



FLOWMINDER.ORG

Estimating population mobility from mobile phone usage data

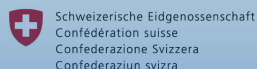
26 January 2022

Linus Bengtsson, Co-founder and Chair of the Board

Tom Smallwood, Knowledge Centre Manager

Aurélie Jeandron, Infectious Disease Epidemiologist

Some of our supporters:



Federal Department of Foreign Affairs FDFA
State Secretariat STS-FDFA
Peace and Human Rights

Our supporters

Non-profit funded
by & supporting key
actors

Photo credit: ECHO, Susana Perez Diaz, Flickr



Backstory
2010 Haiti
Earthquake &
cholera epidemic



Science & Innovation
Solid academic
research. 50+ peer
reviewed
publications



Our team & work
38 staff to enable
data driven decision
support for LMICs

FLOWMINDER.ORG

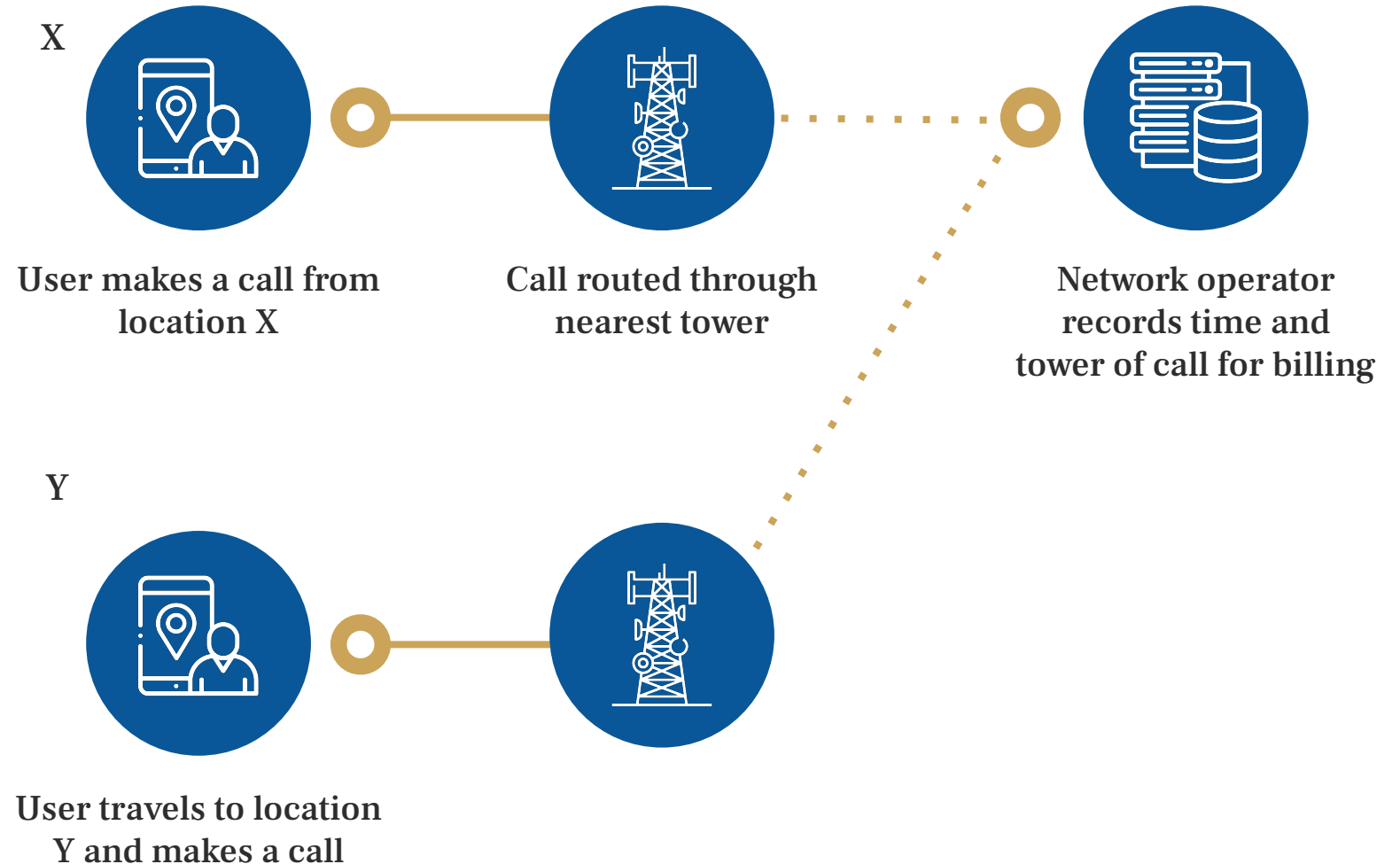
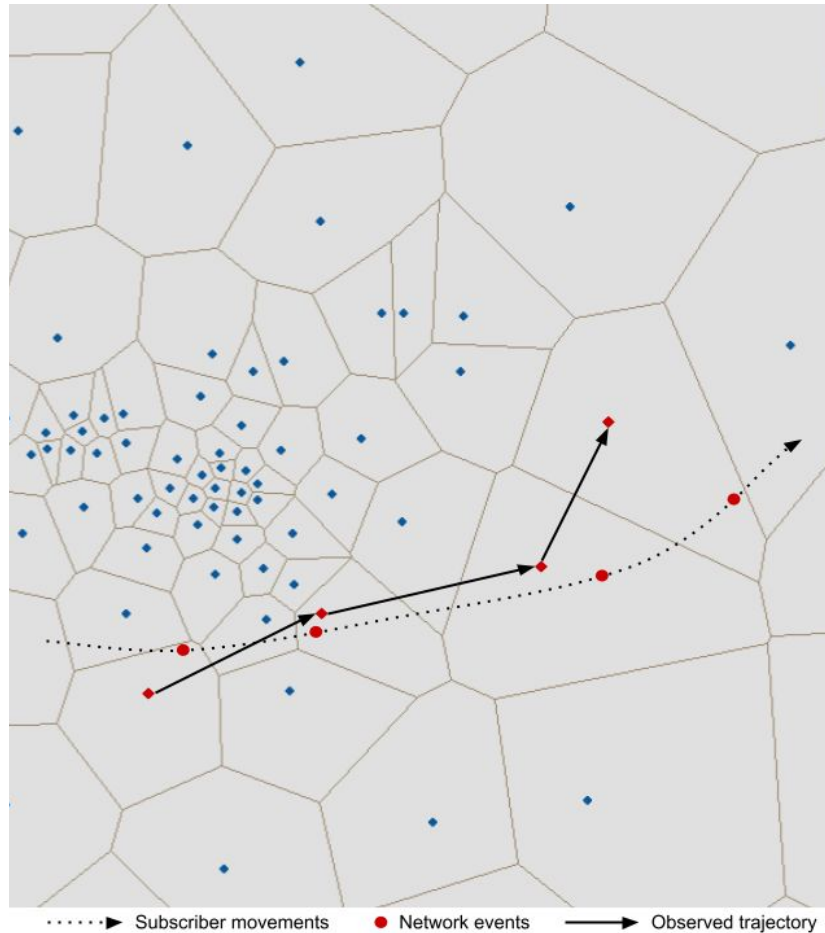
Flowminder MNO collaborations to date

Countries where Flowminder has collaboration with MNOs (present and past):

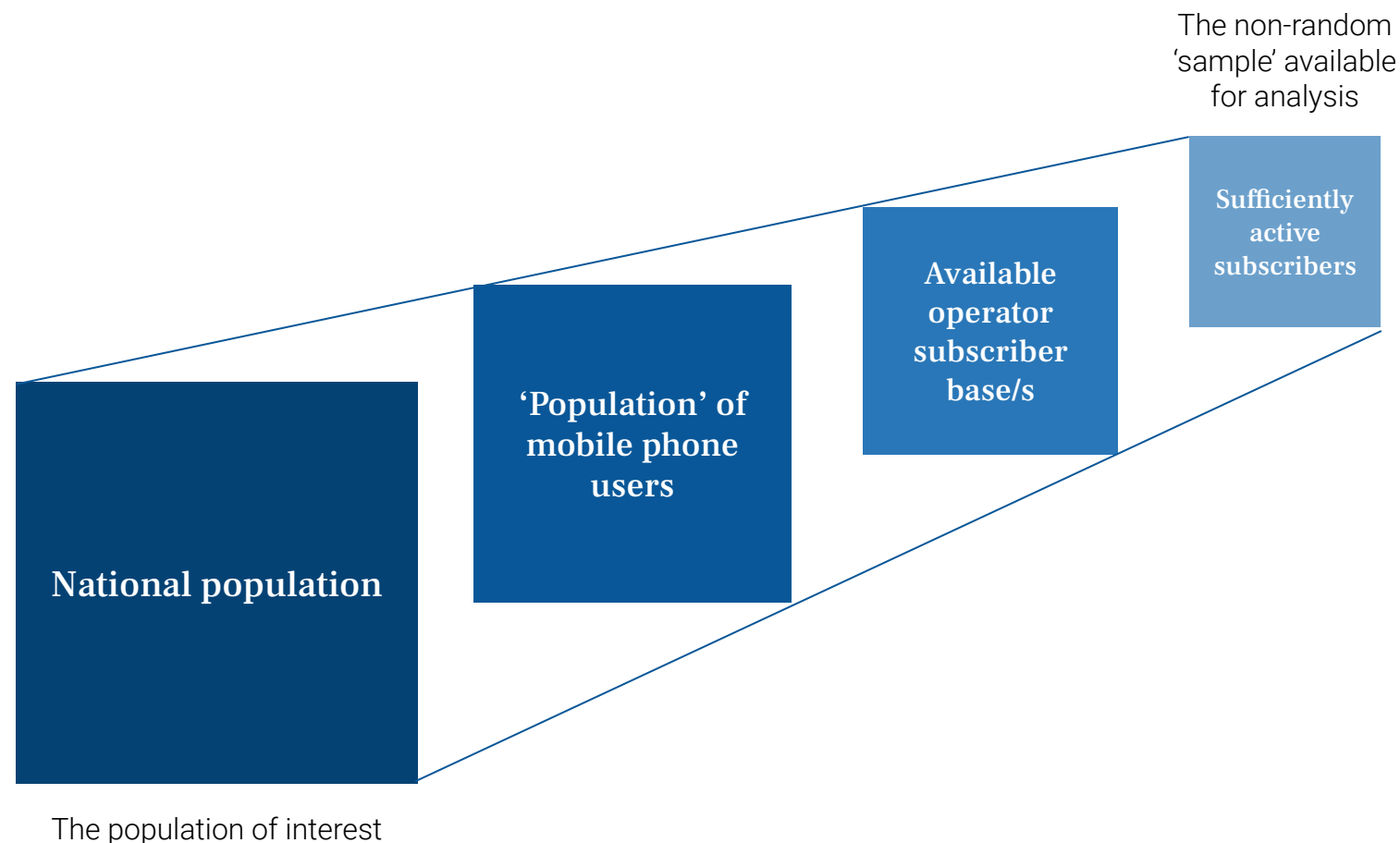
- Curacao (x 2 MNOs)
- Haiti
- Sierra Leone
- Ghana
- DRC (x 2 MNOs)
- Namibia
- Mozambique (x 3 MNOs via INCM)
- Nepal
- Papua New Guinea
- Western African country (in discussion)



CDRs can provide near-real time estimates of population movements & changes in population density



Addressing potential sampling biases



Additional data on demographics, phone use and mobility from field and phone surveys can help to address biases and therefore to get the most out of CDR data.

CDR-derived
insights should
never permit the
identification of
individual
subscribers.

Ensuring privacy and transparency

Key principles

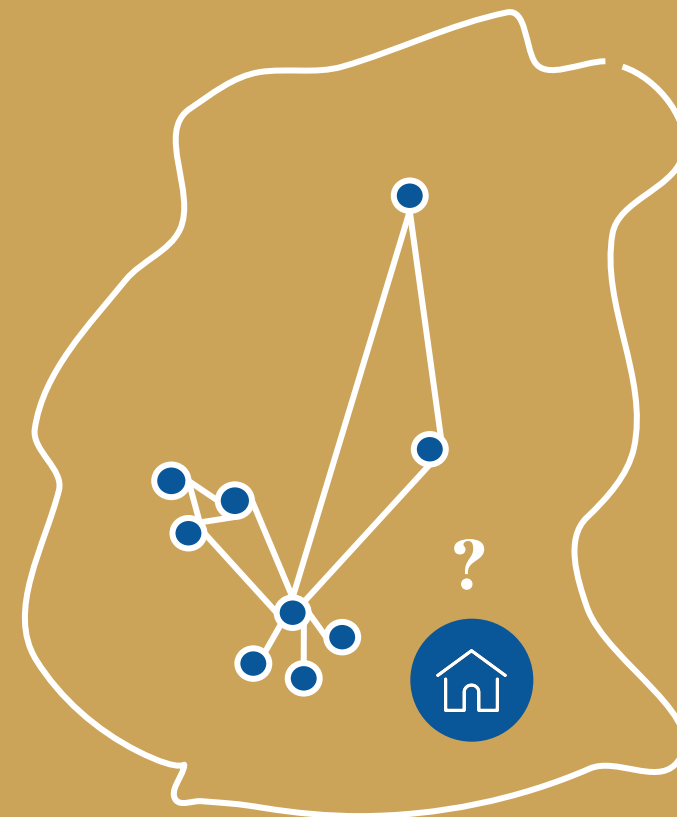
- GDPR compliance throughout
- Transparency and peer review:
 - Detailed and open method descriptions
 - Open algorithms
 - Publications in peer-reviewed academic journals



A broad range of mobility indicators can be derived from CDRs

- Subscriber presence
- Home locations
- Crowdedness
- Population mixing
- Intra-regional travel
- Inter-regional travel
- Locations of interest
- Trajectories and mobility patterns

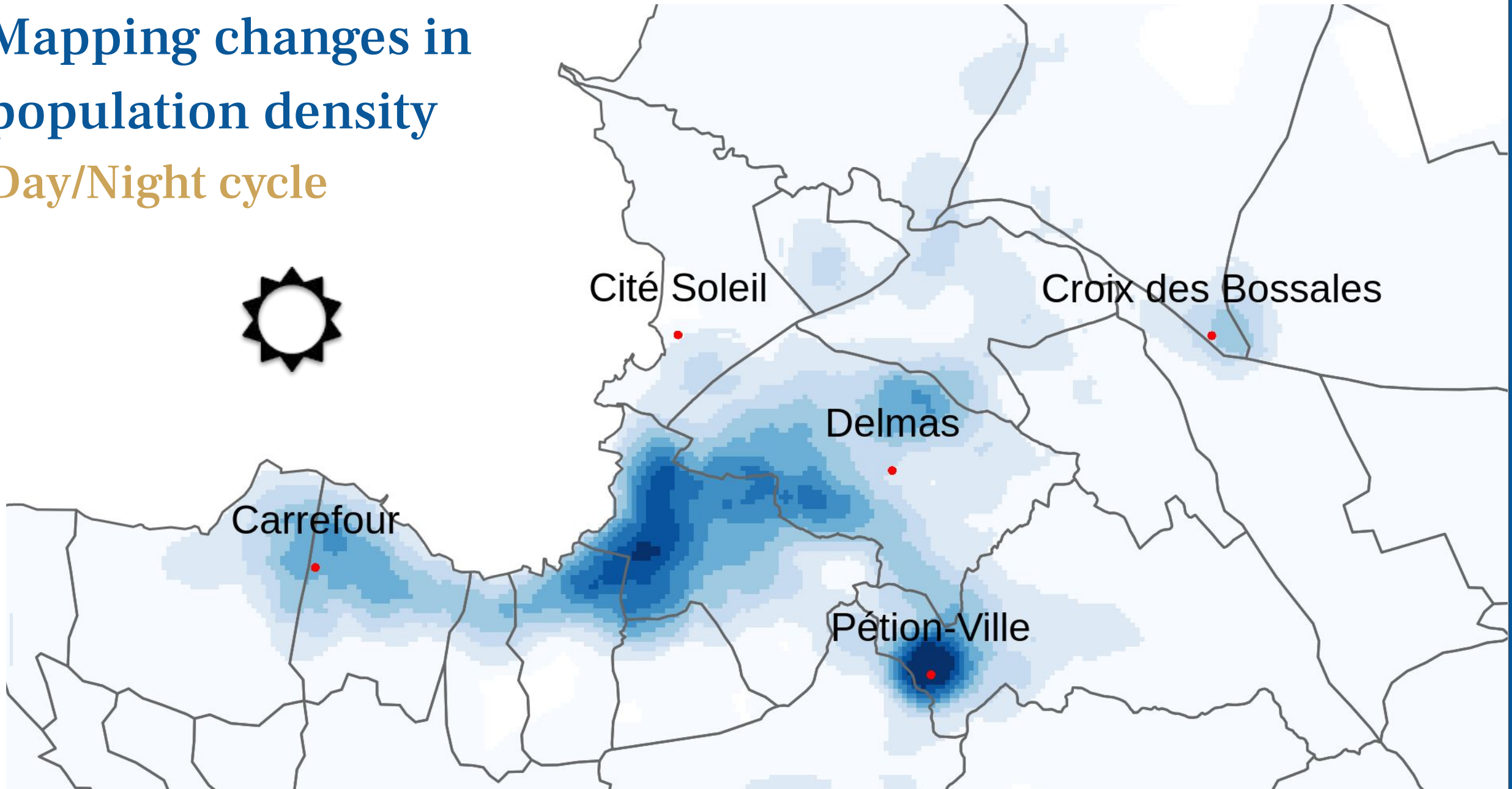
Other indicators: social connectivity, mobile phone usage and top-up expenses...



CDR data applications
Population dynamics:
The building blocks for
applications

Mapping changes in population density

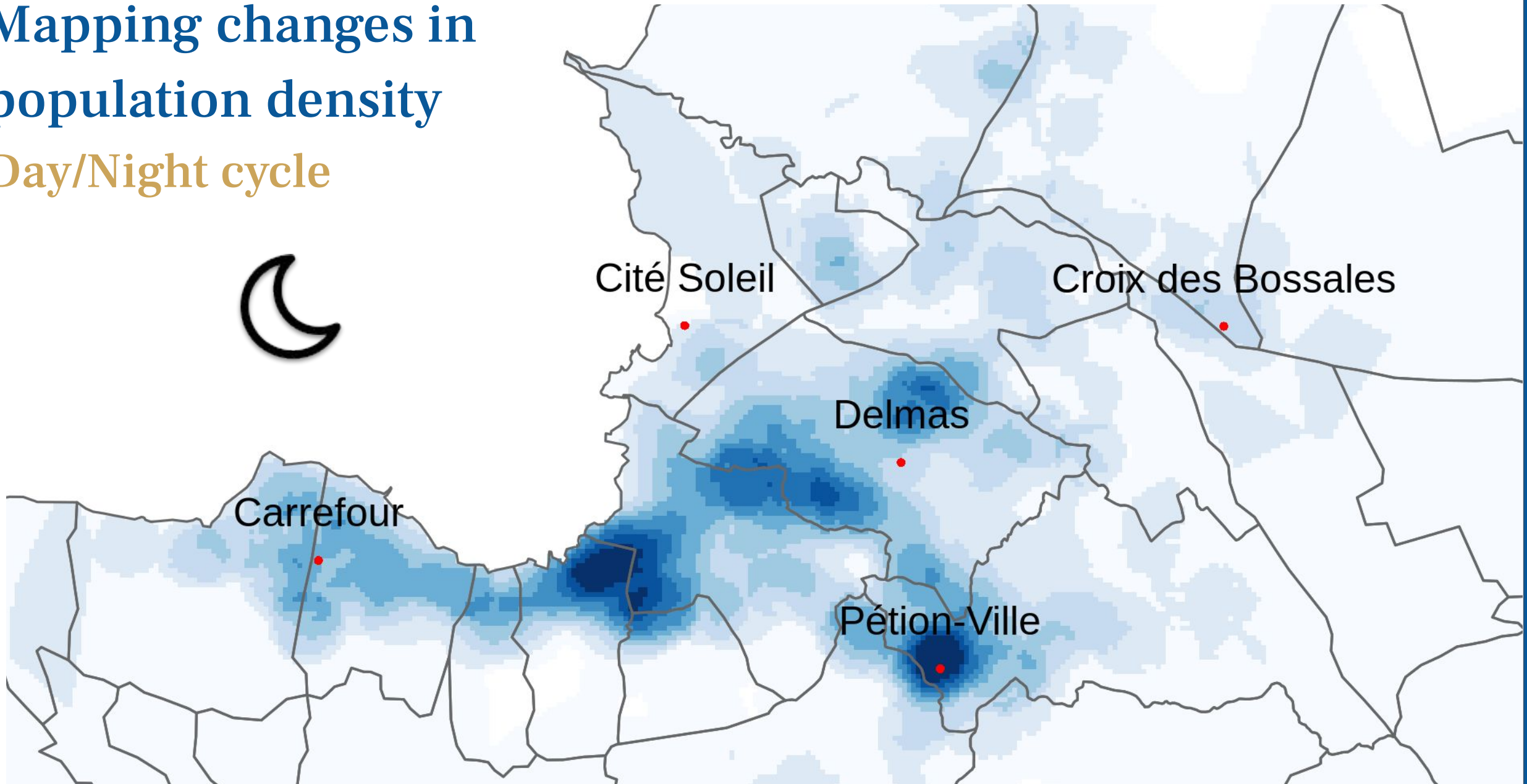
Day/Night cycle



Locations of phone users during the day

Mapping changes in population density

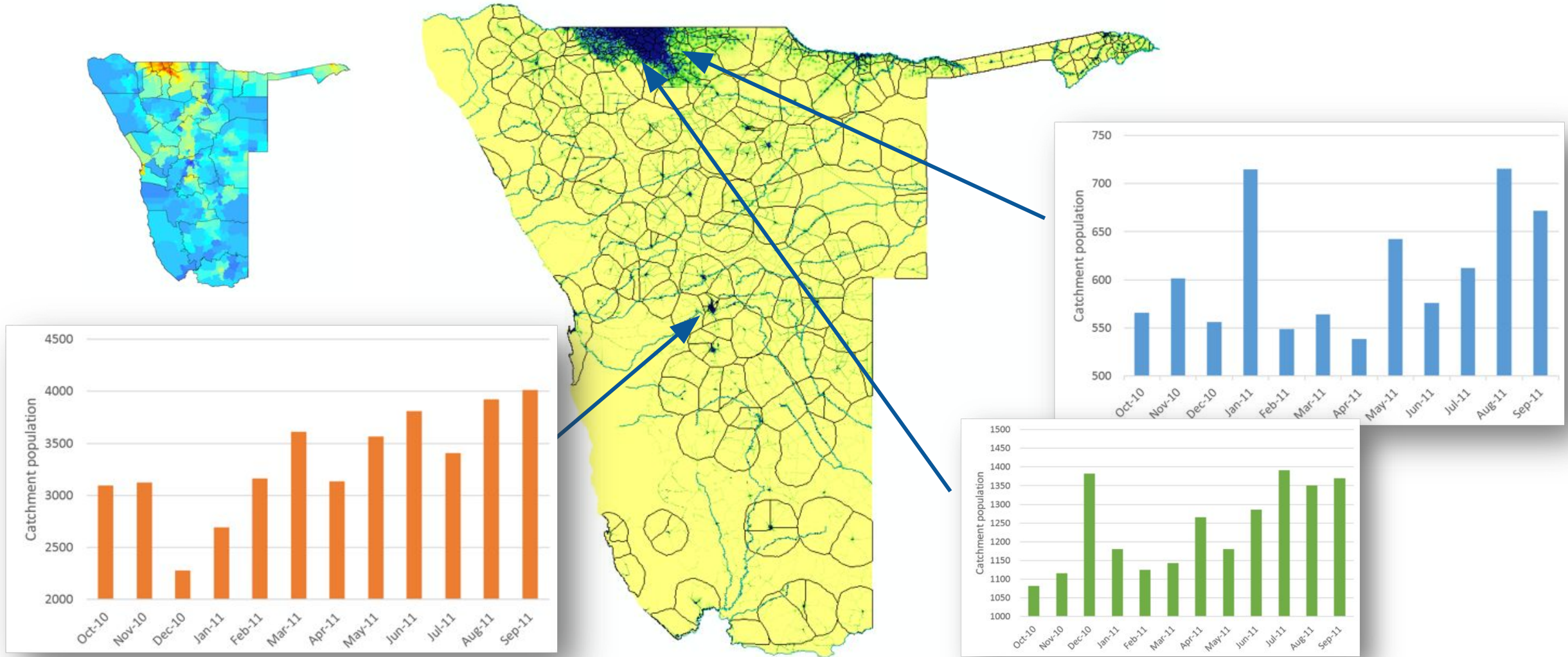
Day/Night cycle

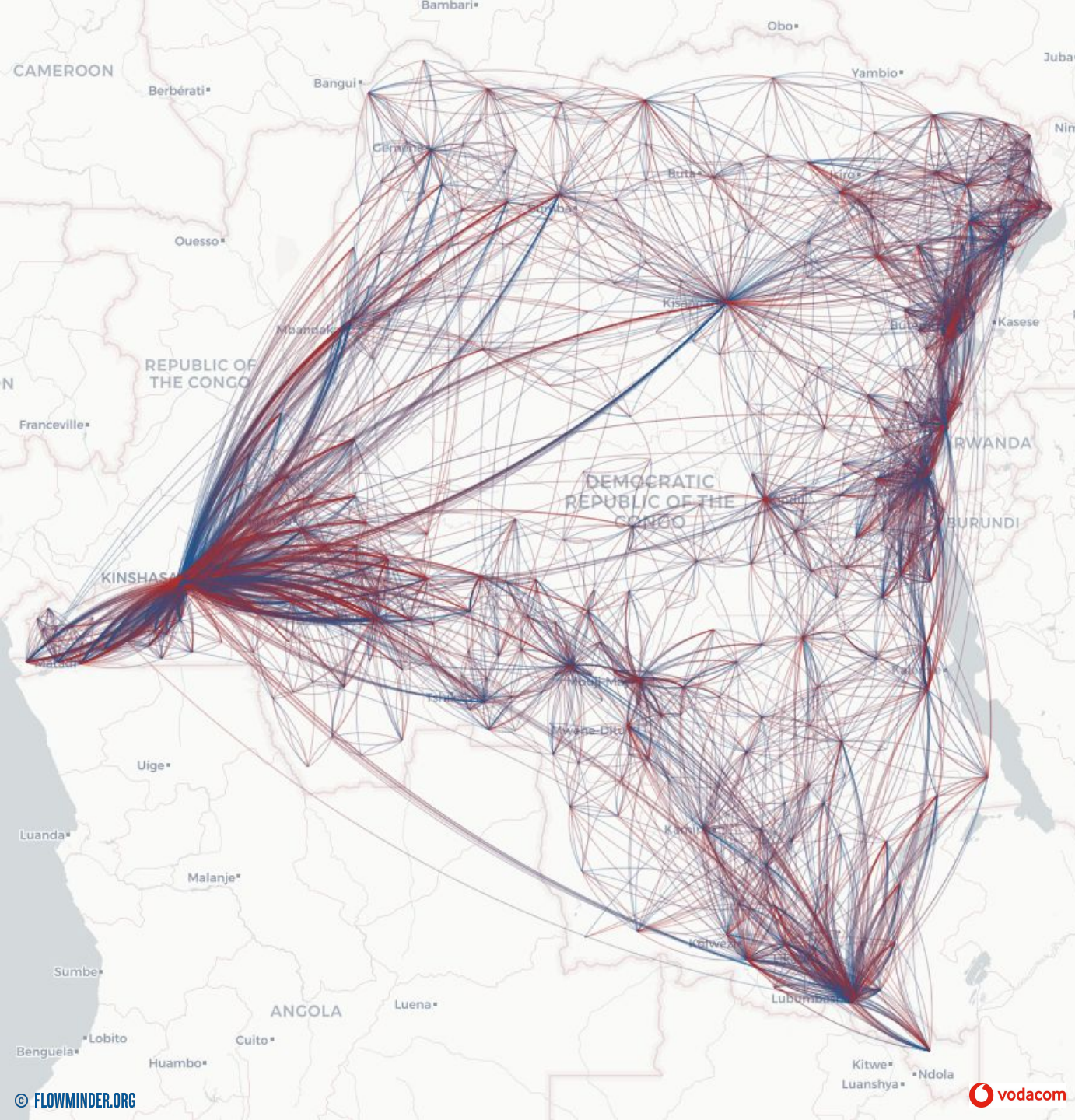


Locations of phone users at night

Mapping changes in population density

Seasonal variation





Mapping monthly migration flows

Seasonal variation

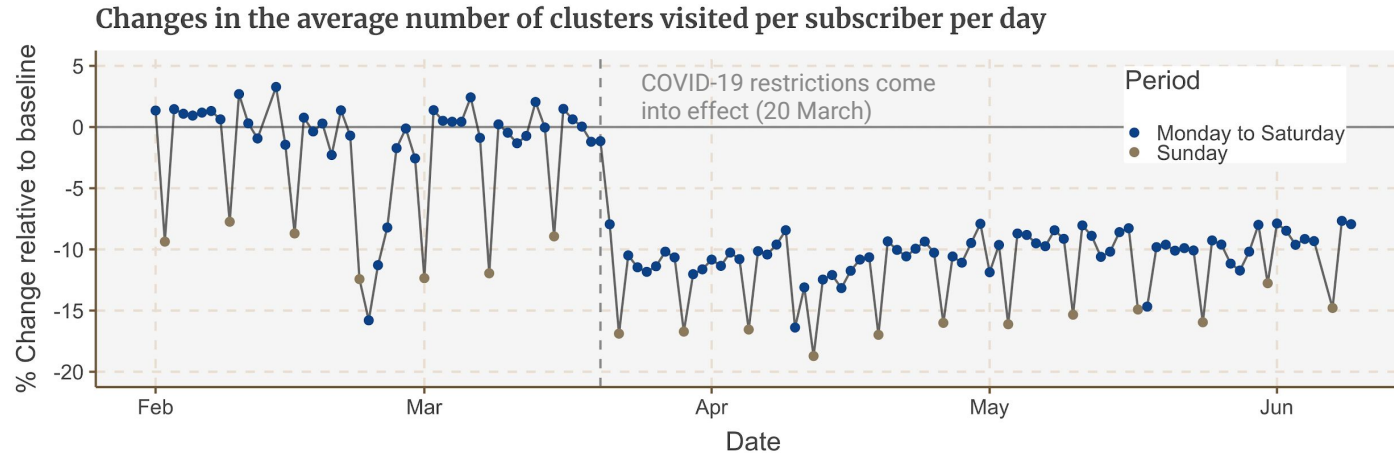
Migration flows from March 2020
to February 2021 in the DRC

Mapping travel flows

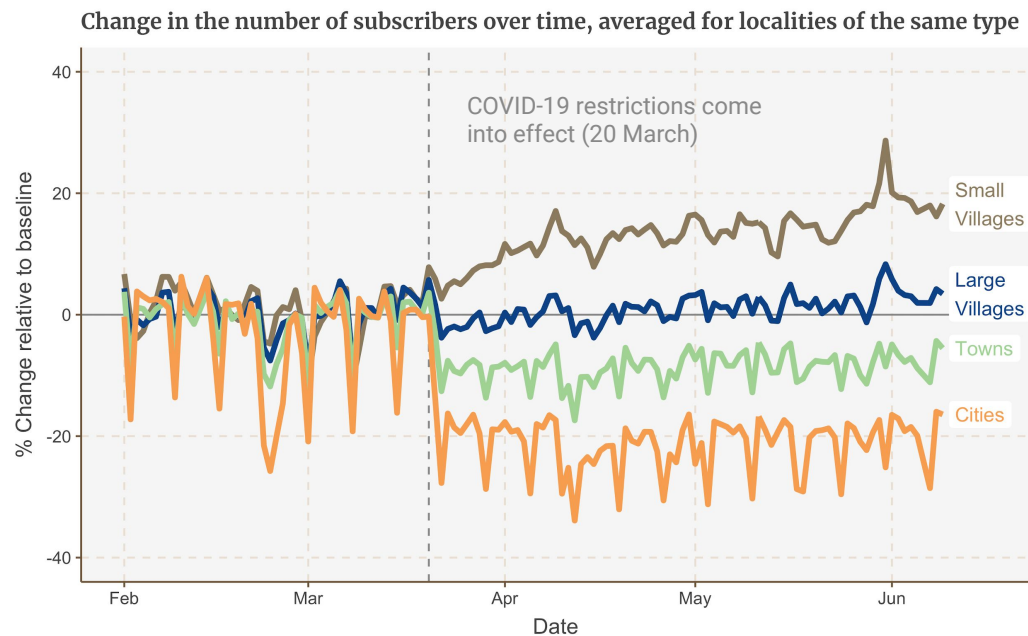
Routine flows highlight the catchment areas of larger cities and towns, with Port-au-Prince catchment being the largest.



Analysing mobility disruption during a crisis



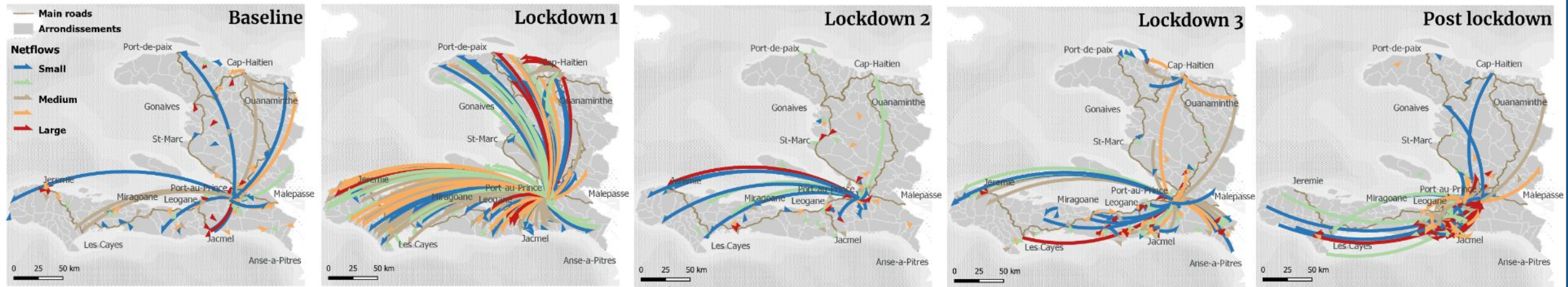
Mobility restrictions reduced the number of places visited during the day..



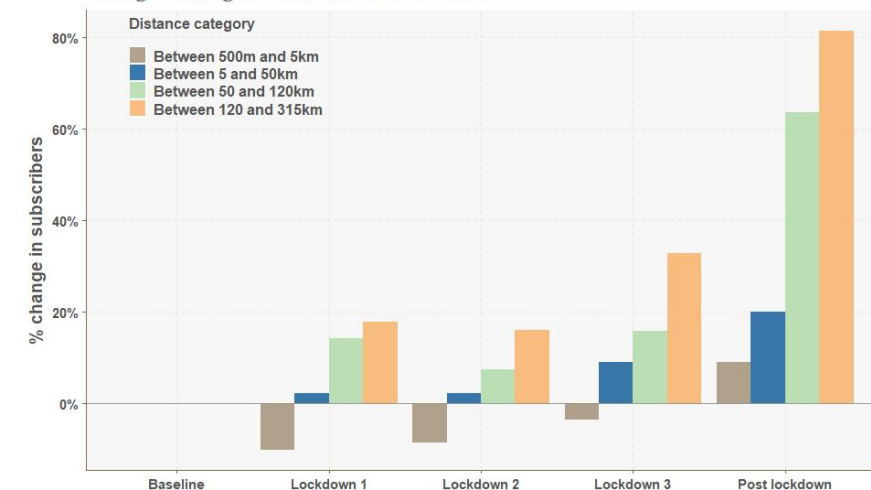
..but triggered a shift of population distribution from urban to rural areas (similar to changes occurring during the Christmas period)

Analysing change in mobility patterns post-crisis

Migration top percentile netflows in Haiti - Before, during and after COVID-related mobility restrictions in 2020



Changes in migrations relative to baseline



Post COVID-19 restrictions, people appear to relocate more often and at further distances, with dissimilar patterns to those observed at baseline.

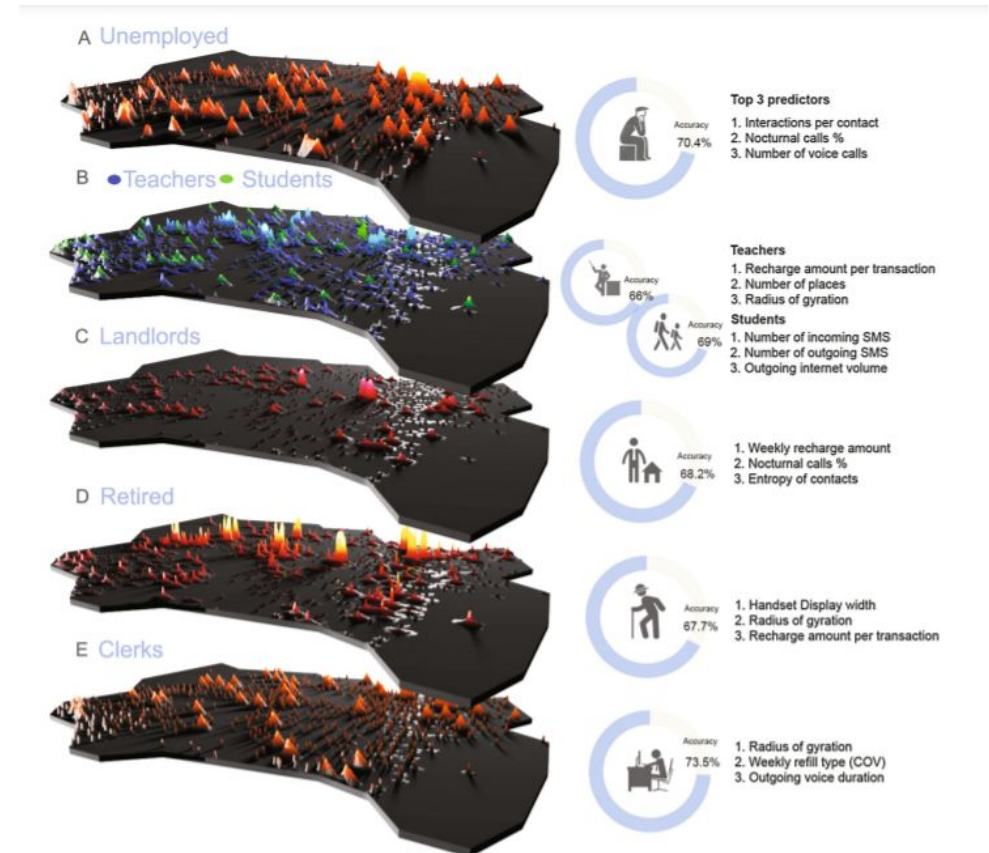
Further work on COVID-19 recovery starting in Papua New Guinea, possible in other countries such as Haiti

Using mobile phone data as a proxy for employment or socio-economic status

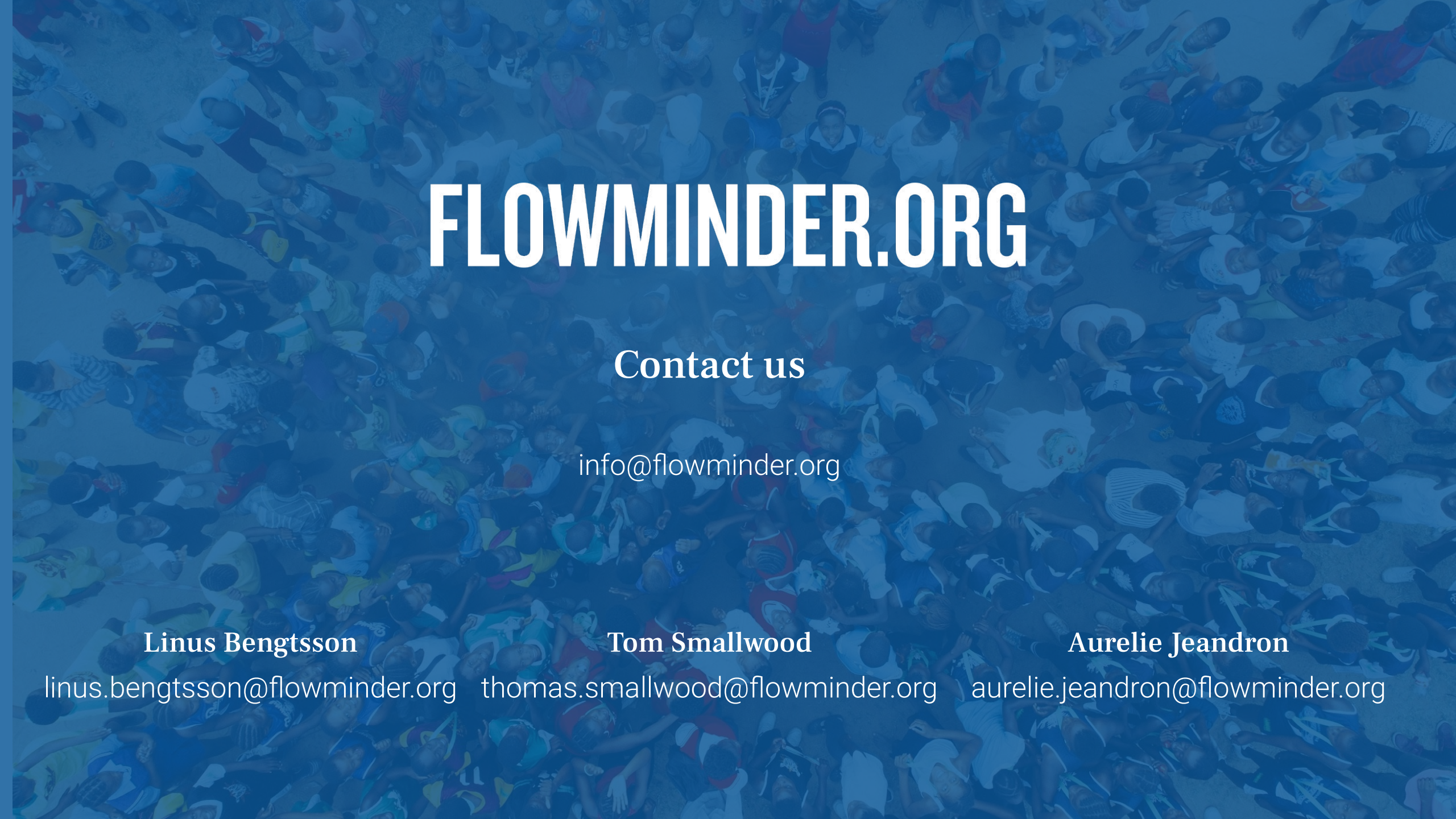
Examples of metadata used for subscribers profiling

Financial	Airtime purchases: Recharge amount per transaction, Spending speed, fraction of lowest/highest recharge amount, coefficient of variation recharge amount etc. Revenue: Charge of outgoing/incoming SMS, MMS, voice, video, value added services, roaming, internet etc. Handset: Manufacturer, brand, camera enabled, smart/feature/basic phone etc.
Mobility	Home district/tower, radius of gyration, entropy of places, number of places visited etc.
Social	Social Network: Interaction per contact, degree, entropy of contacts etc. General phone usage: Out/In voice duration, SMS count, Internet volume/count, MMS count, video count/duration, value-added services duration/count etc.

Adapted from Sundsøy P. et al. (2017) Towards Real-Time Prediction of Unemployment and Profession. https://doi.org/10.1007/978-3-319-67256-4_2



Similar approaches to be used in Papua New Guinea and Ghana for wealth and poverty mapping



FLOWMINDER.ORG

Contact us

info@flowminder.org

Linus Bengtsson

linus.bengtsson@flowminder.org

Tom Smallwood

thomas.smallwood@flowminder.org

Aurelie Jeandron

aurelie.jeandron@flowminder.org