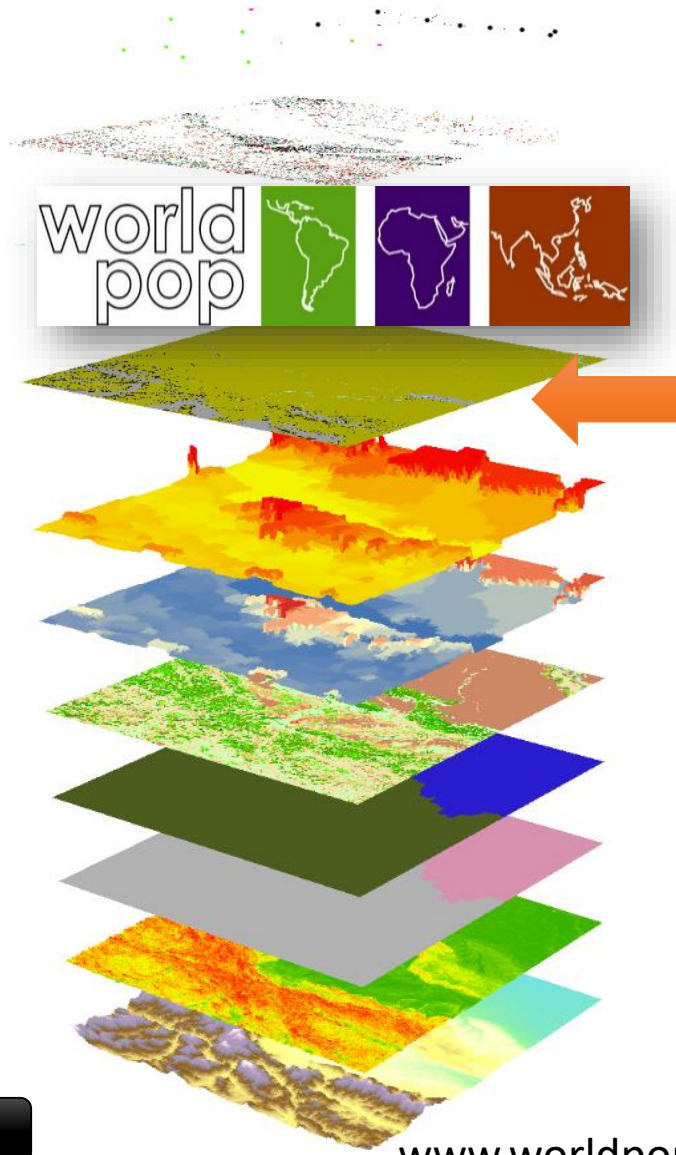
Wardrop et al., 2018 (PNAS)

Top-down disaggregation

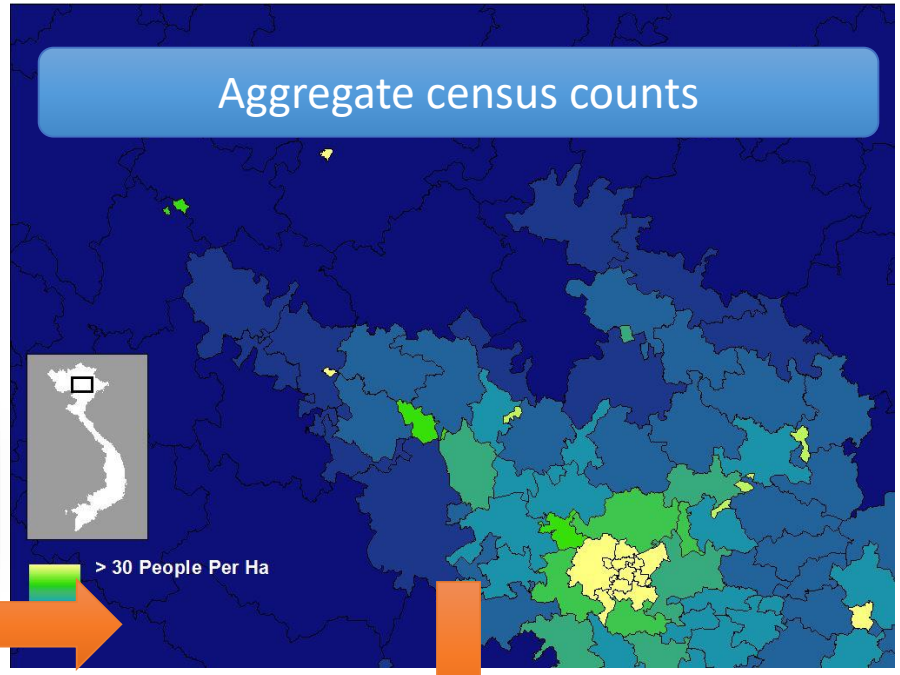
Integration with satellite/GIS data related to human population distribution patterns to disaggregate counts to regular grids



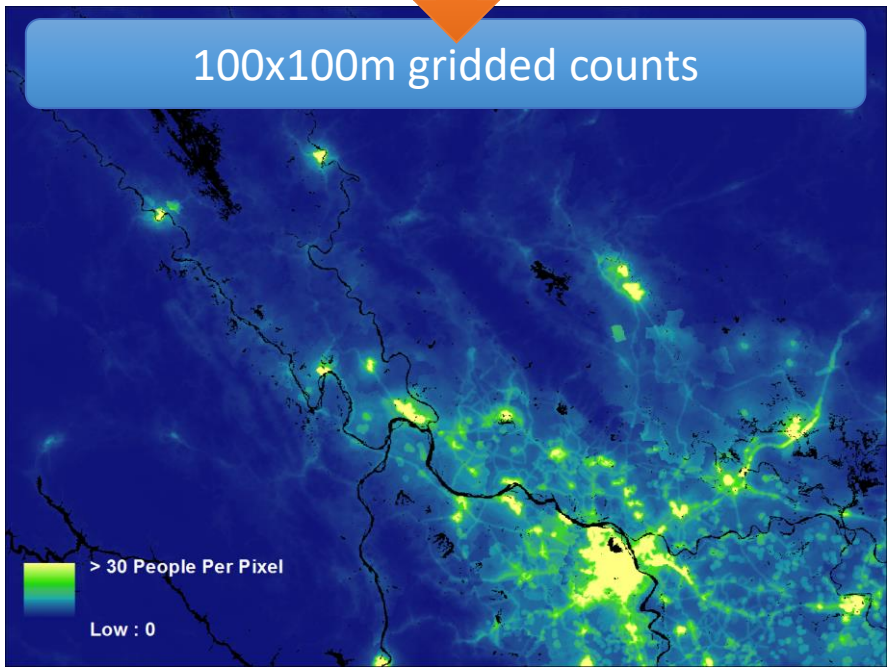
People per 1x1km 2017



Aggregate census counts



100x100m gridded counts

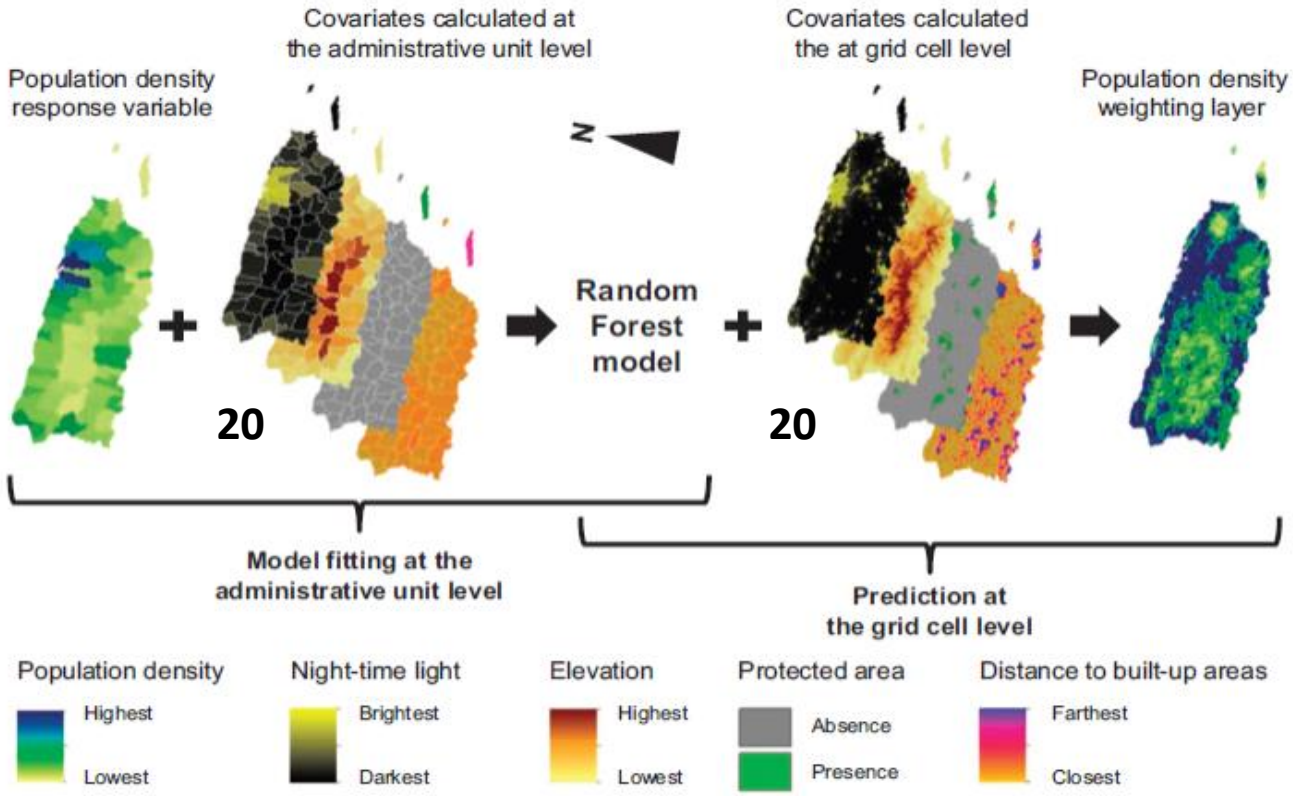


www.worldpop.org

Tatem (2017) Nature Sci Data

Random Forest-based Dasymetric Approach

- Used to disaggregate subnational census-based figures^, #



PLOS ONE

RESEARCH ARTICLE

Disaggregating Census Data for Population Mapping Using Random Forests with Remotely-Sensed and Ancillary Data

Forrest R. Stevens[1]*, Andrea E. Gaughan[1], Catherine Linard[2,3], Andrew J. Tatem[4,5]

1 Department of Geography and Geosciences, University of Louisville, Louisville, Kentucky, United States of America, 2 Fonds National de la Recherche Scientifique (F.R.S.-FNRS), Rue d'Egmont 5, B-1000 Brussels, Belgium, 3 Biological Control and Spatial Ecology, Université Libre de Bruxelles, CP 160/12, Avenue FD Roosevelt 50, B-1050 Brussels, Belgium, 4 Department of Geography and Environment, University of Southampton, Highfield, Southampton SO17 1BJ, United Kingdom, 5 Fogarty International Center, National Institutes of Health, Bethesda, MD 20892, United States of America

* forrest.stevens@louisville.edu

SCIENTIFIC DATA

OPEN

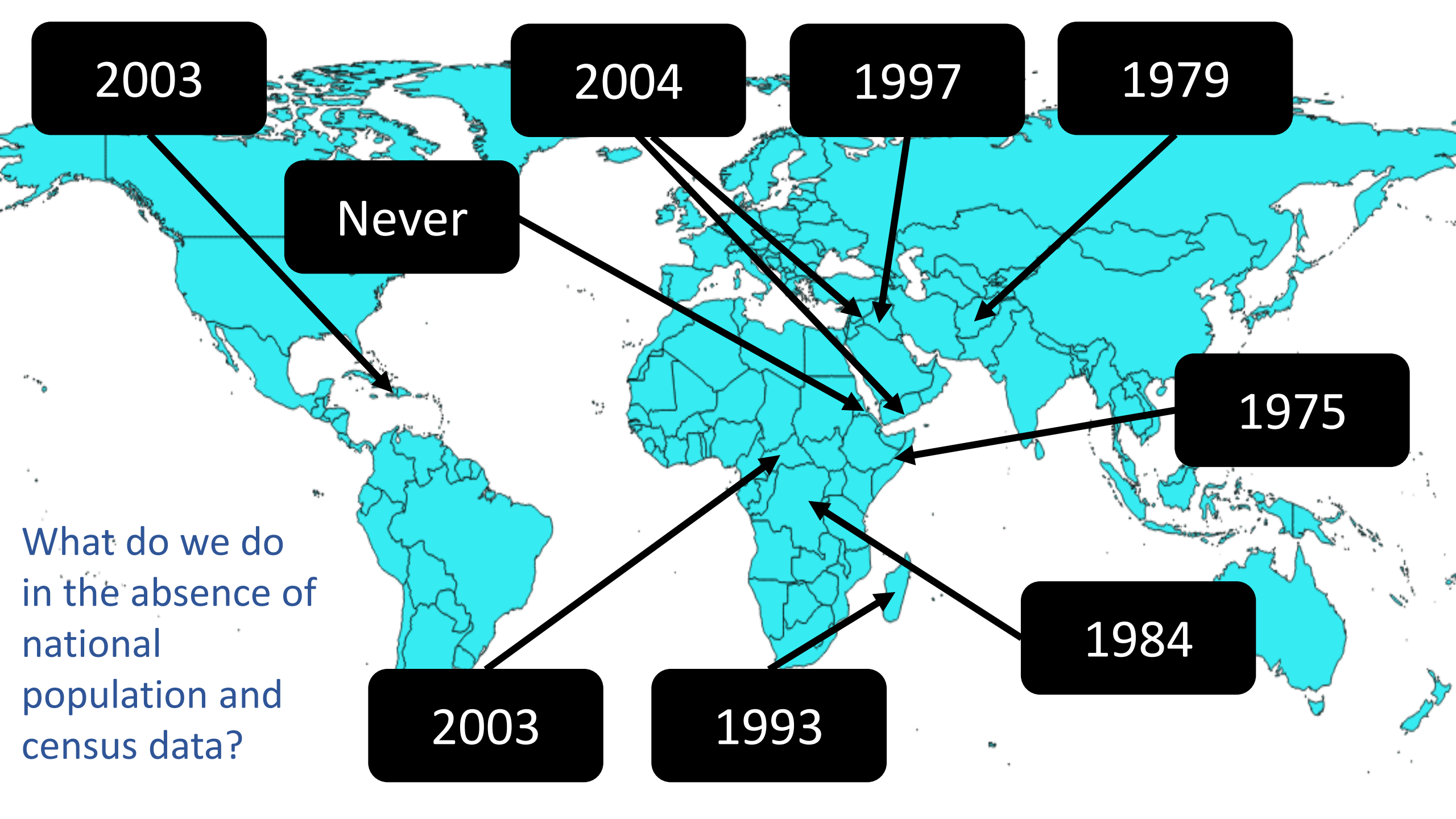
SUBJECT CATEGORIES
» Geography
» Malaria
» Sustainability
» Environmental sciences

High-resolution gridded population datasets for Latin America and the Caribbean in 2010, 2015, and 2020

Alessandro Sorichetta[1,2], Graeme M. Hornby[3], Forrest R. Stevens[4], Andrea E. Gaughan[4], Catherine Linard[5,6] & Andrew J. Tatem[1,7,8]

^Stevens et al, 2015; #Sorichetta et al., 2015

Isn’t there a basic data problem in some countries?



What do we do in the absence of national population and census data?

High-resolution population mapping in Afghanistan

UNFPA

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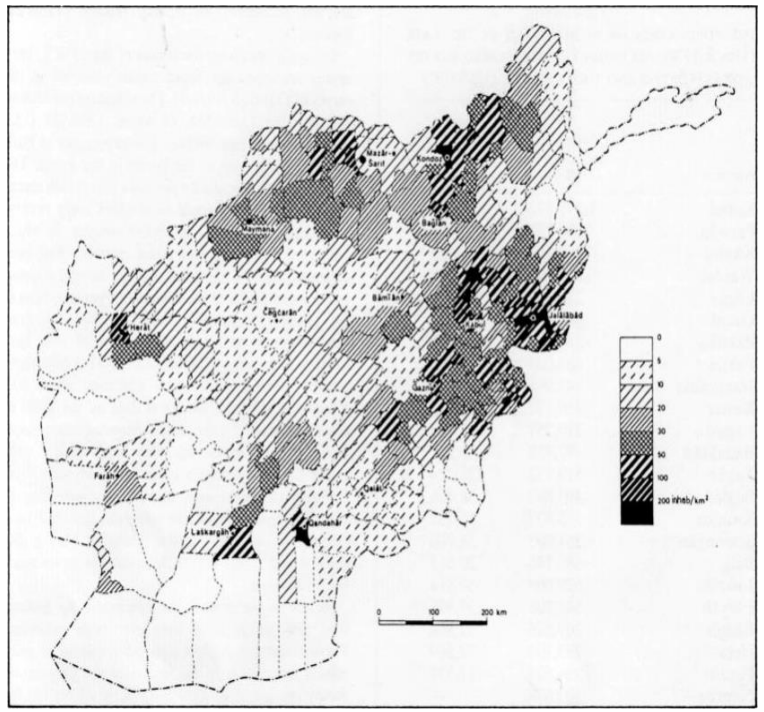
UNIVERSITY OF Southampton

Afghanistan - Background



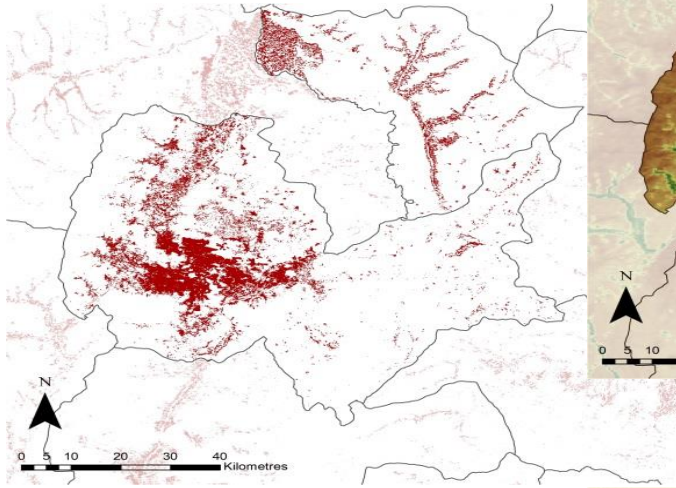
Last national population census was in 1979
Significant uncertainties in national and subnational estimates

1979 Census map

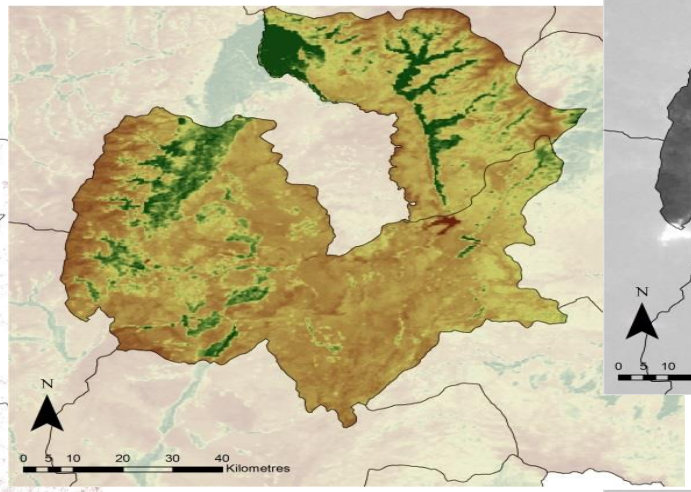
One-third of country covered by a rolling census (SDES), but insecurity preventing additional data collection

President Ghani requested exploration of new methods for obtaining subnational population numbers

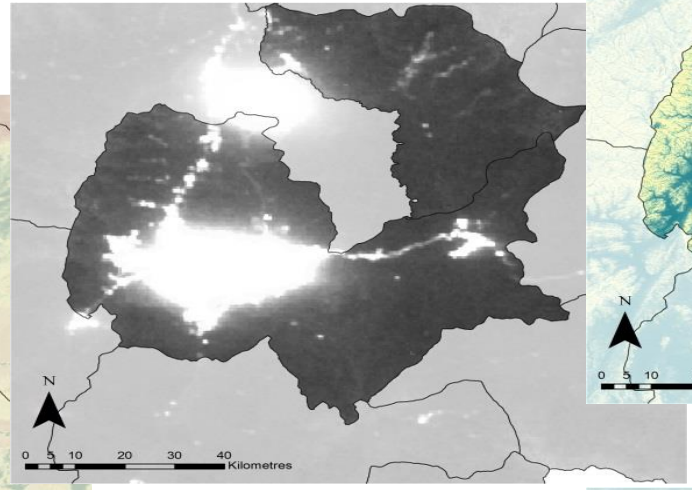
Example geospatial datasets for population prediction



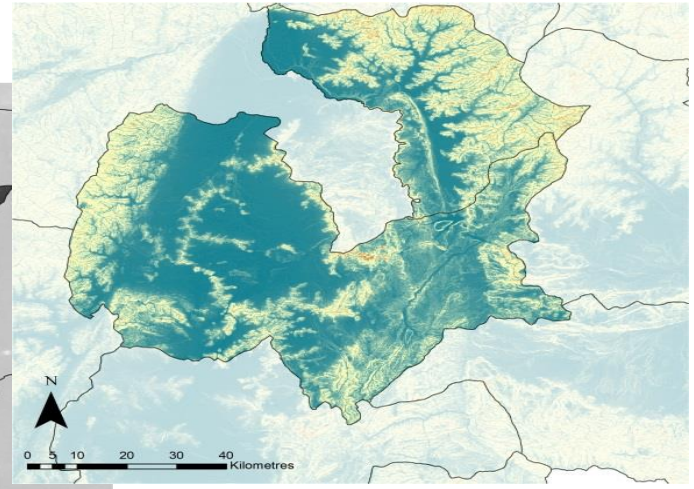
Number of compounds & area settled



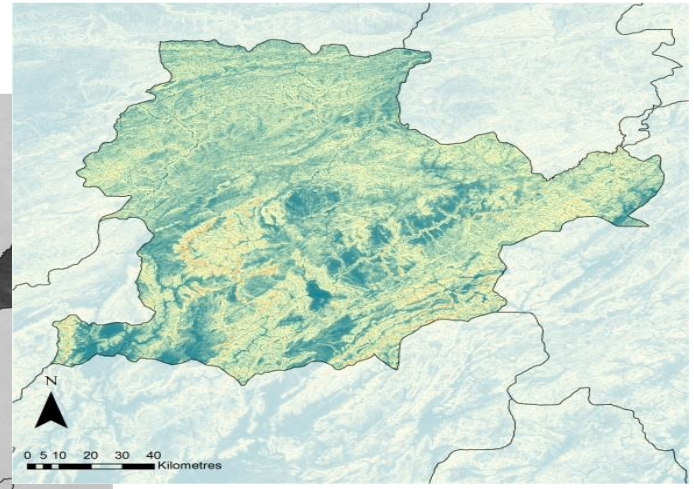
Vegetation index

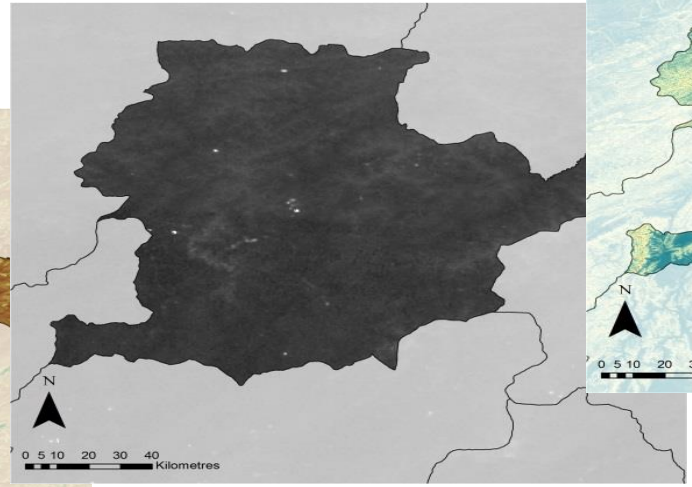


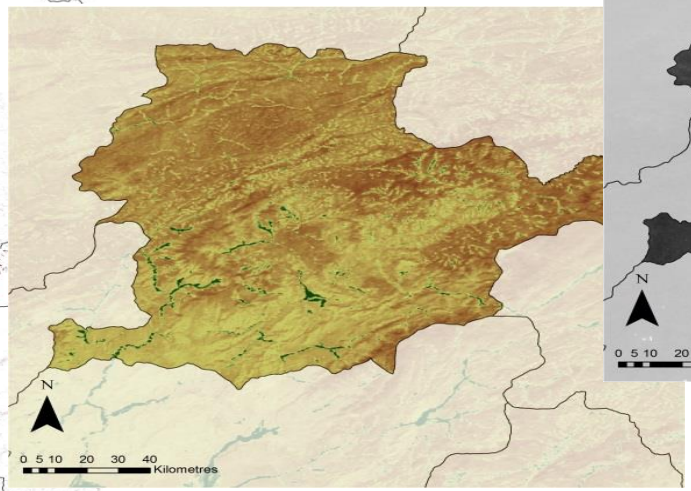
Night-time lights

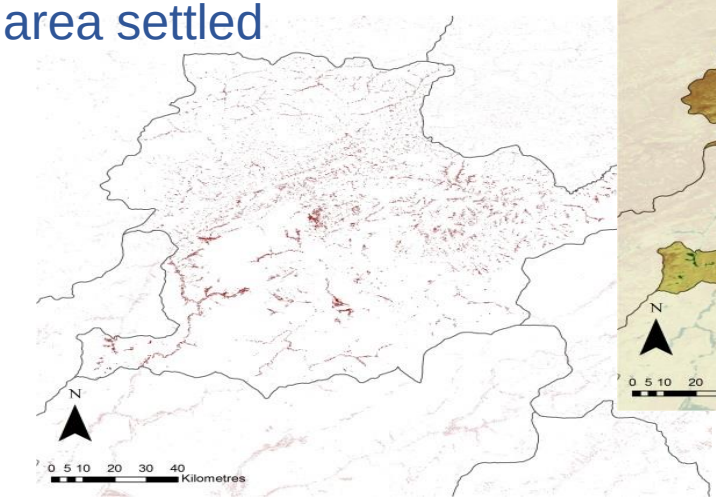


Slope



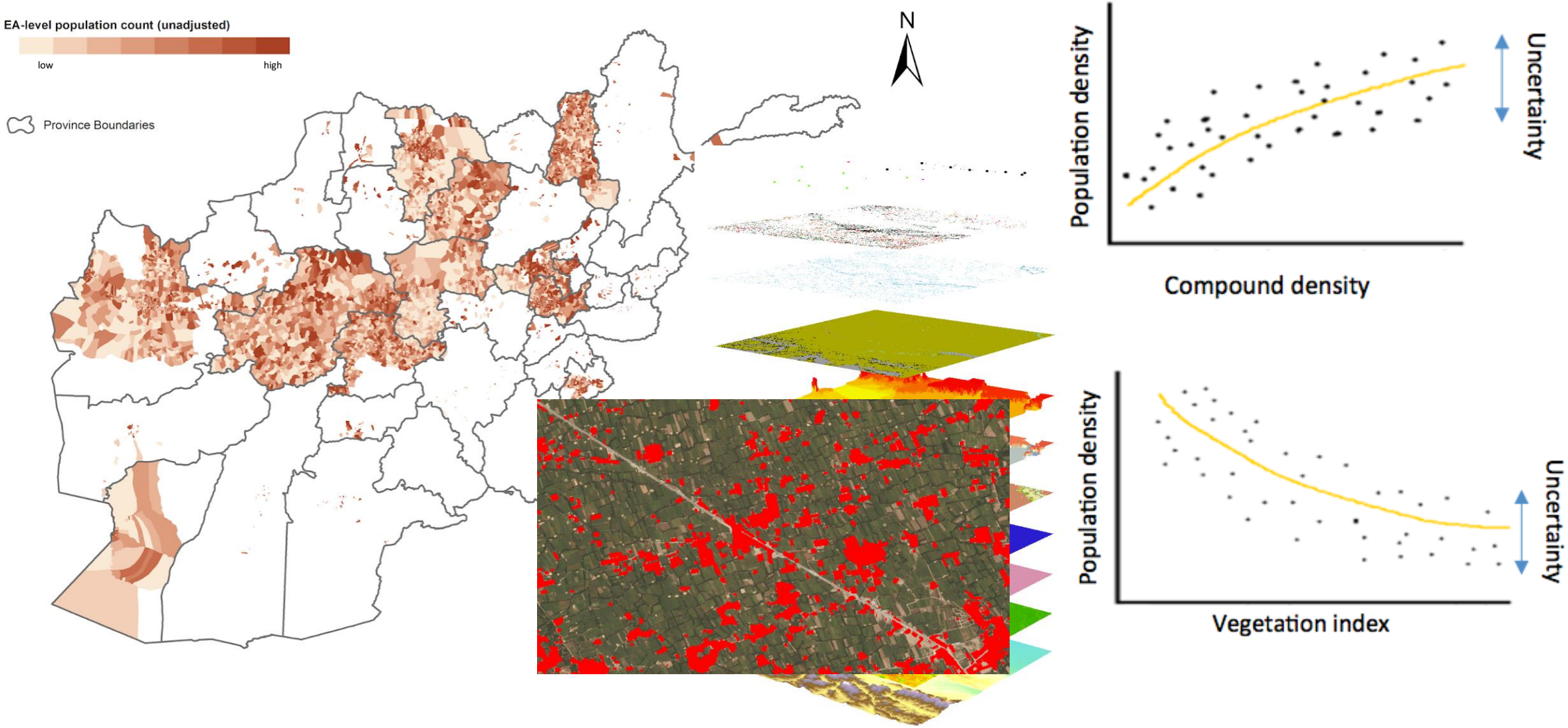


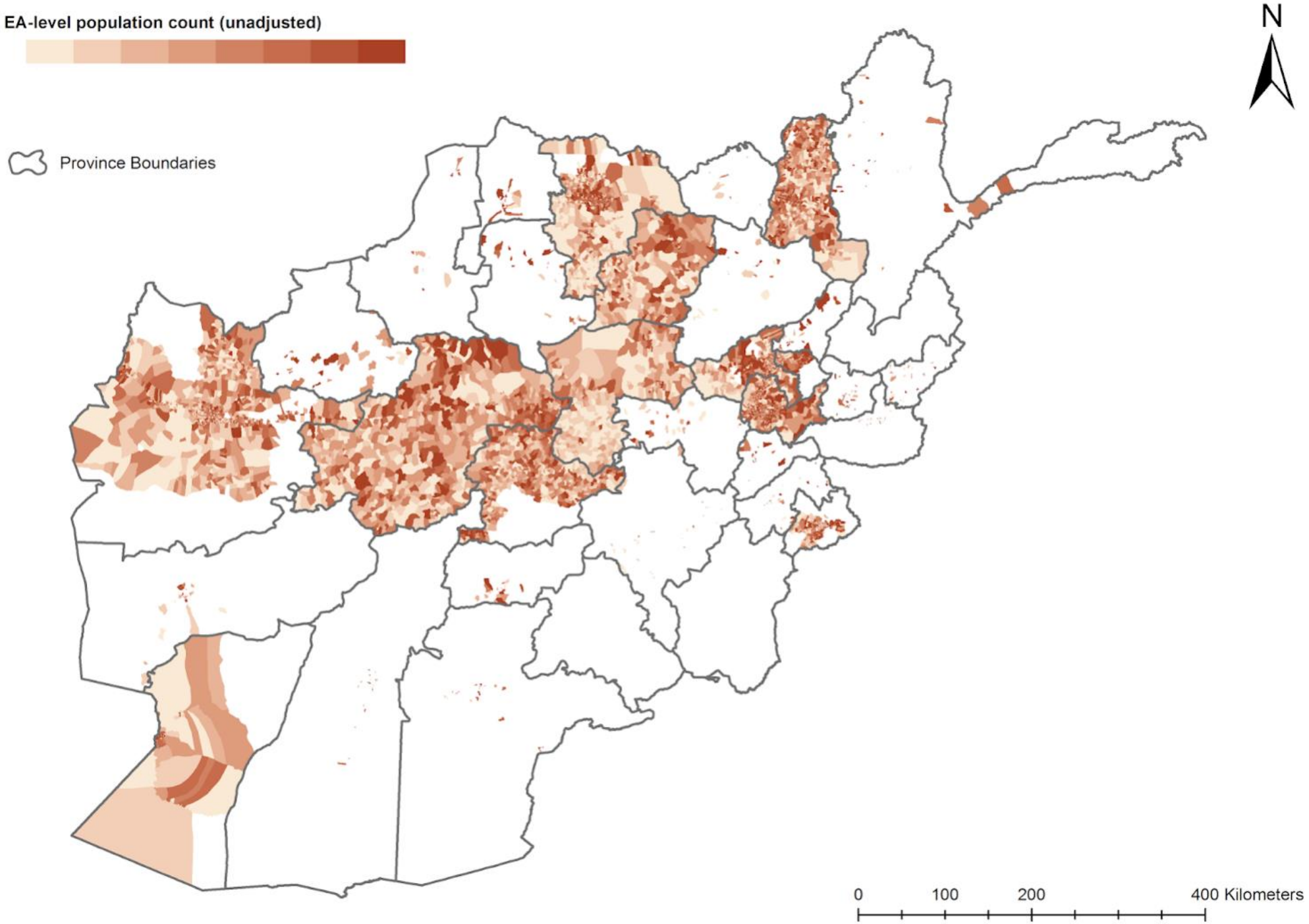


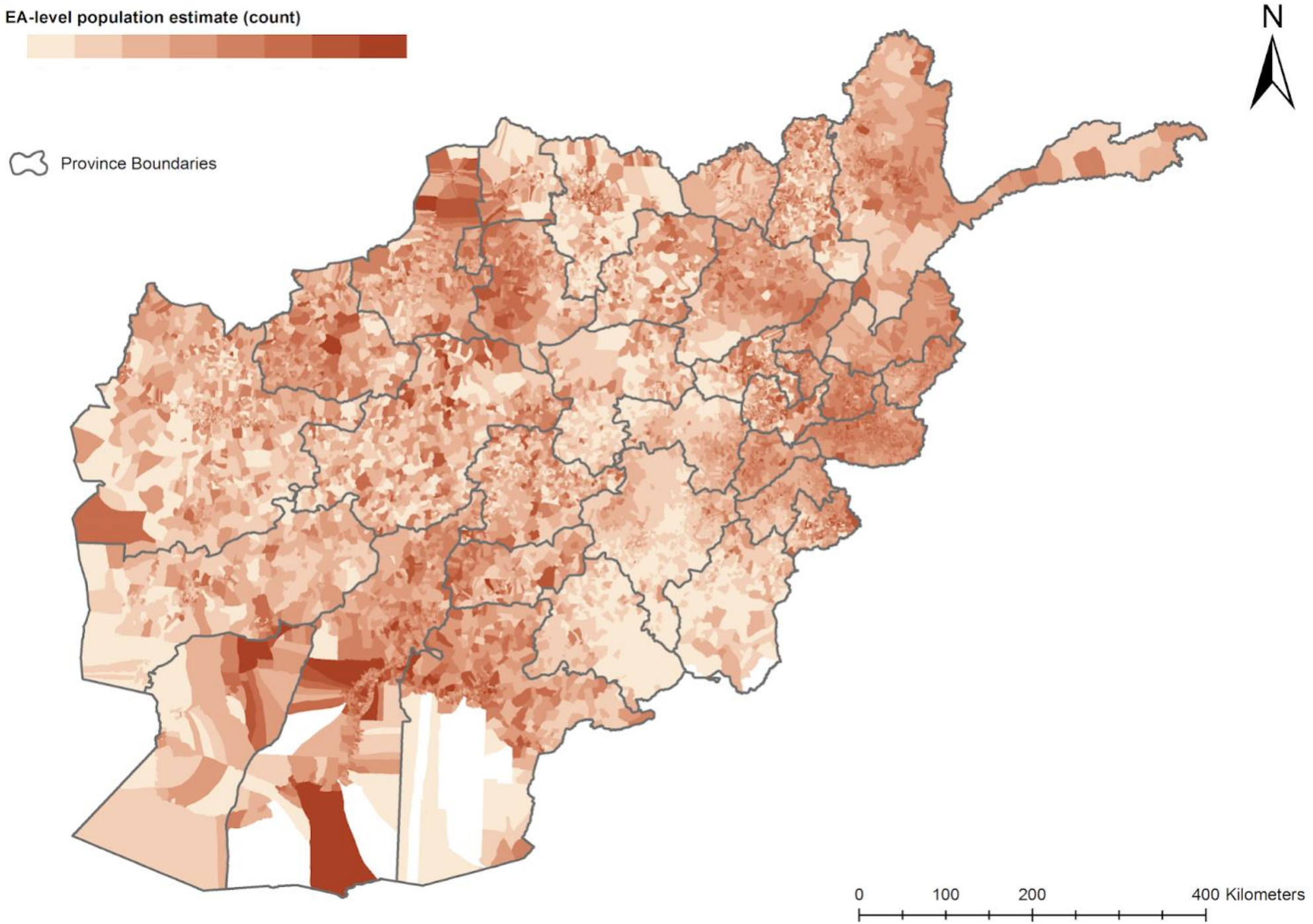


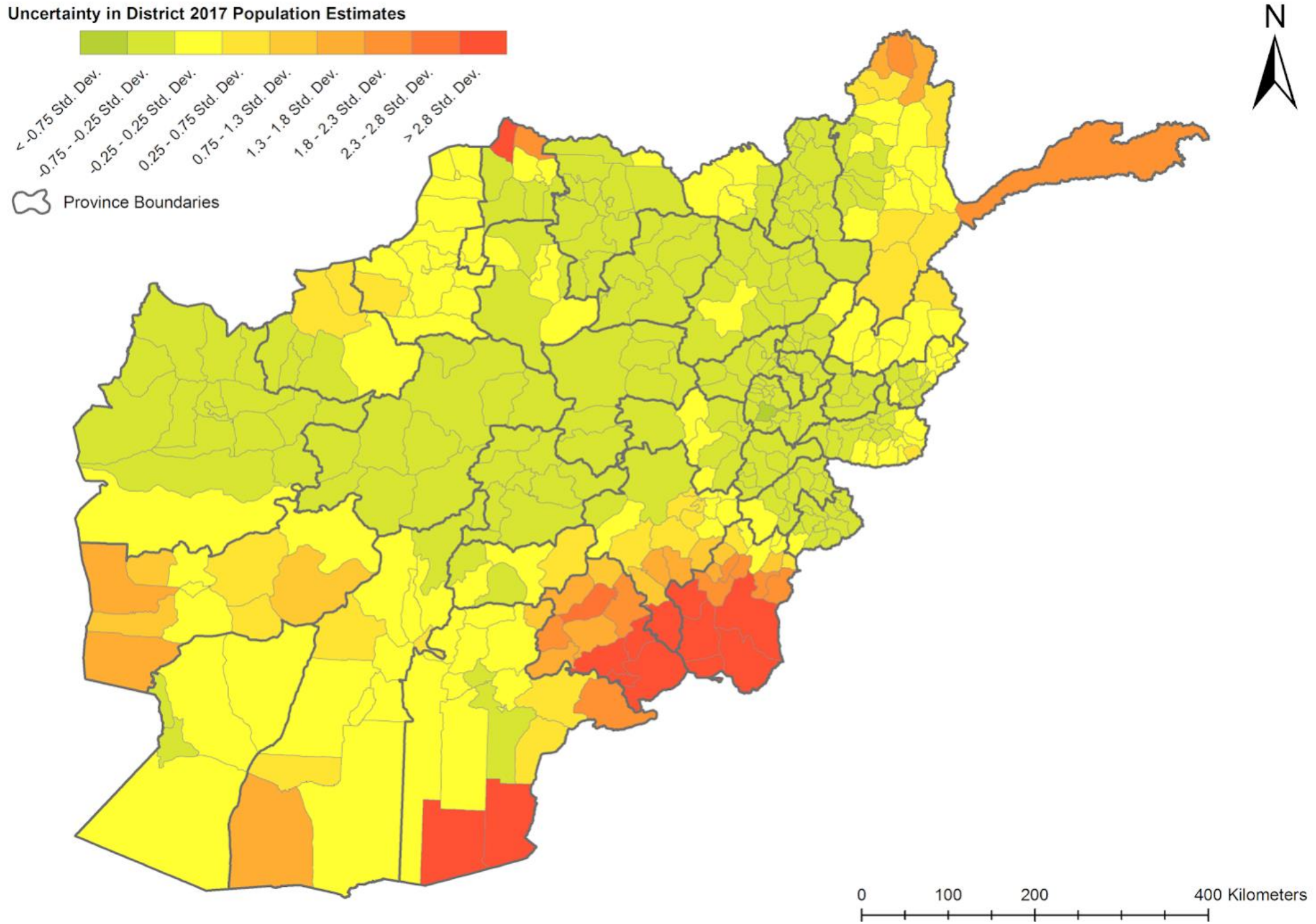
>100 geospatial datasets

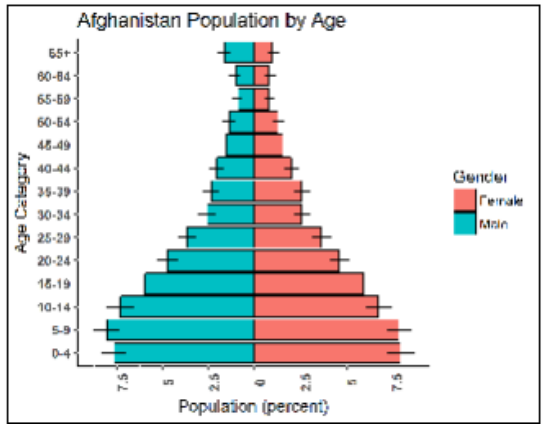
Model-based estimates




EA-level population count (unadjusted)
Province Boundaries
N
0
100
200
400 Kilometers


EA-level population estimate (count)
Province Boundaries
N
0
100
200
400 Kilometers


Uncertainty in District 2017 Population Estimates
< -0.75 Std. Dev.
-0.75 - -0.25 Std. Dev.
-0.25 - 0.25 Std. Dev.
0.25 - 0.75 Std. Dev.
0.75 - 1.3 Std. Dev.
1.3 - 1.8 Std. Dev.
1.8 - 2.3 Std. Dev.
2.3 - 2.8 Std. Dev.
> 2.8 Std. Dev.
Province Boundaries
N
0
100
200
400 Kilometers



Province boundaries

N

0 50 100 200 Km

GRID3

GEO-REFERENCED INFRASTRUCTURE AND DEMOGRAPHIC DATA FOR DEVELOPMENT

BILL & MELINDA GATES foundation

UKaid from the British people

world pop FLOWMINDER.ORG

UNFPA

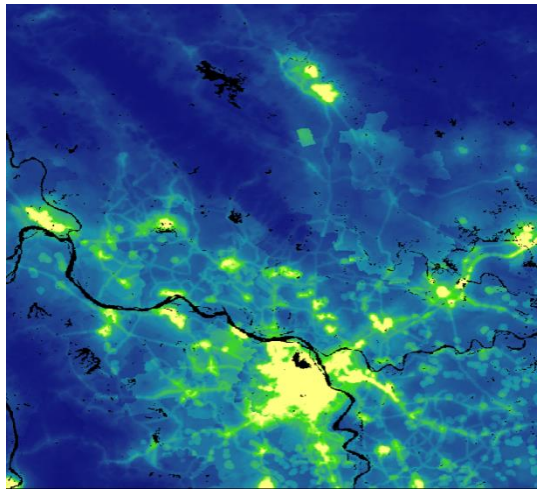
Center for International Earth Science Information Network
EARTH INSTITUTE | COLUMBIA UNIVERSITY

Our vision

"We envision a world where data analytics puts everyone on the map, ensuring that especially the most vulnerable count.

What we do

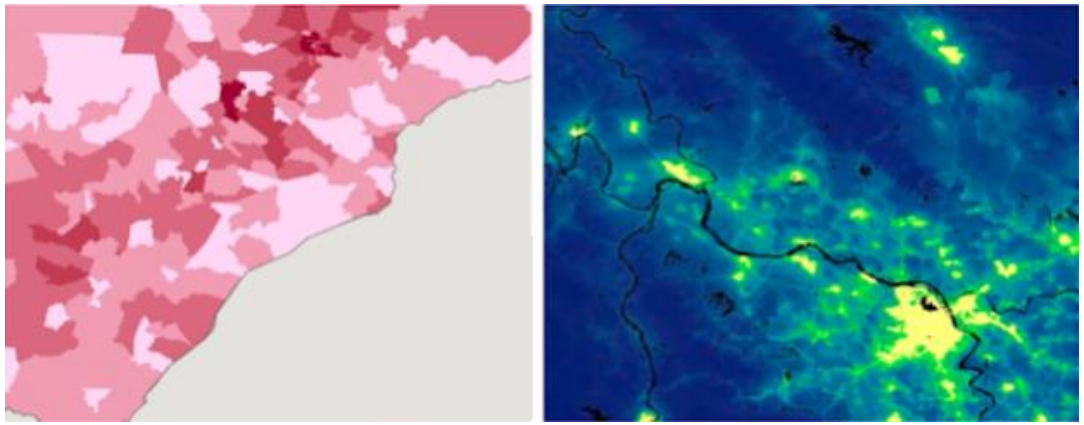
GRID^3 provides support to low- and medium-income countries to collect, analyse, integrate, disseminate, and utilise high-resolution geo-referenced data for development and humanitarian decision making.



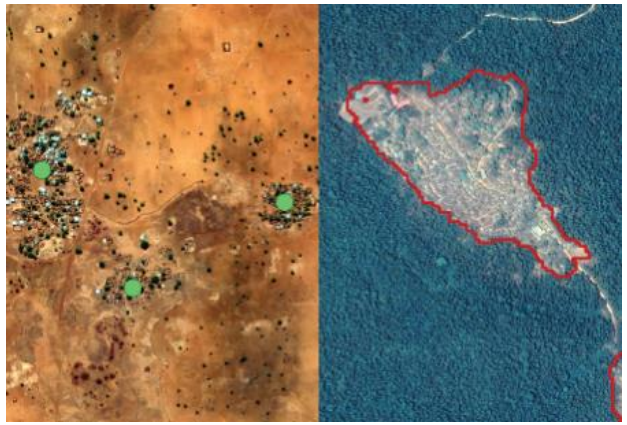
Spatial Data Production

GRID³ helps produce three spatial data layers to meet critical development needs:

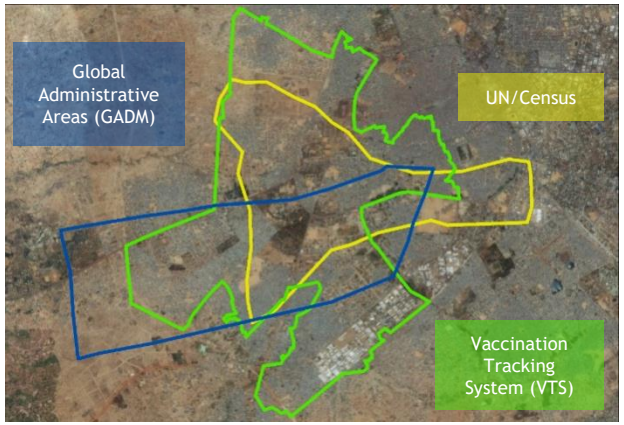
High-Resolution Population Maps



Settlement Locations



Subnational Boundaries



Current Focus

GRID³ is underway within five African countries:

Nigeria

Mozambique

Zambia

Tanzania

Democratic Republic of the Congo

GRID3

GEO-REFERENCED INFRASTRUCTURE AND DEMOGRAPHIC DATA FOR DEVELOPMENT

Parallel Session : Measuring and Monitoring the SDGs

Geospatial Innovations for Detecting and Mapping Infrastructure, Censuses and Modelled Population

Wednesday 21 November 2018
9:00 – 10:30
E303, Exhibition Centre