

An aerial photograph of a very busy street market in Lagos, Nigeria. The street is filled with numerous yellow taxis, many of which are carrying passengers on their roofs. A large crowd of people is walking along the sidewalks and crossing the street. On the right side, there are several market stalls and shops, some with colorful umbrellas for shade. The buildings lining the street are multi-story and appear to be in an urban area. The overall scene depicts a high-density, active urban environment.

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Estimating population flows and
distributions using mobile phone
data: innovations and applications



Our services

What we do



Mobile Data
Partnerships



Population
Distribution &
Mobility
Analysis



Geospatial Data
Analysis & Site
Placement
Optimisation



Capacity
Strengthening

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Our mobile data collaborations to date

Countries where Flowminder has collaborated 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
- Senegal (advanced discussion)





To enable **decision makers** to access
the **data** they need to **transform** the
lives of vulnerable people, at scale.

The background of the slide is a collage of two photographs. The left photograph shows a busy street with many yellow taxis and a large crowd of people. The right photograph shows a large crowd of people in a market, with many people carrying items on their heads and shoulders. The text is overlaid on the left photograph.

How we do what we do

Who we
work with

Who we work with



Mobile network
operators (MNOs)



Governments



Non-governmental
organisations



GRID3
programme*



Funders &
Supporters

* Flowminder is one of the **co-founders** and implementing partners of GRID3

Implementation & real impact requires collaboration

- The use of CDR data often involves many stakeholders e.g.:
 - MNOs
 - Government end users
 - Regulators
 - IGOs
- **Ghana is a good model of government partnership**
 - Ghana Statistical Services
 - Vodafone Ghana
 - Flowminder

Working with governments is an essential criteria for generating impact.



vodafone



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“If we want to achieve the SDGs, we need to invest in data systems, and we are confident that our **successful partnership** with Vodafone Ghana & Flowminder is the way forward to **leverage data for good**.

— Omar Seidu, Head of Demographic Statistics and SDGs Coordinator at [Ghana Statistical Service](#)



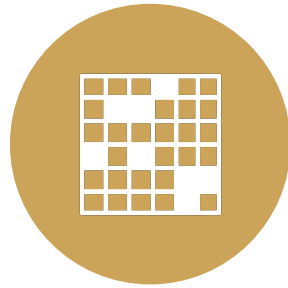
How we do what we do

We work with
different types
of data

We work with different types of data



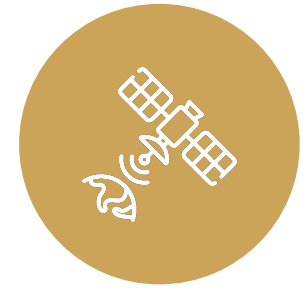
Pseudonymised
Call Detail Records
(CDRs)



Gridded population
estimates



Survey or census
data

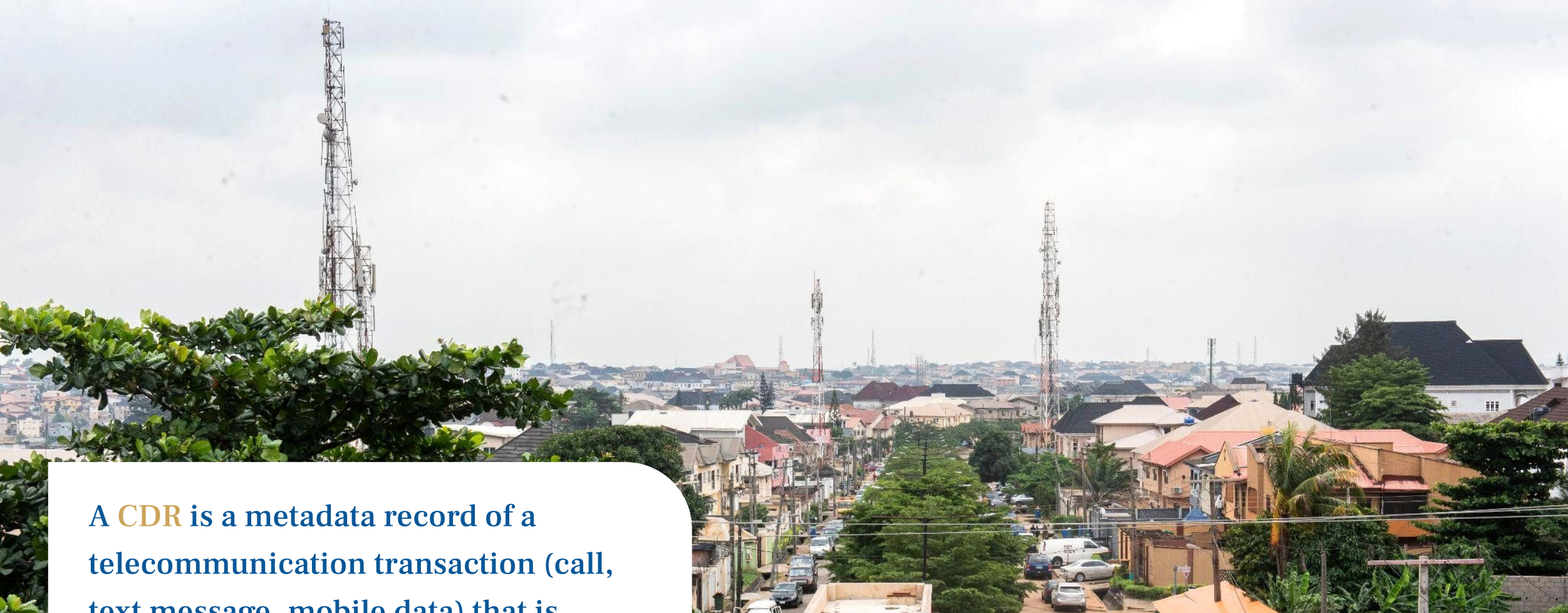


Satellite imagery and
geospatial data

All depending on the services we provide and the **context** of the project.



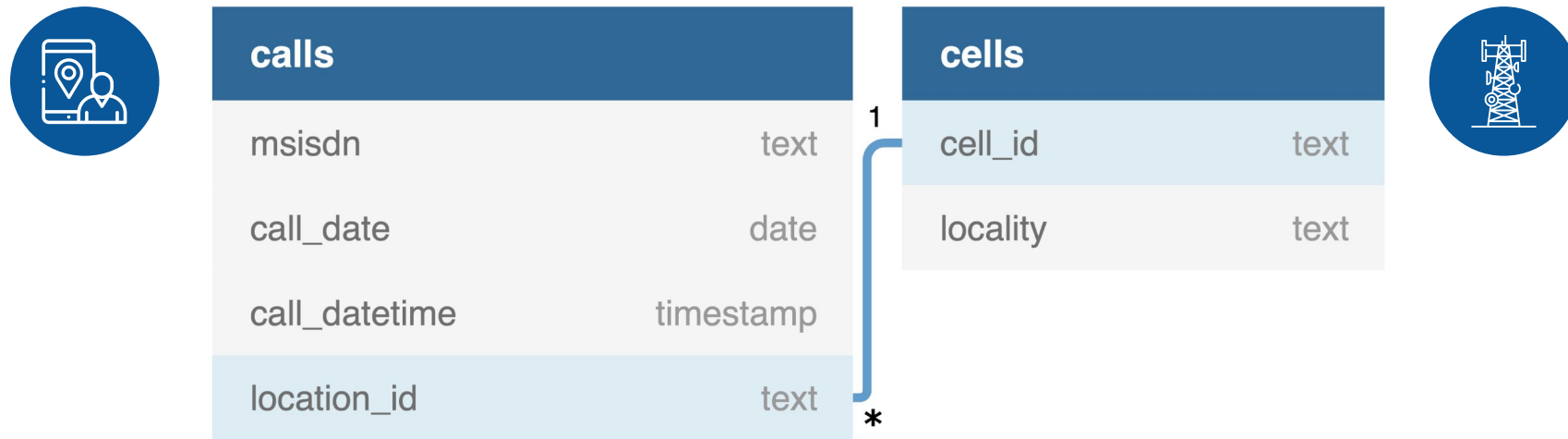
What are Call Detail Records (CDRs)?



A **CDR** is a metadata record of a telecommunication transaction (call, text message, mobile data) that is stored by an MNO for billing purposes. It includes (as a minimum) a **subscriber ID**, a **timestamp** and a **cell tower ID**.

Cell Tower Data is a set of geographic data indicating the spatial position of each cell tower in a network. It includes (as a minimum) all cell tower identifiers, together with their **associated locations (typically latitude and longitude)**.

Data required for mobility analysis



Essentially for our purposes, a **very large collection of individual:**



Anonymised
identifier

+



Spatial
location

+



Precise
time

Call Detail Records (CDRs) | Subset example

MSISDN	MSISDN_COUNTERPART	CELL_ID	EVENT_TYPE	TIMESTAMP
AA204V1542DCA00	VEWV782AS945GJE	451154211	voice	2016-10-10 15:35:25
AA204V1542DCA00	GNBE72BEA00HE51	451354312	voice	2016-10-10 20:03:45
AA204V1542DCA00	04EC	451354312	voice	2016-10-10 21:21:56
AA204V1542DCA00	6220	451354312	voice	2016-10-10 21:59:32
AA204V1542DCA00	5GJE	452616792	voice	2016-10-10 22:42:23
B45QHV45CAEVA5	ETG942BCVAEH36L	476126941	sms	2016-10-10 08:13:21
B45QHV45CAEVA5	ETG942BCVAEH36L	476126941	sms	2016-10-10 08:14:15
B45QHV45CAEVA5	ETG942BCVAEH36L	476126941	sms	2016-10-10 08:14:59
B45QHV45CAEVA5	RBY25BAC9		sms	2016-10-10 12:41:01
B45QHV45CAEVA5	RBY25BAC9		sms	2016-10-10 13:10:45
B45QHV45CAEVA11	EVG365BCA		sms	2016-10-10 15:20:43
B45QHV45CAEVA11	PRA19HXME36P64B	413579554	voice	2016-10-10 18:08:32
B45QHV45CAEVA11	RVC830RMC29EBB7	413579554	voice	2016-10-10 18:54:39
B45QHV45CAEVA11	DOB402VRM70GIBE	413579554	sms	2016-10-10 20:53:32
B45QHV45CAEVA11	DOB402VRM70GIBE	413579554	sms	2016-10-10 21:21:51
CZW926NRV43WEP4	EBI69BCA033KKK6	48620511	voice	2016-10-10 09:01:10
CZW926NRV43WEP4	EBG663JJEB234PM	49250051		2016-10-10 21:58:20
CZW926NRV43WEP4	TTBE206B67FDWUT	42059423		2016-10-10 12:01:29
CZW926NRV43WEP4	TTBE206B67FDWUT	42059423	voice	2016-10-10 15:46:18
DBT396BCW22YTVR	CRQB506BHCLR38Y	455193201	sms	2016-10-10 16:28:28

Pseudonymised caller ID
(phone number)

Date and
time of call

Pseudonymised caller ID
(phone number)

ID of network cell
tower

One row
corresponds to
one event.

A CDR dataset for
one country will
often have billions
of events.

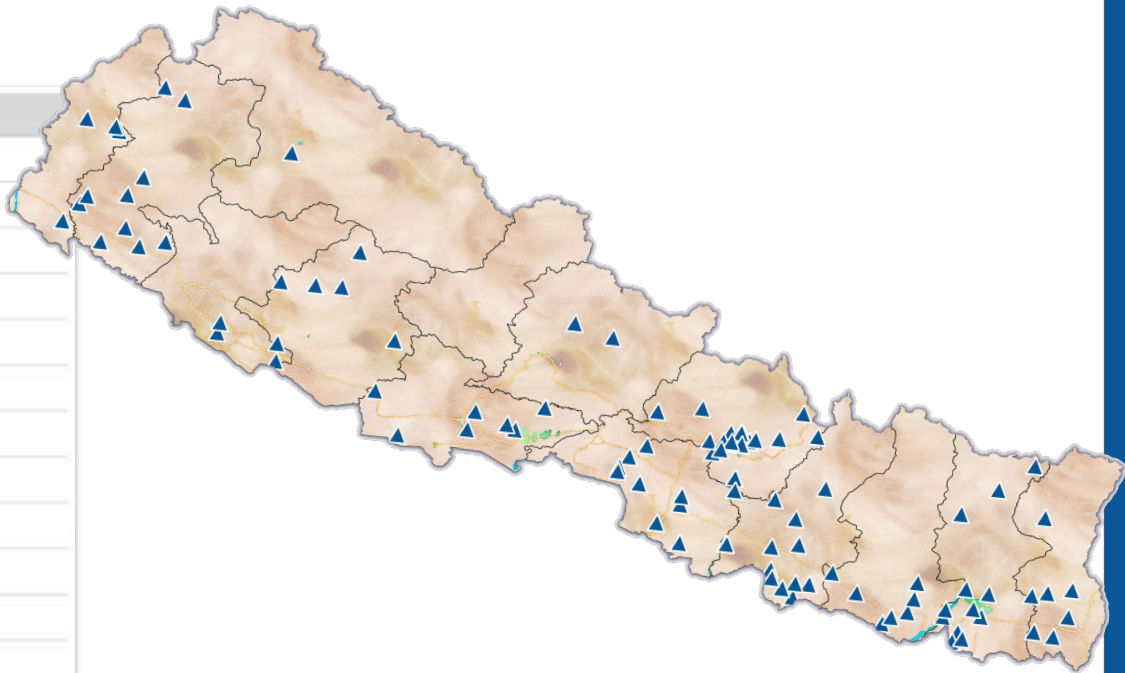


Cellular network data | Subset example

ID	LOCATION	AZIMUTH	DATE_OF_FIRST_SERVICE
413579554	(5.609057, -0.181275)	30	2016-01-01
413579555	(5.610765, -0.184537)	0	2016-01-01
413579556	(5.612473, -0.189172)	270	2016-01-01
413579557	(5.614181, -0.177670)	90	2016-01-01
420594230	(5.597268, -0.198270)	120	2016-01-01
420594231	(5.562927, -0.188657)	0	2016-01-01
451154211	(6.686166, -1.626804)	30	2016-06-10
451354312	(6.69435, -1.626804)	30	2016-06-10
451354313	(6.685484, -1.626804)	30	2016-06-10
451354314	(6.677299, -1.626804)	30	2016-06-10
452616792	(6.698442, -1.594528)	150	2016-06-10
455193201	(6.676617, -1.599336)	240	2016-07-15
476126941	(5.116660, -1.246974)	180	2016-07-15
476126943	(5.145415, -1.336243)	150	2016-07-15
476126944	(5.104393, -1.377453)	60	2016-07-15
476126945	(5.090730, -1.469458)	0	2016-07-15
476126946	(5.092095, -1.580682)	210	2016-07-15
476126947	(5.103026, -1.643851)	30	2016-07-15
486201511	(4.902175, -1.753477)	210	2016-07-15
492500516	(4.916887, -1.790901)	90	2016-07-15

Cell tower ID

Geographical location

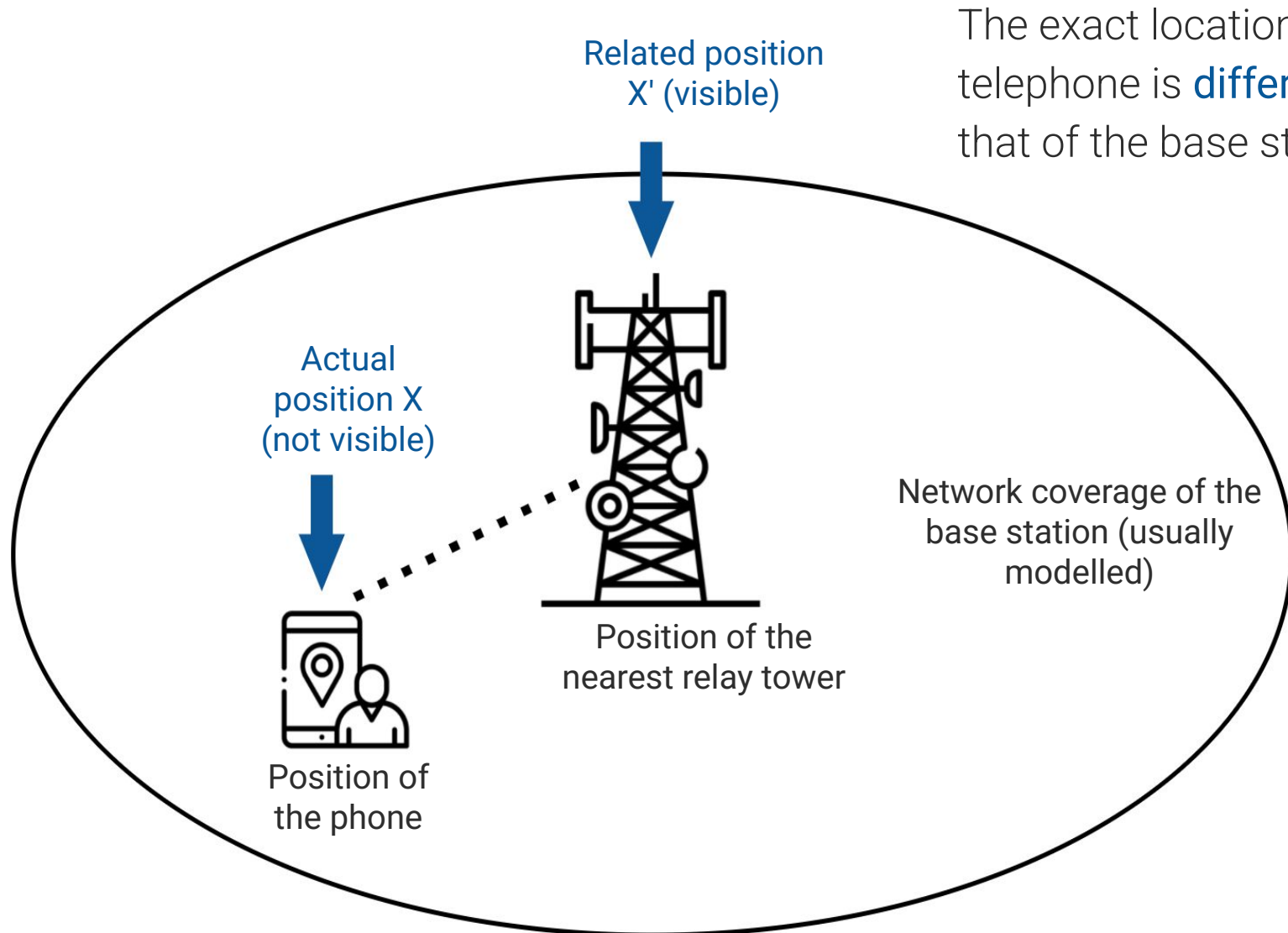


One row corresponds to one cell tower.

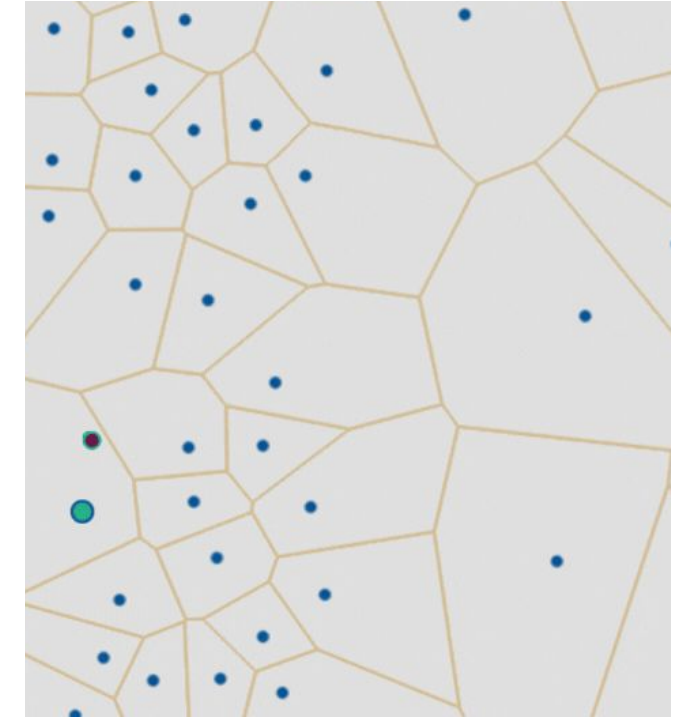
Each cell tower has a spatial location (see map).



Cell towers & subscriber location

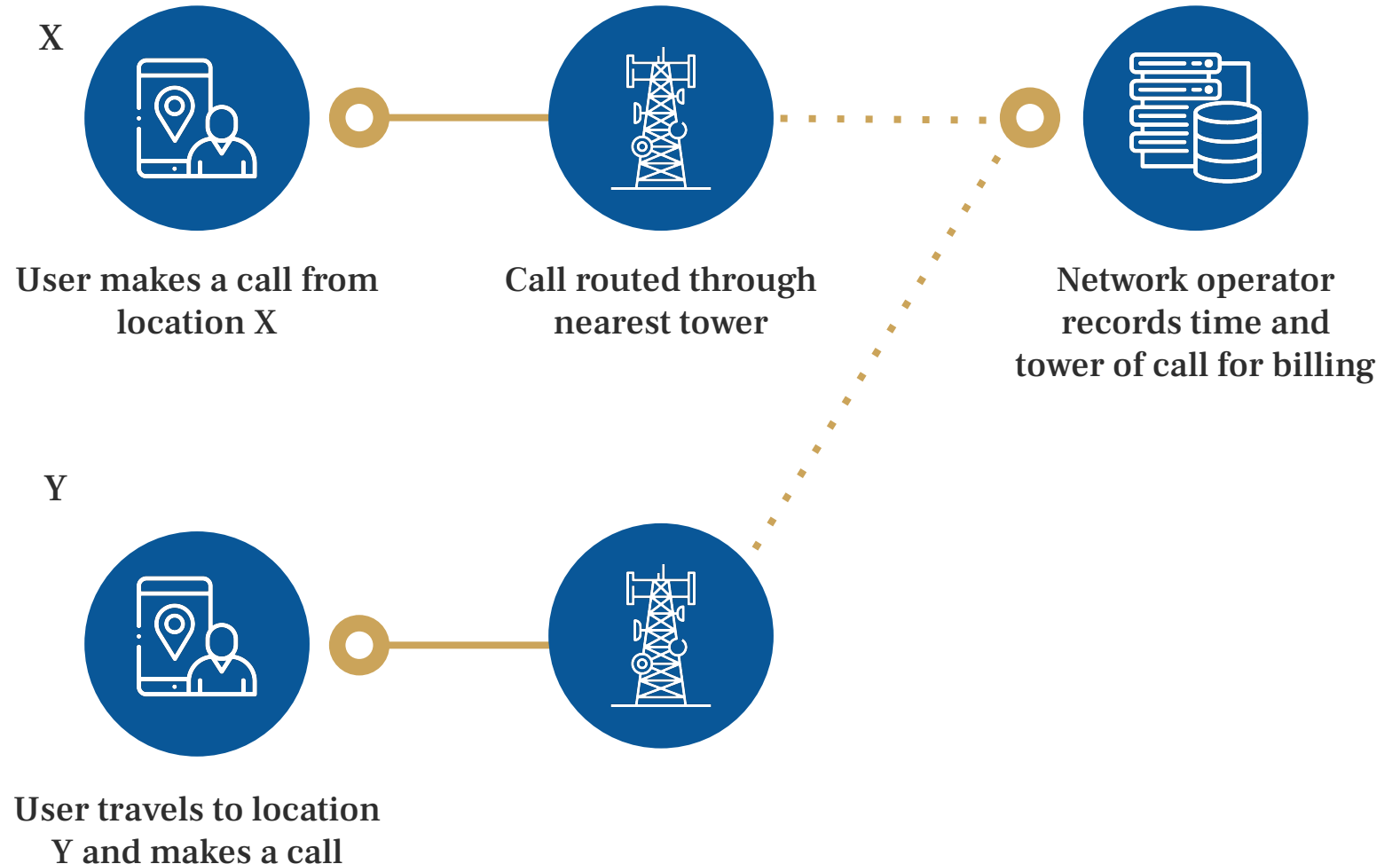
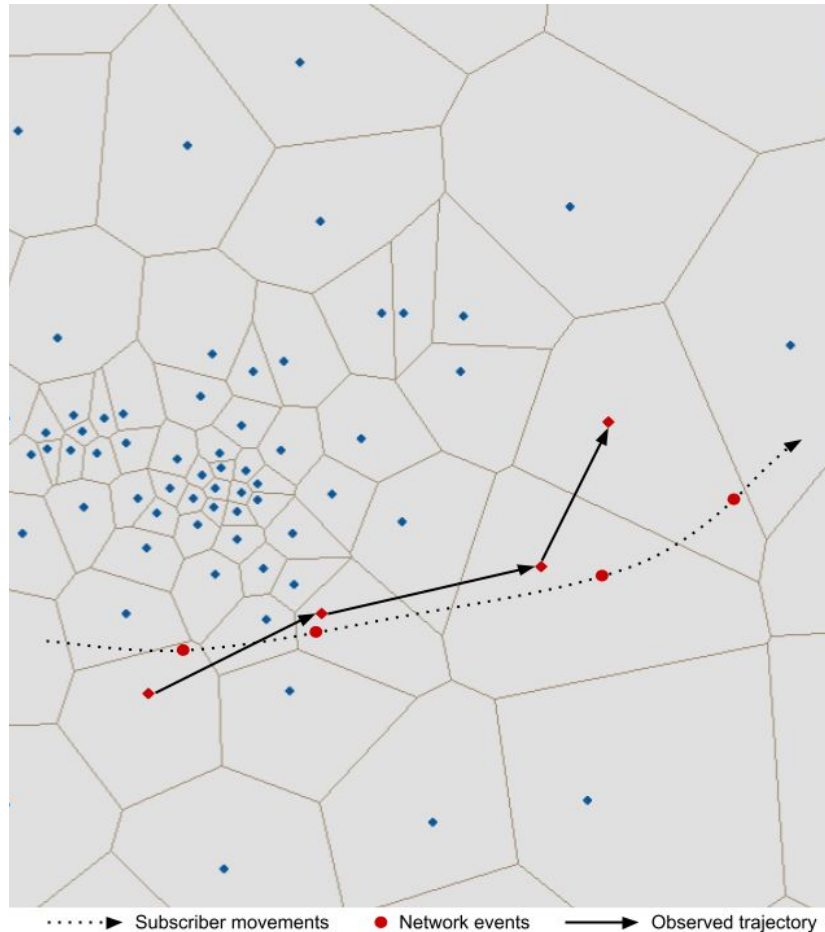


The exact location of the telephone is **different** from that of the base station.



Application of CDR data in **geographic space for a user**.
Each point represents a cell tower, each arrow the inferred movement of the user.

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

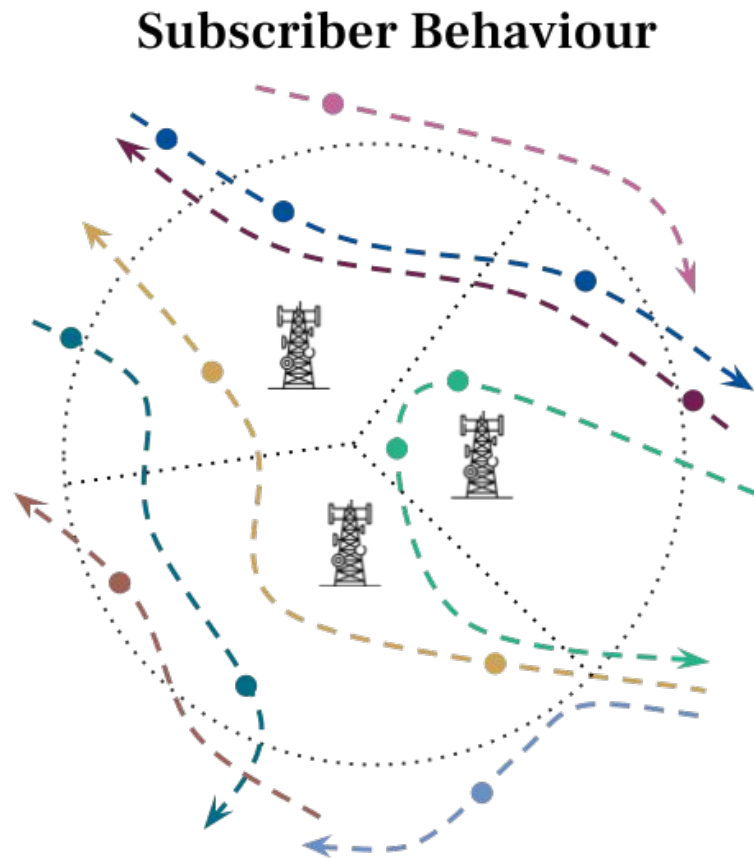




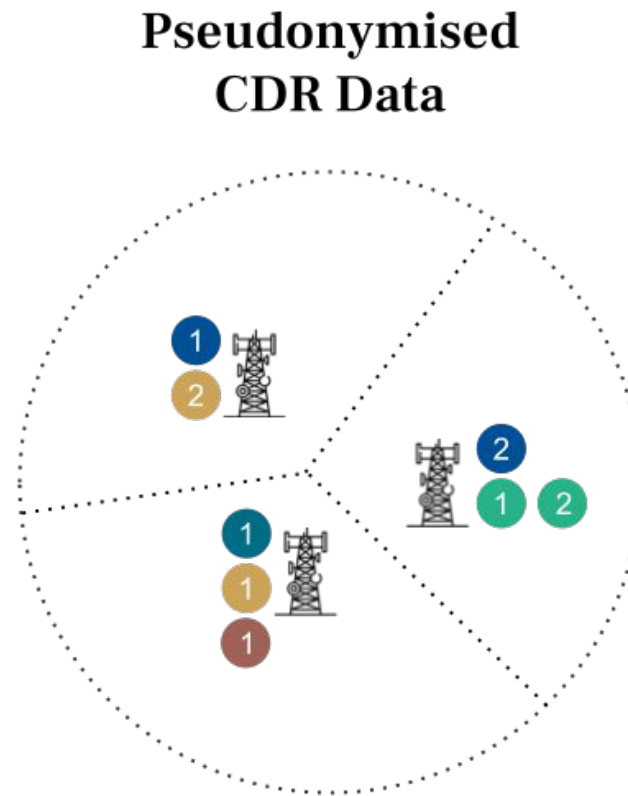
How we do what we do

How we process and analyse CDR data

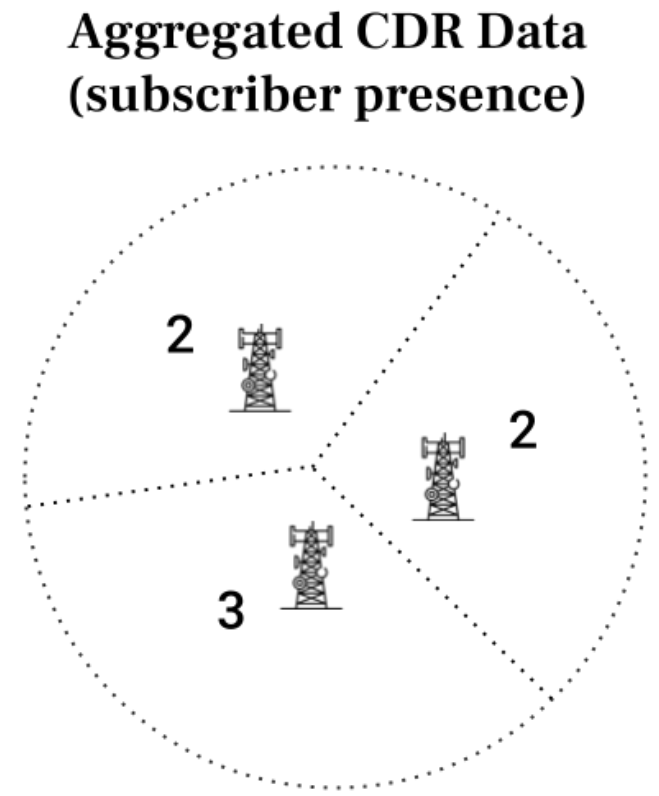
MPD are aggregated to preserve the individual privacy of subscribers



- Subscriber movements
- Exact location of network events



- Recorded network events (order)



Note: Flowminder also enforces k-anonymity with a threshold of $k = 15$ by redacting values with 15 or fewer subscribers

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



Key CDR aggregates

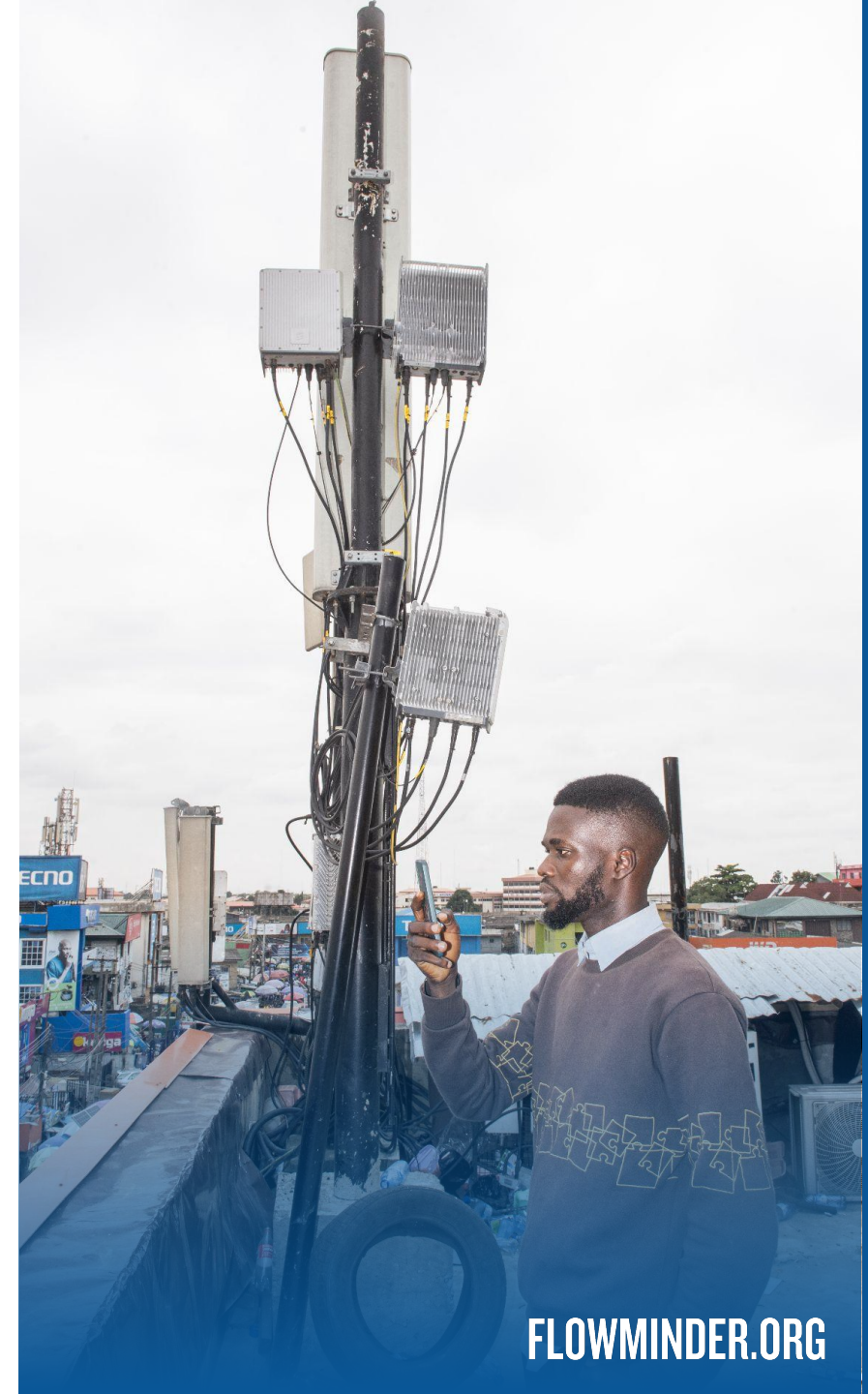
For most use cases or applications, there are generally **four key CDR aggregates** which are fundamental to the production of related indicators:

Aggregates **specific to residents**:

1. **“Residents”**: Number of subscribers **living** in a given area, in a given period of time
2. **“Relocations”**: Number of subscribers **moving their residence** from area A to area B, in a given period of time

Aggregates more **generally describing people**:

1. **“Presence”**: Number of subscribers **present** in a given area, in a given period of time (*correspond to the previous aggregate(s) examples*)
2. **“Trips”**: Number of subscribers **present in** area A **then in** area B, in a given period of time





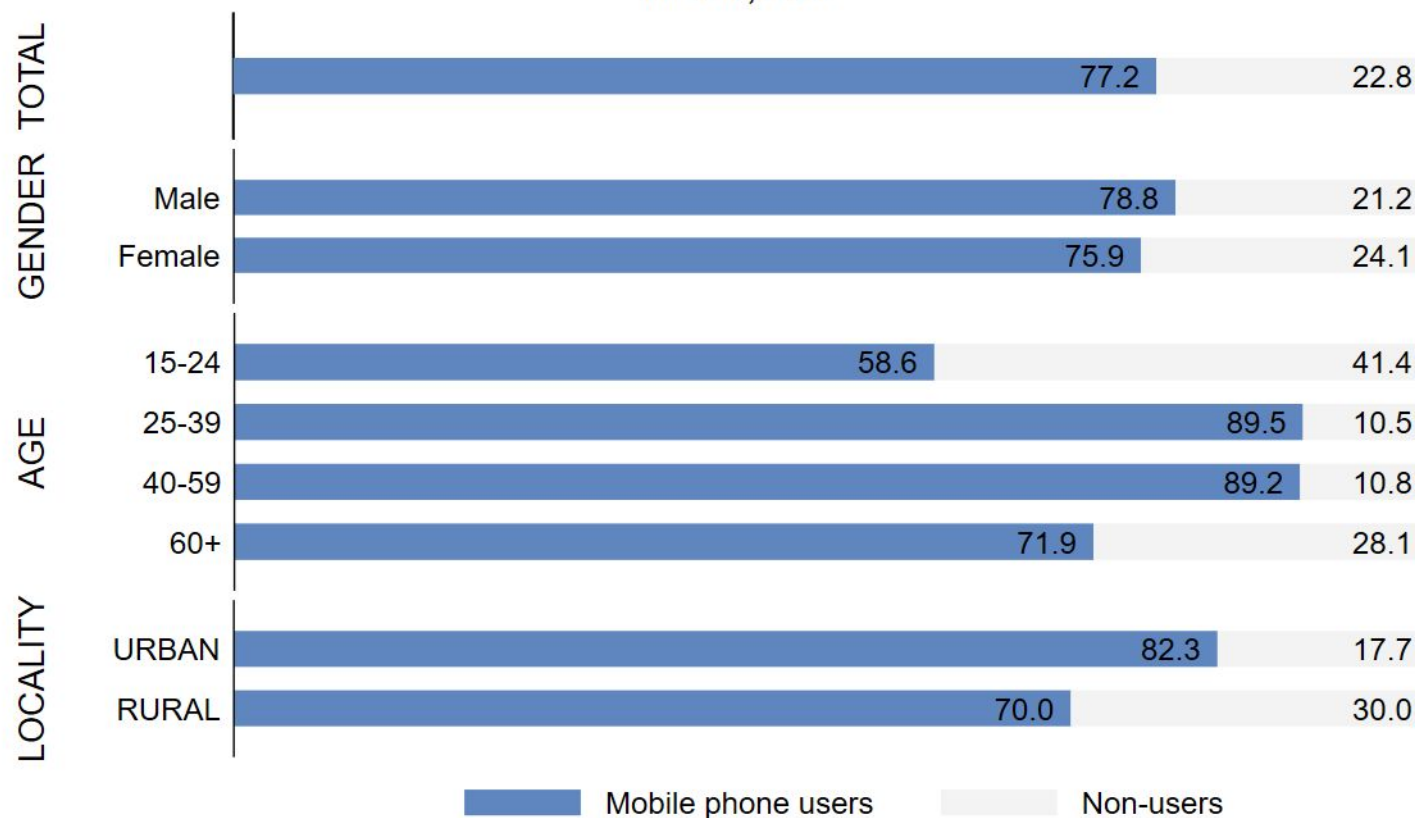
MNO subscribers are
not a random sample of the population,
nor can be assumed to be.

Mobile phone users by demographics | Ghana

- **Mobile phone use** is
 - More common among **men** than among women
 - More common among persons of **working-age** than among the elderly, and among children
 - More widespread in **urban areas** than in rural areas

Ghana: percentage of mobile phone users (ages 15+)

n=31,284



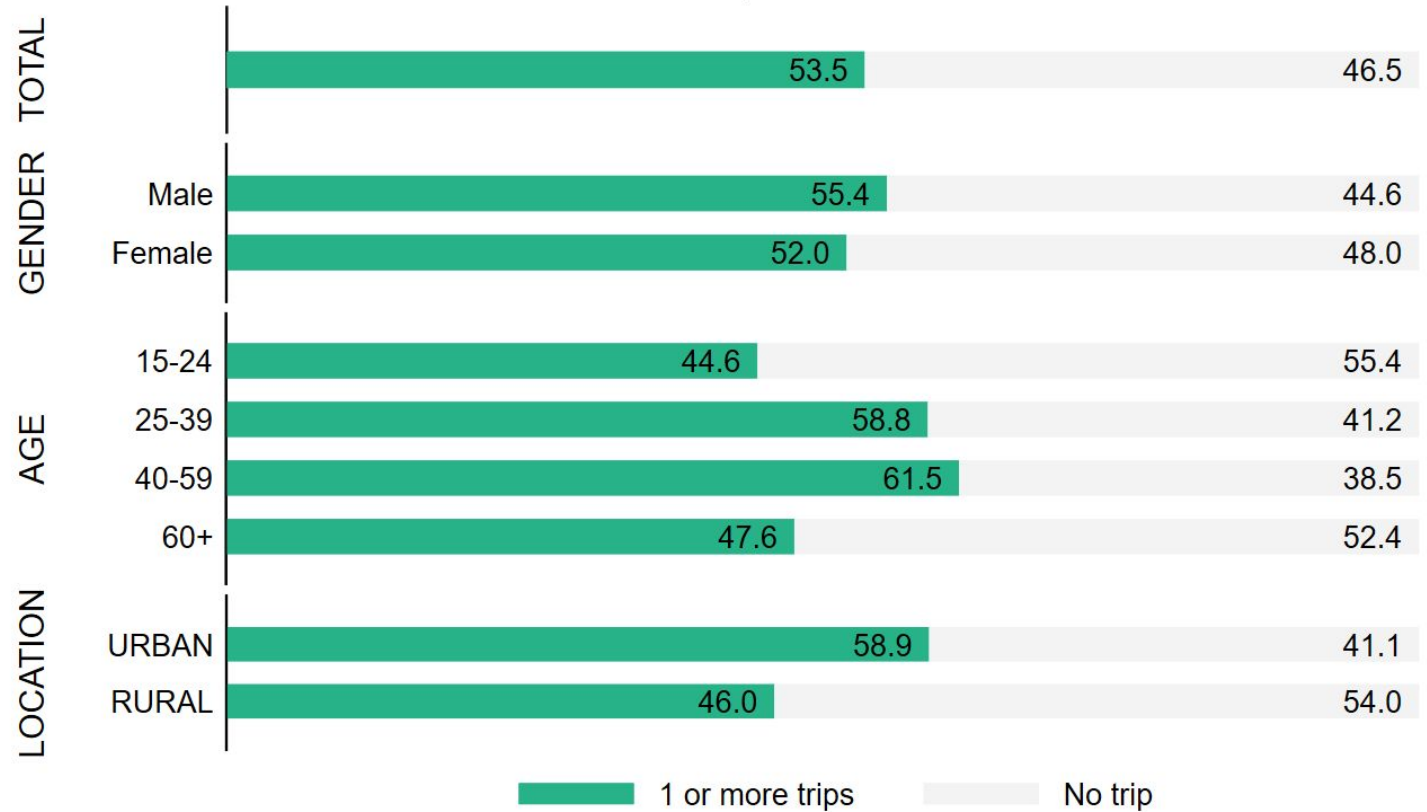
Source: AHIES 2022, Q3, weighted(pop_weight)

Mobility by demographics | Ghana

- Also, **mobility** is
 - More common among **men** than among women
 - More common among persons of **working-age** than among the elderly, and among children
 - More widespread in **urban areas** than in rural areas

Ghana: percent of population w recent trips 5+km (ages 15+)

n=31,284

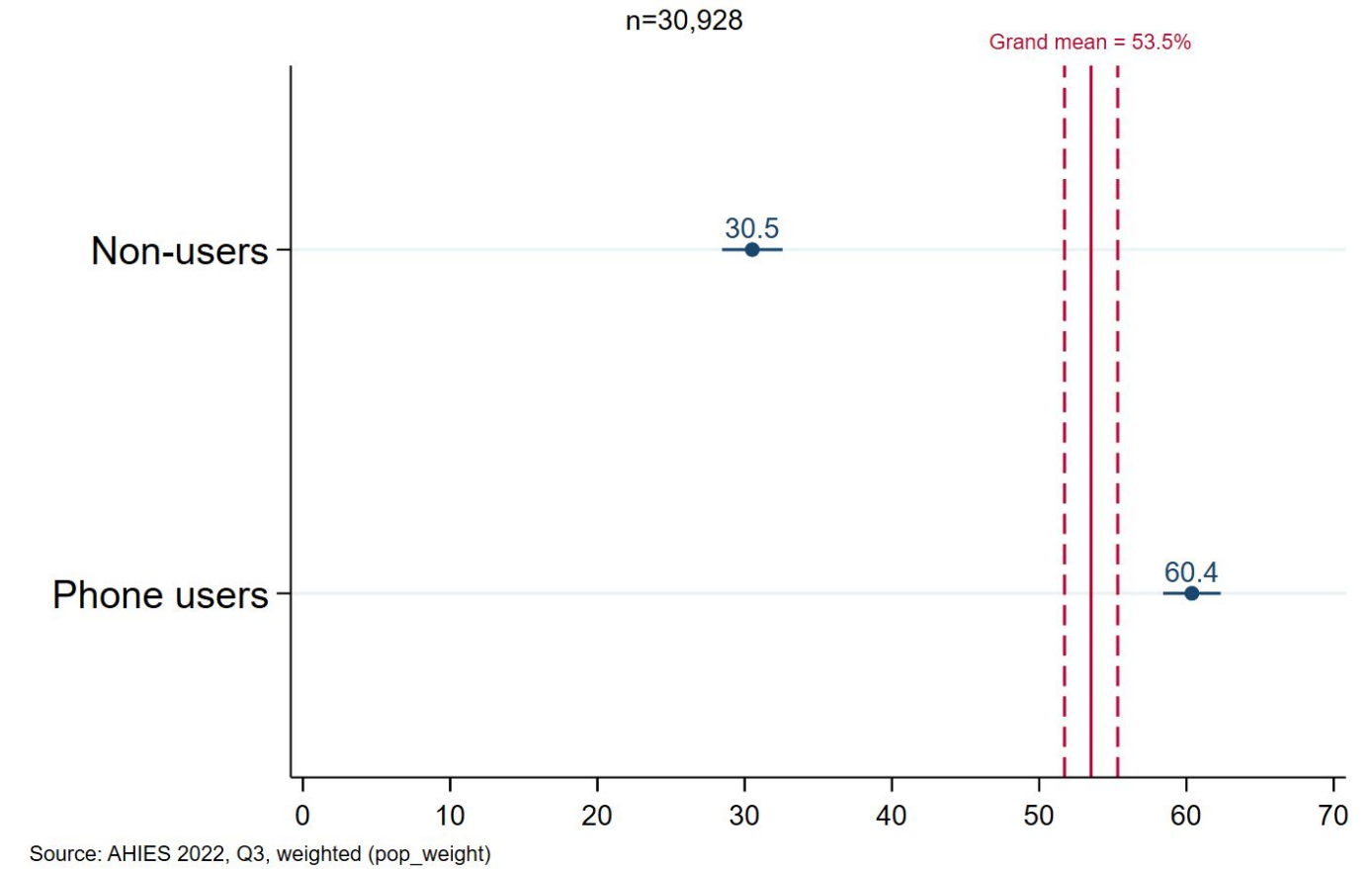


Source: AHIES 2022, Q3, weighted(pop_weight)

Biases due to mobility differentials | Ghana

- As a consequence, **mobility is often different** between mobile phone users and **non-users**
 - With mobile phone users showing **higher mobility**, on average, **than non-users**
 - Mobility estimates based on phone user data alone can **overestimate mobility** (can also be an underestimate for some types of mobility)
 - Not all mobility indicators, however, show such large differences between these two groups

Ghana: % of population who did a 5+km trip in past 3 months





Flowminder has recently developed estimation methods to **adjust for representation biases** & provide **population-scaled** estimates for

- **Relocations** from sub-region to sub-region, per month
- **Residents** per sub-region, per month

Bias-adjusted and population-scaled estimates

These estimates are based on

- CDR aggregates
- Primary & secondary survey data
- Existing population estimates

Method for monthly residents' estimates

- The estimate of residents in area a for month n ($\text{est_residents}_{an}$) is calculated as the sum of the baseline population for that area (est_base_pop_a) and by iteratively adding the cumulative sum of all net arrivals (est_netflow_{amn}) for all months between the baseline month and the current month, and by applying an area-specific rate of natural population growth (growthrate_a) to each monthly sum:

$$\text{est_residents}_{a1} = \text{est_base_pop}_a \quad (\text{Month 1 (baseline), } m=0, n=1)$$

$$\text{est_residents}_{a2} = (\text{est_residents}_{a1} + \text{est_netflow}_{a12}) * \text{changerate}_a \quad (\text{Month 2, } m=1, n=2)$$

$$\text{est_residents}_{a3} = (\text{est_residents}_{a2} + \text{est_netflow}_{a23}) * \text{changerate}_a \quad (\text{Month 3, } m=2, n=3)$$

... = ...

$$\text{est_residents}_{an} = (\text{est_residents}_{am} + \text{est_netflow}_{amn}) * \text{changerate}_a$$

- where the net arrivals estimate for area a between months m and n is the sum of all estimated inflows to that area minus all estimated outflows from that area:

$$\text{est_netflow}_{amn} = \text{est_inflow}_{amn} - \text{est_outflow}_{amn}$$

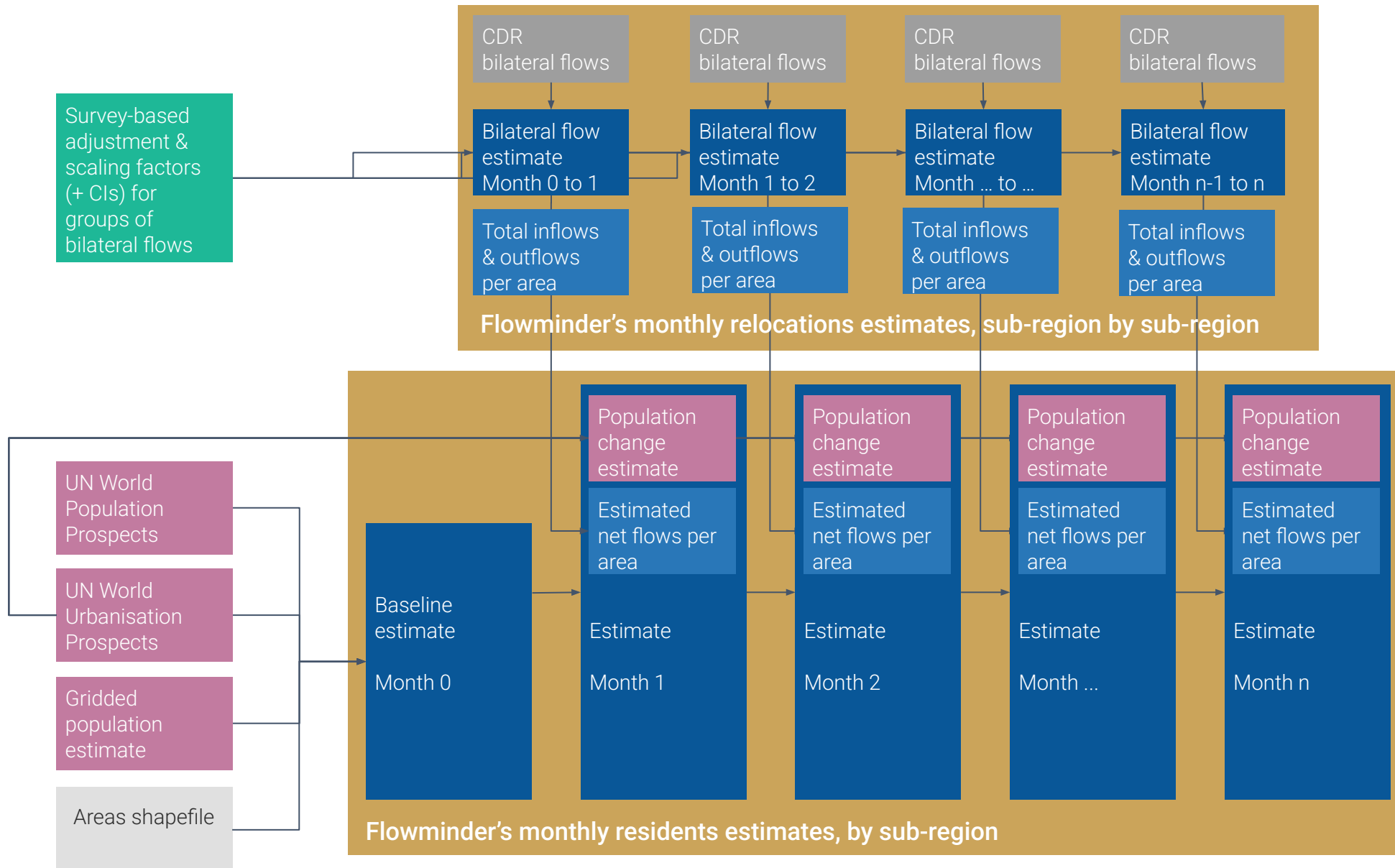
Method for relocations' estimates

- Relocations from area a to area b between month m and month n can be estimated from CDR aggregates of relocations (cdr_flow_{abmn}) between those areas and months, and from a flow **adjustment factor** and a flow **scaling factor**
- Flows are adjusted for the number of users per SIM (users_{ab}) and the number of SIMs per user (sims_{ab}). The flow scaling factor is the inverse of the share of MNO users (mno_share_{ab}) in the flows:

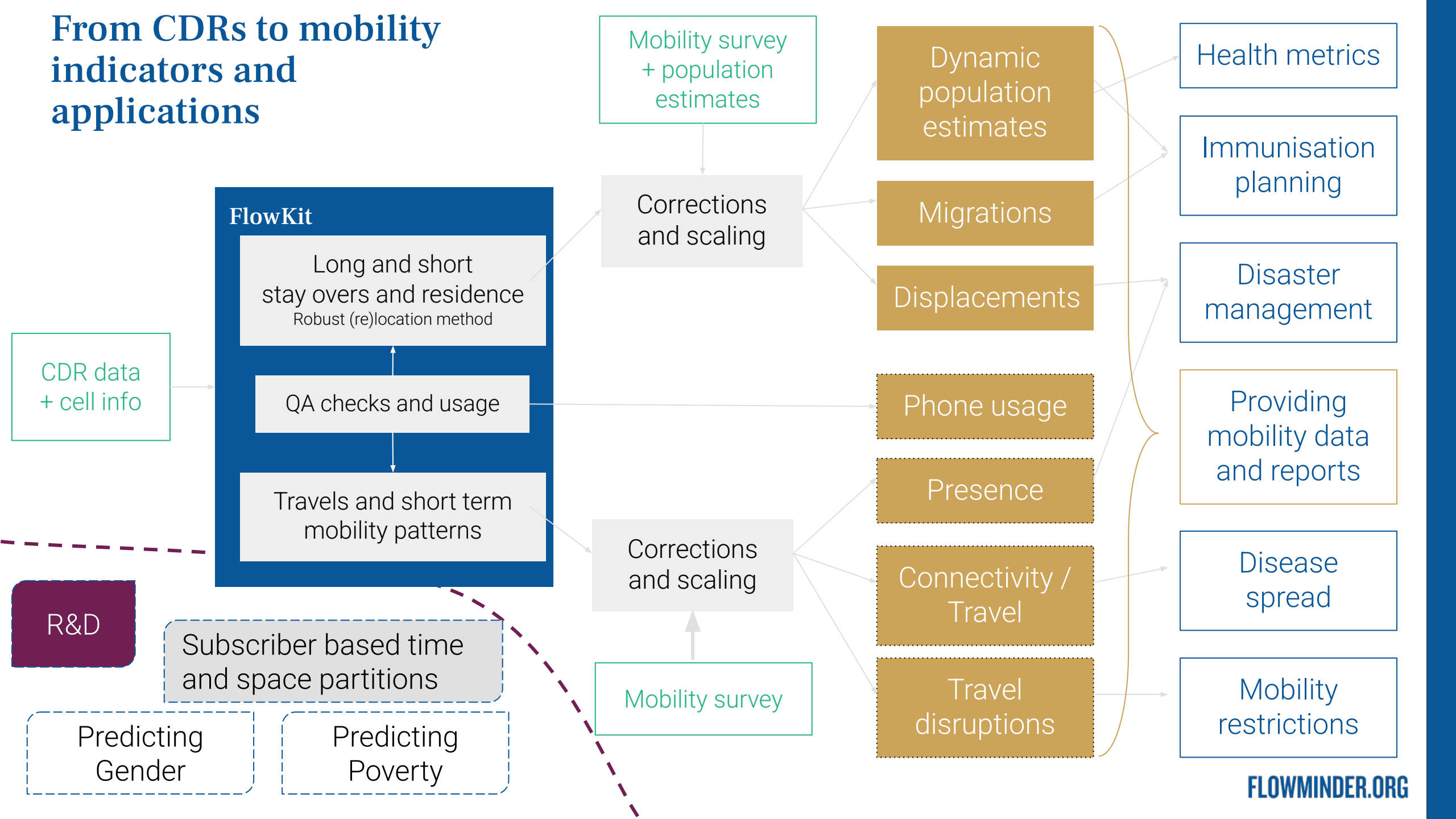
$$\text{est_flow}_{abmn} = \text{cdr_flow}_{abmn} * (\text{users}_{ab} / \text{sims}_{ab}) * (1 / \text{mno_share}_{ab})$$

- Note: Parameters for the subset of mobile households/individuals only available at admin1 by admin1 level

Method for monthly residents' estimates



From CDRs to mobility indicators and applications



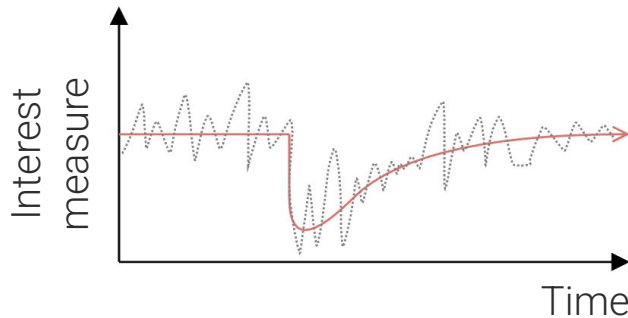


Population & Mobility Analysis

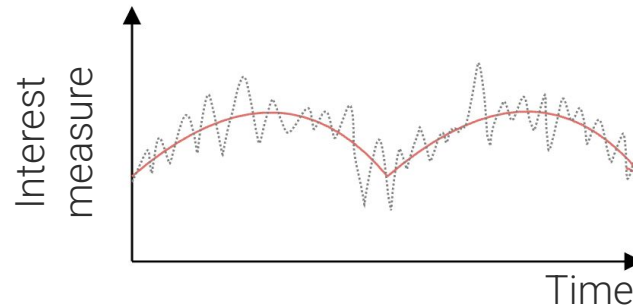
Information extracted from CDR | Spatial & temporal

Using CDRs, we can measure the **number of subscribers at a given location (administrative units)** and **its variation over time (hours, days, weeks, etc.)**.

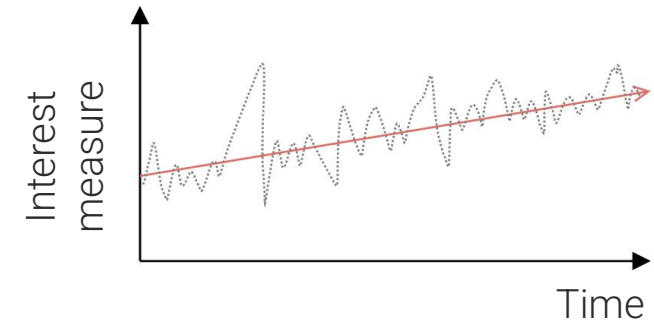
All types of information can be studied over time to investigate:



- 'Ordinary' trends versus 'anomalies' or 'disturbances' (e.g. special events or crises).



- Cyclical trends (e.g. seasons)



- Long-term trends (e.g. growth in mobility over time)

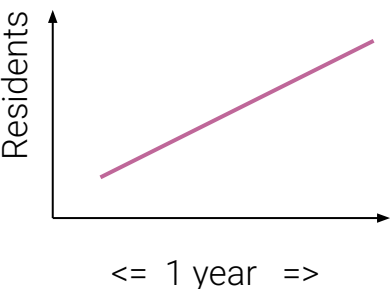
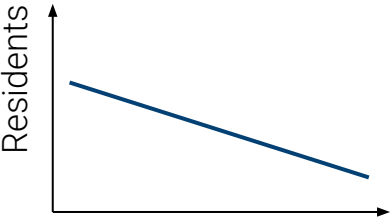
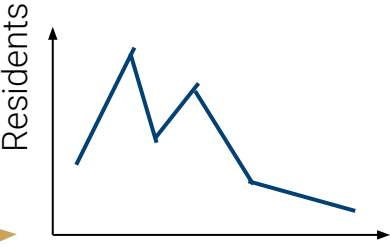
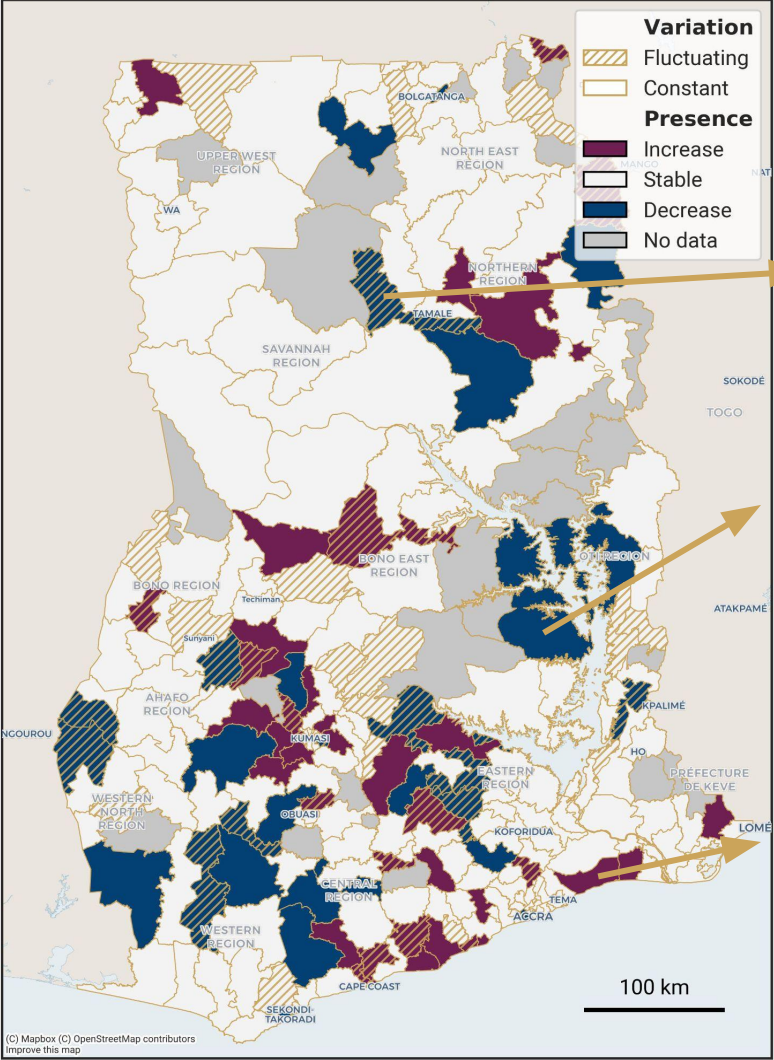


Applications

Official statistics

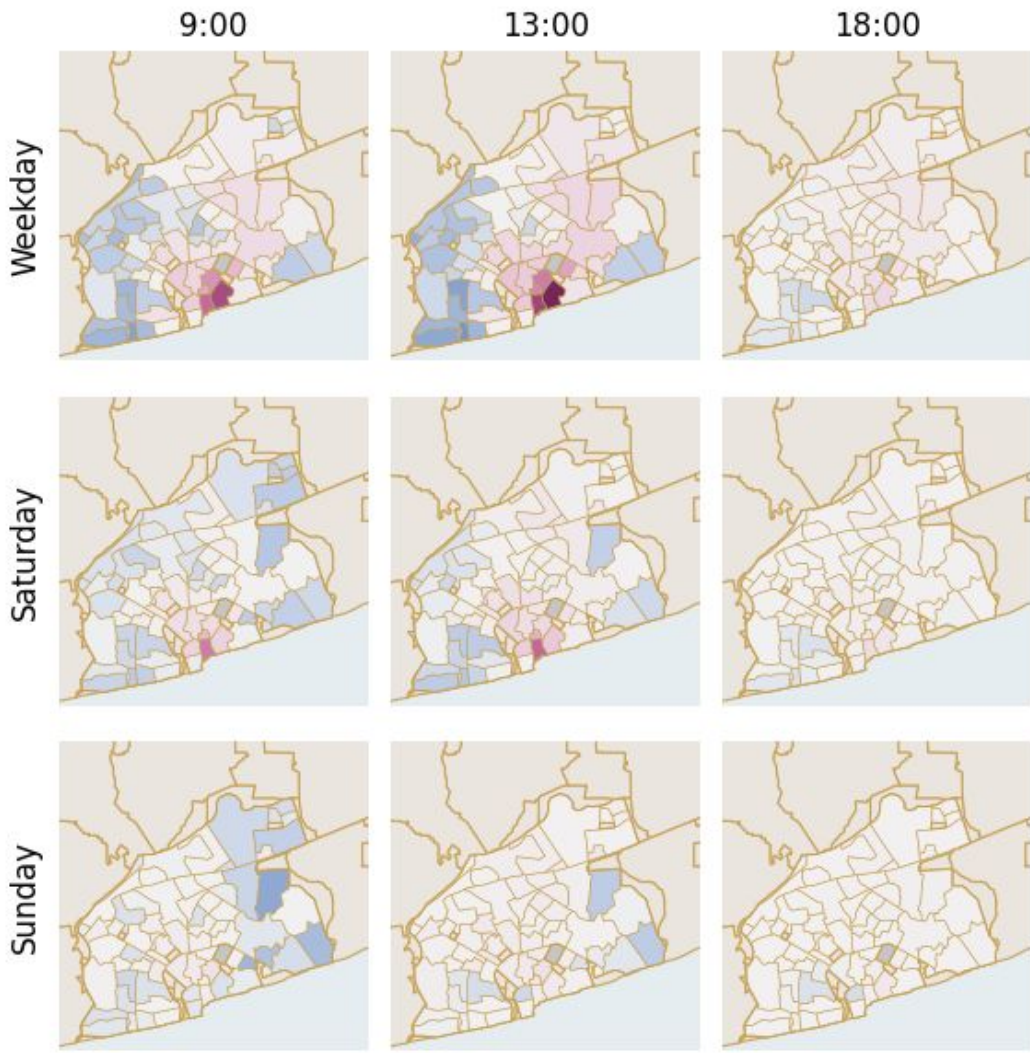
Estimating routine population
dynamics & migration

Residents



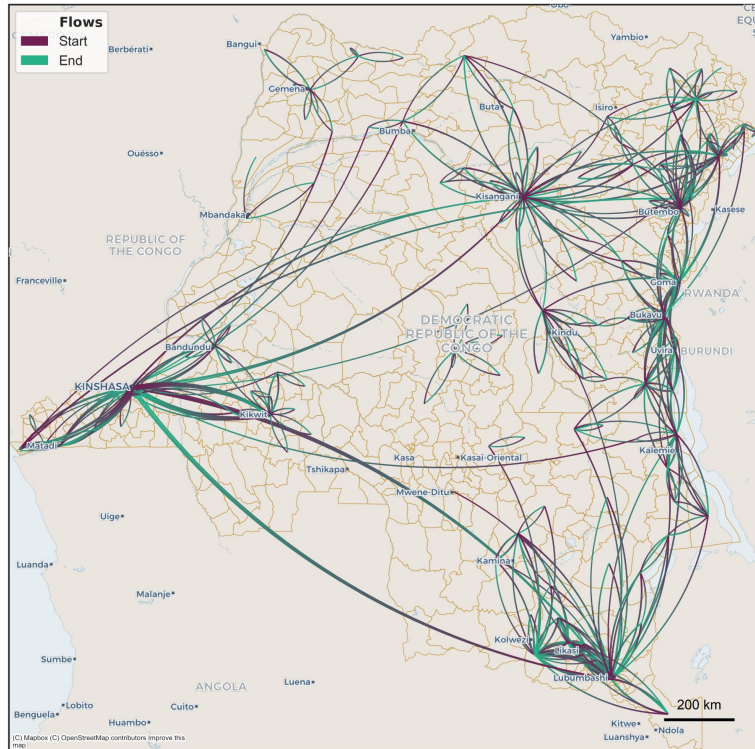
<= 1 year =>

Presence



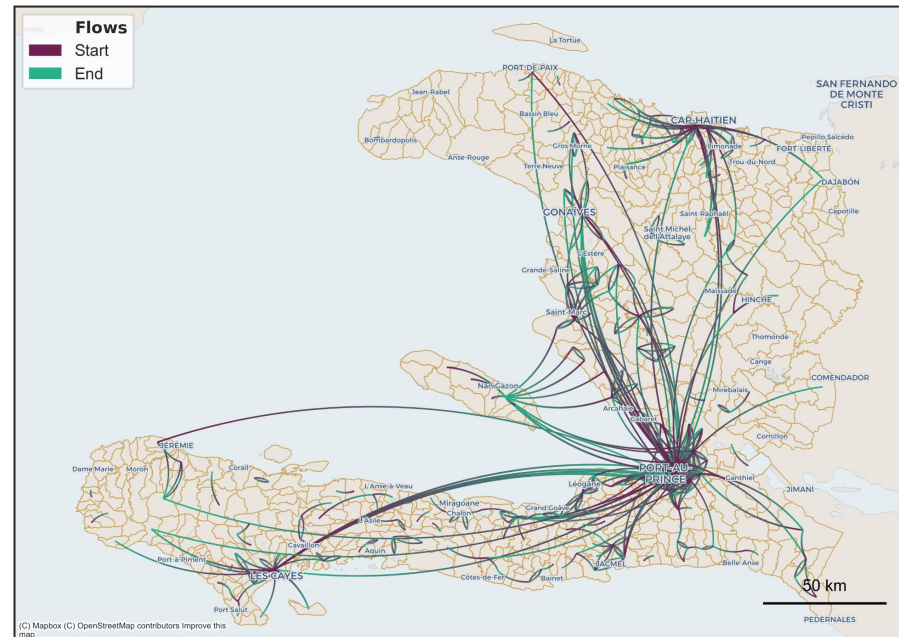
Monthly relocations between administrative areas, using CDR data

Democratic Republic of the Congo



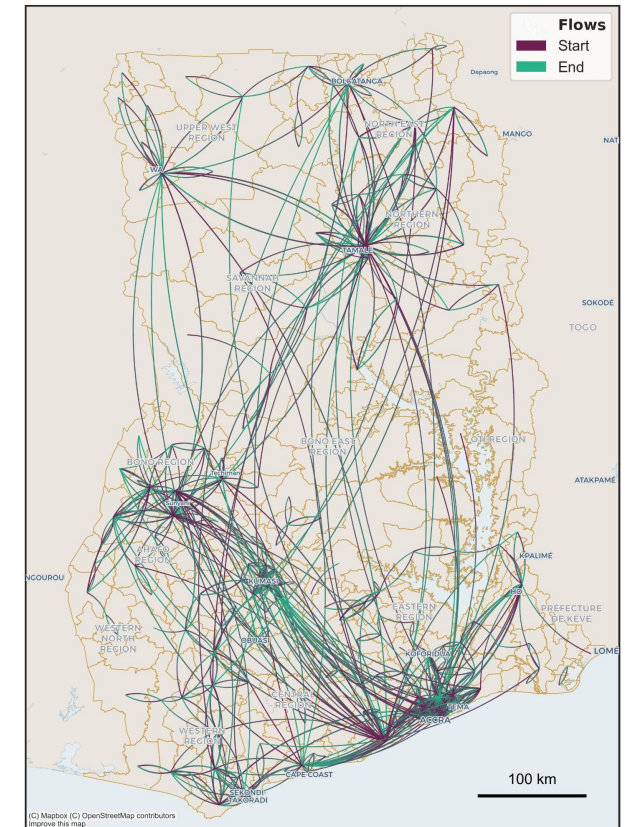
Note: estimated top 1,000 flows, median, Nov 2021- Dec 2022

Haiti



Note: top 500 flows, median, Feb 2020 - Feb 2022

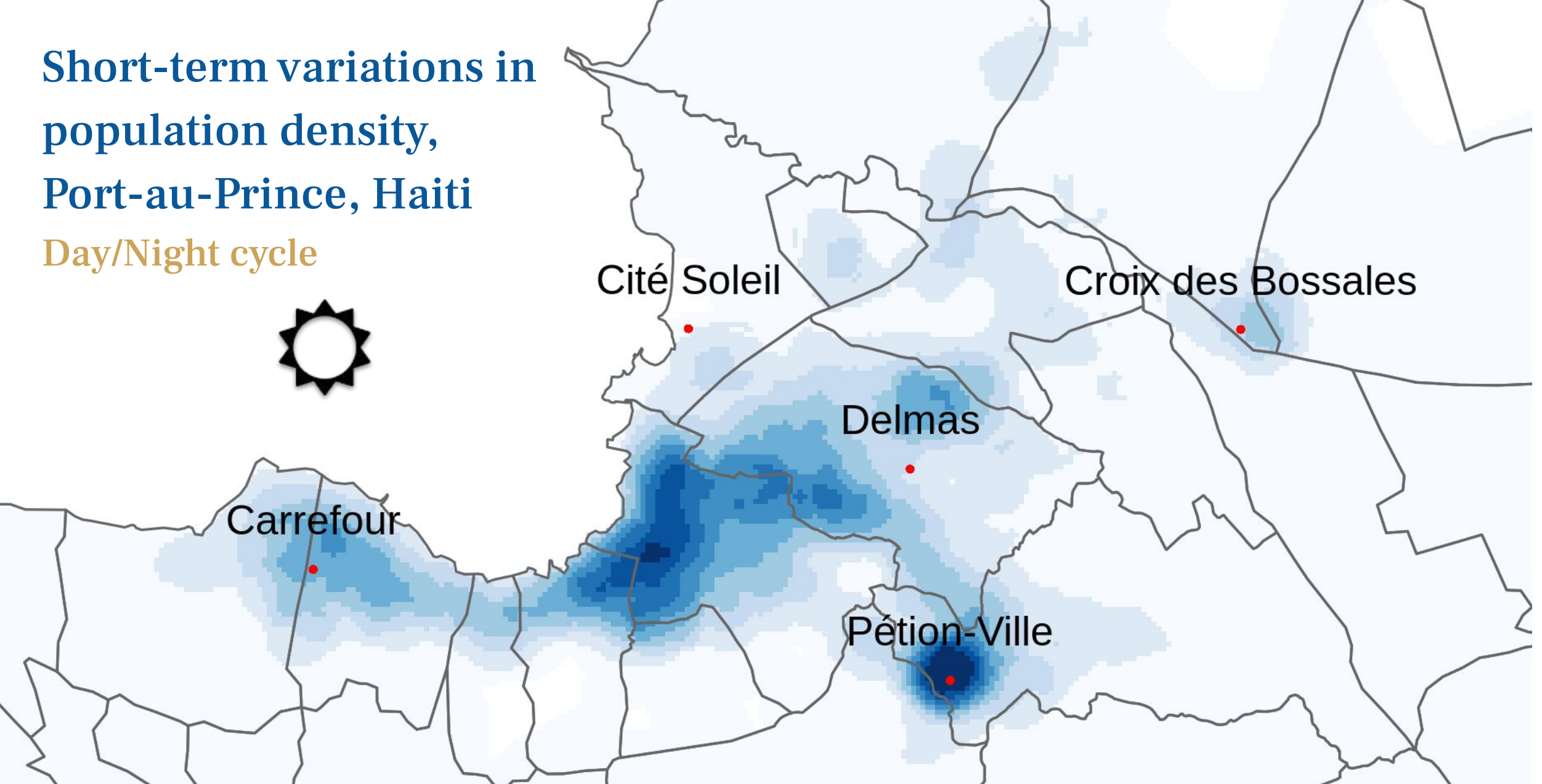
Ghana



Note: unscaled top 1000 flows, median, Jan - July 2021

Short-term variations in population density, Port-au-Prince, Haiti

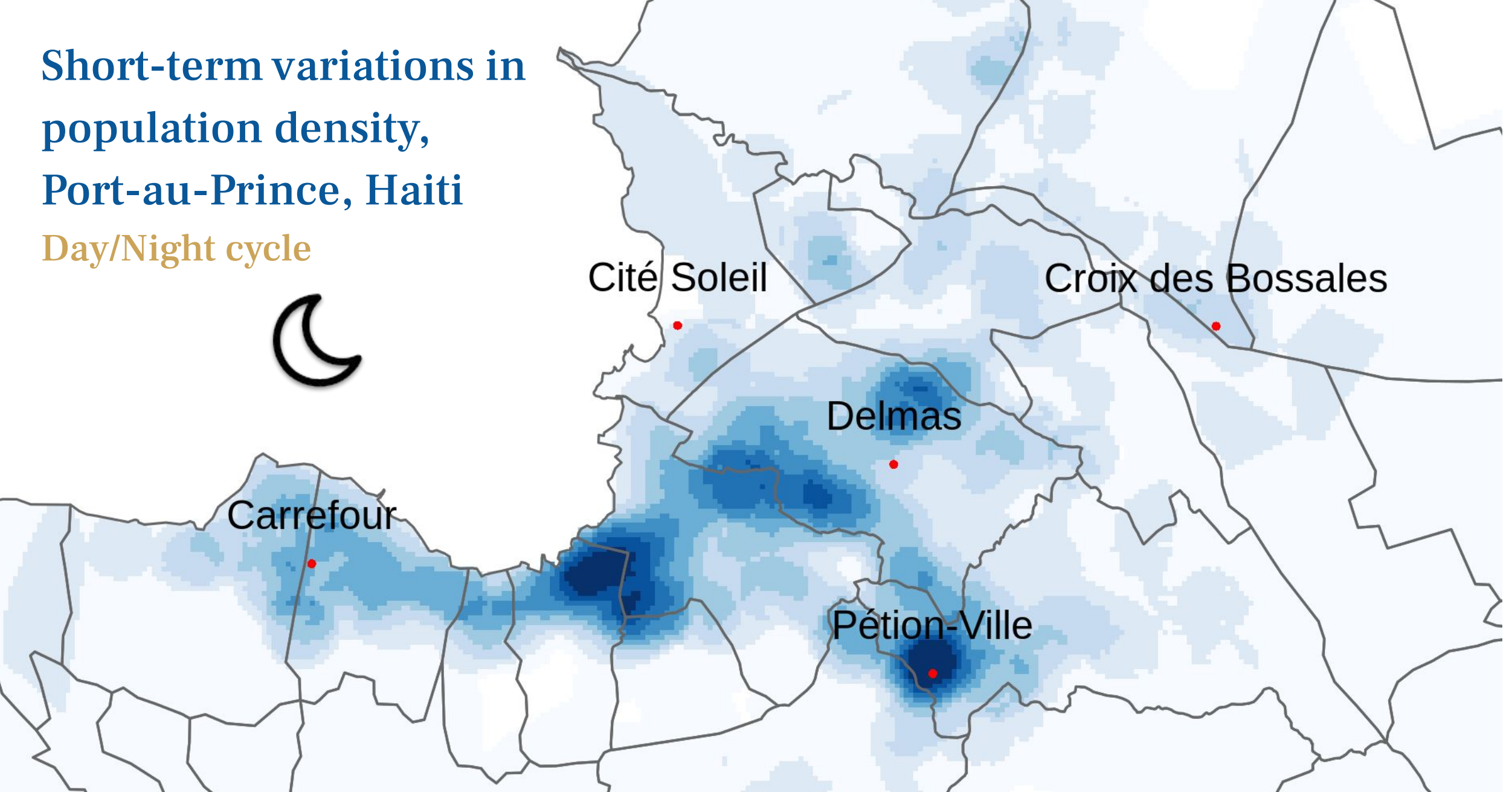
Day/Night cycle



Locations of phone users during the day

Short-term variations in population density, Port-au-Prince, Haiti

Day/Night cycle



Locations of phone users at night

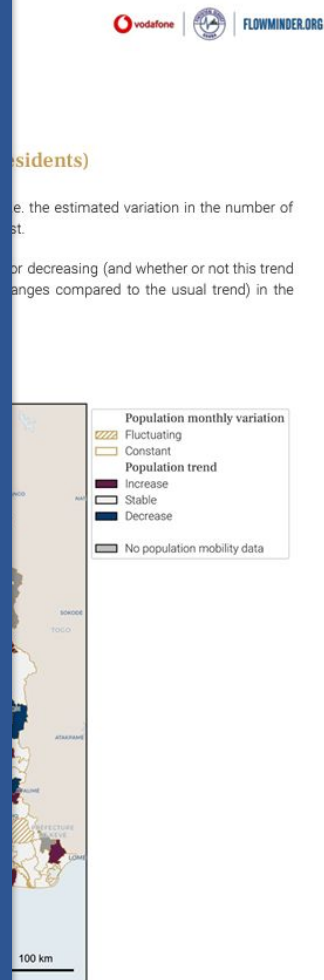
Routine mobility | Ghana

Data for Good partnership

Ghana | Routine Mobility Analysis for 2020-2022

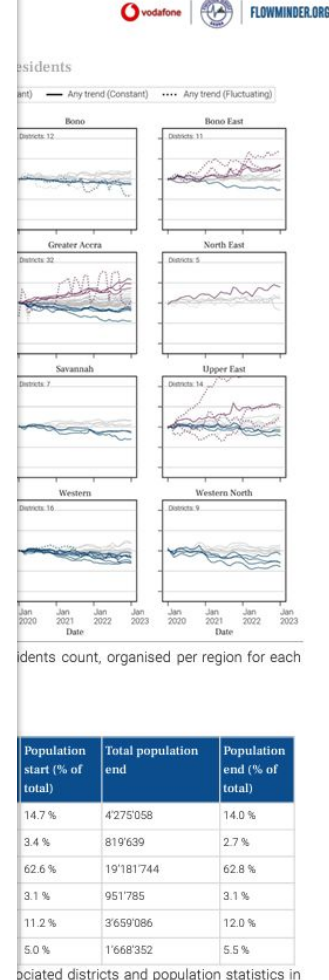
Insights into routine long term and short term mobility in Ghana

Beta version



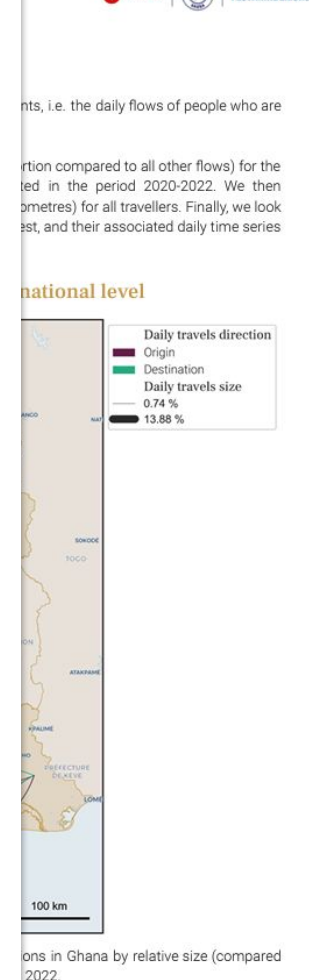
er the period 2020 to 2022.

10 | 34



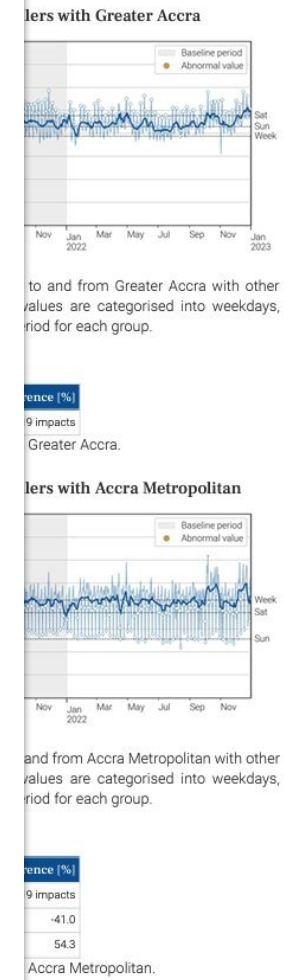
associated districts and population statistics in

11 | 34



ons in Ghana by relative size (compared
2022

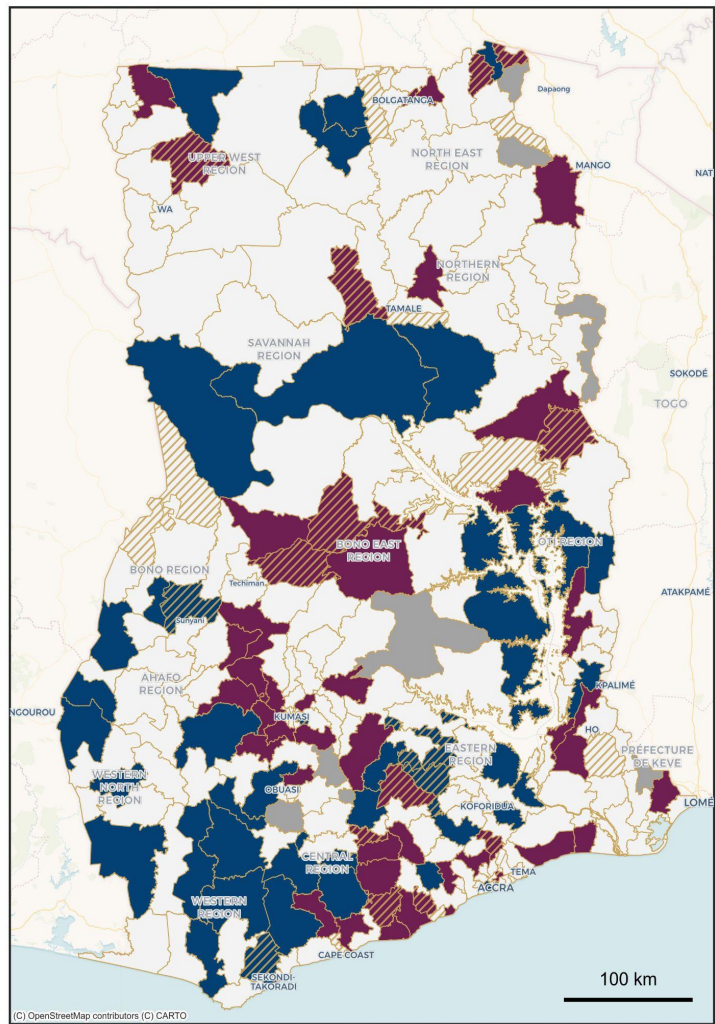
24 | 34



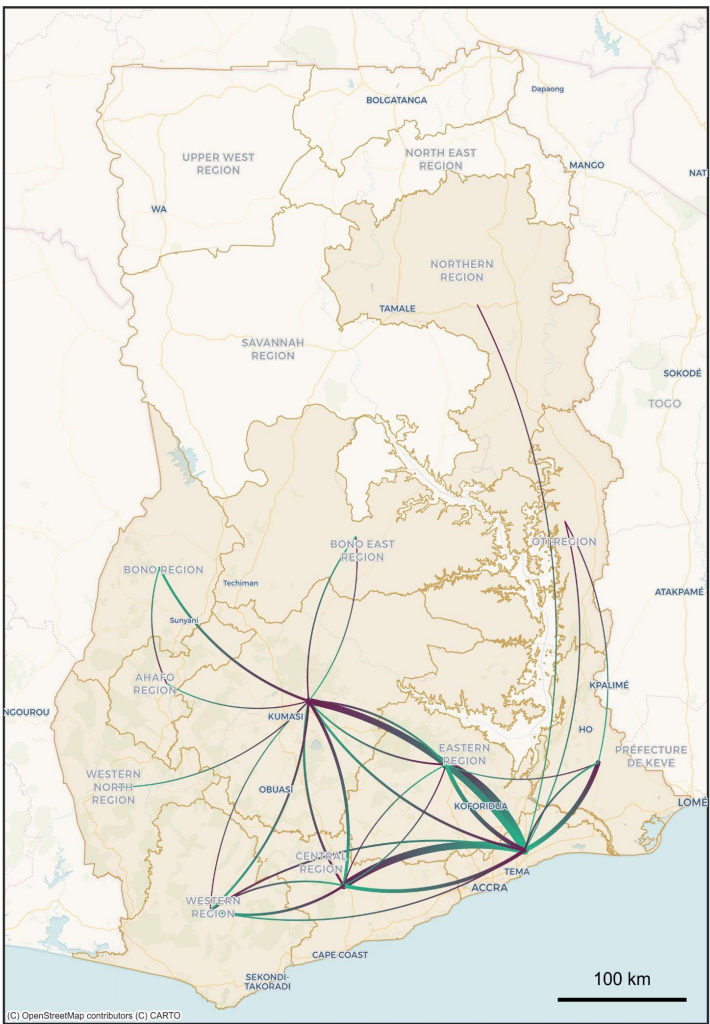
Accra Metropolitan.

27 | 34

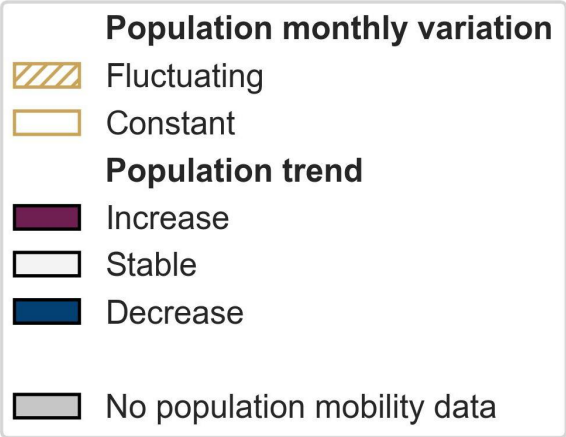
Routine mobility | Long-term mobility



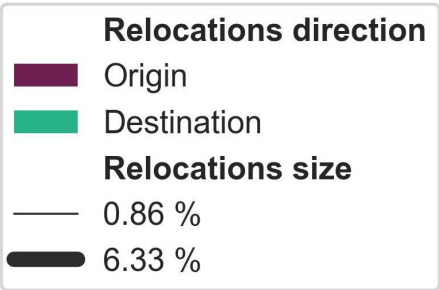
A. Population trends per district



B. Largest relocations (top 30) at region scale

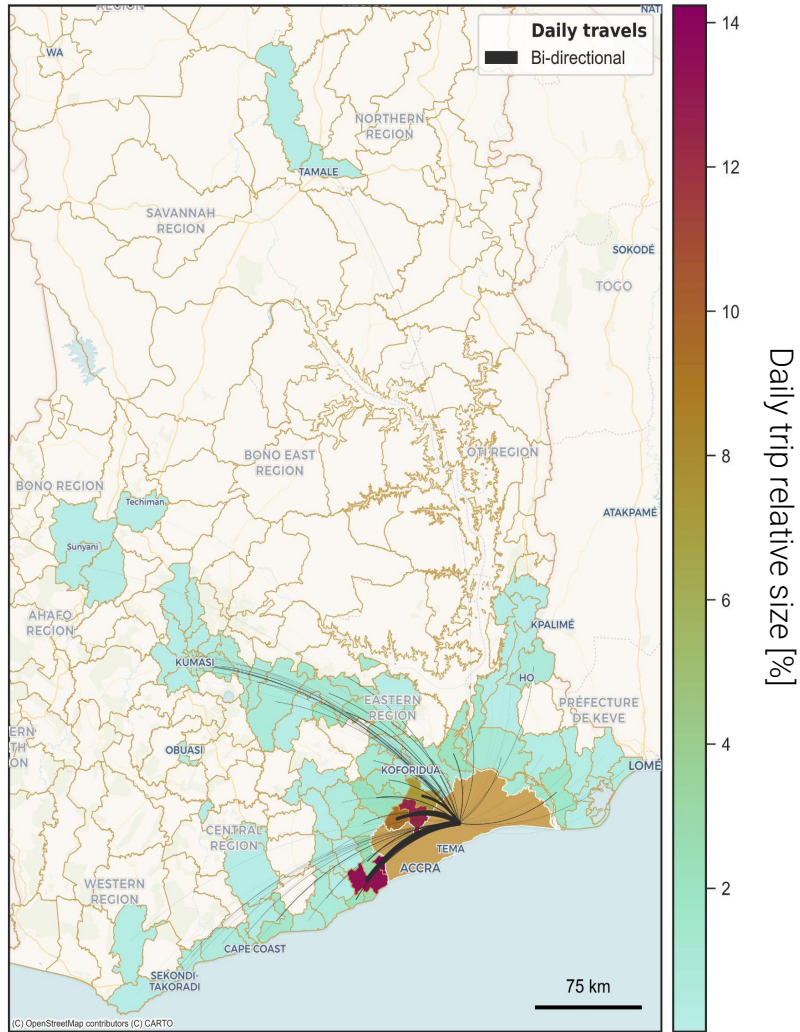


Legend A.

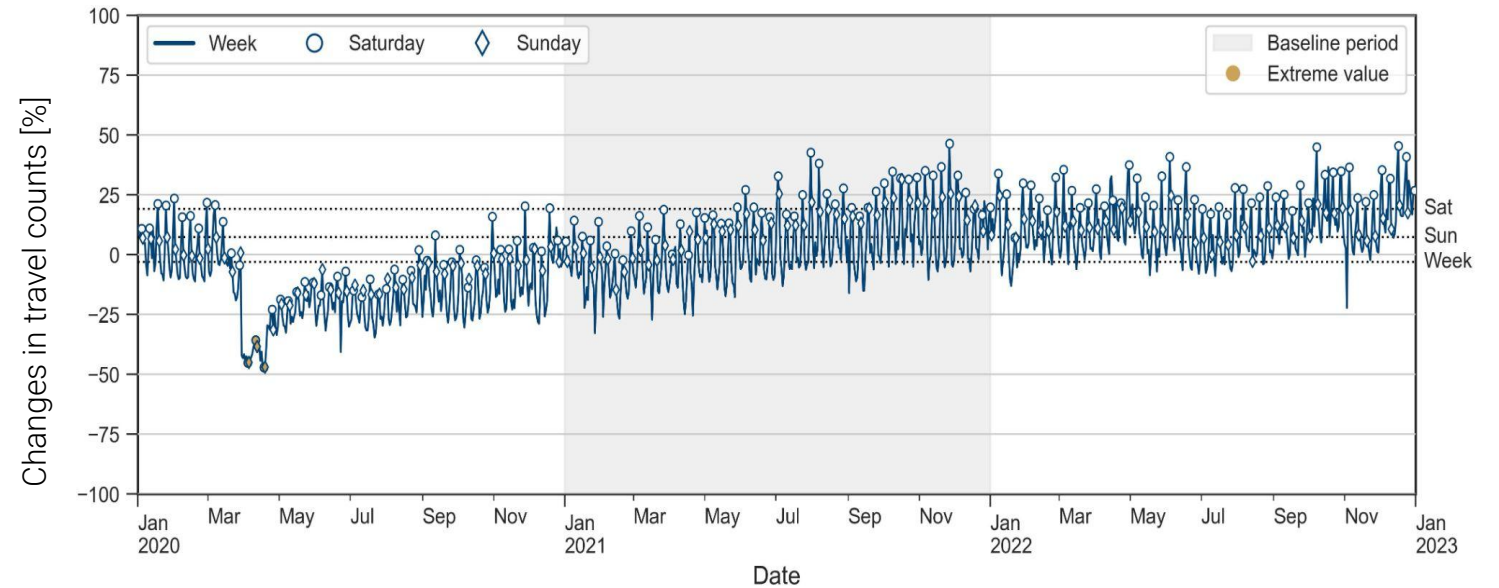


Legend B.

Routine mobility | Short-term mobility in Ghana



A. Daily travels with Greater Accra



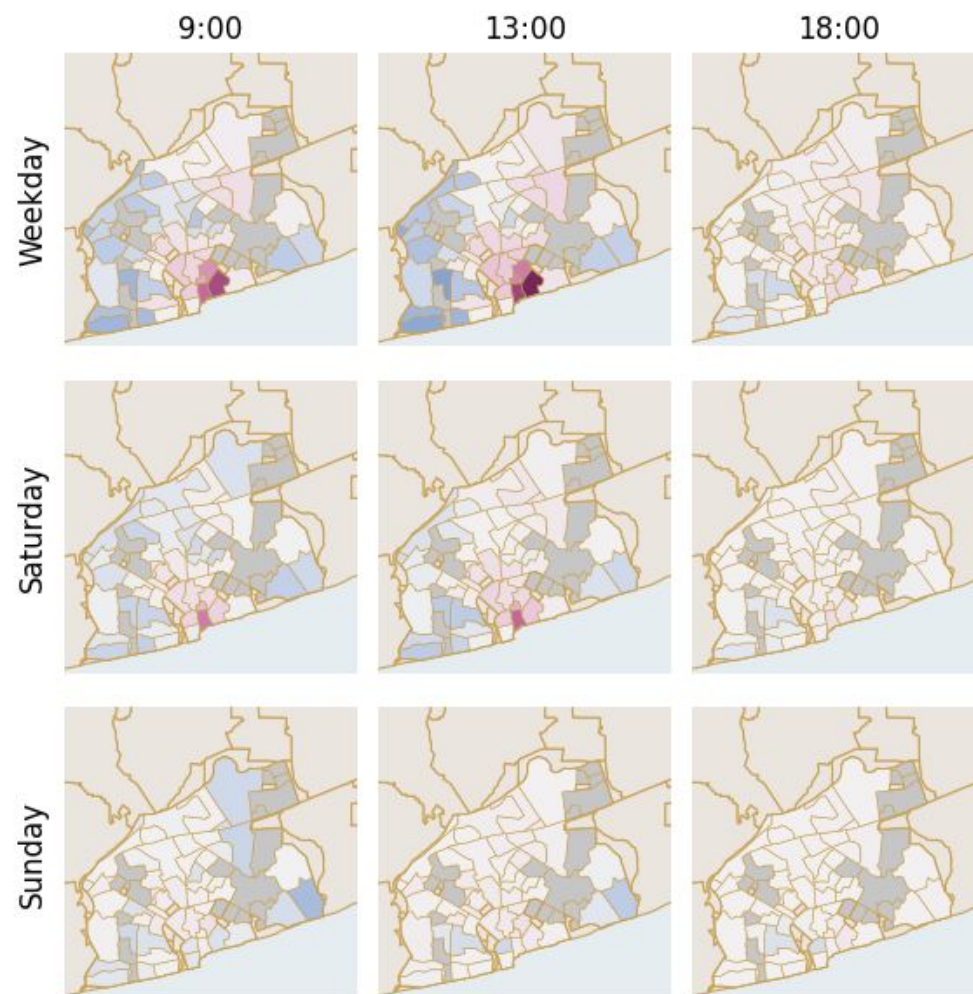
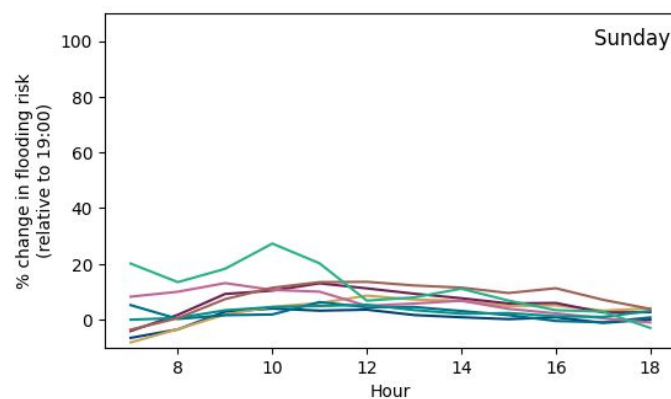
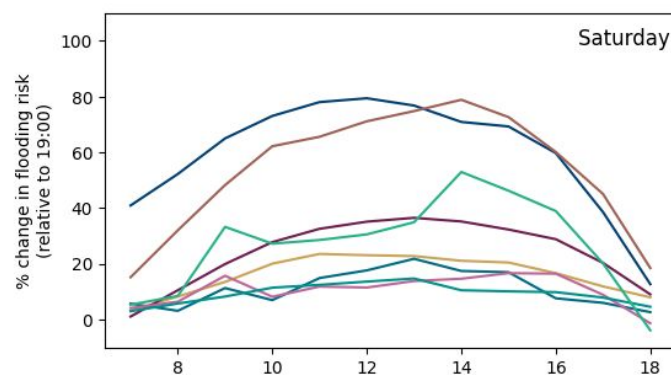
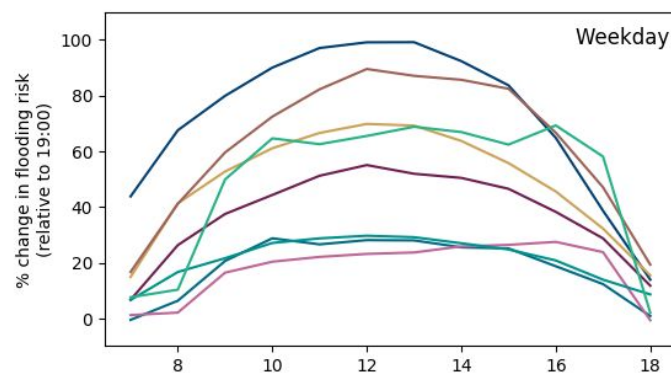
B. Time series of daily travels from and to Greater Accra



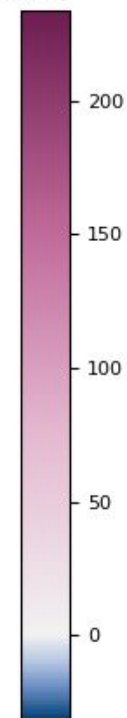
Applications

Disaster management

Dynamic Hazard Risk | Flooding risk in Ghana



Percentage change
in flooding risk
(relative to 19:00)



Preparedness | Haiti

Preparedness report

Preparedness report

Preparedness report

Published: XX MONTH YEAR
Updated every six months

Preparedness | Mobility situation report - Haiti Part 2 | Artibonite department overview (August 2020 - July 2021)

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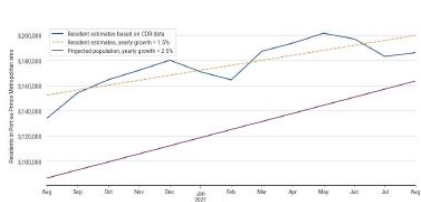
Preparedness report

Published: XX MONTH YEAR
Updated every six months

Preparedness | Mobility situation report - Haiti Part 1 | National overview (August 2020 - July 2021)

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Number of estimated residents in Port-au-Prince metropolitan area in the reporting period - compared to estimates based on UN projections



Key observations (August 2020 - July 2021)

The departments of **Centre** (+3.3%), **South** (+3.31%) and **North-East** (+2.56%) have all **increased** in population during this reporting period due to internal migration, faster than projections based on UN estimates of net growth and net international migration (0% for Centre and South, 1.7% for North-East).

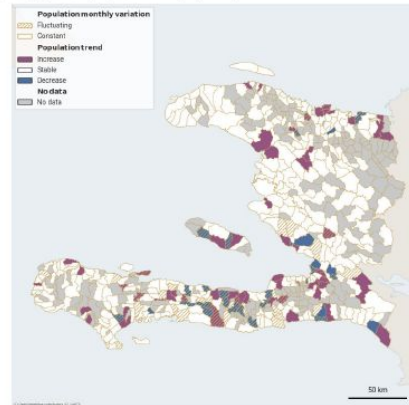
Increases in the North-East are primarily located near **Caracol industrial park** (+13%) and Ouanaminthe (+3%) near the border. In the Centre department, several sections increase mildly (between 1 and 2%) and the section where the town of **Hinche** is located increases by 2.45%. Similarly in the South department, several small increases (<2%) but a large increase in **Les Cayes** (+3.9%)

The **West** department increases less fast (+1.46%, +1.5% for the ZMPP only), and less fast than projected by the UN rates (2.1%, or 2.5% for the ZMPP). Grande-Anse, Nippes, North and South-East also increase mildly (<1%), but all faster than projected except for the North department.

The **North-West** department has had a **large decrease** in population (-5.5%), starting winter 2021, but may have recovered by the summer 2021. Locally, the population in **Port-de-Paix** has increased (+3%). Similarly Arbonite has an average mild decrease (-1%), but local increases in **Gonaïves** and **Saint-Marc** (+3%).

Generally, we observe an **increase in population in urban areas by 3% or more**, but **Port-au-Prince** increase at a slower rate (1.5%).

Short and long term variations in the estimated number of residents for the reporting period (August 2020 - July 2021)



The estimated number of residents has changed by more than +/-1.5% due to internal mobility in communal sections in blue (decreased), red (increased) and golden stripes (fluctuated) over the six-months reporting period.

Number of estimated residents (population) and annual change rates for the 10 departments

Department (admin 1)	Estimated average population (UN-projection based)	Estimated change, one year average (UN-projection based)	Number of communal sections changing by more than 1.5% (non stable) / number of sections with data change
Artibonite	1,686,110 (1,714,960)	-0.95% (0.85%)	5 / out of 51 sections with data
Centre	459,320 (460,320)	3.3% (0.09%)	1 / out of 18 sections with data
Grande-Anse	386,570 (386,140)	0.34% (0.23%)	4 / out of 34 sections with data
Nippes	276,150 (276,610)	0.63% (-0.13%)	7 / out of 27 sections with data
North	967,010 (968,460)	0.47% (1.33%)	8 / out of 45 sections with data
North-East	204,510 (196,420)	2.56% (1.7%)	4 / out of 9 sections with data
North-West	558,910 (576,200)	-5.53% (0.43%)	2 / out of 25 sections with data
South	628,740 (636,950)	3.31% (-0.07%)	11 / out of 51 sections with data
South-East	535,080 (538,710)	0.92% (-0.22%)	7 / out of 32 sections with data
West	4,418,500 (4,335,880)	1.46% (2.08%)	36 / out of 77 sections with data

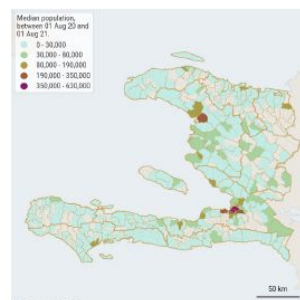
taking into account
August 2020 - July 2021,
UN projections, for the top

Estimated change, one-year average (UN projection based)	Type of change
2.75% (2.32%)	Increasing
2.76% (2.24%)	Increasing
3.16% (2.28%)	Increasing
1.17% (0.85%)	Stable
1.43% (1.22%)	Stable
2.42% (1.68%)	Stable
0.72% (0.81%)	Stable
1.82% (1.69%)	Stable
2.33% (2.27%)	Stable
1.09% (0.9%)	Stable

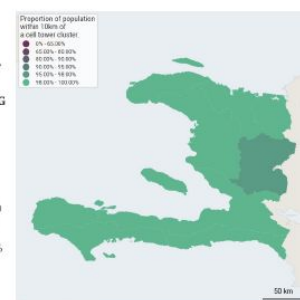
change rates taking into account
August 2020 - July 2021,
based on UN projections, for the top

Estimated change, one-year average (UN projection based)	Type of change
3.06% (2.25%)	Increasing
2.0% (1.83%)	Stable
2.84% (1.73%)	Increasing
-0.14% (-0.35%)	Stable
-0.88% (0.39%)	Stable
-0.81% (-0.97%)	Stable
-0.84% (-0.97%)	Stable
0.88% (0.61%)	Stable
-0.83% (-0.97%)	Stable
-1.18% (-0.97%)	Stable

Average number of residents for the reporting period (August 2020 - July 2021)



Digicel geographical coverage per department (% of the population residing within 2G or 3G Digicel coverage)



The map shows the % of population residing within 2G or 3G Digicel coverage, not the % of Digicel subscribers.

These population and mobility estimates come from CDRs (mobile phone usage data) and other datasets for adjustments. However these are not traditional population and survey estimates, if you are unfamiliar with this data source please read our documentation which can be found at www.flowminder.org

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Ministère de la Santé
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Ministère de l'Énergie
Ministère de l'Industrie

Ministère de l'Agriculture
Ministère de l'Économie

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Ministère de l'Environnement

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Previous preparedness report: DD MONTH YYYY

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Displacement | Flooding on the Lower Volta River, Ghana

Report #1

Most recent data: 22 October 2023
Published: 07 November 2023

Ghana | October 2023 Lower Volta River Floods

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Long- and medium-distance displaced subscribers from flood-affected areas of the Lower Volta River: Situation as of 22 October 2023

Executive summary

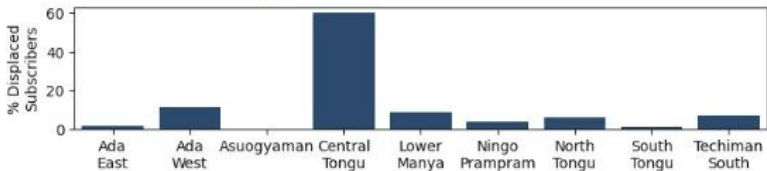
The release of excess water from behind Akosomobo Dam on 11 October 2023, following heavy and unpredictable rainfall, has resulted in the flooding on communities in nine districts along the Lower Volta River. Large displacements have been reported as a result of the flooding (over 26,000, source: EU ERCC). In this report, we focus on medium- (5–25km) and long-distance displacements (greater than 25km). We estimate that 1,430 Vodafone Ghana subscribers have been displaced from the areas around cell clusters in the affected districts. This represents only a portion of the total number of displaced persons, as these figures do not include those without a subscription to Vodafone Ghana or those who were displaced very short distances (less than 2km). We observe very few long distance displacements or displacements to urban centres, such as the Accra Metro area. The largest displacements observed were from the area around Mepe and Aveyime in North Tongu, to Mafi-Adidome in Central Tongu. We estimate that approximately 853 additional subscribers are residing in the area around Mafi-Adidome. We also observe that the increase in the number of subscribers displaced from the affected area has slowed. However, we do not yet observe any indications that subscribers are returning to their previous home locations.

Where have residents of the affected area been displaced to around Ghana?

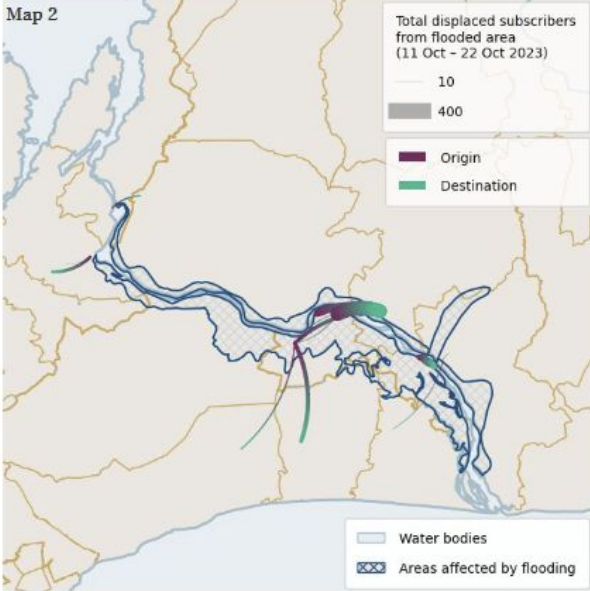
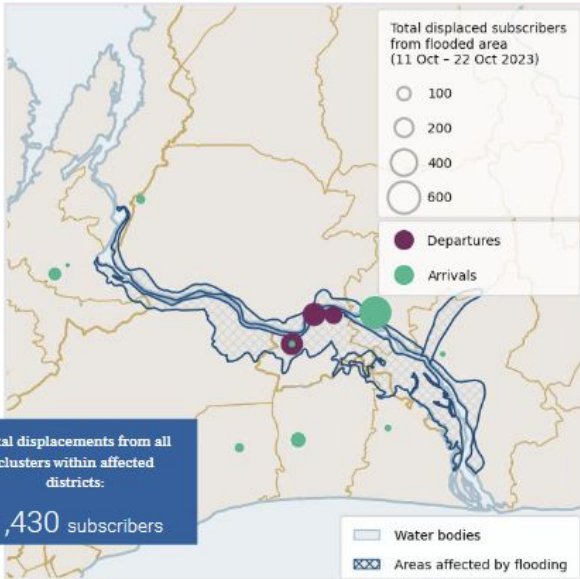
Origins and destinations of displaced subscribers

The bubbles on Map 1 (right) correspond to the number of displaced subscribers who have departed areas affected by flooding (purple) and the areas which have received displaced subscribers (green). The density of cell clusters means that we do not observe very short-distance displacements (less than 2km). The largest number of displaced subscribers depart from the areas around Mepe and Aveyime in North Tongu. The cluster with the largest number of arriving displaced subscribers is close to Mafi-Adidome in Central Tongu. We observed very few displaced subscribers outside of Eastern, Volta or Great Accra regions.

Graph 1 (below) shows that the majority of displaced subscribers (60.1%) relocated from the affected area to Central Tongu.



Graph 1: Percentage of the total displaced subscribers from the affected area who have relocated to each district



Conclusions

Based on anonymous aggregated mobile phone data from Vodafone Ghana, most displacements caused by the flooding on the Lower Volta River may have been local (less than 25km). Furthermore, most displaced subscribers are likely to remain within the affected or neighbouring districts.

The number of new displacements may also have slowed since the initial large displacement. However, we do not yet observe the population around the cell clusters starting to return to their pre-flood baseline, indicating that subscribers remain displaced.

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The mobile operator data provided to Flowminder for this report was fully anonymised. No personal data was made available at any time (e.g. an individual's identity, demographics, location, contacts or movements). All results are aggregated (for example, subscriber density in a given municipality), meaning that they do not contain any information about individual subscribers.



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Displacement | Gang violence in Port-au-Prince, Haiti

Report #3

Most recent data: 04 September 2023

Published: 08 September 2023

Haiti | August-September 2023 Gang violence, Port-au-Prince

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Displaced subscribers from violence-affected neighbourhoods, Carrefour-Feuilles and Savanes Pistache: Situation as of 04 September 2023

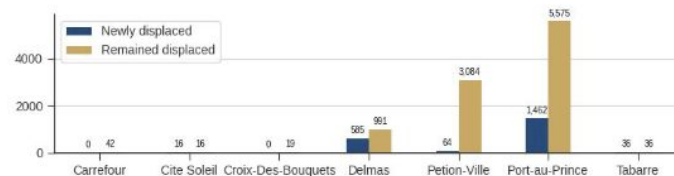
Executive summary:

Heightened gang violence since 12 August 2023 in the neighbourhoods of Carrefour-Feuilles and Savanes Pistache in Port-au-Prince continues to trigger significant population movements out of these areas.

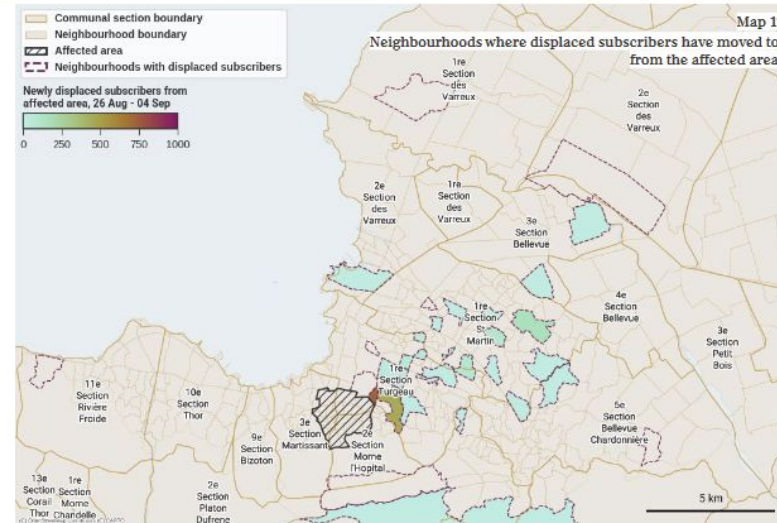
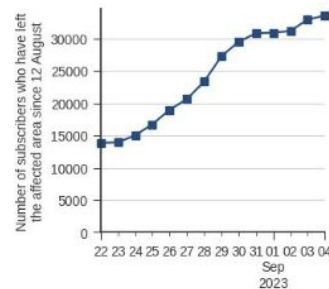
Based on anonymous aggregated mobile phone data, we estimate that up to 32,075 subscribers previously residing in the affected areas have since the start of the crisis left the area because of gang violence (most - if not all - are likely to be displaced and in vulnerable situations). Out of these, we can estimate that 9,770 subscribers are currently staying, primarily, in the neighbourhoods of Avenue Christophe (adjacent to Bas Peu de Chose) and Pacot in the Port-au-Prince commune, and Desire - Boutillier in the commune of Petion-Ville - see graph 1 and table 1), in line with IOM-DTM observations from 05 September. For the remaining 22,000 subscribers likely displaced, most are observed to remain within the Port-au-Prince commune, but in neighbourhoods we were unable to precisely determine (whether Avenue Christophe and Pacot and/or other neighbourhoods in the commune).

In the ten-day period from 26 August to 04 September, we estimate that 3,100 subscribers have been newly displaced, notably to Avenue Christophe and Pacot (commune of Port-au-Prince) and Siloe (commune of Delmas) (see table 1). For comparison, they were 2,000 between 19-26 August (8-day study) and 7,500 between 12-26 August (8-day study), showing that the situation is not yet stabilising.

Graph 1: Number of newly displaced subscribers (blue) and subscribers remaining displaced (gold) into neighbourhoods which we can precisely determine, summed per commune. We also observe that an additional 22,000 subscribers may be displaced, and most may be within the commune of Port-au-Prince.



Graph 2 | Total displaced subscribers: High bound estimate of the number of subscribers who have left the affected area since 12 August because of gang violence, and may still be displaced to date.



Total displaced subscribers since 12 August (high bound estimate)

32,075

Total displaced subscribers in known neighbourhoods since 12 August

9,770

Newly displaced subscribers out of the affected area between 26 August and 04 September

3,051

and newly displaced subscribers between 26 August and 04 September

Commune	Communal Section	Neighbourhood	Newly displaced subscribers this week	Total (Remaining) displaced
Delmas	1ère Saint martin	Peligre - Charbonnière	35	35 (*)
Petion-Ville	3ème Etang du Jong	Bremond	31	31 (*)
Delmas	1ère Saint martin	Jacquet Tybulle	27	27 (*)
Delmas	1ère Saint martin	Delmas 17	19	26
Delmas	1ère Saint martin	Delmas 75	21	21 (*)
Delmas	1ère Saint martin	Valme	20	20 (*)
Delmas	1ère Saint martin	Puits Blain	19	19 (*)
Tabarre	3ème Bellevue	Maia Gate - Clercine 8	19	19 (*)
Petion-Ville	5ème Bellevue Chardonnière	Pernier 24	-	17
Tabarre	3ème Bellevue	Galette Goureau	17	17 (*)
Petion-Ville	5ème Bellevue Chardonnière	Puits Blain	17	17 (*)
Port-au-Prince	1re Section Turgeau	Bourdon	16	16 (*)
Cite Soleil	1ère Section des Varreux	Hasco - Village Democratie	16	16 (*)
Port-au-Prince	1re Section Turgeau	Babiole - Debussy - Haut Turgeau	16	16 (*)
Croix-Des-Bouquets	1ère des Varreux	Village La Renaissance - Les Orangers	-	< 15
Croix-Des-Bouquets	2ème des Varreux	Santo	-	< 15

ates that subscribers likely displaced in this neighbourhood all arrived recently n 26 August and 04 September)

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*Map for illustration purposes only. The boundaries and names shown and the designations featured do not imply official endorsement or acceptance by Flowminder, its partners, or donors.

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Applications

Public health & epidemiology

Dynamic health metrics | Out-patient department attendance in Ghana

Oforikrom, Ashanti



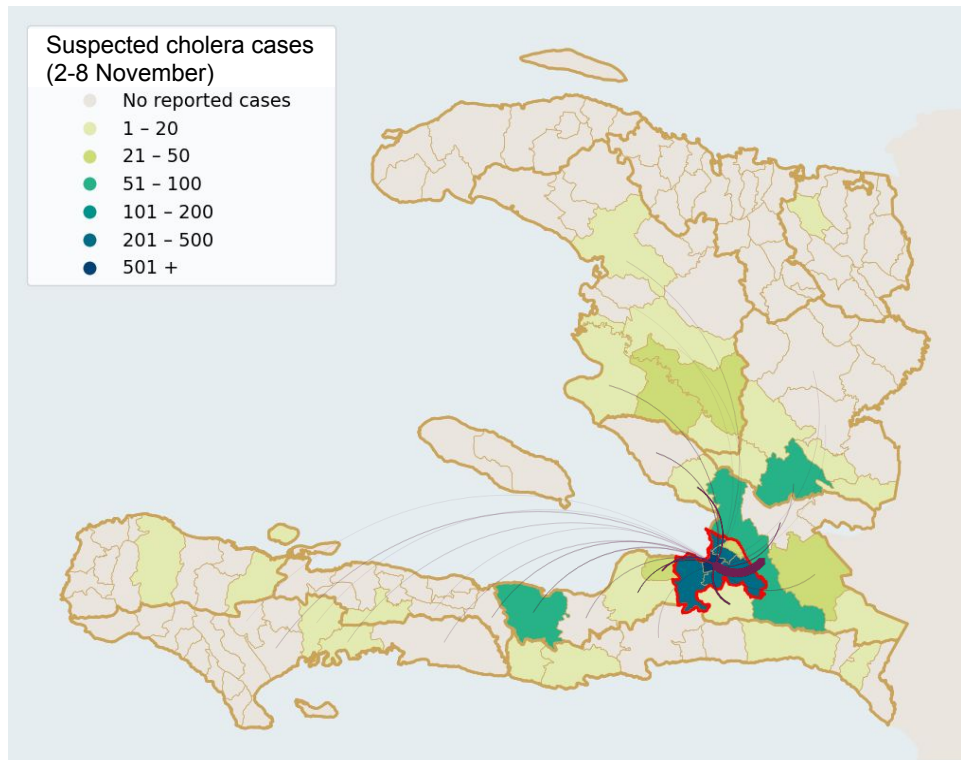
Out-patient department (OPD) attendance 2021-2022, calculated using a **static population estimate**

% change in the population, based on CDR data 2021-2022

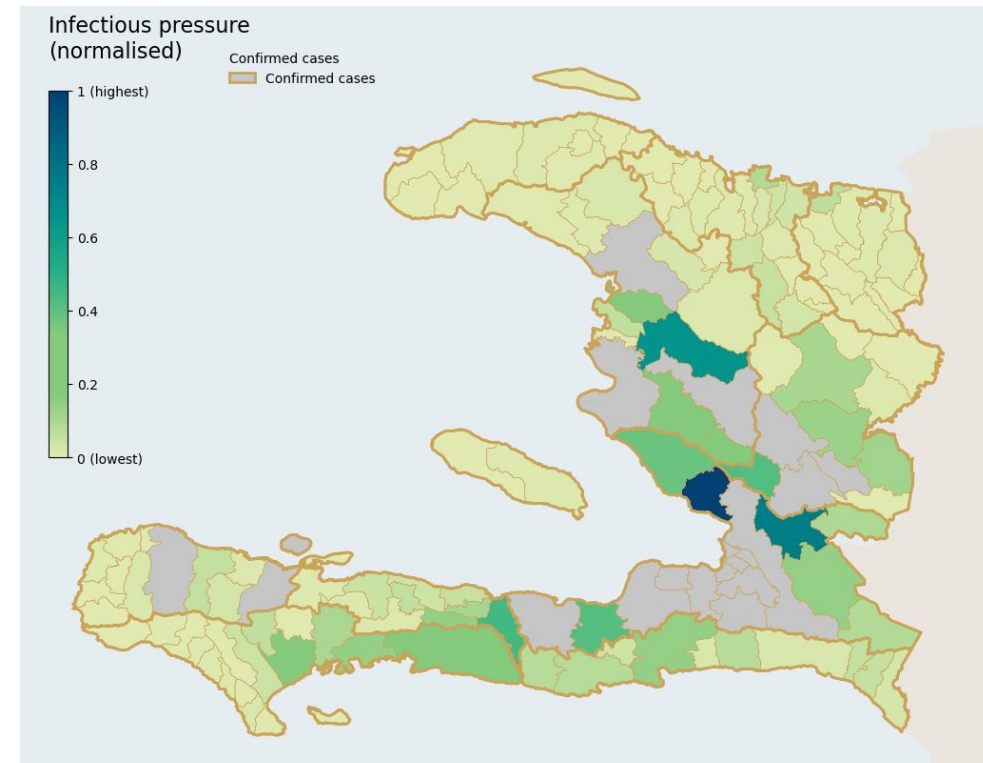
OPD attendance 2021-2022 using **CDR-derived dynamic population estimate (blue)**, compared to a **static population estimate (green)**

Modelling the spread of infectious disease | Cholera outbreak in Haiti

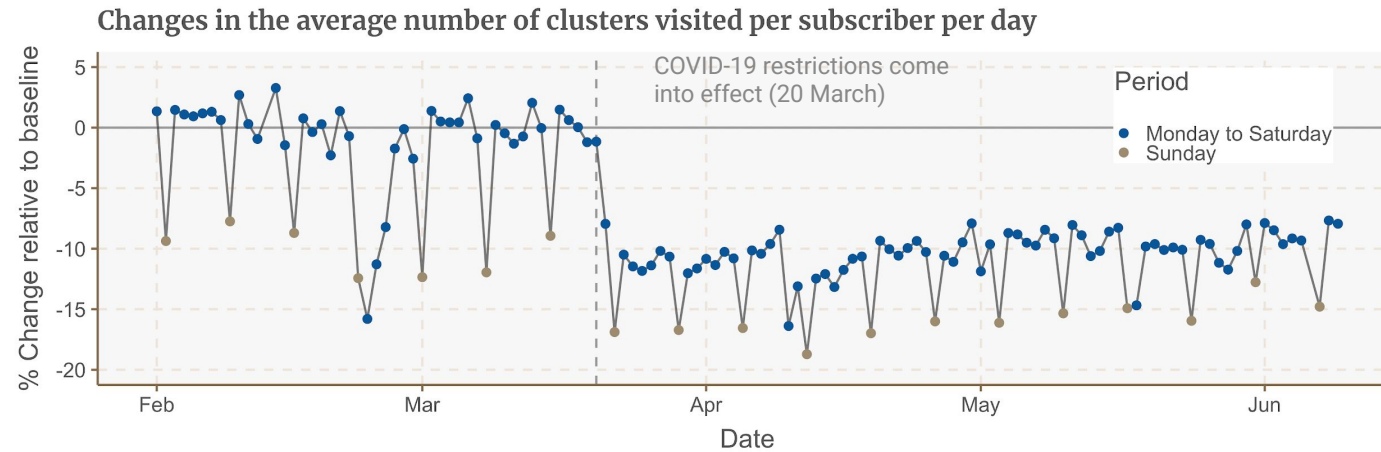
Flows from areas with high incidence in Port-au-Prince



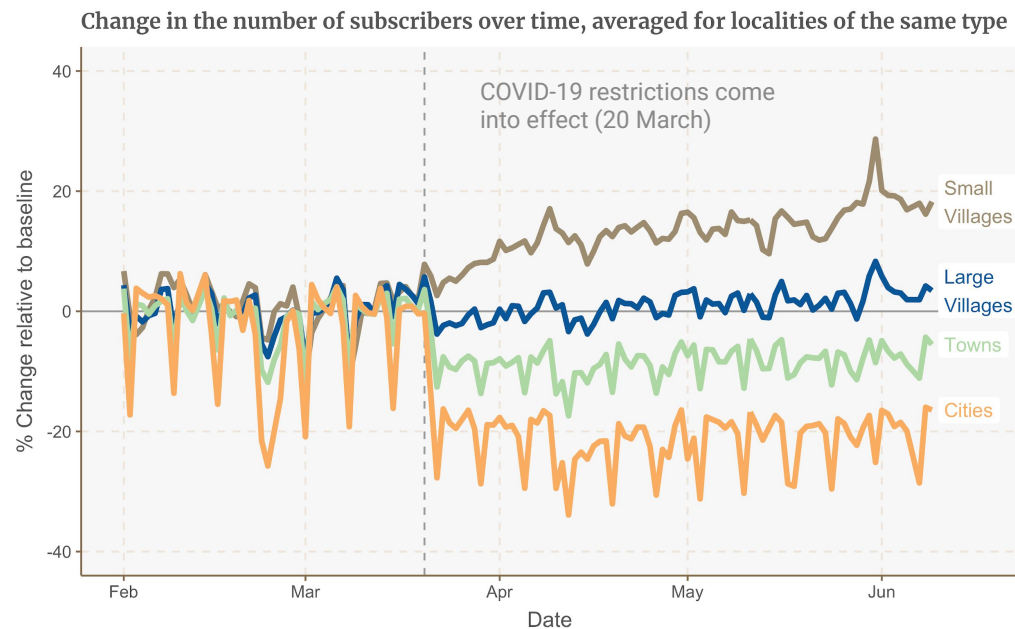
Infectious pressure on unaffected areas



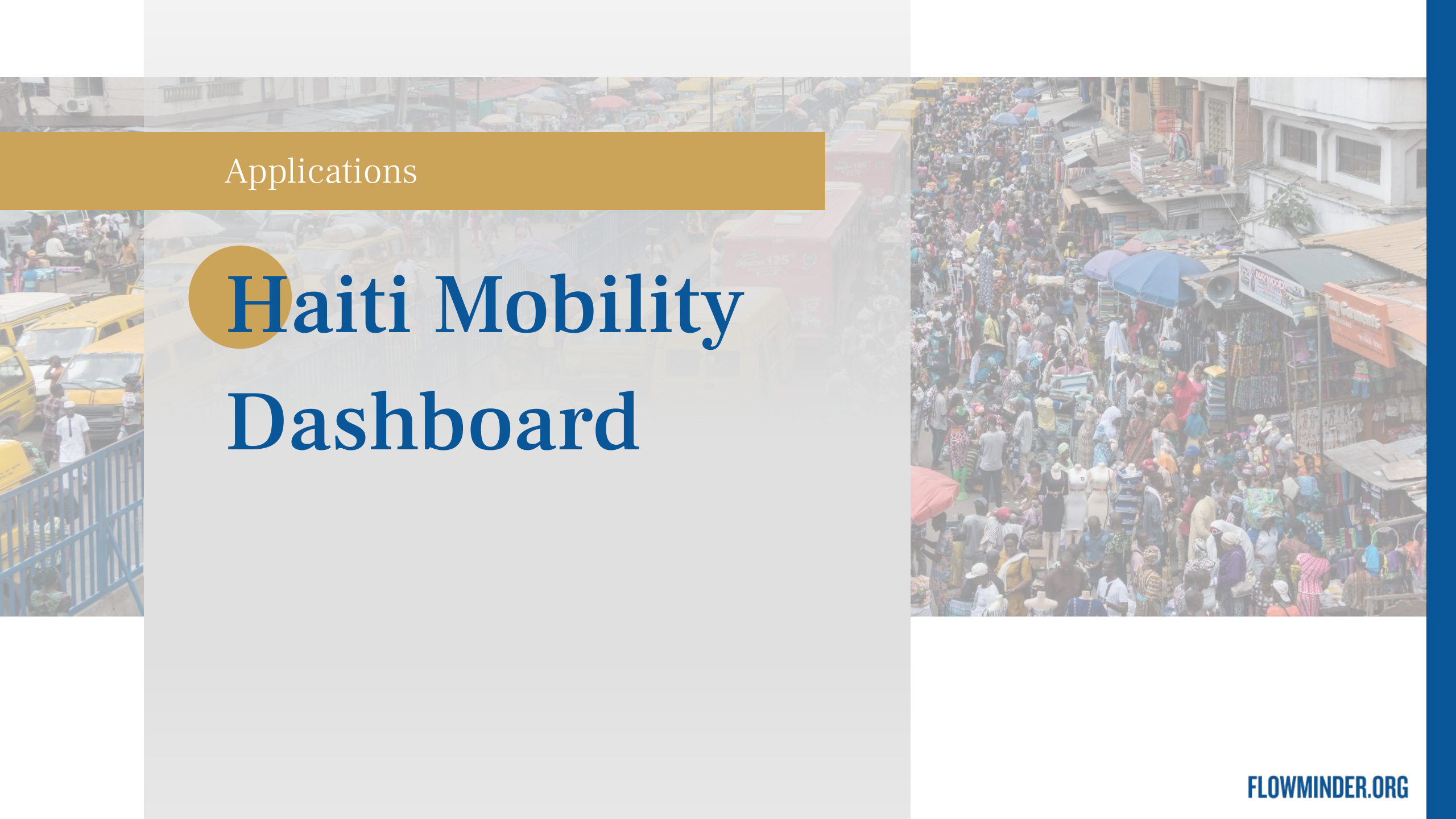
Mobility Disruption | COVID-19 restrictions in Haiti



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)

The background of the slide is a collage of three photographs. The top-left photo shows a street with many yellow taxis and people. The bottom-left photo shows a busy street market with many people and colorful umbrellas. The right side of the slide is a large photo of a crowded street market with many people and colorful umbrellas.

Applications

Haiti Mobility Dashboard

Haiti Mobility Data Platform (haiti.mobility-dashboard.org)

Integrated definitions to support users' understanding of the data

- Simplified definitions
- Detailed definitions & redirects to [FlowGeek.org](https://flowgeek.org)

20+ indicators available under four main categories:

- Residents (8)
- Relocation (4)
- Presence (7)
- Movement (4)

Different resolutions

- Temporal
- Spatial

Controlled user access & account management

- Controlled user access
- Thorough registration process
- Easy-to-use account management

Possibility to choose preferred visualisation

- Map
- Graph
- Chart

Two download options

- Download all
- Download selected





Thank you | Q&As

Any
questions?

FlowGeek

- **FlowGeek** is our open, online knowledge centre on CDR analytics
 - created to **leverage the value** of CDR data and help **strengthen the community** of CDR data experts, enthusiasts and learners on the processing and analysis of such data.
- **Our content includes**
 - What are CDR data?
 - Applications of CDR data
 - Types of CDR indicators
 - Analyses and methodologies
 - Data governance and security



Each record contains the type of network event and the subscriber's identifier, as well as the time of the event and the cell site it was routed through.

The MNO stores these records in a database and may connect them with other information on the subscriber and their account, to inform their billing process. **These data can be analysed to better understand how people move within a country.**

Mobile phone metadata: CDRs

MNIDEN	MNIDEN_COUNTERPART	CELL_ID	REGION	EVENT_TYPE	TIMESTAMP
AA204Y1542DCA00	VENY782AB945GJ2	451154211	north	voice	2016-10-10 15:35:25
AA204Y1542DCA01	ORBE728AD08E51	451354312	north	voice	2016-10-10 20:03:45
AA204Y1542DCA02	ETBA708AM0154BC	451354312	north	voice	2016-10-10 21:21:56
AA204Y1542DCA03					
AA204Y1542DCA04					
BA3QY45CAEVA5	EX09428CVAB34C	476126941	central	voice	2016-10-10 22:42:23
BA3QY45CAEVA6	EX09428CVAB34C	476126941	central	voice	2016-10-10 08:13:21
BA3QY45CAEVA7	ET09428CVAB34C	476126941	central	voice	2016-10-10 08:14:15
BA3QY45CAEVA8	RBV258AC842BC84	476126941	central	voice	2016-10-10 08:14:59
BA3QY45CAEVA9	RBV258AC842BC84	476126941	central	voice	2016-10-10 12:41:01
BA3QY45CAEVA10	RBV258AC842BC84	476126941	central	voice	2016-10-10 13:10:45
BA3QY45CAEVA11	PA81308C2		central	voice	2016-10-10 15:20:43
BA3QY45CAEVA12	RV0C8308C28E8D7	413579554	central	voice	2016-10-10 18:08:32
BA3QY45CAEVA13	DOB402V9MT0G1B8	413579554	central	voice	2016-10-10 20:18:00
BA3QY45CAEVA14	DOB402V9MT0G1B8	413579554	central	voice	2016-10-10 21:09:00
CEW9268RV43MEP1	EB1458CA33389K4	486202112	central	voice	2016-10-10 09:01:10
CEW9268RV43MEP2	RB06432CB8234P6	492505516	central	voice	2016-10-10 21:58:20
CEW9268RV43MEP3	TYR8206867F0W07	420594230	central	voice	2016-10-10 01:01:29
CEW9268RV43MEP4	TYR8206867F0W07	420594230	central	voice	2016-10-10 01:46:18
D8F348C8022Y7YR	QR08506BHC1A3BY	455193201	central	voice	2016-10-10 12:12:28

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